Appendix P

Traffic impact assessment

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Narrabri Gas Project

Traffic Impact Assessment

August 2016

Glossary

Term	Definition
ABARE	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
AEMO	Australian Energy Market Operator
AHIMS	Aboriginal Heritage Information Management System
APIA	Australian Pipeline Industry Association
AS	Australian Standard
BSAL	Biophysical Strategic Agricultural Land
CECs	Critically Endangered Communities
CH_4	Methane
CIC	Critical Industry Cluster
CMA	Catchment Management Authority
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Coolah LEP	*Coolah Local Environmental Plan 2000*
Coonabarabran LEP	*Coonabarabran Local Environmental Plan 1990*
CSIRO	Commonwealth Scientific and Industrial Research Organisation
dBA	Decibels (A-weighted)
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DoP	(Then) NSW Department of Planning (now Planning and Environment)
DPI	(Then) NSW Department of Planning and Infrastructure (now Planning and Environment)
DRE	Division of Resources and Energy (within the NSW Department of Trade and Investment, Regional Infrastructure, and Services
DTIRIS	NSW Department of Trade and Investment, Regional Infrastructure, and Services
EECs	Endangered Ecological Communities
EIS	Environmental Impact Statement
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPA	Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
ESG	Eastern Star Gas Limited
FM Act	NSW *Fisheries Management Act 1994*
GHG	Greenhouse Gas
Gunnedah LEP	*Gunnedah Local Environmental Plan 2012*
ICOMOS	Australia International Council on Monuments and Sites
Infrastructure SEPP	NSW *State Environmental Planning Policy (Infrastructure) 2007*
LALC	Local Aboriginal Land Council
Landholder	Freehold, State or Crown land

Term	Definition
LEP	Local Environmental Plan
LGA	Local Government Area
Mining SEPP	NSW *State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007*
ML	Megalitre
NHMRC	National Health and Medical Research Council
MNES	Matters of National Environmental Significance
Narrabri LEP	*Narrabri Local Environmental Plan 2012*
NO_x	Nitrogen Oxides
NPW Act	NSW *National Parks and Wildlife Act 1974*
NSW	New South Wales
NSW Office of Water	A division within the NSW Department of Primary Industries
PAL	Petroleum Assessment Lease
PEL	Petroleum Exploration License
PEA	Preliminary Environmental Assessment
Petroleum Act	NSW *Petroleum (Onshore) Act 1991*
Pipelines Act	NSW *Pipelines Act 1967*
PJ	Petajoules
POEO Act	NSW *Protection of the Environment Operations Act 1997*
PPEOP	Petroleum Production Environment Operations Plan
PPL	Petroleum Production Lease
REF	Review of Environmental Factors
Roads Act	NSW *Roads Act 1993*
RBLs	Rating Background Levels
RFS	Rural Fire Service
RMS	NSW Roads and Maritime Services
Santos	Santos NSW (Eastern) Pty Ltd
SEPP	State Environmental Planning Policy
SO_2	Sulphur Dioxide
State and Regional Development SEPP	*State Environmental Planning Policy (State and Regional Development) 2011*
SQAD	Santos Quality Asset Development
SRLUP	Strategic Regional Land Use Policy
TJ	Terajoules
TSC Act	NSW *Threatened Species Conservation Act 1995*
VOC	Volatile organic compound
WAL	Water Access Licence
WARR Act	NSW *Waste Avoidance and Resource Recovery Act 2001*
WM Act	NSW *Water Management Act 2000*

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1. Introduction

1.1 Overview

The Proponent is proposing to develop natural gas in the Gunnedah Basin in New South Wales (NSW), southwest of Narrabri (refer Figure 1-1).

The Narrabri Gas Project (the project) seeks to develop and operate a gas production field, requiring the installation of gas wells, gas and water gathering systems, and supporting infrastructure. The natural gas produced would be treated at a central gas processing facility on a local rural property (Leewood), approximately 25 kilometres south-west of Narrabri. The gas would then be piped via a high-pressure gas transmission pipeline to market. This pipeline would be part of a separate approvals process and is therefore not part of this development proposal.

The primary objective of the project is to commercialise natural gas to be made available to the NSW gas market and to support the energy security needs of NSW. Production of natural gas from coal seams under the project would deliver economic, environmental and social benefits to the Narrabri region and the broader NSW community. The key benefits of the project can be summarised as follows:

- Development of a new source of gas supply into NSW would lead to an improvement in energy security and independence to the State. This would give NSW gas markets greater choice when entering into gas purchase arrangements. Potential would also exist for improved competition on price. Improved competition on price would have flow on benefits for NSW's economic efficiency, productivity and prosperity.
- The provision of a reduced greenhouse gas emission fuel source for power generation in NSW as compared to traditional coal-fired power generation.
- Increased local production and regional economic development through employment and provision of services and infrastructure to the project.
- The establishment of a regional community benefit fund equivalent to five per cent of the royalty payment made to the NSW Government within the future production licence area. If matched by the NSW Government, the fund could reach $120 million over the next two decades.

1.2 Description of the project

The project would involve the construction and operation of a range of exploration and production activities and infrastructure including the continued use of some existing infrastructure. The key components of the project are presented in Table 1-1 and are shown on Figure 1-1.

Table 1-1 Key project components

Component	Infrastructure or activity
Major facilities	
Leewood	• a central gas processing facility for the compression, dehydration and treatment of gas • a central water management facility including storage and treatment of produced water and brine • optional power generation for the project • a safety flare • treated water management infrastructure to facilitate the transfer of treated water for irrigation, dust suppression, construction and drilling activities • other supporting infrastructure including storage and utility buildings, staff amenities, equipment shelters, car parking, and diesel and chemical storage • continued use of existing facilities such as the brine and produced water ponds • operation of the facility
Bibblewindi	• in-field compression facility • a safety flare • supporting infrastructure including storage and utility areas, treated water holding tank, and a communications tower • upgrades and expansion to the staff amenities and car parking • produced water, brine and construction water storage, including recommissioning of two existing ponds • continued use of existing facilities such as the 5 ML water balance tank • operation of the expanded facility
Bibblewindi to Leewood infrastructure corridor	• widening of the existing corridor to allow for construction and operation of an additional buried medium pressure gas pipeline, a water pipeline, underground (up to 132 kV) power, and buried communications transmission lines
Leewood to Wilga Park underground power line	• installation and operation of an underground power line (up to 132 kV) within the existing gas pipeline corridor
Gas field	
Gas exploration, appraisal, and production infrastructure	• seismic geophysical survey • installation of up to 850 new wells on a maximum of 425 well pads – new well types would include exploration, appraisal and production wells – includes well pad infrastructure • installation of water and gas gathering lines and supporting infrastructure • construction of new access tracks where required • water balance tanks • communications towers • conversion of existing exploration and appraisal wells to production

Component	Infrastructure or activity
Ancillary	• upgrades to intersections on the Newell Highway • expansion of worker accommodation at Westport • a treated water pipeline and diffuser from Leewood to Bohena Creek • treated water irrigation infrastructure including: – pipeline(s) from Leewood to the irrigation area(s) – treated water storage dam(s) offsite from Leewood • operation of the irrigation scheme

The project is expected to generate approximately 1,300 jobs during the construction phase and sustain around 200 jobs during the operational phase; the latter excluding an ongoing drilling workforce comprising approximately 100 jobs.

Subject to obtaining the required regulatory approvals, and a financial investment decision, construction of the project is expected to commence in early 2018, with first gas scheduled for 2019/2020. Progressive construction of the gas processing and water management facilities would take around three years and would be undertaken between approximately early/mid-2018 and early/mid-2021. The gas wells would be progressively drilled during the first 20 or so years of the project. For the purpose of impact assessment, a 25-year construction and operational period has been adopted.

1.3 Project location

The project would be located in north-western NSW, approximately 20 kilometres south-west of Narrabri, within the Narrabri local government area (LGA) (see Figure 1-1).

The project area covers about 950 square kilometres (95,000 hectares), and the project footprint would directly impact about one per cent of that area.

The project area contains a portion of the region known as 'the Pilliga', which is an agglomeration of forested area covering more than 500,000 hectares in north-western NSW around Coonabarabran, Baradine and Narrabri. Nearly half of the Pilliga is allocated to conservation, managed under the NSW *National Parks and Wildlife Act 1974*. The Pilliga has spiritual meaning and cultural significance for the Aboriginal people of the region.

Other parts of the Pilliga were dedicated as State forest, and set aside for the purpose of 'forestry, recreation and mineral extraction, with a strategic aim to "provide for exploration, mining, petroleum production and extractive industry" under the *Brigalow and Nandewar Community Conservation Area Act 2005*. The parts of the project area on state land are located within this section of the Pilliga.

The semi-arid climate of the region and general unsuitability of the soils for agriculture have combined to protect the Pilliga from widespread clearing. Commercial timber harvesting activities in the Pilliga were preceded by unsuccessful attempts in the mid-1800s to establish a wool production industry. Resource exploration has been occurring in the area since the 1960s; initially for oil, but more recently for coal and gas.

The ecology of the Pilliga has been fragmented and otherwise impacted by commercial timber harvesting and related activities over the last century through:

- the establishment of more than 5,000 kilometres of roads, tracks and trails
- the introduction of pest species
- the occurrence of drought and wildfire.

The project area avoids the Pilliga National Park, Pilliga State Conservation Area, Pilliga Nature Reserve and Brigalow Park Nature Reserve. Brigalow State Conservation Area is within the project area but would be protected by a 50 metre surface exclusion zone.

Agriculture is a major land use within the Narrabri LGA; about half of the LGA is used for agriculture, split between cropping and grazing. Although the majority of the project area would be within State forests, much of the remaining area is situated on agricultural land that supports dry-land cropping and livestock. No agricultural land in the project area is mapped by the NSW Government to be biophysical strategic agricultural land (BSAL) and detailed soil analysis has established the absence of BSAL. This has been confirmed by the issuance of a BSAL Certificate for the project area by the NSW Government.

1.4 Planning framework and structure of this report

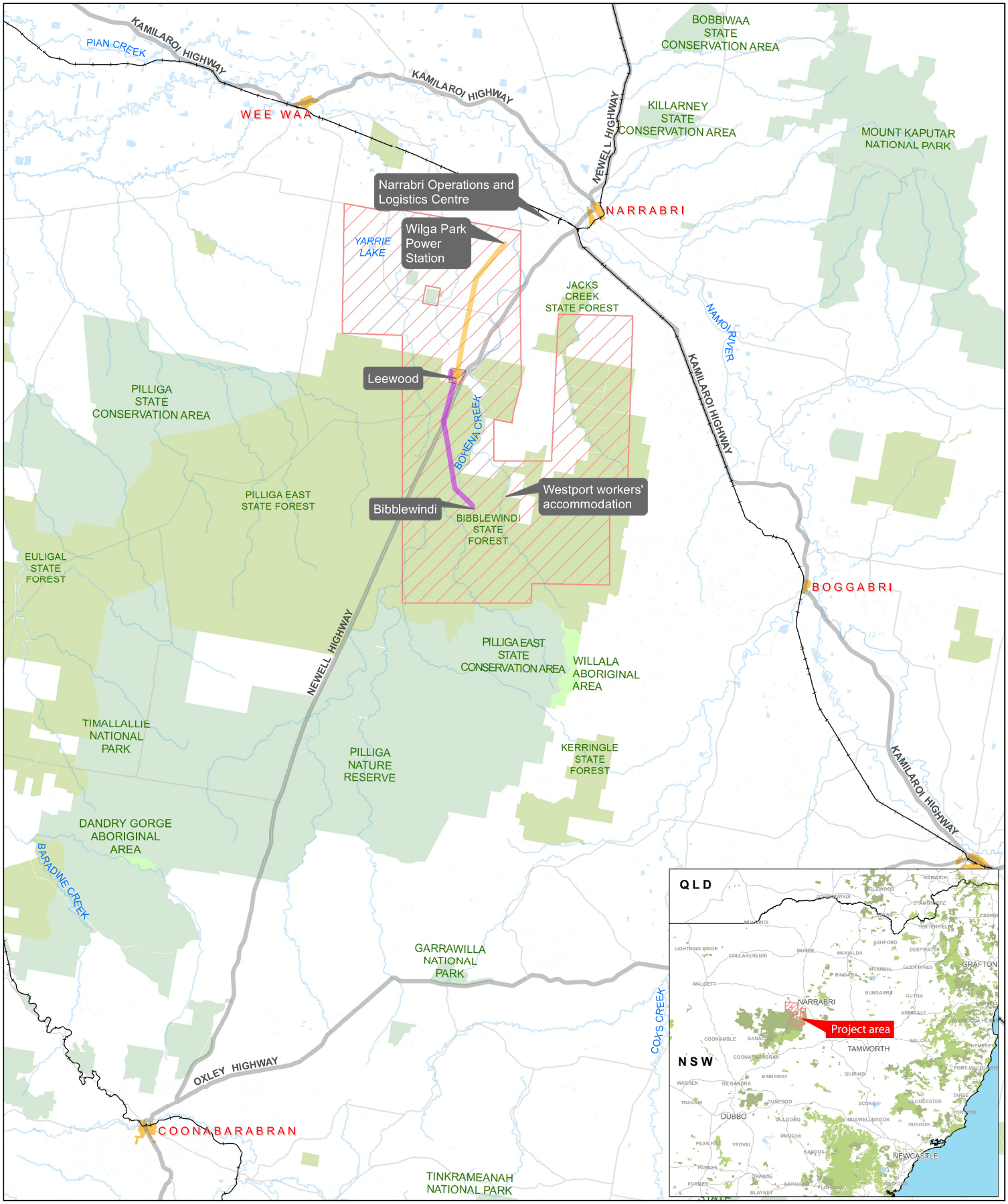
1.4.1 Planning framework

The project is permissible with development consent under the *State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007*, and is identified as 'State significant development' under section 89C(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *State Environmental Planning Policy (State and Regional Development) 2011*.

The project is subject to the assessment and approval provisions of Division 4.1 of Part 4 of the EP&A Act. The Minister for Planning is the consent authority, who is able to delegate the consent authority function to the Planning Assessment Commission, the Secretary of the Department of Planning and Environment or to any other public authority.

The project is also a controlled action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The project was declared to be a controlled action on 5 December 2014, to be assessed under the bilateral agreement between the Commonwealth and NSW Governments, and triggering the following controlling provisions:

- listed threatened species and ecological communities
- a water resource, in relation to coal seam gas development and large coal mining development
- Commonwealth land.



