6.0 Transportation

6.1 Study Background and Scope

An assessment of the road traffic impacts of the project has been undertaken by Cardno Eppell Olsen. A copy of its report is provided in Appendix B. This section provides a summary of that report.

The scope of the assessment has been agreed with the Department of Main Roads (DMR) to include the following tasks along the extent of haulage routes and site access roads:

- Analysis of the operation of intersections during construction and operation (with and without the refinery).
- A pavement impact assessment related to the construction and operation of the refinery.
- Consideration of impacts related to construction of pipelines related to the projects.
- Assessment of the impacts associated with the residue storage facility (RSF), including access requirements from the Bruce Highway.

The scope of the assessment is summarised in Table 6.1.1. Further details are provided in Appendix B.

Table 6.1.1 Scope of Traffic Assessment

Project Component	Task	Scope
Refinery	Intersection analysis with and without refinery (construction and operation).	Gladstone - Mt Larcom Road/Bruce Highway intersection Hanson Road/Reid Road intersection Dawson Highway/Blain Drive/Herbertson Street intersection Hanson Road/Blain Drive/Alf O'Rourke Drive intersection Hanson Road/Red Rover Road intersection Dawson Highway/Don Young Drive intersection Gladstone - Mt Larcom Road/Landing Road intersection Gladstone - Mt Larcom Road/Targinie - Calliope River Road intersection Bruce Highway/Targinie - Calliope River Road intersection Dawson Highway/Phillip Street intersection
	Pavement impact assessment (construction and operation).	Gladstone - Mt Larcom Road between Bruce Highway and Landing Road Hanson Road between Landing Road and Reid Road Hanson Road between Reid Road and Red Rover Road Hanson Road between Red Rover Road and Blain Drive Dawson Highway between Don Young Drive and Bruce Highway
Pipeline	Assessment of impacts during construction.	Ridgelands Road west of Rockhampton Bruce Highway near Bajool Bruce Highway between Mt Larcom and Raglan Creek Gladstone - Mt Larcom Road between Bruce Highway and Landing Road
RSF	Intersection analysis	Assessment of access requirements with the Bruce Highway

This transport study has also investigated the project's effects on shipping, rail and air transport facilities.

6.2 Road Transport

6.2.1 Existing Road Network for Refinery

The refinery site is bounded by Hanson Road to the north, Reid Road to the west, and the North Coast Railway to the south. Vehicular access to the proposed site is available via Reid Road and Hanson Road. Hanson Road is a designated haulage route for 23 m and 25 m B-Doubles only and is controlled by the DMR. Reid Road is a local road and is thus controlled by the local authority (Calliope Shire).

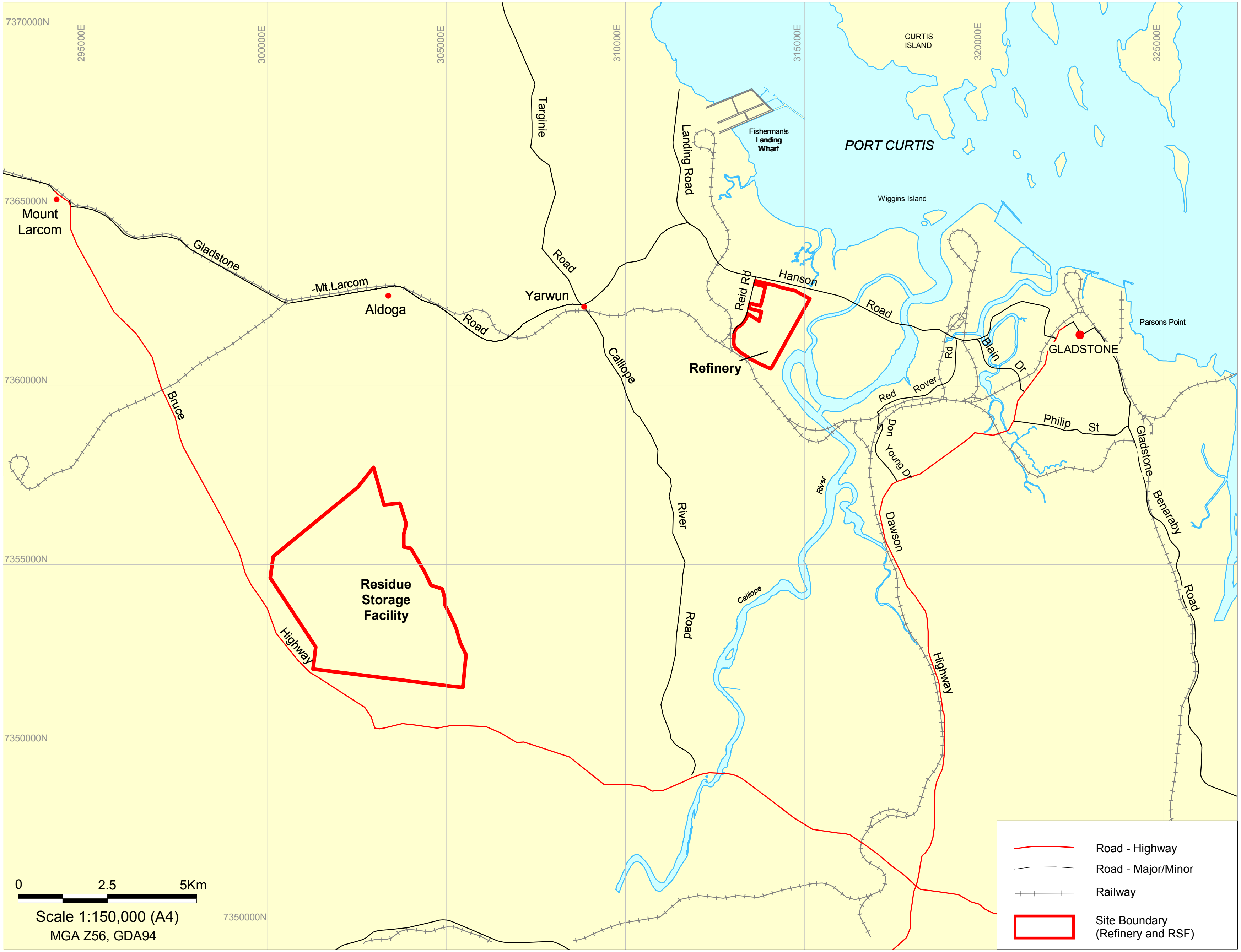
Queensland Rail (QR) currently provides access to the Gladstone State Development Area (GSDA) via the main North Coast Rail with branch lines to both Fisherman's Landing and East End.

Existing industry near and within the GSDA is serviced by the Central Queensland Ports Authority's (CQPA) facility at Fisherman's Landing.

The road network surrounding the proposed refinery site and key links to be assessed for the pipeline construction are described in Table 6.2.1 and are shown in Figure 6.2.1.

Table 6.2.1 Road Network Surrounding the Refinery Site

Road	Description
Bruce Highway	The Bruce Highway is part of the national highway system. It currently comprises a two lane, undivided form with 1 – 1.5 m sealed shoulder. The pavement appears to be of good quality. The posted speed limit is generally 100 km/h, except through the Mt Larcom section where 80 km/h applies and in the Rockhampton urban section where a 70 km/h speed limit is posted. The urban section generally comprises a median divided, four lane carriageway.
Ridgelands Road	Ridgelands Road is a two lane, undivided form. Access to abutting land uses, mainly agricultural, are generally untreated priority intersections. The posted speed limit is 100 km/h.
Hanson Road	Hanson Road between the Landing Road and Blain Drive intersections consists of a two lane form. Access intersections to adjacent industrial sites are generally provided in either unsignalised or roundabout configurations. The speed limit is generally 100 km/h in the western section and is reduced to 60 km/h at the Calliope River. Four lanes are provided in the Gladstone urban area east of the intersection with Blain Drive.
Dawson Highway	The Dawson Highway, between Don Young Drive and the Bruce Highway, provides a 100 km/h speed environment. The link is generally a two lane undivided road. Overtaking lanes are provided throughout the link.
Targinie – Calliope River Road	South of Gladstone – Mt Larcom Road, Calliope River Road is a recently sealed two lane, 100 km/h road. The northern section extends through the township of Yarwun. Through this section the adjacent land use is mainly residential and the speed limit is reduced to 60 km/h.
Landing Road	Landing Road extends north from Gladstone – Mt Larcom Road in a two lane undivided form to Fisherman's Landing. The northern section is unsealed. The speed limit is 80 km/h throughout.
Reid Road	Reid Road consists of a two lane undivided link with a 9 m seal and unsealed shoulders. The southernmost section is gravel. Adjacent land uses are mainly industrial, including the ORICA chemical plant, rail yards and water and sewage treatment plants.
Blain Drive	Blain Drive is a two lane undivided link. It provides a through traffic role as well as an access role to the adjacent industrial and residential areas. Current works to Red Rover Road will reduce through traffic demands on Blain Drive.



