Hexham Relief Roads

Traffic Impact Assessment

July 2012

Upper Hunter Valley Alliance

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Glossary

AADT	Annual Average Daily Traffic
ARTC	Australian Rail Track Corporation
DGR	Director-General Requirements
EIS	Environmental Impact Statement
EAR	Environmental Assessment Report
km/h	Kilometres per hour
LoS	Level of Service
PEA	Preliminary Environmental Assessment
QR National	Queensland Rail National
REF	Review of Environmental Factors
RTA	Roads and Traffic Authority NSW
RMS	Roads and Maritime Services NSW
SH	State Highway
SISD	Safe Intersection Sight Distance
TIA	Traffic Impact Assessment
UHVA	Upper Hunter Valley Alliance

1. Introduction

The Upper Hunter Valley Alliance (UHVA) on behalf of the Australian Track Rail Corporation (ARTC) has commissioned Parsons Brinckerhoff to prepare a traffic impact assessment (TIA) for the proposed Hexham Relief Roads (the proposed Project). A Relief Road is a rail line that allows trains to be diverted off the Up Coal and re-sequenced to mitigate congestion at the coal terminals.

This report considers the traffic impact associated with construction activities of the proposed Project (refer to Appendix A) and the Queensland Rail National (QR National) Train Support Facility, nearby the study area. Subject to design and planning approvals, the construction activities are expected to commence in March 2013 and continue for approximately 18 months. The peak construction activity is expected in mid-2013 for assessment purposes.

1.1 Overview of proposed project

ARTC proposes to develop five Relief Roads (train lines) and associated infrastructure at Hexham in the NSW Hunter Valley. The proposed Project is located approximately 15 kilometres (km) north-west of Newcastle and approximately 176 km north of Sydney by rail.

The key components of the proposed Project comprise:

- five Up Relief Roads (Train Lines) to the west of the existing Up and Down Mains between the existing Up Coal and a new Down Coal including:
  - the removal of the existing Down Coal (located to the west and right of the Up Coal)
  - the construction of five new train lines (tracks) for the Relief Roads
  - the construction of a new Down Coal to the west and outside of the proposed Relief Roads
  - each Relief Road to have capacity to store trains generally comprising of 2 or 3 locomotives and up to 91 wagons (1,543 metres (m) long), requiring a minimum standing room of 1,670 m
  - new turnouts, return curves and other track changes
- new signal infrastructure for the five Relief Roads (including signal location cases, huts and gantries)
- earth and civil works of approximately 265,000 cubic metres, including cut to fill, track formation, drainage and minor structures
- ancillary infrastructure that may include vehicle access tracks, temporary construction compounds and stockpile sites
- land acquisition and the modification to existing rail infrastructure and public utilities as required.

The preparation of this traffic impact assessment is in response to the Roads and Maritime Services (RMS) letter dated 7 December 2011 (refer to Table 1.1) as well as the Director-General Requirements (DGRs) for the Environmental Assessment issued on 14 December 2011 (refer to Table 1.2). Parsons Brinckerhoff undertook a review of approved projects and those in the early stages of planning within the immediate study area. These projects included:

- ARTC Hexham Crossing Loop
- Hunter Water Corporation Chichester Trunk Gravity Main – Tarro to Shortland
- F3 Freeway to Raymond Terrace Pacific Highway Upgrade
- Richmond Rail Trail
- QR National Train Support Facility including Intermodal Site and Industrial Subdivision.

1.2 Scope of work

An assessment was undertaken to investigate the potential traffic impacts of the construction of the proposed Project and other approved projects nearby the study area. The report was developed in accordance to the Roads and Traffic Authority's *Guide to Traffic Generating Developments* 2002 and Department of Planning's *EIS Guidelines: Road and Related Facilities*.

The traffic impact assessment scope of works includes:

- an assessment of the existing road network performance in the study area
- a review of existing public transport services, pedestrian and cyclist amenity
- a review of the proposed Project site layout, access and haulage routes
- an assessment of the future road network performance with and without construction activity from the proposed Project including proposed intersection upgrades, taking into account the cumulative traffic impact imposed by the nearby approved development
- an assessment of potential road safety issues associated with the proposed Project
- development of mitigation measures to alleviate the identified traffic, safety and operational impacts.

Table 1.1 shows the reference of Parsons Brinckerhoff's response to the RMS requirements included in this report.

Table 1.1 Reference of response to RMS requirements

RMS requirements	Location addressed in this report
Assessment of all relevant vehicular traffic routes and intersections for access to/from the subject area during the construction and operational phases.	Section 4.4 addresses the proposed construction haulage route. Section 6.2.2 assesses the predicted intersection performance. Section 6.2.3 assesses mid-block level of service. Section 6.12 assesses the traffic impact during operations.
Current traffic counts for all of the traffic routes and intersections.	Section 2.3.
The anticipated additional vehicular traffic generated from the proposed development and associated trip distribution on the road network during both the construction and operational phases.	Sections 4.5 to 4.8. Section 6.12 assesses the traffic impact during operations.
Consideration of the traffic impacts on existing and proposed intersections and the capacity of the local and classified road network to safely and efficiently cater for the additional vehicular traffic generate by the proposed development. The traffic impact shall also include the cumulative traffic impact of other proposed developments in the area.	Sections 6.2.2 and 6.2.3 assess the traffic impacts on local road network. Section 6.10 assesses the regional road network. Section 6.3.2 contains the cumulative traffic impact assessment. Section 6.3.3 assesses the cumulative impact on mid-block level of service.
Identify the necessary road network infrastructure upgrades that are required to maintain existing levels of service on both the local and classified road network. In this regard, strategic concept drawings shall be submitted with the EA for any identified road infrastructure upgrades. Any identified road infrastructure upgrades will need to be to the satisfaction of RMS and Council.	Figure 6.1 assesses the proposed new intersection. Section 6.2.2 assesses the predicted intersection performance. Section 6.2.3 assesses the mid-block level of service.
Intersection analysis (such as SIDRA) shall be submitted to determine the need for intersection and road capacity upgrades. The intersection analysis shall include (but not be limited to) the following: ▪ current traffic counts and 10 year traffic growth projections ▪ with and without development scenarios considered ▪ 95th percentile back of queue lengths ▪ delays and level of service on all legs for the relevant intersections ▪ electronic data for RMS review.	Sections 6.2, 6.3 and 6.12 assess intersection performance. The assessment does not include a comparison against a do-nothing scenario as the proposed intersection does not exist at present.
Impact of construction traffic on the classified road network in the vicinity of the development and measures to minimise any identified impact. To this end, a Construction Traffic Management Plan shall be prepared to the satisfaction of RMS and Council.	Section 7 contains the study recommendations. Construction Traffic Management Plan to be prepared at a later stage. Refer to Section 6.11.

Table 1.2 shows the reference of Parsons Brinckerhoff's response to the DGRs to be included in this report.

Table 1.2 Reference of response to DGRs

DGRs	Location addressed in the report
Access to the site and associated property severance and access restrictions, including access across the project to the adjacent National Park, to existing and proposed Hunter Water infrastructure, and from Hexham Railway Station to the proposed QR National Project and adjoining lands.	Sections 6.7 and 6.8.
Preparation of a Traffic Study, taking into account the *Guide to Traffic Generating Development* (RTA, 2002), including construction and operational traffic impacts to the local and regional road network, including impacts of access onto the New England highway, and in particular at Woodlands Close (including intersection analysis).	Sections 6.2 and 6.3 assess the traffic impacts on local road network. Section 6.10 assesses the regional road network.
Impacts to passenger rail services and operation of Hexham Station.	Sections 6.5 and 6.8.2.
Interaction and integration with existing and planned transport infrastructure (e.g. F3 to Raymond Terrace Pacific Highway Upgrade, Richmond Rail Trail) and services. Consideration should be given to safety, capacity, efficiency and any required augmentation (e.g. Tarro interchange).	Sections 1.1 and 6.9.
Interaction with existing and proposed utilities infrastructure, including the Hunter Water Truck Main upgrade.	Section 1.1 and Section 6.8.3.

1.3 Report structure

This traffic impact assessment has the following structure:

- Section 2 discusses the existing traffic and road conditions within the study area.
- Section 3 analyses the mid-block Level of Service (LoS) for Anderson Drive in the vicinity of the proposed Project, reviews crash history, reviews public transport services, and reviews pedestrian and cyclist amenity.
- Section 4 provides a description of the proposed Project's construction activities.
- Section 5 provides a description of the other known approved development.
- Section 6 provides a discussion of traffic impact and future intersection performance and mid-block LoS, as well as the cumulative traffic impact taking into consideration the nearby approved development.
- Section 7 lists the recommended mitigation measures to improve overall traffic, safety and operational impacts.
- Section 8 provides the study conclusions.
- Section 9 provides a list of documents referenced as part of this assessment.

1.4 Site visit

Parsons Brinckerhoff undertook a site inspection of the proposed Project site and surrounding road network within the study area on Monday 4 July 2011. The site inspection allowed Parsons Brinckerhoff to gain a better understanding of the site, the haulage routes, existing land use and to identify any traffic or road safety related issues. A number of photographs and video footage were captured during the site inspection.

1.5 Proposed Project site location

The proposed Project location is to the west of the existing rail lines and are proposed to be located adjacent to the Pacific Highway and Hexham Railway Station approximately 15 kilometres north of Newcastle by rail (refer to Figures 1.1 and 1.2). Access to the site would be gained from a new connection from Anderson Drive (Tarro Interchange) westbound ramps to Woodlands Close.

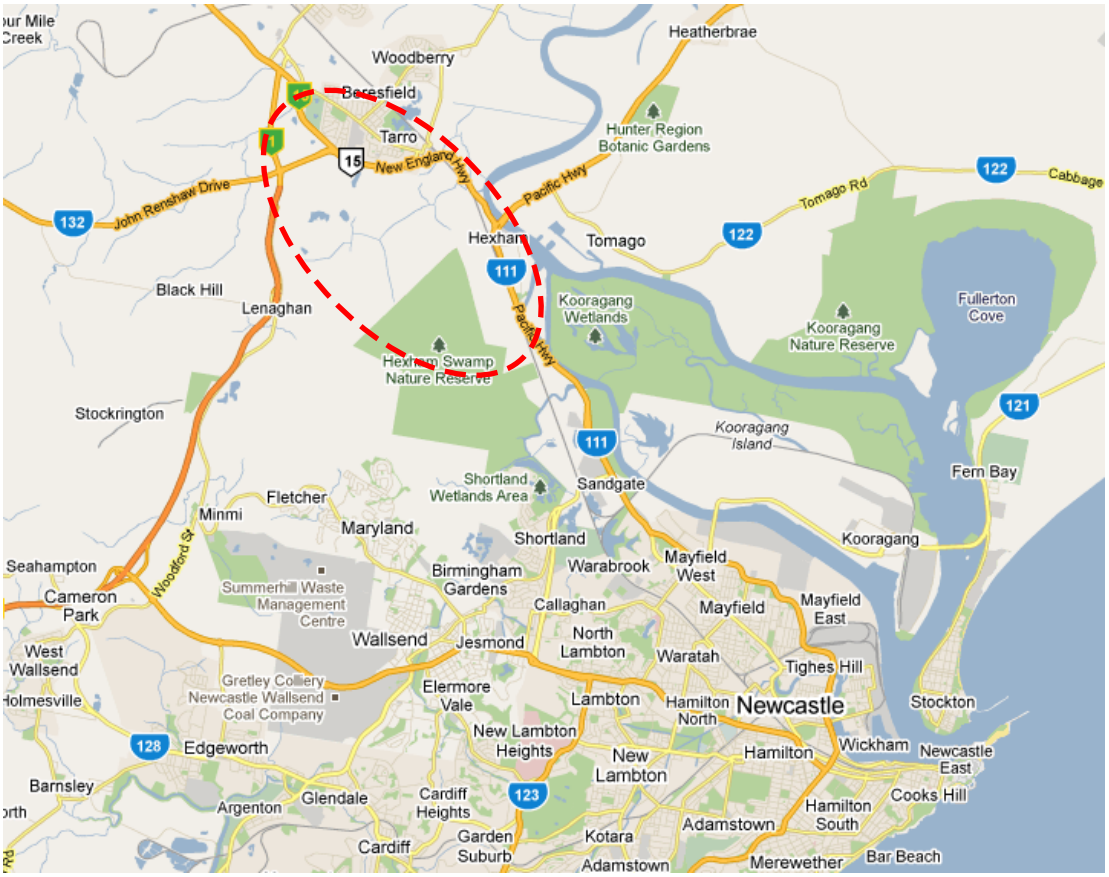


Figure 1.1 Study area

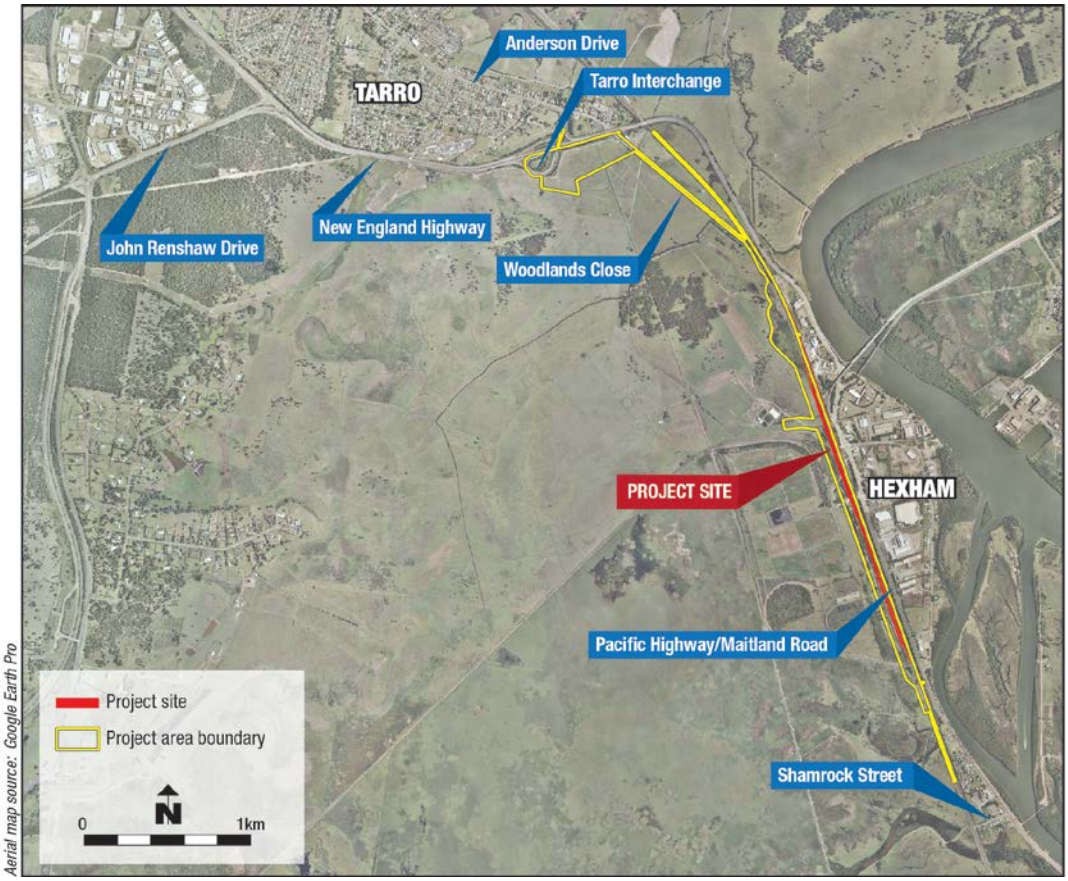


Figure 1.2 Site location and surrounding road network

1.6 Recent and proposed developments in the vicinity of the proposed Project site

1.6.1 ARTC Hexham Crossing Loop

The Hexham Crossing Loop project serves to improve freight capacity and reliability along the Main North Line. The construction of the crossing loop is complete, with commissioning on 24 June 2012.

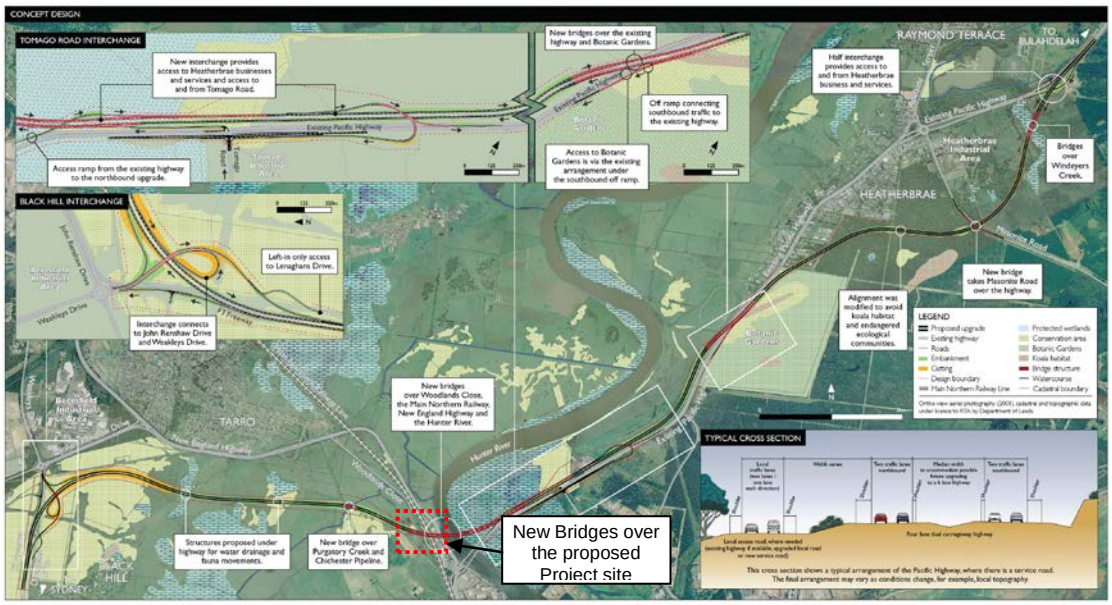
1.6.2 Hunter Water Corporation Chichester Trunk Gravity Main – Tarro to Shortland

Hunter Water has recently replaced a section of the Chichester Trunk Gravity Main between Tarro and Shortland to improve regional water security. The new pipeline is approximately 7.4 kilometres long, starting 100 m south of the New England Highway at Tarro, running along the edge of the Hexham Swamp Nature Reserve next to the existing rail line and continuing north-south across the southern section of the proposed Project site, through to the Newcastle Practice Golf Centre.

The upgrade was completed in February 2012.

1.6.3 F3 Freeway to Raymond Terrace Pacific Highway Upgrade

The Pacific Highway upgrade between the F3 Freeway and Raymond Terrace involves a 15 kilometre provision of dual carriageway along the Pacific Highway. Based on current concept design drawings, the preferred route involves the construction of a new bridge over the proposed Project site, Woodlands Close, the Main Northern Railway and the New England Highway (refer to Figure 1.3).



Source: RMS

Figure 1.3 Concept design of the preferred route between F3 Freeway and Pacific Highway

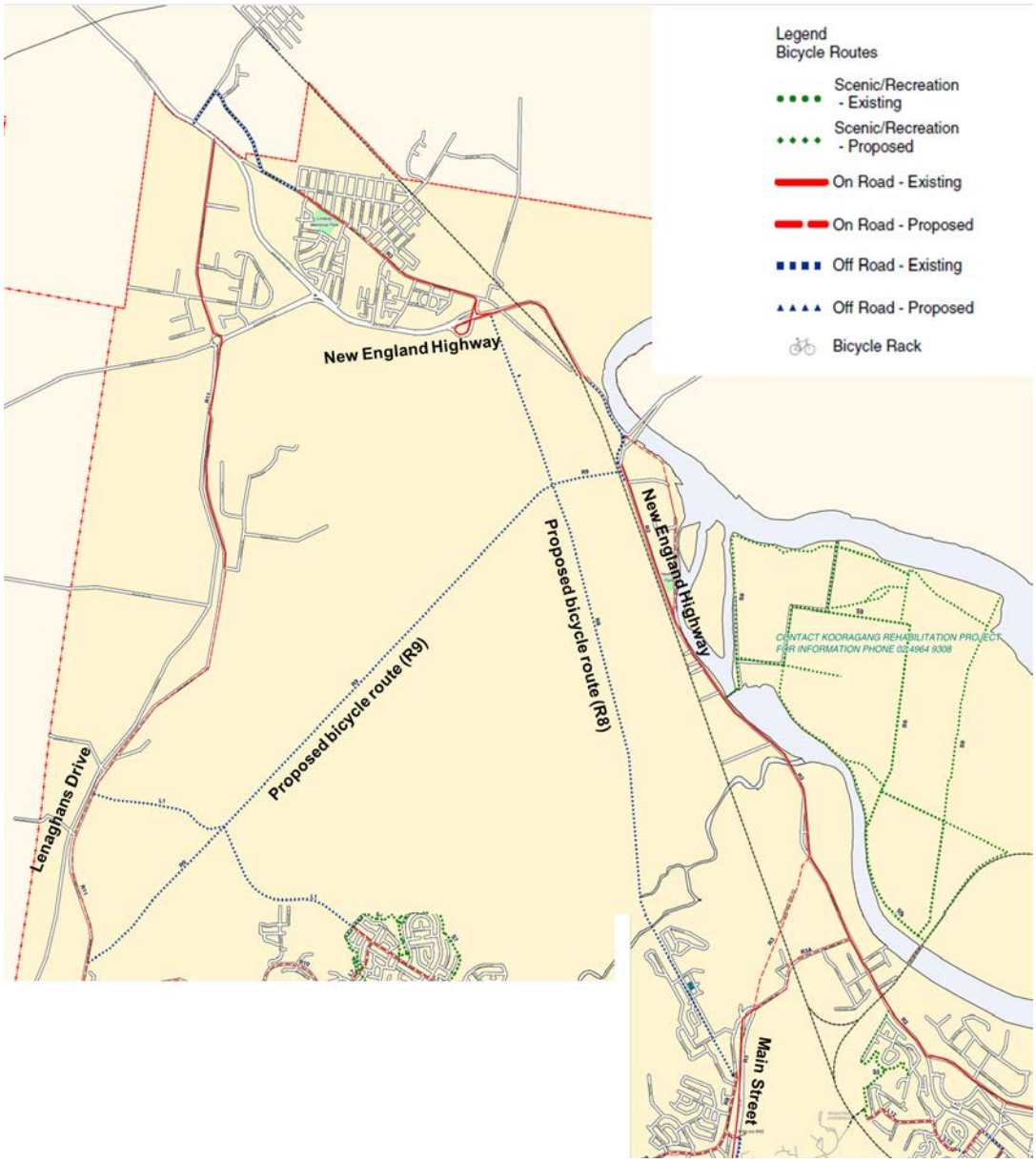
The RMS has not determined the timing of construction as it is dependent on funding availability. Once this is determined, an environmental assessment will be carried out and planning approval will be sought to allow construction to commence. This is expected to occur after this proposed Project is completed in 2014.

