

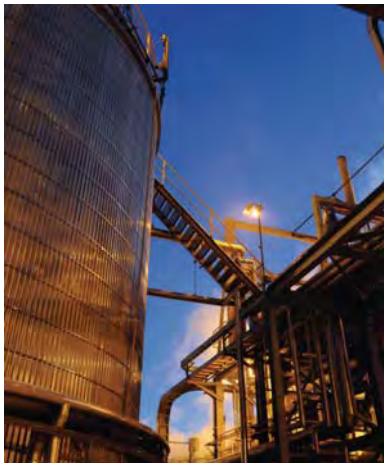

Appendix J

Transport Impact Assessment

URS DYNO Dyno Nobel Incitec Pivot SouthernCross International

Incitec Pivot Limited

Appendix J

Transport Impact Assessment

22 AUGUST 2012

Prepared for

Incitec Pivot Ltd

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43177771

URS

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Date:	**22 August 2012**
Reference:	43177771/TIA/02
Status:	Final

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Introduction

1.1 Background

Incitec Pivot Limited (IPL) is seeking planning approval for the development of a Nitric Acid (NA)/Technical Grade Ammonium Nitrate (TGAN) facility (the 'Project') at Kooragang Island, Newcastle. The Project is required to service the needs of the growing mining industry in the Hunter Valley. Whilst not an explosive itself, ammonium nitrate (AN) is the main raw material used in the manufacture of commercial blasting products used by the mining, quarrying and construction industries. Projections have indicated that by 2012 there will be an AN supply shortfall in the Hunter Valley. The Project would help address this shortfall and ensure that the expanding mining operations in the Hunter Valley are not unnecessarily constrained.

IPL's Kooragang Island site (the 'Site') has been used as a fertiliser manufacturing facility since its development and was originally owned by Greenleaf Australia. IPL now owns the Site, which is currently used as a fertiliser distribution centre. This existing development is concentrated in the western portion of the Site and comprises a number of industrial buildings and facilities such as storage tanks, as well as office buildings and associated infrastructure. The existing operation and the majority of the existing infrastructure would be retained alongside the Project.

The nearest residential properties are located at Stockton, approximately 800 metres (m) to the south east of the Site boundary. Residential properties are also located in Carrington to the south, Fern Bay to the north east and Mayfield to the west, approximately 1.5 kilometres (km), 1.5 km and 2 km from the Site respectively.

This Project requires planning approval and is considered to be State Significant Development (SSD). Therefore this Traffic Impact Assessment (TIA) has been prepared in support of an Environmental Impact Statement (EIS) prepared under the provisions of Part 4 of the *Environmental Planning and Assessment Act* (1979) (EP&A Act).

This report presents the findings of the TIA for the Project. It is structured as follows:

- chapter 2 outlines the existing traffic and transport situation in the vicinity of the Site;
- chapter 3 describes the Project and the traffic and operational features of the Site;
- chapter 4 describes the impact that traffic generated by the Project would have on the surrounding road network;
- chapter 5 discusses the mitigation and management measures that would be implemented in order to support the proposal;
- chapter 6 summarises the findings of the TIA and outlines conclusions; and
- chapter 7 provides a description of the limitations of this report.

1.2 Site Location

The Site is located on the south eastern industrial area of Kooragang Island in Newcastle. The main arterial road that runs the length of Kooragang Island starts as Tourle Street in Mayfield and crosses over the south arm of the Hunter River at the Tourle Street Bridge. Tourle Street continues north becoming Cormorant Road when it turns east. Cormorant Road becomes Teal Street at a roundabout on Kooragang Island heading north before heading east again and crossing over the north arm of the Hunter River via the Stockton Bridge to Stockton.

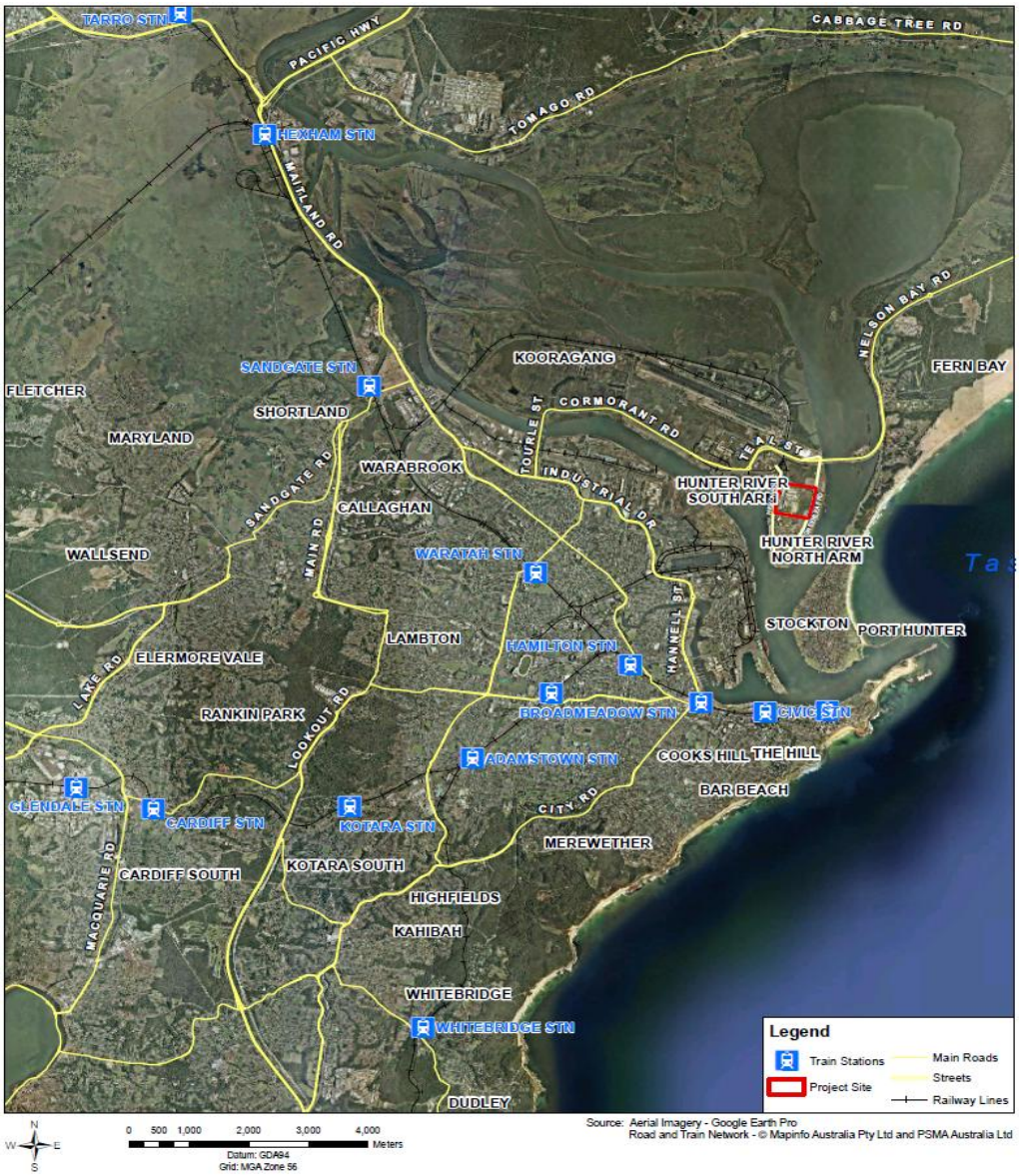
1 Introduction

Access to the existing operation on Site is via a security gate located on Heron Road. Heron Road runs north to south on the western side of the Walsh Point part of Kooragang Island. It connects to Cormorant Road in the north and meets Greenleaf Road at Walsh Point. Greenleaf Road runs up the eastern side of Walsh Point and is largely parallel to Heron Road. Heron Road and Greenleaf Road form the western and eastern boundary to the Site respectively.

The intersection of Tourle Street with Industrial Drive links Kooragang with the wider road network in Newcastle and New South Wales (NSW). A location plan including the surrounding road network can be found in **Figure 1-1**.

In addition to the road network, Kooragang Island is also accessible through a number of Newcastle Port Corporation (NPC) Berths. The land to the east and west of the Site including the roads is owned by the State Property Authority (SPA) and is managed by Newcastle Port Corporation (NPC).

Figure 1-1 Site Location



1.3 Assessment Methodology

This TIA involved a Site visit and detailed desktop analysis using internet-based aerial photography. Traffic count data for relevant locations along classified roads was obtained from the NSW Roads and Maritime Service (RMS) database. Traffic generation during the construction and operational phases of the Project was estimated based on construction vehicle volumes and operational activities provided by IPL. These traffic generation estimates were applied to existing traffic volumes to determine the proportional increase arising as a result of the Project.

A Site visit was conducted on 23 November 2011. The purpose of the visit was to verify the initial findings of the study and to understand any key traffic and transport considerations specific to the local area.

1.4 Stakeholder Consultation

During the preparation of this TIA relevant stakeholders were consulted with regarding the Project. A brief summary of this consultation is presented below.

Roads and Maritime Services

A representative from URS consulted with Roads and Maritime Services (RMS) regarding their requirements for the scope of the Traffic Impact Assessment (TIA). The following comments were noted:

- The TIA should be undertaken in accordance with the RMS guidance *Guide to Traffic Generating Developments Issue 2.2* (RTA, 2002); and
- There is to be no direct access from the Site to State roads.

Following this consultation this report has been prepared to conform to the RMS guidance as detailed above. There is no direct access from the Site to any State roads.

Newcastle City Council

During the consultation period a representative from URS consulted with the planning department of Newcastle City Council (NCC). NCC had no direct requirements for the TIA as it was not anticipated that the Project would impact upon Council controlled roads. The only request made was that the TIA complies with the RMS guidelines noted above.

Newcastle Ports Corporation

Newcastle Ports Corporation were also consulted and indicated that the TIA should conform to RMS guidelines. No additional requirements were specified.

1.5 Risk Assessment Workshop

A representative from URS attended a route plan and risk assessment workshop on 23 November 2011 to assess the route between the Site and IPL's Warkworth facility near Singleton and Hunter Valley mines.

This workshop assessed the entire length of the routes identifying any potential risks encountered by drivers along this route.

1 Introduction

The main outcomes of the workshop related to existing heavy peak hour traffic volumes at various sections of the route and the need for drivers to exercise caution. Specific measures identified as a result of the workshop were:

- Drivers should be familiar with the route, with particular attention given to:
  - known passing areas;
  - known congestion locations, particularly at locations where turn movements are required;
  - roadway shoulders / known pull over areas;
- a fatigue management plan should be in place;
- an emergency response procedure should be in place;
- a safety management plan should be in place;
- drivers should maintain communication with their base;
- roadworks, both scheduled and unscheduled should be monitored along the route; and
- ensure security seal and load integrity is checked prior to departure from consignor or rest stops.

The findings of this workshop are included in Appendix A.

2

Existing Transport Conditions

2.1 Intersection Capacity

The capacity of the road network is determined by the capacity of the intersections. Level of Service (LOS) is a performance measure used to describe the performance of an intersection or midblock location. LOS ranges from A, which indicates good intersection performance to F, which indicates saturated conditions with long queues and delays. **Table 2-1** provides a summary of the LOS based on RMS's *Guide to Traffic Generating Developments,* version 2.2 (RTA, 2002).

Table 2-1 Intersection Levels of Service

LOS	Average delay (seconds per vehicle)	Traffic Signals
A	Less than 14	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 delay.
F	Greater than 71	Unsatisfactory with excessive queuing.

2.2 Midblock Capacity

In accordance with the *Guide to Traffic Generating Developments*, version 2.2 (RTA, 2002), the LOS relevant to midblock sections of rural and suburban roads are summarised in **Table 2-2**. For purposes of this study, the proportion of heavy vehicles has been assumed to be 10% of total traffic, based on industry best practice.

Table 2-2 Midblock Levels of Service, Two-Way Roads

LOS	Traffic Volume Rural Roads (vehicles/ lane/ hour)	Traffic Volume Suburban Roads (vehicles/ lane/ hour)	Definition
A	Less than 715	Less than 645	Free-flow conditions with a high degree of freedom for motorists to select speed and manoeuvre within traffic flow.
B	715 to 955	645 to 860	Stable flow conditions, reasonable freedom to select speed and manoeuvre within traffic flow.
C	956 to 1,210	861 to 1,090	Stable flow conditions, restricted freedom to select speed and manoeuvre within traffic flow.
D	1,211 to 1,590	1,091 to 1,440	Approaching unstable flow conditions, severely restricted to select speed and manoeuvre within traffic flow.
E	1,591 to 1,750	1,441 to 1,580	Close to capacity, virtually no freedom to select speed and manoeuvre within traffic flow.
F	More than 1,750	More than 1,580	Breakdowns in vehicular flow occur.

2 Existing Transport Conditions

2.3 Road Network

The Site is located on the south eastern end of Kooragang Island, north of Walsh Point, within the City of Newcastle. The Site is approximately 3 km from the Central Business District (CBD) of Newcastle, NSW and approximately 800 m from suburb of Stockton. The Site is accessed via Heron Road from Cormorant Road/Tourle Street.

Low Density Ammonium Nitrate (LDAN) is currently transported from the Site to the Hunter Valley sites along Heron Road, Cormorant Road, Tourle Street, Industrial Drive, Old Pacific Highway, New England Highway and Golden Highway. This Route is illustrated in **Figure 2-1**.

Figure 2-1 Route between the Site and IPL's Warkworth Facility

(Source: ©2010 Microsoft Corporation and its data suppliers)

Heron Road/Greenleaf Road

Heron Road along the western boundary of the Site connects with Cormorant Road. It provides a typical industrial road standard, with an overall width in the order of 15 m. It provides a single lane of travel in both directions and provides access to a number of industrial users along its length.