Client: URS — Gladstone Pacific Nickel Ltd

Project: GLADSTONE NICKEL PROJECT ENVIRONMENTAL IMPACT STATEMENT

Title: ROAD NETWORK

Drawn: TN | Approved: CMP | Date: 23-10-06

Job No: 4262 5791 | File No: 42625791-g-093.wor

Figure: 6.2.1 | Rev: A | A4

Table 6.2.1 Road Network Surrounding the Refinery Site

Road	Description
Red Rover Road/Don Young Drive	Red Rover Road is generally a two lane undivided link. The northern section has frequent access to abutting industrial uses and the pavement is of high quality. The southern section provides indirect connection to the Dawson Highway as it currently has two at-grade rail crossings. Upgrades are underway to provide a more direct alignment at the Don Young Drive continuation of the link. When complete, this will provide a high quality connection from the Dawson Highway to Hanson Road, offering an alternative to Blain Drive.

6.2.2 Existing Traffic

Australasian Traffic Surveys was commissioned to undertake traffic surveys at key intersections. Manual traffic counts were undertaken on Thursday 9 February 2006 between 5:45 am to 8:30 am and 2:45 pm to 5:30 pm at the following locations:

- Bruce Highway/Gladstone - Mt Larcom Road.
- Hanson Road/Reid Road.
- Hanson Road/Blain Drive/Alf O’Rourke Drive.
- Dawson Highway/Blain Drive/Herbertson Street.
- Hanson Road/Red Rover Road.
- Dawson Highway/Don Young Drive.

Additional manual turning movement counts were taken on Wednesday 15 March 2006 between 5:45 am to 8:30 am and 2:45 pm to 5:30 pm at the following locations:

- Dawson Highway/Philip Street.
- Bruce Highway/Targinie - Calliope River Road.
- Gladstone - Mt Larcom Road/Targinie - Calliope River Road.
- Gladstone - Mt Larcom Road/Hanson Road/Landing Road.

The 2006 traffic count volumes are illustrated in Appendix B.

There was an error with the count data taken in the AM Peak at the intersection of Hanson Road, Blain Drive and Alf O’Rourke Drive. The turning movement volumes for the left turn from Blain Drive and the through movement from Hanson Road (east) were considered to be extremely low and needed to be amended. Traffic count data taken at this intersection in 2003 were used to determine the correct volume of traffic for each of these movements. The 2003 count data for this intersection in the AM peak is provided in Appendix B.

Additionally, the traffic volumes at the intersection of Hanson Road and Reid Road in the AM and PM peaks were thought to be somewhat higher than normal due to the construction of the Orica chemical plant at the time the count data was obtained. The 2006 traffic volumes for movements into and out of Reid Road were amended based upon traffic count data provided by SKM which was obtained in 2004, prior to the construction of the Orica plant commencing. The turning volumes used for the future background traffic scenarios (i.e. 2009 to 2026) were based upon the projected traffic volumes associated with the Orica plant. The 2004 traffic count data and the projected Orica 2009 traffic volumes for this intersection are included in Appendix B.

6.2.3 Project Traffic

6.2.3.1 Refinery Construction Traffic

As noted in Section 1.5, Stage 1 construction is expected to begin in early 2008. At the time the traffic studies were undertaken, a more aggressive project schedule was assumed with construction beginning in late 2007. It is this more aggressive schedule that has been assumed in the following traffic assessment. Further details of the construction traffic are given in Section 2.3.4.6.

Stage 1

The Stage 1 construction phase is proposed to start in late 2007 with an expected completion in mid to late 2010. The later stages of this construction stage will coincide with start of operations (proposed mid 2010). At the construction peak, expected to occur in mid 2009 and last for two months, staff numbers are expected to be in the order of 2,600 personnel, including a small number of operation staff.

Of these staff, it is expected that approximately 67% will travel to and from the construction site in 30-seat buses. The remaining 33% will travel to and from the site in private vehicles with two people in each vehicle. In the construction peak, this will generate approximately 430 light vehicle trips and 58 bus trips each day. On average, approximately 10 heavy vehicle trips per day will also be generated in delivering construction materials to the site.

These mode share assumptions were based upon observations at similar sites in the Gladstone area. The Comalco Alumina Refinery had a total of 2,200 workers at its construction peak. Of these workers, approximately 1,000 travelled to the site by bus with the remainder travelling by car, with an average occupancy of 1.8 people per car. While the proportion of workers travelling by car was higher in this circumstance, the number of workers travelling by car can be controlled by ensuring that the supply of car parking spaces on the site is limited only to the minimum site requirements to force use of the bus fleet.

Stage 2

The Stage 2 construction phase is due to commence at the end of 2012 and take approximately three years to complete. The construction is expected to peak in the middle of 2014 with staff numbers in the order of 1,700 workers. The mode share assumptions for this stage are the same as for Stage 1 i.e. 67% of staff will travel by 30 seater bus and 33% by private vehicle. The Stage 1 plant is expected to continue operating at capacity during the Stage 2 construction phase. As for Stage 1, an average of 10 heavy vehicle trips per day will be generated in delivering construction materials to the site.

6.2.3.2 Residue Storage Facility Construction Traffic

The construction of the RSF is also expected to occur during construction of Stage 1. The RSF construction is due to commence during 2008 and take approximately one year to complete. Fifty people are expected to be required to construct the RSF. All of these people are expected to travel in private vehicles, with one person per vehicle.

6.2.3.3 Pipeline Construction Traffic

Pipeline Source

The source of the pipe has not been finalised, although it will be sourced from Australian suppliers and/or offshore mills (depending on design aspects and mill capacity). It is presently anticipated that pipes will be transported to Gladstone by either rail from manufacturing centres at Kembla Grange or by sea. The final transport option will be determined in the detailed design phase of the project and will be dependent on the location of the pipeline supplier. The high density polyethylene (HDPE) liners for the pipelines will be shipped from overseas to Gladstone.

State-Controlled Roads

State-controlled roads will be used for the delivery of pipe from Gladstone to the construction sites. Trucks used for pipeline delivery will most likely be extendable semi-trailers and the pipes are likely to be transported in lengths of 12 m to 18 m.

Where the pipes are delivered by rail, it is proposed that the pipes will be delivered at a rate to match the construction rate and will be transported direct to the right-of-way (ROW) for stringing. Where the pipes are delivered by sea, it is proposed that the pipes will be transported via road to stockpiles located adjacent to the proposed workers' villages and then trucked from the stockpiles to the ROW.

Other heavy vehicle movement associated with the pipelines construction include the transport of the construction equipment to the ROW and mobilisation and demobilisation of the workers' villages. Additional traffic on state-controlled roads will be associated with daily travel of the construction workforce to the construction location. The workforce will most likely travel in a combination of four-wheel drives and minibuses.

Local Government-Controlled Roads and Private Tracks

Construction traffic will access the ROW by existing local roads and private tracks wherever possible. Prior to construction, an inspection of the access roads will be made in consultation with the relevant local authority representatives to determine the state of the road, whether any upgrade is required, and to record the pre-construction condition of the road (e.g. written record, photographs). Gladstone Pacific Nickel Limited (GPNL) will work with the relevant local authorities to make any necessary road upgrades and to agree the reinstatement condition necessary for each road. GPNL will also work with landholders to develop agreements on any upgrades or reinstatement to private access tracks.

Truck movements on the ROW and private tracks will take place in daylight hours as far as practical. Transport to and from the ROW will utilise local roads as far as possible, to minimise access via private tracks or extensive travel along the ROW.

Assumptions

The pipeline construction traffic scenario assumes the following:

- Three workers' village sites will be established near Mt Larcom, Gracemere and Fitzroy River to house a total of 300 construction workers. Workers are assumed to commute to the site using mini buses.
- Pipeline materials being transported by ship to Gladstone and stockpiled at each of the three workers' village sites. The pipes will be transported to the workers' village sites by semi-trailer.
- Pipes transported from the stockpiles to the pipeline construction location throughout the construction period.
- A total construction period of approximately eight months with a peak period of four months.
- Construction of the pipeline will occur over two spreads.
- Pipe transport involving approximately 3,600 truck trips carrying up to 22 t each over the eight month period (10 - 17 trucks per day).
- Local traffic consisting of an estimated 30 four-wheel drive trips each day distributed over the construction ROW and local roads.
- Up to 100 truck trips will be required for mobilisation and demobilisation of plant and equipment required for each spread. Additionally, 100 semi trailer trips will be required for the establishment of workers' village sites.

