Annex J

Traffic Impact Assessment

BETTER TRANSPORT FUTURES
MARK WAUGH

Proposed Storage Facility

Sandgate, NSW

ERM Australia Pty Ltd

Traffic Impact Assessment

November 2012

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ABN 67 106 169 180

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Contents

1 Introduction

Background

Better Transport Futures has been commissioned by ERM Australia Pty Ltd to prepare a Traffic Impact Assessment (TIA) for the existing ammonium nitrate storage and distribution facility, operated by Crawfords Freightlines (Crawfords) at Sandgate, NSW.

In 2011, ERM submitted a request to the Director General of the NSW Department of Planning and Infrastructure (DoPI) for their requirements (Director General Requirements (DGRs)) for consideration and assessment in the preparation of an Environmental Impact Statement (EIS) to accompany a development application for the storage and distribution of 13,500 tonnes of ammonium nitrate. It is noted that since 2008, Crawfords have operated their business over part of the site, under a lease agreement with the property owners Sierra Sun Pty Ltd. The Director General has requested that a TIA be undertaken as part of the EIS assessment process.

Consent is sought for an ammonium nitrate storage and distribution facility with a capacity of 13,500 tonnes. Currently, Crawfords is managing operating conditions with a capacity of just 2,000 tonnes

Due to the proximity and impact of the development on the Pacific Highway (that forms part of the regional road network) the Roads and Maritime Services of NSW (RMS) will be required to review the TIA and provide concurrence.

Scope of Report

The scope of this report was to review the traffic and parking implications for the existing ammonium nitrate storage and distribution facility. The report also provides advice on access issues, internal site layout and issues relating to service vehicles.

Issues and Objectives of the study

The issues relative to the proposal are:

- Assess impact on the arterial and local road network due to the development's traffic flows;
- Assess the parking requirements of the existing development;
- Review the access arrangements for the proposed development;
- Review the service arrangement for the proposed development; and
- Assess any other transport impacts associated with the development.

The objective of the report is to document the impacts of the existing development and provide advice on any infrastructure work required as a consequence of the development.

Planning Context

In preparing this document, the following guides and publications were used:

- RTA Guide to Traffic Generating Developments, Version 2.2 Dated October 2002;
- The City of Newcastle Local Environmental Plan (2011)
- Newcastle DCP Parking Guidelines;
- Australian / New Zealand Standard – Parking Facilities Part 1 : off-street car parking (AS2890.1:2004);

- *Table 1-1 DGR Response*

Comment	Report Inclusion
Details of all traffic types and volumes likely to be generated during construction and operation.	Section 2.3
Assessment of predicted impacts on road safety and the capacity of the road network to accommodate the facility including traffic counts, details of truck routes and modelling of key intersections.	Section 4.4 and 4.5
Assessment of where off site infrastructure works are required as a result of traffic impacts including detailed plans of proposed road upgrades.	Section 5
Access, including detailed consideration of various access options and justification for the proposed location of the main access point	Section 2.1 and 3.2
Parking	Section 2.5 and 3.3

Source: NSW Planning and Infrastructure

2 Existing Situation

2.1 Site Description and Proposed Activity

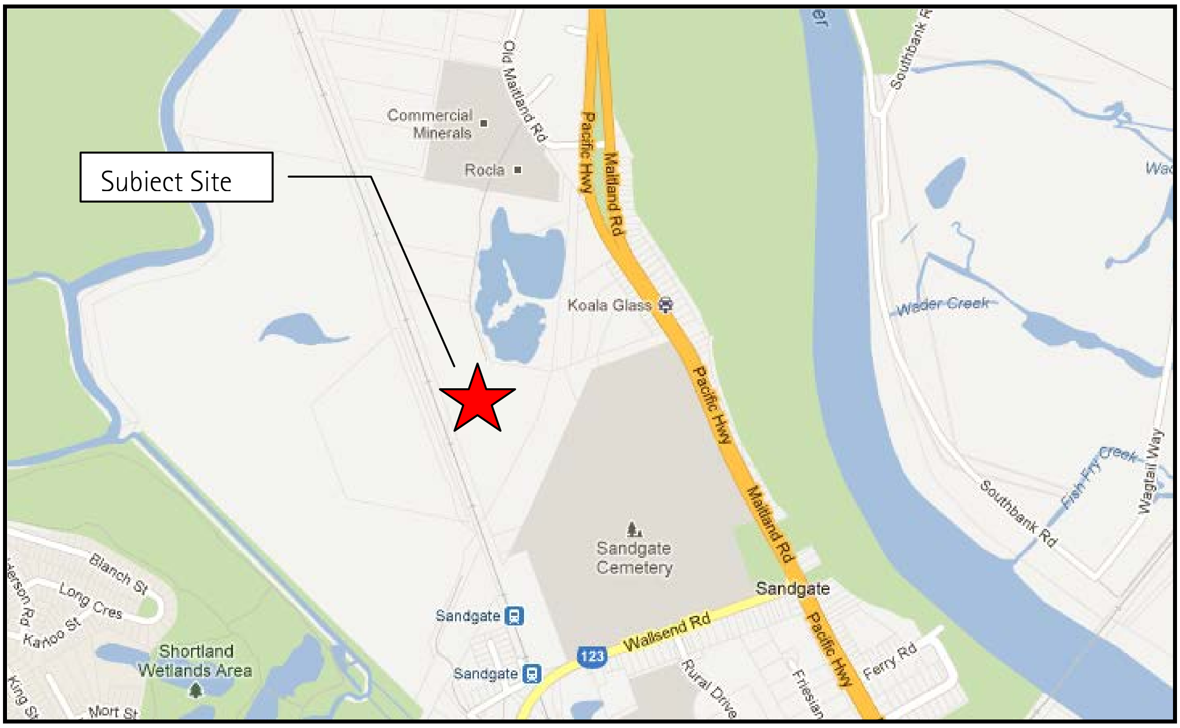
2.1.1 Site Location and Access

The subject site is located in proximity to the intersection of the Pacific Highway and Old Maitland Road at Sandgate, NSW. Access to the site is provided from a service road off Old Maitland Road.

The site is currently managed by Sierra Sun and part leased by Crawfords Freightlines and Scafflink. Crawfords not only store and distribute Ammonium Nitrate but also timber, aluminium and other industrial machinery. Scafflink lease a small portion of the site for the storage of dismantled scaffolding equipment.

Crawfords Freightlines provides a service to their Client's for the storage and distribution of ammonium nitrate. The layout of the existing development is shown in Appendix A.

The location of the site is shown below in Figure 2-1.



Source: Google maps

Figure 2-1 - Site Location

Existing land uses adjacent to the site are generally industrial with Sandgate Cemetery located to the south of the subject site. A small number of residences and two aged care facilities are located on Old Maitland Road. A number of residences and retail facilities are located on the Pacific Highway in Sandgate.

2.1.2 Zoning

The City of Newcastle Local Environmental Plan (2011) zones the subject site as IN3 Heavy Industrial.

2.2 Existing Traffic Conditions

The key roads in the vicinity of the subject site are described below. Road classification data is included in Appendix B.

2.2.1 Road Hierarchy

Pacific Highway

The major road through the locality is the Pacific Highway, which forms part of the State Highway Network. Newcastle City Council is the road authority for any new works on or along the Pacific Highway in this location. However, as the Pacific Highway is classified as a State Road any new works along it requires concurrence from the RMS.

The Pacific Highway is a dual carriageway providing two lanes in each direction. A median of approximately 7m separates northbound and southbound traffic; however, at the intersection with Old Maitland Road the median widens to 50m.

The overall alignment of the road is good with relatively straight alignments offering good forward visibility. The speed limit on the Pacific Highway in Sandgate is 80km/hour.

In the vicinity of the subject site kerbs and gutters are provided at the locations where residential and retail developments are located adjacent the Pacific Highway and are absent elsewhere. Footpaths are not located on the Pacific Highway but grassed verges are provided to the frontages of residential and retail developments.

Shoulders of approximately 3m width are provided on both sides of the Pacific Highway. The shoulder on the western side of the road contains markings designating it as an on street bicycle path.

In the vicinity of the subject site street lighting is provided on both sides of the Pacific Highway.

Photo 1 - Pacific Highway north from Old Maitland Road

Old Maitland Road

Old Maitland Road is a local cul-de-sac with a single travel lane in each direction. To the north of the service road, that provides access to the subject site, parking lanes are provided on both sides of Old Maitland Road. Footpaths, street lighting, kerbs and gutters are provided intermittently along short sections of Old Maitland Road. A small number of residential developments and aged care facilities are provided on Old Maitland Road.

The posted speed limit on Old Maitland Road is 50km/hour. Old Maitland Road is an approved B-double route.

The service road providing access to the subject site intersects Old Maitland Road at a priority controlled intersection.

Photo 2 - Old Maitland Road looking south towards the Pacific Highway

Photo 3 - Old Maitland Road looking north at Service Road

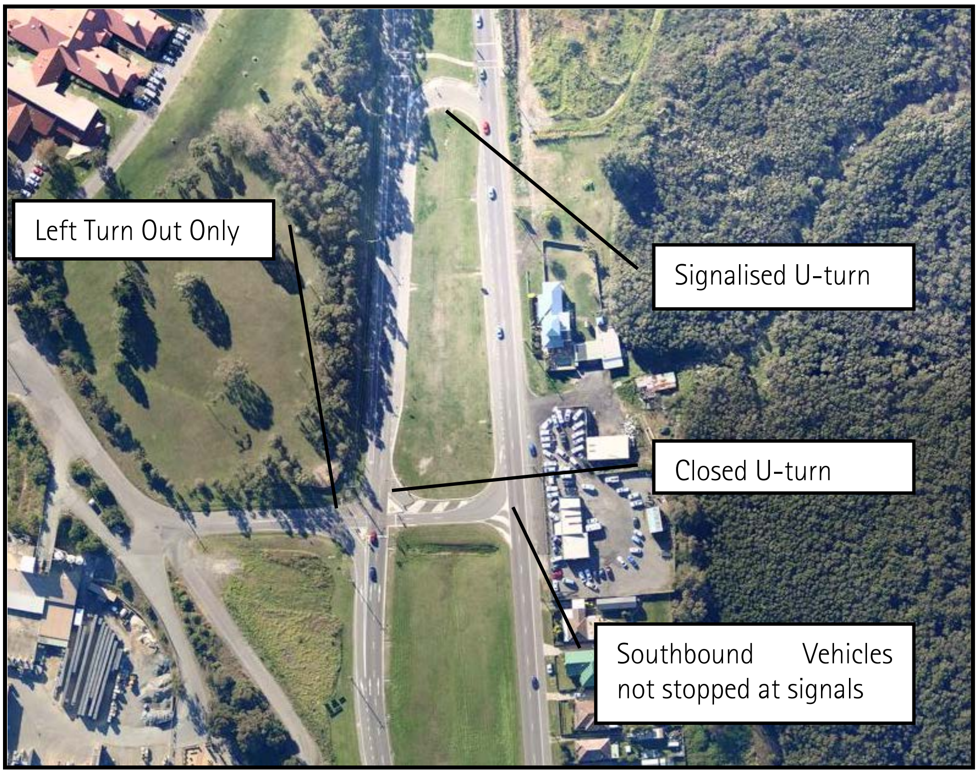
Intersection of Old Maitland Road and the Pacific Highway

Old Maitland Road intersects the Pacific Highway at a signalised intersection. The intersection, previously priority controlled, was upgraded with traffic signals in December 2005. Southbound vehicles on the Pacific Highway are not included in the phasing and are not subject to any delay at this location. Vehicles exiting onto the Pacific Highway from Old Maitland Road are only permitted to turn left in a northerly direction. A signalised U-turn facility is provided approximately 160 metres north of Old Maitland Road on the Pacific Highway, allowing vehicles to turn south. A 125 metre storage lane is provided at the U-turn facility.