2 Existing Transport Conditions

Greenleaf Road connects with Teal Street via grade separated slips. Greenleaf Road provides a typical industrial road standard, with an overall width in the order of 15 m. It provides a single lane of travel in both directions and provides access to a number of industrial users along its length.

Teal Street / Cormorant Road / Tourle Street

Teal Street, Cormorant Road and Tourle Street are part of the designated Main Road 108 or State Highway 121 which is the main access between Kooragang Island, Stockton and Port Stephens from Newcastle. Teal Street connects to the Stockton Bridge crossing the Hunter River North Arm while Cormorant Road joins Tourle Street at the bridge crossing of the Hunter River south arm. Tourle Street connects with Industrial Drive at a signal controlled "T" intersection approximately 500 m south of the Hunter River.

Tourle Street and Cormorant Road are classified roads comprising a single-lane two-way configuration extending from the intersection with Industrial Drive to the level crossing approximately 2.5 km east of the Tourle Street Bridge. Between the level crossing and the intersection with Teal Street the road is comprised of a two-lane dual carriageway configuration. The single lane section of Tourle Street and Cormorant Road is considered to be the main bottleneck for traffic accessing Kooragang Island.

There is a shoulder on both sides of the road generally with a width of approximately 1 m. Tourle Street has a posted speed limit of 60 km/h for the majority of its length. Cormorant Road and Teal Street operate under a posted speed limit of 80 km/h.

Tourle Street Bridge

Tourle Street Bridge is a single carriageway bridge, comprising a single lane in each direction that connects Kooragang Island to the mainland. Tourle Street Bridge comprises one lane in each direction and, in conjunction with the single lane section of road primarily on the north side of the bridge, acts as the key capacity constraint for vehicles travelling to and from the Site. A typical cross section on the Tourle Street Bridge is presented in **Figure 2.2**.

Figure 2-2 Tourle Street Bridge Cross Section

Industrial Drive

Industrial Drive forms part of State Route 124 connecting Tourle Street to the regional arterial road network via Old Pacific Highway and connections to Newcastle CBD 2 km to the east.

Industrial Drive is a dual carriageway road comprising two lanes in each direction and operates under a posted speed limit of 80 km/h.

Maitland Road/Old Pacific Highway

The Old Pacific Highway/Maitland Road is classified as a section of State Highway 111 and is a dual carriageway road comprising two lanes in each direction with a posted speed limit of 90 km/h.

The Old Pacific Highway/Maitland Road is a regional arterial road which links New South Wales and Queensland. From the north, connections to Cormorant Road (Kooragang Island) can be made via the intersection of Pacific Highway and Industrial Drive (a distance of approximately 3 km). From the south, connections to Cormorant Road (Kooragang Island) can be made via the intersection of Pacific Highway and Hanell Street and then along Industrial Drive (a distance of approximately 7.5 km).

New England Highway from Pacific Highway to Golden Highway

New England Highway forms part of National Route 15 and is a four lane dual carriageway with two lanes in each direction. New England Highway operates under a posted speed limit of 90 km/h. It links to the Pacific Highway at Hexham and links to the Golden Highway south east of Singleton and covers approximately 50 km of the Kooragang Island to Warkworth Facility route.

Golden Highway from New England Highway to Warkworth

Golden Highway is a classified road comprising one lane in each direction. There is a shoulder on both sides of the road generally with a width of approximately 1 m. Golden Highway has a posted speed limit of 100 km/h for the majority of its length with 50 or 60 km/h through towns. Golden Highway is classified as part of State Highway 84. It meets the New England Highway south east of Singleton and links this to the Warkworth Facility over a length of approximately 30 km.

2.4 Background Traffic

The traffic between Tourle Street Bridge and Stockton Bridge consists of mainly light vehicles going to and from Port Stephens, Stockton and Fern Bay, and light and heavy vehicles related to the industries and activities on Kooragang Island. This section of State Highway 121 provides the main vehicular access between the communities of Port Stephens, Stockton and Fern Bay and the rest of Newcastle.

Traffic data has been obtained from the RMS publication that provides traffic volumes from automatic count stations. The RMS has an automatic count station located on Stockton Bridge to the north of the Site. This count station has been selected as it is the closest count station to the Site. At time of report preparation the most recent Annual Average Daily Traffic (AADT) volume data at the count station was for 2010. The count station provides historic data as well as daily and weekly variation in traffic flows. Historic AADT volumes at this location are presented in **Table 2-3**.

2 Existing Transport Conditions

Table 2-3 Historic AADT Traffic Growth from RMS Count Station on Stockton Bridge

Year	2004	2005	2006	2007	2010
Two-way Volume	18,966	19,581	19,691	20,233	21,732
Compound Annual Growth Rate from 2004 Base	-	3.2%	1.9%	2.2%	2.3%

From the above, it can be seen that the traffic flows along this route have been steadily increasing over the period between 2004 and 2010 at an annual compound growth rate of 2.3%. For purposes of this assessment, a background traffic growth rate of 2.5% per annum has been adopted to account for unaccounted development in the area over and above that reflected in historic growth and to ensure robustness of the assessment.

Traffic count data for relevant locations along the classified roads was obtained from the RMS database. **Table 2-4** provides an outline of the 2010 AADT volumes for the traffic count stations relevant to this TIA as well as an estimate for 2011 (representing existing background traffic levels). 2011 peak hour traffic volumes, as well as LOS are also provided.

Table 2-4 2010 AADT and Estimated 2011 AADT Flows on the Existing Road Network

Road	Traffic Count Location	2010 AADT (two-way)	2011 Estimated AADT (two-way)[1]	2011 Peak Hour Volume (two-way)	2011 Peak Direction (Flow vehicles per lane)[3]	2011 Existing LOS
Tourle Street/ Cormorant Road	North of Tourle Street Bridge	28,923	29,588	2,935	1,761	**F**
Industrial Drive	East of Tourle Street	26,518	27,128	2,713 [2]	814	**B**
Maitland Road/ Old Pacific Highway	East Maitland	44,788	45,818	4,582 [2]	1,375	**D**
New England Highway	Black Creek Bridge	47,720	48,818	4,882 [2]	1,465	**E**
Golden Highway	East of Broke Road	3,907	3,997	400 [2]	120	**A**

Notes:

1. Based on compound annual growth rates calculated from RMS Stockton Bridge automatic count location between 2004 and 2010 AADT data.
2. Based on the assumption that approximately 10% of the AADT represents the peak traffic volume as verified by peak hour directional counts at Tourle Street.
3. Assuming a 60:40 split in peak direction travel.

2.5 Existing Operational Traffic

Traffic generated at the Site from the existing operations is presented in **Table 2-5**.

Table 2-5 Existing Operational Traffic

	Mon – Fri			Sat - Sun		
	0700-1800	1800-2200	2200-0700	0700-1800	1800-2200	2200-0700
Heavy Vehicles[1]						
Average day	40	-	-	3	-	-
Peak day	60	6	-	6	-	-
Ship unload[2]	176	64	144			
Light vehicles[3]	25	2	2	5	2	2

Notes:

1. Heavy vehicles include rigid trucks, short, medium and long combinations of trucks, semi-trailers, B-doubles and special purpose vehicles.
2. Ship unload traffic would be transporting deliveries between the K2 and K3 berths and the Site and therefore only has a very localised impact upon crossing Heron Road and does not impact upon the wider highway network. Peak day traffic relates to traffic on the wider road network.
3. Light vehicles include motorbikes, cars, vans, and trailers.

2.6 Existing Onsite Parking Provision

A Site visit undertaken in November 2011 confirmed that there is sufficient visitor and employee car parking for the existing operations currently provided on Site. There are approximately 160 spaces provided in the main car park.

2.7 Public Transport

Port Stephens coaches operates a service between Newcastle and Port Stephens which includes MR 108 (Cormorant Road). On a typical weekday there are a total of 11 services in either direction. The service operates on an approximate hourly frequency during peak periods.

There are no bus stops located along Cormorant Road. The closest bus stop to the Site is located on Teal Street at its intersection with Sandpiper Court approximately 1.3 km from the Site. Route 118 connects Newcastle to Stockton via Tourle Street, Cormorant Road and Teal Street. Route 118 is presented in **Figure 2-3**.

The Stockton to Newcastle ferry operates three services per hour during peak periods and two services per hour at other times between Mitchell Street Wharf, Stockton and Queen's Wharf, Newcastle.

2 Existing Transport Conditions

Figure 2-3 Bus Route 118

2.8 Rail Freight

The Kooragang Island mainline runs along the length of Kooragang Island (refer to **Figure 1-1**). The mainline is currently used for the transportation of coal from various sources in the Hunter Valley to the existing coal loader facilities. It also connects to the NSW rail network and interstate freight network, providing rail transport links to Sydney, Brisbane and beyond.

The mainline runs from west to east along the north of the island before turning south and eventually splitting into a number of spurs. One spur crosses Heron Road and then heads west, parallel to Cormorant Road before crossing it close to Egret Street and heading north. The RMS has advised the crossing close to Egret Street will be upgraded at some time in the future and full traffic signal control at the level crossing will be introduced.

The other mainline spurs continue south. One of these spurs crosses Heron Road and then two of them run either side of Heron Road. The eastern of these two spurs enters the Site in its north western corner and runs the length of it passing into the Orica site to the south. It is understood that this spur is currently disused, however Orica are reviewing options for utilising this spur as part of the planned expansion of their existing facilities on Kooragang Island, *Proposed Extension to Orica Works EIS* (Orica, 2009).

2.9 Pedestrians and Cyclists

There are no footpaths along Cormorant Road or Heron Road. On street marked cycle lanes are provided along Cormorant Road between Stockton Bridge and Industrial Drive. The route then connects to the existing cycle network within the residential area of Mayfield. During the Site visit no additional pedestrian or cyclist facilities were identified along key road corridors surrounding the Site, although it was noted that the Kooragang Cycle Club hold races weekly each Saturday along Greenleaf Road and around Kooragang Island with training activities occurring during the week.

2.10 Port of Newcastle

The Port of Newcastle currently accommodates approximately 1,860 ship movements per year across a number of wharfs.

Kooragang No.2 Berth (K2) operated by P&O is used for the shipment of bulk cargo, bulk liquids, general cargo and containers. The existing facilities at Kooragang no. 2 berth include:

- Two ship unloaders;
- 18 tonne gantry grab;
- Design throughput (combined) 650 tonnes per hour; and
- One ship loader.

There is storage adjacent to the berth. K2 currently handles approximately 145 ships per year.

Kooragang no. 3 Berth (K3) operated by Kooragang Bulk Facilities (KBF) is used for the shipment of bulk cargo, general cargo and containers. The existing facilities at K3 include two pneumatic loaders. K3 currently handles approximately 75 ships per year.

3

Proposed Project

3.1 Project Description

The Project involves construction of an Ammonium Nitrate (AN) Manufacturing Complex at the IPL Site on Kooragang Island. The plant consists of a number of components. Key amongst these are the ammonia storage tank, the nitric acid (NA) plant, the AN plant and various pipe work, storage and bagging facilities.

The main feedstock for AN manufacturing is ammonia. The Project proposes to import the majority of anhydrous ammonia by ship. It is proposed that the ammonia be unloaded at the new dolphin berth between K2 and K3 berths. The ammonia would then be piped to the ammonia storage tank. Some NH_3 would be delivered to Site by tanker. Once processed, approximately 80% of the AN would be dispatched by road as TGAN prill to IPL's Warkworth facility or Hunter Valley mines. The remaining AN would be exported by road to IPL's Warkworth site as an 88% AN concentration solution (ANSOL) for further processing into emulsion. It is expected that the majority of the prill and emulsion would be sent to customers in the Hunter Valley.

3.2 Proposed Routes

Cormorant Road is the primary route connecting Kooragang Island with the wider Newcastle Road Network via:

- Teal Street – connecting to the northern regions of Newcastle and Port Stephens;
- Cormorant Road – connecting to the Western and southern regions of Newcastle and the wider NSW highway network at Industrial Drive; and
- Tourle Street – connecting to Route 128 and western New South Wales region.

The existing access to the Site is via Heron Road, which would be used by construction traffic during initial Site preparation works. It is however proposed to construct a new Site entrance on Greenleaf Road, which would be used to facilitate the main construction works, as well as post construction for operational purposes. From either access point, vehicles would travel north along either Greenleaf Road or Heron Road to their intersections with Teal Street.

AN would be transported from Kooragang Island to the Hunter Valley facility using the existing road network, as follows:

- Heron Road and Greenleaf Road – these are the local roads surrounding the Site and providing access to the State road network at Teal Street from Greenleaf Road via the slip lanes west of the Stockton Bridge;
- Teal Street / Cormorant Road / Tourle Street – part of the State road network providing connections to Industrial Drive and the wider State Highway network via the Tourle Street Bridge;
- Industrial Drive – providing connections to Newcastle CBD to the east and the Old Pacific Highway to the west;
- Old Pacific Highway / Maitland Road – allows connections to the State road network and connections to National Route 15 at Hexham;
- New England Highway – to the intersection with Golden Highway (State route 84); and
- Golden Highway – provides connections between the New England Highway and the IPL Facility at Warkworth.

It should be noted that the future route would utilise the new Hunter Expressway scheduled to open in late 2013, which would provide a more direct and efficient route for freight movements between the Upper Hunter and the Port of Newcastle. The Hunter Expressway is expected to deliver improvements in journey times and traffic safety.

3.3 Traffic Generation Information

The following sections outline specific Project information for both construction and operation. This information will be used to predict the likely impacts during each stage.

3.3.1 Construction Phase

It is expected that the construction phase of the Project would occur over a 28 month period from February 2013 until May 2015. In terms of workforce, the peak construction period would be from November 2013 to August 2014. During this period between 260 and 337 construction personnel are expected on Site as shown in **Table 3-1**. As a general rule, construction hours would be limited to 7am to 6pm Monday to Friday and 8am to 1pm on Saturdays.