6.2.3.4 Refinery Operational Traffic

Stage 1

Operations at the refinery are expected to start on a small scale in December 2009 and gradually build up to full operation with 385 staff by 2011. The majority of the staff will work twelve-hour shifts on a four-shift roster and commute to the site in private vehicles with one person per vehicle. There will be a small number of regular day shift personnel for routine refinery operations (e.g. admin etc).

During Stage 1 operations, the refinery is expected to produce approximately 60,000 tonnes of nickel annually. There will also be 170,000 tonnes per year of amsul generated. In addition, there will be a small number of trucks delivering chemicals and consumables each day. This will generate approximately 24 heavy vehicle trips daily.

It is assumed that deliveries will arrive at the site relatively consistently throughout the day. Hence any heavy vehicle traffic is unlikely to have a significant impact on the operation of the surrounding intersections.

The primary concern will be the impact of heavy vehicles on the pavement quality of the surrounding road network.

Stage 2

Full operation of Stage 2 is expected to commence in late 2015. Approximately 450 staff are required for full operation of the refinery. Again, it is expected that staff will work twelve-hour shifts on a four-shift roster and they will travel in private vehicles.

The output for Stage 2 is expected to increase to 126,000 tonnes of nickel annually as well as 343,000 tonnes of amsul. The Stage 2 heavy traffic will be approximately 49 heavy vehicle trips each day.

Once again, it is assumed that deliveries will arrive at the site somewhat consistently throughout the day and thus any heavy vehicle traffic is unlikely to have a significant impact on the intersection operations within the surrounding road network.

6.2.4 Traffic Distribution and Assignment

The assumed distribution of staff associated with the refinery activities is as follows:

- Gladstone City, via Hanson Road 10%
- Gladstone, via Hanson Road and Lord Street 10%
- Philip Street, via Hanson Road and Blain Drive 55%
- West Gladstone, via Hanson Road and Blain Drive 5%
- Clinton, via Hanson Road and Red Rover Road 5%
- Calliope, via Calliope River Road and Bruce Highway 5%
- Yarwun, via Gladstone – Mt Larcom Road 5%
- Rockhampton area, via Gladstone – Mt Larcom Road 5%

This distribution applies to all construction staff for the plant and the RSF as well as operational staff. The distribution is represented graphically in Appendix B.

The distribution of operational heavy vehicle traffic has been based upon vehicle origin and destination data provided. The main origins and destinations for the heavy vehicles are Gladstone Port, Rockhampton, Brisbane and Fisherman’s Landing. Tables with the origin and destination of the refinery’s inputs and outputs for Stages 1 and 2 operations are provided at Appendix B.

6.2.5 Traffic Predictions

6.2.5.1 Background Traffic Growth

One-year, five-year and ten-year growth data were obtained from the DMR and analysed across the study network. It was found that a linear growth rate of 5% per annum is expected through the rural areas of the network. This growth rate was deemed to be appropriate since this area is largely undeveloped and a reasonable amount of growth could be expected in the coming years. In the urban areas, a lower rate of 3% per annum was determined. This was because the urban area is already largely developed and growth in this area is expected to occur at a slower rate than the undeveloped rural area. These rates have subsequently been agreed with DMR, and have been applied to the count data to determine the background traffic volumes for the scenarios detailed below.

6.2.5.2 Traffic Scenarios

The following scenarios have been considered for the traffic operations impact assessment:

- Scenario 1: 2006 Existing Traffic Volumes
- Scenario 2: 2009 Background Traffic Volumes
- Scenario 3: 2009 Background + Stage 1 Construction Traffic Volumes
- Scenario 4: 2011 Background Traffic Volumes
- Scenario 5: 2011 Background + Stage 1 Operation Traffic Volumes
- Scenario 6: 2014 Background Traffic Volumes
- Scenario 7: 2014 Background + Stage 1 Operation + Stage 2 Construction Traffic Volumes
- Scenario 8: 2016 Background Traffic Volumes
- Scenario 9: 2016 Background + Stage 2 Operation Traffic Volumes
- Scenario 10 2026 Background Traffic Volumes
- Scenario 11: 2026 Background + Stage 2 Operation Traffic Volumes

Figure 6.2.2 shows the timeline against which the above scenarios have been considered.

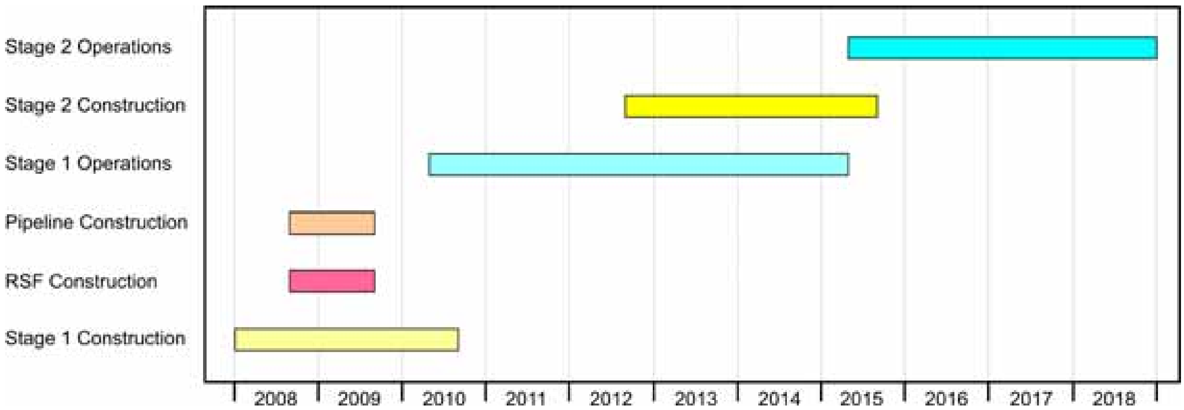


Figure 6.2.2 Project Timeline

The base traffic and equivalent standard axle (ESA) loadings have been determined using 2006 traffic volumes as a baseline reference.

6.2.5.3 Traffic Volumes – State-Controlled Traffic Network

Using the material and assumptions provided herein, the daily two way traffic volumes on each of the state-controlled road sections are summarised in Table 6.2.2. The year 2026 represents the ten year design horizon following the completion of Phase 2 construction. Detailed traffic volumes including intersection turning movements are included at Appendix B.

Table 6.2.2 Daily (Two Way) Link Volumes – State-Controlled Roads

Scenario	Gladstone – Mt Larcom Rd		Hanson Road			Dawson Highway
	Bruce Hwy to Targinie Rd	Targinie Rd to Landing Rd	Landing Rd to Reid Rd	Reid Rd to Red Rover Rd	Red Rover Rd to Blain Dr	Don Young Dr to Bruce Hwy
2006 Base	2,700	2,700	5,800	5,800	6,200	4,400
2009 Background	3,100	3,100	6,600	6,600	7,200	5,100
2011 Background	3,400	3,400	7,200	7,200	7,800	5,500
2014 Background	3,800	3,800	8,100	8,100	8,700	6,200
2016 Background	4,000	4,000	8,700	8,700	9,300	6,600
2026 Background	5,400	5,400	11,500	11,500	12,400	8,900
2009 with Construction	3,200	3,300	6,800	7,600	8,000	5,100
2011 with Operation	3,400	3,400	7,300	7,600	8,100	5,500
2014 with Construction	3,800	3,900	8,300	9,000	9,600	6,200
2016 with Operation	4,100	4,100	8,800	9,100	9,700	6,600
2026 with Operation	5,400	5,500	11,700	11,900	12,800	8,900

The link capacities for these roads are as follows:

- Two lanes: < 7,500 vehicles/day
- Two lanes with overtaking lanes: < 15,000 vehicles/day
- Four lanes: > 15,000 vehicles/day

Based upon these capacities and the volumes shown in Table 6.2.2, the required mid-block configuration for these links is detailed in Table 6.2.3.