Vehicles accessing the site from the north are only permitted to drive straight into Old Maitland Road from the Pacific Highway. A U-turn facility was previously provided at the intersection with the Pacific Highway, however, this was closed in 2005 when the intersection was signalised.

There are no pedestrian crossing facilities provided at this intersection.

The intersection of Old Maitland Road and the Pacific Highway is displayed below in Figure 2-2.



Source: Nearmap

Figure 2-2 Old Maitland Road and Pacific Highway

The traffic signals at Old Maitland Road and the Pacific Highway operate by providing maximum green time for the high through movements on the Pacific Highway. Sensors detect when a vehicle is waiting to turn in or out of Old Maitland Road. The signals allowing for the turn wait 60 seconds before changing their operation. If no vehicles are detected the signals will continue to provide a green phase for the major through movements on the Pacific Highway. This results in a phase time of 3 to 4 minutes at times with the through movements getting 2 – 3 minutes of continual green time.

The green time for the turning movements is very low, in the order of 20 seconds, reflective of the relatively low traffic demands in and out of the side road whilst ensuring minimum delays for through traffic.

The signalised U-turn to the north of the intersection acts in a similar manner and the signals are only triggered when a vehicle arrives to undertake a U-turn manoeuvre.

2.2.2 Road Works

The RMS is currently constructing a four-lane divided carriageway extension of the Newcastle Inner City Bypass for 1.8 km between Shortland and Sandgate. The link is part of the Newcastle Inner City Bypass project (H23).

The link, which will run to the south of the subject site, will intersect the Pacific Highway at a new signalised junction approximately 330m south of the intersection with Old Maitland Road.

The RMS has indicated that the opening of this link is unlikely to have an impact upon the volumes of traffic utilising the Pacific Highway in this location.

2.2.3 Traffic Management Works

From discussions with Council and the RMS, it is understood that there are no planned traffic management works in the general locality of the subject site.

2.2.4 Pedestrian and Cycling Facilities

There are minimal pedestrian and cycling facilities within the general locality of the subject site. Pedestrian footpaths are generally not provided on the Pacific Highway in Sandgate and footpaths are provided only intermittently on Old Maitland Road. Cyclists can use the shoulders of the Pacific Highway and in the vicinity of the subject site the west shoulder includes a marked on-road cycle lane. This is identified in the Newcastle City Bike Plan as regional bike route (R2) between Newcastle and Maitland. This includes an on road bicycle route the full length of Industrial Drive and the Pacific Highway to Hexham.

2.3 Traffic Flows

2.3.1 Peak Hour Flows

To identify the existing traffic conditions a manual traffic survey count was undertaken at the intersection of Old Maitland Road and the Pacific Highway. The counts were undertaken for the typical AM and PM peak periods as follows:

- 7:00am – 9:00am – AM Peak Period; and
- 3:30pm – 6:30pm – PM Peak Period.

The traffic counts were undertaken on Thursday, June 7th 2012 and were recorded at 15 minute intervals. A copy of the traffic survey report is included in Appendix C.

Determining the peak hours was undertaken based on the analysis of the 15 minute turning counts as a network average across the intersections of interest. From the traffic survey data the network morning and evening peak hours were calculated to occur at the following times:

- 7:45am – 8:45am – AM Peak Period; and
- 4:45pm – 5:45pm – PM Peak Period.

The peak hour traffic volumes are displayed below in Figure 2-3.

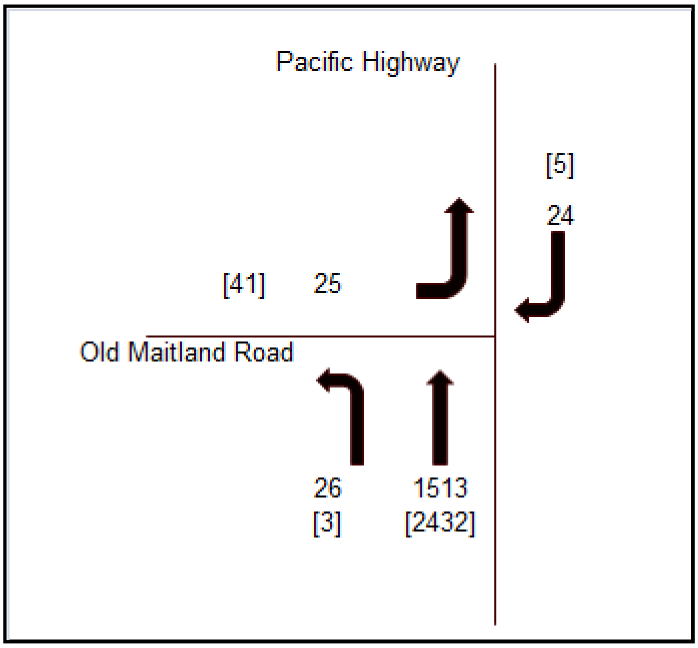


Figure 2-3 Existing Traffic Volumes

The traffic volumes indicate that 25 vehicles exited Old Maitland Road and 50 entered in the AM peak period. During the PM peak period 41 vehicles exited Old Maitland Road and 7 entered. During peak periods a maximum queue of 6 vehicles were observed on Old Maitland Road at the traffic signals waiting to undertake a left turn manoeuvre on to the Pacific Highway and a maximum queue of 3 vehicles were observed for vehicles undertaking a right turn into Old Maitland Road from the Pacific Highway.

On the Pacific Highway 1,513 northbound vehicles were observed in the AM peak and 2,432 vehicles in the PM peak.

During the AM peak hour 12 vehicles were observed making a U-turn at the turn facility to the north of the intersection of interest, of which 25% had an origin from Old Maitland Road. In the PM peak 34 vehicles were observed to undertake a U-turn of which approximately 75% had an origin from Old Maitland Road.

It is noted that a maximum queue of 5 vehicles was observed at the U-turn facility, well within the 125m storage lane provided at the U-turn.

2.3.2 Daily Traffic Flows

Traffic flow data has been sourced from the RMS publication "Traffic Volumes Data for the Hunter and Northern Regions, 2004" has been reviewed (Count Station: 05.052 Hexham-S Of SH9, New England Hwy). This RMS publication contains details on traffic flows along the Pacific Highway. Additionally, the RMS has provided more contemporary traffic data from the Pacific Highway count stations.

From the RMS data, the two-way traffic flow on the Pacific Highway in 2001 was 48,220 vehicles per day and in 2004 it was 52,833 vehicles per day (Annual Average Daily Traffic, AADT). Data received from the RMS based on counts undertaken on the Pacific Highway in 2011 indicate ADT of 55,480 vehicles, with 28,120 northbound vehicles and 27,360 southbound vehicles. This represents an increase in traffic flows of 1.5% per annum.

Typically peak hour flows represent 10% of the daily flows. Based upon the survey data collected on the 7th June 2012 daily flows on Old Maitland Road are in the order of 400 – 500 vehicles per day and based on the average of the AM and PM peak hour flows, northbound traffic volumes on the Pacific Highway are approximately 19,720 vehicles per day.

2.3.3 Daily Traffic Flow Distribution

There is no data available from the RMS publication for the daily variation in traffic flows. The traffic survey data indicates the peak hour traffic volumes on the Pacific Highway in the vicinity of the subject site will be tidal, with heavier southbound flows in the AM peak towards Newcastle and heavier northbound flows in the PM peak hour towards Hexham.

2.3.4 Vehicle Speeds

No vehicle speed measurements have been taken as part of the study work. Observations on site would indicate that traffic appears to travel within the posted speed limits, with no obvious signs of excessive speed. Signage indicating the presence of speed cameras is located on the Pacific Highway in proximity to the subject site.

2.3.5 Existing Site Flows

The existing facility operates with 65 employees, the majority of which access the facility in the morning and exit in the evening. Additionally, the subject site generates service vehicle flows associated with the delivery of materials into the site and the outbound movement of materials to various end users.

As the traffic movements associated with the staff and the transportation and storage of aluminium and timber on site have been allowed for in the traffic surveys, and as there is no proposed change to these activities in the proposed development, there has been no further consideration of these traffic movements in this assessment.

2.3.6 Heavy Vehicle Flows

Based on the current capacity of 2,000 tonnes, the facility typically generates 100 two-way (inbound and outbound) heavy vehicle movements per day associated with the movement of ammonium nitrate. Approximately half of these are articulated B-double trucks along the approved B-double route with the remaining half being semi-trailers.

Crawfords Freightlines has a fleet of 35 B-doubles and semi-trailers, of which 30 are in use at any one time with the remaining 5 undergoing maintenance.

The existing site flows associated with the inbound delivery of ammonium nitrate are shown below:

- *Table 2-1 Existing Site Movement for the inbound movement of AN*

	Current Situation
Truck movement associated with shipments arriving into Newcastle Port being stored by Crawfords Freightlines clients	100 inbound and 100 outbound truck movements per month. Average 5 two-way movements daily
Truck movements associated with rail deliveries arriving from Sydney	Average 20 in bound , 20 outbound truck movements per day

For the traffic movements along the Pacific Highway, there are a reasonably high percentage of heavy goods vehicles, including B-doubles, associated with interstate movements of products. Traffic surveys data indicates about 5% of movements on the Pacific Highway are undertaken by heavy vehicles.

2.3.7 Current Road Network Operation

The existing peak hour operation of the intersection of Old Maitland Road and the Pacific Highway has been undertaken utilising the SIDRA traffic modelling software.

SIDRA calculates the amount of delay to vehicles using an intersection and gives a level of service rating which indicates the relative performance of the intersection control. There are six levels of service measures ranging from A (very low delay, very good operating conditions) to F (over-saturation, where arrival rate exceeds intersection capacity).

Analysis of the operation of the intersection of interest has been undertaken in SIDRA utilising the existing road geometry and traffic volumes, the results of the analysis are presented in Table 2-1.

Table 2-2 Existing Intersection Analysis AM Peak Hour, Pacific Highway and Old Maitland Road

Intersection	AM Peak		PM Peak	
	Delay (secs)	LOS	Delay (secs)	LOS
Pacific Highway - Northbound	2.6	A	4.4	A
Pacific Highway – right turn to Old Maitland Road	74.8	F	72.6	F
Old Maitland Road	74.7	F	76.4	F
Total Intersection	4.8	A	5.7	A

The results indicate that the intersection of Old Maitland Road and the Pacific Highway currently operates to a good standard consistent with LOS A.