Table 3-1 Peak Daily Construction Workforce on Site each Quarter

Construction Stage	2013				2014				2015	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Site Preparation	35	35	-	-	-	-	-	-	-	-
Civil and Structural Works	-	-	78	238	275	262	216	38	-	-
Modules Erection and Overall Activities	-	-	-	22	62	72	78	66	23	-
Pre-Commissioning. Commissioning	-	-	-	-	-	-	14	14	14	14
Total	**35**	**35**	**78**	**260**	**337**	**335**	**307**	**119**	**36**	**14**

Note:
The peak month for construction work would occur during March 2014 with 337 workers on Site

Peak construction vehicle figures are used in this report to provide a conservative assessment of impacts. These figures are shown in **Table 3-2**.

IPL are proposing to operate a park and ride service for construction workers to the Site to reduce the impact that the construction workforce personal transport would have on the highway network. Under this scenario approximately 80 car park spaces would be available within the existing Site car park for use by the construction workforce with the remainder of the workforce travelling to the Site in buses.

For purposes of this assessment and analysis of the key intersection, namely Tourle Street/ Industrial Drive, it has been assumed that the park and ride service would operate during the peak hours of 08:00-09:00 and 17:00 to 18:00 identified for this intersection.

3 Proposed Project

Table 3-2 Construction Transport Daily Vehicle Movements

Phase		Vehicle Class	Vehicles Per Day
1	Site Preparation& Civil Work	Heavy Vehicles (SPMTs , Low Loaders, Over Dimensional loads)	2
		Trucks (Semis, Large Trays etc.)	60-80
		Buses	8-10
		General Vehicles (Cars, Utes, General transport)	40
2	Module Installation	Heavy Vehicles (SPMTs , Low Loaders, Over Dimensional loads)	4
		Trucks (Semis, Large Trays etc.)	20-30
		Buses	15-20
		General Vehicles (Cars, Utes, General)	80
3	Mechanical/Piping Electrical/Instrument Installation	Heavy Vehicles (SPMTs , Low Loaders, Over Dimensional loads)	0
		Trucks (Semis, Large Trays etc.)	10-15
		Buses	15-20
		General Vehicles (Cars, Utes, General)	80
4	Pre-commissioning and Commissioning	Heavy Vehicles (SPMTs , Low Loaders, Over Dimensional loads)	0
		Trucks (Semis, Large Trays etc.)	2
		Buses	6-8
		General Vehicles (Cars, Utes, General)	50

Note: Each movement includes travel to and from the Site

A number of components related to the Project would be brought to Site as modules. These modules would be brought into Newcastle Harbour on ocean going ships before being transferred to barges, moored at Kooragang Island and transferred to Site. The modules are likely to be transferred from the ships on to the barges at the NPC Western Basin berths. The barges would then move the modules to the CTB wharf at 64 Greenleaf Road for unloading and transport to Site. There are expected to be approximately 60 modules in total, which would require a maximum of 9 ship movements into Newcastle Harbour and maximum of 30 barge movements.

Large modules would be moved from the CBT wharf to the Site by Self Propelled Modular Transporters (SPMTs). Medium sized modules would be moved to Site using hydraulic vehicles. Smaller modules would be transported to Site on trucks or lowbed trucks. Movements from the CBT wharf to the Site would be along Greenleaf Road. The modules would enter the Site at a new road entrance on Greenleaf Road.

3.3.2 Background

The Project would operate 24 hours per day, 7 days per week. The Project would require an additional full-time 60 employees and a similar number of contractors for maintenance, security and transport. The Project is expected to have a life of 25+ years.

Peak employee figures are used in this report to provide a conservative assessment of impacts.

3 Proposed Project

A new Site entrance is proposed for Greenleaf Road. This new access point would provide access to the AN plant for the delivery of ammonia and export of AN as prill or ANSOL. This new access point would also be used to maintenance activities for the Project. The existing operations would continue to use the Heron Road entrance.

3.3.2.1 Surface Transport Movements

Table 3-3 summarises the vehicles required for the operation of the Project and **Table 3-4** summarises the associated daily vehicle movements.

Table 3-3 Project Transport – One-way Traffic Movements

Vehicles	Quantity per Delivery (te)	Annual Qty te	Annual Ship / Vehicle Movements
Ammonia Import Shipment	20,000	160,000	8
Ammonia B-double in-bound	32	20,000	625
Ammonia B-double out-bound	32	20,000	625
AN B-double out-bound	40	280,000	7,000
ANSOL B-double out-bound	36	79,560	2,210
ANSOL Fertiliser out-bound	20	4,500	225

Notes:
1. Big N season – March to August 6 days per week
2. AN B-double – 50 weeks per year 6 days per week
3. ANSOL B-double – 50 weeks 6 days per week

Table 3-4 Expected Project Daily Traffic Movements

	Mon – Fri			Sat – Sun		
	0700-1800	1800-2200	2200-0700	0700-1800	1800-2200	2200-0700
Heavy vehicles						
Average Operations	35	4	6	27	4	6
Peak Operations	60	12	8	40	12	8
Light vehicles						
Average Operations	35	8	8	5	4	4

3.3.2.2 Ship Movements

Ammonia would be imported in dedicated ammonia transport ships. Potential suppliers include Yara and Mitsui. Yara operate the Nordic River and Viking River out of north west Australia. The ships have a maximum cargo capacity of 25,000 tonne of refrigerated ammonia. The Mitsui ships are generally smaller with a cargo of 15,000 tonne refrigerated ammonia. Mitsui operate the Nashwan, Gaz Millennium and Jag Viraj.

Each ammonia ship would be unloaded at 1,100 tonnes per hour. The berthing and connection of the ship would take approximately 6-8 hours, 24 hours to unload and 6 hours to disconnect and depart.

4

Impact of Traffic Generation from Proposed Development

This section assesses the degree of traffic impact created by the increase in the proposed vehicle movements and extended operational hours of the Site. The assumptions used in determining the traffic impact are outlined in Section 4.4.

4.1 Baseline Analysis

The intersection of Industrial Drive and Tourle Street has only been analysed as it is likely that the majority of traffic travelling to the Site would pass through this intersection, travelling along Tourle Street / Cormorant Road and Teal Street. It would access the local road network and proposed new access on the west side of the Site on Heron Road via the Teal Street / Greenleaf Road slip roads. The Cormorant Road / Teal Street intersection has therefore not been analysed, as it is unlikely to be used by the majority of construction traffic.

There are a number of other intersections in the surrounding area, however the impact of operational and construction vehicles at these intersections is likely to be negligible as traffic would be dispersed as vehicles travel throughout the road network.

The SIDRA modelling package was used to analyse the performance of the existing road network to identify the current traffic characteristics (in 2011 estimates) at the signalised T-intersection of Industrial Drive and Tourle Street, between the Site and the Hunter Valley.

The 'Degree of Saturation' (DOS) and '95th Percentile Queue Length' are used to compare the affect that construction and operational vehicles would have on the operation of the intersection.

DOS refers to the ratio of an intersection between the traffic demand at the intersection compared to its total capacity. An intersection with a DOS approaching 0.90 to 0.95 is considered to be at capacity.

The 95th Percentile Queue Length value is used as an indication of the length whereby the probability of exceeding it is only 5% - often referred to as the design queue length.

4.1.1 2011 Intersection Performance – Peak Hour

In 2011 the Tourle Street/Industrial Drive intersection was already operating close to capacity. The problematic lanes appear to have been the through movement on Industrial Drive West and the right turn movement from Industrial Drive (east) into Tourle Street and the right turn movement from Tourle Street into Industrial Drive (west). **Table 4-1** presents the intersection performance of the Tourle Street/Industrial Drive intersection during existing conditions. The SIDRA modelling package was also used to determine peak construction year intersection performance as well as peak operational year performance.

Table 4-1 2011 Existing Conditions at Industrial Drive / Tourle Street Intersection

Year	Time of Day	Degree of Saturation	Average Intersection LOS	Worst Performing Movement
2011	AM	0.88	B	Industrial Drive West Through
2011	PM	0.91	C	Industrial Drive West Through

The analysis indicates that the intersection is already approaching capacity. The worst performing lane is the Industrial Drive West through movement in both the AM and PM peak hours.

4.2 Construction Impacts

As discussed in **Section 3.3.1**, IPL is proposing to operate a park and ride bus service to transport construction workers to the Site during the construction phase. Some 80 car parking spaces would be allocated within the existing car park on the Site for transport during construction. The remaining contractors would utilise the proposed park and ride facility. It is assumed that construction activities would occur over a 10 hour period each day and that approximately 10% of deliveries to the Site would occur during each hour. To ensure robustness of the assessment it has been assumed that all construction workers would travel to the Site during the peak hours.

4.2.1 2014 Construction Year Intersection Performance - Peak Hour

A 2.5% annual growth factor has been applied to the 2011 traffic volumes to predict the 2014 background traffic volumes, as discussed in Section 2.4 of this report. The majority of traffic generated during the peak of the construction stage is related to construction workers transport to the Site with relatively low volumes of construction related deliveries. **Table 4-2** illustrates the intersection performance during the peak construction year for both the AM and PM peak hours.

Table 4-2 2014 Peak Construction Year Intersection Performance

Time of Day	2014 Background		2014 With Construction Traffic		
	Degree of Saturation	Average Intersection LOS	Degree of Saturation	Average Intersection LOS	Degree of Saturation
AM	0.88	B	0.89	B	Industrial Drive West Through
PM	0.91	C	0.93	C	Industrial Drive East Right Turn

Note:
Background traffic based on compound annual growth rates calculated from RMS Stockton Bridge automatic count location between 2004 and 2010 AADT data and the assumption that approximately 10% of the AADT represents the peak traffic volume.

The analysis indicates that the intersection will already be performing close to capacity during 2014 with the forecast growth in background traffic. The addition of construction traffic indicates that the DOS would remain within the 90-95% threshold and that the LOS would remain unchanged. Although the LOS remains unchanged, the analysis indicates that there would be a slight variation in the operation of the intersection performance, however the impact of this is considered to be marginal. It is therefore considered that there would be no significant traffic impacts relating to the additional vehicular movements associated with the peak construction activities at the Site. SIDRA outputs are included in Appendix B.

4.2.2 2014 Construction Year Midblock Performance - Peak Hour

The majority of traffic generated during the peak construction stage is related to construction workers transport to the Site. The majority of construction workers are expected to travel from the Newcastle area, gaining access via Industrial Drive. For the purposes of this assessment, it is assumed that construction workers would travel to the Site using the proposed park and ride services. The impact that the construction stage of the Project would have on key roads surrounding the Site with respect to increased traffic volumes is presented in **Table 4-3.**

An annual growth rate of 2.5% has been applied to background traffic levels to predict 2014 traffic levels, as discussed in Section 2.3 of this report.

Table 4-3 2014 Midblock Impact Assessment of AM Peak Hour Vehicle Movements (two-way)

Road	2014 Background Traffic 1			2014 With Construction Traffic	
	Peak Hour Flows (two-way)	Peak Direction Flow (vehicles per lane) 2	LOS	Peak Direction Flow (vehicles per lane) 2	LOS
Tourle Street/ Cormorant Road	3,193	1,916	F	2,020	F
Industrial Drive (West)	2,927	878	C	886	C
Industrial Drive (East)	4,944	1,483	E	1,583	E

Notes:

1. Based on compound annual growth rates calculated from RMS Stockton Bridge automatic count location between 2004 and 2010 AADT data and the assumption that approximately 10% of the AADT represents the peak traffic volume.
2. Assuming a 60:40 split in peak direction travel.

Analysis of results contained in **Table 4-3** indicates that construction traffic would not result in an increase in traffic sufficient to change the existing LOS of the highway network and would therefore not require any mitigation measures.

4.3 Operational Impacts

4.3.1 2015 Peak Operational Year Intersection Performance - Peak Hour

A 2.5% annual growth factor has been applied to the 2011 traffic volumes to predict the 2015 background traffic volumes, as discussed in Section 2.3 of this report. The Site would operate 24 hours per day, 7 days per week. It is anticipated that the peak hours for employees arriving on Site would be between 05:30 and 07:00 in the morning and between 16:00 and 17:00. Therefore employee movements would not significantly impact the road network during peak periods. The peak operational traffic generated by the Project during the peak periods would consist of approximately four heavy goods vehicles, which corresponds to 10% of the daily heavy goods vehicle movements.

Table 4-4 illustrates the intersection performance during the peak operational year for both the AM and PM peak hours.

4 Impact of Traffic Generation from Proposed Development

Table 4-4 2015 Peak Operational Year Intersection Performance

Time of Day	2015 Background		2015 With Operational Traffic		
	Degree of Saturation	Average Intersection LOS	Degree of Saturation	Average Intersection LOS	Worst Performing Movement
AM	0.90	B	0.90	B	Industrial Drive East Right Turn
PM	0.93	C	0.93	C	Industrial Drive East Right Turn

Note:
Background traffic based on compound annual growth rates calculated from RMS Stockton Bridge automatic count location between 2004 and 2010 AADT data and the assumption that approximately 10% of the AADT represents the peak traffic volume.

The analysis indicates that the intersection will already be performing close to capacity during 2015 with the forecast growth in background traffic. The addition of operational traffic indicates that the DOS would remain within the 90-95% threshold and that the LOS would remain unchanged. The analysis summary provided in **Table 4-4** during the AM and PM peak hour indicates that, although the addition of operational traffic would result in a marginal variation in the DOS, the LOS would remain unchanged. It is therefore considered that there would be no significant traffic impacts at the intersection associated with the peak operational phase. SIDRA outputs are included in Appendix B.

4.3.2 2015 Peak Operational Year Midblock Performance - Peak Hour

The impact that the operational stage of the Project would have on key roads between the Site and the IPL Warkworth facility is presented in **Table 4-5**. An annual growth rate of 2.5% has been applied to the background traffic levels to predict 2015 traffic levels, as discussed in Section 2.4 of this report.