LEGEND

- Project area
- Leewood
- Urban Areas
- State forest
- Parks and reserves
- Aboriginal areas
- Lakes and dams
- Watercourses
- Highways
- Major Roads
- Train line
- Leewood to Wilga Park infrastructure corridor
- Bibblewindi to Leewood infrastructure corridor

0 5 10 20
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Narrabri Gas Project
EIS Technical Appendix Traffic and Transport

Regional context and location of key infrastructure

Job Number 21-22463
Revision A
Date 12 Mar 2015

Figure 1-1

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Data source: NSW Department of Lands: DTDB and DCDB - 2012-13. Santos: Operational and Base Data - 2013. Created by: afoddy

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This Traffic Impact Assessment identifies the potential environmental issues associated with construction and operation of the project and addresses the Secretary's environmental assessment requirements for the project (see Section 2.1).The assessment will be used to support the EIS for the project. The requirements addressed in this report include:

- an assessment of traffic and transport impacts associated with the proposed construction arrangements
- an assessment of traffic and transport impacts associated with the proposed construction arrangements

1.4.2 Structure of report

- **Chapter 1 – Introduction.** This chapter introduces the project and the proponent and describes the project area
- **Chapter 2 – Methodology.** This chapter defines the study area assessed in this report and describes the steps undertaken in the assessment
- **Chapter 3 – Legislative context.** This chapter outlines the relevant Commonwealth and State legislation relating to the assessment. Guidelines and assessment criteria (where applicable) relevant to the gas field construction, operation and decommissioning are also identified.
- **Section 4 - Existing environment.** This chapter provides a review of existing road features, adjacent developments, traffic volumes, sight distances and crash data
- **Section 5 - Construction arrangements.** This chapter details the additional traffic generated as a result of construction and operation of the gas field.
- **Section 6 - Impact assessment:** This chapter examines the potential traffic and transport impacts associated with the construction and operation of the project
- **Chapter 7 – Mitigation measures.** This chapter outlines the proposed mitigation strategies to be implemented during the life of the project to manage the potential environmental impacts
- **Section 8 – Risk management.** provides an understanding of risks identified in the risk management workshop and mitigation measures to improve the risk rating
- **Chapter 9 – Conclusion.** This chapter presents a conclusion to the report and presents the next steps in the advancement of the project.

2. Methodology

This section outlines the methodology and evaluation criteria used in the assessment of the project.

2.1 Scope

This report provides an assessment of traffic impacts during the construction and operational stages of the project. It identifies any mitigation measures to address identified impacts. It focuses on the traffic implications from haulage of material required by the project along the road network; and the transporting of plant, equipment and vehicular traffic generated by construction employees. The report focuses on the ultimate peak scenario during this period and the overall effect on the higher order road network.

Traffic generation associated with decommissioning activities for the project will be significantly lower than during the peak construction period. Traffic impacts will therefore be reduced during the decommissioning period compared to the construction period.

Secretary's Environmental Assessment Requirements

This report addresses the Secretary's Environmental Assessment Requirements (SEARs), which states that the EIS must address the following specific issues in relation to transport:

> *"**Transport** – including an assessment of the likely transport impacts of the development on the capacity, condition, safety and efficiency of the local and State road network, having regard to Road and Maritime Services' requirements."*

2.2 Consultation

This study has included and taken into consideration consultation with the following road authorities:

- Roads and Maritime Authority
- Narrabri Shire Council
- Forestry NSW.

2.3 Data sources

The investigation of impacts was undertaken as part of a desktop assessment. The desktop assessment included the collection and review of the following data sets:

- A review of aerial photography and other GIS mapping information.
- Existing traffic count data for the Newell Highway obtained from the NSW Roads and Maritime Authority.
- Traffic data for local roads in the Study Area provided by Narrabri Sire Council.
- October 2014 AM and PM peak traffic counts commissioned by GHD at the following intersections:
  - Newell Highway/Tibbereena Street priority controlled intersection;
  - Newell Highway/Mooloobar Street/Old Turrawan Road roundabout; and
  - Newell Highway/Kamilaroi Highway roundabout.

- Roads and Maritime Authority crash data for state and local authority controlled roads in the Study Area. No crash data was provided for the forest roads, including X-Line Road and Old Mill Road.
- Traffic count data for the Newell Highway provided in the *Dewhurst Gas Exploration Traffic and Transport Assessment* report, prepared by GTA in October 2013 (GTA 2013).

2.4 Methodology

This Traffic Impact Assessment (TIA) has been undertaken with reference to *Guide to Traffic Generating Development* (Roads and Maritime, 2002). While not mandatory, the guide provides a process and methodology to undertake the TIA. The traffic operation assessment process outlined in the guide identifies the operating characteristics which need to be compared with agreed performance criteria.

The assessment criteria adopted for this report is outlined in the following sections.

2.4.1 Midblock assessment criteria

Roads are to be assessed based with reference to their general traffic caring capacity and traffic demands. Table 4.5 of the Roads and Maritime *Guide to Traffic Generating Developments* (2002) sets out two-way hourly road capacities for two-lane roads for different levels of service, with a design speed of 100 km/hr, based on different terrain types. The capacity assumes a 60/40 directional split of traffic.

The level of service criteria is shown in Table 2-1. Roads and Maritime generally require Level of Service (LoS) C operations for major roads during weekday peak hours and LoS D for weekend / recreational periods.

Where design speeds of 80 km/hr are used, the resulting capacities are between 85-95% of the figures quoted, depending on the level of service. peak hour flow on two-lane rural roads (veh/hr) (Design speed of 100 km/hr).

The LoS criteria shown in Table 2-1.is based on conditions which are generally represented along the Castlereagh highway, including:

- A 60 / 40 split of traffic during peak periods;
- Level terrain; and
- Wide traffic lanes with shoulders / side clearances of at least 2 metres in width.

Table 2-1 Peak Hour Flow on two-lane rural roads (veh/h) – Design speed of 100 km/h

Terrain	Level of Service	Percent of Heavy Vehicles			
		0	5	10	15
Level	B	630	590	560	530
	C	1030	970	920	870
	D	1630	1550	1480	1410
	E	2630	2500	2390	2290
Rolling	B	500	420	360	310
	C	920	760	650	570
	D	1370	1140	970	700
	E	2420	2000	1720	1510
Mountainous	B	340	230	180	150
	C	600	410	320	260
	D	1050	680	500	400
	E	2160	1400	1040	820

Source: Roads and Maritime Guide to Traffic Generating Developments (2002)

2.4.2 Intersection assessment criteria

The 'Level of Service' (or LoS) is the standard measure used to understand the operational performance of intersections. This is defined as the qualitative assessment of the quantitative effect of factors such as speed, traffic volume, geometric features, delays and freedom of movement. The level of service concept is applied to intersections through measures of effectiveness, as summarised in Table 2-2.

Table 2-2 Measures of Effectiveness for Level of Service Definition for Intersections

Intersection Control	Measure of Effectiveness
Priority controlled	Degree of Saturation Delay to critical movements (sec/vehicle) Queue length for critical movements
Traffic Signals	Average Delay (sec/vehicle) Delay to critical movements Degree of Saturation Cycle Length Queue length for critical movements
Roundabout	Average Delay (sec/vehicle) Delay to critical movements Degree of Saturation Queue length for critical movements

The assessment of intersection operation is based on criteria outlined in Table 2-3, as defined by the NSW Roads and Traffic Authority (*Guide to Traffic Generating Developments*, Roads and Maritime 2002).

Table 2-3 Intersection Level of Service Assessment Criteria

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

Source: Guide to Traffic Generating Developments (Roads and Maritime 2002)
Note:

- *The average delay assessed for signalised intersections is over all movements.*
- *For roundabouts and priority control intersections (with Stop and Give Way signs or operating under the T-junction rule), the critical criterion for assessment is the movement with the highest delay per vehicle.*
- *Average delay is expressed in seconds per vehicle.*

The operational performance of intersections has been assessed using SIDRA Intersection analysis software tool. The Level of Service criteria set by the RMS is outlined in Table 2-3 and it is noted that LoS 'D' is generally an accepted operating condition along urban roads.

2.4.3 Intersection treatment warrant criteria

Guidance on the required intersection design treatments has been sourced from the *Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections*.

2.5 Assumptions and limitations

The TIA for this report has been limited by the following:

- The availability of traffic flow data for roads surrounding the project, as traffic data has not been obtained for all local roads within the study area.
- The availability of crash data for roads surrounding the project, as crash data has not been obtained for all local roads within the study area.
- Assumptions on the construction and operational traffic generated by the project provided by Santos.

A number of assumptions have been included to enable an estimate of traffic generation to be determined. These include:

- Approximately 50 well sets drilled per year.
- A peak of 6 drill rigs and 2 completion rigs to operate at one time.
- A maximum of two drill rigs moving on the same day.
- A drill rig will move approximately every 30 days.
- Standard hours of construction would be 12 hours' shifts (including two hours for travel and 10 hours working), seven days a week. Construction workers are assumed to work 13 days in a fortnight with one week rostered off every three weeks.
- 12 hour shifts for drilling and completion activities with many of the activities operating 24 hours per day.
- Haulage of materials and plant would operate seven days a week, although this would not be continuous throughout the construction period.
- Material and plant deliveries would most likely come from the Port of Brisbane and could include night time deliveries.
- Construction vehicles associated with drilling activities would mobilise at the start of the Project and remain in the construction areas until construction finishes. Therefore, there will be a peak in construction trips to the site at the start of the construction works, with ongoing construction traffic generation limited to the delivery of materials.
- The Leewood Property is considered to be the main logistics base and equipment storage for the main construction period. Other construction sites, including Bibblewindi, would have mainly direct material delivery when required.
- Roads inside the forest area are deemed as Forestry roads. Of these roads, only the X-Line Road has been considered as part of this assessment given the low number of vehicles using these routes.

3. Legislative Framework

3.1 Legislation

The relevant government legislation and planning instruments that determine policy for traffic generating developments are:

- State Environmental Planning Policy (SEPP) Infrastructure 2007.
- Environmental Planning and Assessment Act 1979, Section 90 Matters for Consideration.

3.1.1 Roads and Maritime Guide to Traffic Generating Developments

This study has been prepared in accordance with the *Guide to Traffic Generating Developments* (The Guide) document (Roads and Maritime October 2002) where applicable.

The Guide states that existing daily traffic volumes on roads adjacent to a proposed development should be compared with estimated daily traffic volumes. This enables the functions of roads in the overall hierarchy of roads to be reviewed in the context of the proposed development. This approach has been used to assess this impact of the Proposal on the Newell Highway and surrounding local roads including Mooloobar Street, Yarrie Lake Road, Old Turrawan Road and X-Line Road.

An assessment of the impact of the project to key intersections within the project area has been undertaken based on level of service criteria for intersections provided from the *Guide to Traffic Generating Developments* document, as detailed in Section 2.4.2.

4. Existing Environment

4.1 Overview

This section outlines the existing conditions around the site including traffic conditions on roads in the vicinity of the site. This includes the existing transport and accessibility conditions and the existing road network performance.

4.2 Existing road network characteristics

4.2.1 Functional road hierarchy

Roads are classified according to the functions that they perform. The main purpose of defining a road's functional class is to provide a basis for establishing the policies, which guide the management of the road according to their intended service or qualities. Functional road classification involves the relative balance of the mobility and access functions.

NSW Roads and Maritime Services (Roads and Maritime) define four levels in a typical functional road hierarchy, ranking from high mobility and low accessibility, to high accessibility and low mobility. These road classes are:

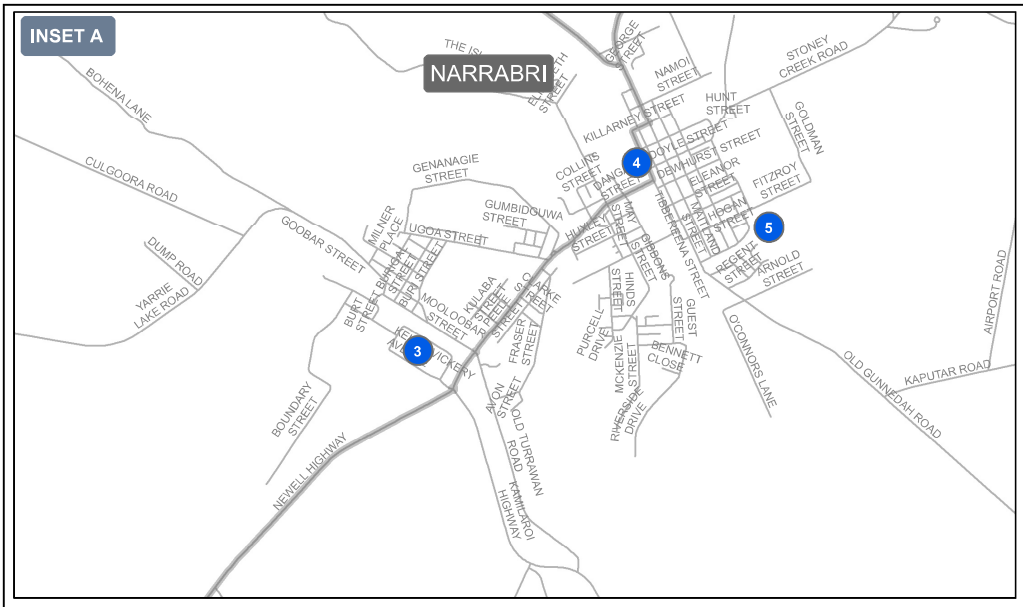
- **Arterial roads** – controlled by Roads and Maritime Services, typically no limit in flow and designed to carry vehicles long distance between regional centres.
- **Sub-Arterial roads** – can be managed by either Roads and Maritime Services or council. Typically, their operating capacity ranges between 10,000 and 20,000 vehicles per day, and their aim is to carry through traffic between specific areas in a sub region, or provide connectivity from arterial road routes (regional links).
- **Collector roads** – provide connectivity between local sites and the-arterial road network, and typically carry between 2,000 and 10,000 vehicles per day.
- **Local roads** – provide direct access to properties and the collector road system and typically carry between 500 and 4,000 vehicles per day.

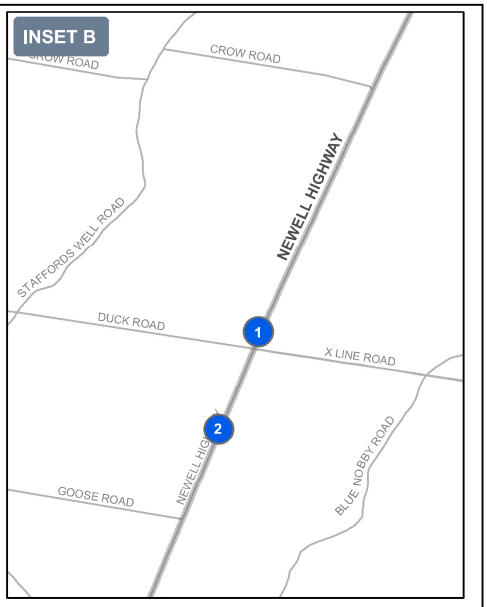
The road network, along with photographs of key roads, is shown at Figure 4-1.