1.6.4 Richmond Rail Trail

The Richmond Rail Trail is a proposed 28 km cycle way running between Hexham and Kurri Kurri. Newcastle Council's *Bike Plan* 2009 included two potential routes that would traverse the proposed Project site:

- Route 8 is a proposed off-road bicycle route that runs north-south between the New England Highway at Tarro and Main Street at Shortland, through the Hexham Swamp Nature Reserve. The northern end of the route traverses the proposed Project site.

- Route 9 is a proposed off-road bicycle route that runs between the New England Highway and Lenaghans Drive, through the Hexham Swamp Nature Reserve. The north-eastern end of the route traverses the proposed Project site and the Hunter rail line and connects with the New England Highway.



Source: City of Newcastle Bike Plan 2009

Figure 1.4 Proposed bicycle routes in the vicinity of the proposed Project site

Consultation with the City of Newcastle indicated that this lies within the long term planning horizon, and no timeframe has been set for its implementation. The timing of this project is anticipated to occur post 2014 - after this proposed Project is completed.

1.6.5 QR National Train Support Facility including Intermodal Site and Industrial Subdivision.

QR National is currently preparing plans for a Train Support Facility and adjoining industrial development located immediately to the west of the Relief Roads. The QR National facility has been scheduled to proceed in 2013. It is likely that the construction of the QR National facility and the proposed Project would overlap for some months during the construction phase. Cumulative traffic impacts from the QR National facility project have been considered as part of this assessment as presented in sections 5 and 6.

1.7 Adjoining lands and infrastructure

1.7.1 Hexham Swamp Nature Reserve

Hexham Swamp Nature Reserve covers approximately 920 hectares, located to the south of the proposed construction site. Access to the nature reserve is via Woodlands Close through a private property. Vehicle access within the nature reserve is provided by tracks for authorised vehicles only, including vehicles for maintaining infrastructure such as the water pipeline and power lines.

1.7.2 Hexham railway station

Hexham railway station is located on the western side of Maitland Road (Pacific Highway). Access to the station is via its eastern side from Maitland Road (New England Highway) only.

1.7.3 Hunter Water infrastructure

As mentioned in section 1.6.2, the Chichester Trunk Gravity Main runs alongside the Hunter Rail Line and crosses the Hexham Swamp Nature Reserve. Recently, the new underground pipeline has replaced the above ground facility and is scheduled to be operational in 2012. Access to the pipeline is via Woodlands Close.

2. Existing traffic and road conditions

This section describes the existing traffic and road conditions, traffic volumes and road network within the study area.

2.1 Surrounding road network

Figure 1.2 shows the surrounding road network in the vicinity of the proposed Project site, which consists of John Renshaw Drive, New England Highway, Tarro Interchange, Woodlands Close, Maitland Road (Pacific Highway) and Shamrock Street.

2.1.1 Anderson Drive at Tarro Interchange

Tarro Interchange is a grade separated intersection between the New England Highway and Anderson Drive. It consists of four one-way ramps connecting with the New England Highway. Anderson Drive is a two-lane two-way undivided road at the Tarro Interchange. The posted speed limit on Anderson Drive at this location is 60 km/h. Figure 2.1 shows the section of Anderson Drive near the proposed connection to Woodlands Close.

Figure 2.1 Anderson Drive, looking north at Tarro Interchange

2.1.2 New England Highway

The New England Highway (State Highway SH9) is part of the Auslink Sydney–Brisbane inland highway (refer to Figure 2.2). Within the study area, it is in general a four-lane divided road, with two traffic lanes in each direction separated by a raised concrete/vegetated central median. The speed limit on the New England Highway at the Tarro Interchange is 90 km/h. The eastbound off-ramp from the New England Highway to the Tarro Interchange is 60 km/h and the westbound on-ramp has an advisory speed limit of 55 km/h.

Figure 2.2 New England Highway, looking west toward the Anderson Drive exit

2.1.3 Maitland Road (Pacific Highway)

Maitland Road (Pacific Highway (State Highway SH1)) in the study area is generally a four-lane divided road, with two traffic lanes in each direction separated by a raised concrete central median (refer to Figures 2.3 and 2.4). The speed limit on this section of Maitland Road (Pacific Highway) is 80 km/h. Dedicated on-road cycle facilities are provided within the road shoulders.

Figure 2.3 Maitland Road (Pacific Highway), looking south toward Newcastle

Figure 2.4 Maitland Road (Pacific Highway), looking north toward Hexham

2.1.4 Woodlands Close

Woodlands Close is two-lane, two-way local no-through road. Woodlands Close consists of sealed and unsealed sections. A sealed section of approximately 1 km length is provided from the intersection with the New England Highway (refer to Figure 2.5). No speed limit signage is provided therefore the default speed limit is 50 km/h. An unsealed section of Woodlands Close is signed with a 20 km/h speed limit.

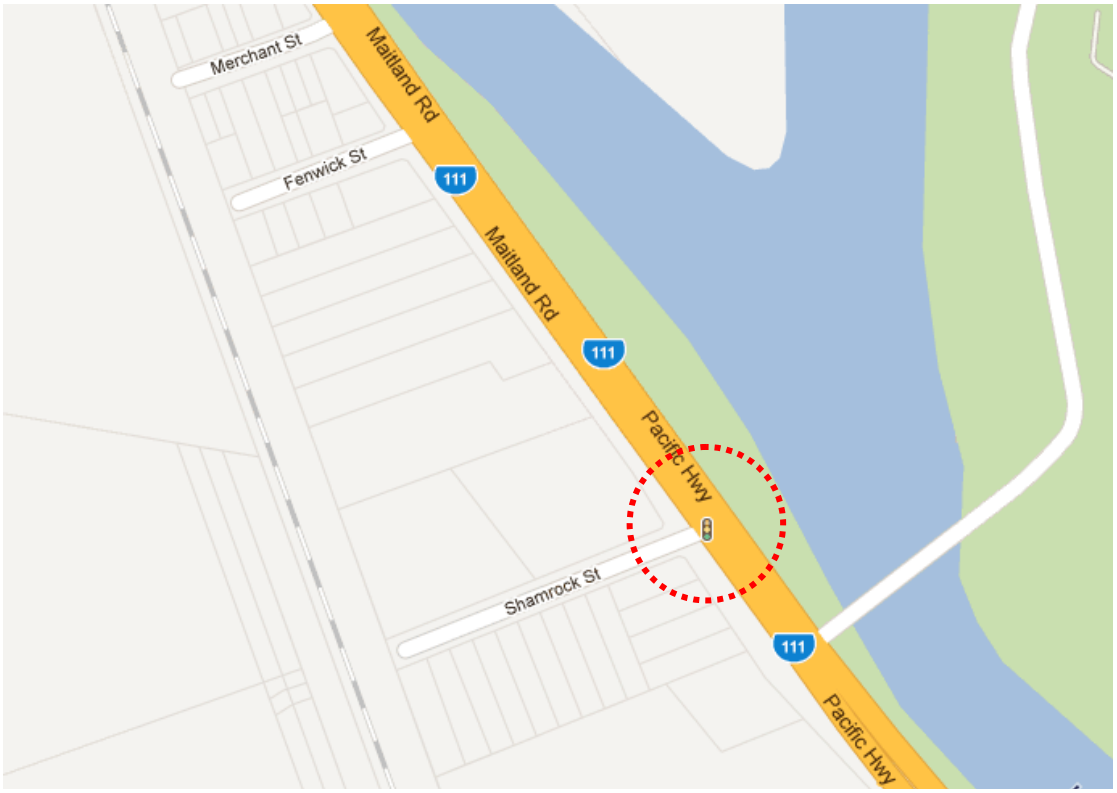
Figure 2.5 Woodlands Close, looking north, on approach to the intersection with the New England Highway

2.2 Existing intersection layouts

2.2.1 Maitland Road (Pacific Highway)/Shamrock Street intersection

Maitland Road (Pacific Highway)/Shamrock Street (refer to Figures 2.6 to 2.8) is a signalised T-junction with adequate sight distance provided on all approaches in all directions with the following features:

- an auxiliary left turn lane on Maitland Road (Pacific Highway) for vehicles to turn left from Maitland Road (Pacific Highway) into Shamrock Street
- a designated right turn lane on Maitland Road (Pacific Highway) for vehicles turning into Shamrock Road.



Source: Google Map

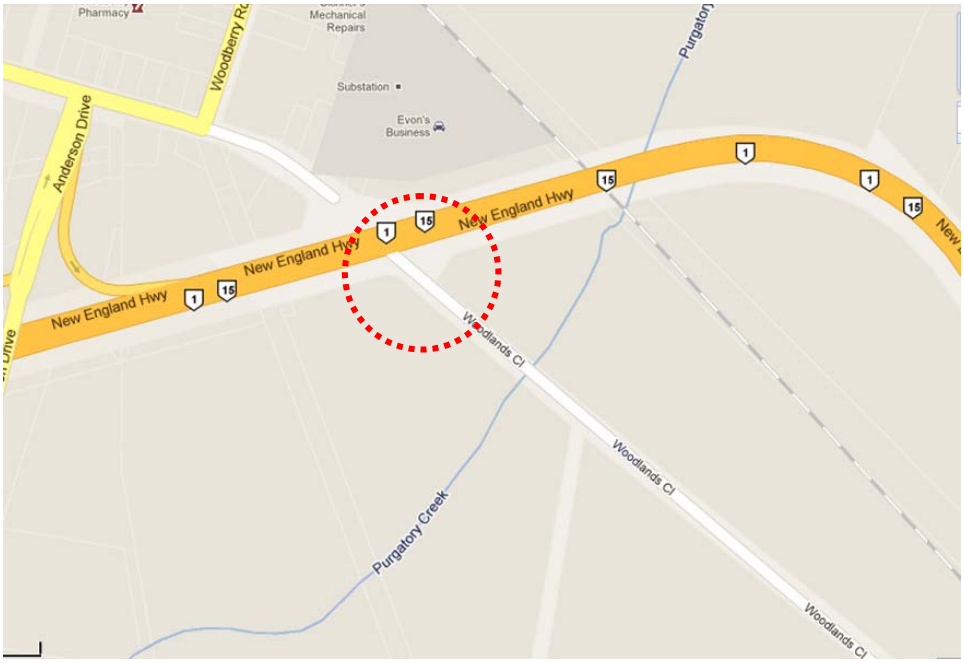
Figure 2.6 Maitland Road/Shamrock Street intersection map

Figure 2.7 **Maitland Road (Pacific Highway)/Shamrock Street intersection, looking south toward Newcastle**

Figure 2.8 **Maitland Road (Pacific Highway)/Shamrock Street intersection, looking east looking toward Maitland Road**

2.2.2 New England Highway/Woodlands Close intersection

The New England Highway/Woodlands Close intersection (refer to Figures 2.5, 2.9 and 2.10) is a Give Way priority controlled T-junction. Despite an opening in the central concrete median on the New England Highway, the right turn is banned from the New England Highway onto Woodlands Close as well as from Woodlands Close onto the New England Highway.



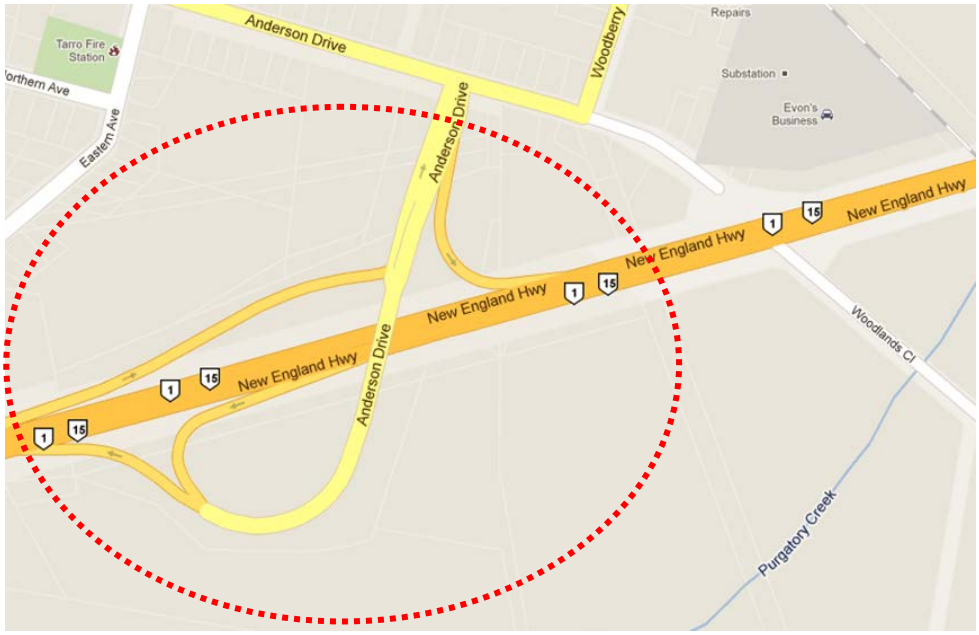
Source: Google Map

Figure 2.9 New England Highway/Woodlands Close intersection map

Figure 2.10 New England Highway/Woodland Close intersection, looking south toward Woodlands Close

2.2.3 Tarro Interchange

The Tarro Interchange (refer to Figures 2.11 and 2.12) is a grade separated intersection between the New England Highway and Anderson Drive, located in Tarro. It consists of four one-way ramps connecting with the New England Highway. An off-ramp and on-ramp are provided in both the eastbound and westbound directions. The right turn from the northbound off ramp is banned as all traffic is to turn left onto Anderson Drive.



Source: Google Map

Figure 2.11 Tarro Interchange map

Figure 2.12 Tarro Interchange, looking south from Anderson Drive

2.2.4 New England Highway/Vehicle turnaround intersection

Vehicles travelling from Sydney or Maitland via John Renshaw Drive wanting to access Woodlands Close, are required to make a looping movement at a specially built vehicle turnaround intersection (refer to Figure 2.13 and 2.14). The turnaround intersects with the New England Highway under Hexham Bridge. From here, vehicles can travel in the northbound direction on the New England Highway to access Woodlands Close.
The turnaround area is identified as Lot 1 and Lot 2 from in Figure 2.13 below.

Source: Google Map

Figure 2.13 New England Highway/Vehicle turnaround intersection

Figure 2.14 **New England Highway/vehicle turnaround intersection, looking south toward Newcastle**

2.2.5 F3 Freeway/John Renshaw Drive Roundabout

Vehicles travelling to Newcastle or Raymond Terrace from Anderson Drive are required to travel westbound towards John Renshaw Drive and make a U-turn movement at the F3 Freeway/John Renshaw Drive roundabout and return to John Renshaw Drive and travel eastbound toward the New England Highway (refer to Figure 2.15).

Source: Google Map

Figure 2.15 F3 Freeway/John Renshaw Drive intersection

2.2.6 New England Highway U-turn Bay

Vehicles travelling to Newcastle or Raymond Terrace from Anderson Drive have an option to make a U-turn movement at the existing New England Highway U-turn Bay located about 400 m north-west of the John Renshaw Drive turn off (refer to Figures 2.16 to 2.18).

Source: Google Map

Figure 2.16 New England Highway U-turn bay

Figure 2.17 New England Highway, looking northbound towards U-turn bay

Figure 2.18 New England Highway U-turn bay, looking northbound towards Maitland

2.3 Existing traffic conditions – traffic volumes

The existing traffic volumes and the turning movements were identified from the following sources:

- RMS count stations on the New England Highway east of Woodlands Close (count station 05.055) and the Pacific Highway at Hexham Bridge (count station 05.001). These were used to establish regional traffic growth
- turning movement traffic counts at the Anderson Drive (south)/Anderson Drive (west) intersection was used to determine heavy vehicle percentage of total traffic on Anderson Drive (south)
- mid-block traffic counts at the Tarro Interchange based on Better Transport Future's *Proposed Train Facility and Industrial Estate Traffic Impact Assessment* (2011). This was used to establish traffic volume on the New England Highway westbound on- and off-ramps.

The location of traffic counts and surveys is shown in Figure 2.19.

Figure 2.19 Location of traffic surveys

2.3.1 Regional traffic growth

In order to estimate the future traffic growth rate on the New England Highway, the average annual daily traffic (AADT) data provided from RMS count station 05.055, located east of Woodlands Close (its location is shown in Figure 2.20) was assessed. A summary of AADT at this count station is provided in Table 2.1.

Table 2.1 Recorded AADT on the New England Highway, count station 05.055

Year	2001	2004	2005	2006	2007	2008
AADT (growth)	45,783	48,879 (+2.2%)	51,523 (+2.9%)	51,003 (+2.2%)	52,806 (+2.4%)	52,976 (+2.1%)

Table 2.1 indicates that traffic on the New England Highway (just east of Woodlands Close) has increased over the period of 7 years (from 2001 to 2008) with a compound growth rate of approximately 2% per annum applied from the base year of 2001. The proportion of heavy vehicles at this location is approximately 15% (Source: Parsons Brinckerhoff survey 2011).

In order to determine the future traffic growth rate on the Pacific Highway, the average annual daily traffic (AADT) data from RMS count station 05.001, located at Hexham Bridge (its location is shown in Figure 2.20)was assessed. A summary of AADT at this count station is provided in Table 2.2.

Table 2.2 Recorded AADT on the Pacific Highway, count station 05.001

Year	2001	2004	2005	2006	2007	2008
AADT (growth)	33,275	37,781 (+4.3%)	38,099 (+3.4%)	38,242 (+2.8%)	38,913 (+2.6%)	38,411 (+2.0%)

Table 2.2 indicates that traffic on the Pacific Highway (at Hexham Bridge) has increased over the period of 7 years (from 2001 to 2008) with a compound growth rate of approximately 2% per annum applied from the base year of 2001. For the purpose of this study, a traffic growth of 2% was applied to estimate future traffic volumes on both the New England Highway and Pacific Highway.

2.3.2 Heavy vehicle percentage

Turning movement surveys were undertaken between 6.00 am and 8.00 pm on 28 June 2011 at the Anderson Drive (south)/Anderson Drive (west) intersection, located to the north of the Tarro Interchange.

Table 2.3 shows a summary of the total number and percentage of light vehicle and heavy vehicle on the southern leg of the intersection during the selected time periods. The selected time periods are based on the peak hours derived in Section 2.3.3.

Table 2.3 Traffic volume and heavy vehicle percentage on Anderson Drive (south)

Time	Road	Light vehicles (Total)	Heavy vehicles (Total)	Light vehicles (%)	Heavy vehicles (%)
7.30 am – 8.30 am	Anderson Drive (south) northbound	466	23	95%	5%
	Anderson Drive (south) southbound	149	14	91%	9%
3.30 pm – 4.30 pm	Anderson Drive (south) northbound	380	18	95%	5%
	Anderson Drive (south) southbound	392	23	94%	6%

Source: Parsons Brinckerhoff survey 2011

Table 2.3 indicates that heavy vehicle on the Anderson Drive (south) made up from 5% to 9% of the total traffic flow. These heavy vehicle percentages were applied to the mid-block traffic volume shown in Section 2.3.3.

2.3.3 Mid-block traffic volume summary

Traffic count data was collected for the traffic movements to and from the New England Highway via the Tarro Interchange, between 6.00 am and 9.30 am, and between 2.30 pm and 6.30 pm. The traffic surveys indicated that the traffic peak hours occurred between 7.30 am and 8.30 am and between 3.30 pm and 4.30 pm, on the westbound on and off ramps.

Figures 2.21 and 2.22 show the existing traffic volumes at Tarro Interchange during the peak hours. Table 2.4 shows the existing volumes by direction and the percentage of light and heavy vehicles at the Interchange. It should be acknowledged that the survey did not include classification counts for light and heavy vehicles, therefore heavy vehicle percentages as derived in Section 2.3.2 were applied to the surveyed traffic volumes.