Table 4-5 2015 Midblock Impact Assessment of AM Peak Hour Vehicle Movements (two-way)

Road	2015 Background Traffic 1			2015 with Operation	
	Peak Hour Flows (two-way)	Peak Direction Flow (vehicles per lane) 2	LOS	Peak Direction Flow (vehicles per lane) 2	LOS
Tourle Street/ Cormorant Road	3,272	1,963	F	1,977	F
Industrial Drive	3,000	900	C	914	C
Old Pacific Highway	5,067	1,520	E	1,534	E
New England Highway	5,399	1,620	F	1,634	F
Golden Highway	442	133	A	147	A

Notes:
1. Based on compound annual growth rates calculated from RMS Stockton Bridge automatic count location between 2004 and 2010 AADT data and the assumption that approximately 10% of the AADT represents the peak traffic volume.
2. Assuming a 60:40 split in direction of travel during the peak hour.

Analysis of assessment results contained in **Table 4-5** indicate that operational traffic on the route between the Site and the Hunter Valley would not result in an increase in traffic sufficient to change the existing LOS of the highway network and would therefore not require any mitigation measures.

4 Impact of Traffic Generation from Proposed Development

4.3.3 2024 Design Year Intersection Performance - Peak Hour

In accordance with the requirements of RMS's *Guide to Traffic Generating Developments,* version 2.2 (RTA, 2002) a future design year assessment has been undertaken for the intersection of Tourle Street and Industrial Drive. The Project is expected to experience peak construction during 2014 after which the Project will be operational; therefore a 10 year design horizon (design year 2024) has been assessed.

The 2024 traffic was estimated by applying an annual growth rate to the existing volumes and adding proposed Project traffic during operation. A 2.5% compound growth rate was applied to the existing traffic volumes to develop 2024 background traffic volumes. This growth rate is consistent with the growth rate identified in Section 2.3 of this report and has been applied to all intersection legs.

Table 4-6 illustrates the intersection performance during the 2024 design year for both the AM and PM peak hours.

Table 4-6 2024 Design Year Intersection Performance

Time of Day	2024 Background		2024 With Project Traffic		
	Degree of Saturation	Average Intersection LOS	Degree of Saturation	Average Intersection LOS	Worst Performing Movement
AM	1.1	F	1.1	F	Industrial Drive East Right Turn
PM	1.1	F	1.1	F	Industrial Drive East Right Turn

Note:
Background traffic based on compound annual growth rates calculated from RMS Stockton Bridge automatic count location between 2004 and 2010 AADT data and the assumption that approximately 10% of the AADT represents the peak traffic volume.

The analysis indicates that demand at the intersection will have exceeded capacity by 2024. The forecast growth in background traffic results in intersection DOS of 1.1 and average intersection LOS level F. With the addition of Project traffic, the DOS would be 1.1 and that the average intersection LOS would reach level F for both AM and PM peak hours during the 2024 design year. The Project would therefore have no net detrimental effect on the intersection performance in the 2024 design year. The fact that demand exceeds capacity is due to the level of future year background traffic rather than Project traffic.

4.3.4 2024 Design Year Midblock Performance - Peak Hour

Midblock analyses have been undertaken for the design year of 2024, 10 years after the peak construction year. The impact that the Project would have on key roads between the Site and the Hunter Valley, during the 2024 design year, is presented in **Table 4-7**. An annual growth rate of 2.5% has been applied to the background traffic levels to predict 2024 traffic levels, as discussed in Section 2.4 of this report.

4 Impact of Traffic Generation from Proposed Development

Table 4-7 2024 Midblock Impact Assessment of AM Peak Hour Vehicle Movements

Road	2024 Background Traffic [1]			2024 with Operation	
	Peak Hour Flows (two-way)	Peak Direction Flow (vehicles per lane) [2]	LOS	Peak Direction Flow (vehicles per lane) [2]	LOS
Tourle Street/ Cormorant Road	4,087	2,452	F	2,466	F
Industrial Drive	3,747	1,124	D	1,138	D
Old Pacific Highway	6,328	1,899	F	1,913	F
New England Highway	6,743	2,023	F	2,037	F
Golden Highway	552	166	A	180	A

Notes:

1. Based on compound annual growth rates calculated from RMS Stockton Bridge automatic count location between 2004 and 2010 AADT data and the assumption that approximately 10% of the AADT represents the peak traffic volume.
2. Assuming a 60:40 split in direction of travel during the peak hour.

Analysis of assessment results contained in **Table 4-7** indicate that various sections of the route between the Site and the Hunter Valley would be operating close to capacity during the design year (2024). However, the addition of project traffic would not result in an increase in traffic sufficient to change the existing LOS of the highway network and would therefore not require any mitigation measures.

It should be noted that the future route between the Site and the Hunter Valley would utilise the new Hunter Expressway scheduled to open in late 2013, which would provide a higher capacity, direct and efficient route for freight movements between the Hunter Valley and the Port of Newcastle.

4.4 Assumptions

Turning movements and heavy vehicle volumes must be known or estimated in order for intersection performance to be analysed in SIDRA. Scats output traffic volumes have been used and provide peak hour turning volumes at the Industrial Drive / Tourle Street intersection but this does not provide turn volumes for the unsignalised left turn movements entering and exiting Tourle Street. Midblock volumes, supplied by RMS counts, have been used to estimate the left turn volumes. A number of assumptions have been made for the purposes of SIDRA modelling, as follows:

- Existing Traffic Conditions
  - An estimate of 10% heavy vehicles has been assumed and applied to all road sections, which is common industry practice; and
  - Both the AM and PM peak hours have been modelled and each are estimated to represent 10% of total daily volumes derived from RMS Tourle Street directional traffic counts.
- Additional Project Vehicles
  - Teal Street north west of the Project entrance was analysed as a potential route option for vehicles from the west, however given the additional distance and increased travel times, it is not considered to be a feasible option;
  - The majority of the construction and operation workers are expected to be from the Newcastle area, gaining access via Industrial Drive;

- All personnel vehicle movements would occur during the AM Peak Hour and would be inbound to the Site;
- The return trip for all personnel vehicle movements would occur during the PM Peak Hour and would be outbound from the Site; and
- Daily heavy vehicle volumes are assumed to occur evenly over the proposed working day.

These assumptions may be conservative when being applied to the peak hours however this will provide a 'worst-case scenario' of the traffic impacts associated with increased operations of the Project.

4.5 Vehicle Size

The capacity of vehicles proposed for transportation between the Site and the Hunter Valley is likely to be a B-Double truck. This vehicle size and mass has a defined road network capable of accommodating these size limits. Map 18 of the RMS's *Travel Restrictions Vehicle Routes,* available via the RMS website, indicates that Greenleaf Road, Heron Road, Cormorant Road, Tourle Street, Industrial Drive, Old Pacific Highway, New England Highway and Golden Highway are declared to be suitable for B-Double vehicle movements.

These road sections incorporate the entire route between the Site and the Hunter Valley and as such there are no limitations in the existing infrastructure for vehicle sizes up to and including the B-Double (which includes 19-tonne trucks).

Consequently, road and intersection upgrades due to physical dimensions, weight and swept path of vehicles associated with the Project are not required as this is already accommodated along the required lengths of each section of the route.

4.6 Access Arrangements

The proposed access via Greenleaf Road is adequate for the construction and operational traffic expected to be generated by the Project and would allow for heavy vehicle turning movements associated with the haulage of goods, including movements associated with B-doubles.

4.7 Parking Provision

During the construction phase 80 spaces within the existing car park would be specifically allocated for contractor parking, the majority travelling to Site by park and ride bus. Parking for trucks would be provided on a widened access road.

4.8 Ship Movements

The operation of the Project and the delivery of anhydrous ammonia to the Site would result in approximately eight additional ship movements per annum at the new dolphin berth between the existing K2 and K3 berths on Kooragang Island with ammonia being transferred from ship via a pipeline connecting the wharf to the Site. Ship docking would be an irregular activity, occurring approximately eight times per year.

Newcastle Port has approximately 1,860 ship movements per year (Newcastle Port Corporation website) which carry a variety of cargoes, the most significant being coal. The predicted increase of eight movements per year represents an overall increase of approximately 0.4%. The ships would be

4 Impact of Traffic Generation from Proposed Development

prescheduled for entry to the port, therefore it is not predicted that the Project would have an impact on ship movements based on current movements. Newcastle Port Corporation are currently developing a new berthing schedule and this requires that users of the port provide a 12 month plan for the expected ship movements at the K2 and K3 berths. The exact date of ship movements in the plan needs to be confirmed two weeks prior to their arrival to allow for scheduling.

IPL are proposing to construct the Project using a number of pre-constructed modules that would be delivered to the Site by ship and then barge. This approach has the benefit of allowing part of the construction work to take place offsite and away from residential receptors. It also reduces the amount of construction related traffic on the surrounding road network, as the modules would be brought to Site via the CBT Berth on Kooragang Island, opposite to the eastern part of the Site on Greenleaf Road.

The modular construction approach would result in additional traffic in the Port of Newcastle as the modules are delivered to the port and brought to Site. The 60 modules are likely to be delivered to the port in a maximum of nine ocean going ships. From here barges would take the modules from Western Basin berths to the CTB berth. A maximum number of 30 barges would be required, but the actual figure is likely to be less. The expected date of ship deliveries and barge movements would need to be confirmed with Newcastle Port Corporation to allow for scheduling at the port.

During the operational stage of the Project bulk liquid ammonia tankers would travel from other ports in Australia and overseas and enter the Hunter River directly on arrival at Newcastle Port.

Delivery planning would obviate the need for tankers to anchor off the port, avoiding the potential for a ship grounding hazard in heavy seas.

Once the ship approaches the port it would be met by a port pilot, who would assist with the navigation duties whilst entering and traversing the Newcastle Port entry and Hunter River environs. Tugs would have met the ship outside the ports heads and would assist in the berthing of the vessel. Key hazard reduction and safety features of this method of harbour entry and berthing are:

- Ship does not anchor offshore, avoiding the potential for the ship to be driven on the coast by heavy seas;
- Pilot assisted navigation entering and in the harbour, which eliminates the hazard of unfamiliarity with the harbour entry and port navigation requirements; and
- Tug assistance in berthing, which reduces the risk of striking the wharf and damaging the tanker hull leading to the potential for release of product.

The wharf transfer lines would be pre-cooled and pressure-tested to ensure their integrity prior to the arrival of each ship and before products are transferred. All ship unloading operations would be undertaken initially under low flow conditions while additional checks are conducted to ensure the unloading operation is occurring appropriately. Hourly line walks and regular control room checks and wharf monitoring would also be implemented.

4.9 Cumulative Developments in Area

There are a number of other developments in the vicinity of the Site that may be granted development approval in the future or have been granted approval but are not yet operational. Details of relevant cumulative developments are provided in the following paragraphs, whilst cumulative impacts relating to these developments are considered in **Section 4.10 Cumulative Impact Assessment** of this report.

Dredging and Remediation of the Hunter River (DA-134-3-2003-i MOD 8)

Newcastle Port Corporation proposes to modify the existing development consent for the extension of shipping channels within the Port of Newcastle, including dredging, excavation, treatment and disposal of sediments from the south arm of the Hunter River.

The proposed modification seeks to amend the location of the swing basin approximately 200 m downstream (east) of the current approved location, and to increase the diameter of the swing basin from 420 m to 500 m.

Peak Construction is expected to occur during 2014 and will generate approximately 135 vehicle movements per day along Tourle Street / Cormorant Road, with 40 in the peak hour. Traffic from this development will impact upon Tourle St, Cormorant Road and Teal Street. Peak construction for this development is expected to coincide with the Project peak construction phase in 2014.

NCIG Kooragang Coal Loader (06_0009)

Construction and operation of a Coal Export Terminal on Kooragang Island and associated infrastructure for the export of up to 66 million tonnes per annum of coal.

The first stage of the terminal, with export capacity of 30 million tonnes per annum (Mtpa) has been operating effectively since it was officially opened in May 2010. At the end of November 2010, there had been 5.5 million tonnes exported through the terminal on 90 ships.

Construction of the second stage of the coal export terminal commenced in August 2010 following completion of financial arrangements. This second stage will boost capacity to 53 Mtpa.

Stage 2 of the works include a new rail unloading facility and rail sidings, an additional stacker/reclaimer and stockyards, additional conveyors and sample stations and an additional ship loader. The commencement of the next stage of works means that coal export capacity at Newcastle is expected to increase to more than 180 Mtpa by 2013.

The NCIG Kooragang Coal Loader has an expected completion date of 2013 and will therefore be in its operational phase during 2014 and will generate approximately 90 vehicles per day along Tourle Street / Cormorant Road, with 30 movements during the peak hour during operations.

PWCS Kooragang Coal Loader T4 Project, Kooragang Island (06_0189 MOD 2)

Construction and operation of a new coal export terminal at the port of Newcastle. The project will provide additional port capacity required to accommodate projected future coal export demands. The T4 Project is proposed to include new rail tracks, coal stockyard, conveyors and ancillary facilities on Kooragang Island adjacent to the existing Kooragang Coal Terminal. Wharfs, berths, ship loaders and ancillary facilities will be constructed and operated within the Hunter River South arm and along its northern and southern banks.

4 Impact of Traffic Generation from Proposed Development

This project is scheduled to occur in three stages, with the peak construction expected to occur during Stage 1 of the development in 2015 with the majority of employees cars accessing the site before 7am and leaving after 6pm and approximately 230 personnel movements during the peak periods.

Orica Expansion Project (08_0129)

Development to increase Nitric Acid production from 345 ktpa to 605 ktpa and AN production from 500 ktpa to 750 ktpa. The proposed expansion of the AN facility would require:

- An additional nitric acid plant;
- An additional AN plant;
- Modification of the existing ammonia plant;
- Additional storage facilities; and
- Upgrading of existing infrastructure to handle the increased capacity.