4.2.2 A39 Newell Highway

The A39 Newell Highway is a National Highway and arterial Road. It is part of a major north-south transport corridor which links NSW with both Queensland to the north and Victoria to the south. Newell Highway in the vicinity of X-Line Road has the following characteristics:

- the carriageway is sealed with one lane in each direction that is undivided
- the carriageway is around 7 metres wide, with a 0.5 metre sealed shoulder
- it carries around 1,900 vehicles per day
- It has a sign posted speed limit of 110 km/h



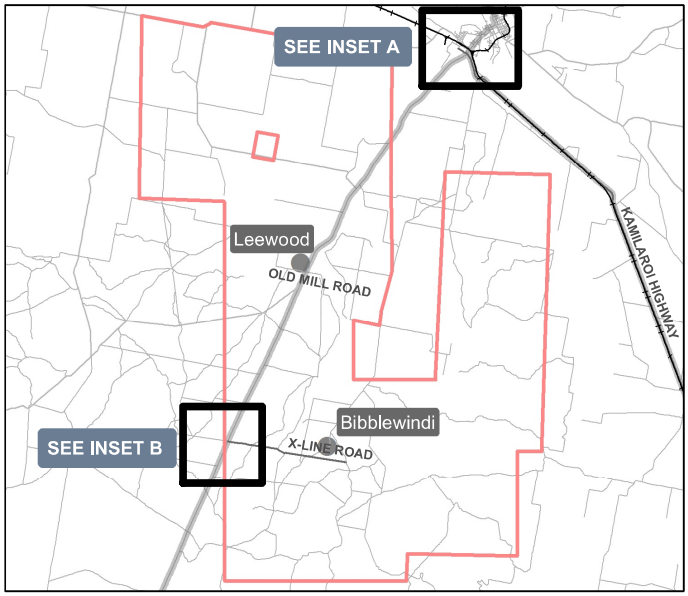


1 Newell Highway, looking north towards X-Line Road (source: Google Maps 2014)

2 X-Line Road looking east from Newell Highway

3 Mooloobar Street, looking west from Newell Highway (source: Google Maps 2014)

4 Newell Highway/Dangar Street, looking north from Gibbons Street (source: Google Maps 2014)



5 Maitland Street, looking west towards Tibbereena Street (source: Google Maps 2014)

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Narrabri Gas Project
EIS Technical Appendix Traffic and Transport

Job Number 21-22463
Revision A
Date 25 Feb 2015

Road Network

Figure 4-1

G:\21\22463\GIS\Maps\21_22463_Z127.mxd

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The Newell Highway has a Roads and Maritime Services approved higher mass limit (HML) and is an A-double road train (36.6 metre vehicle) route. An extract from the Roads and Maritime interactive HML vehicle route map in the vicinity of Narrabri is shown at Figure 4-2.

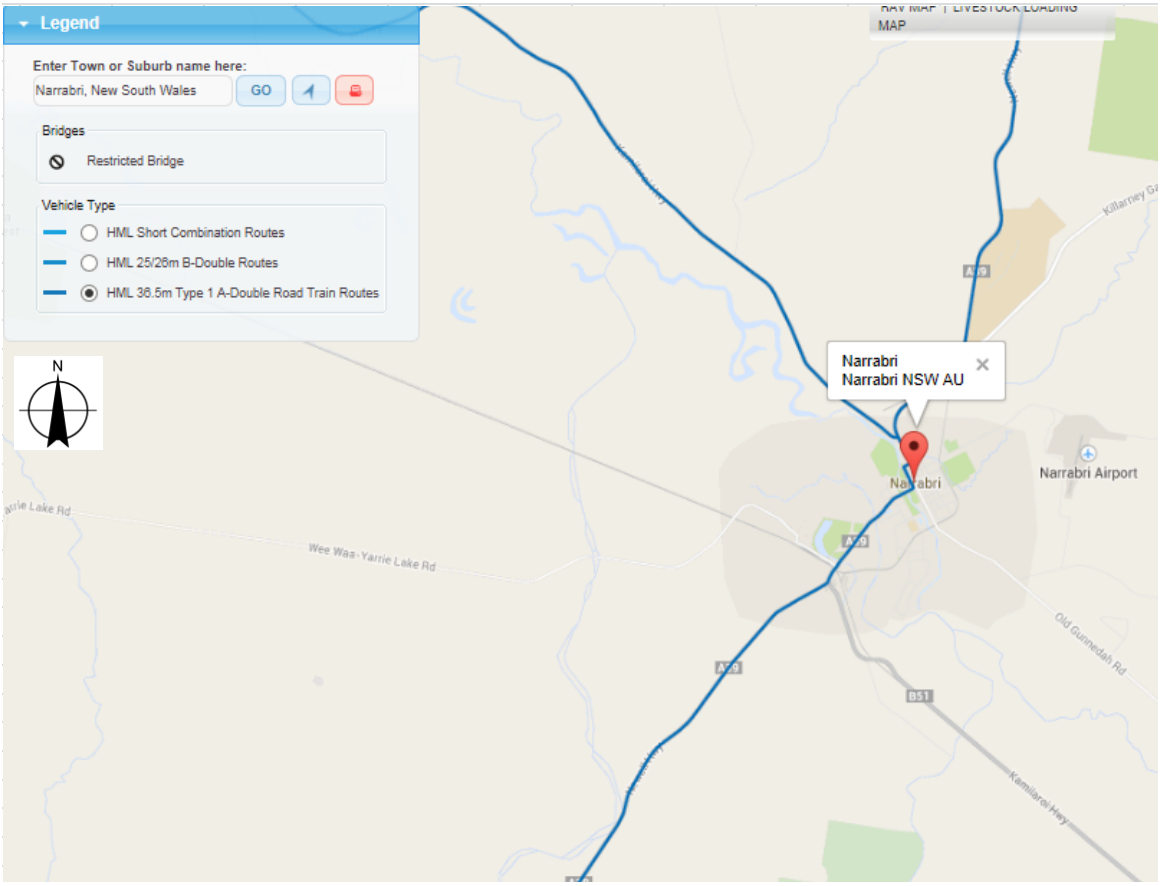


Figure 4-2 Newell Highway 36.6 metre A-double road train route

Source:http://www.rms.nsw.gov.au/business-industry/heavy-vehicles/maps/intelligent-access-program/hml-map/index.html

Through the town centre of Narrabri, the Newell Highway the speed limit reduces to 50 km/h. The road remains road marked with only one lane in each direction, however the carriageway has wide shoulders and a wide, line marked median is provided for turning vehicles so that through traffic is not impeded.

4.2.3 X-Line Road

X-Line Road functions as a rural forestry road which is generally unsealed travelling in an east-west direction from the Newell Highway around 35 km south of Narrabri. X-Line Road intersects with the Newell Highway at a priority controlled intersection. The intersection has recently been upgraded to include 30 metres of sealed pavement from the Newell Highway which is recommended for intersections with arterial roads.

Some sections of X-Line Road and some forestry roads were previously upgraded as part of the ongoing gas field appraisal program.

4.2.4 Yarrie Lake Road – Goobar Street – Mooloobar Street

Yarrie Lake Road functions as a rural collector road providing an alternative connection between Narrabri and Wee Waa to the Kamilaroi Highway. Yarrie Lake Road and Mooloobar Street provide access from the Newell Highway to the Narrabri Operations Centre (NOC) and drilling locations in the northern part of the project area.

Yarrie Lake Road is a two way sealed road with no road marking. It has a sign posted speed limit of 80 km/h which reduces to 50 km/h prior to the road turning into Goobar Street. Goobar Street connects with Mooloobar Street which forms the western approach of a roundabout with the Newell Highway. Both Goobar Street and Mooloobar Street are two way sealed roads with sections of kerb and gutter but generally with sealed shoulders. Both roads are 50 km/h.

Mooloobar Street is a local road which provides a link between Newell Highway, Goobar Street and Yarrie Lake Road. Mooloobar Street has the following road characteristics:

- it has a two-way unsealed carriageway, about 10 metres wide
- the sign posted speed limits is 40 km/h on the approach to the Narrabri Town area, and a speed limit of 50 km/h in other sections
- no parking is permitted on both sides of the road
- gutters, footpaths and verges with road shoulders are not provided along either side of the road
- the road does not have a centreline.

4.2.5 Old Gunnedah Road – Maitland Street – Tibbereena Street

A seagull intersection provides connection from the Newell Highway to Tibbereena Street, which connects to Maitland Street which becomes Old Gunnedah Road to the south west of Narrabri. Tibbereena Street, Maitland Street and Old Gunnedah Road provide access to the Narrabri town accommodation camp from the Newell Highway.

Tibbereena Street and Maitland Street are generally residential streets within the Narrabri town that are sign posted 50 km/h.

Tibbereena Street functions as a collector road and has the following road characteristics:

- it has a two-way sealed carriageway, about 24 metres wide
- the sign posted speed limits is 50 km/h
- both marked and unmarked parking is permitted along either side
- two traffic lanes in each direction, each about three metres wide
- road marked double white centreline in certain sections
- gutters, footpaths and verges with road shoulders, provided along either side of the road.

Maitland Street becomes Old Gunnedah Road at its eastern end. Within the town area the road is a two way sealed road with one lane in each direction, a marked centreline and a marked cycle way on the southern side. From the intersection with Regent Street, Old Gunnedah Road turns into a rural collector road and the sign posted speed limit increases to 80 km/h. Old Gunnedah Road provides a connection to the settlement of Turrawan, which is on the Kamilaroi Highway.

4.2.6 Old Mill Road

Old Mill Road functions is a rural forestry road, providing access to the Leewood Property. Old Mill Road intersects with the Newell Highway at a priority controlled intersection.

4.3 Existing daily and peak hour traffic volumes

Traffic data has been obtained from the *Dewhurst Gas Exploration Traffic and Transport Assessment,* prepared by GTA in October 2013 (GTA 2013). This traffic data was provided by Narrabri Shire Council from a "tube" traffic count undertaken on the Newell Highway between September and November in 2011. The location of this traffic was around 20 km south of Narrabri and 20 km north of X-Line Road.

The average daily and peak hourly traffic volumes along the Newell Highway to the north of X-Line Road are summarised in Table 4-1. Newell Highway experiences the highest daily combined traffic flows during the weekdays, with an average of 1,860 vehicles per day.

Table 4-1 Existing traffic volumes (2011)

Location	Average daily traffic (vpd)	7 day average peak hour (vph)	Highest peak hour (vph)	Proportion of heavy vehicles
Newell Highway	1,860	134	156	40%

As part of the *Dewhurst Gas Exploration Traffic and Transport Assessment* report (GTA 2013), various traffic counts on the Newell Highway were compared and it was agreed with RMS (on 22nd November 2013) that the two-way daily traffic volumes to be used for the assessment would be 1,860 vehicles per day and 169 during the peak hour, for a most conservative assessment. It is noted that this is higher than the 156 shown in Table 4-1.

Cotton harvesting generally peaks in the region throughout April, with wheat harvesting throughout September and October. This harvest activity can cause traffic fluctuations of up to 25% along the Newell Highway. As such, the daily traffic volumes shown in Table 4-1 can be considered representative of a peak season and are therefore conservative. Accordingly, average daily traffic outside of these seasons in the *Dewhurst Gas Exploration Traffic and Transport Assessment* (GTA 2013) was lower than the average adopted for this assessment, being 1,465 vehicles per day.

The average weekday, Saturday and Sunday daily traffic profile along the Newell Highway is shown at Figure 4-3. The survey data indicates that the traffic volumes are relatively consistent across the day between 8am and 4pm. This is considered consistent with the intended use of the Newell Highway.

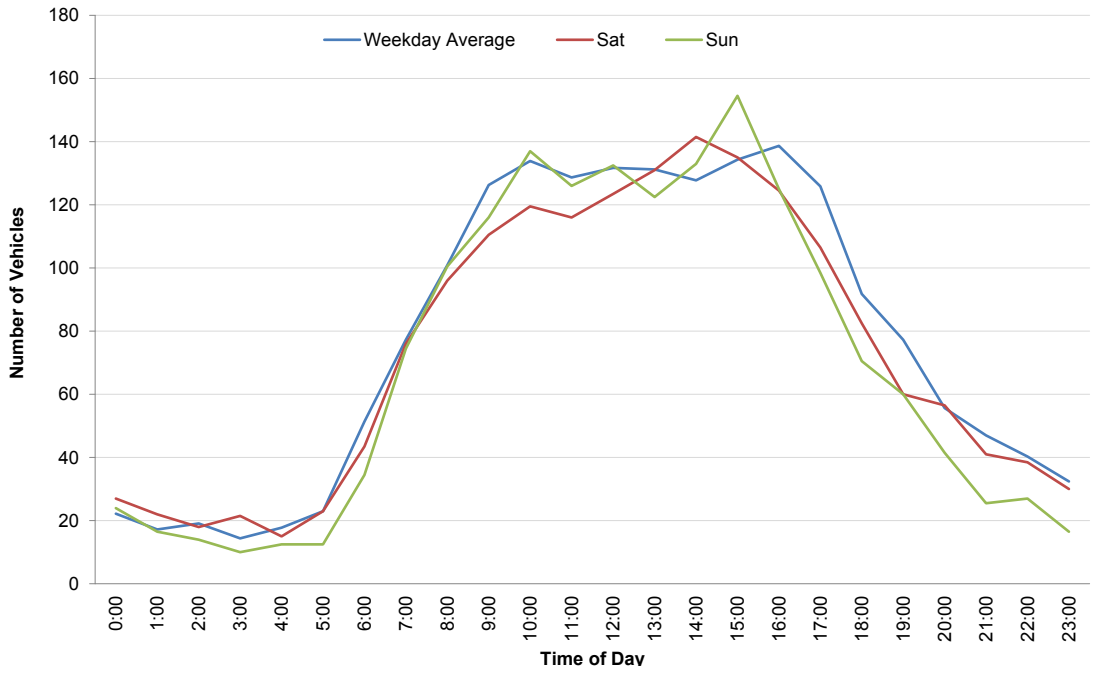


Figure 4-3 Average weekday, Saturday and Sunday traffic profile - Newell Highway

Figure 4-4 provides an understanding of the percentage of heavy vehicles on the Newell Highway, based on traffic count data provided by Roads and Maritime Services. Around 73 percent of vehicles travelling along Newell Highway consisted of light vehicles, while 17 percent were articulated vehicles with five or more axles and B-doubles.

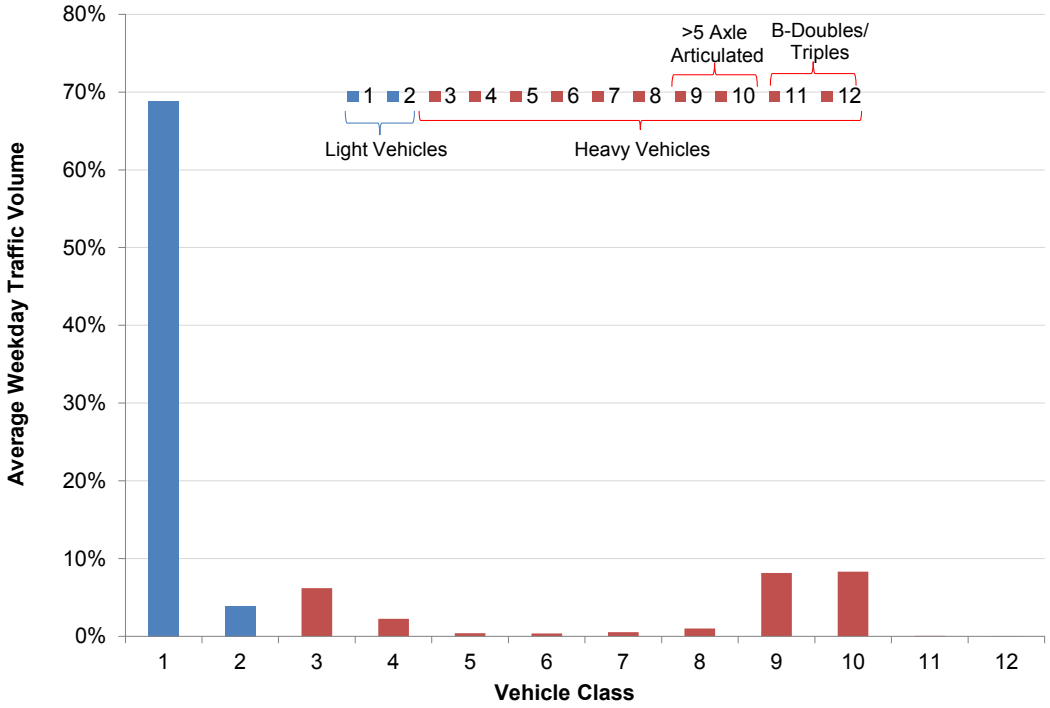


Figure 4-4 Newell Highway –vehicle type breakdown

GHD also contacted both the Roads and Maritime Services and the Narrabri Shire Council to see if there was additional traffic volume data available through the town of Narrabri. Table 4-2 provides a summary of the additional data received along the Newell Highway and other key roads within the Study Area.