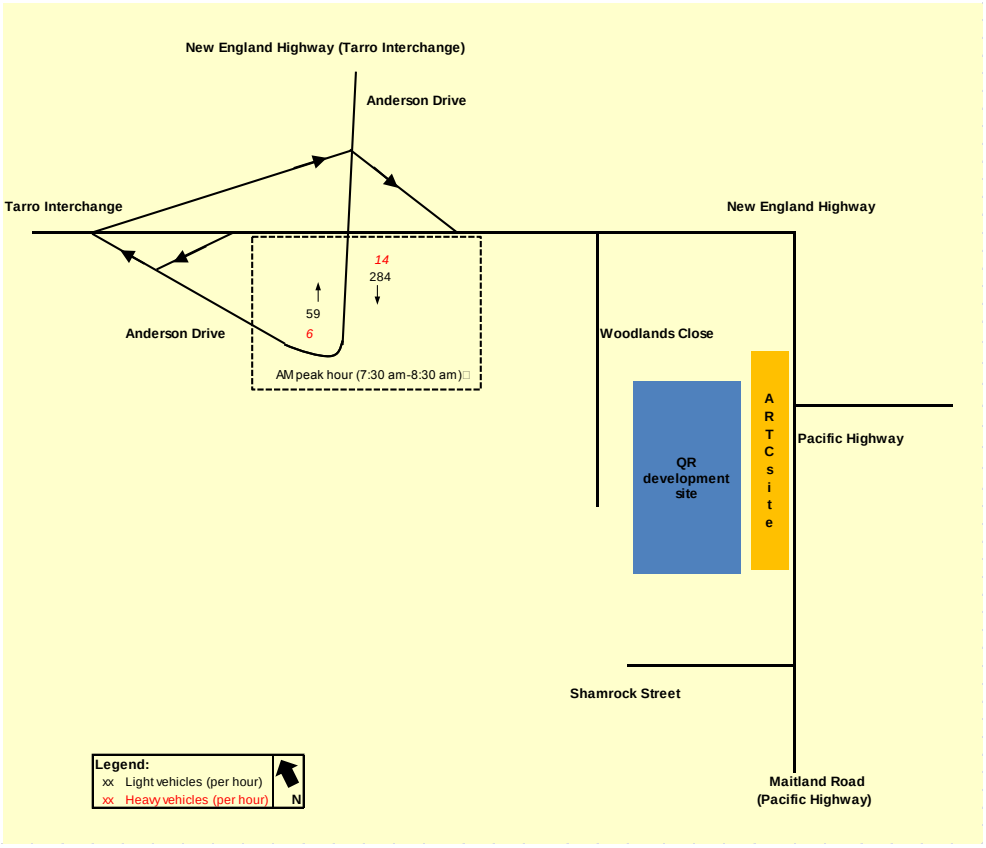


Figure 2.20 Existing AM peak traffic volumes at Tarro Interchange

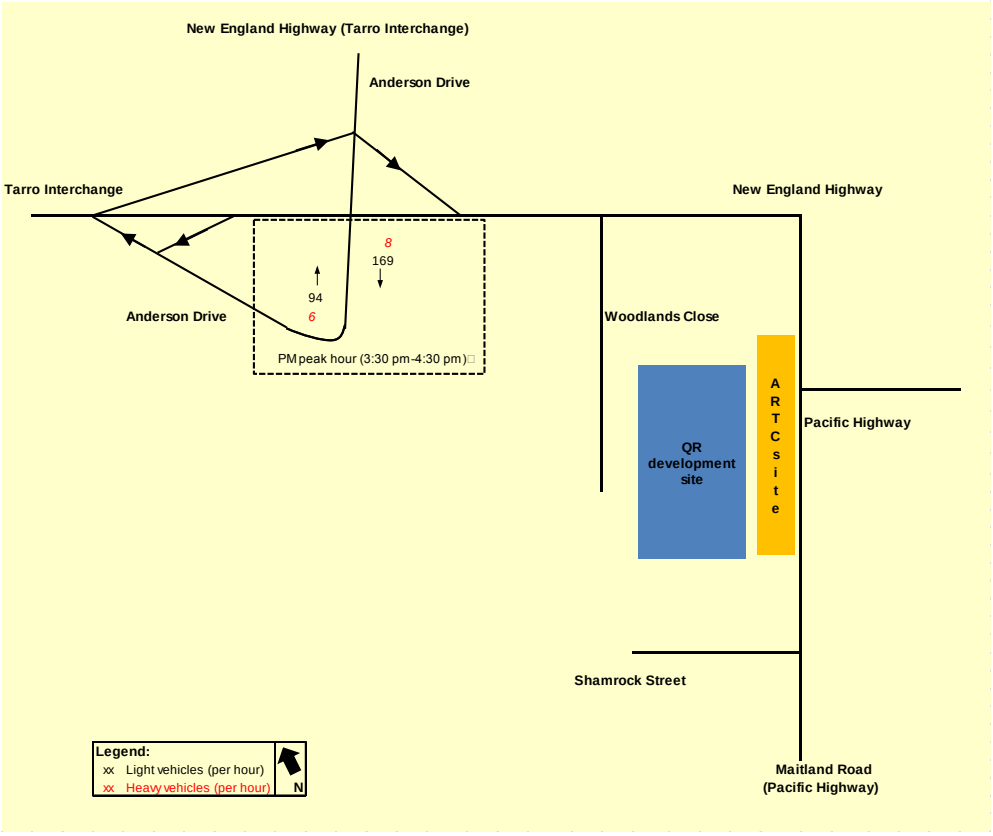


Figure 2.21 Existing PM peak traffic volumes at Tarro Interchange

Table 2.4 Existing mid-block traffic volumes on the New England Highway westbound ramps

Peak hour	Road	Light vehicles (Total)	Heavy vehicles (Total)	Light vehicles (%)	Heavy vehicles (%)
7.30 am–8.30 am	Anderson Drive (New England Highway westbound on ramp)	284	14	95%	5%
	Anderson Drive (New England Highway westbound off ramp)	59	6	91%	9%
3.30 pm–4.30 pm	Anderson Drive (New England Highway westbound on ramp)	169	8	95%	5%
	Anderson Drive (New England Highway westbound off ramp)	94	6	94%	6%

Source:
Total traffic volume: Better Transport Future's *Proposed Train Facility and Industrial Estate Traffic Impact Assessment* (2011)
Heavy vehicle percentage: Parsons Brinckerhoff survey 2011

3. Existing situation

3.1 Mid-block Level of Service

The Road and Traffic Authority 2002, *Guide to Traffic Generating Developments* sets out the hourly urban road capacities for two-lane roads for different level of service (LoS), as shown in Table 3.1. The LoS descriptions are shown in Appendix B.

Table 3.1 Peak hour flow on two-lane urban roads per direction

Level of service	One lane (vehicles per hour)	Two lanes (vehicles per hour)
A	200	900
B	380	1,400
C	600	1,800
D	900	2,200
E	1,400	2,800

Source: RTA's Guide to Traffic Generating Developments 2002

Table 3.2 shows the existing LoS based the surveyed traffic volumes on Anderson Drive at the Tarro Interchange. The two-way two-lane road is currently operating at LoS B or better.

Table 3.2 Existing mid-block LoS

Peak hour	Road	Direction	Total traffic volume (veh/hr)	LoS
7.30 am–8.30 am	Anderson Drive (New England Highway westbound off ramp)	Northbound	65	A
	Anderson Drive (New England Highway westbound on ramp)	Southbound	298	B
3.30 pm–4.30 pm	Anderson Drive (New England Highway westbound off ramp)	Northbound	100	A
	Anderson Drive (New England Highway westbound on ramp)	Southbound	177	A

3.2 Crash data analysis

A review of RMS crash data has been undertaken for Anderson Drive in the vicinity of the proposed access point.

From January 2005 to June 2010, a total of four crashes occurred on Anderson Drive (south) at the Tarro Interchange. These involved one injury crash and three non-injury crashes. Crash reports from the RMS are presented in Appendix C.

Three crashes involved a vehicle losing control on a bend when the road surface condition was wet. Speeding was reported as a contributing factor in these crashes.

One crash involved a vehicle travelling on the incorrect side of Anderson Drive which collided with another vehicle travelling in opposing direction. Speeding was reported as a contributing factor in this crash.

The crash data analysis indicates the most common crash type was the 'run-off the road on a bend crash' where speeding was a contributing factor on this 60 km/h road (with advisory speed limit of 55 km/h on the bend).

3.3 Public transport

The following public transport services are provided:

- Bus services provided by Hunter Valley Buses between Raymond Terrace and Newcastle via Hexham (Route 140). The route is served by up to two buses per hour during the commuter peak periods, with one service per hour during off peak periods and weekends. The closest bus stop near the construction site is on Maitland Road (Pacific Highway) near Shamrock Road.
- Passenger rail services provided on the Hunter Line between Newcastle and Scone via Hexham.

3.4 Cycling and pedestrians

Dedicated and shared on-road cycle lanes are provided on the New England Highway and Maitland Road (Pacific Highway), between Tarro Interchange and Shamrock Street.

There is no formal provision of pedestrian facilities at Tarro Interchange, Woodlands Close, Maitland Road (Pacific Highway) and the New England Highway.

4. Proposed construction activity

4.1 Proposed construction program

The following proposed construction activity and timing has been assumed for this study:

- site establishment – March 2013 to May 2013
- construction – May 2013 to March 2014
- testing and commissioning – March 2014
- ancillary works, drainage and demobilisation – March 2014 to October 2014.

4.2 Construction schedule, working hours and material delivery hours

The proposed typical working hours are:

- between 7.00 am and 6.00 pm, Monday to Friday
- between 8.00 am and 1.00 pm, Saturday.

No works are proposed to be carried out on Sunday or public holidays with the exception of works undertaken during track possessions, when rail services are discontinued.

Exemption to the above working hours would be required during:

- rail possessions
- works required by utility service providers
- delivery of oversize equipment and materials, which may be required to travel at non-disruptive times by the RMS or NSW Police.

4.3 Proposed temporary construction access road and other works on Anderson Drive

A number of access options have been assessed between the proposed Project site and the external road network. The preferred option involves the construction of an access road connecting Anderson Drive (Tarro Interchange) and Woodlands Close (refer to Figure 4.1). The unsealed temporary construction access road would be approximately 10 m wide. The proposed speed limit on this access road would be 60 km/h.

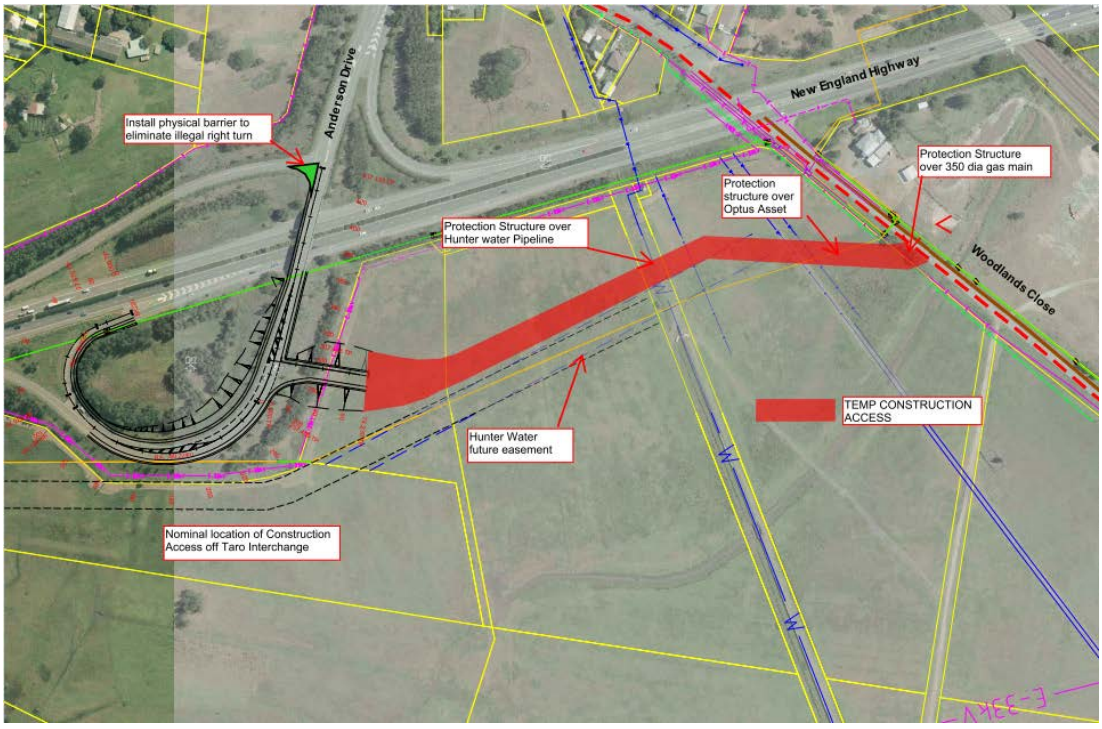


Figure 4.1 Proposed temporary construction access road connecting with the Tarro Interchange and a median barrier on Anderson Drive

The construction of the temporary construction access road and the new intersection off Anderson Drive would take approximately three months. During this time period, construction vehicles would enter the construction site via the New England Highway/Woodlands Close intersection, primarily for the purposes of construction of the new access road and intersection, establishment of the main site compound, heritage investigations and delivery of plant to be used for protection of utilities. It is anticipated these traffic movements would be minimal and occur outside peak hours.

Following the construction of the temporary construction access road, construction vehicle access would be via the Tarro Interchange at the temporary construction access road intersection. This newly created Anderson Drive/temporary construction access road intersection would be a Give Way controlled 'Type AU' auxiliary intersection (according to Austroads *Guide to Road Design Part 4A Unsignalised and Signalised Intersections*) with a separate right turn bay. Through traffic lanes would be provided in both directions at this intersection.

The temporary construction access road would allow right-in, left-in and left-out movements at the intersection with Anderson Drive. No right-out movement would be permitted from the temporary construction access road as it would increase the number of conflicts at the intersection. In addition, heavy vehicles are prohibited to turn left from Anderson Drive onto the temporary construction access road due to the insufficient swept path for the left turn movement.

As part of this proposed intersection construction, a concrete median barrier would be constructed to prevent illegal right turn movements from Tarro Interchange eastbound off-ramp toward Anderson Drive.

4.4 Haulage routes

Heavy vehicles travelling from Sydney or Maitland via John Renshaw Drive and the New England Highway would enter the temporary construction access road and Woodlands Close via the following route (refer to the blue line on Figure 4.2):

- travel eastbound on John Renshaw Drive
- John Renshaw Drive becomes the New England Highway
- turn left into the vehicle turnaround on the New England Highway via the signalised intersection (under Hexham Bridge)
- loop around turnaround area and return to signalised intersection (under Hexham Bridge)
- turn right onto the New England Highway
- leave the New England Highway at the Anderson Drive exit
- turn right onto the temporary construction access road
- turn right onto Woodlands Close.

Heavy vehicles travelling to Sydney or Maitland would exit Woodlands Close and the temporary construction access road, via the following route (refer to the blue line on Figure 4.2):

- turn left from the temporary construction access road onto Anderson Drive
- enter the New England Highway via the westbound on-ramp
- travel westbound along the New England Highway and John Renshaw Drive.

Heavy vehicles travelling from Newcastle or Raymond Terrace via Maitland Road (Pacific Highway) would enter Woodlands Close via the following route (refer to the orange line on Figure 4.2):

- travel northbound on Maitland Road (Pacific Highway)
- Maitland Road (Pacific Highway) becomes the New England Highway
- leave the New England Highway at the Anderson Drive exit

- turn right onto the temporary construction access road
- turn right onto Woodlands Close.

Heavy vehicles travelling to Newcastle or Raymond Terrace would exit Woodlands Close and the temporary construction access road, via the following route (refer to the blue line on Figure 4.2):

- travel westbound along the New England Highway and John Renshaw Drive
- make a U-turn at the F3 Freeway/John Renshaw Drive roundabout or at the U-turn Bay on the New England Highway just north of John Renshaw Drive
- travel along the New England Highway toward Newcastle.

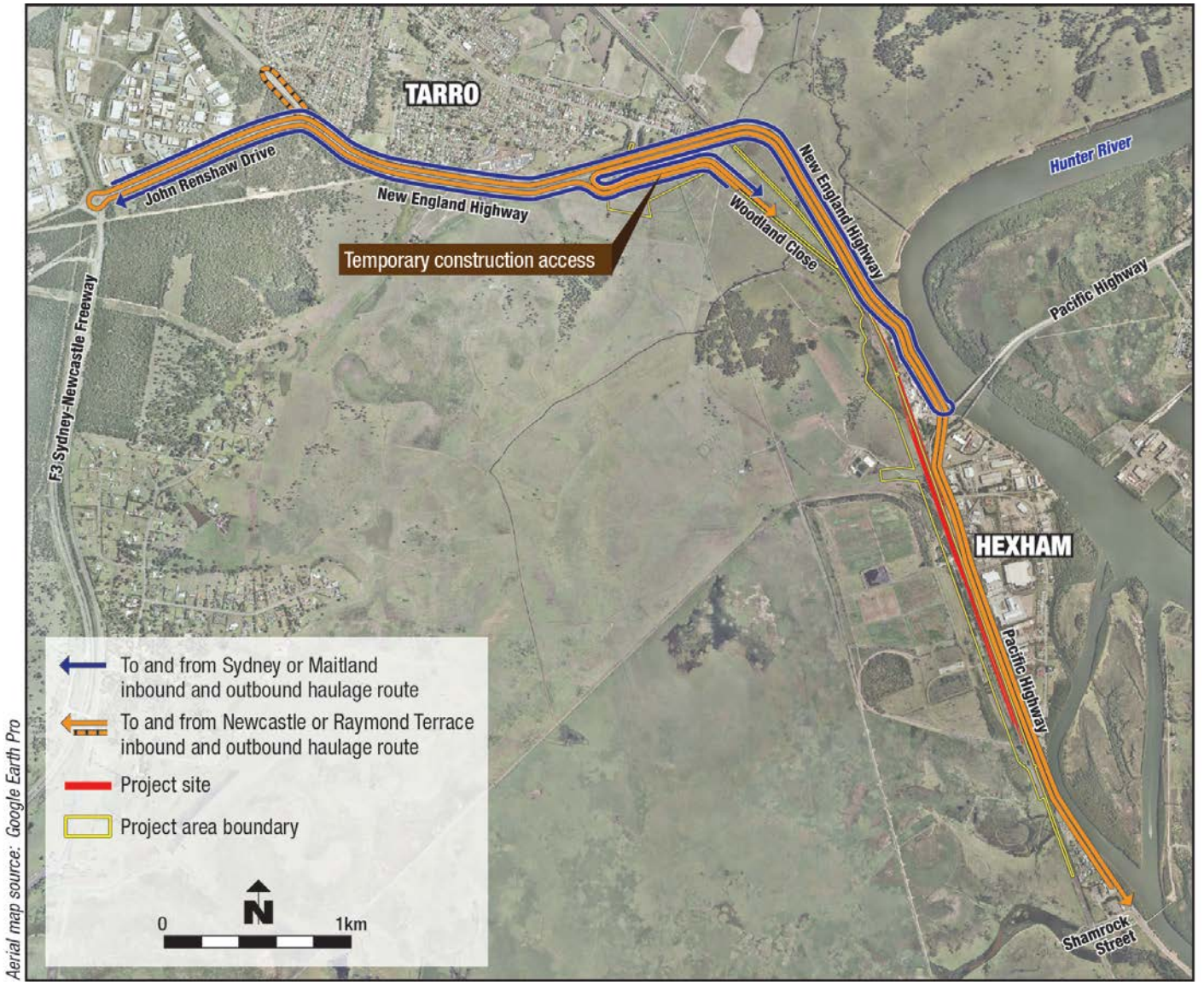


Figure 4.2 Proposed haulage routes

4.5 Daily traffic generation

The anticipated daily maximum number of light and heavy vehicles entering and exiting the proposed Project site has been broken down as follows:

Table 4.1 Estimated maximum daily construction traffic generation (light and heavy vehicles)

Vehicle type	Estimated number of vehicles per day	Estimated number of trips per day
Light vehicles	70	140
Heavy vehicles	120	240
Total	**190**	**380**

Based on estimates from Table 4.1, there would be a maximum of up to 70 inbound light vehicle trips before the start of the shift and 70 outbound light vehicle trips after the shift. During working hours, with the inclusion of heavy vehicles, up to 190 inbound and 190 outbound movements would be generated by the site.

Heavy vehicles coming to the site would include floats, rigid trucks, truck and dog trailers, semi-trailers, cranes, concrete agitators, reinforcement deliveries, toilet pump out trucks, sucker trucks and miscellaneous deliveries. Truck and dog trailers make up the majority of truck movements expected to access the compound site.

On completion of the proposed Project works, road traffic to the site will cease, with the exception of occasional rail corridor maintenance vehicles.

4.6 Hourly traffic generation

Traffic generated by construction personnel travelling to and from the site would consist of up to 70 light vehicles between 6.00 am and 7.00 am when the personnel arrive at work, as well as personnel leaving the compound between 6.00 pm and 7.00 pm at the end of the shift.

Assuming the 120 heavy vehicles for material delivery are distributed throughout the working hours (between 7.00 am and 6.00 pm), there would be 11 trucks per hour arriving and 11 trucks per hour departing from the site per hour.

The traffic peak on the surrounding road network occurs at a different time to the construction peak traffic for this proposed Project. The traffic peak occurs between 7.15 am and 8.15 am and 4.00 pm and 5.00 pm which differ to the construction peak traffic period expected between 6.00 am and 7.00 am and 6.00 pm and 7.00 pm. The light vehicle trips made by construction personnel would occur outside of the traffic peaks, with only heavy vehicle trips being made during traffic peak periods.

Table 4.2 shows the number of hourly trips generated by the proposed Project site during the day.

Table 4.2 Estimated hourly construction vehicle trips at the site

Working hours	Direction of traffic	Trip type	Time	Contributors
Between 7.00 am and 7.00 pm	Inbound traffic	Construction personnel trip	6.00 am to 7.00 am	70 construction personnel trips by light vehicles at the start of their work shift
	Inbound and outbound traffic	Construction vehicle trip	Throughout the day between 7.00 am and 6.00 pm	11 inbound and 11 outbound trips per hour for delivery by heavy vehicles throughout the working hours
	Outbound traffic	Construction personnel trip	6.00 pm to 7.00 pm	70 construction personnel trips by light vehicles at the end of their work shift

4.7 Track possessions

Due to the intense nature of track possessions (to maximise the work completed outside of peak train movements before the rail tracks must be opened up for passenger and freight trains), the arrival and departure of construction personnel would occur late at night/early in the morning, and therefore does not coincide with peak traffic periods.

4.8 Traffic distribution

At the Tarro Interchange, traffic distribution for the construction activity related traffic was assumed to comprise:

- 50% of trips to/from the direction of Newcastle and Raymond Terrace via the New England Highway

- 50% of trips to/from the the direction of Maitland and Sydney via John Renshaw Drive, the New England Highway and Anderson Drive.

5. QR National Train Support Facility

QR National is currently preparing plans for a Train Support Facility and adjoining industrial development located immediately to the west of the Relief Roads. The layout and key features of both projects are shown in Volume 1 of this Environmental Impact Statement (EIS). QR National is liaising with ARTC to co-ordinate the design and integration of the two projects.

The QR National proposal is not yet approved, however given its proximity to the Relief Roads project, it is considered as part of the cumulative assessment.

As part of this study and report, the QR National 2008 Environmental Assessment Report (EAR) has been reviewed. Where updated (2011) reports are available, these have also been reviewed.

The QR National proposal is located on approximately 40 ha of land and would include wagon storage roads, locomotive maintenance sheds, fuel storage area, wash bays, a second provisioning facility, wheel lathe building, turntable and administration offices. The facility would operate 24 hours a day 7 days a week and would employ up to 30 people.

QR National prepared an Environmental Assessment for a larger (255 ha) site in 2008. The Train Support Facility comprised one component of this EAR. In December 2011, QR National submitted a revised Preliminary Environmental Assessment (PEA) and requested DGRs for a Project which retains the same site boundaries (255 ha) as the previous application but limits the project to the Train Support Facility.

QR National considered access for their proposed development via a connection from Woodlands Close to the Tarro interchange, at the same proposed intersection at the Tarro Interchange as described in section 4.3.

The construction of the QR National facility would commence in 2013 and likely take 12 to 18 months to complete. Based on the current program for both the QR National project and the proposed Project, it is likely that there would be an overlap of construction activities for several months. During this time period vehicle access for both construction sites is via the Tarro Interchange and the temporary construction link road.

5.1 Traffic generation

During early months of the construction, approximately 20 to 30 construction workers' vehicles per day are expected to enter the site, and 20 to 30 construction workers' vehicles per day are expected to depart the site. At peak construction time, there could be in the order of 170 construction workers' vehicles per day entering the site and 170 construction workers' vehicles per day departing the site per day associated with the construction works on site.