It is noted that vehicles turning into and out of Old Maitland Road experience delays of approximately 75 seconds corresponding to a LOS F. However, these delays are consistent with the existing operation of the intersection which provides maximum green time to the through movements on the Pacific Highway.

Figure 2-4 from Austroads Part 5 Intersections at Grade provides advice on intersection operation (reproduced below). Where these limits are not met, traffic effectively does not suffer from any delay.

Major Road Type[1]	Major Road Flow (vph)[2]	Minor Road Flow (vph)[3]
Two-lane	400	250
	500	200
	650	100
Four-lane	1000	100
	1500	50
	2000	25

Source: Table 4.1 Austroads Part 5 Intersection at Grade

Figure 2-4 Austroads Intersection at Grade

It can be seen that for the current traffic flows, these limits are not met at the intersection of the service road and Old Maitland Road and therefore capacity modelling is not required at the access to the subject site.

Observations on site show that there are little if any delays for traffic movements at the intersection formed by the service road to the subject site and Old Maitland Road. Traffic entering or exiting the side road also suffer from minimal delay, with the majority of the delay only caused by drivers having to slow down and negotiate the intersection.

2.4 Traffic Safety and Accident History

The Pacific Highway in this location provides straight alignment and is flat, allowing good visibility for drivers in all directions.

The overall width of the Pacific Highway has allowed for a sheltered right turn lane and left turn lane into Old Maitland Road, allowing through traffic movements to pass any vehicles waiting to turn left or right into the side road.

Additionally, a number of movements have been removed at the intersection of Old Maitland Road and the Pacific Highway, reducing the number of conflicting vehicle movements. The installation of the traffic signals also controls the critical right turn movements at this intersection.

The Hunter Crash Data Depart Department in the Road and Marine Services (RMS) has provided accident data for incidents recorded within the last 5 years at or in proximity to the Old Maitland Road and Pacific Highway intersection. (Appendix D)

The data indicates that 22 recorded accidents have occurred over the last 5 years as follows:

- 2006 – 3 accidents;
- 2007 – 5 accidents;
- 2008 – 8 accidents;
- 2009 – 5 accidents;
- 2010 – no accidents; and
- 2011 – 1 accident.

The traffic data indicates that since 2009 only a single recorded accident has occurred at or in proximity to the intersection of interest.

Of the 22 accidents, 20 involved rear end collisions. These accidents typically occurred during the day in dry conditions.

No accidents involving vehicles has occurred on the service road to or within the Crawfords Freightlines subject site.

2.5 Parking Supply and Demand

2.5.1 On-street Parking Provision

There is limited on-street parking supply on Old Maitland Road in the vicinity of the subject site. All parking for staff and visitors is currently provided on site.

2.5.2 Set down or pick up areas

There are no set down or pick up areas in the locality of the site.

2.5.3 Rail Station Locations

Sandgate railway station is approximately 500m south of the subject site. The station is part of the Hunter Line which provides a service between Newcastle and Scone. During peak periods services run approximately every half an hour.

2.5.4 Bus Stops and Associated Facilities

Hunter Valley Buses operates Route 140 – Raymond Terrace to Newcastle which operates on Pacific Highway in Sandgate whilst Rover Coaches runs from Newcastle to Cessnock (Route 160) and Busways Route 152 runs between Newcastle and Hawks Nest.

Bus stops are located on both sides of the Pacific Highway in proximity to the subject site.

2.6 Other Proposed Developments

Council has indicated that there are no other developments of significance in the general locality of the subject site.

3 Proposed Development

3.1 The Development

Crawfords Freightlines proposes to operate as an ammonium nitrate storage facility, with a storage capacity of 13,500 tonnes. It is currently operating with a reduced capacity of just 2,000 tonnes.

The infrastructure on site includes access to a rail line and an industrial rail layover which delivers materials to the site from Sydney. The movement and storage of ammonium nitrate accounts for approximately 50% of activity at the subject site, other activities include the movement and packing/unpacking of aluminium and timber.

The facility employs 65 staff as follows:

- 30 drivers;
- 15 office staff; and
- 20 yard staff.

Drivers and yard staff typically work between 6:00am – 6:00pm, while 5 of the yard staff work the afternoon shift between 12:00pm – 10:00pm. Office staff work eight hour shifts starting between 6:00am - 8:00am and finishing 4:00pm – 6:00pm.

The ammonium nitrate is currently imported from Scandinavian, South American and Asian countries. It is typically delivered in 2 different ways and the proposal is that:

1. It is delivered to the Port of Newcastle by sea and transported to site by trucks;
2. It is received at Port Botany, Sydney and is loaded onto trains to be transported to the facility.

Photo 4 Ammonium nitrate bulker bags stored on-site.

3.1.1 Phasing and Timing

The ammonium nitrate and storage facility is currently operational and the proposed increase in capacity can be affective once approval is provided.

3.1.2 Access and Circulation Requirements

The development currently accommodates cars and heavy vehicles up to the size of an articulated B-double truck. These vehicles access the site to collect/deliver their load, manoeuvre internally and exit in a forward direction.

3.2 Access

3.2.1 Driveway Location

Access to the site is provided from a service road from Old Maitland Road. The service road has a single lane in each direction and serves a number of other industrial developments.

There is currently sufficient capacity to accommodate the light and heavy vehicle trips generated by Crawfords Freightlines and other nearby industrial developments and no queues form on the service road during periods of peak activity.

Photo 5 - Service Road towards Old Maitland Road

3.2.2 Service Vehicle Access

An average 100 inbound and outbound heavy vehicle movements occurs onsite each day. All service vehicles access/egress the subject site via the service road and utilise the Old Maitland Road and Pacific Highway intersection. The proposal provides for the continuation of these current arrangements.

3.2.3 Access to Public Transport

There is no need for public transport to access the site.

3.3 Circulation

3.3.1 Pattern of circulation

The design of the site permits vehicles to enter the site, collect or deliver their loads, and exit in a forward direction.

3.3.2 Internal Bus Movements

It is considered that there will be neither internal bus movements nor a requirement for a bus to travel within the development site.

3.3.3 Service Area Layout

The layout of the site allows for existing truck movements to enter and exit the site in a forward direction.

3.3.4 Parking Supply

All parking for the development is currently contained within the site.

The Newcastle Development Control Plan (2011) Traffic Parking and Access specifies a parking demand for "General Industry" of 1 space per 2 staff. Based upon the existing 65 staff members this corresponds to a provision of 33 parking bays.

The site contains 61 vehicle parking bays for staff, which is in excess of the parking provision specified in the DCP and is sufficient to accommodate staff.

3.3.5 Parking Layout

The onsite parking bays have dimensions of 5.5m by 3.0m and comply with Australian Standard requirements.

3.3.6 Service Vehicle Parking

All vehicles that are parked on site overnight are parked in a designated parking area.

3.3.7 Pedestrian and Bicycle Facilities

There are no specific pedestrian and bicycle facilities currently located within the subject site. There is no current demand as no staff members walk or cycle to work.

4 Transportation Analysis

4.1 Traffic Generation

Trip generation analysis is typically undertaken for proposed developments utilising trip rates specified in the RTA Guide to Trip Generating Developments. However, as the Crawfords Freightlines subject site is currently operational, the analysis has been undertaken on a first principles basis, accounting for the existing movement of staff and service vehicles.

At present an average of 100 inbound and outbound heavy vehicle movements per day occur at the subject site. Approximately 50% of these are by articulated B-doubles with the remainder being semi-trailers. This vehicle activity occurs over the course of typical working day with no distinct periods of peak activity.

4.1.1 Port of Newcastle Arrivals

A ship carrying approximately 3,500 tonnes of ammonium nitrate arrives at the port of Newcastle on average once a month. The ammonium nitrate is delivered in "bulker" bags of approximately 1 tonne in weight. A B-double vehicle has a maximum weight capacity for transportation of 36 tonnes. Accordingly, it requires approximately 100 B-double truck movements to unload the ship.

The proposed operation for the Sandgate facility provides a storage capacity of 13,500 tonnes of ammonium nitrate. The movements associated with the offloading of a full ship will provide for delivery directly to the facility where the bulker bags will be stored. This will typically involve 5 B-doubles working in concurrent 12 hour shifts and require 2 full days. As the trucks will deliver the ammonium nitrate over a 24 hour period, the majority of the impact occurs outside of the adjoining road network periods of peak activity. This operation is consistent with the previous operation of the facility when operating at a storage capacity of 13,500 tonnes.

The individual bags can be opened at the Sandgate site and via conveyor the product is placed in the rear container of the truck for delivery to the end user, typically a mine site. It is noted that other than the opening of bulker bags no additional processing of the ammonium nitrate occurs on site.

This proposed operation differs slightly from the current logistics associated with the facility's reduced storage capacity. Currently upon arrival at the Port of Newcastle any spare storage capacity at Sandgate facility is filled, with the balance of the shipment delivered to and stored by Crawfords Freightlines clients in bulker bags. They are subsequently delivered to the Sandgate facility as capacity allows, are kept in bags or broken down to bulk and then delivered as required to the mine sites.

The movement of ammonium nitrate from the Crawfords Freightlines facility is entirely driven by demand at mine sites. Accordingly the number of truck movements associated with deliveries to mines will not change with the proposed increase in storage capacity.

However, the reinstatement of capacity to 13,500 tonne compared to the current 2,000 tonne capacity will have two significant effects on arrivals at the Port of Newcastle :

1. It will remove the additional road link currently between Crawfords Freightlines clients and the Sandgate facility; and
2. Although the number of deliveries will stay the same, the period of delivery will be intensified into a shorter period (2 days) associated with direct delivery of a full shipload of product as opposed to ad hoc deliveries throughout a month.

As the majority of activity associated with emptying a ship occurs outside AM and PM peak periods, the re-introduction of the capacity of 13,500 tonnes will not adversely affect the road network in the vicinity of the subject site and will actually result in the reduction in the overall number of trips associated with the movement and storage of the product arriving into Newcastle by ship.

4.1.2 Port Botany, Sydney Arrivals

Prior to the reduction in storage capacity, ammonium nitrate that arrived at Port Botany was placed on trains and delivered directly to the facility at Sandgate. The trains consisted of 40 carriages each with a 20 tonne capacity and arrived at the site an average of 3 times per week. The product would then be off loaded and kept in bags or broken down to bulk and delivered to the mine sites as required. It is proposed to reinstate this arrangement as part of the proposal.

Currently, in response to the reduced storage capacity, the ammonium nitrate is delivered by rail to an alternative storage area operated by the TOLL Group. It is then delivered by road to the Sandgate facility and kept in bags or broken down to bulk and delivered to mine sites as required.

Accordingly the current procedure results in an additional road trip, namely the movement of the product from the alternative storage facility to the Sandgate facility. This equates to an additional 20 truck movements per day to and from the subject site.