The Orica Expansion Project will enter its operational Phase during 2014 and will generate approximately 20 vehicle movements along Tourle Street / Cormorant Road during the peak hour.

Gloucester Gas Project Application (60-90 Gas Wells, Processing Plant, Pipeline) (MP 08_0154)

The proposed development includes:

- Gas Transmission Pipeline - an approximately 95-100 kilometre length pipeline between the central processing facility and existing gas supply network at Hexham (located within an overall assessment corridor of 100 metres width), traversing the Gloucester Shire, Great Lakes Shire, Dungog Shire, Port Stephens, Maitland City and Newcastle City local Government areas; and
- Hexham Delivery Station - a gas delivery station at Hexham to deliver the transported gas to the existing Newcastle-Sydney gas supply pipeline, in the Newcastle City local Government area.

The construction phase of this project is expected to span 28 months with approximately 250 workers on site at the peak of construction arriving on site before 7 am and leaving after 5 pm. Peak construction will occur during 2014 and will generate approximately 480 vehicle movements per day along Pacific Highway, with 200 during the peak hour. The operational phase of this development is expected to commence in 2014 and would produce and increase of 10 – 13 one-way car trips and 6 – 7 two-way truck movements during the peak period and is unlikely to have any impact at the Industrial Drive / Tourle Street intersection and a minimal impact on the Kooragang Island to Hunter Valley transport route.

Newcastle Gas Storage Facility Project

The Newcastle gas storage facility project consists of the construction and operation of a gas plant site which includes a processing plant capable of processing up to 66,500 tonnes of liquefied natural gas (LNG) per year, a storage tank capable of containing up to 30,000 tonnes of LNG, a truck loading facility to allow the dispatch of up to 1,000 tankers of LNG per year, a new road to connect the gas plant site to the northern access road and an emergency access road. The proposed Newcastle gas storage facility is located adjacent to the Pacific Highway in Hexham, approximately 15 km northwest of the Site. The project also consists of a natural gas pipeline which connects the gas plant to a receiving station in Hexham.

The Newcastle gas storage facility is scheduled to commence operations during 2014 by which time the Hunter Expressway is expected to be open to traffic and will be utilised by Project traffic on the Kooragang Island to Hunter Valley transport route. During its operational phase the gas storage facility is expected to generate up to 32 two-way vehicle movements per day along the Pacific Highway with 27 movements during the project's peak hour of 3pm – 4pm. Given the low volumes of vehicles and the distance from the Site, the gas storage facility is unlikely to have any cumulative impact on the road network relevant to the assessment undertaken for the Project. As the Hunter Expressway will be operational and will be used by Project traffic for the Kooragang Island to Hunter Valley transport route the gas storage facility will not have a cumulative impact on the Kooragang Island to Hunter Valley transport route.

Marstel Bulk Fuel Storage Facility

The proposal is for the provision of a bulk fuels terminal which would comprise:

- Use of an existing ship berthing facility via Berth 4 (M4) to deliver fuels from bulk tankers. Fuel to be pumped along a new 300 mm diameter steel pipeline from Mayfield M4 to the facility;
- Storage of bulk fuels in above ground tanks;
- Distribution of fuels by road tankers. Ancillary components including site office, car parking and truck loading gantry; and
- Construction access to the site via Selwyn Street and operational access via Ingall Street.

The Marstel Bulk Fuel Storage Facility is expected to be operational during 2014 and will generate 56 vehicle movements per day along Industrial Drive, with approximately 14 vehicle movements during the peak hour.

This development is located in Mayfield North and will not have any impact upon traffic operations along Kooragang Island, it is expected to be operational during 2014 and will produce 56 vehicle trips per day along Industrial Drive with approximately 14 trips during the peak periods and is unlikely to have any impact at the Industrial Drive / Tourle Street intersection and a minimal impact on the Kooragang Island to Hunter Valley transport route.

4.10 Cumulative Impact Assessment

Given the increase in vehicles generated by the Project (when compared to background conditions), consideration of additional projects along Tourle Street / Cormorant Road / Teal Street will impact on the LOS in 2014 when the Project is in its construction phase.

Six projects have been identified in **Section 4.9** as likely to have a cumulative effect upon the road network. A summary of traffic generated by the above cumulative developments is presented in **Table 4-6**.

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Table 4-8 AM Peak Hour Cumulative Development Traffic Generation

Development	Cormorant Road / Tourle Street	Industrial Drive
Dredging and remediation of the Hunter River	40	-
Kooragang Coal Loader Project	30	-
PWCS Coal Loader Expansion T4 Project	240	-
Orica Expansion Project	20	-
Gloucester Gas Project	-	-
Newcastle Gas Storage Facility	-	-
Bulk Fuel Storage	-	14
Total	**330**	**14**

Table 4.7 provides an indication of the likely cumulative impact on the surrounding road network during the peak construction phase.

Table 4-9 AM Peak Hour Cumulative Impacts

Road	2014 Background Traffic		2014 With Project Construction Traffic		2014 with Project and Cumulative developments	
	Peak Direction Flow per lane	LOS	Peak Direction Flow per lane	LOS	Peak Direction Flow per lane	LOS
Tourle Street	1,916	F	2,020	F	2,350	F
Industrial Drive (West)	900	C	914	C	928	C
Industrial Drive (East)	1,483	E	1,583	E	1,597	E

As identified in **Table 4-7**, the LOS remains unchanged when taking account of the cumulative impacts of construction activities relating to other projects that may occur simultaneously.

The Tourle Street/ Industrial Drive intersection operates close to capacity with the addition of Project traffic. The further addition of traffic relating to cumulative developments may mean that some additional delay is caused to traffic using this junction; however the cumulative scenario does not result in a change in LOS across this intersection.

5

Mitigation and Management Measures

The impact assessment has identified that the Project would have minimal additional impact on the operation of the existing road network both during construction and operation. However, in order to manage vehicle activities during both phases of the Project, it is recommended that a Traffic Management Plan be developed as part of the Construction Management Plan for the Project during construction and for the operation phase. The Traffic Management Plan would include:

- hours of permitted vehicle activity;
- designated routes for construction and operational traffic and defined access points to the Site;
- a community consultation plan to ensure residents in close proximity to the Site (i.e. within Stockton) are informed of upcoming construction activities and have a point of contact during construction activities;
- designated areas within the Site for truck turning movements, parking, loading and unloading to allow heavy vehicles to enter and leave the Site in a forward direction;
- a park and ride facility operating during the construction phase;
- sequence for implementing traffic works and traffic management devices should these be required; and
- procedures and/or principles for construction vehicle speed limits and the safe operation of construction vehicles.

6

Conclusion

The following conclusions are drawn from the investigations into the construction and operation of the Project at Kooragang Island, Newcastle.

1. The Site is currently used by IPL for existing operations off Heron Road located on Kooragang Island. The Site has frontage to both Greenleaf Road and Heron Road.
2. The existing road network in the vicinity of the Site is typical of an industrial area, with local access roads designed for heavy vehicle access and turning manoeuvres. The industrial access roads all allow for B-double truck use, due to the high number of heavy industries in the general vicinity.
3. For the key intersection relative to this study, namely Tourle Street/ Industrial Drive, traffic data has been obtained to determine peak period traffic flows. Assessment of employee shift patterns indicates that employee travel movements would occur outside the peak hours identified at this intersection.
4. The level of Project traffic generation from Site operations during the peak periods is relatively low.
5. Access to the existing operations would continue to be via the existing route along Heron Road. This route provides for B-double access and allows for safe and easy access for large vehicles.
6. Access for the Project would be via a new entrance in Greenleaf Road route and provides for B-double access and allows for safe and easy access for large vehicles.
7. Midblock performance levels would largely remain unchanged from forecast background conditions during the peak construction year (2014), the Project opening year (2015) and the Project design year (2024). The midblock analyses demonstrated that there would be no net detriment to midblock performance associated with the Project.
8. Analysis of the signalised intersection of Tourle Street and Industrial Drive shows that the DOS of the intersection would decrease only very marginally from the forecast background conditions during the peak construction year (2014), the opening year (2015) and that there would be no net detriment at the future design year (2024). The LOS at the intersection would remain unchanged from background traffic conditions with the addition of construction, or operational related traffic. It is therefore considered that there would be no significant traffic impacts relating to additional vehicular movements associated with peak construction, opening year and design year activities, of the Project, and no mitigation is proposed at this intersection.
9. An allocation of some 80 spaces for light vehicles would be made at the Site for transport during construction. The remaining contractors would be transported to Site by bus from the proposed park and ride facility.

The overall conclusion resulting from assessment undertaken in this report is that the proposed access arrangements and Project generated traffic would have minimal additional impact on the operation of the existing road network both during construction and operation and that the Project should be approved on traffic and access grounds.

Mitigation and Management measures recommended by the Traffic Impact Assessment are provided in **Table 6-1**.

6 Conclusion

Table 6-1 Mitigation Measures

Mitigation Measure	Implementation	
	Construction	Operation
Vehicle movements would be limited to the designated routes to minimise impacts to road users caused by the Project.	✓	✓
Produce a Traffic Management Plan for the proposed construction and operational activities.	✓	✓
All ship movements would be prescheduled for entry to the port and would undertake pilot assisted navigation to the new Dolphin loader located between the K2 and K3 berths with berthing movements assisted by tugs.		✓

7

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Incitec Pivot Limited and only those third parties who have been authorised in writing by URS to rely on this Report.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this Report.

It is prepared in accordance with the scope of work and for the purpose outlined in the contract dated 3 October 2011.

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A

Appendix A Route Assessment and Risk Management Workshop

Route Plan and Risk Assessment 23 Nov 11

From: IPL Kooragang Island

To: IPL Warkworth

Reference: Ammonium Nitrates SSAN / ANSOL - Class 5.1

Main Roads or Streets in Sequence

Drivers Action	Location	Additional Comment / Risks
Depart IPL Kooragang Island plant	Green Leaf Rd	Weighbridge, site traffic and security requirements
Turn left	Green Leaf Rd	Industrial area beware approaching traffic, parked vehicles
Turn left, merge	Teal St	Approaching traffic when merging
Turn right	Round about Cormorant Rd and Teal St	Heavy traffic volumes at peak hour, traffic entering from right
Turn right	Intersection Tourle St, Industrial Highway	Heavy traffic volumes at peak hour, caution turning right at traffic lights
Turn right	Intersection Pacific Highway, Industrial Highway	Heavy traffic volumes at peak hour, caution turning right at traffic lights, road narrows at Pacific Highway
Drive to Hexham	Pacific Highway	High incidence of traffic accidents area, caution during peak hour traffic
Drive to intersection of New England Highway and Golden Highway	Maitland, Lochinvar, Branxton	Heavy traffic volumes at peak hour, school zones, caution at roundabouts
Turn left	Intersection Golden Highway and New England Highway	Speed approaching corner, negative camber at corner on return journey

Route Plan and Risk Assessment 23 Nov 11

Drive to intersection Golden Highway and Putty Rd	Golden Highway	Wildlife, drive to conditions, traffic entering from side roads
Drive to intersection Putty Rd and Golden Highway	Golden Highway	Drive to conditions
Turn left	Intersection Putty Rd and Golden Highway	Approaching traffic
Turn right	Intersection Golden Highway and Gouldsville Rd	Approaching traffic
Turn left	Gouldsville Rd and Long Point Rd	Approaching traffic
Turn left	Long Point Rd, IPL Plant	Observe site entry and security requirements

Route Plan and Risk Assessment 23 Nov 11

Physical Conditions	Changing Conditions	Other Issues
Restricted View – especially at intersections and 'blind corners'	Oncoming traffic – known passing areas	Speed – yours and other traffic on the road
Roundabouts – size, location, condition, alternative route to avoid these	Other heavy vehicle movement – coal trucks, logging trucks, road trains	Fatigue Management
Cross Walks and Pedestrian islands	Congestion	First time travel on the route
Intersections and concealed roadways	Road works – scheduled and unscheduled	Emergency Response Procedure in place
Bridges – esp. if small or one way	Detours – scheduled and unscheduled	Safety Management Plan in place
Roadway shoulders / known pull over areas	Weather – rain, high wind areas, ice (known black ice areas)	Media reports – cultural events, sporting events, protest action, political activity
Concealed crest, sharp curves, poor camber	Known flood areas	Maintain communication with base
Over / Underpass clearance	Livestock / farm areas	Ensure Security seal and load integrity checked prior to departure from consignor or rest stop
Rail crossings	Bush fires – usually seasonal	

Route Plan and Risk Assessment 23 Nov 11

Floodways, culverts, water courses	Transport Vehicle fire	
Overtaking lanes. Caution required when changing lanes		
Designated rest areas & Road house locations. Must be designated and approved		
Recreational areas & Industrial areas. Required additional precautions when transiting		
Locations of Protected Works A & B type areas. Required additional precautions when transiting		

Route Plan and Risk Assessment 23 Nov 11

From: IPL Warkworth

To: Cadia

Reference: Ammonium Nitrates SSAN - Class 5.1

Main Roads or Streets in Sequence

Drivers Action	Location	Additional Comment / Risks
Depart Depot	IPL Warkworth	Site traffic and security requirements
Turn left	Access road	Approaching traffic
Turn right	Intersection of Golden Highway and Long Point Rd	"T" intersection approaching traffic
Drive to Ulan Rd and Golden Highway intersection	Jerrys Plains, Denman, Sandy Hollow-Golden Highway	Speed approaching intersection
Turn left	Ulan Rd and Golden Highway intersection	Drive to conditions
Turn left	Goolma Rd Gulgong	Speed at intersection
Drive to Wellington	Goolma Rd	Drive to conditions, road narrows in sections, adjust speed to suit road conditions
Drive to Orange	Mitchell Highway	Drive to conditions
Turn right Peisley St	Summer St Orange	Main thoroughfares drive to conditions