The construction would have controlled start and finish times, to avoid traffic movements accessing the site during peak periods on the adjacent road network. For inbound trips, the majority of trips would occur before 7.00 am, when the traffic flow on the New England Highway is much lower than during the peaks. Similarly, the outbound movements would again be controlled to ensure that outbound movements do not occur during the afternoon peak period. These outbound movements would occur after 6.00 pm.

The construction would generate 5 to 10 inbound and outbound heavy vehicle movements per hour. The proposed TSF requires 150,000 cubic metres of fill, requiring a number of trucks to enter and exit the site. Assuming a weight of 1.5 tonnes per cubic metres, this equates to 225,000 tonnes of fill. Based on 30 tonnes per 'truck and dog' trailer, this mass requires 7,500 truck trips, inbound and outbound. With this activity taking approximately 4 to 6 months to complete, this would generate 320 to 470 trucks per week, or 60 to 95 trucks per day. These movements would be spread out over the full working day resulting 5 to 10 inbound and outbound movements per hour.

Table 5.1 shows the number of hourly trips generated by the construction of the QR National facility.

Table 5.1 Estimated hourly construction vehicle trips related to the QR National facility

Working hours	Direction of traffic	Trip type	Time	Contributors
Between 7.00 am and 6.00 pm	Inbound traffic	Construction personnel trip	6.00 am to 7.00 am	170 construction personnel trips by light vehicles at the start of their work shift
	Inbound and outbound traffic	Construction vehicle trip	Throughout the day between 7.00 am and 6.00 pm	five inbound and five outbound trips per hour for delivery by heavy vehicles throughout the working hours
	Outbound traffic	Construction personnel trip	6.00 pm to 7.00 pm	170 construction personnel trips by light vehicles at the end of their work shift

Source: Better Transport Future's Proposed Train Facility and Industrial Estate Traffic Impact Assessment (2011)

5.2 Traffic distribution

It was assumed that there would not be a dominant direction for traffic entering and departing from the site for the construction works, thereby traffic would be equally split between origins and destinations to the north and south of the site.

6. Traffic impact assessment

A traffic impact assessment has been undertaken based on an assumption for traffic modelling purposes that there would be an overlap period of several months in 2013 for the construction of the proposed Project and QR National facility.

The following future traffic scenarios were analysed:

- Scenario 1: the proposed Project construction phase without the traffic associated with the construction of QR National facility (2013)
- Scenario 2: the proposed Project construction phase plus traffic associated with the construction of QR National facility (2013).

The assessment does not include a comparison against a do-nothing scenario as this proposed intersection does not exist at present. During the assessed construction period vehicle access for both construction sites is via the new T-junction off Anderson Drive with the temporary construction access road.

6.1 Future traffic and intersection layout

The performance of the road network has been assessed at the new intersection and Anderson Drive using the predicted 2013 traffic volumes, calculated as the sum of background traffic and its growth, plus additional traffic associated with the construction activities of the proposed Project and the QR National facility, distributed onto the road network, during typical working days. Construction activity is expected to be at its peak during 2013. At this time, the construction of the QR National facility is likely to take place concurrently.

Due to the variance in the proposed Project's traffic generation peak and the background road traffic peak periods, two peak periods have been analysed for the construction period.

The proposed Project's peak traffic generation would occur between 6.00 am and 7.00 am and between 6.00 pm and 7.00 pm, when construction personnel arriving at the site before the start of the working hours and departing from the site after the end of the working hours (refer to Table 4.2).

The background road traffic peak would occur between 7.30 am and 8.30 am and between 3.30 pm and 4.30 pm, based on the existing traffic volumes recorded on the New England Highway westbound on and off- ramps (refer to Section 2.3.3).

The sketch layout of the proposed T-junction at the Tarro Interchange is shown in Figure 6.1 and the modelled layout in Figure 6.2. The sketch and modelled layout include a 50 m short right turn lane on Anderson Drive.

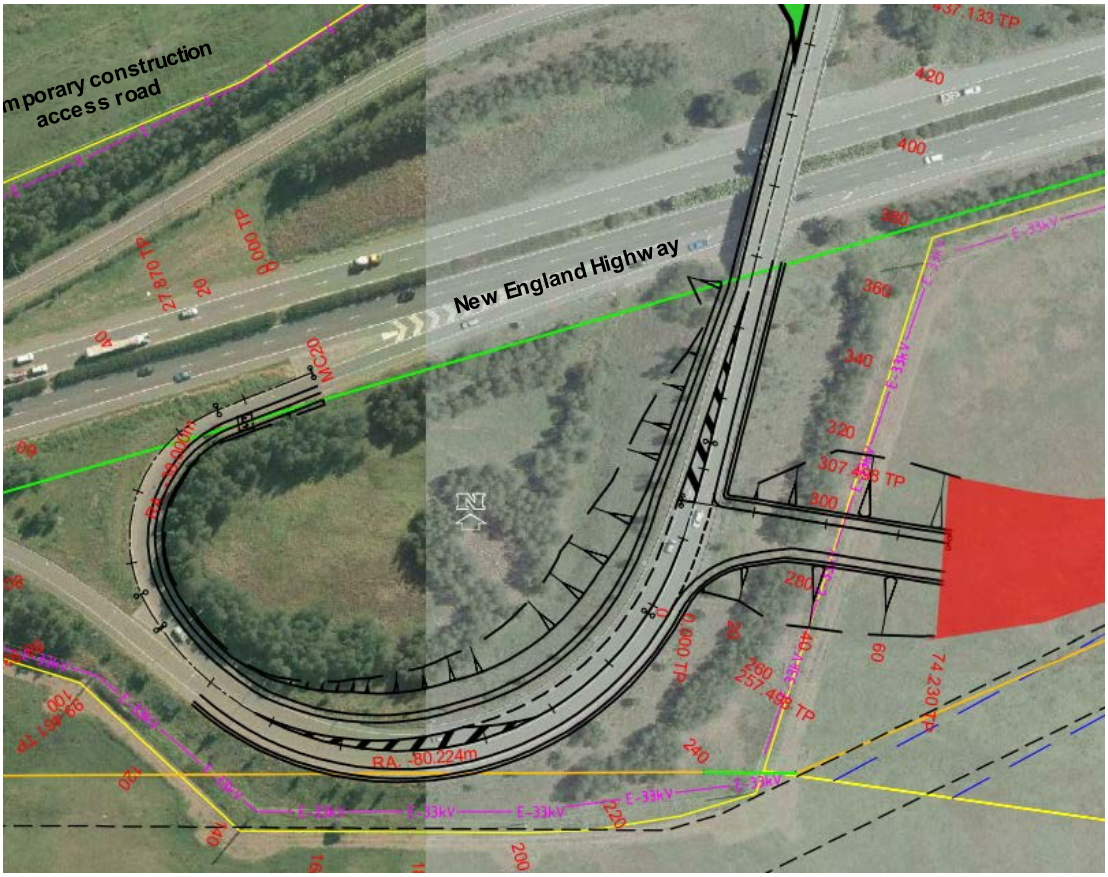


Figure 6.1 **Proposed sketch layout of Anderson Drive intersection with the temporary construction access road**

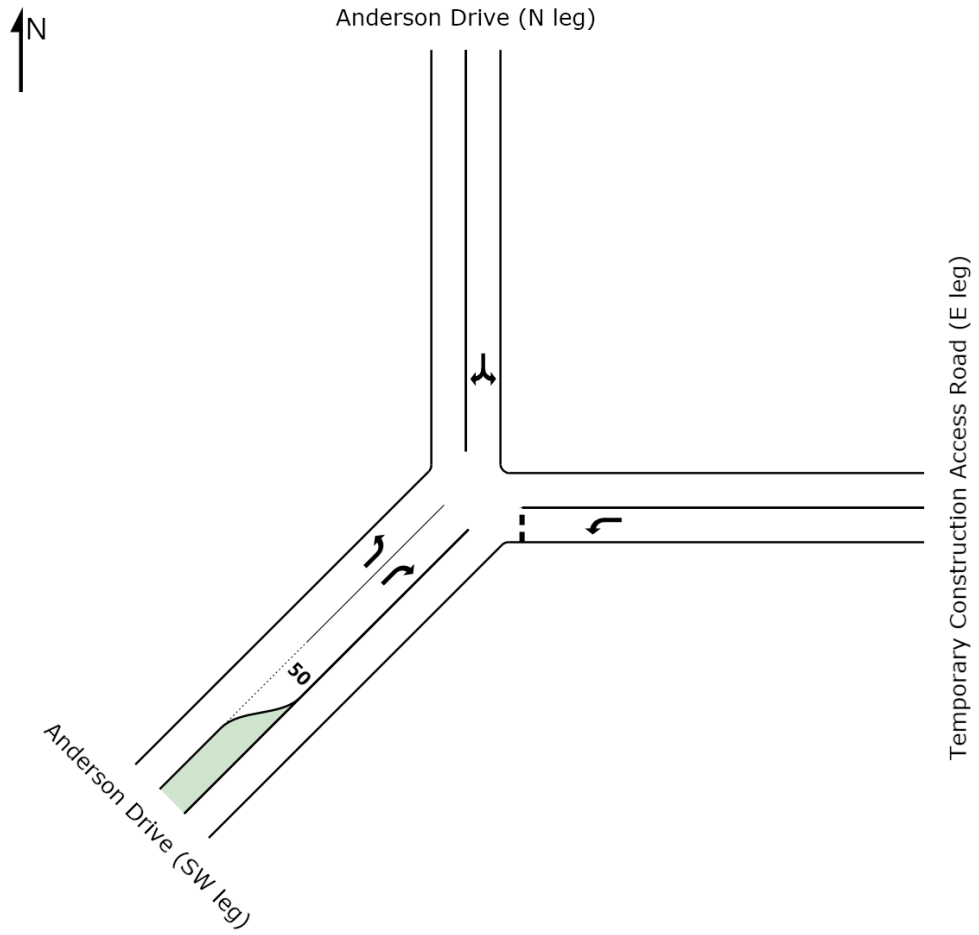


Figure 6.2 Modelled proposed layout of Anderson Drive intersection with the temporary construction access road

6.2 Traffic impact of the proposed Project (Scenario 1)

6.2.1 Peak hour traffic volume (2013)

Future traffic volumes were calculated as combination of the 2011 existing traffic, growth in the background traffic (2% p.a.) and the traffic generation associated with the construction of the proposed Project (refer to Table 4.2).

6.2.1.1 Proposed Project traffic generation peak

Figures 6.3 and 6.4 show the forecast future typical work day traffic assigned to Anderson Drive/temporary construction access road intersection including the construction traffic. Table 6.1 shows the volumes by direction and the percentage of light and heavy vehicles at the intersection. It was assumed that no heavy vehicles would access the site during the proposed peak hours for the Project generated traffic, because these peak hours would occur outside the working hours when construction personnel arrive to and depart from the construction site.

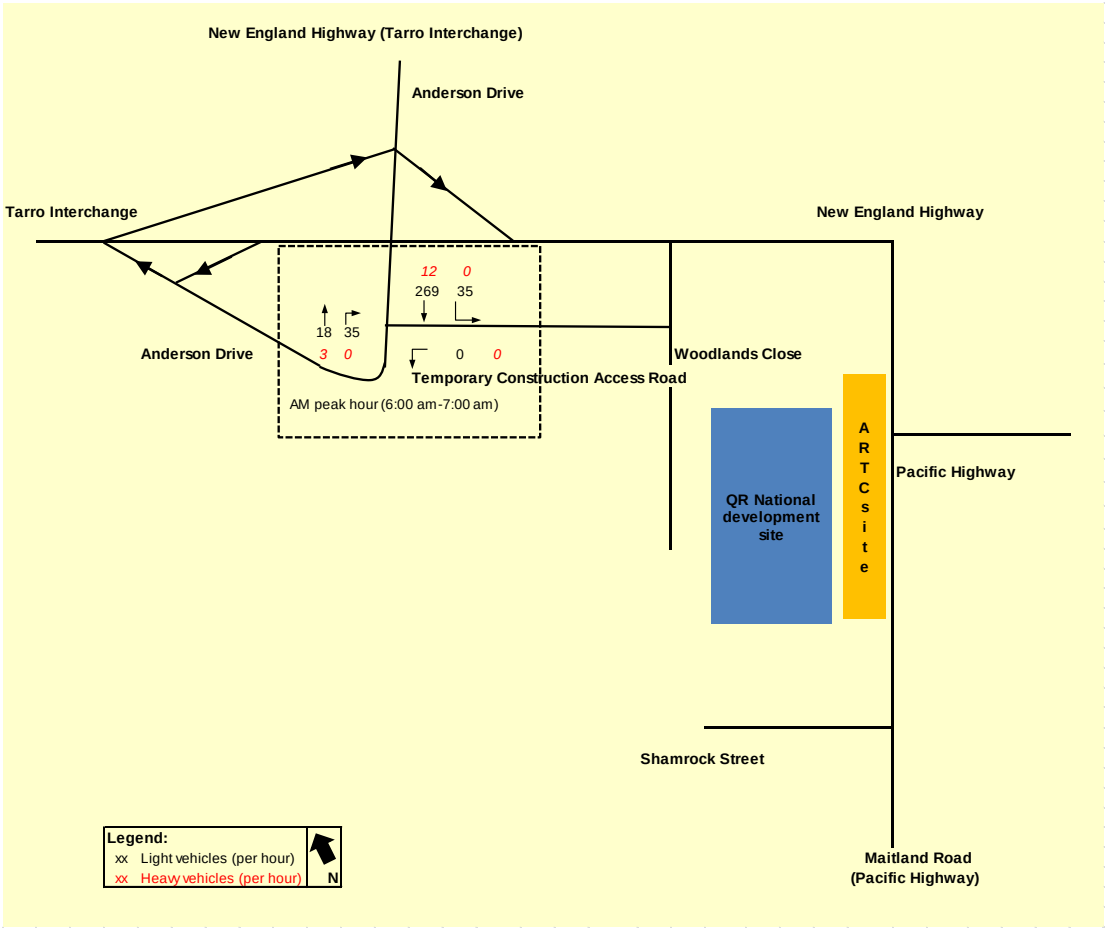


Figure 6.3 2013 AM peak hour traffic volumes (6.00 am–7.00 am) – proposed Project traffic generation peak (Scenario 1)

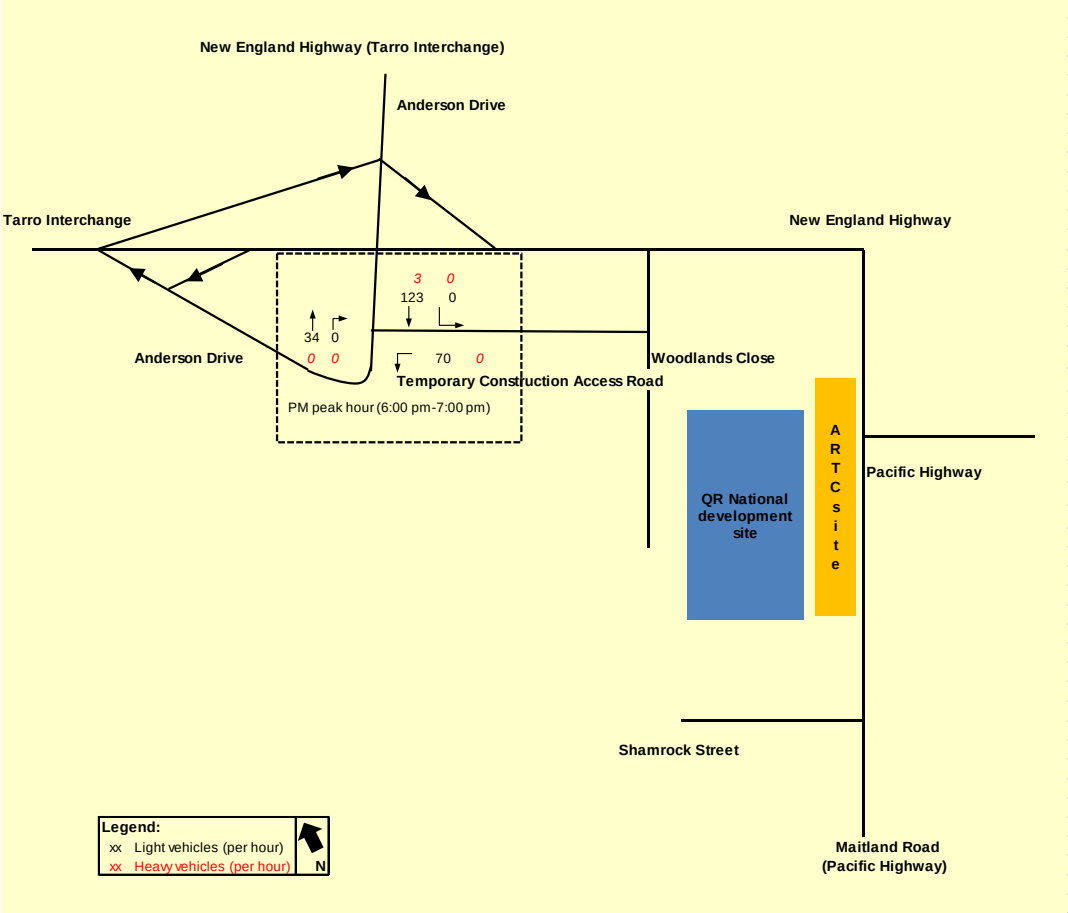


Figure 6.4 **2013 PM peak hour traffic volumes (6.00 pm–7.00 pm) – proposed Project traffic generation peak (Scenario 1)**

Table 6.1 **2013 traffic volumes (Scenario 1) – Project traffic generation peak**

Peak hour	Road	Location	Light vehicles (Total)	Heavy vehicles (Total)	Light vehicles (%)	Heavy vehicles (%)
6.00 am–7.00 am	Anderson Drive, north of temporary construction access road	Northbound	18	3	88%	13%
		Southbound	304	12	96%	4%
	Anderson Drive, south of temporary construction access road	Northbound	53	3	95%	5%
		Southbound	269	12	96%	4%
	Temporary construction access road	Eastbound	70	0	100%	0%
		Westbound	0	0	-	-
6.00 pm–7.00 pm	Anderson Drive, north of temporary construction access road	Northbound	34	0	100%	0%
		Southbound	123	3	98%	2%
	Anderson Drive, south of temporary construction access road	Northbound	34	0	100%	0%
		Southbound	193	3	99%	1%
	Temporary construction access road	Eastbound	0	0	-	-
		Westbound	70	0	100%	0%

6.2.1.2 Background road traffic peak

Figures 6.5 and 6.6 show the forecast future typical working day traffic assigned to the Anderson Drive/temporary construction access road intersection including construction traffic. Table 6.2 shows the volumes by direction and the percentage of light and heavy vehicles at the intersection. It was assumed no light vehicles would access the site during the working hours. The results would not change if small numbers of light vehicles use the temporary construction.

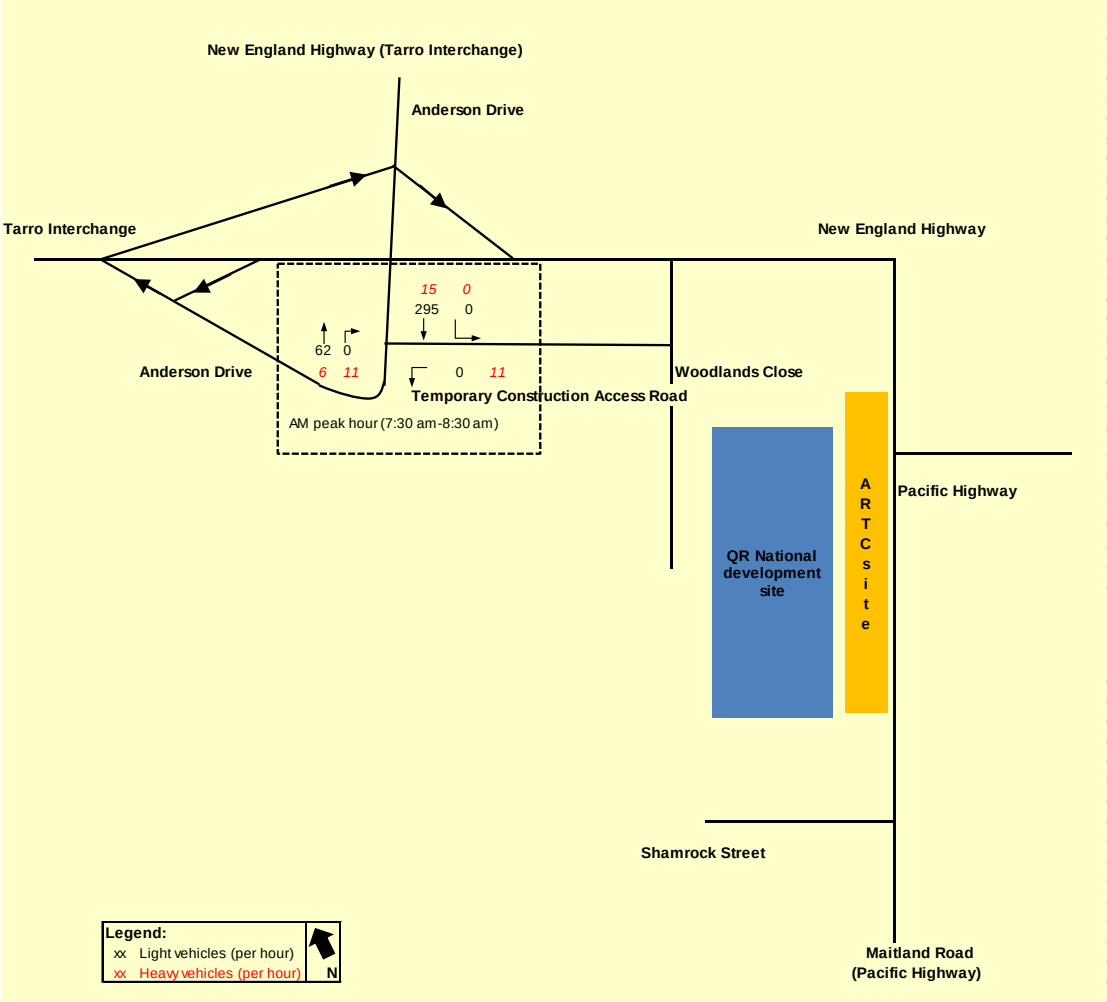


Figure 6.5 2013 AM peak hour traffic volumes (7.30 am–8.30 am) – background traffic peak (Scenario 1)