Based upon the assessment of the proposal for the re-introduction of the 13,500 tonnes storage capacity at the Sandgate facility compared with the current trip generation associated with the delivery of the product to Sandgate, the proposal will result in a reduction of 20 truck movement per day.

4.1.3 Staff and Other Movements

As elements of the existing facility do not change with the proposed increase in capacity and given that Old Maitland Road is a cul-de-sac and its intersection with the Pacific Highway is the only external entry and exit point to/from the subject site, these elements have been accounted for in the peak hour surveys.

The 6:00am start time for the majority of staff precedes the road network AM peak period, while the 6:00pm end time occurs at the end of the network PM peak period.

Each staff member generates one inbound trip and one outbound trip per day, which corresponds to 130 daily trips. Staff activity is tidal with the majority of trips being inbound at the start of shifts and outbound at the end of shifts.

	Current Situation	Proposal	Impact
Staff Movements	65 inbound and 65 outbound trips per day	65 inbound and 65 outbound trips per day	Nil
Truck movement associated with shipments arriving into the Port of Newcastle	100 inbound and 100 outbound truck movements per month. Average 5 two-way movements daily per month	100 inbound and 100 outbound truck movements per month over a 2 day period.	No increase in volume. Increase in intensity
Truck movements associated with rail deliveries arriving from Port Botany, Sydney.	Average 20 inbound 20 outbound truck movements per day	Nil	Reduction of 20 inbound 20 outbound truck movements per day
Total	65 inbound/outbound light trips 120 inbound/outbound heavy trips	65 inbound/outbound light trips Average of 100 inbound/outbound heavy trips daily	Reduction of 20 inbound/outbound truck movements per day

- *Table 4-1 Impact of proposed development on site trip generation*

As described above the heavy vehicle movements are expected to reduce to 100 daily inbound and outbound service vehicle movements per day with the reinstatement of the storage capacity to 13,500 tonnes.

4.1.4 Daily and Seasonal Factors

Activity at the facility is unaffected by seasonal changes and is consistent throughout the year.

4.1.5 Sight Distances

The service road providing access to the subject site intersects Old Maitland Road at a priority controlled junction and Old Maitland Road has a posted speed limit of 50km/hr.

For the indicative speed limit of 50 km/h, the required visibility splay is 69 metres (source: AS2890.2). The visibility has been checked on site and it exceeds 100 metres in both directions.

The Pacific Highway at Sandgate provides a reasonably straight alignment, ensuring good visibility for all drivers entering and exiting Old Maitland Road from the Pacific Highway.

4.1.6 Queuing at entrance to site

No queues occur on the service road providing access to the site, which operates with free flow conditions. Similarly, when the site has previously operated at full capacity there were no queues.

4.2 Traffic Distribution and Assignments

4.2.1 Origin / Destinations Assignment

The majority of staff access/egress the subject site to/from the south from the direction of Newcastle.

The majority of heavy vehicles access/egress the subject site to/from the north in the direction of the mine sites in the Hunter Region.

During periods of arrivals from the Port of Newcastle there would be an increase in truck movements to and from Newcastle.

4.3 Modal Split

At present all movement to and from the site occurs by private vehicle. None of the staff utilise public transport to access and egress the subject site.

4.4 Impact of Generated Traffic (Capacity and Level of service)

4.4.1 Impact on Daily Traffic Flows

The existing daily traffic flows are well within acceptable limits for their classifications.

The Pacific Highway around Sandgate is a regional road acting as an arterial road. The capacity of a 4 lane divided road with clearway conditions is 1,900 vehicles per hour per lane (Source Table 4.3 Peak Typical mid-block capacities for urban roads with interrupted flows, RTA Guide to Traffic Generating Developments 2002). While the capacity of Old Maitland Road is 900 vehicles per hour per lane.

These capacities are significantly higher than the existing peak hour traffic volumes.

4.4.2 Background traffic and other developments

In accordance with normal RMS requirements, the impact of the additional traffic has been assessed allowing for 10 years background growth along the Pacific Highway. An allowance of 2% per annum, giving 20% overall growth, has been used. This provides an absolute worst case scenario, as it can be seen that the historic growth along the Pacific Highway has been less than 2% per annum. The 2022 horizon year traffic volumes are displayed in Figure 4-1.

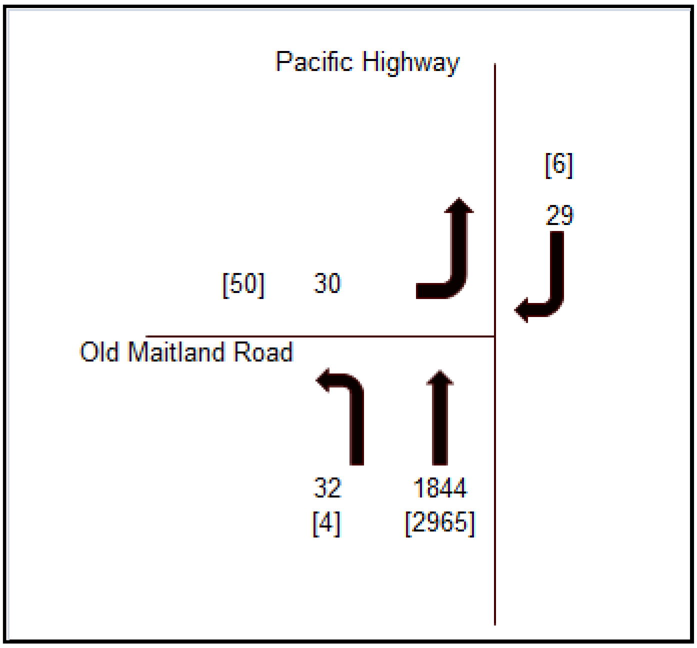


Figure 4-1 Horizon Year 2022 Traffic Volumes

4.4.3 Peak Hour Impacts on Intersections

As part of the assessment for the proposed development, the intersection capacity analysis program SIDRA has been used to assess the operation of Old Maitland Road and the Pacific Highway in the 2022 horizon year. The results of the analysis as presented below in Table 4-2. The changes reflect the increase in background growth as there is no increase in development traffic.

Table 4-2 Horizon Year 2022 Old Maitland Road and Pacific Highway Intersection Analysis

Intersection	AM Peak		PM Peak	
	Delay (secs)	LOS	Delay (secs)	LOS
Pacific Highway - Northbound	3.0	A	36.9	C
Pacific Highway – right turn to Old Maitland Road	75.2	F	72.8	F
Old Maitland Road	75.1	F	78.4	F
Total Intersection	5.2	A	37.7	C

The SIDRA results indicate that in the 2022 horizon year that the intersection of Old Maitland Road and the Pacific Highway will continue to operate to an acceptable level of service.

All SIDRA outputs are included in Appendix E.

The application of the 2% annual growth rate to the U-turn volumes corresponds to 14 vehicles in the AM peak hour and 41 vehicles in the PM peak hour.

Accordingly the trips generated by the existing Crawfords Freightlines subject site are low and have a marginal effect on the surrounding road network. This is reflected in the operation of the Old Maitland Road and Pacific Highway intersection which currently operates with an acceptable level of service.

4.5 Impact of Construction Traffic

As the development is currently operational there will be no construction traffic activity.

4.6 Impact on Road Safety

The traffic flows associated with the existing facility have a minimal impact upon traffic safety. The sightlines at the intersection of the service road and Old Maitland Road exceed Australian Standard requirements.

For the key intersection of Old Maitland Road and the Pacific Highway the sight lines are very good allowing for good visibility for traffic turning both into and out of the access road. It is considered that the intersection operates in a safe and acceptable manner with the traffic associated with the Sandgate facility. This is reflected in the accident data which indicates that a single accident has occurred at the intersection of the Old Maitland Road and the Pacific Highway since 2009. Road safety has been enhanced with the traffic signals.

Additionally, no vehicular accidents have occurred on the Crawfords Freightlines service road or within the subject site.

4.7 Parking Analysis

There is adequate parking for light and heavy vehicles currently provided on site.

4.8 Public Transport

There is currently no demand for public transport generated by the existing facility. No specific pedestrian access to any new or existing bus stops along the Pacific Highway needs be provided.

4.9 Pedestrian and Cyclists

There is currently no demand for additional pedestrian and cyclist facilities generated by the existing Sandgate facility in the vicinity of the subject site.

5 Improvement Analysis

5.1 Improvements to Accommodate Existing Traffic

It is considered that the existing site access and circulation provides a safe and appropriate access arrangement for the development and that no improvements are required to accommodate the existing traffic flows.

5.1.1 Improvements to Accommodate Background Traffic

The SIDRA analysis shows that the signalised intersection of Old Maitland Road and the Pacific Highway can continue to operate to an acceptable level in the 2022 horizon years. Accordingly no mitigation measures are required to accommodate the horizon year traffic volumes.

5.2 Additional Improvements to Accommodate Development Traffic

As the impact of the development proposal is a positive one on the current traffic flows it is considered that there are no improvements necessary to accommodate development traffic.

5.3 Alternative Improvements

No works are put forward as part of the impact assessment of the site.

5.4 Status of Improvements Already Funded, Programmed or Planned.

The RMS is currently constructing a four-lane divided carriageway extension of the Newcastle Inner City Bypass for 1.8 km between Shortland and Sandgate. The link is part of the Newcastle Inner City Bypass project.

The link which will run adjacent to the south of the subject site will intersect the Pacific Highway at a new signalised junction approximately 330m south of the intersection with the Old Pacific Highway.

The RMS has indicated that the opening of this link is unlikely to have an impact upon the volumes of traffic utilising the Pacific Highway.

5.5 Evaluation

There are no works required to accommodate the existing traffic generated by the development or the anticipated background growth in traffic.