Table 4-2 Surveyed AADT traffic volumes

Location	Survey Dates	Source of Data	Two Way Traffic Flows (veh/day)
Newell Highway, North of Francis Street	27/10/2008 - 02/11/2008	RMS	3,107
Newell Highway, North of Killarney Street	27/10/2008 - 02/11/2008	RMS	10,279
Tibbereena Street, North of Dewhurst Street	30/04/2010	Council	4,729
Old Gunnedah Road, South of Regent Street	27/10/2008 - 02/11/2008	Council	2,819
Mooloobar Street, West of Buri Street	05/04/2011	Council	1,182
Yarrie Lake Road, east of Bohena Creek	13/11/2012	Council	495
Newell Highway, South of Mooloobar Street	27/10/2008 - 02/11/2008	RMS	7,520
Kamilaroi Highway, East of Newell Highway	26/12/2011 - 01/01/2012	RMS	1,559

4.3.1 Intersection traffic surveys

Classified intersection traffic surveys were undertaken at the following intersections on Wednesday 8th October 2014 between 7am and 10am and between 4pm and 7pm:

- Newell Highway/Tibbereena Street priority controlled intersection.
- Newell Highway/Mooloobar Street/Old Turrawan Road roundabout.
- Newell Highway/Kamilaroi Highway roundabout.

Analysis of the traffic count data found the peak hours to occur between 8 am and 9 am and between 5 pm and 6 pm. A summary of the weekday AM and PM peak hour two-way traffic volumes along roads in the vicinity of the above intersections is shown in Table 4-3. The traffic surveys are provided in full in Appendix A.

Table 4-3 Weekday Peak Hourly Traffic Volumes

Location	AM Peak		PM Peak	
	Two-way Traffic Volumes (vph)*	%Heavy Vehicles	Two-way Traffic Volumes (vph)*	%Heavy Vehicles
Tibbereena Street (east of Newell Highway)	411	3%	470	9%
Newell Highway (west of Tibbereena Street)	847	12%	990	10%
Newell Highway (south of Tibbereena Street)	1,060	11%	1,156	6%
Newell Highway (north of Mooloobar Street)	583	17%	519	17%
Mooloobar Street (west of Newell Highway)	169	14%	162	6%
Old Turrawan Road (east of Newell Highway)	180	10%	58	7%
Newell Highway (south of Mooloobar Street)	420	17%	401	21%
Kamilaroi Highway (east of Newell Highway)	145	14%	155	15%
Newell Highway (south of Kamilaroi Highway)	107	26%	131	50%

Note: * vph – vehicles per hour

4.3.2 Intersection capacity assessments

The capacity and LoS analysis has been carried out for the intersections during AM and PM weekday peak period conditions using the SIDRA intersection model. SIDRA model calculates capacities, queue lengths and delays for traffic signals, roundabouts and priority controlled intersections. The following intersections have been analysed using SIDRA for the weekday AM and PM peak hours based on the 2014 traffic counts discussed in section 4.3.1:

- Newell Highway/Tibbereena Street priority controlled intersection.
- Newell Highway/Mooloobar Street/Old Turrawan Road roundabout.
- Newell Highway/Kamilaroi Highway roundabout.

No assessment of the Newell Highway/X-Line Road intersection was undertaken for the 2014 existing traffic conditions scenario, as the X-Line road is a forestry road which currently generates very little traffic.

A summary of the results of the SIDRA intersection modelling is shown in Table 4-4, with detailed SIDRA outputs provided in Appendix B. Based on this SIDRA analysis, the key intersections within the study area currently operate with an acceptable level of service.

Table 4-4 SIDRA Results - 2014 Surveyed Traffic Flows

Intersection	AM Peak		PM Peak	
	Ave Delay (s)	LoS	Ave Delay (s)	LoS
Newell Highway/Tibbereena Street	6	A	7	A
Newell Highway/Mooloobar Street/Old Turrawan Road	6	A	5	A
Newell Highway/Kamilaroi Highway	8	A	8	A

4.4 Public transport

Lowder & Sons Bus Company provides transport for local routes within the Narrabri local area. A summary of the bus services and frequencies operating in the Narrabri study area is provided in Table 4-5. Long distance coaches also operate from Narrabri to Wee Waa and vice versa, where bookings have to be made prior to the journey.

The only bus service that operates along the Newell Highway to the south of Narrabri is the Narrabri West bus service. This service operates two services a day on weekdays and one bus service on a Saturday. There are no bus services operating within the project area on Sundays.

Table 4-5 Bus services in the study area

Route	Via	Service frequency	
		Weekdays	Saturdays
Narrabri West	Narrabri Town Centre via Village and Hospital	2 services per day	1 service per day
Narrabri Town Loop	Krohns Corner, Railway Station and Swimming Pool	1 service per day	1 service per day
Narrabri Town West	Krohns Corner, Hinds Street, Dangar and Hospital	Hourly (five times daily)	1 service per day
Narrabri to Gunnedah	Krohns Corner, Hinds Street, Baan Baa and Gunnedah	1 service per day	-
Gunnedah to Narrabri	Bloomfield Street, Baan Baa, Hinds Street and Narrabri	1 service per day	-
Narrabri to Wee Waa	Narrabri and Wee Waa	2 services on Mondays and 1 service on Fridays	-

Source: http://www.countrytransport.131500.com.au/index.asp?InfoMode=TownReport&Town=Narrabri

Table 4-6 provides an overview of the long distance bus services operating on the Newell Highway through Narrabri.

Table 4-6 Long distance bus routes

Route No.	Route	No. weekday services	No. weekend services
GX340	Melbourne to Brisbane (meal break at Narrabri at 10:15am)	1	-

Source: http://www.countrytransport.131500.com.au/index.asp?InfoMode=TownReport&Town=Narrabri

There are 12 school bus routes that services areas around Narrabri. A plan showing the approved bus routes in Narrabri, provided by Narrabri Council, is shown at Figure 4-5. These school bus routes include:

- Newell Highway
- Kamilaroi Highway
- Yarrie Lake Road
- Old Gunnedah Road
- Maitland Street.

However, Council do not have the bus routes for the local streets.

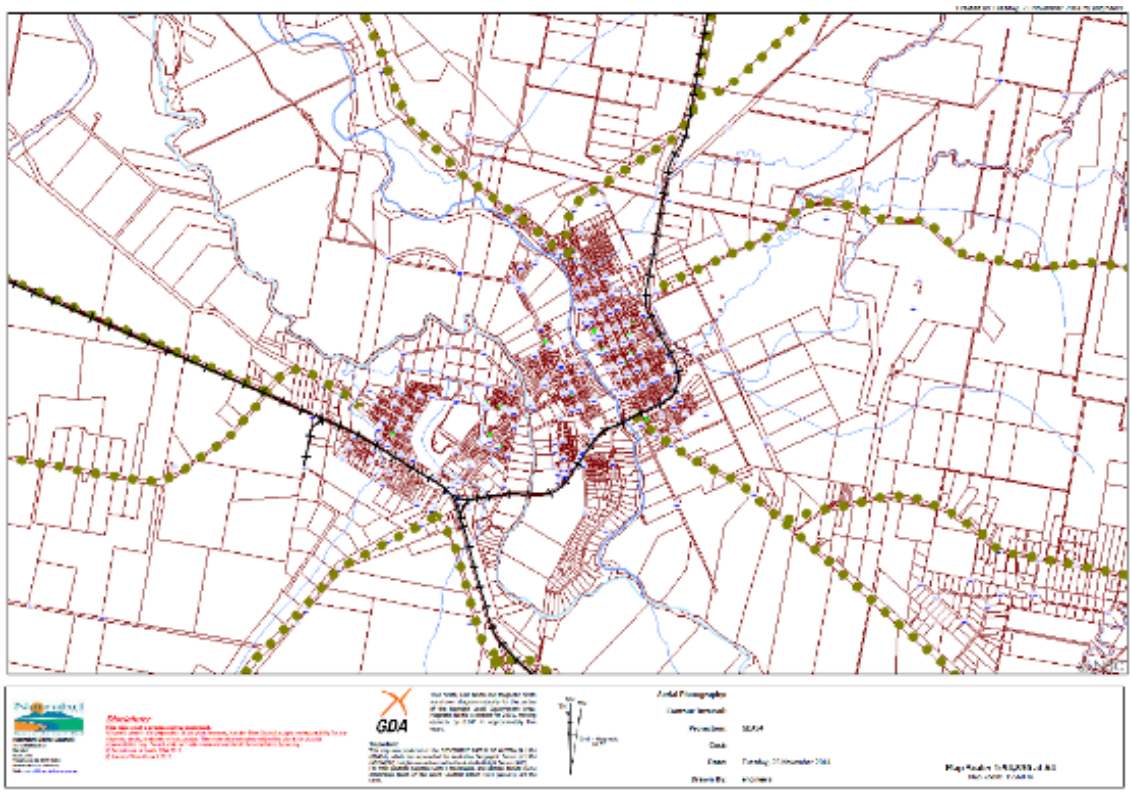


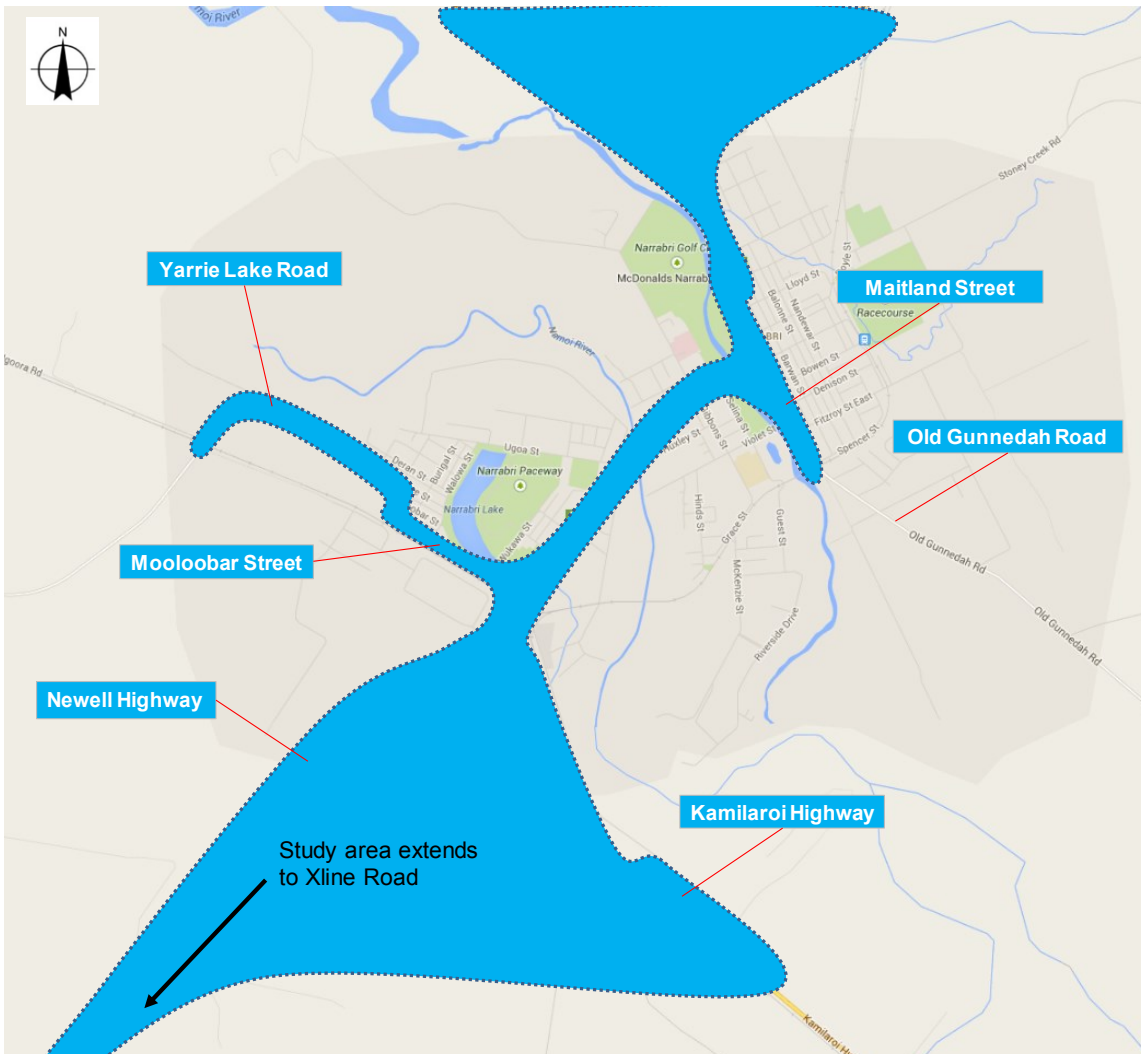
Figure 4-5 Approved school bus routes in Narrabri

Source: Narrabri Sire Council (2014)

4.5 Crash statistics

Roads and Maritime Services supplied crash statistics for roads within the study area over a five-year period between (January 2009 and November 2013). This crash data was used to determine the main factors contributing to crashes within the project (shown in Figure 4-6), with a detailed report of the data supplied in Appendix C. It should be noted that crash data was not provided for the forestry roads, including X-Line Road and Old Mill Road.

In total, 46 crashes were recorded within the project area shown in Figure 4-6. No incidents were recorded along the Newell Highway two kilometres south of the Newell Highway/Kamilaroi Highway intersection.



Source: Google Maps (2014), modified by GHD

Figure 4-6 Study area for crash data analysis

4.5.1 Newell Highway

In total, there were thirty-seven crashes recorded along Newell Highway within the study area. Of these:

- one (3%) incident resulted in a fatality, which occurred 1.5 km south of the Newell Highway and Kamilaroi Highway intersection, at a midblock section. This involved a head on collision with a car and a light truck.
- five (14%) incidents involved pedestrians
- twenty (54%) incidents resulted in injuries
- twenty-one (62%) incidents occurred at an intersection. Of these:
  - 6 (29%) occurred at the Newell Highway/Tibbereena Street intersection
  - 2 (10%) occurred at the Newell Highway/Maitland Street intersection
  - 2 (10%) occurred at the Newell Highway/Maitland Street intersection
  - 2 (10%) occurred at the Newell Highway/Mooloobar Street/Old Turrawan Road intersection
  - 2 (10%) occurred at the Newell Highway/Namoi Street intersection
  - 2 (10%) occurred at the Newell Highway/Belar Street intersection

- six (16%) incidents occurred along a 500 metres length of Newell Highway between Gibbons Street and Bridge Street, of which four involved rear end collisions with other vehicles
- thirteen (35%) incidents involved vehicles driving off the road.

4.5.2 Maitland Street

In total, there were four crashes recorded along Maitland Street within the study area. Of these:

- one (25%) incidents involved pedestrians
- two (50%) incidents resulted in injuries
- four (100%) incidents occurred at midblock sections.

4.5.3 Tibbereena Street

In total, there were two crashes recorded along Tibbereena Street within the study area.