Table 6.2.3 Required Mid-Block Configuration

Scenario	Gladstone – Mt Larcom Rd		Hanson Road			Dawson Highway
	Bruce Hwy to Targinie Rd	Targinie Rd to Landing Rd	Landing Rd to Reid Rd	Reid Rd to Red Rover Rd	Red Rover Rd to Blain Dr	Don Young Dr to Bruce Hwy
2009 Background	2 Lanes	2 Lanes	2 Lanes	2 Lanes	2 Lanes	2 Lanes
2011 Background	2 Lanes	2 Lanes	2 Lanes	2 Lanes	2 Lanes + Overtaking Lanes	2 Lanes
2014 Background	2 Lanes	2 Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes
2016 Background	2 Lanes	2 Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes
2026 Background	2 Lanes	2 Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes
2009 with Construction	2 Lanes	2 Lanes	2 Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes
2011 with Operation	2 Lanes	2 Lanes	2 Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes
2014 with Construction	2 Lanes	2 Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes
2016 with Operation	2 Lanes	2 Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes
2026 with Operation	2 Lanes	2 Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes	2 Lanes + Overtaking Lanes

The addition of the project traffic causes Hanson Road between Reid Road and Red Rover Road to require overtaking lanes in 2009 as opposed to 2014 without the project. Hanson Road also requires overtaking lanes between Red Rover Road and Blain Drive in 2009, as opposed to 2011 without the project traffic. This equates to a bring forward of 21% for the Reid Road to Red Rover Road section and 9% for the Red Rover Road to Blain Drive section.

6.2.5.4 Traffic Volumes – Council-Controlled Network

In addition to considering the impacts upon the state-controlled road network, the daily two way traffic volumes on key council-controlled road sections are summarised in Table 6.2.4.

Table 6.2.4 Daily (Two Way) Link Volumes – Council Roads

Scenario	Landing Road	Calliope River Road	Reid Road
	West of Hanson Road	East of Gladstone – Mt Larcom Road	South of Hanson Road
2006 Base	750	750	3,050
2009 Background	850	850	3,500
2011 Background	950	950	3,800
2014 Background	1,050	1,050	4,300
2016 Background	1,150	1,150	4,600
2026 Background	1,500	1,500	6,100
2009 with S.1 Construction	900	1,000	4,600
2011 with S.1 Operation	950	1,000	4,250
2014 with S.1 Operation & S.2 Construction	1,100	1,200	5,500
2016 with S.2 Operation	1,200	1,200	5,150
2026 with S.2 Operation	1,550	1,550	6,650

Note: S.1 = Stage 1, S.2 = Stage 2

Based upon the capacities listed in Section 6.2.5.3 and the volumes shown in Table 6.2.4, the required mid-block configuration for these links is detailed in Table 6.2.5.

Table 6.2.5 Required Mid-Block Configuration

Scenario	Landing Road	Calliope River Road	Reid Road
	West of Hanson Road	East of Gladstone – Mt Larcom Road	South of Hanson Road
2006 Base	Two Lanes	Two Lanes	Two Lanes
2009 Background	Two Lanes	Two Lanes	Two Lanes
2011 Background	Two Lanes	Two Lanes	Two Lanes
2014 Background	Two Lanes	Two Lanes	Two Lanes
2016 Background	Two Lanes	Two Lanes	Two Lanes
2026 Background	Two Lanes	Two Lanes	Two Lanes
2009 with S.1 Construction	Two Lanes	Two Lanes	Two Lanes
2011 with S.1 Operation	Two Lanes	Two Lanes	Two Lanes
2014 with S.1 Operation & S.2 Construction	Two Lanes	Two Lanes	Two Lanes
2016 with S.2 Operation	Two Lanes	Two Lanes	Two Lanes
2026 with S.2 Operation	Two Lanes	Two Lanes	Two Lanes

It can bee seen from Table 6.2.5 that no upgrades are required for any of the key council-controlled roads due to the addition of project traffic.

The traffic volumes for Calliope River Road have been investigated further, since this route passes through the town of Yarwun. The traffic volumes are displayed in Table 6.2.6.

Table 6.2.6 Calliope River Road Daily Two Way Traffic Volumes

Year	Refinery Stage	Background Traffic	Project Traffic		
			Light Vehicles	Heavy Vehicles	Total Vehicles
2009	Construction S.1	850	90	22	112
2011	Operation S.1	950	40	2	42
2014	Operation S.1 & Construction S.2	1,050	102	24	126
2016	Operation S.2	1,150	46	4	50
2026	Operation S.2	1,500	46	4	50

As shown in this table, the maximum number of vehicles per day using Calliope River Road to access the refinery will be 126 vehicles, of which 19% (24 vehicles) will be heavy. This volume is expected in the peak of Stage 2 construction. The other peak in heavy vehicle volumes is associated with the construction of Stage 1.

One method of lessening the impact of these additional heavy vehicles upon the residents of Yarwun, would be to ensure that the trucks only pass through the town during the day time. If heavy vehicle movements are required between dusk and dawn, it is proposed that these vehicles use the Bruce Highway and Gladstone – Mt Larcom Road to access the refinery.

6.2.6 Intersection Analysis

To assess the impact of the project on the intersections, the following scenarios were analysed using the aaSIDRA program:

- Scenario 1: 2006 Existing Traffic Volumes
- Scenario 2: 2009 Background Traffic Volumes
- Scenario 3: 2009 Background + Stage 1 Construction Traffic Volumes
- Scenario 4: 2011 Background Traffic Volumes
- Scenario 5: 2011 Background + Stage 1 Operation Traffic Volumes
- Scenario 6: 2014 Background Traffic Volumes
- Scenario 7: 2014 Background + Stage 1 Operation + Stage 2 Construction Traffic Volumes
- Scenario 8: 2016 Background Traffic Volumes
- Scenario 9: 2016 Background + Stage 2 Operation Traffic Volumes
- Scenario 10 2026 Background Traffic Volumes
- Scenario 11: 2026 Background + Stage 2 Operation Traffic Volumes

Note that Scenario 1 was assessed to identify any existing network deficiencies. This scenario is therefore only considered for the analysis of the existing intersection layouts.

A degree of saturation (DOS) of less than 1.0 indicates the intersection is operating within theoretical capacity. However, the maximum DOS typically desired for unsignalised (i.e. not controlled by traffic lights), roundabout and signalised (i.e. controlled by traffic lights) intersection forms are 0.80, 0.85 and 0.90, respectively. A DOS exceeding these values indicates that the intersection is nearing its operational capacity and identifies potential constraints that may impact traffic operations.

Intersection layouts and detailed aaSIDRA output tables for each intersection are included in Appendix B.

6.2.6.1 Bruce Highway/Gladstone – Mt Larcom Road

The Bruce Highway/Gladstone – Mt Larcom Road intersection operates as an unsignalised T-junction with a 50 m channelised right turn lane and a 140 m deceleration lane into Gladstone – Mt Larcom Road from the Bruce Highway. Gladstone – Mt Larcom Road has a give way controlled single lane that allows both right and left turning movements. The aaSIDRA outputs are detailed in Appendix B and show that this intersection operates adequately for all scenarios.

6.2.6.2 Hanson Road/Reid Road

The intersection of Hanson Road and Reid Road is currently a T-junction with give way control on Reid Road. Reid Road has one depart lane and two approach lanes, with the left lane being a 30 m slip lane. Hanson Road from the west has a single through lane and a channelised right turn lane. From the east, Hanson Road has a through lane and a 100 m left turn slip lane. Hanson Road has a single depart lane to the west and an acceleration lane for traffic turning right out of Reid Road to the east. The intersection was analysed in aaSIDRA and the outputs are detailed in Table 6.2.7.

Table 6.2.7 Hanson Road/Reid Road – 1 Hour Peak Intersection Performance Measures – Existing Layout

Scenario	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
2006 Existing	0.28	2.1	6	0.19	2.4	5
2009 Background	0.40	4.0	19	0.29	3.5	12
2009 with S.1 Construction	≥ 1	40.0	214	≥ 1	780	2,620
2011 Background	0.50	4.5	23	0.32	3.6	13
2011 with S.1 Operations	0.82	9.8	48	0.67	7.7	37
2014 Background	0.71	6.3	34	0.38	3.8	16
2014 with S.2 Construction	≥ 1	71.3	462	≥ 1	876	2,667
2016 Background	0.88	9.2	50	0.43	3.9	18
2016 with S.2 Operations	≥ 1	24.3	139	0.98	19.9	113
2026 Background	≥ 1	18.1	80	0.79	7.0	38
2026 with S.2 Operations	≥ 1	28.9	160	≥ 1	112	565

This intersection would exceed the accepted DOS criteria in the 2016 AM peak without the project. However, with the addition of the refinery's construction traffic, the intersection fails in 2009.

To overcome this problem, the traffic volumes were applied to a single lane roundabout form with a single approach and depart lane in each direction. The analysis results are displayed in Table 6.2.8.