6 Summary and Recommendations

6.1 Summary

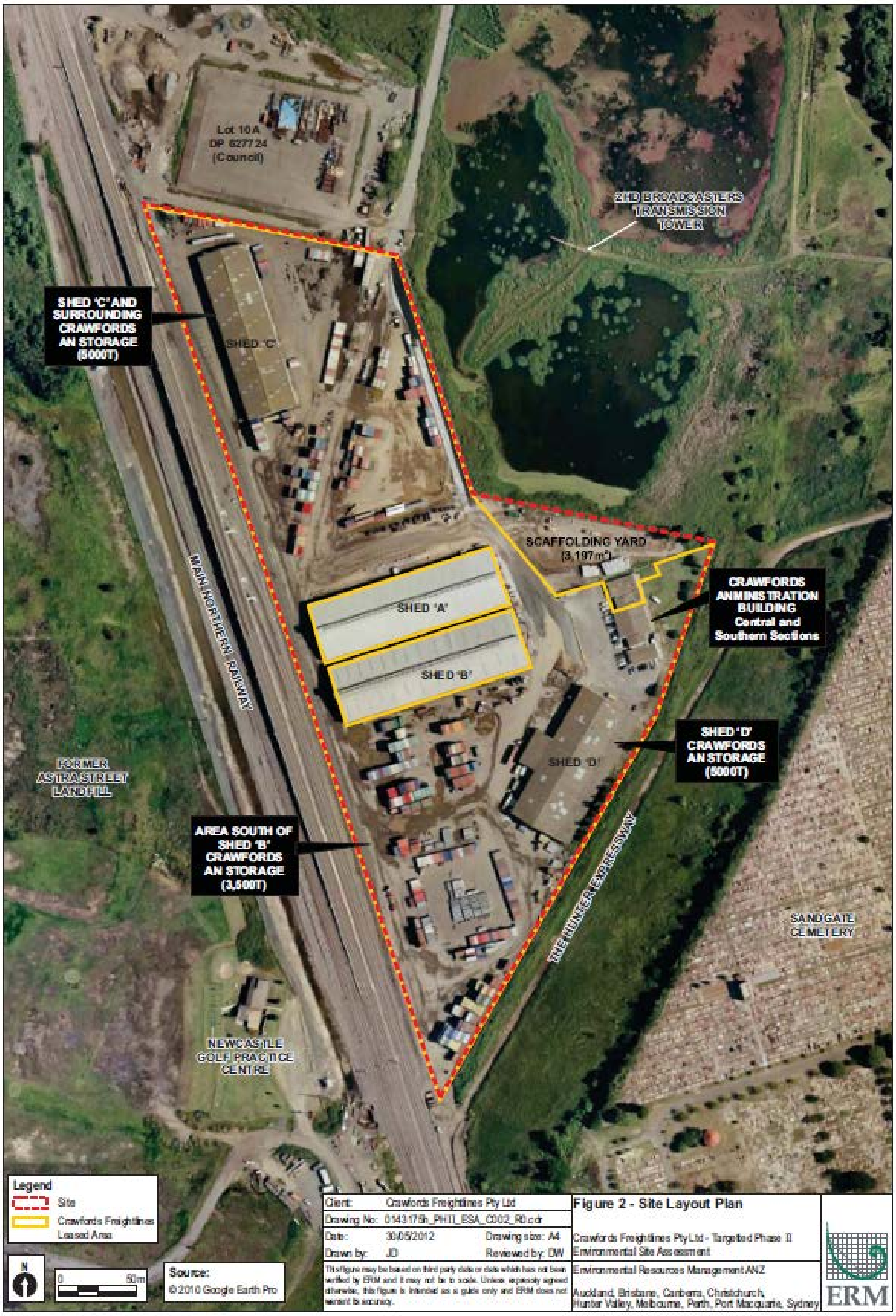
The following conclusions are drawn from the investigations into the existing Ammonium Nitrate Storage and Distribution Facility, Sandgate, NSW.

1. Better Transport Futures has been commissioned by ERM Australia Pty Ltd to prepare a Traffic Impact Assessment (TIA) for the Ammonium Nitrate Storage and Distribution Facility, Sandgate, NSW.
2. The subject site is located in proximity to the intersection of the Pacific Highway and Old Maitland Road at Sandgate, NSW. Access to the site is provided from a service road from Old Maitland Road.
3. As part of the development, traffic survey data has been collected at the intersection of Old Maitland and the Pacific Highway. The assessment of this intersection with SIDRA confirms that this intersection operates within acceptable limits.
4. The traffic generated by the subject site comes from existing staff (light) and heavy vehicle movements. The facility employs 65 staff. Each staff member generates one inbound trip and one outbound trip per day, which corresponds to 130 daily trips. Activity is tidal with the majority of trips being inbound at the start of shifts and outbound at the end of shifts. There is no change to these movements caused by the reinstatement of the storage capacity to 13,500 tonnes.
5. An average of 100 inbound and outbound heavy vehicle movements occur at the subject site each day. The heavy vehicle activity occurs over the course of typical working day with no distinct periods of peak vehicle activity. Heavy vehicle movements are expected to reduce to 100 daily inbound and outbound service vehicle movements per day when the capacity of the facility is returned to 13,500 tonnes as product arriving from Sydney can be delivered to the site directly by rail instead of the current need to transport smaller amounts by road.
6. The overall impact on the proposed reinstatement of the storage facility is to reduce the traffic compared to that being currently generated.
7. All parking for staff and service vehicles currently occurs on site. All vehicles are able to enter the facility, manoeuvre with it and exit in a forward direction.
8. Analysis indicates that in the 2022 horizon year the intersection of Old Maitland Road and the Pacific Highway will continue to operate with an acceptable level of service.

The overall conclusion from the investigations is that traffic and parking arrangements for the development proposal are satisfactory and there are no traffic or parking impediments to the development.

BETTER TRANSPORT FUTURES

Appendix A Site Layout



Appendix B Road Classification

<table>
<tr><th>Road Class</th><th>Role</th><th>Existing/New</th><th>Traffic Management Guidelines</th></tr>
<tr><td>Freeways/ Motorways</td><td>
▪ Freeways/Motorways are a particular form of arterial road in a hierarchical sense, but are considered separately in Part 4 of the Guide because of their distinctive operating characteristics.
▪ Provide for major regional and inter-regional traffic movement in a safe and operationally efficient manner.
▪ The prime traffic movement function dominates entirely and full access control ensures there are no competing access issues.
</td><td>Existing And New</td><td>
▪ Freeways and motorways do not have direct access to abutting land. There is thus effectively no access function and traffic management is directed entirely at the traffic movement function and associated aspects of capacity, congestion and speed.
</td></tr>
<tr><td rowspan="2">Arterial Roads</td><td rowspan="2">
▪ Provide for major regional and inter-regional traffic movement in a safe and operationally efficient manner.
▪ Commercial or industrial access requirements or local public transport priorities may need to be given significant weight in developing suitable traffic management strategies.
</td><td>Existing</td><td>
▪ Aim to obtain a balance between providing for traffic and providing for activities which occur, or are desired to occur, beside and across the road. The balance will generally favour traffic movement rather than the abutting access function with a focus on capacity and congestion management.
▪ Obtaining this balance will involve negotiations with affected parties including councils.
</td></tr>
<tr><td>New</td><td>
▪ Planning and design of new arterial roads (other than freeways and motorways) need not necessarily seek to entirely eliminate access to abutting land. However, it is desirable to have substantial control of access for these roads.
▪ Opportunity to plan for the desired balance between traffic and other activities beside and across the road. The planning of that ‘balance’ should consider:
– Type of land use allowed to locate beside the road
– Interactions between land uses on either side of the road
– Degree of access control for the arterial road, recognising that design and traffic management objectives on arterial roads should be biased towards the needs of through traffic.
▪ Coordinate the planning and design of new arterial roads with the land use development and amending of town planning schemes.
▪ Encourage roadside developments and access arrangements that are compatible with arterial road traffic conditions
</td></tr>
</table>

Road Class	Role	Existing/New	Traffic Management Guidelines
Distributor/ Collector Roads	▪ Streets which do not easily fall into either the arterial or the local road category. ▪ Distribute traffic and bus services within the main residential, commercial and industrial built-up areas and link traffic on local roads to the arterial road network. ▪ may be streets which have been designed as local streets, but which have additional traffic functions, usually serving major traffic generators or providing for some non-local traffic movements. ▪ problems often arise with intermediate streets, as their design usually promotes the traffic movement function, while the residents and sometimes the local council, consider the street to be a local street with emphasis on the need for low traffic speed and restricted width ▪ Alternatively, in newer growth areas they may sometimes be under-designed in response to a desired emphasis on local road functions, resulting in operational and safety problems for the higher traffic volume that must use them.	Existing	▪ Traffic management principles are less well-defined than for arterial roads and local streets. ▪ As a consequence actions which result in the traffic function or roadside factors dominating the road environment will not normally be able to be implemented. ▪ Traffic management will normally be aimed at managing relatively high levels of conflict between: – Traffic movement activities generated by abutting land use – The desire of residents for local street functions to dominate, with severe restrictions on traffic speed and the width allocated to traffic movement. ▪ The extent of these conflicting demands may vary considerably throughout the day and a balance needs to be made to achieve traffic operations acceptable to the needs of both motorists and abutting residents.
		New	▪ In new street and road networks, the length of intermediate street classed as distributor/ collector should be minimised as far as possible. ▪ Where these streets are included, they should have complementary abutting land uses which generate a low degree of non-motorised traffic demands or incorporate a degree of access control, or include appropriate treatments to reduce traffic speed and other adverse impacts.
Local Roads and Streets	▪ May serve several functions to a greater or lesser degree. Some of the functions are at least partially incompatible. Typical functions include: – providing vehicular access to abutting property – providing vehicular access to other properties within a local area – providing access for emergency and service vehicles – providing a network for the movement of pedestrians and cyclists – providing a means to enable social interaction within a neighbourhood, e.g. serving as a play area or community open space – contributing visually to the "living" environment. ▪ The extent of each of these functions will vary within a local street network. For example, a street which provides access to several other streets, will have a more prominent vehicle movement role than a small cul-de-sac.	Existing And New	▪ Convey to motorists the impression that they are operating in a space or area which has not been designed soley for motor traffic. ▪ In many instances with residential streets, this desirably requires the road reservation to be constructed in such as way as to eliminate cleer, visual impressions of separate vehicle and pedestrian space. ▪ Detailed guidance can be found in *Part 8:Local Area Traffic Management*

Appendix C Survey Data

Turning movement count

Job:	P0924
Day, date	07/06/12 4
Location:	Maitland Road and Old Maitland Road Sandgate
Weather:	Rain
Client:	ERM

N

25

26 1513

24

3 2

Time Period	Through	Through	Left	Left	Total
07:00 to 07:15	3	274	4	4	277
07:15 to 07:30	6	272	4	3	278
07:30 to 07:45	4	310	2	3	314
07:45 to 08:00	7	335	3	8	342
08:00 to 08:15	3	396	1	4	399
08:15 to 08:30	8	375	13	8	383
08:30 to 08:45	6	407	9	5	413 peak
08:45 to 09:00	3	336	3	5	339
Total	40	2705	39	40	
Hourly summary					
07:00 to 08:00	20	1191	13	18	1211
07:15 to 08:15	20	1313	10	18	1333
07:30 to 08:30	22	1416	19	23	1438
07:45 to 08:45	24	1513	26	25	1537 Peak Hour
08:00 to 09:00	20	1514	26	22	1534