- One (50%) incident resulted in a fatality, which occurred on the Tibbereena Street and Dewhurst Street intersection. This involved a pedestrian motorised wheel chair using the pedestrian crossing and a car travelling northbound along Tibbereena Street.
- The other incident resulted in an injury.

4.5.4 Fitzroy Street

In total, there were two crashes recorded along Fitzroy Street within the study area.

- no pedestrian incidents were recorded
- none of the incidents resulted in injuries
- both (100%) incidents occurred at the intersection of Fitzroy Street and Maitland Street
- both (100%) were cross traffic related crashes due to disobedience of traffic rules.

4.5.5 Doyle Street

One incident occurred at the Doyle Street and Maitland Street intersection. No injuries were recorded.

4.5.6 Vehicle crash data review

The following key points were noted from the assessment of this data:

- over the five-year period, 46 crashes were recorded in the study area
- 80% of crashes (37 crashes) occurred along Newell Highway
- 57% of crashes (26 crashes) occurred at intersections
- 52% of crashes (24 crashes) involved injuries
- 4% of crashes (2 crashes) involved fatalities.

Crash analysis over a five-year period indicated that 46 crashes had occurred within the study area. The study area covers a mixture of rural highway with speed environments greater than 100 km/h as well as through the Narrabri town centre where the speed reduces to 50 km/h. There were 37 crashes which occurred along the Newell Highway, of these 26 occurred at intersections throughout the Narrabri town centre. The crashes recorded were spread out along the route and not concentrated to one particular intersection or section of road way.

5. Construction arrangements

5.1 Construction activities

The project would involve the construction of a range of exploration and production activities and infrastructure. The key construction components and activities of the project include:

- the gas field:
  - exploration and appraisal activities including constructing up to 850 new wells on a maximum of 425 new well pads. The 850 wells would include new exploration, appraisal and production wells. The wells would be progressively commissioned and decommissioned within the project area.
  - gas and water gathering systems and access tracks
  - in-field temporary pilot well flares and water balance tanks
  - communication towers.
- the Leewood property:
  - a central gas processing facility for the compression, dehydration and treatment of gas to commercial specifications
  - the central water management facility including storage and treatment
  - optional power generation for powering infrastructure at Leewood and Bibblewindi
  - a communications tower
  - a safety flare
- the Bibblewindi site:
  - in-field compression
  - a safety flare
  - an electrical substation and motor control centre
  - storage and utilities area
  - upgrades to staff amenities and car parking.
- widening of the Bibblewindi to Leewood infrastructure corridor including a buried intermediate gas pipeline, two water pipelines and buried power transmission and communications lines
- a new underground 132kV transmission line along an existing corridor to reticulate power from the Wilga Park power station to the Leewood Property
- other supporting infrastructure and activities including roads, worker accommodation, and water management infrastructure such as agricultural irrigation and a managed release pipeline to Bohena Creek; and dust suppression.

5.1.1 Location of construction activities

Construction movements would be to the three major construction sites at Leewood, Bibblewindi and the Leewood to Bibblewindi Services Corridor as well as the camp at Westport, as shown at Figure 5-1. The Narrabri Operations and Logistics Centre, accessed from the Newell Highway from Narrabri, would also be used for construction activities, including concrete production, drilling fluid recycling, laydown area and deliveries.

Access to the Leewood construction area would be provided from the Newell Highway. The Bibblewindi construction area would also be accessed from the Newell Highway via X-Line Road and along forest tracks. Accommodation for construction workers would be at purpose built workers' accommodation such as the accommodation camp located on the fringe of Narrabri.

Accommodation for workers associated with drilling activities would be provided at Westport workers' accommodation. This would be upgraded from the approved 64-person camp to accommodate approximately 200 people. The location of the drilling camp is also shown in Figure 5-1.

The following sections provide a summary of the key components of the project.

Gas field (drilling activities)

Development of a gas field generally includes the following stages:

- **Exploration** - this broadly involves undertaking seismic surveys, drilling core and chip holes, and collecting baseline scientific data.
- **Appraisal** - the drilling of pilot wells to gain knowledge on gas content and composition to inform gas field design.
- **Field development planning** - determination of the final well, access track and gathering system locations, based on the outcomes from the exploration and appraisal program, utilisation of the Field Development Protocol, and land access agreements in place.
- **Construction** - building components of the gas field; this includes drilling wells, and constructing the in-field compression unit, power generation facility, the gas processing facility and the water treatment facility. Gas field supporting infrastructure and activities include:
  - ***Drill pad clearing and access tracks*** – includes well pad and access track construction.
  - ***Gathering lines and well head infrastructure*** - Includes construction of the water and gas gathering lines between gas wells and telecommunications infrastructure, surface facilities, installation of the well head, separators, pumps, telemetry, fuel skid, and generators.
- **Operations** – extracting gas and water, processing gas to commercial quality, and treatment with beneficial reuse of the extracted water.
- **Well decommissioning and rehabilitation** - once wells are no longer economically producing gas, they are plugged and decommissioned in accordance with NSW Government guidelines, or converted to monitoring wells, and the well pad is rehabilitated.
- **Gas processing plant and water treatment facility decommissioning and rehabilitation** - once the gas field is no longer commercially viable, the equipment is decommissioned and the sites are rehabilitated.

Processing facilities (water and gas) at Leewood

The following equipment and activities would be constructed and undertaken at the central gas and water processing facilities:

- gas compression
- flare
- brine and permeate ponds
- reverse osmosis plant
- brine concentrator and salt crystalliser
- water treatment
- water civil works
- water mechanical plant and equipment
- gas treatment plant.

Supporting infrastructure

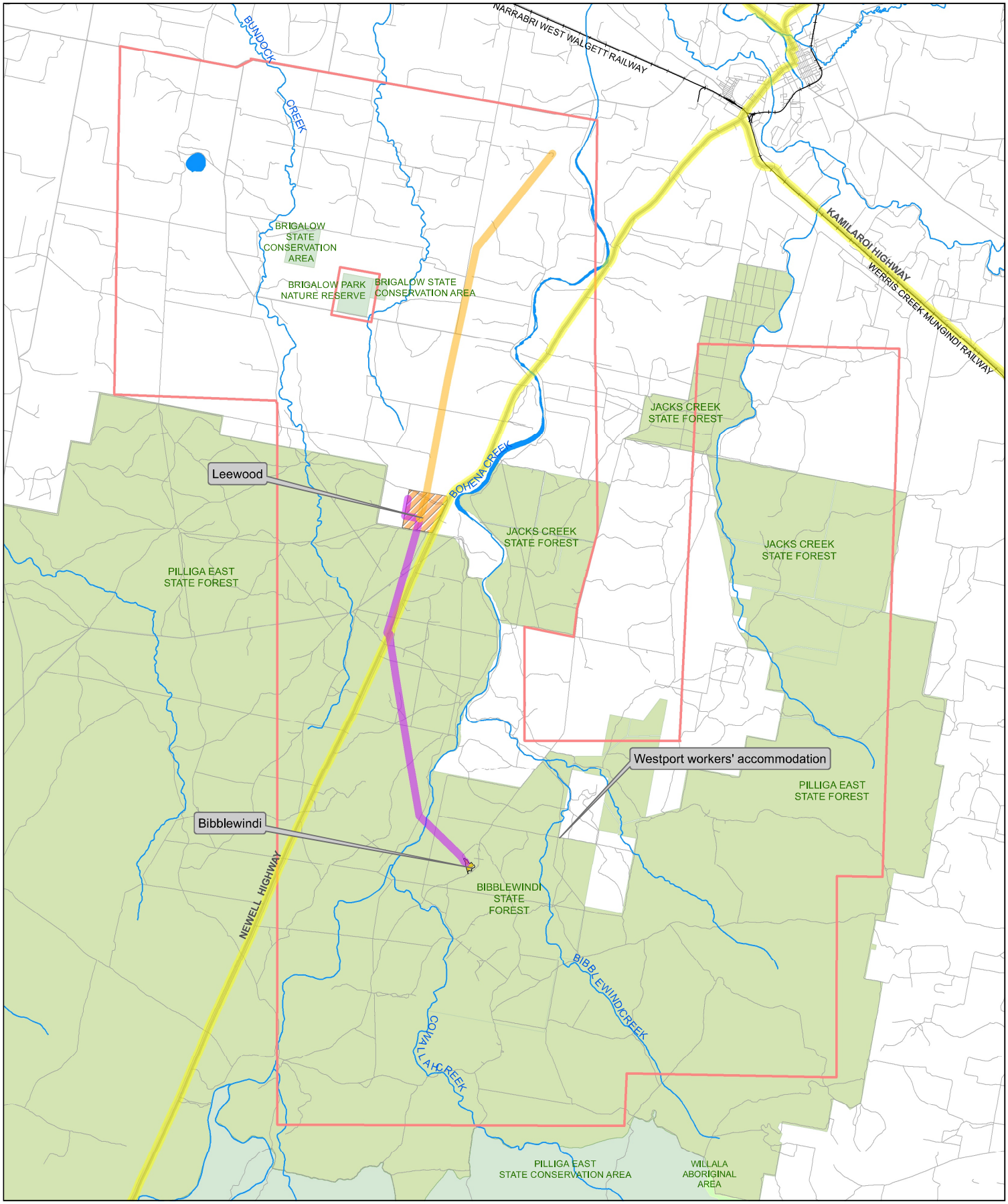
Supporting infrastructure for the Project includes:

- ***Road upgrades*** – includes upgrades to Newell Highway and re-surfacing and upgrading X-line Road between Newell Highway and Bibblewindi
- ***Workers' accommodation construction*** – includes an upgrade of the Westport workers' accommodation.
- **Construction facilities -** Includes construction of the operations admin building, construction office, contractor yards and logistics site.
- ***Leewood to Wilga Park Services Corridor*** - The following infrastructure would be located along the existing corridor under this project:
  - a new intermediate gas pipeline to transfer gas from the infield compression station at the Bibblewindi site to the Leewood Property for further processing in the proposed central gas processing facility;
  - two new water pipelines;
  - a new underground 132kV transmission line to reticulate power from the Leewood site to the Bibblewindi site, and then onto Wilga park from Leewood;
  - communications cabling from Bibblewindi to Wilga Park;
  - the construction and installation of this infrastructure would require an expansion of the existing Bibblewindi to Leewood corridor from approximately 12 to 30 metres wide. The Wilga Park to Leewood corridor would be approximately 10 metres wide.

5.1.2 Project schedule

The project will be constructed over a period of around three years, commencing in 2018. The gas field drilling works will be undertaken in stages over a time period of around 20 years with the first stages expected to commence in 2018. The Construction Plan for the project indicates that traffic volumes generated by the construction of the project will vary and depend on the drilling timetable.

Table 5-1 presents the likely staging of the works by construction location, with an indication of the expected duration.



LEGEND

- Project area
- Leewood
- Bibblewindi
- Parks and reserves
- State forest
- Aboriginal areas
- Lakes and dams
- Watercourses
- Roads
- Train line
- Arterial Road
- Leewood to Wilga Park infrastructure corridor
- Bibblewindi to Leewood infrastructure corridor

0 1.75 3.5 7
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Narrabri Gas Project
EIS Technical Appendix Traffic and Transport

Location of construction activities (fixed infrastructure)

Job Number 21-22463
Revision 1
Date 27 Jul 2016

Figure 5-1

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Data source: NSW Department of Lands: DTDB and DCDB - 2012-13. Santos: Operational and Base Data - 2013. Created by: jrichardson

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Table 5-1 Summary of location of construction activates and staging

Location	Infrastructure to be Constructed or Construction Activity	Estimated duration
Leewood	Central gas processing facility Central water processing facility Laydown area and deliveries 100 MW power plant and control works (optional, assumed for the purposes of this study) Safety flare	2018-2021
Bibblewindi	Infield compression Safety flare Electrical substation/motor control centre	2018-2021
Westport Camp	Accommodation for drilling staff. It is proposed to increase the camp size from the approved 64 to approximately 200 person camp.	2017
Narrabri Operations and Logistics Centre (NOC)	*Concrete batching plant *Drilling fluid recycling Laydown area and deliveries	2018
Gas Field	Exploration Drill pad clearing and access tracks Drilling of pilot and production wells Surface facilities Gathering lines Well decommissioning and rehabilitation	2018-2043 (approximate date for the purposes of this study)
Road Upgrades	Upgrades to Newell Highway and re-surfacing and upgrading X-line Road between Newell Highway and Bibblewindi	2018-2021
Leewood to Bibblewindi Infrastructure Corridor	Construction and commissioning of power distribution, a mid-compression gas transfer pipeline, and water transfer pipelines	2019-2020
Leewood to Wilga Park Services Corridor	High voltage Cable installation parallel to existing gas pipeline	2019

*Already constructed infrastructure which would generate traffic for project construction activities

The indicative construction schedule for the key components of the project by location is shown at Figure 5-2. The information provided in Figure 5-2 has been used to estimate the absolute peak traffic volumes on the surrounding road network.

A chart showing the approximate peak manning schedule during construction period is shown at Figure 5-3. The highest number of staff would occur in around the middle of 2019, with approximately 1,300 staff/workers in total, comprising of:

- 240 drilling labour
- 20 drilling staff
- 800 construction labour
- 240 construction support staff