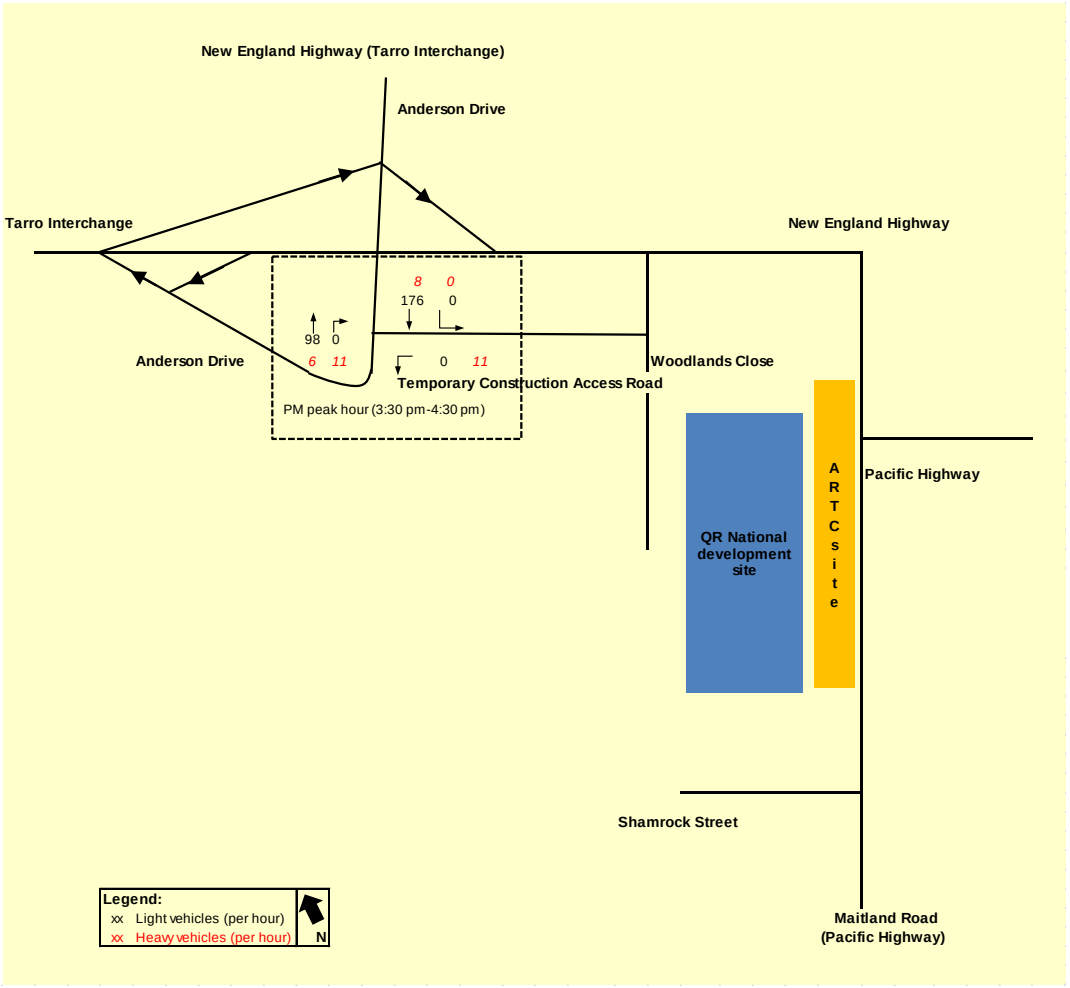


Figure 6.6 **2013 PM peak hour traffic volumes (3.30 pm–4.30 pm) – background traffic peak (Scenario 1)**

Table 6.2 **2013 traffic volumes (Scenario 1) – Background road traffic peak**

Peak hour	Road	Location	Light vehicles (Total)	Heavy vehicles (Total)	Light vehicles (%)	Heavy vehicles (%)
7.30 am–8.30 am	Anderson Drive, north of temporary construction access road	Northbound	62	6	91%	9%
		Southbound	295	15	95%	5%
	Anderson Drive, south of temporary construction access road	Northbound	62	17	79%	21%
		Southbound	295	26	92%	8%
	Temporary construction access road	Eastbound	0	11	0%	100%
		Westbound	0	11	0%	100%
3.30 pm–4.30 pm	Anderson Drive, north of temporary construction access road	Northbound	98	6	94%	6%
		Southbound	176	8	95%	5%
	Anderson Drive, south of temporary construction access road	Northbound	98	17	85%	15%
		Southbound	176	19	90%	10%
	Temporary construction access road	Eastbound	0	11	0%	100%

6.2.2 Intersection performance (2013)

Tables 6.3 and 6.4 show a summary of the forecast intersection performance (using SIDRA intersection modelling) during the peak traffic hours when construction is at its peak in 2013 with the newly created Anderson Drive/temporary construction access road intersection. Please refer to Appendix B for a description of intersection performance terms and criteria.

6.2.2.1 Proposed Project traffic generation peak

Table 6.3 provides intersection summary results for the proposed Projects traffic generation peak.

Table 6.3 Intersection summary results 2013 (Scenario 1) – Proposed Project traffic generation peak

Intersection	Peak period	DoS	Average delays (s)	LoS	95th % Queue (m)
Anderson Drive/temporary construction access road intersection	AM (6.00 am–7.00 am)	0.18	9	A	1
	PM (6.00 pm–7.00 pm)	0.07	8	A	2

The analysis indicates that the proposed Anderson Drive/temporary construction access road intersection is forecast to operate at an acceptable LoS A, with short delays and virtually no queuing. The intersection would operate within its design capacity.

The results tabled for the intersection performance relate to the worst performing vehicle movements for this intersection:

- for the AM peak hour, this is the left-turn movement from the temporary construction access road onto Anderson Drive
- for the PM peak hour, these are the left and through movements on Anderson Drive's northern approach.

Based on the model result, the right turning motorists from Anderson Drive onto the construction access road would experience minimal delay during the peak hours, indicating there would be sufficient gaps in Anderson Drive southbound traffic. The proposed 50 m right turn lane would be sufficient to accommodate the traffic waiting to turn right from the Anderson Drive onto the temporary construction access road, without interrupting traffic on the adjacent lane (northbound through lane on Anderson Drive).

6.2.2.2 Background road traffic peak

Table 6.4 provides intersection summary results for the background road traffic peak.

Table 6.4 Intersection summary results 2013 (Scenario 1) – Background road traffic peak

Intersection	Peak period	DoS	Average delays (s)	LoS	95th % Queue (m)
Anderson Drive/temporary construction access road intersection	AM (7.30 am–8.30 am)	0.18	17	B	2
	PM (3.30 pm–4.30 pm)	0.11	13	A	2

The analysis indicates that the proposed Anderson Drive/temporary construction access road intersection is forecast to operate at LoS B or better, with short delays and virtually no queuing. The intersection would operate within its design capacity. The results tabled for the intersection performance relate to the worst performing vehicle movement for this intersection which is the left-turn movement from the temporary construction access road onto Anderson Drive.

Based on the model result, the right turning motorists from Anderson Drive onto the construction access road would experience minimal delay during the peak hours, indicating there would be sufficient gaps in Anderson Drive southbound traffic. The proposed 50 m right turn lane would be sufficient to accommodate the traffic waiting to turn right from the Anderson Drive onto the temporary construction access road, without interrupting traffic on the adjacent lane (northbound through lane on Anderson Drive).

6.2.2.3 Comparison of peak traffic periods

The left-turn movement from the temporary construction access road onto Anderson Drive is forecast to perform at an acceptable LoS B or better during the AM and PM peak hours for all peak periods. The left-turn and through movements on Anderson Drive's northern approach are also forecast to perform at LoS B or better during the proposed Project traffic generation peak hour. During these peaks, the average delays and queue lengths remain at similar acceptable levels.

6.2.3 Mid-block Level of Service

The mid-block LoS was assessed based on the expected construction traffic volumes on Anderson Drive at the Tarro Interchange (refer to Tables 6.5 and 6.6), compared with the base case mid-block LoS (refer to Table 3.2). Based on the assumptions provided, Anderson Drive is forecast to operate at LoS B or better during both the project traffic generation peak and background road traffic peak.

Table 6.5 2013 mid-block LoS (Scenario 1) – Project traffic generation peak

Peak hour	Road	Direction	Total traffic volume (veh/hr)	LoS
6.00 am–7.00 am	Anderson Drive, north of temporary construction access road	Northbound	21	A
		Southbound	316	B
	Anderson Drive, south of temporary construction access road	Northbound	56	A
		Southbound	281	B
	Temporary construction access road	Eastbound	70	A
		Westbound	0	A
6.00 pm–7.00 pm	Anderson Drive, north of temporary construction access road	Northbound	35	A
		Southbound	126	A
	Anderson Drive, south of temporary construction access road	Northbound	35	A
		Southbound	196	A
	Temporary construction access road	Eastbound	0	A
		Westbound	70	A

Table 6.6 2013 mid-block LoS (Scenario 1) – Background road traffic peak

Peak hour	Road	Direction	Total traffic volume (veh/hr)	LoS
7.30 am–8.30 am	Anderson Drive, north of temporary construction access road	Northbound	68	A
		Southbound	310	B
	Anderson Drive, south of temporary construction access road	Northbound	79	A
		Southbound	321	B
	Temporary construction access road	Eastbound	11	A
		Westbound	11	A
3.30 pm–4.30 pm	Anderson Drive, north of temporary construction access road	Northbound	104	A
		Southbound	184	A
	Anderson Drive, south of temporary construction access road	Northbound	115	A
		Southbound	195	A
	Temporary construction access road	Eastbound	11	A
		Westbound	11	A

6.3 Cumulative traffic impact assessment (Scenario 2)

A cumulative traffic impact assessment has been undertaken taking into consideration an overlap of construction activities of both the proposed Project and QR National facility in 2013.

6.3.1 Peak hour traffic volume (2013)

Future traffic volumes were calculated as combination of the 2011 existing traffic, growth in the background traffic (2% p.a.) and the traffic generation associated with the construction of the project site (refer to Table 4.2) and the QR National facility (refer to Table 5.1).

6.3.1.1 Proposed Project traffic generation peak

Figures 6.7 and 6.8 show the forecast future typical working day traffic assigned to Anderson Drive/temporary construction access road intersection including construction traffic and traffic associated with the construction of QR National facility. Table 6.7 shows the volumes by direction and the percentage of light and heavy vehicles at the intersection. It was assumed that no heavy vehicles would access the site during the proposed peak hours for the Project generated traffic, because these peak hours would occur outside the working hours when construction personnel arrive to and depart from the construction site.

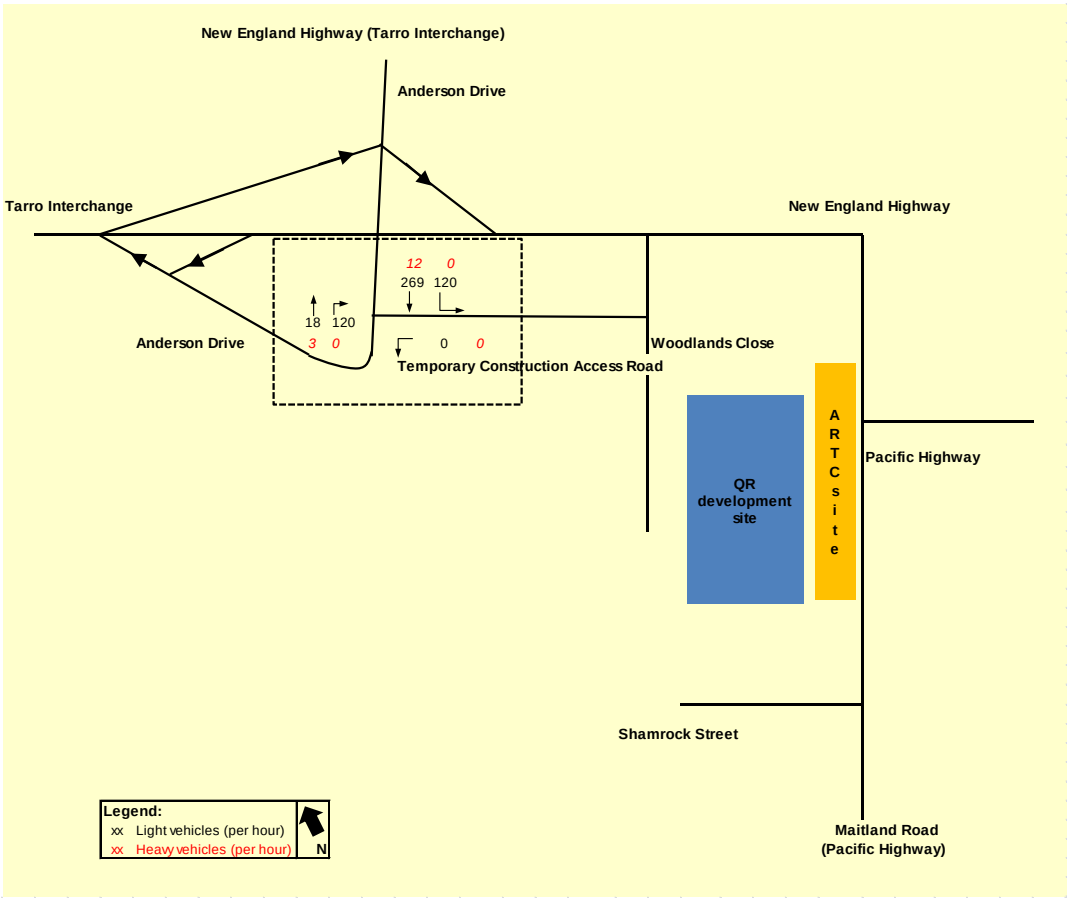


Figure 6.7 2013 AM peak hour traffic volumes (6.00 am–7.00 am) – proposed Project traffic generation peak (Scenario 2)

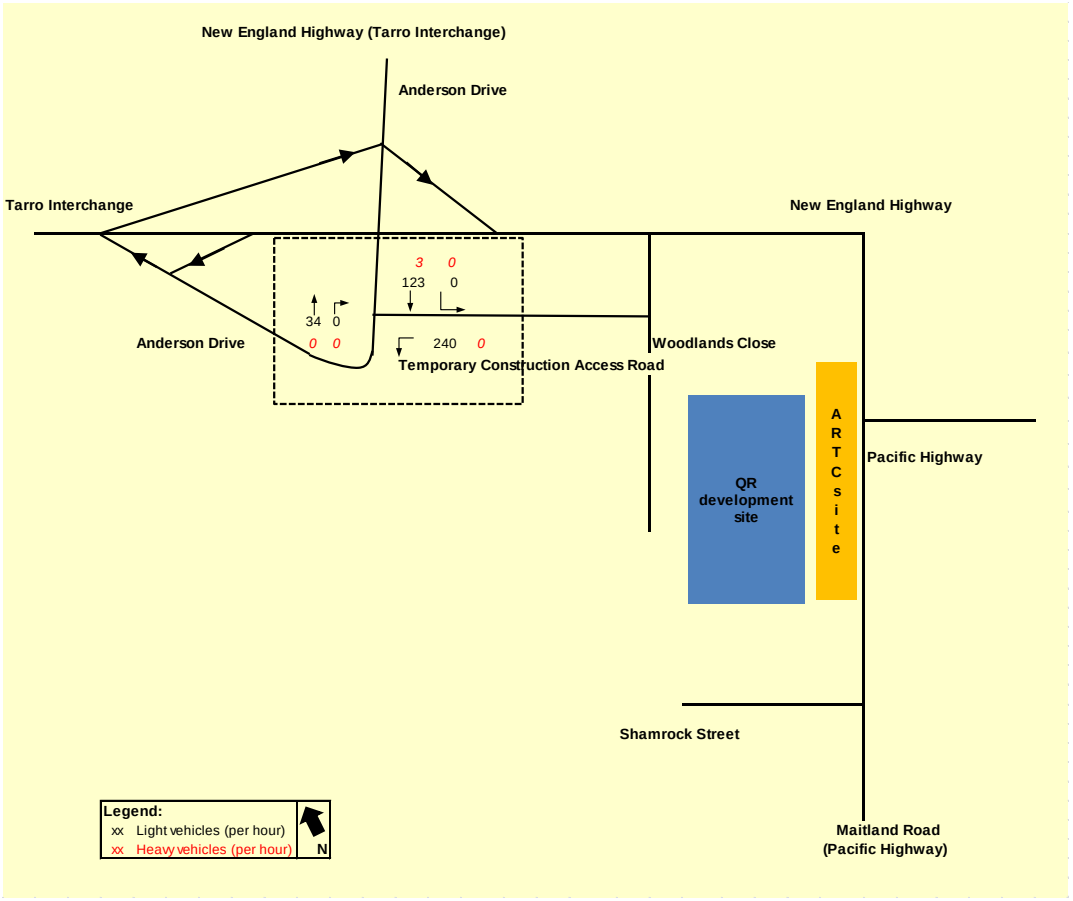


Figure 6.8 **2013 PM peak hour traffic volumes (6.00 pm–7.00 pm) – proposed Project traffic generation peak (Scenario 2)**

Table 6.7 **2013 traffic volumes (Scenario 2) – Project traffic generation peak**

Peak hour	Road	Location	Light vehicles (Total)	Heavy vehicles (Total)	Light vehicles (%)	Heavy vehicles (%)
6.00 am–7.00 am	Anderson Drive, north of temporary construction access road	Northbound	18	3	88%	13%
		Southbound	389	12	97%	3%
	Anderson Drive, south of temporary construction access road	Northbound	138	3	98%	2%
		Southbound	269	12	96%	4%
	Temporary construction access road	Eastbound	240	0	100%	0%
		Westbound	0	0	-	-
6.00 pm–7.00 pm	Anderson Drive, north of temporary construction access road	Northbound	34	0	100%	0%
		Southbound	123	3	98%	2%
	Anderson Drive, south of temporary construction access road	Northbound	34	0	100%	0%
		Southbound	363	3	99%	1%
	Temporary construction access road	Eastbound	0	0	-	-
		Westbound	240	0	100%	0%

6.3.1.2 Background road traffic peak

Figures 6.9 and 6.10 show the forecast future typical working day traffic assigned to the Anderson Drive/temporary construction access road intersection including construction traffic and traffic associated with the construction of QR National facility. Table 6.8 shows the volumes by direction and the percentage of light and heavy vehicles at the intersection. It was assumed no light vehicles would access the site during the working hours. The results would not change if small numbers of light vehicles use the temporary construction access road.

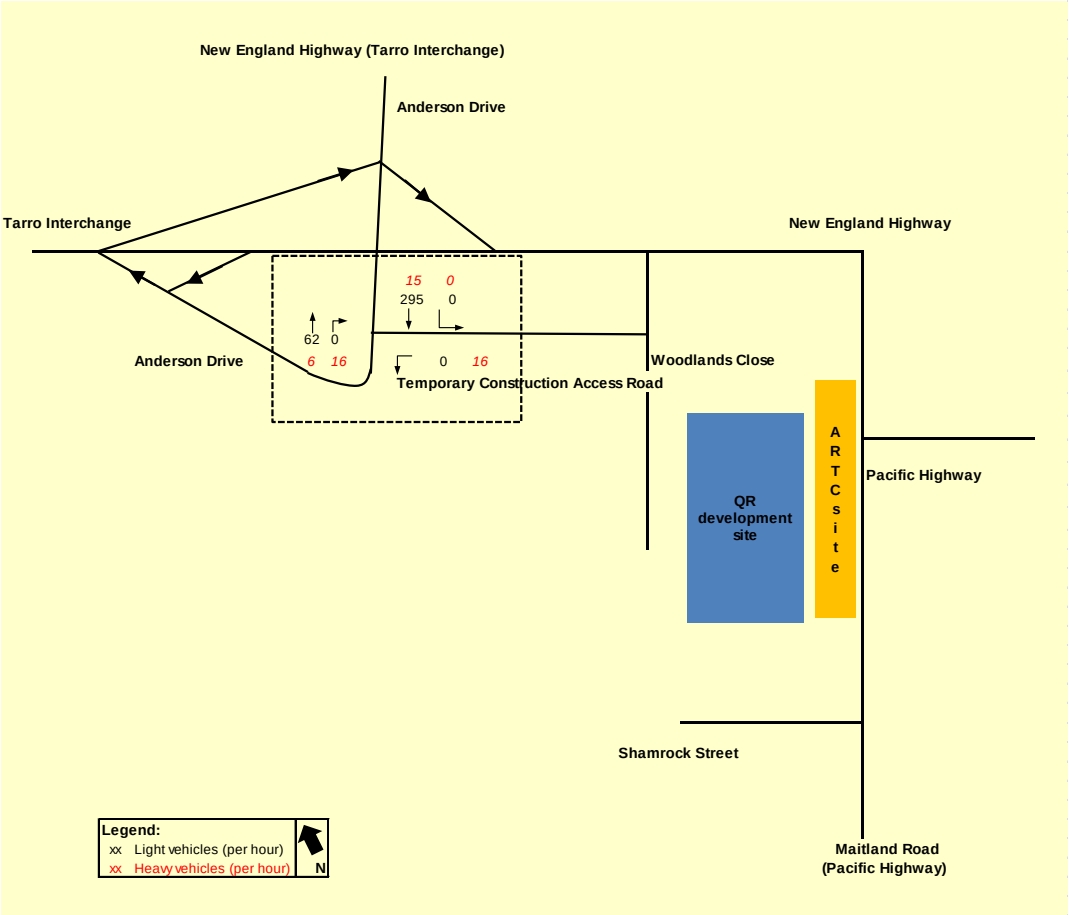


Figure 6.9 2013 AM peak hour traffic volumes (7.30 am–8.30 am) – proposed Project traffic generation peak (Scenario 2)