Table 6.2.8 Hanson Road/Reid Road: 1 Hour Peak –Single Lane Roundabout

Scenario	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
2006 Existing	0.35	5.3	24	0.23	5.6	8
2009 Background	0.41	5.6	29	0.28	5.9	10
2009 with S.1 Construction	0.76	7.9	88	0.53	8.7	43
2011 Background	0.44	5.6	33	0.31	5.8	11
2011 with S.1 Operations	0.51	6.6	40	0.36	6.6	15
2014 Background	0.49	5.6	38	0.34	5.8	12
2014 with S.1 Operations and S.2 Construction	0.79	8.0	98	0.57	8.2	39
2016 Background	0.52	5.5	42	0.36	5.7	13
2016 with S.2 Operations	0.60	6.7	54	0.43	6.5	18
2026 Background	0.66	5.6	73	0.47	5.9	41
2026 with S.2 Operations	0.75	6.9	91	0.56	6.3	23

The outcome of this analysis shows that the intersection operates within the accepted limits for the intersection performance measures for all scenarios in this form.

To determine whether the roundabout would be subject to peak period influences due to shift changes during construction periods, a 30 minute analysis was undertaken. This maintained the Reid Road volumes at the full hour level, but halved the through traffic volumes on Hanson Road. When the 2009 Stage 1 construction traffic scenario is analysed in this form with a 30 minute peak hour, the DOS for both the AM and PM peaks is greater than 1 (see Appendix B). Thus this intersection form was considered to be inappropriate.

To address this deficiency, a single lane roundabout with a continuous through lane for traffic travelling east along Hanson Road (so through traffic can bypass the intersection) was considered. This roundabout has single depart lanes in all three directions and Hanson Road from the east, and Reid Road from the south, both have two approach lanes, of which the left is a short lane. The results of this analysis are displayed in Table 6.2.9. Analysis was only conducted for 2009 with Stage 1 construction and 2014 with Stage 1 operation and 2 construction scenarios, since these were considered the most critical at this intersection.

Table 6.2.9 Hanson Rd/Reid Rd: 30 Minute Peak - Roundabout with Bypass Lanes

Scenario	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
2009 with S.1 Construction	0.76	12.7	92	0.71	15.8	68
2014 with S.1 Operation & S.2 Construction	0.66	12.3	61	0.66	14.9	56

In this form the intersection operates within accepted limits for both AM and PM 30 minute peaks for both scenarios.

The intersection of Hanson Road and Reid Road has also been proposed as one option for accessing the Wiggins Island Coal Terminal (WICT). Thus this intersection was also analysed in the form of a roundabout with two circulating lanes with a 30 minute peak so that access could be provided in the future to the WICT. Again this intersection was analysed for 2009 with Stage 1 construction and 2014 with Stage 2 construction scenarios. The results of this analysis showed that a two-lane roundabout would operate adequately for both of these scenarios.

6.2.6.3 Dawson Highway/Blain Drive/Herbertson Street

The intersection of the Dawson Highway, Blain Drive and Herbertson Street is a roundabout with two circulating lanes. The Dawson Highway has two approach lanes and two depart lanes in each direction, north and south of the roundabout. Blain Drive, to the west, has two depart lanes and two approach lanes, with the left lane being 50 m in length. Herbertson Street has one approach and one depart lane. The aaSIDRA outputs for this intersection are displayed in Table 6.2.10.

Table 6.2.10 Dawson Highway/Blain Drive/Herbertson Street Intersection Performance Measures – Existing Layout

Scenario	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
2006 Existing	0.34	5.0	18	0.51	7.1	31
2009 Background	0.37	5.1	20	0.58	7.7	40
2009 with S.1 Construction	0.50	6.0	31	0.74	11.7	72
2011 Background	0.39	5.2	22	0.63	8.2	48
2011 with S.1 Operations	0.42	5.5	23	0.65	8.7	53
2014 Background	0.43	5.3	25	0.71	9.3	62
2014 with S.1 Operation & S.2 Construction	0.52	6.0	33	0.89	19.6	135
2016 Background	0.46	5.4	27	0.77	10.5	76
2016 with S.2 Operations	0.50	5.7	29	0.81	12.3	91
2026 Background	0.58	5.8	40	>1	146	1,170
2026 with S.2 Operations	0.61	6.2	43	>1	213	1,735

With project traffic volumes, this intersection exceeds the accepted limits for intersection performance in the 2014 PM peak traffic scenario. The intersection is expected to operate acceptably until 2026 without the additional traffic demand from the refinery project.

To overcome this problem, the intersection was analysed in a signalised form. The outputs for this analysis are recorded in Table 6.2.11.

Table 6.2.11 Dawson Highway/Blain Drive/Herbertson Street Intersection Performance Measures – Signalised

Scenario	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
2014 –S.1 Operations and S.2 Construction	0.52	24.7	134	0.88	45.1	258
2026 Background	0.65	26.6	185	1.0	79.0	509
2026 – S.2 Operations	0.65	27.0	185	>1.0	94.6	563

Using this layout and phasing arrangement, the intersection operates adequately until around 2026, with or without the project. The provision of additional capacity at the intersection would require additional through lanes on the Dawson Highway, resulting in a six lane form on Dawson Highway.

It is questionable whether this would be the preferred intent for the Dawson Highway in this location. There are proposals to increase the capacity and connectivity in the road network to the west (e.g. Red Rover Road etc) and it is likely that improvements in those areas would be more appropriate than six-laning the Dawson Highway In this event, the analysis herein of a four lane signalised intersection is considered appropriate.

6.2.6.4 Hanson Road/Blain Drive/Alf O'Rourke Drive

The Hanson Road/Blain Drive/Alf O'Rourke Drive intersection is in the form of a roundabout with a single circulating lane and a single approach and depart lane in each of the four directions. This intersection form was analysed using aaSIDRA and the outputs are displayed in Appendix B. As can be seen from Table 6.2.12, without project traffic, this intersection fails in 2026.

Table 6.2.12 Hanson Road/Blain Drive/Alf O'Rourke Drive Intersection Performance Measures – Existing Layout

Scenario	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
2006 Existing	0.48	5.0	33	0.34	6.7	22
2009 Background	0.54	5.1	39	0.37	6.9	25
2009 with S.1 Construction	0.86	9.4	154	0.62	9.2	59
2011 Background	0.64	7.4	58	0.39	7.1	27
2011 with S.1 Operations	0.65	6.1	63	0.44	7.3	32
2014 Background	0.64	5.8	59	0.43	7.3	30
2014 with S.1 Operation & S.2 Construction	0.93	12.7	223	0.64	9.9	63
2016 Background	0.67	6.0	67	0.45	7.4	33
2016 with S.2 Operations	0.77	7.3	101	0.51	7.9	40

Table 6.2.12 Hanson Road/Blain Drive/Alf O'Rourke Drive Intersection Performance Measures – Existing Layout

Scenario	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
2026 Background	0.89	10.3	181	0.63	9.5	62
2026 with S.2 Operations	>1	31.6	551	0.69	10.9	79

The intersection was re-analysed with a two lane roundabout with two approach lanes for each leg except for Alf O'Rourke Drive for 2014 with 1 operations and Stage 2 construction and the two 2026 scenarios. The outcomes of this analysis are shown in Table 6.2.13.

Table 6.2.13 Hanson Road/Blain Drive/Alf O'Rourke Drive Intersection Performance Measures – Two Lane Roundabout

Scenario	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
2014 with S.1 Operation & S.2 Construction	0.67	6.3	61	0.43	7.9	21
2026 Background	0.61	5.8	50	0.42	7.4	21
2026 with S.2 Operations	0.70	6.6	73	0.44	7.7	23

The intersection operates within accepted limits for all scenarios analysed as a two lane roundabout.

6.2.6.5 Hanson Road/Red Rover Road

Hanson Road and Red Rover Road intersect at a single lane roundabout with a single approach lane to the south and west and single depart lanes on all three legs. There is an additional 50 m left-turn lane on the eastern leg of Hanson Road.

The aaSIDRA outputs for this intersection are detailed in Appendix B and show that the intersection is within prescribed limits and thus operates effectively for all scenarios.

6.2.6.6 Dawson Highway/Don Young Drive

The intersection of the Dawson Highway and Don Young Drive is a T-junction with single approach and depart lanes with give-way control on Don Young Drive. The Dawson Highway has two approach lanes and one depart lane on each leg. To the south, a 50 m left turn lane is provided and to the north there is a 60 m channelised right turn lane. Impacts from project traffic at this intersection will be limited to works related to the RSF construction in 2008 - 2009. The aaSIDRA assessment, which is outlined in Appendix B, was undertaken only for the 2006 base and 2009 future year operation.