Route Plan and Risk Assessment 23 Nov 11

Drive to Forest Rd, Cadia Rd intersection	Bloomfield	Drive to conditions
Turn right	Cadia Rd intersection	Drive to conditions
Drive to Cadia Mine site	Cadia Rd	Drive to conditions
Enter Cadia Mine	Cadia Rd and mine access road intersection	Site access and security requirements

Route Plan and Risk Assessment 23 Nov 11

Physical Conditions	Changing Conditions	Other Issues
Restricted View – especially at intersections and 'blind corners'	Oncoming traffic – known passing areas	Speed – yours and other traffic on the road
Roundabouts – size, location, condition, alternative route to avoid these	Other heavy vehicle movement – coal trucks, logging trucks, road trains	Fatigue Management
Cross Walks and Pedestrian islands	Congestion	First time travel on the route
Intersections and concealed roadways	Road works – scheduled and unscheduled	Emergency Response Procedure in place
Bridges – esp. if small or one way	Detours – scheduled and unscheduled	Safety Management Plan in place
Roadway shoulders / known pull over areas	Weather – rain, high wind areas, ice (known black ice areas)	Media reports – cultural events, sporting events, protest action, political activity
Concealed crest, sharp curves, poor camber	Known flood areas	Maintain communication with base
Over / Underpass clearance	Livestock / farm areas	Ensure Security seal and load integrity checked prior to departure from consignor or rest stop
Rail crossings	Bush fires – usually seasonal	

Route Plan and Risk Assessment 23 Nov 11

Floodways, culverts, water courses	Transport Vehicle fire	
Overtaking lanes. Caution required when changing lanes		
Designated rest areas & Road house locations. Must be designated and approved		
Recreational areas & Industrial areas. Required additional precautions when transiting		
Locations of Protected Works A & B type areas. Required additional precautions when transiting		

B

Appendix B SIDRA Intersection Analysis

INTERSECTION SUMMARY

Site: 2011 AM Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 70 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	4934	veh/h	5920	pers/h
Percent Heavy Vehicles	10.0	%		
Degree of Saturation	0.883			
Practical Spare Capacity	1.9	%		
Effective Intersection Capacity	5585	veh/h		
Control Delay (Total)	31.74	veh-h/h	38.09	pers-h/h
Control Delay (Average)	23.2	sec	23.2	sec
Control Delay (Worst Lane)	53.5	sec		
Control Delay (Worst Movement)	53.5	sec	53.5	sec
Geometric Delay (Average)	5.0	sec		
Stop-Line Delay (Average)	18.2	sec		
Level of Service (Aver. Int. Delay)	LOS B			
Level of Service (Worst Movement)	LOS D			
Level of Service (Worst Lane)	LOS D			
95% Back of Queue - Vehicles (Worst Lane)	26.9	veh		
95% Back of Queue - Distance (Worst Lane)	204.1	m		
Total Effective Stops	3901	veh/h	4681	pers/h
Effective Stop Rate	0.79	per veh	0.79	per pers
Proportion Queued	0.59		0.59	
Performance Index	166.4		166.4	
Travel Distance (Total)	3285.7	veh-km/h	3942.9	pers-km/h
Travel Distance (Average)	666	m	666	m
Travel Time (Total)	78.8	veh-h/h	94.6	pers-h/h
Travel Time (Average)	57.5	sec	57.5	sec
Travel Speed	41.7	km/h	41.7	km/h
Cost (Total)	2871.30	$/h	2871.30	$/h
Fuel Consumption (Total)	576.5	L/h		
Carbon Dioxide (Total)	1447.1	kg/h		
Hydrocarbons (Total)	2.237	kg/h		
Carbon Monoxide (Total)	123.20	kg/h		
NOx (Total)	3.898	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).

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2,368,169	veh/y	2,841,802	pers/y
Delay	15,236	veh-h/y	18,283	pers-h/y
Effective Stops	1,872,498	veh/y	2,246,998	pers/y
Travel Distance	1,577,151	veh-km/y	1,892,582	pers-km/y
Travel Time	37,832	veh-h/y	45,398	pers-h/y
Cost	1,378,223	$/y	1,378,223	$/y
Fuel Consumption	276,737	L/y		
Carbon Dioxide	694,610	kg/y		
Hydrocarbons	1,074	kg/y		
Carbon Monoxide	59,134	kg/y		
NOx	1,871	kg/y		

MOVEMENT SUMMARY

Site: 2011 AM Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 70 seconds

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Industrial Drive - East											
5	T	1011	10.0	0.435	7.1	LOS A	10.5	79.7	0.55	0.49	61.0
6	R	440	10.0	0.879	53.5	LOS D	10.7	81.4	1.00	1.00	29.2
Approach		1451	10.0	0.879	21.2	LOS B	10.7	81.4	0.69	0.64	46.0
North: Tourle Street											
7	L	885	10.0	0.506	7.8	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
9	R	589	10.0	0.842	44.7	LOS D	13.0	98.8	1.00	0.99	27.0
Approach		1475	10.0	0.842	22.6	LOS B	13.0	98.8	0.40	0.75	37.3
West: Industrial Drive - West											
10	L	701	10.0	0.400	11.4	NA[9]	NA[9]	NA[9]	0.00	0.68	58.8
11	T	1307	10.0	0.883	32.3	LOS C	26.9	204.1	1.00	1.05	36.6
Approach		2008	10.0	0.883	25.0	LOS B	26.9	204.1	0.65	0.92	42.1
All Vehicles		4934	10.0	0.883	23.2	LOS B	26.9	204.1	0.59	0.79	41.7

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

9 Continuous movement

INTERSECTION SUMMARY

New Site
Signals - Fixed Time Cycle Time = 90 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	5434	veh/h	6520	pers/h
Percent Heavy Vehicles	10.0	%		
Degree of Saturation	0.906			
Practical Spare Capacity	-0.7	%		
Effective Intersection Capacity	5995	veh/h		
Control Delay (Total)	44.25	veh-h/h	53.10	pers-h/h
Control Delay (Average)	29.3	sec	29.3	sec
Control Delay (Worst Lane)	58.8	sec		
Control Delay (Worst Movement)	58.8	sec	58.8	sec
Geometric Delay (Average)	5.5	sec		
Stop-Line Delay (Average)	23.8	sec		
Level of Service (Aver. Int. Delay)	LOS C			
Level of Service (Worst Movement)	LOS E			
Level of Service (Worst Lane)	LOS E			
95% Back of Queue - Vehicles (Worst Lane)	30.0	veh		
95% Back of Queue - Distance (Worst Lane)	227.9	m		
Total Effective Stops	4283	veh/h	5140	pers/h
Effective Stop Rate	0.79	per veh	0.79	per pers
Proportion Queued	0.60		0.60	
Performance Index	215.2		215.2	
Travel Distance (Total)	3628.4	veh-km/h	4354.1	pers-km/h
Travel Distance (Average)	668	m	668	m
Travel Time (Total)	95.4	veh-h/h	114.5	pers-h/h
Travel Time (Average)	63.2	sec	63.2	sec
Travel Speed	38.0	km/h	38.0	km/h
Cost (Total)	3413.93	$/h	3413.93	$/h
Fuel Consumption (Total)	654.0	L/h		
Carbon Dioxide (Total)	1641.5	kg/h		
Hydrocarbons (Total)	2.569	kg/h		
Carbon Monoxide (Total)	138.10	kg/h		
NOx (Total)	4.363	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).

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2,608,169	veh/y	3,129,802	pers/y
Delay	21,239	veh-h/y	25,487	pers-h/y
Effective Stops	2,056,047	veh/y	2,467,256	pers/y
Travel Distance	1,741,653	veh-km/y	2,089,984	pers-km/y
Travel Time	45,798	veh-h/y	54,957	pers-h/y
Cost	1,638,684	$/y	1,638,684	$/y
Fuel Consumption	313,914	L/y		
Carbon Dioxide	787,923	kg/y		
Hydrocarbons	1,233	kg/y		
Carbon Monoxide	66,290	kg/y		
NOx	2,094	kg/y		

MOVEMENT SUMMARY

Site: 2011 PM Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 90 seconds

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Industrial Drive - East											
5	T	1256	10.0	0.518	8.6	LOS A	15.6	118.4	0.56	0.51	58.7
6	R	795	10.0	0.888	58.8	LOS E	21.4	162.4	1.00	0.98	27.5
Approach		2051	10.0	0.888	28.1	LOS B	21.4	162.4	0.73	0.69	40.9
North: Tourle Street											
7	L	800	10.0	0.457	7.8	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
9	R	636	10.0	0.860	54.3	LOS D	17.0	129.0	1.00	0.98	24.2
Approach		1436	10.0	0.860	28.4	LOS B	17.0	129.0	0.44	0.77	33.9
West: Industrial Drive - West											
10	L	829	10.0	0.474	11.5	NA[9]	NA[9]	NA[9]	0.00	0.68	58.8
11	T	1118	10.0	0.906	46.0	LOS D	30.0	227.9	1.00	1.07	30.4
Approach		1947	10.0	0.906	31.3	LOS C	30.0	227.9	0.57	0.91	38.2
All Vehicles		5434	10.0	0.906	29.3	LOS C	30.0	227.9	0.60	0.79	38.0

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 E. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

9 Continuous movement

INTERSECTION SUMMARY

Site: 2014 AM Base Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 90 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	5312	veh/h	6374	pers/h
Percent Heavy Vehicles	10.0	%		
Degree of Saturation	0.878			
Practical Spare Capacity	2.5	%		
Effective Intersection Capacity	6051	veh/h		
Control Delay (Total)	38.32	veh-h/h	45.99	pers-h/h
Control Delay (Average)	26.0	sec	26.0	sec
Control Delay (Worst Lane)	61.6	sec		
Control Delay (Worst Movement)	61.6	sec	61.6	sec
Geometric Delay (Average)	5.0	sec		
Stop-Line Delay (Average)	21.0	sec		
Level of Service (Aver. Int. Delay)	LOS B			
Level of Service (Worst Movement)	LOS E			
Level of Service (Worst Lane)	LOS E			
95% Back of Queue - Vehicles (Worst Lane)	34.1	veh		
95% Back of Queue - Distance (Worst Lane)	259.1	m		
Total Effective Stops	4099	veh/h	4918	pers/h
Effective Stop Rate	0.77	per veh	0.77	per pers
Proportion Queued	0.58		0.58	
Performance Index	198.9		198.9	
Travel Distance (Total)	3537.3	veh-km/h	4244.7	pers-km/h
Travel Distance (Average)	666	m	666	m
Travel Time (Total)	88.9	veh-h/h	106.7	pers-h/h
Travel Time (Average)	60.3	sec	60.3	sec
Travel Speed	39.8	km/h	39.8	km/h
Cost (Total)	3194.64	$/h	3194.64	$/h
Fuel Consumption (Total)	623.6	L/h		
Carbon Dioxide (Total)	1565.1	kg/h		
Hydrocarbons (Total)	2.426	kg/h		
Carbon Monoxide (Total)	131.23	kg/h		
NOx (Total)	4.169	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).

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2,549,558	veh/y	3,059,470	pers/y
Delay	18,396	veh-h/y	22,075	pers-h/y
Effective Stops	1,967,334	veh/y	2,360,800	pers/y
Travel Distance	1,697,882	veh-km/y	2,037,459	pers-km/y
Travel Time	42,695	veh-h/y	51,234	pers-h/y
Cost	1,533,429	$/y	1,533,429	$/y
Fuel Consumption	299,305	L/y		
Carbon Dioxide	751,256	kg/y		
Hydrocarbons	1,164	kg/y		
Carbon Monoxide	62,989	kg/y		
NOx	2,001	kg/y		

MOVEMENT SUMMARY

Site: 2014 AM Base Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 90 seconds

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Industrial Drive - East											
5	T	1088	10.0	0.449	8.1	LOS A	13.1	99.4	0.53	0.47	59.8
6	R	474	10.0	0.870	61.6	LOS E	13.5	102.5	1.00	0.96	26.6
Approach		1562	10.0	0.869	24.3	LOS B	13.5	102.5	0.67	0.62	43.6
North: Tourle Street											
7	L	953	10.0	0.544	7.9	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
9	R	635	10.0	0.859	54.2	LOS D	16.9	128.6	1.00	0.98	24.2
Approach		1587	10.0	0.858	26.4	LOS B	16.9	128.6	0.40	0.75	35.0
West: Industrial Drive - West											
10	L	755	10.0	0.431	11.4	NA[9]	NA[9]	NA[9]	0.00	0.68	58.8
11	T	1407	10.0	0.878	35.2	LOS C	34.1	259.1	0.99	1.01	35.1
Approach		2162	10.0	0.878	26.9	LOS B	34.1	259.1	0.64	0.90	40.8
All Vehicles		5312	10.0	0.878	26.0	LOS B	34.1	259.1	0.58	0.77	39.8

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

9 Continuous movement

INTERSECTION SUMMARY

New Site
Signals - Fixed Time Cycle Time = 100 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	5446	veh/h	6536	pers/h
Percent Heavy Vehicles	10.7	%		
Degree of Saturation	0.885			
Practical Spare Capacity	1.7	%		
Effective Intersection Capacity	6157	veh/h		
Control Delay (Total)	42.71	veh-h/h	51.25	pers-h/h
Control Delay (Average)	28.2	sec	28.2	sec
Control Delay (Worst Lane)	64.7	sec		
Control Delay (Worst Movement)	64.7	sec	64.7	sec
Geometric Delay (Average)	5.2	sec		
Stop-Line Delay (Average)	23.1	sec		
Level of Service (Aver. Int. Delay)	LOS B			
Level of Service (Worst Movement)	LOS E			
Level of Service (Worst Lane)	LOS E			
95% Back of Queue - Vehicles (Worst Lane)	37.7	veh		
95% Back of Queue - Distance (Worst Lane)	286.2	m		
Total Effective Stops	4192	veh/h	5030	pers/h
Effective Stop Rate	0.77	per veh	0.77	per pers
Proportion Queued	0.57		0.57	
Performance Index	216.2		216.2	
Travel Distance (Total)	3627.1	veh-km/h	4352.5	pers-km/h
Travel Distance (Average)	666	m	666	m
Travel Time (Total)	94.5	veh-h/h	113.4	pers-h/h
Travel Time (Average)	62.4	sec	62.4	sec
Travel Speed	38.4	km/h	38.4	km/h
Cost (Total)	3384.29	$/h	3384.29	$/h
Fuel Consumption (Total)	654.0	L/h		
Carbon Dioxide (Total)	1642.0	kg/h		
Hydrocarbons (Total)	2.539	kg/h		
Carbon Monoxide (Total)	137.10	kg/h		
NOx (Total)	4.356	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).