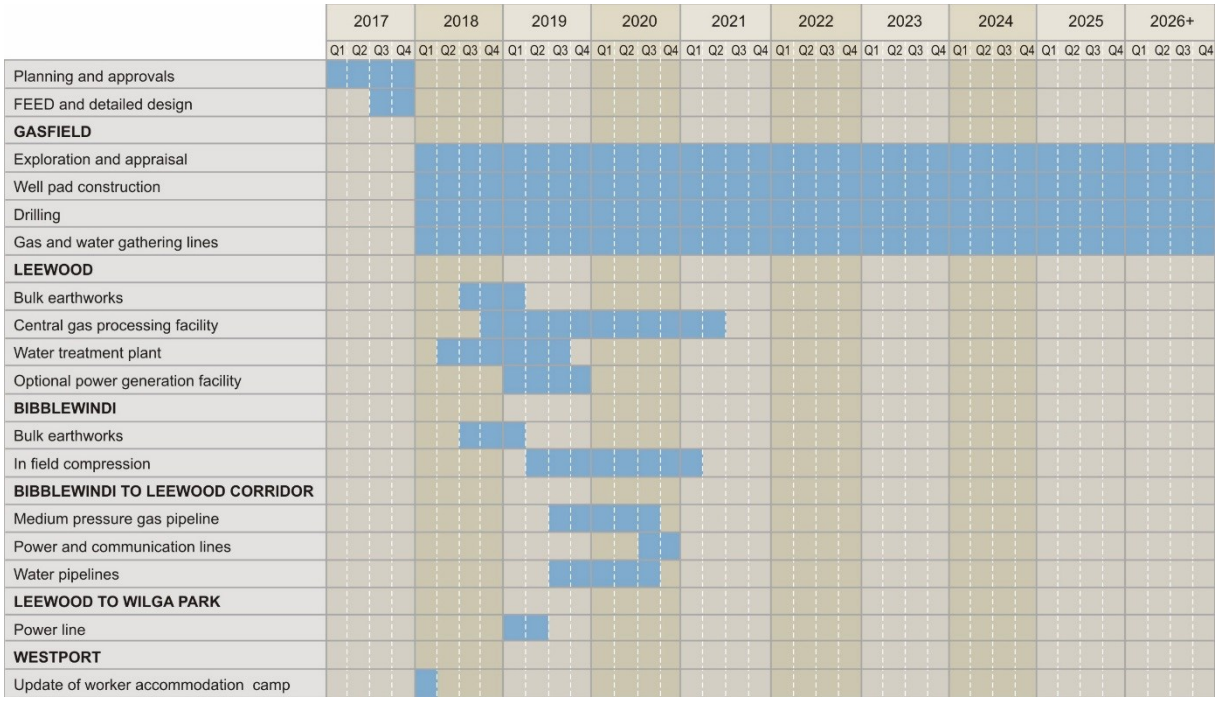


Figure 5-2 Proposed construction schedule

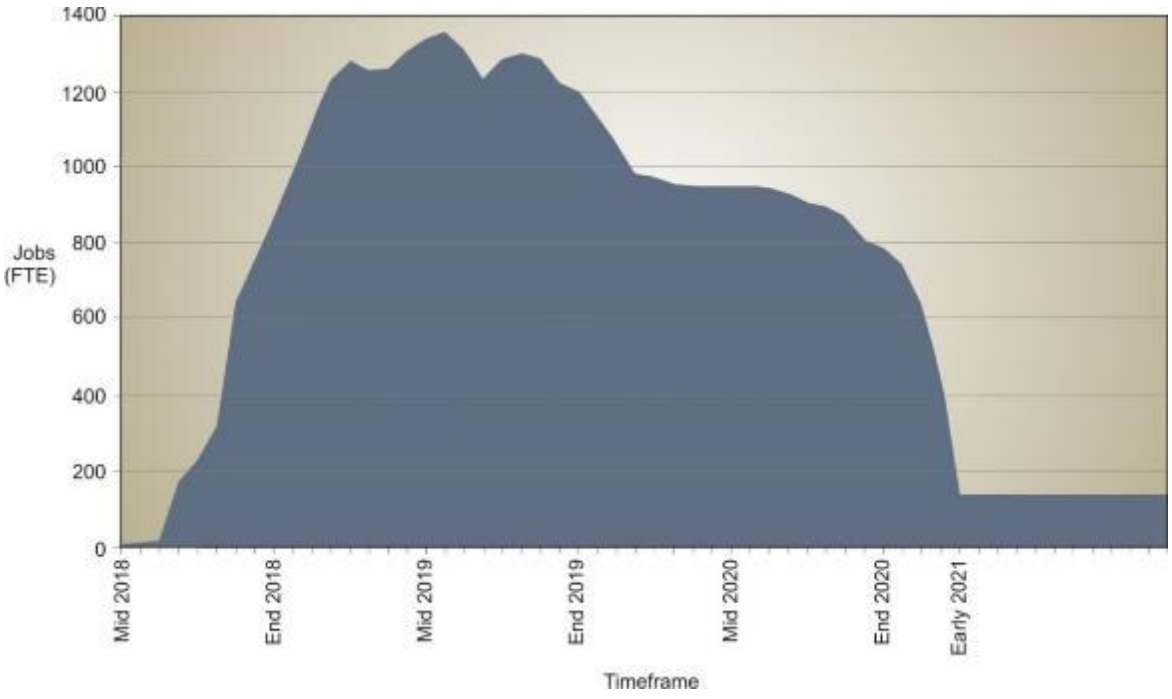


Figure 5-3 Total manning schedule (construction labour and staff)

5.1.3 Working hours

The work day is assumed to be governed by when crews are expected to leave and return to the camp. Working hours will be consistent with NSW daylight working hours. However, it is expected that there would be some construction works occurring 24 hours a day in more remote locations, where noise impacts would be minimal or where there is agreement with the impacted landowners.

Workers could be driven to the site before daylight hours, and be on site to start work in the day light. However, for the purposes of this assessment it has been assumed that these would be between 7 am and 6 pm Monday to Friday, and between 8 am and 1 pm on weekends and public holidays. These working hours are in accordance with the NSW EPA noise regulations.

A summary of the proposed working hours is provided at Table 5-2. Travel to and from work sites would take place during the hours before and after the core working hours. Therefore, workers are likely to travel outside of peak traffic periods on the surrounding road network.

Table 5-2 Assumed Working hours

Crew	Core Hours	Rotation
Facilities Construction Crew - Leewood and Bibblewindi facilities, site clearing and access tracks, surface facilities at the well head and the water and gas gathering lines	Daylight hours season dependant, assumed between 7 am and 6 pm for the purposes of this assessment	Local DIDO Specific to each contractors HR and IR management plan - assumed to be between 7 am and 6 pm for this assessment
Drilling and Completions Crew	24 hour Operations	FIFO Specific to each contractors HR and IR management plan
Operations Centre	Manning 24 hours	Local
Emergency Crews	24 hours on-call	Local & Interstate

5.2 Construction traffic movements (deliveries)

5.2.1 Construction traffic vehicles and equipment

Various types of machinery will be used for the construction of the gas processing and water treatment facilities, construction facilities, camps and road upgrades. The different types of heavy vehicles that are required are three-, five- and seven-axle trucks, B-doubles, double road trains and triple road trains to transport plant and material to the site.

The tipper and standard truck sizes are expected to be mostly utilised for the transporting of material and equipment along haulage routes. Vehicles, crane, excavator, bulldozer, drilling and boring machinery will be brought to site in most cases on standard sized trucks and then transferred between construction zones and the drilling lease area. In some cases, oversized vehicles may be required to transport large equipment.

All major/specific construction plant and equipment required for construction works will be identified by the contractor in the Construction Work Method Statement for each work area package.

Dust migration onto RMS roads, such as the Newell Highway, will be managed to limit the impact of dust from construction vehicles. It should also be noted that the Newell Highway/X-Line Road intersection has recently been upgraded to include 30 metres of sealed pavement from the Newell Highway which would reduce the gravel/dust spread onto the highway.

5.2.2 Oversize material deliveries

For the purposes of this assessment, Port of Brisbane has been used to assess the traffic impact on the national road system. Other ports will be used where logically reasonable and will be assessed during project planning.

The proposed site of the Module Yard and major equipment would be through the existing Narrabri Operations Centre and a proposed logistics centre at Leewood. Heavy loads and oversized vehicles would go directly to the construction sites, rather than stopping at the logistics centres.

The gas processing and water treatment facilities will be modular, constructed remotely and then transported to site, which leads to a number of oversize, heavy vehicle deliveries. The haulage routes for construction vehicles from Queensland (Port of Brisbane) or NSW (Port of Newcastle) to the Narrabri Operations Centre, Leewood, Bibblewindi and the Leewood to Bibblewindi and Leewood to Wilga Park infrastructure corridors would be via the Newell Highway.

The delivery of oversize materials would be subject to permit operations and is not considered as part of this assessment.

Bibblewindi

A summary of the haulage movements for oversized materials to Bibblewindi is provided in Table 5-3. Around 250 one-way vehicle movements are expected between the third quarter of 2017 and the first quarter of 2020. The busiest period for traffic generation at Bibblewindi would be at the start and end of this construction period.

Table 5-3 Haulage movements – oversize material deliveries to Bibblewindi

Description	Duration	Total Heavy Vehicles (one-way)
Compressor Module A	Q3 2018 to Q1 2021	20
Compressor Module B		20
Compressor Module C		20
Miscellaneous (Walkways Ladders / Off module Piping / Structural Steel)		50
After cooler		20
Flare Package		5
Transformers / Switch Gear		5
Utility / Miscellaneous Packages		20
Construction Plant and Equipment		80
Delivery of Diesel Fuel		10
MCC / Control Rooms		5
Total Deliveries		**250**

Leewood

A summary of the haulage movements for oversized materials to Leewood is provided in Table 5-4. Construction of the gas processing facility is expected to occur between the quarter four of 2017 and the second quarter of 2020, and would generate around 600 one-way vehicle movements. Construction of the water treatment facility is expected to occur between the second quarter of 2018 and the third quarter of 2019, and would generate around 800 one-way vehicle movements.

Table 5-4 Haulage movements – oversize material deliveries to Leewood

Facility	Description	Duration	Total Heavy Vehicles (one-way)
Gas Processing Facility	LP Reciprocating Compressor	Q4 2018 to Q2 2021	20
	HP Reciprocating Compressor		15
	Membrane CO2 Removal Package		10
	Amine CO2 Removal Package		60
	TEG Package		20
	Metering Package		10
	Flare Packages		10
	Off Skid Piping / Structural Steel Modules		250
	MCC / Control Rooms		10
	Transformers / Switch Gear		10
	Utility / Miscellaneous Packages		50
	Construction Plant and Equipment		100
	Diesel Fuel		20
Water Treatment Plant	Water treatment plant	Q2 2018 to Q3 2019	75
	Brine treatment plant		20
	Salt Storage Building		10
	300ML Brine Pond		360
	200ML Treated Water Pond		230
	Misc. minor deliveries		100
Total Deliveries			**1,380**

Leewood to Bibblewindi Infrastructure Corridor

Construction of the Leewood to Bibblewindi Infrastructure Corridor, include construction and commissioning of communications and power cabling, and construction of a gas and water pipelines. Construction equipment would be delivered at the start of the project and then remain on site.

As summarised in Table 5-5, it is estimated that around 500 one way vehicle movements would be generated by the construction of the infrastructure corridor between the third quarter of 2019 and final quarter of 2020.

Table 5-5 Haulage movements – Leewood to Bibblewindi services corridor

Description	Duration	Total Heavy Vehicles (one-way)
Intermediate Pressure Gas Pipeline (16 km) DN850 and water pipelines	Q3 2019 to Q4 2020	
132 kV Cable and communications lines		150
40' Container (4 pieces x 12 m length)		350
Total Deliveries		**500**

For the purposes of this assessment, it has been assumed there would be up to:

- 5 oversized vehicle movement (one way) accessing Leewood per day
- 1 oversized vehicle movement (one way) accessing Bibblewindi per day
- 4 oversized vehicles accessing Leewood to Bibblewindi services corridor per day.

Leewood to Wilga Park Infrastructure Corridor

A new underground transmission line up to 132kV would be constructed between Leewood and Wilga Park to reticulate power from the Wilga Park Power Station to Leewood and onto Bibblewindi to power the project infrastructure under the grid power option.

For the purposes of this assessment, it has been assumed there would be up to:

- 5 trucks accessing Leewood per day
- 5 trucks accessing Bibblewindi per day.

5.2.3 Westport workers' accommodation construction traffic

Worker accommodation units would be pre-built off-site and transported to the worker camp site by heavy vehicle. Construction of the workers' camp would be undertaken at the start of the construction program, and are expected to generate the following heavy vehicle movements:

- Construction of the Westport camp from a 64 to approximately a 200-person camp is expected to generate up to 100 heavy vehicle movements in total, with up to 15 heavy vehicle movements a day.

5.2.4 General deliveries

General deliveries would comprise of both local trips and long distance trips to the site, most likely from Brisbane, Newcastle and other regional centres.

Construction trips would consist of water trucks, drilling fluids and concrete trucks. These would be local trips within the study area, i.e. between the logistics areas and drilling sites, and would mainly be along the Newell Highway, with access to forest roads via Newell Highway and X-Line Road. Access to cleared land would be via Kiandool Lane, Yarrie Lake Road, Goobar Street, Baranbar Street, Mooloobar Street and Cooma Road.

Access to the Narrabri Operation Centre would be via Yarrie Lake Road, Goobar Street, Baranbar Street, Mooloobar Street and Cooma Road. Typical transport routes for construction vehicles are shown in Figure 5-4.

For the full development phase of drilling activities, there would be four cement units (heavy vehicles) and four light vehicles that would be traveling to two locations each day, with 10 workers involved in the cement operations each day. For construction activities, there would also be concrete foundations laid at Leewood and Bibblewindi, which is expected to generate up to 4 heavy vehicle trips per day.

For the purposes of this assessment, it has been assumed there would be up to:

- 32 heavy vehicles accessing Leewood per day
- 10 heavy vehicles accessing Bibblewindi per day
- 10 heavy vehicles accessing Leewood to Bibblewindi services corridor per day.

5.2.5 Transportation of sewage effluent

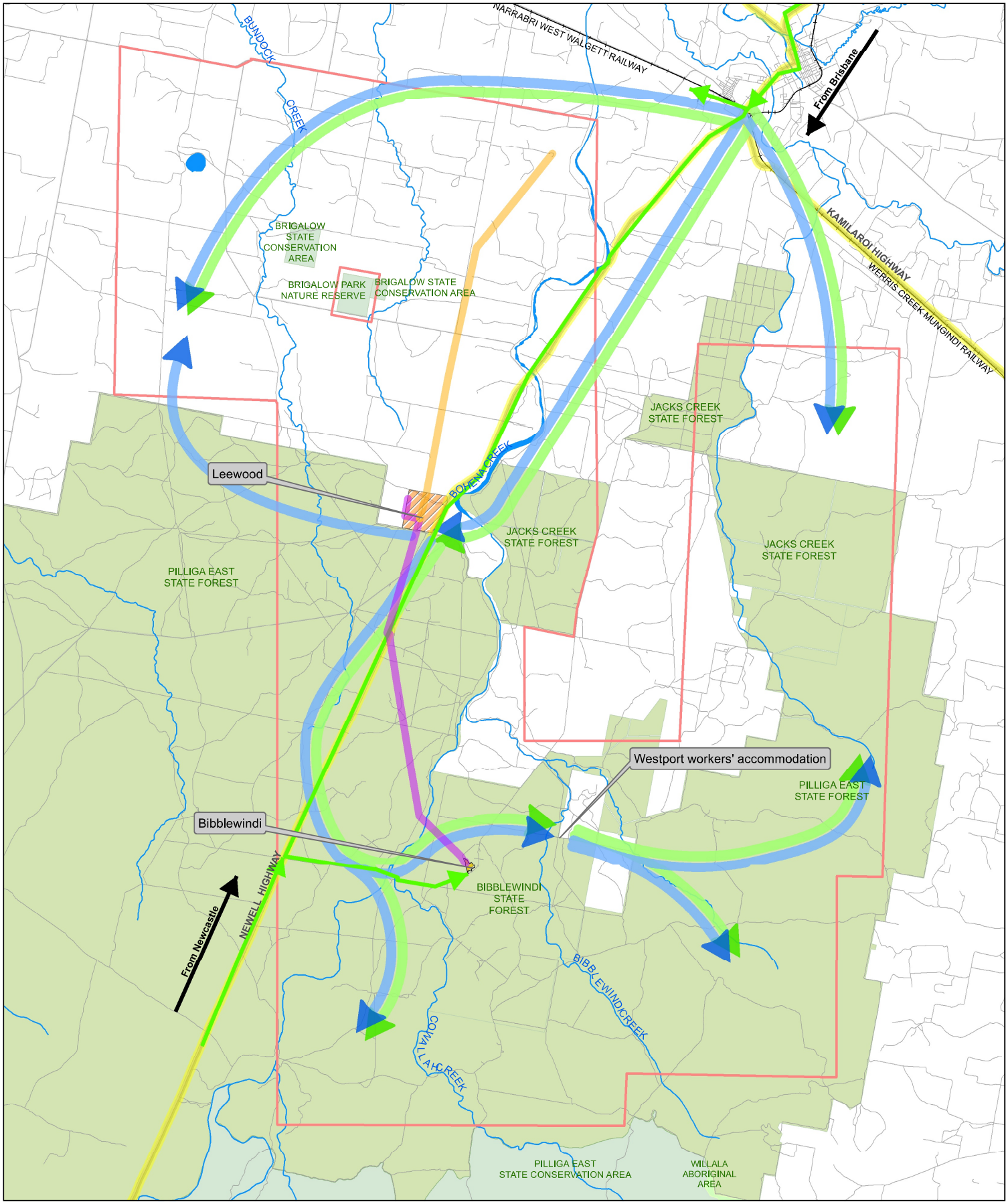
Vacuum trucks will collect sewage waste generated during construction for transport to appropriate facilities. For the purposes of this assessment, it has been assumed there would be up to:

- One heavy vehicle accessing Leewood and nearby corridor construction sites from Narrabri per day
- One heavy vehicle accessing Bibblewindi and nearby corridor construction sites from Narrabri per day
- One heavy vehicle accessing the Westport workers' accommodation from Narrabri per week. Only sewage sludge would be transported from the Westport workers' accommodation.
- Two heavy vehicles accessing gas field sites per day.