Based upon the aaSIDRA outputs, this intersection operates with sufficient capacity to cater for all traffic scenarios assessed.

6.2.6.7 Gladstone – Mt Larcom Road/Hanson Road/Landing Road

At the time analysis of this intersection was undertaken, there was a single approach and departure lane in each direction. Gladstone – Mt Larcom Road was under give-way control and there was a 50 m left turn slip lane into Landing Road from Gladstone – Mt Larcom Road.

This intersection has since been upgraded to include a protected short left-turn lane on Hanson Road and a protected short right-turn lane on Landing Road. The performance measures for this intersection have been assessed in Appendix B. These figures are more conservative than would actually be the case because of the upgrade detailed above.

This intersection operates well within prescribed limits for a give-way controlled intersection and operates well for all scenarios.

6.2.6.8 Gladstone – Mt Larcom Road/Targinie – Calliope River Road

At the intersection of Gladstone – Mt Larcom Road and Targinie – Calliope River Road, Targinie – Calliope River Road has a single approach and depart lane under give-way control both north and south of Gladstone – Mt Larcom Road. At the intersection, Gladstone – Mt Larcom Road has two approach and depart lanes in each direction. The left-depart lanes in each direction are short, effectively mirroring the short left-turn lanes on the approach side and providing a short acceleration lane provision for vehicles turning left into Gladstone – Mt Larcom Road. The aaSIDRA outputs for this intersection are outlined in Appendix B.

This intersection operates effectively for all scenarios.

6.2.6.9 Bruce Highway/Targinie – Calliope River Road

At the Bruce Highway/Calliope River Road intersection, Calliope River Road has a single approach lane under give-way control that meets the Bruce Highway at a T-junction. The Bruce Highway from the south has two approach lanes with a 140 m short right-turn lane and a single departure lane. On the northern side, the Bruce Highway has a single through lane and a 50 m left-slip lane into Calliope River Road. There are two departure lanes to the north, one of which is a 140 m short downstream lane that requires the traffic to merge into the right lane. The aaSIDRA outputs for this intersection are detailed in Appendix B.

The intersection performance measures for this intersection are within accepted limits, thus this intersection will continue to operate well with the addition of the project traffic.

6.2.6.10 Dawson Highway/Philip Street

The Dawson Highway/Philip Street intersection is a roundabout with two circulating lanes and two approach and depart lanes on each leg. The western leg of the roundabout provides access to a shopping centre. The intersection performance measures output by aaSIDRA are listed in Table 6.2.14.

Table 6.2.14 Dawson Highway/Philip Street Intersection Performance Measures – Existing Layout

Scenario	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
2006 Existing	0.58	7.7	38	0.69	9.6	55
2009 Background	0.64	8.2	49	≥ 1	11.2	81

Based on the aaSIDRA analysis, this intersection exceeds the accepted intersection performance limits in the 2009 background scenario (i.e. even without the addition of project traffic). Therefore the intersection would require upgrading before 2009 regardless of whether the project was to occur or not.

6.2.6.11 Bruce Highway/RSF Site Access

Access to the RSF is proposed via the Bruce Highway west of its intersection with Calliope River Road. Since the RSF construction is expected to occur over a two-year period starting in 2008, the analysis of this intersection was only undertaken for the scenario of 2009 with Stage 1 construction traffic.

Similar to the analysis of the Hanson Road/Reid Road intersection, the RSF Access/Bruce Highway intersection was analysed for both a one-hour peak and a 30-minute peak to determine if the intersection would have sufficient capacity to cater for construction traffic in the peak period due to shift changes. This 30-minute analysis maintained the RSF staff volumes at the full hour level, but halved the through traffic volumes on the Bruce Highway. The analysis results are shown in Table 6.2.15.

Table 6.2.15 Bruce Highway/RSF Site Access Intersection Performance Measures – Proposed Layout

Scenario	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
2009 with S.1 Construction – One Hour Peak	0.04	7.9	2	0.04	8.1	1
2009 with S.1 Construction – 30 Minute Peak	0.07	9.6	3	0.09	9.8	3

Based on the aaSIDRA outputs, this intersection operates effectively with this volume of traffic for both the standard one-hour peak and the 30-minute peak. The analysis shows that due to the relatively low volumes of traffic both on the Bruce Highway and accessing the RSF, acceleration and deceleration lanes are not required.

6.2.6.12 Summary of Intersection Effects

Table 6.2.16 summarises the impact of the project on the study area's intersections. Table 6.2.17 displays the existing and proposed intersection layouts for the intersections that require upgrading.

Table 6.2.16 Intersection Analysis Summary

Intersection	Upgrade Year		Treatment
	Background	With Project	
Bruce Highway/ Gladstone – Mt Larcom Road	-	-	-
Hanson Road/Reid Road	2015	2009	Single-lane roundabout with bypass lane OR two-lane roundabout
Dawson Highway/Blain Drive/ Herbertson Street	2018	2014	Signals
Hanson Road/Blain Drive/ Alf O'Rourke Drive	2024	2009	Two-lane roundabout
Hanson Road/Red Rover Road	-	-	-
Dawson Highway/ Don Young Drive	2018	2018	-
Gladstone – Mt Larcom Road/ Hanson Road/Landing Road	-	-	-
Gladstone – Mt Larcom Road/ Targinie – Calliope River Road	-	-	-
Bruce Highway/ Targinie – Calliope River Road	-	-	-
Dawson Highway/Philip Street	2009	2009	-

Table 6.2.17 Intersection Layouts – Existing and Proposed

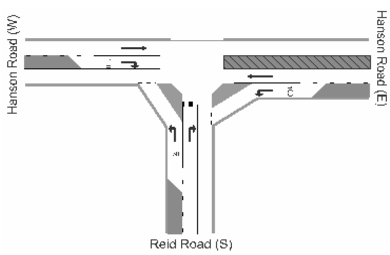
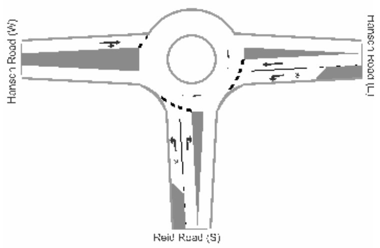
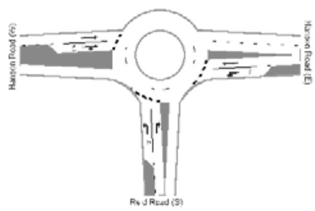
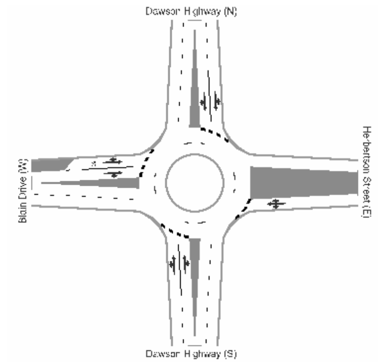
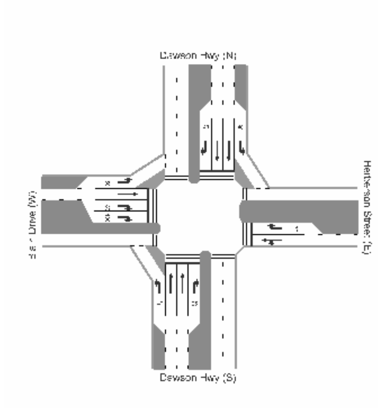
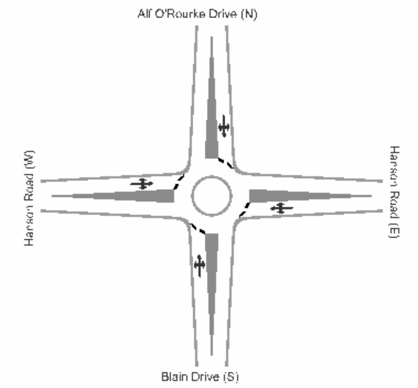
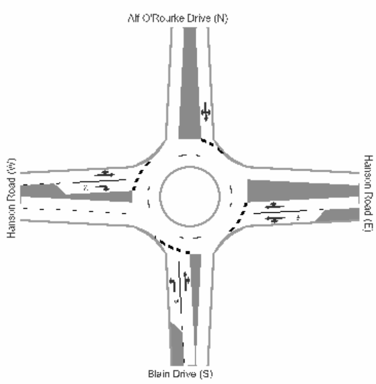
Intersection	Existing Layout	Proposed Layout
Hanson Road/Reid Road		 (with bypass lane) or 

Table 6.2.17 Intersection Layouts – Existing and Proposed

Intersection	Existing Layout	Proposed Layout
Dawson Highway/ Blain Drive/ Herbertson Street		
Hanson Road/Blain Drive/ Alf O'Rourke Drive		

At the Hanson Road/Reid Road intersection, upgrades would be required to accommodate the Stage 1 construction traffic volumes in 2009. Regardless of the Gladstone Nickel Project (GNP), DMR will have to upgrade the intersection by 2015 due to background growth. The 2015 to 2009 bring-forward responsibility is calculated as 25%.