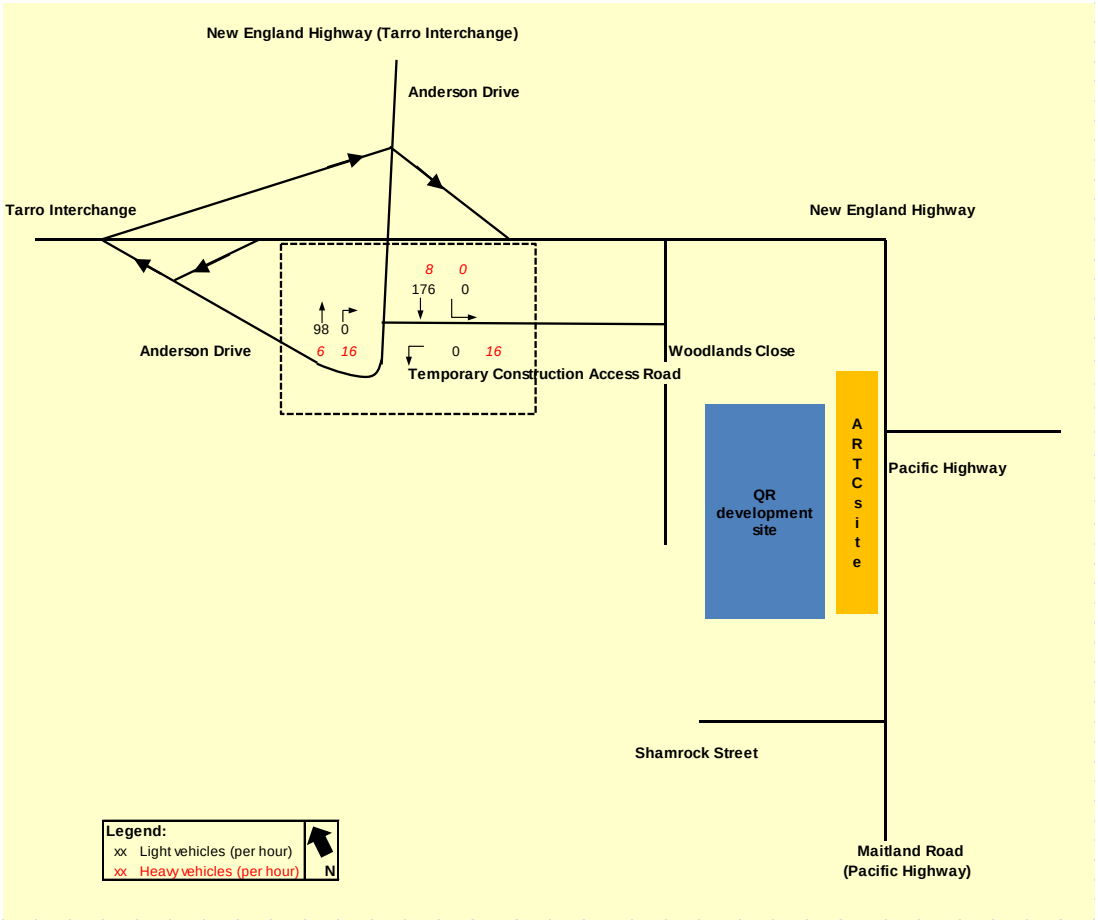


Figure 6.10 **2013 PM peak hour traffic volumes (3.30 pm–4.30 pm) – proposed Project traffic generation peak (Scenario 2)**

Table 6.8 **2013 traffic volumes (Scenario 2) – Background road traffic peak**

Peak hour	Road	Location	Light vehicles (Total)	Heavy vehicles (Total)	Light vehicles (%)	Heavy vehicles (%)
7.30 am–8.30 am	Anderson Drive, north of temporary construction access road	Northbound	62	6	91%	9%
		Southbound	295	15	95%	5%
	Anderson Drive, south of temporary construction access road	Northbound	62	22	74%	26%
		Southbound	295	31	91%	9%
	Temporary construction access road	Eastbound	0	16	0%	100%
		Westbound	0	16	0%	100%
3.30 pm–4.30 pm	Anderson Drive, north of temporary construction access road	Northbound	98	6	94%	6%
		Southbound	176	8	95%	5%
	Anderson Drive, south of temporary construction access road	Northbound	98	22	82%	18%
		Southbound	176	24	88%	12%
	Temporary construction access road	Eastbound	0	16	0%	100%
		Westbound	0	16	0%	100%

6.3.2 Intersection performance (2013)

Tables 6.7 and 6.8 show a summary of the forecast intersection performance (based on SIDRA modelling) during the peak traffic hours when construction is at its peak in 2013, with the newly created Anderson Drive/temporary construction access road intersection. The assessment considered the construction traffic associated with the QR National facility.

6.3.2.1 Proposed Project traffic generation peak

Table 6.9 provides intersection summary results for the proposed Projects traffic generation peak.

Table 6.9 Intersection summary results 2013 (Scenario 2) – proposed Project traffic generation peak

Intersection	Peak period	DoS	Average delays (s)	LoS	95th % Queue (m)
Anderson Drive/temporary construction access road intersection	AM (6.00 am–7.00 am)	0.23	9	A	4
	PM (6.00 pm–7.00 pm)	0.20	9	A	7

When compared to the Scenario 1 results in Table 6.3, the performance of the intersection is similar that it is forecast to operate at an acceptable LoS A, with short delays and virtually no queuing. The intersection would operate within its design capacity. The results tabled for the intersection performance relate to the worst performing vehicle movement for this intersection which is the left-turn movement from the temporary construction access road onto Anderson Drive.

Based on the model result, the right turning motorists from Anderson Drive onto the construction access road would experience minimal delay during the peak hours, indicating there would be sufficient gap in Anderson Drive southbound traffic. The proposed 50 m right turn lane would be sufficient to accommodate the traffic waiting to turn right from the Anderson Drive onto the temporary construction access road, without interrupting traffic on the adjacent lane (northbound through lane on Anderson Drive).

6.3.2.2 Background road traffic peak

Table 6.10 provides intersection summary results for the background road traffic peak.

Table 6.10 Intersection summary results 2013 (Scenario 2) – Background road traffic peak

Intersection	Peak period	DoS	Average delays (s)	LoS	95th % Queue (m)
Anderson Drive/temporary construction access road intersection	AM (7.30 am–8.30 am)	0.18	17	B	3
	PM (3.30 pm–4.30 pm)	0.11	13	A	2

When compared to the Scenario 1 results in Table 6.4, the performance of the intersection is similar that it is forecast to operate at LoS B or better, with short delays and virtually no queuing. The intersection would operate within its design capacity. The results tabled for the intersection performance relate to the worst performing vehicle movement for this intersection which is the left-turn movement from the temporary construction access road onto Anderson Drive.

Based on the model result, the right turning motorists from Anderson Drive onto the construction access road would experience minimal delay during the peak hours, indicating there would be sufficient gap in Anderson Drive southbound traffic. The proposed 50 m right turn lane would be sufficient to accommodate the traffic waiting to turn right from the Anderson Drive onto the temporary construction access road, without interrupting traffic on the adjacent lane (northbound through lane on Anderson Drive).

6.3.2.3 Comparison of peak traffic periods

The left-turn movement from the temporary construction access road onto Anderson Drive is forecast to perform at acceptable LoS B or better during the AM and PM peak hours for both the proposed Project traffic generation peak and the background road traffic peak. During these peaks, the average delays and queue lengths remain at similar acceptable levels.

6.3.3 Mid-block Level of Service

The mid-block LoS was assessed based on the expected cumulative construction traffic volumes for Anderson Drive at the Tarro Interchange (refer to Tables 6.11 and 6.12), as compared with the base case mid-block LoS (refer to Table 3.2). Anderson Drive is forecast to operate at LoS C or better during the project traffic generation peak, and at LoS B or better during the background road traffic peak.

Table 6.11 2013 mid-block LoS (Scenario 2) – Project traffic generation peak

Peak hour	Road	Direction	Total traffic volume (veh/hr)	LoS
6.00 am–7.00 am	Anderson Drive, north of temporary construction access road	Northbound	21	A
		Southbound	401	C
	Anderson Drive, south of temporary construction access road	Northbound	141	A
		Southbound	281	B
	Temporary construction access road	Eastbound	240	B
		Westbound	0	A
6.00 pm–7.00 pm	Anderson Drive, north of temporary construction access road	Northbound	35	A
		Southbound	126	A
	Anderson Drive, south of temporary construction access road	Northbound	35	A
		Southbound	366	B
	Temporary construction access road	Eastbound	0	A
		Westbound	240	B

Table 6.12 2013 mid-block LoS (Scenario 2) – Background road traffic peak

Peak hour	Road	Direction	Total traffic volume (veh/hr)	LoS
7.30 am–8.30 am	Anderson Drive, north of temporary construction access road	Northbound	68	A
		Southbound	310	B
	Anderson Drive, south of temporary construction access road	Northbound	84	A
		Southbound	326	B
	Temporary construction access road	Eastbound	16	A
		Westbound	16	A
3.30 pm–4.30 pm	Anderson Drive, north of temporary construction access road	Northbound	104	A
		Southbound	184	A
	Anderson Drive, south of temporary construction access road	Northbound	120	A
		Southbound	200	A
	Temporary construction access road	Eastbound	16	A
		Westbound	16	A

6.4 Road safety impacts of the proposed new intersection

A road safety assessment has been undertaken to review sight distance from the proposed new intersection off Anderson Drive, as well as to assess the implication of creating a new intersection off Anderson Drive.

6.4.1 Sight distance

A review of both Safe Intersection Sight Distance (SISD), Approach Sight Distance (ASD) and Minimum Gap Sight Distance (MGSD) has been undertaken via desk-top analysis using the Austroads Guide to Road Design Part 4A for the proposed access intersection on the Tarro Interchange.

Some of the key parameters for SISD, ASD and MGSD requirements include the design speed of the vehicle, the road gradients (grade corrections), gap acceptance and the driver reaction time. For this assessment, we have applied a 60 km/h design speed for westbound vehicles on the Tarro Interchange and a 40 km/h design speed for eastbound vehicles as they are required to negotiate the off-ramp from the New England Highway at a 35 km/h advisory speed limit and then a steep grade to cross the New England Highway.

A critical gap acceptance time of 5 seconds applies for the left turn movement out of the construction access road and the right turn movement into the construction access road.

The SISD for the westbound traffic movement on Anderson Drive (Tarro Interchange) is 130 m, exceeding the minimum requirement of 123 m for a 60 km/h speed limit zone. The SISD for the eastbound traffic movement is 100 m exceeding the minimum requirement of 73 m for a 40 km/h speed limit zone.

The ASD for the westbound traffic movement on Anderson Drive (Tarro Interchange) is 130 m, exceeding the minimum requirement of 73 m for a 60 km/h speed limit zone. The ASD for the eastbound traffic movement is 100 m, exceeding the minimum requirement of 40 m for a 40 km/h speed limit zone.

The MGSD for the left turn movement out of the construction access road is 130 m, exceeding the minimum requirement of 83 m for a 60 km/h approach vehicle speed. The MGSD for the right turn movement into the construction access road is 100 m, exceeding the minimum requirement of 83 m for a 60 km/h approach vehicle speed. In summary, the SISD, ASD and MGSD for this proposed intersection location comply with the Austroads guideline requirements. Motorists would have sufficient sight distance along Anderson Drive when negotiating the intersection.

6.4.2 Road safety impacts

The following road safety impacts may occur as a direct result of creating a new intersection on Anderson Drive for the temporary site access, and along with the change in traffic patterns due to the proposed Project's related traffic:

- the number of 'loss control on bend' crashes may be reduced as motorists may slow down when approaching the intersection, thus the lower travel speed would reduce the occurrence of loss control on bend crashes
- crossing/turning crashes may be introduced due to the inclusion of a new intersection, involving proposed Project site traffic turning right from Anderson Drive onto the temporary construction access road
- rear end crashes may be introduced on Anderson Drive as a result of traffic decelerating on approach to the intersection
- head-on crashes may be introduced on Anderson Drive as the new intersection does not have sufficient space to accommodate large vehicles' left turning path, they may over-sweep across the centreline and encroach onto the opposite lane on Anderson Drive, increasing the potential for a head-on crash to occur.

6.5 Public transport impacts

During the construction period of the proposed Project, the construction personnel and haulage trucks are unlikely to impose any impacts to the public transport services that are currently available on the New England Highway.

The proposed Project would not affect the passenger rail services and freight movements along the Hunter Line.

6.6 Pedestrian and cyclist impacts

Although the existing level of pedestrian and cycling activities is considered low, the safety of pedestrians and cyclists that may use the haulage route will be considered in a construction traffic management plan (refer to section 6.11).

The proposed Project is not expected to generate any pedestrian or cyclist activities, and is unlikely to impose any adverse impacts on the existing pedestrian and cycling facilities available.

6.7 Impacts on local access on Woodlands Close

Access to Woodlands Close via New England Highway would be maintained for local residents located in the vicinity of Woodlands Close, and local and State Government authorities such as Hunter Water, Hunter–Central Rivers Catchment Management Authority and the Australian Rail Track Corporation to adjacent lands and to their infrastructure.

Construction traffic would use the southern section of Woodlands Close and the temporary construction access road as part of the proposed haulage routes. Therefore, construction traffic would not impose significant impact on the local access to Woodlands Close via the New England Highway.

6.8 Impacts on the access to adjoining lands and infrastructure

6.8.1 Hexham Swamp Nature Reserve

Authorised vehicles' access to the nature reserve via Woodlands Close would be maintained at all time. Suitable signage would be provided to warn road users of the turning construction trucks at the southern end of Woodlands Close's sealed section.

6.8.2 Hexham Railway Station

Construction activities would not affect vehicular and pedestrian access to the Hexham Railway Station as its access is via Maitland Road (Pacific Highway) located on the other side of the rail line.

6.8.3 Hunter Water infrastructure

Access to Woodlands Close via New England Highway would be maintained for Hunter Water to their infrastructure.

6.9 Interaction with other proposed developments

6.9.1 ARTC Hexham Crossing Loop

The crossing loop and the proposed Project are on opposite sides of the rail corridor and hence do not interact. The exception is with cable route requirements, where UHVA is looking to identify opportunities for combined infrastructure for both projects.

6.9.2 F3 Freeway to Raymond Terrace Pacific Highway Upgrade

UHVA have liaised with RMS on multiple occasions to ensure the proposed highway upgrade and the proposed Project would not conflict. Through this process, the alignment of the temporary construction access road has been modified to allow for the piers of the RMS Hunter River viaduct.

6.9.3 Richmond Rail Trail

UHVA has discussed the proposed bike path with Newcastle City Council. It was agreed that the rail lines would not affect the planned route, and that the temporary construction access road at Tarro Interchange will actually benefit the accessibility of the future bike path.

6.10 Impacts on the regional road network

Throughout the working day, it is expected that up to 22 additional heavy vehicle trips per hour would be assigned to Anderson Drive and the temporary construction access road for the proposed Project. The intersection that would be immediately affected is the newly created Anderson Drive/temporary construction access road intersection.

The number of heavy vehicles for the proposed Project, when assigned to the New England Highway, is a very small increase on top of the existing heavy vehicle traffic that this road normally experiences. The proposed Project heavy vehicle traffic would equate to 0.4% of the total vehicle traffic on the New England Highway at this location. The existing heavy vehicle traffic at this location accounts for approximately 15% of the total vehicle traffic (Source: Parsons Brinckerhoff survey 2011). Given the temporary nature of the increase (one year construction duration), and the fact that the New England Highway is designated for heavy vehicle traffic, the potential impacts of the additional vehicle movements associated with the works are anticipated to be insignificant.

Potential impacts will therefore be limited to a possible temporary and mild disruption of users of the New England Highway when equipment and materials are being delivered to the proposed Project site.

Earlier sections indicate that there would be insignificant traffic impacts associated with the increased traffic due to the construction activities of both the proposed Project and the nearby QR National facility on Anderson Drive. Any impact would be further reduced as the personnel trips disperse into the broader, regional road network distant from the construction site. Additionally, most of the personnel trips would occur outside commuter peak hours, therefore they are unlikely to impose adverse traffic impacts on the regional road network.

Delivery vehicles would travel on a designated route along the New England Highway. The low magnitude would not impose adverse impacts on the regional road network. It is proposed that no heavy vehicles would use Anderson Drive north of the New England Highway, thus it is expected that no impact would be imposed on local residents of Tarro.

6.11 Construction traffic management

Prior to construction commencing, a construction traffic management plan (TMP) would be prepared as part of the pre-construction planning. The plan would detail how the traffic associated with construction should be managed in accordance with the Roads and Traffic Authority 2010 *Traffic Control at Work Sites*, as well as relevant Australian Standards including AS1742.

The construction traffic management plan would make particular consideration of:

- provide a swept path analysis to ascertain that sufficient manoeuvring space is provided for all vehicles at intersections along the haulage routes
- traffic management signs to advise road users in advance of work zones and surrounding intersections, and advanced warning signs to be erected in advance of the works commencing
- emphasis on banned right turn movements on the Anderson Drive/temporary construction access intersection and the documentation of suitable U-turn facilities elsewhere.

Traffic control plans would be prepared as part of the construction traffic management plan for specific stages of work or locations as required. A review of temporary road work traffic control measures, signage and speed limits in areas of potential risk would also be undertaken.

The construction traffic management plan would outline procedures to audit implementation of the plan and to ensure safety aspects are observed.

The following recommendations, to form a part of the TMP, are made to minimise the safety and operational impact as a result of the construction activity:

- Provide advanced T-junction warning signs to warn motorists of the upcoming intersection on Anderson Drive.
- Provide suitable signage to prohibit non-construction vehicles from entering the temporary construction access.
- Provide suitable signage to prohibit large vehicles from turning left from Anderson Drive onto the temporary construction access.
- Provide Project personnel with information on site access as well as locations where vehicle turnaround intersections are provided.
- Establish a site rule that entry and exit to/from the site must be from the newly created Anderson Drive/temporary construction access road intersection and vehicular access to the New England Highway via Woodlands Close is banned after the temporary construction access road is constructed.

6.12 Post construction

Although the use of the temporary construction access road for the Relief Roads project will end after Relief Roads construction work is complete, it will still be used by QR National as an access road, possibly even upgraded.

Maintenance works would be required in the rail corridor following the commissioning of the Relief Roads in March 2014. The amount of operational activities and the associated number of maintenance vehicles will vary depending on what work needs to be undertaken. Some maintenance works will be undertaken on an ‘as needs’ basis. Maintenance vehicles’ access to the rail corridor will be via the New England Highway and Woodlands Close.

The amount of operational activities is expected to be less than the construction activities that have been considered in this traffic impact assessment. It is anticipated that the traffic generated by the operational activities are unlikely to impose adverse traffic impacts to the local and regional road network.

A future 10 year intersection traffic analyses has not been undertaken for this reason.

7. Recommendations

The following recommendations are made to minimise the safety and operational impact as a result of the construction activity:

- Provide suitable signage to warn road users of the turning construction trucks at the southern end of Woodlands Close's sealed section.
- Provide advanced T-junction warning signs to warn motorists of the upcoming intersection on Anderson Drive.
- Provide suitable signage to prohibit non-construction vehicles from entering the temporary construction access.
- Provide suitable signage to prohibit large vehicles from turning left from Anderson Drive onto the temporary construction access due to the insufficient swept path for the left turn movement.
- Provide Project personnel with information on site access as well as locations where vehicle turnaround intersections are provided.
- Establish a site rule that entry and exit to/from the site must be from the newly created Anderson Drive/temporary construction access road intersection and vehicular access to the New England Highway via Woodlands Close is banned after the temporary construction access road is constructed.

8. Conclusion

The traffic impact assessment has identified that the cumulative traffic impacts due to the construction associated with the proposed Project and the QR National facility during peak hours is considered minor and will have a negligible impact on the existing road network. The traffic impacts would be temporary in nature with only minor additional delays expected along haulage routes and at the Tarro Interchange in addition to the existing situation.

During construction, all vehicles' access to the Project site is via a temporary construction access road which connects between Anderson Drive and Woodlands Close. Based on the assumptions provided, the mid-block level of service on Anderson Drive is forecast to remain at LoS B with the additional traffic movements during construction. The mid-block level of service on this road is forecast to be reduced slightly from LoS B to C, but is still acceptable, with the cumulative traffic movements associated with the construction of both the Hexham Relief Roads and QR National facility. SIDRA modelling results indicate that the new intersection of Anderson Drive and the temporary construction access road would operate at acceptable LoS B or better and would operate within the design capacity, with or without traffic associated with the construction of QR National facility. The proposed 50 m right turn bay on Anderson Drive would be sufficient to store waiting vehicles without interrupting the adjacent through lane.

Six recommendations have been made to minimise the safety and operational impact as a result of the construction activity:

- Provide suitable signage to warn road users of the turning construction trucks at the southern end of Woodlands Close's sealed section.
- Provide advanced T-junction warning signs to warn motorists of the upcoming intersection on Anderson Drive.
- Provide suitable signage to prohibit non-construction vehicles from entering the temporary construction access.
- Provide suitable signage to prohibit large vehicles from turning left from Anderson Drive onto the temporary construction access due to the insufficient swept path for the left turn movement.
- Provide Project personnel with information on site access as well as locations where vehicle turnaround intersections are provided.
- Establish a site rule that entry and exit to/from the site must be from the newly created Anderson Drive/temporary construction access road intersection and vehicular access to the New England Highway via Woodlands Close is banned after the temporary construction access road is constructed.