Turning movement count

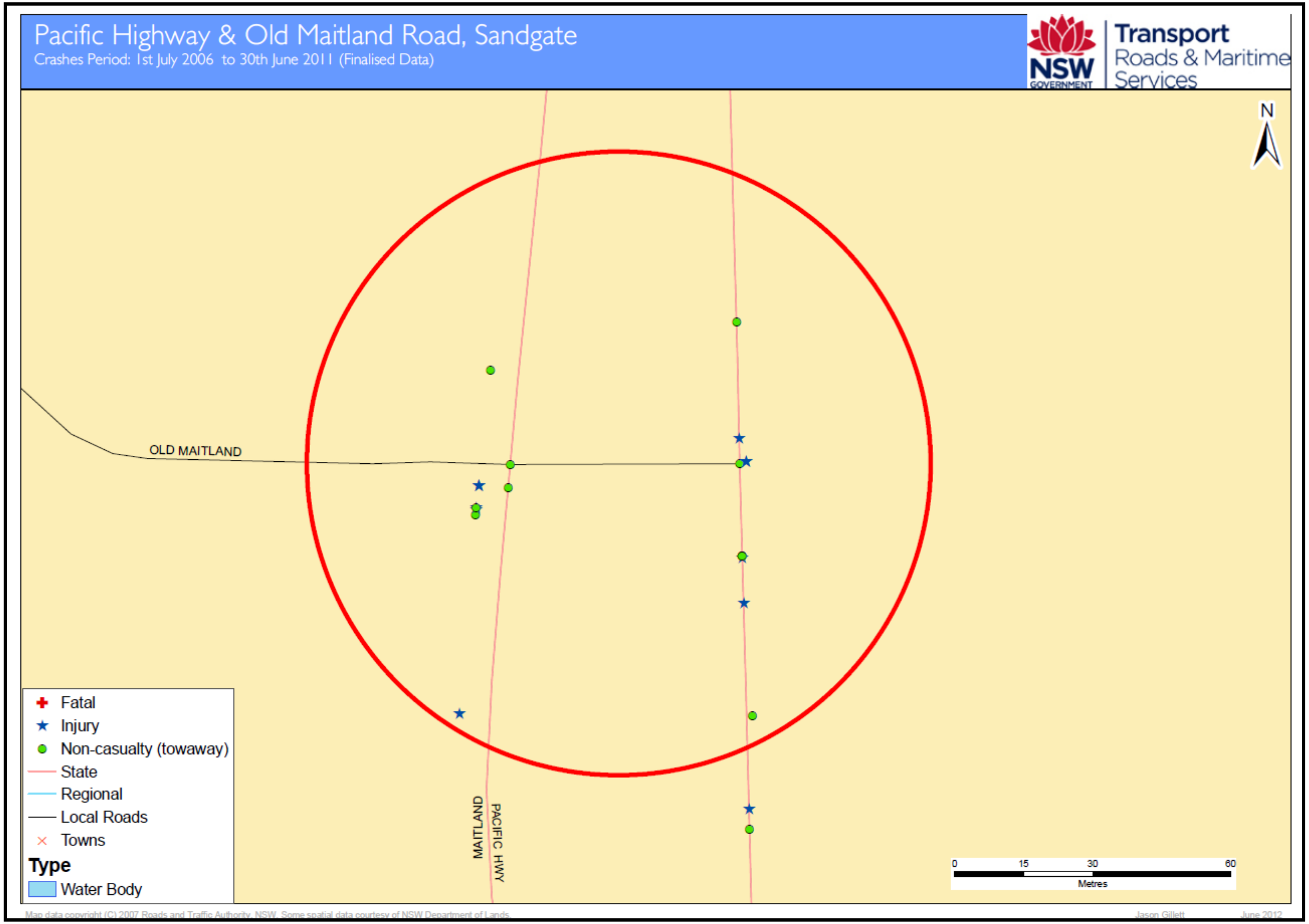
Job: P0924
Day, date 07/06/12 4
Location: Maitland Road and Old Maitland Road Sandgate
Weather: Rain
Client: ERM

N

41 | 3 | 2432 | 5
3 | 2

Time Period	Through	Through	Left	Left	Total
15:30 to 15:45	1	528	1	29	529
15:45 to 16:00	7	560	9	16	567
16:00 to 16:15	3	579	2	18	582
16:15 to 16:30	5	569	1	11	574
16:30 to 16:45	2	559	2	27	561
16:45 to 17:00	0	605	3	13	605
17:00 to 17:15	3	567	0	9	570
17:15 to 17:30	1	673	0	10	674 peak
17:30 to 17:45	1	587	0	9	588
17:45 to 18:00	2	502	0	8	504
18:00 to 18:15	1	457	2	4	458
18:15 to 18:30	0	352	2	6	352
Total	26	6538	22	160	
Hourly summary					
15:30 to 16:30	16	2236	13	74	2252
15:45 to 16:45	17	2267	14	72	2284
16:00 to 17:00	10	2312	8	69	2322
16:15 to 17:15	10	2300	6	60	2310
16:30 to 17:30	6	2404	5	59	2410
16:45 to 17:45	5	2432	3	41	2437 Peak Hour
17:00 to 18:00	7	2329	0	36	2336
17:15 to 18:15	5	2219	2	31	2224
17:30 to 18:30	4	1898	4	27	1902

Appendix D Accident Data



Summary Crash Report

Transport Centre for Road Safety — NSW Government

# Crash Type		
Car Crash	22	100.0%
Light Truck Crash	5	22.7%
Rigid Truck Crash	0	0.0%
Articulated Truck Crash	1	4.5%
'Heavy Truck Crash	(1)	(4.5%)
Bus Crash	0	0.0%
"Heavy Vehicle Crash	(1)	(4.5%)
Emergency Vehicle Crash	0	0.0%
Motorcycle Crash	0	0.0%
Pedal Cycle Crash	0	0.0%
Pedestrian Crash	0	0.0%

' Rigid or Artic. Truck " Heavy Truck or Heavy Bus
These categories are NOT mutually exclusive

Location Type		
*Intersection	13	59.1%
Non intersection	9	40.9%

* Up to 10 metres from an intersection
~ 07:30-09:30 or 14:30-17:00 on school days

Collision Type		
Single Vehicle	1	4.5%
Multi Vehicle	21	95.5%

Road Classification		
Freeway/Motorway	0	0.0%
State Highway	22	100.0%
Other Classified Road	0	0.0%
Unclassified Road	0	0.0%

Contributing Factors		
Speeding	0	0.0%
Fatigue	1	4.5%

Weather		
Fine	14	63.6%
Rain	2	9.1%
Overcast	5	22.7%
Fog or mist	1	4.5%
Other	0	0.0%

Road Surface Condition		
Wet	4	18.2%
Dry	18	81.8%
Snow or ice	0	0.0%

Natural Lighting		
Dawn	1	4.5%
Daylight	17	77.3%
Dusk	1	4.5%
Darkness	3	13.6%

Crash Movement		
Intersection, adjacent approaches	0	0.0%
Head-on (not overtaking)	0	0.0%
Opposing vehicles; turning	1	4.5%
U-turn	0	0.0%
Rear-end	20	90.9%
Lane change	0	0.0%
Parallel lanes; turning	0	0.0%
Vehicle leaving driveway	0	0.0%
Overtaking; same direction	0	0.0%
Hit parked vehicle	0	0.0%
Hit railway train	0	0.0%
Hit pedestrian	0	0.0%
Permanent obstruction on road	0	0.0%
Hit animal	0	0.0%
Off road, on straight	0	0.0%
Off road on straight, hit object	1	4.5%
Out of control on straight	0	0.0%
Off road, on curve	0	0.0%
Off road on curve, hit object	0	0.0%
Out of control on curve	0	0.0%
Other crash type	0	0.0%

Speed Limit					
			~ 40km/h or less	0	0.0%
40 km/h or less	0	0.0%	80 km/h zone	21	95.5%
50 km/h zone	0	0.0%	90 km/h zone	0	0.0%
60 km/h zone	0	0.0%	100 km/h zone	0	0.0%
70 km/h zone	1	4.5%	110 km/h zone	0	0.0%

CRASHES	22	
Fatal crash	0	0.0%
Injury crash	11	50.0%
Non-casualty crash	11	50.0%

CASUALTIES	16	
Killed	0	0.0%
Injured	16	100.0%
^ Unrestrained	0	0.0%

^ Belt fitted but not worn, No restraint fitted to position OR No helmet worn

Time Group			% of Day
00:01 - 02:59	1	4.5%	12.5%
03:00 - 04:59	0	0.0%	8.3%
05:00 - 05:59	2	9.1%	4.2%
06:00 - 06:59	1	4.5%	4.2%
07:00 - 07:59	0	0.0%	4.2%
08:00 - 08:59	1	4.5%	4.2%
09:00 - 09:59	1	4.5%	4.2%
10:00 - 10:59	1	4.5%	4.2%
11:00 - 11:59	0	0.0%	4.2%
12:00 - 12:59	1	4.5%	4.2%
13:00 - 13:59	2	9.1%	4.2%
14:00 - 14:59	0	0.0%	4.2%
15:00 - 15:59	2	9.1%	4.2%
16:00 - 16:59	8	36.4%	4.2%
17:00 - 17:59	1	4.5%	4.2%
18:00 - 18:59	0	0.0%	4.2%
19:00 - 19:59	0	0.0%	4.2%
20:00 - 21:59	1	4.5%	8.3%
22:00 - 24:00	0	0.0%	8.3%

Street Lighting Off/Nil			% of Dark
0	of	3 in Dark	0.0%

Crashes		Casualties
1	2011	3
5	2009	2
8	2008	6
5	2007	3
3	2006	2

~ School Travel Time		
Involvement	9	40.9%

McLean Periods			% Week
A	3	13.6%	17.9%
B	1	4.5%	7.1%
C	5	22.7%	17.9%
D	0	0.0%	3.5%
E	0	0.0%	3.6%
F	3	13.6%	10.7%
G	9	40.9%	7.1%
H	0	0.0%	7.1%
I	0	0.0%	12.5%
J	1	4.5%	10.7%

Day of the Week								
Monday	1	4.5%	Thursday	4	18.2%	Sunday	2	9.1%
Tuesday	2	9.1%	Friday	8	36.4%	WEEKDAY	20	90.9%
Wednesday	5	22.7%	Saturday	0	0.0%	WEEKEND	2	9.1%

# Holiday Periods								
New Year	0	0.0%	Queen's BD	0	0.0%	Easter SH	1	4.5%
Aust. Day	0	0.0%	Labour Day	0	0.0%	June/July SH	0	0.0%
Easter	0	0.0%	Christmas	0	0.0%	Sept./Oct. SH	2	9.1%
Anzac Day	0	0.0%	January SH	1	4.5%	December SH	0	0.0%

Crashid dataset Pacific Highway & Old Maitland Road, Sandgate - 1/7/2006 to 30/6/2011

Percentages are percentages of all crashes. Unknown values for each category are not shown on this report.