Similarly at the Dawson Highway/Blain Drive/Herbertson Street intersection, the bring-forward responsibility is calculated at 13%.

At the Hanson Road/Blain Drive/Alf O'Rourke intersection, upgrades are required for the 2009 construction traffic. Without the additional project traffic this intersection would have continued to operate in its current form until 2024. This represents a bring-forward responsibility of 49%.

GPNL proposes to enter into an infrastructure agreement with DMR to allocate responsibilities for works within the road network, including the intersection upgrades mentioned above, as well as the pavement and maintenance responsibilities discussed below.

6.2.7 Pavement Impact Assessment

6.2.7.1 State-Controlled Road Network

Analysis has been conducted to identify the pavement impacts of the heavy vehicle movements generated by the project. This assessment has been conducted in accordance with DMR guidelines.

The pavement impact assessment relies on:

- Level of heavy vehicle traffic on links, both generated by the project, and also as a background level (existing and other background growth).
- Existing and capacity roughness deficiency with the application of a roughness deterioration rate.
- Cost to upgrade/rehabilitate/maintain (per km adopted).
- Percentage bring forward of the need to rehabilitate.
- Maintenance contributions.

The heavy vehicle generation, by classification, of the proposed refinery has been estimated from classification data relating to construction and operation of the refinery. Each stage of the project was considered individually before the total heavy vehicle generation for each year from 2007 to 2026 was determined. The number and type of vehicles generated for each of the project stages has been included in Appendix B.

The ESA loading for each heavy vehicle along the haulage routes was based upon DMR parameters. For the Bruce Highway a value of 2.8 ESAs for each heavy vehicle was applied. For all other state-controlled roads 3.2 ESAs for each heavy vehicle was used.

Based upon these values, an estimate of existing annual ESA loading along the haulage route was calculated. The classification of heavy vehicles generated by the project was then used to determine additional annual ESA loadings produced along the haulage routes as a result of project's heavy vehicle traffic being added to the network.

Table 6.2.18 shows a summary of the bring-forward effect on pavement rehabilitation on the state-controlled road network as a result of the proposed project. A more detailed summary is provided in Appendix B.

Table 6.2.18 Summary of Bring-Forward Pavement Rehabilitation

Road	Section	Direction	Rehabilitation Year		Bring Forward (%)
			Without Project	With Project	
Gladstone – Mt Larcom Road	Bruce Highway – Targinie Road	Southbound	2016.7	2016.7	0
		Northbound	2016.7	2016.5	0
	Targinie Road – Landing Road	Southbound	2016.7	2016.6	0
		Northbound	2016.7	2016.4	0
Hanson Road	Landing Road – Reid Road	Westbound	2016.7	2016.4	0
		Eastbound	2016.7	2016.5	0
	Reid Road – Red Rover Road	Westbound	2016.7	2016.5	0
		Eastbound	2016.7	2016.6	0
	Red Rover Road – Blain Drive	Westbound	2016.0	2015.8	0
		Eastbound	2016.0	2015.8	0
	East of Blain Drive	Westbound	2021.0	2020.9	0
		Eastbound	2021.0	2021.0	0

Table 6.2.18 Summary of Bring-Forward Pavement Rehabilitation

Road	Section	Direction	Rehabilitation Year		Bring Forward (%)
			Without Project	With Project	
Dawson Highway	West of Don Young Drive	Southbound	2024.4	2024.2	0
		Northbound	2024.4	2024.4	0
	North of Bruce Highway	Southbound	2024.4	2024.2	0
		Northbound	2024.4	2024.4	0

Table 6.2.18 shows that for all road segments considered, the project's effect on timing is less that a one-year bring forward. Hence the project will have no significant impact on pavement rehabilitation works.

The effect of the refinery on routine maintenance of the state-controlled road network has been calculated by assigning the percentage increase in ESAs due to refinery traffic on each road segment through to 2026. This has been reported as a percentage for each link and each year of the project until 2026, and can be found in Appendix B. The averages of these percentages are given in Table 6.2.19.

Table 6.2.19 Average Project Impact - Maintenance

Road	Section	Average Impact (%)
Gladstone – Mt Larcom Road	Bruce Highway – Targinie Road	2.2
Gladstone – Mt Larcom Road	Targinie Road – Landing Road	3.0
Hanson Road	Landing Road – Reid Road	3.8
Hanson Road	Reid Road – Red Rover Road	1.5
Hanson Road	Red Rover Road – Blain Drive	1.7
Hanson Road	East of Blain Drive	0.7
Dawson Highway	West of Don Young Drive	1.0
Dawson Highway	North of Bruce Highway	1.0

6.2.7.2 Pipeline Impacts

The impact of the heavy vehicles used for the construction of the pipeline has been included in the assessment above and has also been assessed independently to determine the impacts of the pipeline alone. A scoping test was undertaken to determine whether the traffic generated by the pipeline would be greater than 5% of the expected background traffic on Gladstone-Mt Larcom Road, the Bruce Highway, and the Rockhampton – Ridgelands Road for 2008 and 2009, the years of pipeline construction. The percentage change expected for these roads for these two years is summarised in Table 6.2.20. Detailed calculations are given in Appendix B.

Table 6.2.20 Pipeline Impact – Scoping Test

Road	Section	Direction	% Impact	
			2008	2009
Gladstone –Mt Larcom Road	Landing Road – Targinie Road	Westbound (G)	3.6	3.6
		Eastbound (A)	0.3	0.3
	Targinie Road – Bruce Highway	Westbound (G)	3.6	3.6
		Eastbound (A)	0.3	0.3

Table 6.2.20 Pipeline Impact – Scoping Test

Road	Section	Direction	% Impact	
			2008	2009
Bruce Highway	Gladstone – Mt Larcom Road to Raglan Creek	Northbound (G)	1.4	1.3
		Southbound (A)	0.1	0.1
	Gavial Creek	Northbound (G)	0.9	0.9
		Southbound (A)	0.1	0.1
Rockhampton – Ridgelands Road	Bruce Highway to end	Westbound (G)	2.0	2.0
		Eastbound (A)	0.0	0.0

The traffic attributed to the pipeline construction has an impact of less than 5% of the existing traffic, thus no further assessment is necessary in relation to pavement impacts.

6.2.8 Public Transport

The Gladstone/Calliope district has limited public transport services. The project will have minimal effect on these services. While buses are likely to be used for the construction workforce, these will be charter buses rather than public transport.

6.3 Shipping

The Port of Gladstone has grown significantly over the last 30 years. This growth can be attributed to the increase in coal exports and the increase in significant industrial projects within the Gladstone region. The CQPA manages the Port of Gladstone which consists of the following major port facilities:

- Boyne Smelter Wharf.
- South Trees Wharf.
- Barney Point Terminal.
- Auckland Point Terminal.
- RG Tanna Coal Terminal.
- Fisherman’s Landing.

6.3.1 Wiggins Island

CQPA and QR are proposing to develop the WICT. It is proposed develop a new coal export terminal and rail infrastructure with supporting infrastructure at Wiggins Island. The WICT will include 4 berths with an initial capacity of 25 Mt/y, with the capability to upgrade it to 70 Mt/y in later stages.

In addition to the coal terminal, another two berths (to be known as Wiggins Island Wharfs (WIW)) will be developed at Wiggins Island to be used as multi-user berths to support commodities other than coal. It is proposed that the GNP will be allocated berth No. 5 of WIW to import nickel laterite ore and sulphur. Berth Nos. 1 to 4 are proposed to be fully utilised by the coal trade.

6.3.2 Fisherman's Landing

The Fisherman's Landing port facility is currently being expanded by CQPA. It already includes a multi-user bulk liquid and storage wharf for the major industries within the GSDA.

A by-product of the refinery, ammonium sulphate (amsul), will be trucked to Fisherman's Landing to be stockpiled in a storage shed and loaded onto export ships via a common user load/unload facility at the planned Berth No. 3. Amsul will be loaded into Handymax vessels, which have an approximate capacity of 45,000 dead weight tonnes (DWT). This shiploader is likely to be able to load at an average rate of 25,000 tonnes per day.