It is assumed that these trips would occur outside of the weekday AM and PM peak periods.

5.2.6 Transport Routes for Construction Traffic

The typical transport routes for gas field deliveries, including pipe and drilling fluids, to each of the drilling and gathering line construction locations are shown in Figure 5-4.



LEGEND

- Project area
- Leewood
- Bibblewindi
- Parks and reserves
- State forest
- Aboriginal areas
- Lakes and dams
- Watercourses
- Roads
- Train line
- Arterial Road
- Transportation Routes
- Leewood to Wilga Park infrastructure corridor
- Bibblewindi to Leewood infrastructure corridor
- Pipeline deliveries from Leewood
- Drilling fluid deliveries from Narrabri Operations and Logistics Centre

0 1.75 3.5 7
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Narrabri Gas Project
EIS Technical Appendix Traffic and Transport

Typical transport routes for gas field deliveries

Job Number 21-22463
Revision 1
Date 27 Jul 2016

Figure 5-4

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Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: NSW Department of Lands: DTDB and DCDB - 2012-13. Santos: Operational and Base Data - 2013. Created by: jrichardson

5.2.7 Drilling construction vehicle movements

A summary of the daily heavy vehicle movements associated with drilling activities is shown in Table 5-6.

Site preparation for drilling sites would occur over a period of around seven days and would generate approximately three heavy vehicle movements per day.

There would be up to six drill rigs operating at one time during the peak, with drilling occurring over a 20-year period. Drill rigs would move every 10-30 days, with a maximum of two drill rig movements at one time. It is estimated that 50 heavy vehicle movements (one-way) for each drill rig move would occur, over a period of two-three days, with around 18 heavy vehicle movements per day.

Delivery and construction of surface facilities (well head, generators, metering skid) would occur over a period of one day and generate approximately three heavy vehicle movements. There could be two site completions occurring at the same time.

During drilling, drilling fluids and other equipment deliveries would occur. These movements are included in the daily heavy vehicle movements shown in Table 5-6.

Table 5-6 Estimated Daily Drilling Construction Vehicle Movements

Description	Duration	Construction Vehicles
Site Preparation	7 days	5
Delivery of Drilling Equipment	3 days	20
Drilling	25 days	5
Removal of Drilling Equipment	3 days	20
Delivery of Systems Gathering Equipment	1 day	5
Gathering Systems	7 days	0
Delivery of Surface Facilities Equipment	1 day	5
Surface Facilities	21 days	0

Based on a most conservative daily traffic generation, with six drill rigs in operation, two drill rigs relocations and two site completions. The drilling and completion operations, including lease construction and production facility installation, would generate approximately 100 heavy vehicles in total per well.

Transport movements between drilling sites

Heavy vehicles would access the drilling areas from the state road network during the mobilisation period at the start of the construction period, where vehicles would access the site over a period of around three days. Once within the drilling areas, vehicle movements associated with drilling activities would typically be on the forestry roads. This would limit the number of trips on other roads such as the Newell Highway or Council roads following mobilisation at the start of the drilling program.

5.3 Staff traffic movements

Two worker accommodation camps are proposed to serve the project; the expanded Westport workers' accommodation, in addition to purpose built workers accommodation in the Narrabri region.

There would be up to 800 workers at the gas field for the construction of the gas processing and water treatment facilities, including some engineering and management works that would not necessarily be on site. There will be a further 300 workers involved in drilling activities during peak periods, with the busiest period expected to occur during the end of 2018 and the start of 2019.

5.3.1 FIFO access to workers' camps

It is anticipated that workers would fly-in-fly-out (FIFO) from anywhere on the east coast of Australia to Moree and Tamworth Airports, or Narrabri Airport if services were to resume. Personnel would then be transferred to the worker camps via buses. The access routes between Moree and Tamworth Airports and the worker camps are shown at Figure 5-5.

There would be a maximum of 800 construction workers at the camp facilities in the Narrabri region with up to 200 workers staying at an expanded camp at Westport. All 300 driller workers would be FIFO.

Workers would rotate every three weeks. Based on this, there would be approximately 25 to 30 coach trips between the airports and the worker camps every three weeks. It is likely that flights would be staggered across the week to manage logistics. For a most conservative assessment, it has been assumed approximately two coaches would access each of the camps in one day, with one coach coming from Tamworth Airport and one coach from Moree Airport.

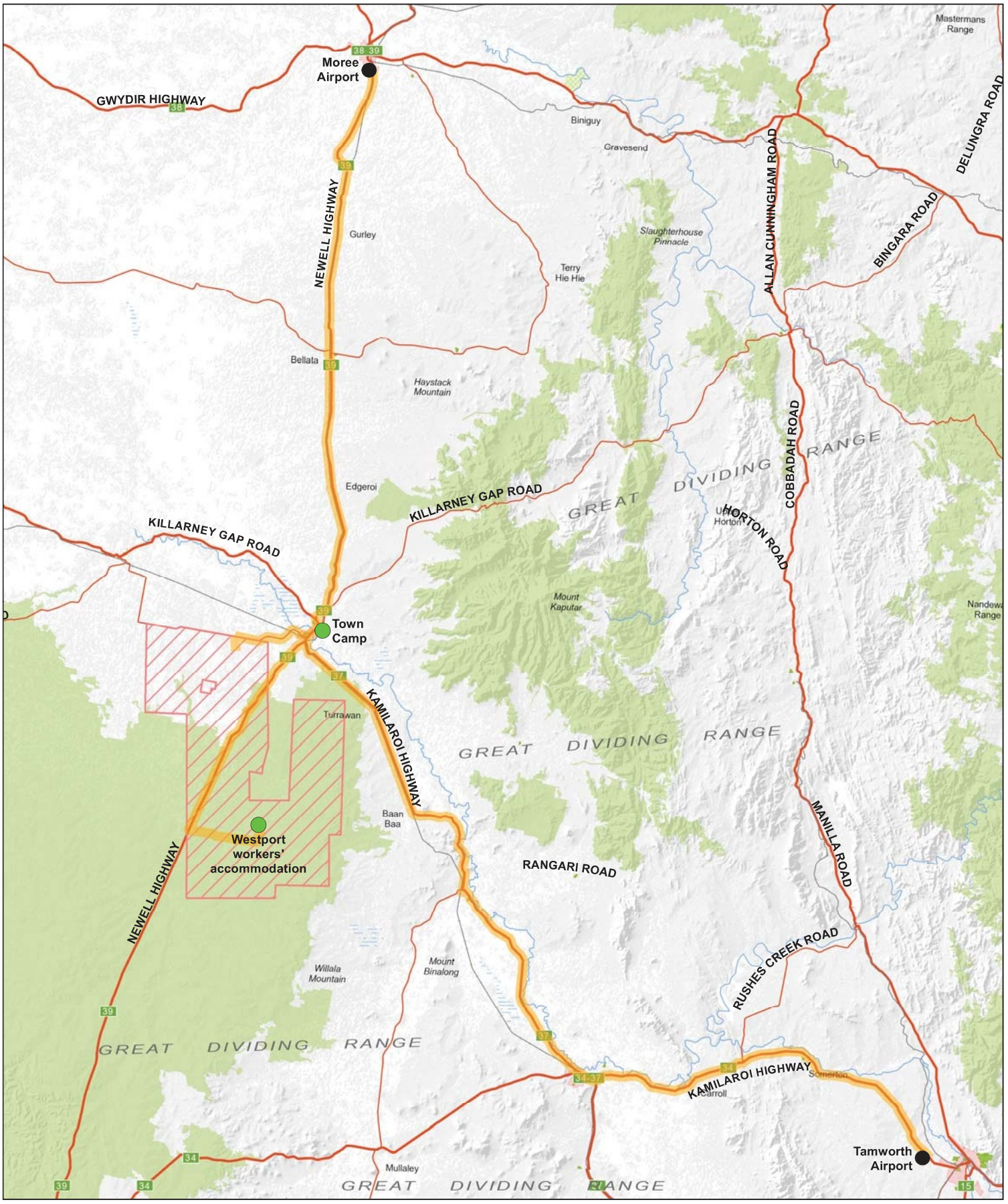
Other traffic generation – worker camps

Additional vehicle movements will also be generated by service vehicles supplying the worker camps. This would typically include services such as food transport, linen laundering, fuel supplies, waste management contractors and maintenance servicemen.

For the purposes of this assessment, it has been assumed that there would be approximately 20 service vehicle (light vehicle) movements per week at each construction camp, with up to five truck movements and two light vehicle movements per day. These movements would generally occur outside of the morning and evening peak periods.

Other traffic generation – dust suppression

Dust suppression activities would be undertaken across the project area on as needed basis over the project life for treated water beneficial reuse purposes.



LEGEND

- Project area
- Access routes
- Airport locations
- Construction Camps

0 5 10 20
Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Narrabri Gas Project
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Date 25 Feb 2015

Access Routes between Airports and Construction Camps

Figure 5-5

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Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data Source: NSW Department of Lands: DTDB and DCDB - 2012, Basemaps: Geoscience Australia, 2014. Created by: afoddy

5.3.2 Major facilities construction traffic generation

Leewood to Bibblewindi services corridor

Construction of the Leewood to Bibblewindi Services Corridor, include construction and commissioning of power cabling, power line construction, two water pipelines and a gas transfer pipeline and would have approximately 50 workers at the site during peak periods.

For the purposes of this assessment, it is assumed that this construction activity would generate up to two coach movements and five, four-wheel-drive movements, with workers accessing the site during the morning peak and departing the site during the evening peak.

The typical journey routes between the construction camp facilities at Narrabri and the construction sites at Leewood, Bibblewindi and the Leewood to Bibblewindi service corridor are shown in Figure 5-6.

Leewood to Wilga Park Infrastructure Corridor

For the purposes of this assessment, it is assumed that construction of the underground transmission line between Leewood and Wilga Park would generate up to 2 coach movement per day, with workers accessing the Leewood site outside of the morning peak and evening peak.

Workers' accommodation construction traffic

Construction of the Westport workers' accommodation would be undertaken early in the construction program. It is expected that up to 200 workers would be accommodated at the Westport camp and would therefore remain on site although there would be some workers accessing the camp from the local area. A conservative estimate of the daily light vehicle movements between Narrabri and the Westport camp for construction are:

- 50 light vehicle movements a day

The construction of the Westport workers' accommodation would be completed before the start of most of the other construction activities.

5.3.3 Drilling worker vehicle movements

The typical journey routes between the Westport workers' accommodation and the drilling sites are shown in shown in Figure 5-6.

There would be around 25-30 people on site during drilling. For the purposes of this assessment it has been assumed that

- 70% of workers would be transported to the construction sites by a 12 seat mini bus
- 20% travelling by four-wheel drive, with two people per vehicle.

A summary of the estimated daily traffic movements associated with drilling activities is provided in Table 5-7.

Table 5-7 Estimated daily drilling worker vehicle movements (per rig)

Description	Duration	Worker Vehicles
Site Preparation	7 days	5
Delivery of Drilling Equipment	3 days	10 (1)
Drilling	25 days	10 (1)
Removal of Drilling Equipment	3 days	10 (1)
Delivery of Systems Gathering Equipment	1 day	5
Gathering Systems	7 days	5
Delivery of Surface Facilities Equipment	1 day	5
Surface Facilities	21 days	5

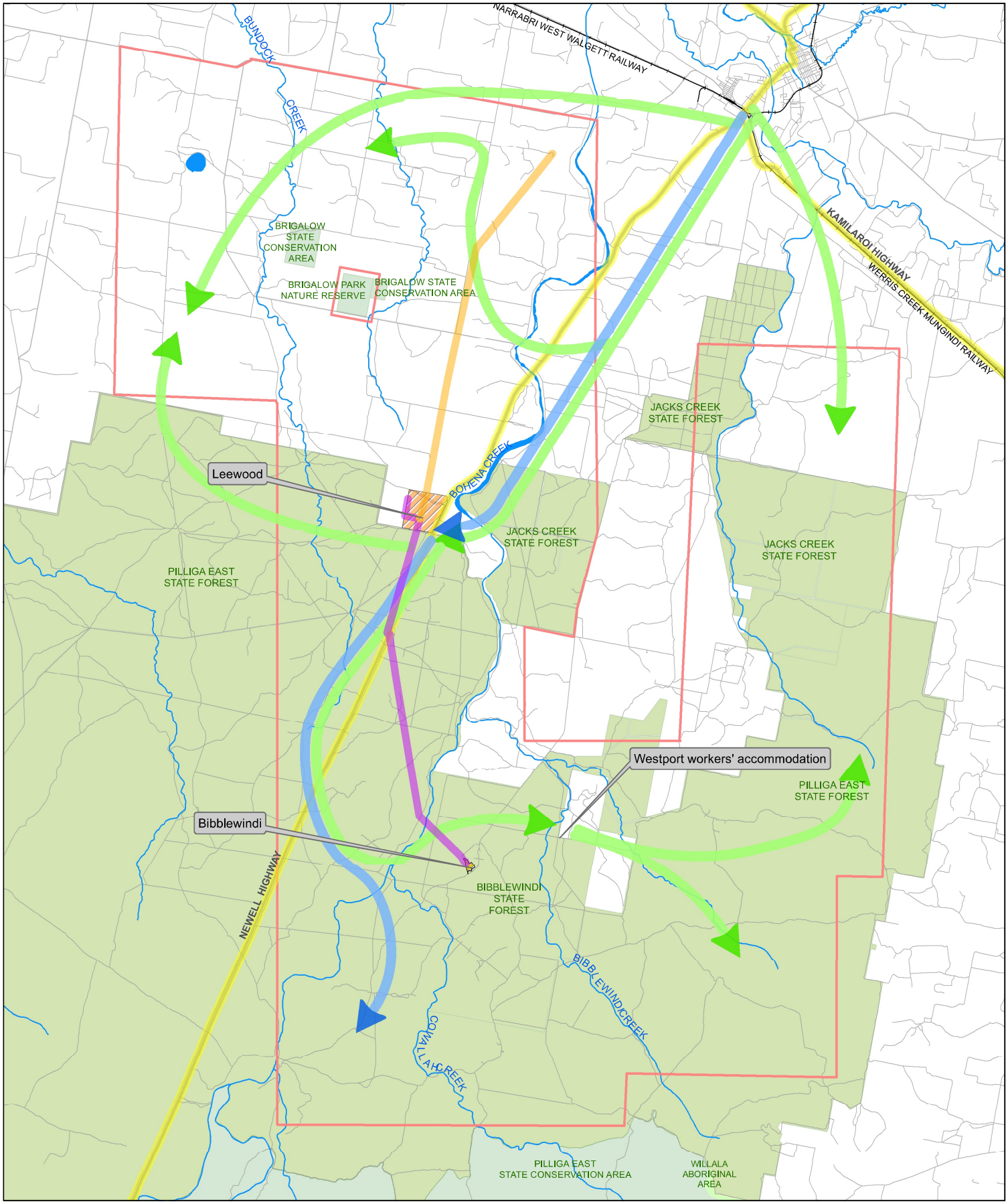
(1) Mini bus movements

It has been assumed that drill rigs would move every 10-30 days, with a maximum of two drill rig movements at the same time. In addition, there would be up to six drill rigs in operation at the same time.