Rep ID: REG01 **Office:** Hunter **User ID:** gillettj Page 1 of 1 Generated: 06/06/2012 09:37

Detailed Crash Report - sorted

Transport Centre for Road Safety

Crash No.	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
					Natural Lighting															**S F**
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
579198	21/09/2006	Thu	05:45	5 m N	OLD MAITLAND RD	TJN	STR	Fine	Dry	80	2	CAR	F42	S in PACIFIC HWY	80	Proceeding in lane	I	0	1	
E130102493					Dawn	DCA :	301	Same - Rear end				CAR	M22	S in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
542329	06/10/2006	Fri	08:15	5 m S	OLD MAITLAND RD	TJN	STR	Fine	Dry	80	2	CAR	M73	N in PACIFIC HWY	Unk	Proceeding in lane	N	0	0	
E28796678					Daylight	DCA :	301	Same - Rear end				WAG	M39	N in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
554961	06/12/2006	Wed	13:10	at	OLD MAITLAND RD	TJN	STR	Fine	Dry	80	2	4WD	M U	N in PACIFIC HWY	Unk	Proceeding in lane	I	0	1	
E29248427					Daylight	DCA :	301	Same - Rear end				CAR	F53	N in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
562153	28/02/2007	Wed	15:45	50 m S	OLD MAITLAND RD	DIV	STR	Overcast	Dry	80	2	CAR	M25	S in PACIFIC HWY	65	Proceeding in lane	N	0	0	
E122198494					Daylight	DCA :	301	Same - Rear end				CAR	M39	S in PACIFIC HWY	60	Proceeding in lane				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
582996	20/07/2007	Fri	13:30	at	OLD MAITLAND RD	TJN	STR	Overcast	Dry	80	2	TRK	M19	W in PACIFIC HWY	70	Proceeding in lane	I	0	1	
E60124901					Daylight	DCA :	301	Same - Rear end				CAR	F44	W in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
584134	29/07/2007	Sun	00:23	at	OLD MAITLAND RD	TJN	STR	Fine	Dry	80	1	CAR	M25	N in PACIFIC HWY	70	Proceeding in lane	I	0	1	F
E128079294					Darkness	DCA :	703	Left off cway into object				Signal pole								
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
593508	12/10/2007	Fri	15:30	5 m N	OLD MAITLAND RD	TJN	STR	Overcast	Wet	80	2	CAR	M18	S in PACIFIC HWY	70	Proceeding in lane	I	0	1	
E31552272					Daylight	DCA :	301	Same - Rear end				CAR	M66	S in PACIFIC HWY	10	Proceeding in lane				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
600059	21/11/2007	Wed	06:45	25 m N	OLD MAITLAND RD	DIV	STR	Fine	Dry	80	4	TRK	M24	N in PACIFIC HWY	60	Proceeding in lane	N	0	0	
E32039148					Daylight	DCA :	301	Same - Rear end				CAR	F39	N in PACIFIC HWY	65	Proceeding in lane				
												4WD	M31	N in PACIFIC HWY	0	Stationary				
												TRK	M34	N in PACIFIC HWY	75	Proceeding in lane				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
610319	22/01/2008	Tue	09:15	5 m S	OLD MAITLAND RD	TJN	STR	Overcast	Dry	80	2	CAR	F29	W in PACIFIC HWY	30	Proceeding in lane	I	0	4	
E32869173					Daylight	DCA :	301	Same - Rear end				CAR	F19	W in PACIFIC HWY	0	Stationary				

Rep ID: DCR02 **Office:** Hunter **User ID:** gillettj

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BETTER TRANSPORT FUTURES

Detailed Crash Report - sorted

Transport Centre for Road Safety (NSW Government)

Crash No.	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
					Natural Lighting															**S F**
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
615149	04/03/2008	Tue	20:40	50 m S	OLD MAITLAND RD	DIV	STR	Fine	Dry	70	2	CAR	U U	N in PACIFIC HWY	30	Proceeding in lane	I	0	1	
E35020480					Darkness	DCA :	301	Same - Rear end				CAR	M28	N in PACIFIC HWY	70	Proceeding in lane				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
619191	13/04/2008	Sun	05:25	5 m S	OLD MAITLAND RD	TJN	STR	Fog or mist	Dry	80	2	4WD	M53	N in PACIFIC HWY	Unk	Proceeding in lane	I	0	1	
E33827428					Darkness	DCA :	301	Same - Rear end				4WD	M86	N in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
622605	05/05/2008	Mon	10:00	5 m S	OLD MAITLAND RD	XJN	STR	Fine	Dry	80	2	WAG	M47	N in PACIFIC HWY	40	Proceeding in lane	N	0	0	
E35539889					Daylight	DCA :	301	Same - Rear end				CAR	F20	N in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
638322	10/09/2008	Wed	17:30	5 m S	OLD MAITLAND RD	TJN	STR	Fine	Dry	80	2	CAR	M20	N in PACIFIC HWY	70	Proceeding in lane	N	0	0	
E34795547					Dusk	DCA :	301	Same - Rear end				4WD	M20	N in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
639831	24/09/2008	Wed	12:50	at	OLD MAITLAND RD	TJN	CRV	Fine	Dry	80	2	CAR	M77	S in PACIFIC HWY	10	Turning right	N	0	0	
E34863717					Daylight	DCA :	202	Opp - Right-thru				CAR	F30	N in PACIFIC HWY	60	Proceeding in lane				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
642021	23/10/2008	Thu	16:15	at	OLD MAITLAND RD	TJN	STR	Overcast	Wet	80	2	CAR	M61	S in PACIFIC HWY	25	Proceeding in lane	N	0	0	
E35612649					Daylight	DCA :	301	Same - Rear end				TRK	M22	S in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
646836	27/11/2008	Thu	16:05	30 m N	OLD MAITLAND RD	DIV	STR	Fine	Dry	80	3	CAR	M49	S in PACIFIC HWY	70	Proceeding in lane	N	0	0	
E35505614					Daylight	DCA :	301	Same - Rear end				TRK	M39	S in PACIFIC HWY	0	Stationary				
												CAR	M U	S in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
668766	30/04/2009	Thu	16:10	5 m N	OLD MAITLAND RD	TJN	STR	Raining	Wet	80	2	BDBL	M33	S in PACIFIC HWY	75	Proceeding in lane	I	0	1	
E37423079					Daylight	DCA :	301	Same - Rear end				CAR	F50	S in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
665827	01/05/2009	Fri	16:00	20 m S	OLD MAITLAND RD	DIV	STR	Fine	Dry	80	2	UTE	F34	S in PACIFIC HWY	80	Proceeding in lane	N	0	0	
E37086722					Daylight	DCA :	301	Same - Rear end				CAR	F36	S in PACIFIC HWY	0	Stationary				

Rep ID: DCR02 **Office:** Hunter **User ID:** gillettj

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Detailed Crash Report - sorted

BETTER TRANSPORT FUTURES

NSW GOVERNMENT | Transport Centre for Road Safety

Crash No.	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
					Natural Lighting															**S F**
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
686817	23/10/2009	Fri	16:25	20 m	S OLD MAITLAND RD	DIV	STR	Raining	Wet	80	4	CAR	M20	S in PACIFIC HWY	60	Proceeding in lane	I	0	1	
E38491609					Daylight	DCA :	301	Same - Rear end				CAR	M30	S in PACIFIC HWY	0	Stationary				
												CAR	F49	S in PACIFIC HWY	70	Proceeding in lane				
												CAR	M59	S in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
689372	13/11/2009	Fri	16:15	20 m	S OLD MAITLAND RD	DIV	STR	Fine	Dry	80	4	4WD	M19	S in PACIFIC HWY	30	Proceeding in lane	N	0	0	
E38561960					Daylight	DCA :	301	Same - Rear end				4WD	F40	S in PACIFIC HWY	0	Stationary				
												CAR	M48	S in PACIFIC HWY	30	Proceeding in lane				
												TRK	M28	S in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
689397	13/11/2009	Fri	16:00	20 m	S OLD MAITLAND RD	DIV	STR	Fine	Dry	80	2	WAG	F36	S in PACIFIC HWY	30	Proceeding in lane	N	0	0	
E134822196					Daylight	DCA :	301	Same - Rear end				CAR	M20	S in PACIFIC HWY	0	Stationary				
Hunter Region				**Newcastle City LGA**		**Sandgate**			**Pacific Hwy**											
746897	11/03/2011	Fri	16:15	30 m	S OLD MAITLAND RD	DIV	STR	Fine	Dry	80	3	CAR	M38	E in PACIFIC HWY	Unk	Proceeding in lane	I	0	3	
E44748008					Daylight	DCA :	301	Same - Rear end				WAG	M22	E in PACIFIC HWY	Unk	Proceeding in lane				
												CAR	M33	E in PACIFIC HWY	Unk	Veering right				

Report Totals: Total Crashes: 22 Fatal Crashes: 0 Injury Crashes: 11 Killed: 0 Injured: 16

Crashid dataset Pacific Highway & Old Maitland Road, Sandgate - 1/7/2006 to 30/6/2011

Note: Ordered by: Crash Date.

Rep ID: DCR02 **Office:** Hunter **User ID:** gillettj

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Appendix E Sidra Results

Criteria for interpreting results of SIDRA

1-Level of Service (LoS)

LoS	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Good	Good
B	Good, with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	Satisfactory	Satisfactory, but requires accident study
D	Operating near capacity	Near capacity and requires accident study
E	At capacity, excessive delay: roundabout requires other control method	At capacity, requires other control mode
F	Unsatisfactory, requires other control mode or additional capacity	Unsatisfactory, requires other control mode

2-Average Vehicle Delay (AVD)

The AVD is a measure of operational performance of an intersection relating to its LoS. The average delay should be taken as a guide only for an average intersection. Longer delays may be tolerated at some intersections where delays are expected by motorists (e.g. those in inner city areas or major arterial roads).

LoS	Average Delay / Vehicle (secs)	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	28 to 42	Satisfactory	Satisfactory but accident study required
D	42 to 56	Operating near capacity	Near capacity, accident study required
E	56 to 70	At capacity, excessive delays: roundabout requires other control mode	At capacity; requires other control mode
F	Exceeding 70	Unsatisfactory, requires additional capacity	Unsatisfactory, requires other control mode

3-Degree of Saturation (D/S)

The D/S of an intersection is usually taken as the highest ratio of traffic volumes on an approach to an intersection compared with the theoretical capacity, and is a measure of the utilisation of available green time. For intersections controlled by traffic signals, both queues and delays increase rapidly as DS approaches 1.0. An intersection operates satisfactorily when its D/S is kept below 0.75. When D/S exceeds 0.9, queues are expected.