6.3.3 Shipping Movements and De-ballasting Requirements

Estimates of annual shipping movements that will be required for the transport of bulk imports and product exports during Stages 1 and 2 of the project are shown in Table 6.3.1, together with the associated ballast discharge requirements. The estimates are based on use of Panamax bulk carriers (60,000-80,000 DWT) for importing both nickel ore and sulphur prill / pastille, plus the spot-charter of part-loaded or empty Handysize or Handymax bulk carriers (20,000-50,000 DWT) for the amsul exports.

Table 6.3.1 Expected Shipments of GNP Bulk Imports and Product Exports

Item	Method	Tonnages per annum (for Stages 1, 2)	Estimated shipments per annum[1]	Ballast discharge estimates for Port Curtis (tonnes)
Nickel ore imports	Through WIW, conveyed to refinery site stockpile	S.1: 3 - 4 million S.2: 8 -10 million	72 (P*) 140 (P*)	0 0
Prill / pastille sulphur imports	Through WIW, conveyed to refinery site stockpile	S.1: 660,000 S.2: 1200,000	9 (P*) 16 (P*)	0 0
Amsul exports	Trucked from refinery to covered stockpile at Fisherman's Landing, then conveyed to Berth No 3	S.1: 166,000 S.2: 343,000	8 (H*) 16 (H*)	25,000 – 53,000 50,000 – 110,000
Nickel briquette exports	Containerised then trucked to Mt Miller Rail Siding for railing to the Port of Brisbane terminal[+]	S.1: 60,000 S.2: 126,000	n/a	n/a
Cobalt briquette exports		S.1: 4,800 S.2: 10,400	n/a	n/a

* P = Panamax carriers (~71,000 payload tonnes); *H = Handymax bulk carriers (20,000 - 41,000 payload tonnes).
[+] No dedicated shipping service required for exporting these containers.
[1] Assumes Handymax and Panamax vessels only for imported ore. Larger Capesize vessels will also be used.

In the financial year 2005/06 1,116 ships visited the Port of Gladstone. Stage 2 of the GNP will increase this number by 174 (16%).

Ships arriving to unload nickel ore or sulphur at WIW will have no pumpable ballast water onboard, and will take up ballast when unloading these imports. De-ballasting will be required during amsul loading except for those ships that arrive already part loaded. Since the size of the enclosed amsul stockpile at Fisherman's Landing will be some 22,000 t (i.e. two holds of a 4-5 hold Handymax carrier), a substantial proportion of these shipments may comprise 'top-up' loading in which the carrier will have zero or negligible de-ballasting requirements. For this reason the ballast discharge estimates in Table 6.3.1 are shown as annual ranges that extend to the maximum (i.e. every carrier arrives empty, in full ballasted condition).

The environmental implications of the project's shipping are discussed in Section 8.3.

6.4 Rail Transport

Nickel and cobalt briquettes produced at the refinery will be containerised and trucked from the refinery along Reid Road to the Mt Miller rail siding which is located immediately west of the refinery. These containers will be railed to the Port of Brisbane for shipping overseas. It is estimated that 130 containers per week will be railed to Brisbane. The nature and frequency of the additional rail movement generated by this activity will be determined by QR.

The project is undertaking additional studies to determine the viability of rail as an alternative for transporting ore from Marlborough and limestone from local sources. However, as discussed in Section 5.4.1, the rail options for these materials are not currently preferred.

6.5 Air Transport

6.5.1 Passenger Movements

Air transport generated by the project will primarily consist of additional passenger movements, not requiring additional aircraft, but rather resulting in slightly higher utilisation of existing services. This will result in increased business for the airlines and for the Gladstone airport. There will be only minor movement of freight by air.

6.5.2 Aviation Safety Assessment

6.5.2.1 Introduction

The refinery site is approximately 5 km from Gladstone Airport and directly below the main flight path for aircraft approaching from the north-west. Due to the site's proximity to the airport and in accordance with the requirements of State Planning Policy 1/02 *Development in the Vicinity of Certain Airports and Aviation Facilities,* a quantitative evaluation has been undertaken of the hazards to aviation posed from the refinery's stack emissions. Appendix C contains an aviation safety assessment report prepared in accordance with requirements of the Civil Aviation Safety Authority's (CASA) Advisory Circular AC 139-05(0) *Guidelines for Conducting Plume Rise Assessments* (June, 2004).

The refinery has four plant areas that have elevated stacks; the sulphuric acid plant (60 m high stacks), hydrogen plant (40 m high stacks), power plant (40 m high stacks) and hydrogen sulphide incinerator (25 m high stacks). The stacks in these areas are all designed to have an initial exit velocity of 15 m/s, and, combined with the elevated temperatures of the plumes and elevated release heights, require an aviation safety assessment.

6.5.2.2 Assessment Criteria

The CASA Advisory Circular AC 139-05(0) considers an exhaust plume with a vertical velocity component of greater than 4.3 m/s to be a potential hazard to aircraft stability during approach, landing, take-off and for low level manoeuvring.

The Protection Plan for Gladstone Airport details the Obstacle Limitation Surface (OLS). which specifies the heights above which the velocity of any plume must be less than 4.3 m/s. The height of the OLS increases with distance from the airport, providing a conservative limit for low-level aircraft manoeuvres.

The OLS above the refinery site ranges from 70 m AHD on the eastern side of the site (closest to the airport), to approximately 130 m AHD on the western side. At the location of the sulphuric acid plant stacks, the OLS is approximately 100 m AHD. The other stacks are located further to the west and hence have a higher OLS. An OLS of 100 m AHD has been adopted as the critical height to evaluate the potential aviation safety risks from all the plume releases from the refinery.

6.5.2.3 Methodology

The aviation safety assessment has been undertaken in accordance with the requirements of CASA (2004). This involved use of the CSIRO's The Air Pollution Model (TAPM) model, which was used to calculate plume rise trajectories for stack emissions for the Stage 2 refinery. TAPM was also used to create site-specific three-dimensional meteorological profiles for use in subsequent analysis of the plume behaviour. Due to the proximity of the site to the airport runway, the assessment was conducted for a modelling period of five years. Further details on the methodology and statistical analysis utilised are given in Appendix C.

6.5.2.4 Assessment Results

The results of the assessment were evaluated to determine which of the five years analysed was the worst-case year for aviation safety risk. The year 2004 gave the highest plume heights, and has been used for detailed data analysis.

The rate at which a plume's vertical velocity dissipates after its release to the atmosphere depends primarily on wind speed. Higher wind speeds result in greater horizontal movement of the plume downwind and enhanced mixing with ambient air. These conditions result in lower aviation safety risks than during calm conditions, as the critical plume height is reduced.

The mean wind speed at the refinery site is 3.2 m/s, with a standard deviation of 1.2 m/s and 95% confidence limits of 1.4 and 5.1 m/s. Refer to Appendix C for further details.

The maximum, minimum and mean plume heights were determined for each of the five years of data analysed. The critical vertical extent represents the height (m AHD) at which the plume's vertical velocity drops below the maximum allowable velocity of 4.3 m/s for a given hour. Above this height, the plume conditions satisfy the requirements of having no effect on aircraft handling and safety. The assessment results for the critical year of 2004 are summarised in Table 6.5.1 for each stack area.

Table 6.5.1 Maximum, Minimum and Mean Critical Vertical Extents (m AHD) for 2004

Stack Area	Maximum	Minimum	Mean
Sulphuric Acid Plant	99.9	79.3	81.4
Hydrogen Sulphide Incinerator	47.2	44.0	44.2
Power Plant	89.6	60.2	61.6
Hydrogen Plant	70.8	59.2	60.2

The results show that the highest plume height before the plume's vertical velocity is less than the critical velocity of 4.3 m/s is 99.9 m AHD. This was for the plume from the sulphuric acid plant. The plumes are not expected to travel more than 32 m downwind of the release point before vertical velocities of 4.3 m/s are achieved, and thus should not affect the lower sections of the OLS that are closer to the airport.

6.5.2.5 Conclusions

Detailed analysis of the plume height results for five years of data showed that the OLS of 100 m AHD is not breached for any hour of the assessment. The most critical case is the sulphuric acid plant plume which reaches up to 99.9 m AHD before the vertical velocity is less than 4.3 m/s for the worst-case hour over the five years of meteorological data analysed.

The results of this assessment have shown that the plumes from all the refinery's stacks will comply with the CASA requirements and will not pose a risk to the safety of the operation of the Gladstone Airport. GPNL will ensure that any changes to the plant layout during detailed design of the refinery will not result in a predicted stack plume velocity exceeding the critical velocity at the OLS.