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2,614,232	veh/y	3,137,078	pers/y
Delay	20,501	veh-h/y	24,602	pers-h/y
Effective Stops	2,012,094	veh/y	2,414,513	pers/y
Travel Distance	1,741,013	veh-km/y	2,089,215	pers-km/y
Travel Time	45,342	veh-h/y	54,410	pers-h/y
Cost	1,624,461	$/y	1,624,461	$/y
Fuel Consumption	313,930	L/y		
Carbon Dioxide	788,174	kg/y		
Hydrocarbons	1,219	kg/y		
Carbon Monoxide	65,809	kg/y		
NOx	2,091	kg/y		

MOVEMENT SUMMARY

Site: 2014 AM Construction Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 100 seconds

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Industrial Drive - East											
5	T	1088	10.0	0.439	8.2	LOS A	13.7	104.4	0.50	0.45	59.7
6	R	537	12.7	0.867	64.7	LOS E	16.1	125.2	1.00	0.95	25.8
Approach		1625	10.9	0.867	26.9	LOS B	16.1	125.2	0.67	0.62	41.8
North: Tourle Street											
7	L	974	11.9	0.563	7.9	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
9	R	639	10.6	0.872	60.0	LOS E	18.8	143.2	1.00	0.98	22.8
Approach		1613	11.4	0.872	28.6	LOS C	18.8	143.2	0.40	0.75	33.9
West: Industrial Drive - West											
10	L	801	10.0	0.457	11.4	NA[9]	NA[9]	NA[9]	0.00	0.68	58.8
11	T	1407	10.0	0.885	39.0	LOS C	37.7	286.2	0.99	1.02	33.3
Approach		2208	10.0	0.885	29.0	LOS C	37.7	286.2	0.63	0.90	39.5
All Vehicles		5446	10.7	0.885	28.2	LOS B	37.7	286.2	0.57	0.77	38.4

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

9 Continuous movement

INTERSECTION SUMMARY

Site: 2014 PM Base Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 120 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	5852	veh/h	7022	pers/h
Percent Heavy Vehicles	10.0	%		
Degree of Saturation	0.908			
Practical Spare Capacity	-0.9	%		
Effective Intersection Capacity	6443	veh/h		
Control Delay (Total)	56.94	veh-h/h	68.33	pers-h/h
Control Delay (Average)	35.0	sec	35.0	sec
Control Delay (Worst Lane)	72.5	sec		
Control Delay (Worst Movement)	72.5	sec	72.5	sec
Geometric Delay (Average)	5.5	sec		
Stop-Line Delay (Average)	29.5	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)	40.4	veh		
95% Back of Queue - Distance (Worst Lane)	306.9	m		
Total Effective Stops	4552	veh/h	5463	pers/h
Effective Stop Rate	0.78	per veh	0.78	per pers
Proportion Queued	0.59		0.59	
Performance Index	271.1		271.1	
Travel Distance (Total)	3907.4	veh-km/h	4688.8	pers-km/h
Travel Distance (Average)	668	m	668	m
Travel Time (Total)	112.0	veh-h/h	134.4	pers-h/h
Travel Time (Average)	68.9	sec	68.9	sec
Travel Speed	34.9	km/h	34.9	km/h
Cost (Total)	3918.39	$/h	3918.39	$/h
Fuel Consumption (Total)	715.9	L/h		
Carbon Dioxide (Total)	1796.8	kg/h		
Hydrocarbons (Total)	2.833	kg/h		
Carbon Monoxide (Total)	148.23	kg/h		
NOx (Total)	4.695	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).

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2,808,758	veh/y	3,370,510	pers/y
Delay	27,330	veh-h/y	32,797	pers-h/y
Effective Stops	2,185,180	veh/y	2,622,217	pers/y
Travel Distance	1,875,534	veh-km/y	2,250,640	pers-km/y
Travel Time	53,757	veh-h/y	64,508	pers-h/y
Cost	1,880,825	$/y	1,880,825	$/y
Fuel Consumption	343,619	L/y		
Carbon Dioxide	862,485	kg/y		
Hydrocarbons	1,360	kg/y		
Carbon Monoxide	71,149	kg/y		
NOx	2,254	kg/y		

MOVEMENT SUMMARY

Site: 2014 PM Base Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 120 seconds

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Industrial Drive - East											
5	T	1353	10.0	0.535	10.0	LOS A	20.3	154.5	0.54	0.49	57.0
6	R	856	10.0	0.889	69.1	LOS E	28.6	217.3	1.00	0.96	24.6
Approach		2208	10.0	0.889	32.9	LOS C	28.6	217.3	0.72	0.67	37.9
North: Tourle Street											
7	L	861	10.0	0.492	7.8	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
9	R	684	10.0	0.902	72.5	LOS F	23.9	181.8	1.00	1.00	20.1
Approach		1545	10.0	0.902	36.5	LOS C	23.9	181.8	0.44	0.77	30.2
West: Industrial Drive - West											
10	L	894	10.0	0.510	11.5	NA[9]	NA[9]	NA[9]	0.00	0.68	58.7
11	T	1204	10.0	0.908	54.5	LOS D	40.4	306.9	1.00	1.04	27.6
Approach		2098	10.0	0.908	36.2	LOS C	40.4	306.9	0.57	0.89	35.5
All Vehicles		5852	10.0	0.908	35.0	LOS C	40.4	306.9	0.59	0.78	34.9

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.

9 Continuous movement

INTERSECTION SUMMARY

New Site
Signals - Fixed Time Cycle Time = 120 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	5986	veh/h	7184	pers/h
Percent Heavy Vehicles	10.6	%		
Degree of Saturation	0.930			
Practical Spare Capacity	-3.2	%		
Effective Intersection Capacity	6438	veh/h		
Control Delay (Total)	63.75	veh-h/h	76.50	pers-h/h
Control Delay (Average)	38.3	sec	38.3	sec
Control Delay (Worst Lane)	77.5	sec		
Control Delay (Worst Movement)	77.5	sec	77.5	sec
Geometric Delay (Average)	5.6	sec		
Stop-Line Delay (Average)	32.8	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)	42.7	veh		
95% Back of Queue - Distance (Worst Lane)	324.5	m		
Total Effective Stops	4777	veh/h	5732	pers/h
Effective Stop Rate	0.80	per veh	0.80	per pers
Proportion Queued	0.60		0.60	
Performance Index	291.0		291.0	
Travel Distance (Total)	3991.4	veh-km/h	4789.7	pers-km/h
Travel Distance (Average)	667	m	667	m
Travel Time (Total)	120.1	veh-h/h	144.1	pers-h/h
Travel Time (Average)	72.2	sec	72.2	sec
Travel Speed	33.2	km/h	33.2	km/h
Cost (Total)	4188.42	$/h	4188.42	$/h
Fuel Consumption (Total)	751.9	L/h		
Carbon Dioxide (Total)	1887.6	kg/h		
Hydrocarbons (Total)	2.977	kg/h		
Carbon Monoxide (Total)	155.42	kg/h		
NOx (Total)	4.907	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).

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2,873,432	veh/y	3,448,118	pers/y
Delay	30,600	veh-h/y	36,720	pers-h/y
Effective Stops	2,292,943	veh/y	2,751,532	pers/y
Travel Distance	1,915,872	veh-km/y	2,299,047	pers-km/y
Travel Time	57,656	veh-h/y	69,187	pers-h/y
Cost	2,010,440	$/y	2,010,440	$/y
Fuel Consumption	360,891	L/y		
Carbon Dioxide	906,068	kg/y		
Hydrocarbons	1,429	kg/y		
Carbon Monoxide	74,599	kg/y		
NOx	2,355	kg/y		

MOVEMENT SUMMARY

Site: 2014 PM Construction Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 120 seconds

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Industrial Drive - East											
5	T	1353	10.0	0.542	10.5	LOS A	20.8	158.1	0.55	0.51	56.2
6	R	877	12.2	0.924	77.2	LOS F	31.4	242.9	1.00	0.99	22.8
Approach		2229	10.9	0.924	36.7	LOS C	31.4	242.9	0.73	0.70	35.8
North: Tourle Street											
7	L	924	11.6	0.533	7.9	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
9	R	731	9.9	0.926	77.5	LOS F	26.6	201.7	1.00	1.03	19.3
Approach		1655	10.8	0.926	38.6	LOS C	26.6	201.7	0.44	0.79	29.3
West: Industrial Drive - West											
10	L	898	10.4	0.514	11.5	NA[9]	NA[9]	NA[9]	0.00	0.68	58.7
11	T	1204	10.0	0.930	60.9	LOS E	42.7	324.5	1.00	1.08	25.7
Approach		2102	10.2	0.930	39.8	LOS C	42.7	324.5	0.57	0.91	33.8
All Vehicles		5986	10.6	0.930	38.3	LOS C	42.7	324.5	0.60	0.80	33.2

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.

9 Continuous movement

INTERSECTION SUMMARY

Site: 2015 AM Base Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 90 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	5445	veh/h	6534	pers/h
Percent Heavy Vehicles	10.0	%		
Degree of Saturation	0.900			
Practical Spare Capacity	0.0	%		
Effective Intersection Capacity	6050	veh/h		
Control Delay (Total)	41.71	veh-h/h	50.05	pers-h/h
Control Delay (Average)	27.6	sec	27.6	sec
Control Delay (Worst Lane)	64.0	sec		
Control Delay (Worst Movement)	64.0	sec	64.0	sec
Geometric Delay (Average)	5.0	sec		
Stop-Line Delay (Average)	22.6	sec		
Level of Service (Aver. Int. Delay)	LOS B			
Level of Service (Worst Movement)	LOS E			
Level of Service (Worst Lane)	LOS E			
95% Back of Queue - Vehicles (Worst Lane)	37.1	veh		
95% Back of Queue - Distance (Worst Lane)	281.7	m		
Total Effective Stops	4307	veh/h	5168	pers/h
Effective Stop Rate	0.79	per veh	0.79	per pers
Proportion Queued	0.58		0.58	
Performance Index	210.8		210.8	
Travel Distance (Total)	3626.2	veh-km/h	4351.5	pers-km/h
Travel Distance (Average)	666	m	666	m
Travel Time (Total)	93.6	veh-h/h	112.4	pers-h/h
Travel Time (Average)	61.9	sec	61.9	sec
Travel Speed	38.7	km/h	38.7	km/h
Cost (Total)	3347.47	$/h	3347.47	$/h
Fuel Consumption (Total)	646.1	L/h		
Carbon Dioxide (Total)	1621.8	kg/h		
Hydrocarbons (Total)	2.525	kg/h		
Carbon Monoxide (Total)	136.37	kg/h		
NOx (Total)	4.315	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).

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2,613,727	veh/y	3,136,472	pers/y
Delay	20,022	veh-h/y	24,026	pers-h/y
Effective Stops	2,067,290	veh/y	2,480,749	pers/y
Travel Distance	1,740,584	veh-km/y	2,088,700	pers-km/y
Travel Time	44,949	veh-h/y	53,939	pers-h/y
Cost	1,606,784	$/y	1,606,784	$/y
Fuel Consumption	310,149	L/y		
Carbon Dioxide	778,475	kg/y		
Hydrocarbons	1,212	kg/y		
Carbon Monoxide	65,458	kg/y		
NOx	2,071	kg/y		

MOVEMENT SUMMARY

Site: 2015 AM Base Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 90 seconds

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Industrial Drive - East											
5	T	1116	10.0	0.460	8.1	LOS A	13.5	102.4	0.53	0.48	59.6
6	R	485	10.0	0.891	64.0	LOS E	14.1	107.2	1.00	0.99	25.9
Approach		1601	10.0	0.891	25.1	LOS B	14.1	107.2	0.67	0.63	43.0
North: Tourle Street											
7	L	977	10.0	0.558	7.9	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
9	R	651	10.0	0.880	56.6	LOS E	17.8	135.0	1.00	1.01	23.6
Approach		1627	10.0	0.880	27.4	LOS B	17.8	135.0	0.40	0.76	34.5
West: Industrial Drive - West											
10	L	774	10.0	0.442	11.4	NA[9]	NA[9]	NA[9]	0.00	0.68	58.8
11	T	1443	10.0	0.900	39.2	LOS C	37.1	281.7	1.00	1.06	33.2
Approach		2217	10.0	0.900	29.5	LOS C	37.1	281.7	0.65	0.93	39.1
All Vehicles		5445	10.0	0.900	27.6	LOS B	37.1	281.7	0.58	0.79	38.7

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

9 Continuous movement

INTERSECTION SUMMARY

Site: 2015 AM Operational Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 90 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	5459	veh/h	6551	pers/h
Percent Heavy Vehicles	10.3	%		
Degree of Saturation	0.900			
Practical Spare Capacity	0.0	%		
Effective Intersection Capacity	6065	veh/h		
Control Delay (Total)	41.77	veh-h/h	50.13	pers-h/h
Control Delay (Average)	27.5	sec	27.5	sec
Control Delay (Worst Lane)	64.0	sec		
Control Delay (Worst Movement)	64.0	sec	64.0	sec
Geometric Delay (Average)	5.0	sec		
Stop-Line Delay (Average)	22.5	sec		
Level of Service (Aver. Int. Delay)	LOS B			
Level of Service (Worst Movement)	LOS E			
Level of Service (Worst Lane)	LOS E			
95% Back of Queue - Vehicles (Worst Lane)	37.1	veh		
95% Back of Queue - Distance (Worst Lane)	281.7	m		
Total Effective Stops	4318	veh/h	5181	pers/h
Effective Stop Rate	0.79	per veh	0.79	per pers
Proportion Queued	0.58		0.58	
Performance Index	211.2		211.2	
Travel Distance (Total)	3635.6	veh-km/h	4362.7	pers-km/h
Travel Distance (Average)	666	m	666	m
Travel Time (Total)	93.8	veh-h/h	112.6	pers-h/h
Travel Time (Average)	61.9	sec	61.9	sec
Travel Speed	38.7	km/h	38.7	km/h
Cost (Total)	3365.59	$/h	3365.59	$/h
Fuel Consumption (Total)	653.1	L/h		
Carbon Dioxide (Total)	1639.5	kg/h		
Hydrocarbons (Total)	2.542	kg/h		
Carbon Monoxide (Total)	137.85	kg/h		
NOx (Total)	4.364	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).