9. References

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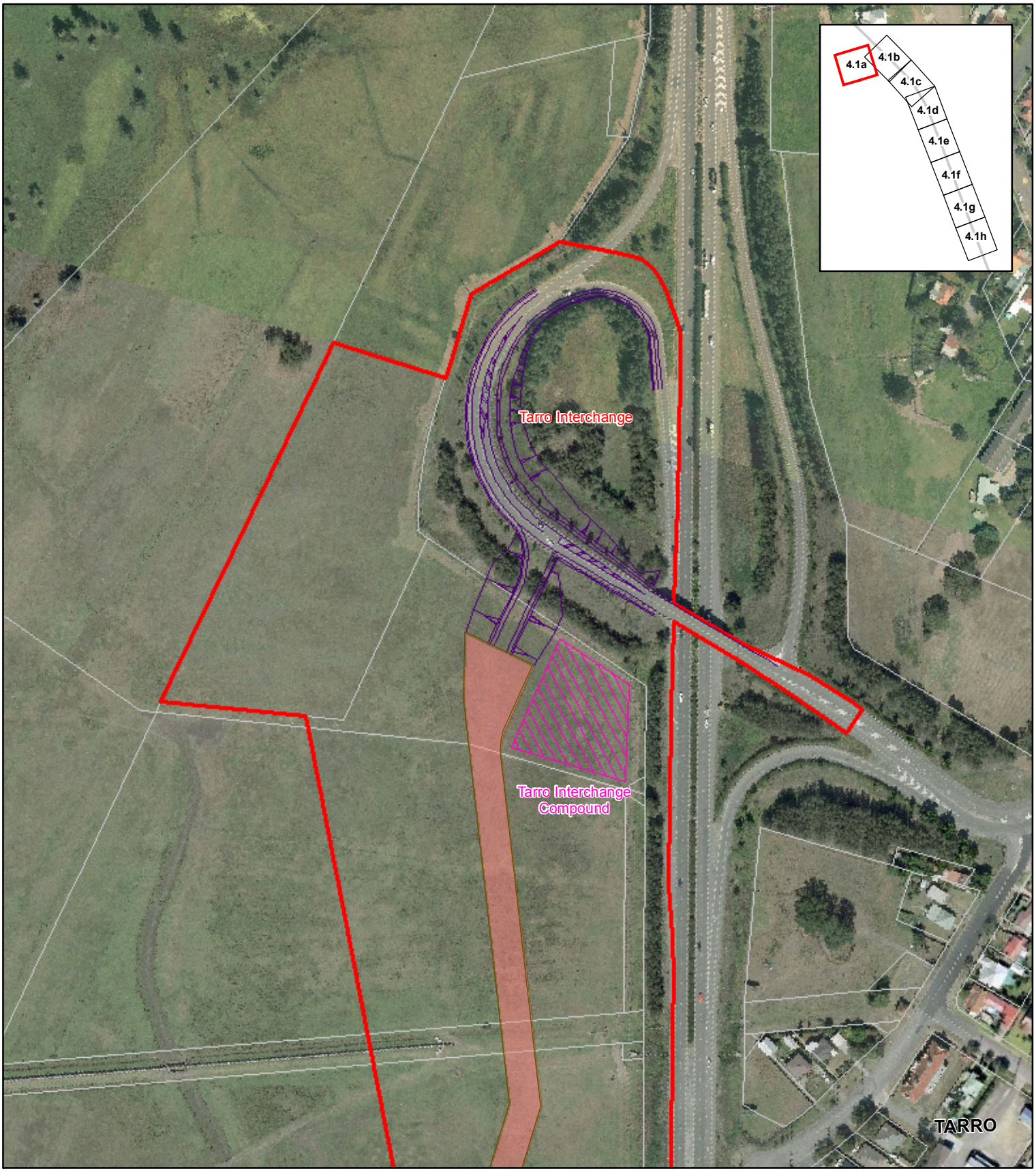
Appendix A

Project area boundary and location of the Relief Roads



- Jemena Gas Pipeline
- Relief Roads
- Proposed Tarro Interchange Access
- Project Area
- Cadastre
- Proposed Compound Area
- Proposed Vehicular Access
- Proposed Vehicular Access to Lot 312 DP 58724
- Indicative Tarro Interchange Access
- Swale Drain

A4 Original

0 30 60 120

Metres

GDA 1994 MGA Zone 56

N

UHVA

ARTC

ARTC
Hexham Relief Roads

Job Number	21105015
Revision	A7
Date	03.05.2012
Scale	1:3,000

Key Project Features

Figure 4.1a

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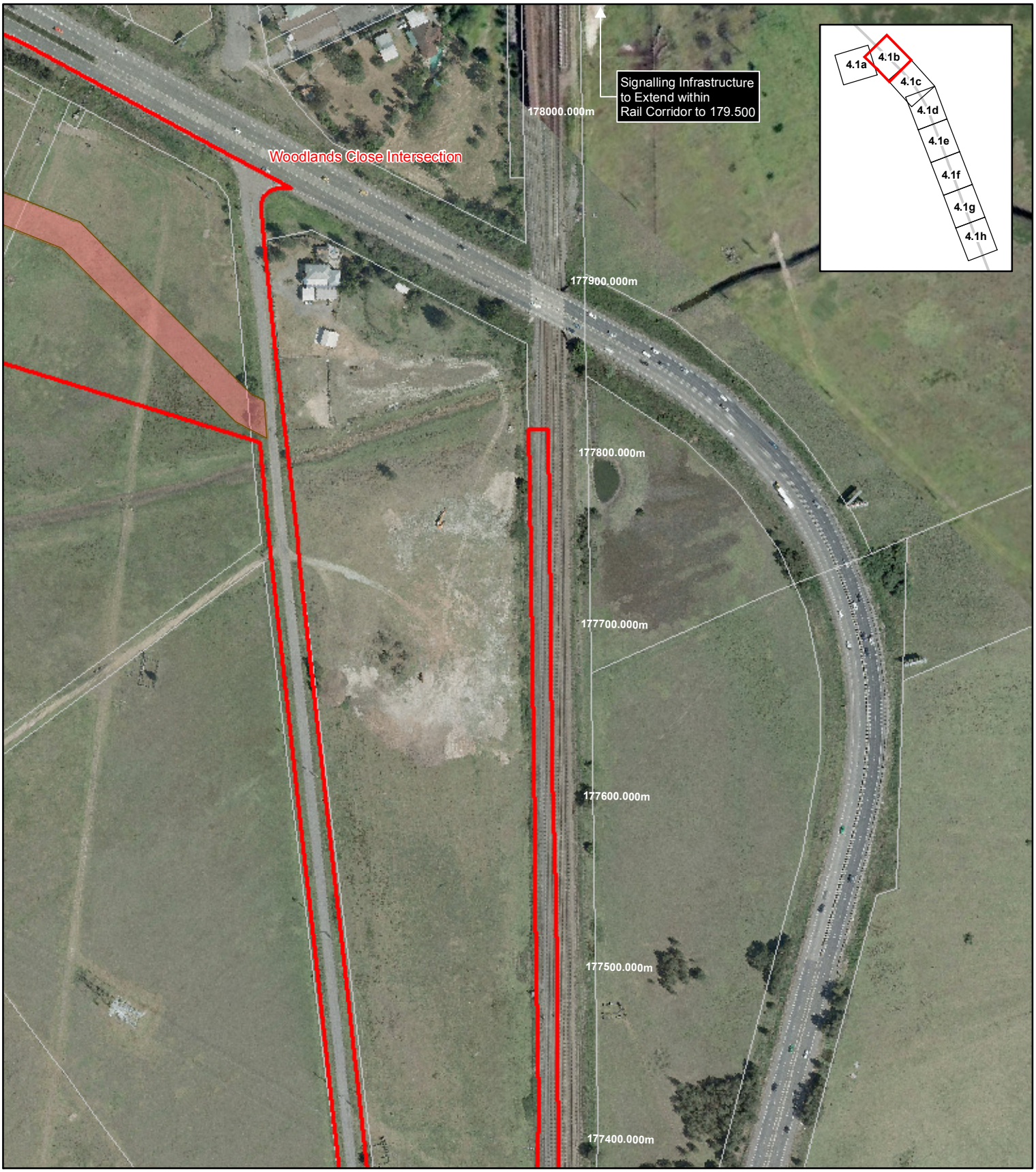

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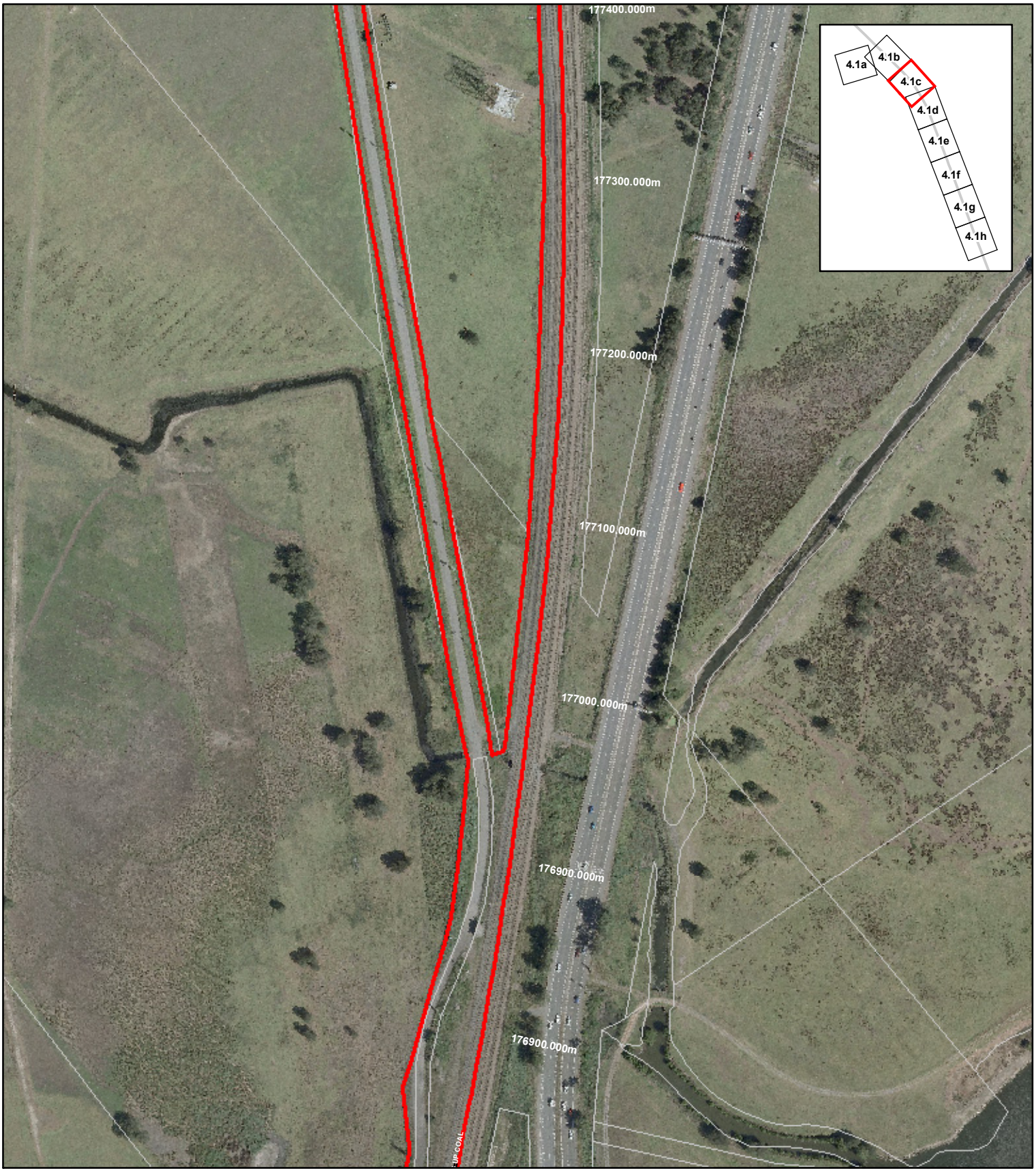
Key Project Features

Figure 4.1b



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Key Project Features

Figure 4.1c

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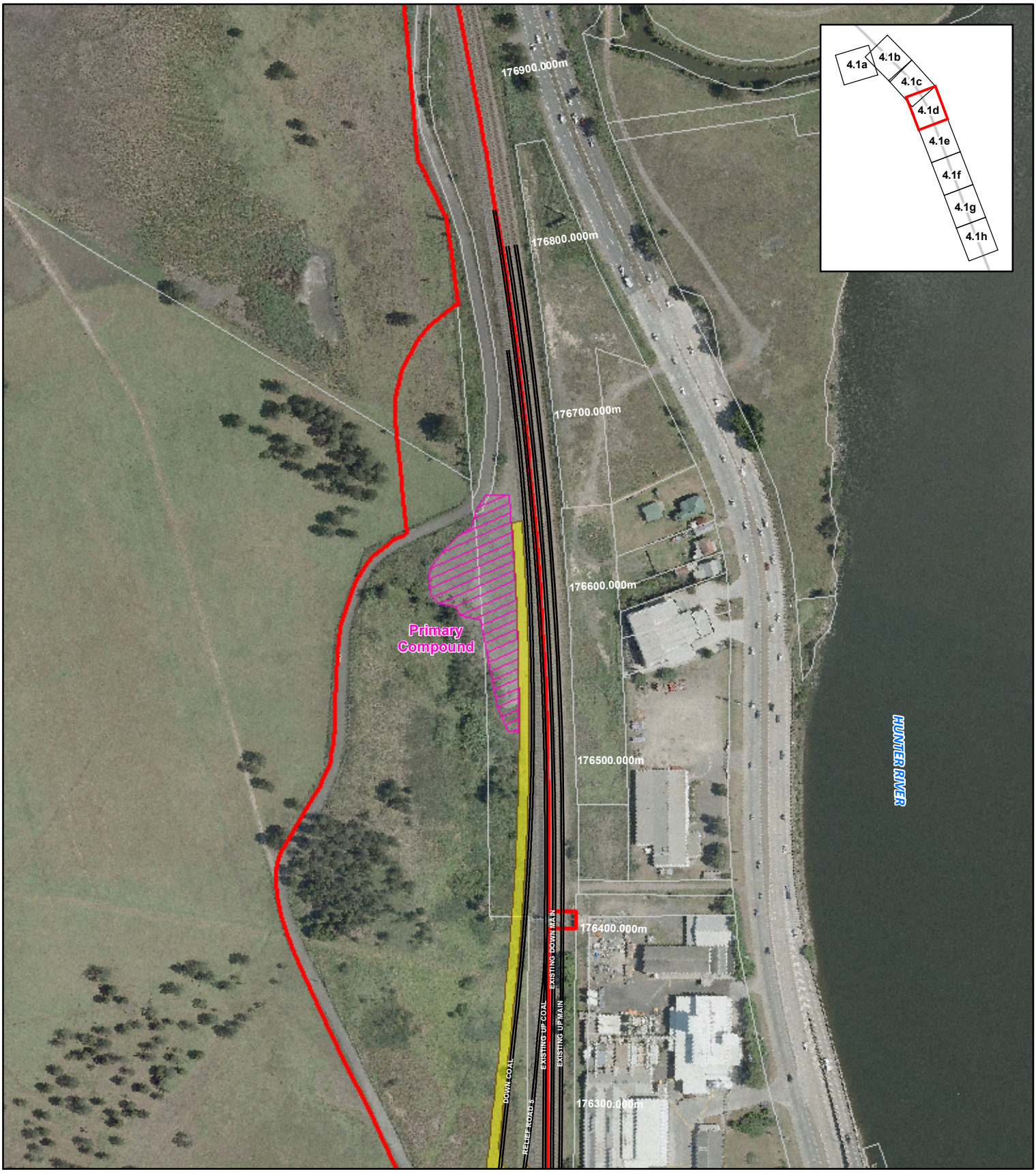

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Scale	1:3,000

Key Project Features

Figure 4.1d

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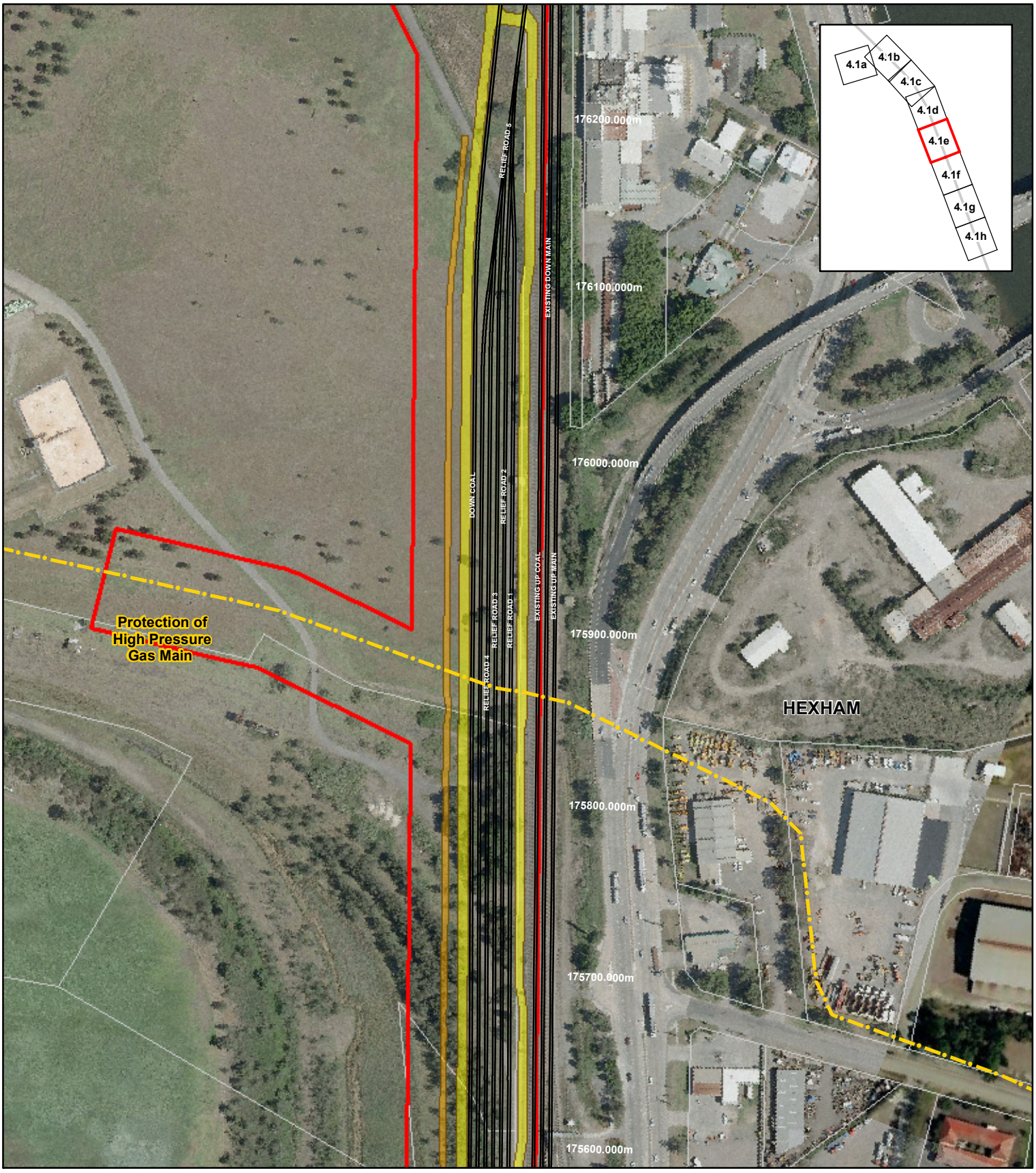

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Revision	A7
Date	03.05.2012
Scale	1:3,000

Key Project Features

Figure 4.1e

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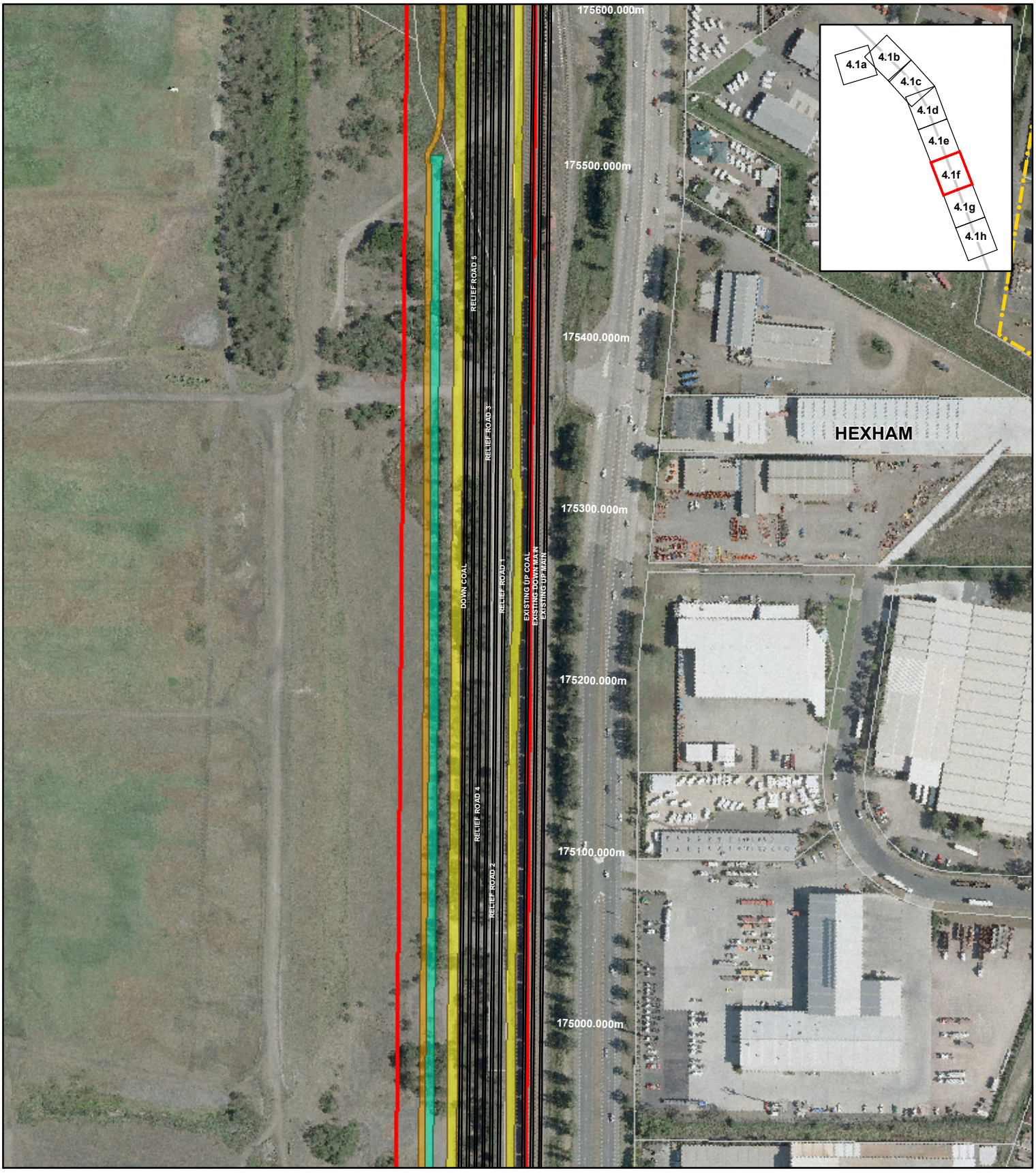

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Job Number	21105015
Revision	A7
Date	03.05.2012
Scale	1:3,000