INTERSECTION SUMMARY

Site: Existing Situation AM Peak

Existing Situation - AM Peak
Signals - Fixed Time   Cycle Time = 120 seconds (User-Given Cycle Time)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	1672	veh/h	2006	pers/h
Percent Heavy Vehicles	6.7	%		
Degree of Saturation	0.496			
Practical Spare Capacity	81.4	%		
Effective Intersection Capacity	3370	veh/h		
Control Delay (Total)	2.23	veh-h/h	2.67	pers-h/h
Control Delay (Average)	4.8	sec	4.8	sec
Control Delay (Worst Lane)	74.8	sec		
Control Delay (Worst Movement)	74.8	sec	74.8	sec
Geometric Delay (Average)	0.5	sec		
Stop-Line Delay (Average)	4.3	sec		
Intersection Level of Service (LOS)	LOS A			
95% Back of Queue - Vehicles (Worst Lane)	11.8	veh		
95% Back of Queue - Distance (Worst Lane)	86.1	m		
Total Effective Stops	469	veh/h	563	pers/h
Effective Stop Rate	0.28	per veh	0.28	per pers
Proportion Queued	0.30		0.30	
Performance Index	38.2		38.2	
Travel Distance (Total)	1013.8	veh-km/h	1216.6	pers-km/h
Travel Distance (Average)	606	m	606	m
Travel Time (Total)	19.5	veh-h/h	23.4	pers-h/h
Travel Time (Average)	42.1	sec	42.1	sec
Travel Speed	51.9	km/h	51.9	km/h
Cost (Total)	640.73	$/h	640.73	$/h
Fuel Consumption (Total)	105.0	L/h		
Carbon Dioxide (Total)	263.4	kg/h		
Hydrocarbons (Total)	0.356	kg/h		
Carbon Monoxide (Total)	13.28	kg/h		
NOx (Total)	0.528	kg/h		

Level of Service (LOS) Method: Delay (RTA NSW).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Existing Situation AM Peak

Existing Situation - AM Peak
Signals - Fixed Time   Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Pacific Highway - Sth											
1	L	27	40.0	0.026	9.4	LOS A	0.1	1.1	0.12	0.60	49.1
2	T	1593	5.0	0.496	2.5	LOS A	11.8	86.1	0.28	0.26	54.8
Approach		1620	5.6	0.496	2.6	LOS A	11.8	86.1	0.28	0.27	54.7
North: Pacific Highway - Nth											
9	R	25	40.0	0.350	74.8	LOS F	1.6	14.6	1.00	0.72	19.9
Approach		25	40.0	0.350	74.8	LOS F	1.6	14.6	1.00	0.72	19.9
West: Old Maitland Road											
10	L	26	40.0	0.364	74.7	LOS F	1.6	15.3	1.00	0.72	19.9
Approach		26	40.0	0.364	74.7	LOS F	1.6	15.3	1.00	0.72	19.9
All Vehicles		1672	6.7	0.496	4.8	LOS A	11.8	86.1	0.30	0.28	51.9

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Project: M:\MW Pty Ltd\Active Projects\P0924 ERM Crawfords Freightlines TIA\Pacific Highway and Old Maitland Road.sip
8000290, MARK WAUGH PTY LTD, SINGLE

INTERSECTION SUMMARY

Site: Existing Situation PM Peak

Existing Situation - PM Peak
Signals - Fixed Time   Cycle Time = 120 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2612	veh/h	3134	pers/h
Percent Heavy Vehicles	5.7	%		
Degree of Saturation	0.797			
Practical Spare Capacity	12.9	%		
Effective Intersection Capacity	3275	veh/h		
Control Delay (Total)	4.17	veh-h/h	5.00	pers-h/h
Control Delay (Average)	5.7	sec	5.7	sec
Control Delay (Worst Lane)	76.4	sec		
Control Delay (Worst Movement)	76.4	sec	76.4	sec
Level of Service (Aver. Int. Delay)	LOS A			
Level of Service (Worst Movement)	LOS F			
Level of Service (Worst Lane)	LOS F			
95% Back of Queue - Vehicles (Worst Lane)	34.4	veh		
95% Back of Queue - Distance (Worst Lane)	250.8	m		
Total Effective Stops	1283	veh/h	1539	pers/h
Effective Stop Rate	0.49	per veh	0.49	per pers
Proportion Queued	0.52		0.52	
Performance Index	81.4		81.4	
Travel Distance (Total)	1583.7	veh-km/h	1900.4	pers-km/h
Travel Distance (Average)	606	m	606	m
Travel Time (Total)	31.8	veh-h/h	38.2	pers-h/h
Travel Time (Average)	43.9	sec	43.9	sec
Travel Speed	49.8	km/h	49.8	km/h
Cost (Total)	1041.15	$/h	1041.15	$/h
Fuel Consumption (Total)	174.9	L/h		
Carbon Dioxide (Total)	438.4	kg/h		
Hydrocarbons (Total)	0.628	kg/h		
Carbon Monoxide (Total)	26.66	kg/h		
NOx (Total)	0.950	kg/h		

LOS (Aver. Int. Delay) for Vehicles is based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
LOS Method for individual vehicle movements and lanes: Delay (RTA NSW).

MOVEMENT SUMMARY

Site: Existing Situation PM Peak

Existing Situation - PM Peak
Signals - Fixed Time   Cycle Time = 120 seconds

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Pacific Highway - Sth											
1	L	3	40.0	0.003	9.2	LOS A	0.0	0.1	0.10	0.59	49.2
2	T	2560	5.0	0.797	4.4	LOS A	34.4	250.8	0.51	0.49	51.2
Approach		2563	5.0	0.797	4.4	LOS A	34.4	250.8	0.51	0.49	51.2
North: Pacific Highway - Nth											
9	R	5	40.0	0.073	72.6	LOS F	0.5	4.7	0.98	0.65	20.3
Approach		5	40.0	0.073	72.6	LOS F	0.5	4.7	0.98	0.65	20.3
West: Old Maitland Road											
10	L	43	40.0	0.598	76.4	LOS F	3.9	36.6	1.00	0.78	19.6
Approach		43	40.0	0.598	76.4	LOS F	3.9	36.6	1.00	0.78	19.6
All Vehicles		2612	5.7	0.797	5.7	LOS A	34.4	250.8	0.52	0.49	49.8

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

BETTER TRANSPORT FUTURES

INTERSECTION SUMMARY

Site: 2022 AM Peak

2022 - AM Peak
Signals - Fixed Time   Cycle Time = 120 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2037	veh/h	2444	pers/h
Percent Heavy Vehicles	6.6	%		
Degree of Saturation	0.605			
Practical Spare Capacity	48.9	%		
Effective Intersection Capacity	3369	veh/h		
Control Delay (Total)	2.96	veh-h/h	3.55	pers-h/h
Control Delay (Average)	5.2	sec	5.2	sec
Control Delay (Worst Lane)	75.2	sec		
Control Delay (Worst Movement)	75.2	sec	75.2	sec
Level of Service (Aver. Int. Delay)	LOS A			
Level of Service (Worst Movement)	LOS F			
Level of Service (Worst Lane)	LOS F			
95% Back of Queue - Vehicles (Worst Lane)	18.2	veh		
95% Back of Queue - Distance (Worst Lane)	133.1	m		
Total Effective Stops	678	veh/h	813	pers/h
Effective Stop Rate	0.33	per veh	0.33	per pers
Proportion Queued	0.35		0.35	
Performance Index	50.8		50.8	
Travel Distance (Total)	1235.3	veh-km/h	1482.4	pers-km/h
Travel Distance (Average)	606	m	606	m
Travel Time (Total)	24.1	veh-h/h	29.0	pers-h/h
Travel Time (Average)	42.7	sec	42.7	sec
Travel Speed	51.2	km/h	51.2	km/h
Cost (Total)	793.39	$/h	793.39	$/h
Fuel Consumption (Total)	131.2	L/h		
Carbon Dioxide (Total)	329.2	kg/h		
Hydrocarbons (Total)	0.450	kg/h		
Carbon Monoxide (Total)	17.54	kg/h		
NOx (Total)	0.674	kg/h		

LOS (Aver. Int. Delay) for Vehicles is based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
LOS Method for individual vehicle movements and lanes: Delay (RTA NSW).

MOVEMENT SUMMARY

Site: 2022 AM Peak

2022 - AM Peak
Signals - Fixed Time   Cycle Time = 120 seconds

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Pacific Highway - Sth											
1	L	34	40.0	0.032	9.4	LOS A	0.2	2.2	0.12	0.60	49.1
2	T	1941	5.0	0.605	2.9	LOS A	18.2	133.1	0.34	0.32	53.9
Approach		1975	5.6	0.605	3.0	LOS A	18.2	133.1	0.33	0.32	53.8
North: Pacific Highway - Nth											
9	R	31	40.0	0.423	75.2	LOS F	2.8	26.2	1.00	0.73	19.8
Approach		31	40.0	0.423	75.2	LOS F	2.8	26.2	1.00	0.73	19.8
West: Old Maitland Road											
10	L	32	40.0	0.437	75.1	LOS F	2.9	27.1	1.00	0.73	19.9
Approach		32	40.0	0.437	75.1	LOS F	2.9	27.1	1.00	0.73	19.9
All Vehicles		2037	6.6	0.605	5.2	LOS A	18.2	133.1	0.35	0.33	51.2

Level of Service (Aver. Int. Delay): LOS A. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

INTERSECTION SUMMARY

Site: 2022 PM Peak

2022 - PM Peak
Signals - Fixed Time   Cycle Time = 120 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	3184	veh/h	3821	pers/h
Percent Heavy Vehicles	5.7	%		
Degree of Saturation	0.972			
Practical Spare Capacity	-7.4	%		
Effective Intersection Capacity	3275	veh/h		
Control Delay (Total)	33.33	veh-h/h	39.99	pers-h/h
Control Delay (Average)	37.7	sec	37.7	sec
Control Delay (Worst Lane)	78.4	sec		
Control Delay (Worst Movement)	78.4	sec	78.4	sec
Level of Service (Aver. Int. Delay)	LOS C			
Level of Service (Worst Movement)	LOS F			
Level of Service (Worst Lane)	LOS F			
95% Back of Queue - Vehicles (Worst Lane)	107.8	veh		
95% Back of Queue - Distance (Worst Lane)	786.8	m		
Total Effective Stops	3390	veh/h	4068	pers/h
Effective Stop Rate	1.06	per veh	1.06	per pers
Proportion Queued	0.95		0.95	
Performance Index	218.8		218.8	
Travel Distance (Total)	1930.9	veh-km/h	2317.1	pers-km/h
Travel Distance (Average)	606	m	606	m
Travel Time (Total)	68.4	veh-h/h	82.1	pers-h/h
Travel Time (Average)	77.3	sec	77.3	sec
Travel Speed	28.2	km/h	28.2	km/h
Cost (Total)	2117.99	$/h	2117.99	$/h
Fuel Consumption (Total)	301.2	L/h		
Carbon Dioxide (Total)	755.0	kg/h		
Hydrocarbons (Total)	1.243	kg/h		
Carbon Monoxide (Total)	56.51	kg/h		
NOx (Total)	1.716	kg/h		

LOS (Aver. Int. Delay) for Vehicles is based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
LOS Method for individual vehicle movements and lanes: Delay (RTA NSW).

MOVEMENT SUMMARY

Site: 2022 PM Peak

2022 - PM Peak
Signals - Fixed Time   Cycle Time = 120 seconds

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Pacific Highway - Sth											
1	L	4	40.0	0.004	9.2	LOS A	0.0	0.2	0.10	0.59	49.2
2	T	3121	5.0	0.972	37.0	LOS C	107.8	786.8	0.95	1.07	28.5
Approach		3125	5.0	0.972	36.9	LOS C	107.8	786.8	0.95	1.07	28.5
North: Pacific Highway - Nth											
9	R	6	40.0	0.087	72.8	LOS F	0.6	5.6	0.98	0.66	20.3
Approach		6	40.0	0.087	72.8	LOS F	0.6	5.6	0.98	0.66	20.3
West: Old Maitland Road											
10	L	53	40.0	0.729	78.4	LOS F	4.7	44.5	1.00	0.85	19.3
Approach		53	40.0	0.729	78.4	LOS F	4.7	44.5	1.00	0.85	19.3
All Vehicles		3184	5.7	0.972	37.7	LOS C	107.8	786.8	0.95	1.06	28.2

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.