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2,620,295	veh/y	3,144,354	pers/y
Delay	20,050	veh-h/y	24,060	pers-h/y
Effective Stops	2,072,521	veh/y	2,487,025	pers/y
Travel Distance	1,745,093	veh-km/y	2,094,112	pers-km/y
Travel Time	45,035	veh-h/y	54,042	pers-h/y
Cost	1,615,485	$/y	1,615,485	$/y
Fuel Consumption	313,496	L/y		
Carbon Dioxide	786,978	kg/y		
Hydrocarbons	1,220	kg/y		
Carbon Monoxide	66,166	kg/y		
NOx	2,095	kg/y		

MOVEMENT SUMMARY

Site: 2015 AM Operational Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 90 seconds

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Industrial Drive - East											
5	T	1123	11.0	0.466	8.2	LOS A	13.6	104.3	0.53	0.48	59.5
6	R	485	10.0	0.891	64.0	LOS E	14.1	107.2	1.00	0.99	25.9
Approach		1608	10.7	0.891	25.0	LOS B	14.1	107.2	0.67	0.63	43.0
North: Tourle Street											
7	L	977	10.0	0.558	7.9	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
9	R	651	10.0	0.880	56.6	LOS E	17.8	135.0	1.00	1.01	23.6
Approach		1627	10.0	0.880	27.4	LOS B	17.8	135.0	0.40	0.76	34.5
West: Industrial Drive - West											
10	L	780	11.0	0.448	11.5	NA[9]	NA[9]	NA[9]	0.00	0.68	58.8
11	T	1443	10.0	0.900	39.2	LOS C	37.1	281.7	1.00	1.06	33.2
Approach		2223	10.4	0.900	29.5	LOS C	37.1	281.7	0.65	0.93	39.1
All Vehicles		5459	10.3	0.900	27.5	LOS B	37.1	281.7	0.58	0.79	38.7

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

9 Continuous movement

INTERSECTION SUMMARY

Site: 2015 PM Base Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 120 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	5998	veh/h	7197	pers/h
Percent Heavy Vehicles	10.0	%		
Degree of Saturation	0.931			
Practical Spare Capacity	-3.3	%		
Effective Intersection Capacity	6446	veh/h		
Control Delay (Total)	62.56	veh-h/h	75.07	pers-h/h
Control Delay (Average)	37.5	sec	37.5	sec
Control Delay (Worst Lane)	77.7	sec		
Control Delay (Worst Movement)	77.7	sec	77.7	sec
Geometric Delay (Average)	5.5	sec		
Stop-Line Delay (Average)	32.0	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)	43.8	veh		
95% Back of Queue - Distance (Worst Lane)	332.5	m		
Total Effective Stops	4767	veh/h	5721	pers/h
Effective Stop Rate	0.79	per veh	0.79	per pers
Proportion Queued	0.60		0.60	
Performance Index	288.9		288.9	
Travel Distance (Total)	4004.9	veh-km/h	4805.9	pers-km/h
Travel Distance (Average)	668	m	668	m
Travel Time (Total)	119.0	veh-h/h	142.8	pers-h/h
Travel Time (Average)	71.4	sec	71.4	sec
Travel Speed	33.7	km/h	33.7	km/h
Cost (Total)	4138.12	$/h	4138.12	$/h
Fuel Consumption (Total)	742.7	L/h		
Carbon Dioxide (Total)	1864.1	kg/h		
Hydrocarbons (Total)	2.954	kg/h		
Carbon Monoxide (Total)	153.54	kg/h		
NOx (Total)	4.849	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).

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2,878,990	veh/y	3,454,787	pers/y
Delay	30,027	veh-h/y	36,032	pers-h/y
Effective Stops	2,288,223	veh/y	2,745,867	pers/y
Travel Distance	1,922,340	veh-km/y	2,306,808	pers-km/y
Travel Time	57,121	veh-h/y	68,545	pers-h/y
Cost	1,986,299	$/y	1,986,299	$/y
Fuel Consumption	356,481	L/y		
Carbon Dioxide	894,768	kg/y		
Hydrocarbons	1,418	kg/y		
Carbon Monoxide	73,700	kg/y		
NOx	2,328	kg/y		

MOVEMENT SUMMARY

Site: 2015 PM Base Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 120 seconds

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Industrial Drive - East											
5	T	1386	10.0	0.548	10.2	LOS A	21.0	159.9	0.55	0.50	56.8
6	R	877	10.0	0.910	73.5	LOS F	30.5	231.7	1.00	0.98	23.6
Approach		2263	10.0	0.910	34.7	LOS C	30.5	231.7	0.72	0.69	36.9
North: Tourle Street											
7	L	883	10.0	0.504	7.8	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
9	R	702	10.0	0.925	77.7	LOS F	25.5	194.1	1.00	1.03	19.2
Approach		1585	10.0	0.925	38.8	LOS C	25.5	194.1	0.44	0.79	29.3
West: Industrial Drive - West											
10	L	916	10.0	0.523	11.5	NA[9]	NA[9]	NA[9]	0.00	0.68	58.7
11	T	1234	10.0	0.930	60.5	LOS E	43.8	332.5	1.00	1.09	25.9
Approach		2149	10.0	0.931	39.6	LOS C	43.8	332.5	0.57	0.91	33.9
All Vehicles		5998	10.0	0.931	37.5	LOS C	43.8	332.5	0.60	0.79	33.7

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.

9 Continuous movement

INTERSECTION SUMMARY

Site: 2015 PM Operational Tourle St - Industrial Drive

New Site
Signals - Fixed Time Cycle Time = 120 seconds

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	6013	veh/h	7215	pers/h
Percent Heavy Vehicles	10.2	%		
Degree of Saturation	0.931			
Practical Spare Capacity	-3.3	%		
Effective Intersection Capacity	6462	veh/h		
Control Delay (Total)	62.62	veh-h/h	75.15	pers-h/h
Control Delay (Average)	37.5	sec	37.5	sec
Control Delay (Worst Lane)	77.7	sec		
Control Delay (Worst Movement)	77.7	sec	77.7	sec
Geometric Delay (Average)	5.5	sec		
Stop-Line Delay (Average)	32.0	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)	43.8	veh		
95% Back of Queue - Distance (Worst Lane)	332.5	m		
Total Effective Stops	4778	veh/h	5734	pers/h
Effective Stop Rate	0.79	per veh	0.79	per pers
Proportion Queued	0.60		0.60	
Performance Index	289.3		289.3	
Travel Distance (Total)	4015.0	veh-km/h	4818.0	pers-km/h
Travel Distance (Average)	668	m	668	m
Travel Time (Total)	119.2	veh-h/h	143.0	pers-h/h
Travel Time (Average)	71.4	sec	71.4	sec
Travel Speed	33.7	km/h	33.7	km/h
Cost (Total)	4151.60	$/h	4151.60	$/h
Fuel Consumption (Total)	747.3	L/h		
Carbon Dioxide (Total)	1875.9	kg/h		
Hydrocarbons (Total)	2.967	kg/h		
Carbon Monoxide (Total)	154.61	kg/h		
NOx (Total)	4.885	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).

Intersection Performance - Annual Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	2,886,063	veh/y	3,463,276	pers/y
Delay	30,058	veh-h/y	36,070	pers-h/y
Effective Stops	2,293,438	veh/y	2,752,126	pers/y
Travel Distance	1,927,183	veh-km/y	2,312,620	pers-km/y
Travel Time	57,213	veh-h/y	68,655	pers-h/y
Cost	1,992,769	$/y	1,992,769	$/y
Fuel Consumption	358,709	L/y		
Carbon Dioxide	900,415	kg/y		
Hydrocarbons	1,424	kg/y		
Carbon Monoxide	74,215	kg/y		
NOx	2,345	kg/y		

MOVEMENT SUMMARY

Site: 2015 PM Operational Tourle St - Industrial Drive

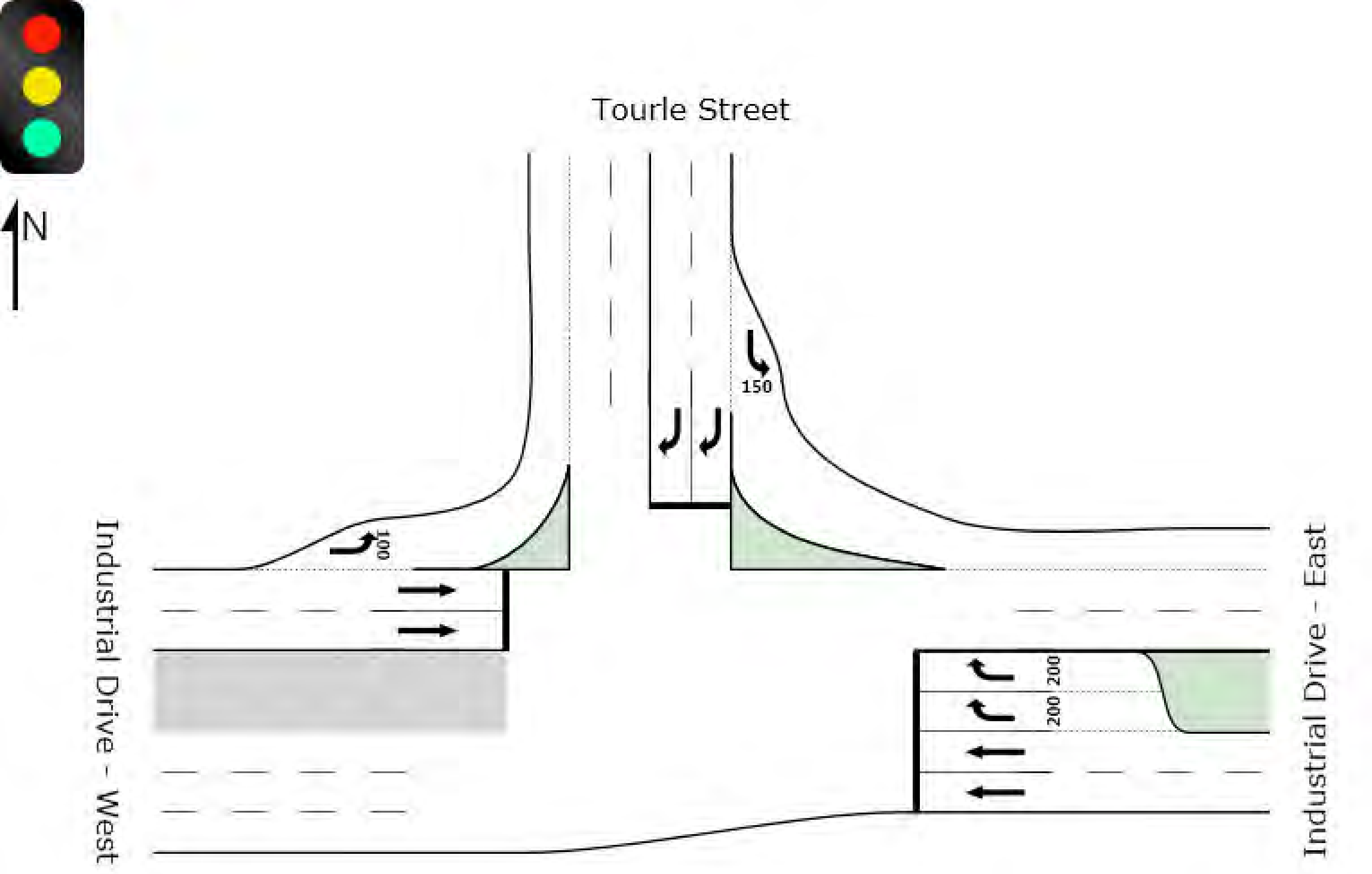
New Site
Signals - Fixed Time Cycle Time = 120 seconds

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Industrial Drive - East											
5	T	1394	10.0	0.551	10.2	LOS A	21.2	161.1	0.55	0.50	56.7
6	R	877	10.0	0.910	73.5	LOS F	30.5	231.7	1.00	0.98	23.6
Approach		2271	10.0	0.910	34.7	LOS C	30.5	231.7	0.72	0.69	36.9
North: Tourle Street											
7	L	883	10.0	0.504	7.8	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
9	R	702	10.0	0.925	77.7	LOS F	25.5	194.1	1.00	1.03	19.2
Approach		1585	10.0	0.925	38.8	LOS C	25.5	194.1	0.44	0.79	29.3
West: Industrial Drive - West											
10	L	923	11.0	0.531	11.5	NA[9]	NA[9]	NA[9]	0.00	0.68	58.7
11	T	1234	10.0	0.930	60.5	LOS E	43.8	332.5	1.00	1.09	25.9
Approach		2157	10.4	0.931	39.5	LOS C	43.8	332.5	0.57	0.91	33.9
All Vehicles		6013	10.2	0.931	37.5	LOS C	43.8	332.5	0.60	0.79	33.7

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.

9 Continuous movement



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Tourle Street
150
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Industrial Drive - West
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