Key Project Features

Figure 4.1f

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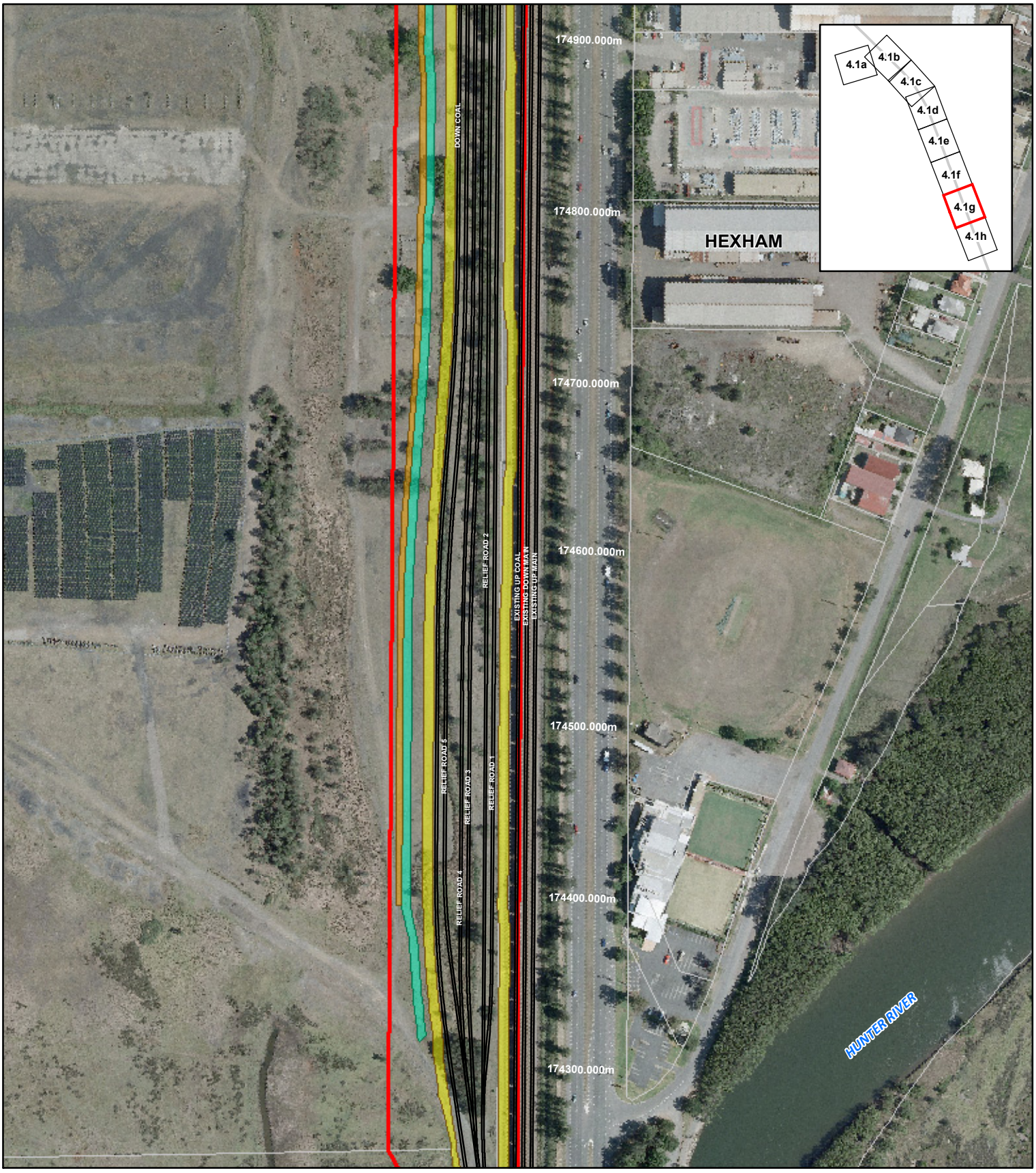

- Jemena Gas Pipeline
- Relief Roads
- Proposed Tarro Interchange Access
- Project Area
- Cadastre
- Proposed Compound Area
- Proposed Vehicular Access
- Proposed Vehicular Access to Lot 312 DP 58724
- Indicative Tarro Interchange Access
- Swale Drain

A4 Original

0 30 60 120

Metres

GDA 1994 MGA Zone 56

N

UHVA

ARTC

ARTC
Hexham Relief Roads

Job Number	21105015
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Key Project Features

Figure 4.1g

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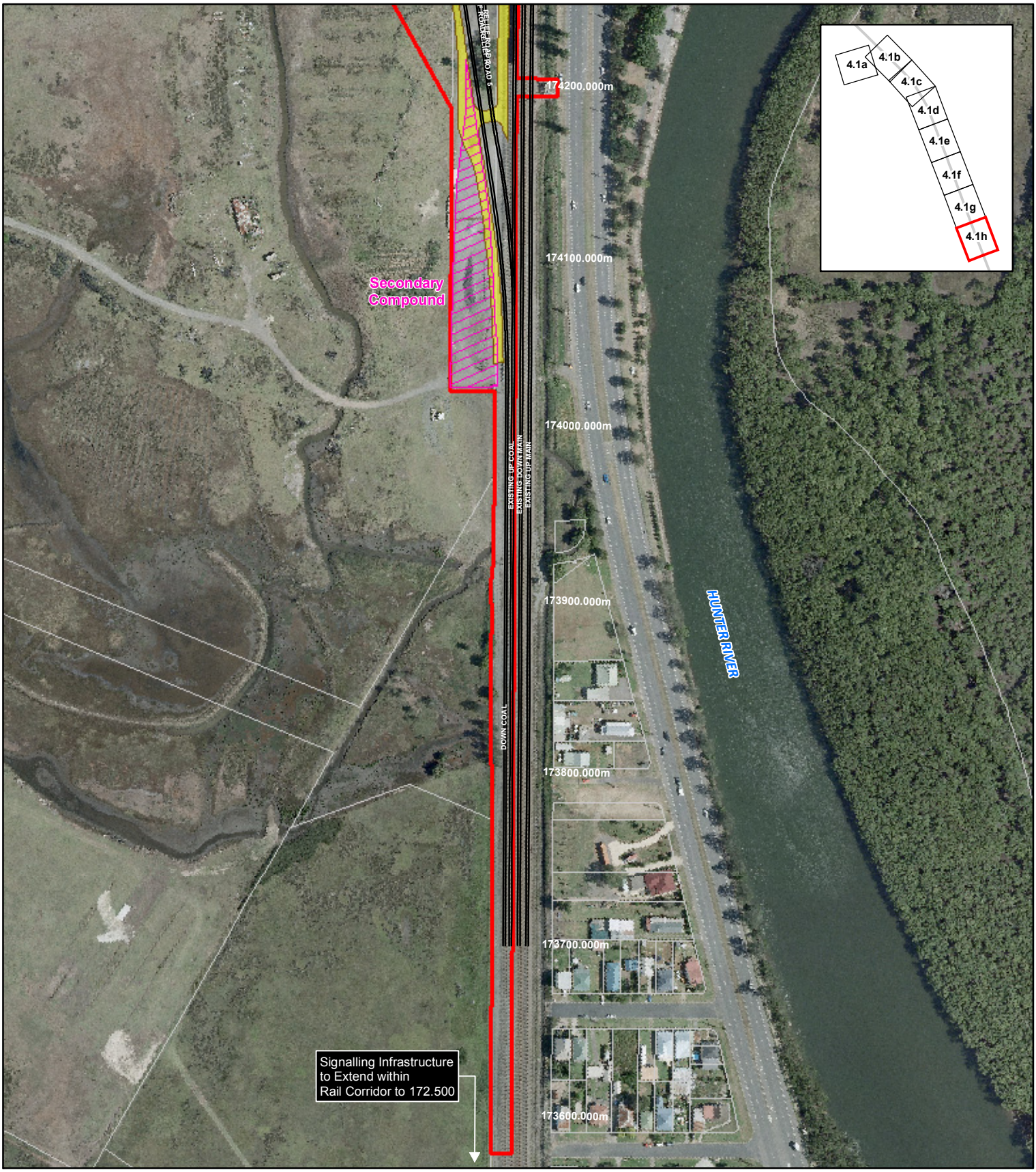

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Key Project Features

Figure 4.1h

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Appendix B

Capacity assessment criteria

Assessment criteria

Intersection

The operation of the proposed new key intersection was assessed using the SIDRA intersection modelling software. SIDRA calculates intersection performance measures including:

- level of service
- degree of saturation
- average delay
- maximum queue length.

Level of service

Level of service (LoS) is one of the basic performance parameters used to describe the operation of an intersection. The levels of service range from A (indicating good intersection operation) to F (indicating over saturated conditions with long delays and queues). At signalised and roundabout intersections, the LoS criteria are related to average intersection delay (seconds per vehicle). At priority controlled intersections, the LoS is based on the average delay (seconds per vehicle) for the worst movement.

Degree of saturation

Degree of saturation (DoS) is defined as the ratio of demand flow to capacity, and therefore has no unit. As it approaches 1.0, extensive queues and delays could be expected. For DoS greater than 1.0, a small increment in traffic volumes would result in an exponential increase in delays and queue length. The intersection DoS is based on the movement with the highest ratio for all types of intersection.

Average delay

Delay is the difference between interrupted and uninterrupted travel times through the intersection and is measured in seconds per vehicle. The delays include queued vehicles decelerating and accelerating to and/or from stop, as well as delays experienced by all vehicles negotiating the intersection. At signalised and roundabout intersections, the average intersection delay is usually reported and is taken as the weighted average delay by summing the product of the individual movement traffic volume and its corresponding calculated delays, and dividing by the total traffic volume at the intersection. At priority controlled intersections, the average delay for the worse movement is usually reported.

Maximum queue length

Queue length is measured in metres reflecting the number of vehicles waiting at the stop line and is usually quoted as the 95^{th} percentile back of queue, which is the value below which 95% of all observed queue lengths fall. It reflects the number of vehicles per traffic lane at the start of the green period, when traffic starts moving again after a red signal. The intersection queue length is usually taken from the movement with the longest queue length.

Table A1 Level of service criteria for intersections

Level of Service	Average delay (seconds per vehicle)	Traffic signals, roundabout	Give Way and Stop signs
A	Less than 14	good operation	good operation
B	15 to 28	good with acceptable delays and spare capacity	acceptable delays and spare capacity
C	29 to 42	satisfactory	satisfactory, but accident study required
D	43 to 56	operating near capacity	near capacity and accident study required
E	57 to 70	at capacity at signals; incidents will cause excessive delays; roundabouts require other control mode	at capacity; requires other control mode
F	Greater than 71	unsatisfactory with excessive queuing	unsatisfactory with excessive queuing; requires other control mode

Source: Roads and Traffic Authority 2002, *Guide to Traffic Generating Developments*

Mid-block level of service descriptions

Source: Highway Capacity Manual 2000, Section 12-7

Each of these measures indicates how well the highway accommodates traffic flow.

Density is the assigned primary performance measure for estimating LoS. The three measures of speed, density, and flow or volume are interrelated. If the values of two of these measures are known, the remaining measure can be computed.

Los A describes completely free-flow conditions. The operation of vehicles is virtually unaffected by the presence of other vehicles, and operations are constrained only by the geometric features of the highway and by driver preferences. Manoeuvrability within the traffic stream is good. Minor disruptions to flow are easily absorbed without a change in travel speed.

LOS B also indicates free flow, although the presence of other vehicles becomes noticeable. Average travel speeds are the same as in LOS A, but drivers have slightly less freedom to manoeuvre. Minor disruptions are still easily absorbed, although local deterioration in LOS will be more obvious.

In LOS C, the influence of traffic density on operations becomes marked. The ability to manoeuvre within the traffic stream is clearly affected by other vehicles. On multilane highways with an FFS above 80 km/h, the travel speeds reduce somewhat. Minor disruptions can cause serious local deterioration in service, and queues will form behind any significant traffic disruption.

At LOS D, the ability to manoeuvre is severely restricted due to traffic congestion. Travel speed is reduced by the increasing volume. Only minor disruptions can be absorbed without extensive queues forming and the service deteriorating.

LOS E represents operations at or near capacity, an unstable level. The densities vary, depending on the FFS. Vehicles are operating with the minimum spacing for maintaining uniform flow. Disruptions cannot be dissipated readily, often causing queues to form and service to deteriorate to LOS F. For the majority of multilane highways with FFS between 70 and 100 km/h, passenger-car mean speeds at capacity range from 68 to 88 km/h but are highly variable and unpredictable.

LOS F represents forced or breakdown flow. It occurs either when vehicles arrive at a rate greater than the rate at which they are discharged or when the forecast demand exceeds the computed capacity of a planned facility. Although operations at these points — and on sections immediately downstream — appear to be at capacity, queues form behind these breakdowns. Operations within queues are highly unstable, with vehicles experiencing brief periods of movement followed by stoppages. Travel speeds within queues are generally less than 48 km/h. Note that the term LOS F may be used to characterise both the point of the breakdown and the operating condition within the queue.

Although the point of breakdown causes the queue to form, operations within the queue generally are not related to deficiencies along the highway segment.

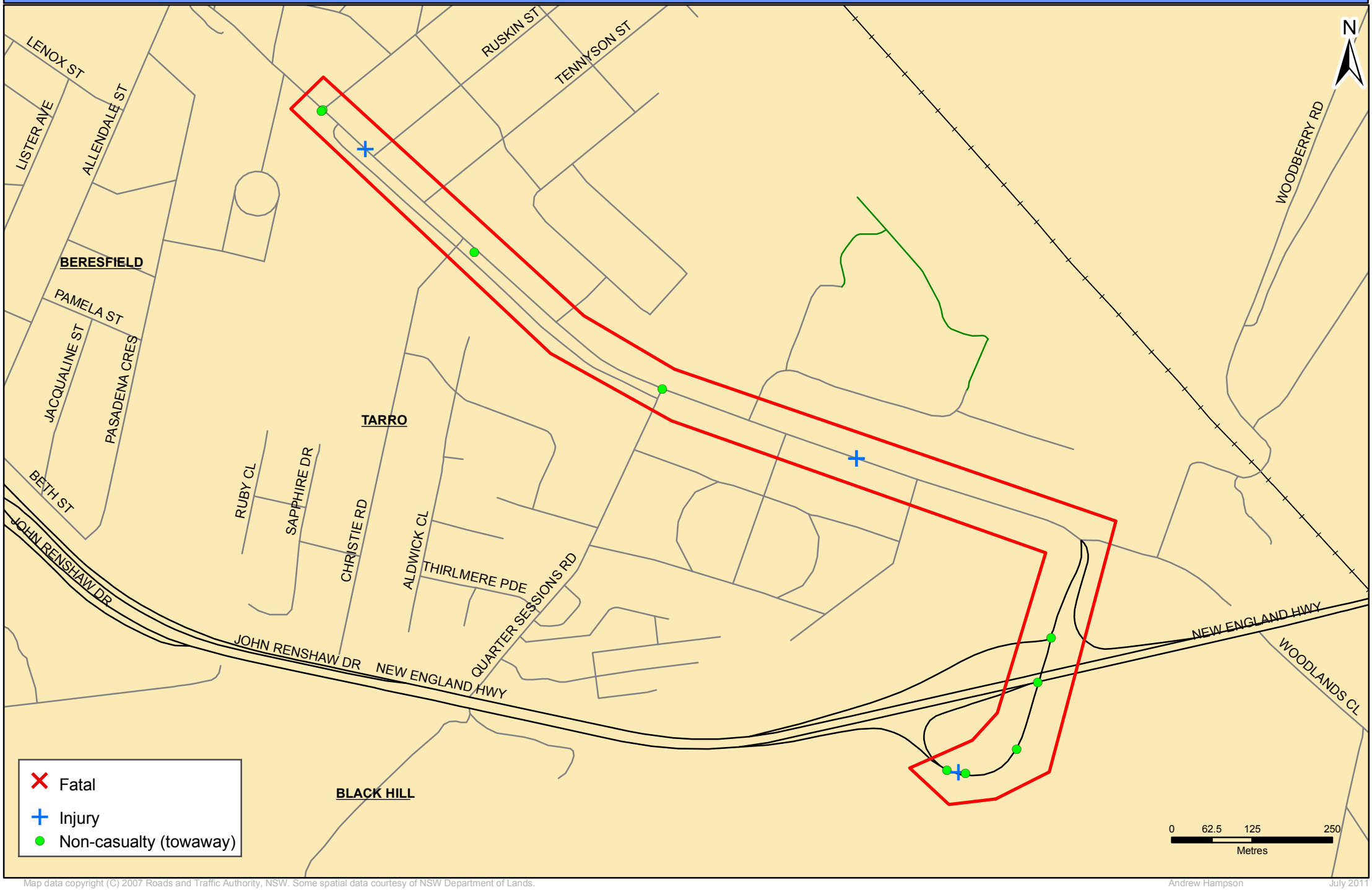
Appendix C

RMS crash data

Anderson Dr, NEH to Lawson Ave, Beresfield

Crash period 1/1/2005 to 30/6/2010 (Finalised Data)

plus provisional data (which is incomplete & subject to change) to date



Andrew Hampson

July 2011

Detailed Crash Report - sorted

RTA

Crash No.	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
Natural Lighting																				**S F**
Hunter Region				**Newcastle City LGA**		**Tarro**						**Anderson Dr**								
471569	04/04/2005	Mon	19:00	270 m S	NEW ENGLAND HWY	OTH	CRV	Raining	Wet	60	1	M/C	M65	N in ANDERSON DR	20 Proceeding in lane		I	0	1	S
E24188653					Darkness	DCA: 805		Out of control on bend												
Hunter Region				**Newcastle City LGA**		**Tarro**						**Anderson Dr**								
499582	30/11/2005	Wed	15:30	200 m S	NEW ENGLAND HI OP	2WY	CRV	Raining	Wet	70	1	TRK	F50	N in ANDERSON DR	30 Proceeding in lane		N	0	0	S
E26104767					Daylight	DCA: 802 R		Off cway left bend												
Hunter Region				**Newcastle City LGA**		**Beresfield**						**Anderson Dr**								
609349	16/02/2008	Sat	20:20	at	LAWSON AVE	TJN	STR	Fine	Wet	50	2	CAR	M42	W in ANDERSON DR	20 Turning right		N	0	0	
E32627125					Darkness	DCA: 202		Opp - Right-thru				CAR	F19	E in ANDERSON DR	30 Proceeding in lane					
Hunter Region				**Newcastle City LGA**		**Tarro**						**Anderson Dr**								
618660	05/04/2008	Sat	17:10	30 m E	CHIRSTIE RD	2WY	STR	Fine	Dry	50	2	CAR	M37	E in ANDERSON DR	50 Proceeding in lane		N	0	0	
E33335861					Daylight	DCA: 703		Left off cway into object				CAR		E in ANDERSON DR	0 Parked					
Hunter Region				**Newcastle City LGA**		**Tarro**						**Anderson Dr**								
619261	16/04/2008	Wed	16:45	at	NEW ENGLAND HI OP	2WY	CRV	Raining	Wet	60	1	CAR	M17	N in ANDERSON DR	50 Proceeding in lane		N	0	0	S
E33895007					Daylight	DCA: 804 R		Off left bend into obj				Fence								
Hunter Region				**Newcastle City LGA**		**Beresfield**						**Anderson Dr**								
628618	22/06/2008	Sun	17:10	at	LAWSON AVE	TJN	STR	Fine	Dry	60	2	4WD	F37	W in ANDERSON DR	20 Turning right		N	0	0	
E34515871					Dusk	DCA: 202		Opp - Right-thru				CAR	F38	E in ANDERSON DR	50 Proceeding in lane					
Hunter Region				**Newcastle City LGA**		**Tarro**						**Anderson Dr**								
641994	21/10/2008	Tue	10:00	100 m W	EASTERN AVE	2WY	STR	Overcast	Dry	60	2	WAG	M72	E in ANDERSON DR	5 Perform U-turn		I	0	1	
E36055941					Daylight	DCA: 401		Manov - Leaving parking				4WD	M40	E in ANDERSON DR	50 Proceeding in lane					
Hunter Region				**Newcastle City LGA**		**Tarro**						**Anderson Dr**								
649554	11/12/2008	Thu	18:00	at	WESTERN AVE	TJN	STR	Fine	Dry	50	2	VAN	F42	E in ANDERSON DR	50 Proceeding in lane		N	0	0	
E69295001					Daylight	DCA: 303		Same - Rear right				CAR	F32	E in ANDERSON DR	0 Wait turn right					
Hunter Region				**Newcastle City LGA**		**Tarro**						**New England Hwy**								
689190	06/11/2009	Fri	08:30	470 m S	ANDERSON DR	OTH	CRV	Raining	Wet	50	2	UTE	U U	S in NEW ENGLAND HWY	Unk Proceeding in lane		N	0	0	
E39279649					Daylight	DCA: 301		Same - Rear end				CAR	M27	S in NEW ENGLAND HWY	10 Proceeding in lane					
Hunter Region				**Newcastle City LGA**		**Tarro**						**New England Hwy**								
713260	23/04/2010	Fri	16:00	at	NEW ENGLAND HWY	TJN	STR	Fine	Dry	50	2	CAR	M33	E in NEW ENGLAND HWY	15 Turning right		N	0	0	
E40908303					Daylight	DCA: 104		Adj - Right-thru from right				TRK	M22	N in NEW ENGLAND HWY	50 Proceeding in lane					

Detailed Crash Report - sorted

RTA

Crash No.	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
Natural Lighting																				**S F**
Hunter Region				**Newcastle City LGA**		**Tarro**				**Anderson Dr**										
708294	30/04/2010	Fri	15:40	110 m S	NEW ENGLAND HI OP	OTH	CRV	Raining	Wet	50	2	CAR	F48	S in ANDERSON DR	Unk	Incorrect side	N	0	0	S
E40560775				Daylight		DCA: 201		Opp - Head on				CAR	F32	N in ANDERSON DR	Unk	Proceeding in lane				
Hunter Region				**Newcastle City LGA**		**Tarro**				**Anderson Dr**										
727651	07/08/2010	Sat	22:00	100 m W	EASTERN AVE	2WY	STR	Fine	Dry	50	2	WAG	U U	E in ANDERSON DR	Unk	Proceeding in lane	I	0	1	
E44372680				Darkness		DCA: 6		Ped - Facing traffic				PED	M29	W in ANDERSON DR		Walk against traffic				
Hunter Region				**Newcastle City LGA**		**Beresfield**				**Anderson Dr**										
751736	08/05/2011	Sun	19:50	90 m E	LAWSON AVE	2WY	STR	Fine	Dry	60	1	UTE	M24	E in ANDERSON DR	Unk	Pull out opposite	I	0	1	
E204925893				Darkness		DCA: 502		Ovtak - Out of control												

Report Totals: Total Crashes: 13 Fatal Crashes: 0 Injury Crashes: 4 Killed: 0 Injured: 4

Crashid dataset Anderson Dr, NEH to Lawson Ave, Beresfield - crash data 1/1/2005 to 30/6/2010 plus provisional data to date

Note: Ordered by: Crash Date,Crash Time,Crash No. Data for the 9 month period prior to the generated date of this report are incomplete and are subject to change.