Based on a most conservative daily traffic generation, with six drill rigs in operation and two drill rigs being moved, the drilling operations would generate approximately 10 mini bus movements and 92 light vehicle movements in total. Workers would need to be transported back to the worker camps in mini buses during shift changeover.

It is assumed that workers arriving by light vehicle would park at the site during the shift. Therefore, the total daily trip generation would be approximately:

- 20 mini bus; and
- 100 light vehicle trips.



LEGEND

- Project area
- Leewood
- Bibblewindi
- Parks and reserves
- State forest
- Aboriginal areas
- Lakes and dams
- Watercourses
- Roads
- Train line
- Arterial Road
- Leewood to Wilga Park infrastructure corridor
- Bibblewindi to Leewood infrastructure corridor
- Construction worker routes
- Delivery workers routes

0 1.75 3.5 7
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Narrabri Gas Project
EIS Technical Appendix Traffic and Transport

Transport routes between

workers' camps and construction and drilling areas

Job Number 21-22463
Revision 1
Date 27 Jul 2016

Figure 5-6

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Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: NSW Department of Lands: DTDB and DCDB - 2012-13. Santos: Operational and Base Data - 2013. Created by: jrichardson

6. Operational traffic movements

This section provides a summary of the expected traffic generation during the operational phase of the project.

6.1 Salt removal

Vehicles removing salt from Leewood would travel from Leewood to the north or south, along the Newell Highway. For the purposes of this assessment, it has been assumed there would be up to:

- four to five heavy vehicles accessing Leewood per day at peak during peak water production
- one to two heavy vehicles accessing Leewood per day during typical operational periods.

Salt removal would only occur during the operational stage, following completion and commission of the water treatment facility.

6.2 Transportation of sewage effluent

Vacuum trucks would collect sludge generated in the sewage treatment process for transport to appropriate facilities.

For the purposes of this assessment, it has been assumed there would be up to:

- One heavy vehicle trip accessing Leewood from Narrabri per quarter during typical operational periods. Only sewage sludge would be transported from the Leewood during operation.
- One heavy vehicle trip accessing Bibblewindi from Narrabri per quarter during typical operational periods. Only sewage sludge would be transported from Bibblewindi during operation.

It is assumed that these trips would occur outside of the weekday AM and PM peak periods.

6.3 Operations staff

6.3.1 Peak construction period

During peak construction periods, there would be around 80 operations staff in the study area, including:

- 40 operations staff would be based at the Narrabri Operations Centre (NOC)
- 40 operations staff at offices in Narrabri town centre

Staff would mainly be travelling to these locations from Narrabri and would be travelling by light vehicle. Assuming that two people per vehicle, it has been assumed that there would be 20 daily light vehicle movements per day (one way) from Narrabri and the NOC. It has been assumed that staff travelling to the offices within Narrabri town centre would already be on the road network, as these are existing offices.

For the purposes of this assessment it is assumed that operations staff would arrive on site during the morning peak hour and depart during the afternoon peak hour.

6.3.2 Typical operation period

Following construction of the major facilities at Leewood and Bibblewindi, the number of operations staff would increase to approximately 150 people in the study area, including:

- 20 staff at the NOC
- 40 staff at Narrabri town centre offices
- 45 staff at Leewood
- 45 staff at Bibblewindi.

A further 50 operations staff would also be based at Santos offices in Brisbane and Sydney, which is not included as part of this study. Some FIFO is possible although this is not expected to be significant.

The following assumptions have been made regarding traffic associated with operations staff during this period:

- five daily light vehicles per day from Narrabri and the NOC to Leewood
- 25 daily light vehicles per day from Narrabri and the NOC to Leewood, based on two people per vehicle.
- 25 daily light vehicles per day from Narrabri to Bibblewindi, based on two people per vehicle.

For the purposes of this assessment it is assumed that operations staff would arrive on site during the morning peak hour and depart during the afternoon peak hour. It has also been assumed that staff travelling to the offices within Narrabri town centre would already be on the road network, as these are existing offices.

7. Impact assessment

This Section of the report provides an assessment of the traffic and transport impacts associated with the proposed construction and operation of the project. The assessment is based on the ultimate peak scenario in terms of traffic generation and the overall effect on the higher order road network. Assumptions on peak hour traffic generation are provided to assess the impact on the state and council road network during peak periods.

7.1 Scenarios for traffic impact assessment

As noted above, this Traffic Impact Assessment report focuses on the ultimate peak scenario in terms of traffic generation and the overall effect on the higher order road network potential impacts associated with the project. However, traffic generation from the project during the typical peak construction period and typical operation period is also considered.

The construction schedule (Figure 5-2) and manning schedule (Figure 5-3) indicates that the highest number of construction staff (including drillers) would be during mid-2019. The peak construction traffic movements would therefore occur during this period, which would include oversized and general deliveries, construction traffic associated with workers accessing the site, and traffic associated with drilling operations.

This assessment is based on the following scenarios for construction and operation periods:

- Scenario 1 - absolute peak daily traffic generation
- Scenario 2 – typical peak daily traffic generation
- Scenario 3 – typical daily movements.

The following sections provide a summary of the estimated number daily heavy and light vehicles for each of the above scenarios.

Scenario 1 – absolute peak, duration 3 days

The duration of the absolute peak is expected to be for around three days. The absolute peak in terms of traffic generation for the project would consist of the following activities:

- mobilisation of Leewood and Bibblewindi construction sites
- mobilisation of two rigs
- work at six other well locations
- shift changeover for staff
- 80 operations staff at NOC, Leewood and Bibblewindi.

Scenario 2 – typical peak, duration 3 days occurring approximately once a month

The duration of the typical peak for construction traffic is expected to be for around three days, occurring once a month. The typical peak in terms of traffic generation for the project would consist of the following activities:

- delivery of oversize loads at Leewood/Bibblewindi
- delivery of general materials at Leewood/Bibblewindi
- mobilisation of two rigs
- work at six other well locations
- shift changeover for staff
- 80 operations staff at NOC, Leewood and Bibblewindi.

Scenario 3 – typical daily movements

The typical daily movements for the project would consist of the following activities:

- materials deliveries and general deliveries to Leewood and Bibblewindi
- materials deliveries and general deliveries to the well locations
- work at six other well locations
- shift changeover for staff
- 150 operations staff at NOC, Leewood and Bibblewindi.

7.1.1 Summary of traffic movements by location

A summary of the expected daily and peak hour traffic generation during each scenario is shown in Table 7-1 for vehicles accessing Bibblewindi and Table 7-2 for vehicles accessing Leewood.

Traffic associated with drilling activities, including movements along forestry roads, is summarised for each traffic generation scenario in

Table 7-3. For the purposes of this assessment, it has been assumed that these vehicles would be accessing the drilling locations from the Newell Highway via X-Line Road.

The proportion of movements occurring during the morning and evening peak periods has been estimated at approximately 10 per cent, which is considered a conservative estimate for these types of movements. It has been assumed that 100 per cent of staff movements accessing the site during the peak hour, which is considered conservative, as based on the proposed working hours most of these movements would be outside of the morning and evening peak periods.

The expected morning and evening peak hour turn volumes at intersections within the study area under Scenario 1, Scenario 2 and Scenario 3 traffic conditions are shown at Appendix D.

Table 7-1 Daily and Peak hour traffic generation (one-way) – Bibblewindi and Westport workers' accommodation

Trip Purpose to Bibblewindi	Vehicle Type	Travel Route From	Traffic Movements (one-way)								
			Scenario 1			Scenario 2			Scenario 3		
			Total	Daily	Peak Hour	Total	Daily	Peak Hour	Total	Daily	Peak Hour
Deliveries	Oversized Vehicles	Queensland	200	5	1						
	General (Trucks)	Leewood		5	1						
	General (Trucks)	NOC		5	1						
Construction Staff Movements	Coaches (70%)	Camp facilities at Narrabri		10	5		10	5			
	Cars from Camp (20%)	Camp facilities at Narrabri		25	25		25	25			
	Cars Local (10%)	Narrabri		10	10		10	10			
Leewood to Bibblewindi Pipeline Deliveries	Oversized Vehicles	Queensland		5	0		5	0			
	General Deliveries	NOC		5	0		5	0		5	0
Leewood to Wilga Park Corridor	General (Trucks)	Narrabri		5	0						
Service vehicles to drillers camp	General (Trucks)	Narrabri	250	5	1						
	Light vehicles	Narrabri		5	1						
Transportation of sewage effluent	Vacuum Trucks	Narrabri		2	0		2	0		1	
Operations Staff	Light vehicles	Leewood		0	0		0	0		25	25
Total - Heavy Vehicles			**450**	**47**	**12**	**2**	**17**	**5**	**2**	**1**	**0**
Total - Light Vehicles				**40**	**35**		**40**	**35**	**0**	**30**	**25**

Table 7-2 Daily and Peak hour traffic generation (one-way) – Leewood

Trip Purpose	Vehicle Type	Travel Route From	Traffic Movements (one-way)								
			Scenario 1			Scenario 2			Scenario 3		
			Total	Daily	Peak Hour	Total	Daily	Peak Hour	Total	Daily	Peak Hour
Power Plant	Oversized Vehicles	Queensland	250	5	1						
	General (Trucks)	NOC		5	1						
Water Treatment Facility	Oversized Vehicles	Queensland	800	5	1						
	General (Trucks)	NOC		20	2						
Gas Processing Facility	Oversized Vehicles	Queensland	550	5	1						
	General (Trucks)	NOC		10	1						
Salt removal	General (trucks)	North or south, along Newell Highway		4	0		2	0		2	0
Staff Movements	Coaches (70%)	Camp facilities at Narrabri		15	5		20	10			
	Cars from Camp (20%)	Camp facilities at Narrabri		40	40		40	40			
	Cars Local (10%)	Narrabri		20	20		20	20			
Leewood to Bibblewindi Pipeline Deliveries	Oversized Vehicles	Queensland	250	5	1						
Leewood to Wilga Park Corridor	General (Trucks)	Narrabri		5	0						
	Coach	Narrabri		2	0						
Transportation of sewage effluent	Vacuum Trucks	Narrabri		1	0		1				
Operations Staff	Light vehicles	Narrabri		0	0		0	0		25	25
Total - Heavy Vehicles			**1,851**	**82**	**13**		**23**	**10**		**2**	**0**
Total - Light Vehicles				**60**	**60**		**60**	**60**		**25**	**25**

Table 7-3 Daily and Peak hour traffic generation (one-way) – Drilling Activities

Trip Purpose to Bibblewindi	Vehicle Type	Travel Route From	Traffic Movements (one-way)								
			Scenario 1			Scenario 2			Scenario 3		
			Total	Daily	Peak Hour	Total	Daily	Peak Hour	Total	Daily	Peak Hour
Site preparation (x2 drill rig moves)	Heavy Vehicles	N/A		5			5			5	
	Light Vehicles	N/A		5			5			5	
Delivery of drilling equipment (x2 drill rig moves)	Heavy Vehicles	N/A		5			5			5	
	Mini buses	N/A		5			5			5	
	Light Vehicles	N/A		5			5			5	
Drilling (x6 drilling operations)	Heavy Vehicles	NOC		5	1		5	1		5	1
	Mini buses	N/A		5			5			5	
	Light Vehicles	N/A		50			50			50	
Removal of Drilling Equipment (x2 drill rig moves)	Heavy Vehicles	N/A		35			35			35	
	Mini buses	N/A		5			5			5	
	Light Vehicles	N/A		15			15			15	
Delivery of Gathering System Equipment (x2 drill rig moves)	Heavy Vehicles	NOC		5	1		5			5	1
	Light Vehicles	NOC		5	5		5	5		5	5
Gathering System (x2 drill rig moves)	Light Vehicles	NOC		5	5		5	5		5	5
Delivery of Surface Facilities Equipment (x2 drill rig moves)	Heavy Vehicles	NOC		5	1		5	1		5	1
	Light Vehicles	NOC		5	5		5	5		5	5
Surface Facilities (x2 drill rig moves)	Light Vehicles	NOC		5	5		5	5		5	5
Transportation of STP waste	Vacuum Trucks	Narrabri		2	0		2	0		2	0

Trip Purpose to Bibblewindi	Vehicle Type	Travel Route From	Traffic Movements (one-way)								
			Scenario 1			Scenario 2			Scenario 3		
			Total	Daily	Peak Hour	Total	Daily	Peak Hour	Total	Daily	Peak Hour
Total - Heavy Vehicles				63	6		63	6		63	6
Total - Light Vehicles				110	110		110	110		110	110
Total - Heavy Vehicles (State and Council Roads)				**16**	**3**		**16**	**2**		**15**	**2**
Total - Light Vehicles (State and Council Roads)				**20**	**20**		**20**	**20**		**20**	**20**

7.2 Mid-block assessment

Daily traffic volumes

A summary of the additional daily increase in traffic associated with the absolute peak (Scenario 1) construction activities is shown in Table 7-4, along with the expected percentage increase in traffic. The highest percentage increase in traffic is expected at X-Line Road, Old Mill Road, Yarrie Lake Road and the Newell Highway, south of Narrabri.

The expected high increase in daily traffic flow at these locations is due to the low existing traffic volumes along these roads, particularly Yarrie Lake Road and X-Line Road and Old Mill Road, which currently carry around 500 and 300 vehicles per day respectively.

It is also noted that this absolute peak in traffic would only occur over a period of approximately three days. In addition, the forecast daily traffic volumes along each road within Study Area would continue to be within the functional classification traffic flow range (refer to Section 4.2.1). Based on this analysis, the project would have acceptable impacts to the daily traffic volumes along the roads within the Study Area.

Table 7-4 Expected daily increase in traffic (two-way) – scenario 1

Road Name	Existing Daily Traffic (two-way)	Additional Construction Traffic (two -way)	With Construction Traffic (two-way)	Percentage Increase	Vehicles per day (capacity)a
Newell Highway, North of Francis Street	3,107	64	3,171	2	76,800
Newell Highway, North of Killarney Street	10,279	64	10,343	1	76,800
Tibbereena Street, North of Dewhurst Street	4,729	243	4,972	5	2,000 – 10,000
Old Gunnedah Road, South of Regent Street	2,819	243	3,062	9	2,000 – 10,000
Mooloobar Street, West of Buri Street	1,182	160	1,342	14	2,000 – 10,000
Yarrie Lake Road, east of Bohena Creek	495	160	655	32	2,000 – 10,000
Newell Highway, South of Mooloobar Street	7,520	479	7,999	6	76,800
Kamilaroi Highway, East of Newell Highway**	1,559	70	1,629	4	76,800
Newell Highway, 20 km south of Narrabri	1,860	479	2,339	26	76,800
X-Line Road*	300	228	528	76	500 – 4,000
Old Mill Road*	300	279	579	93	500 – 4,000

Notes: **Assumed peak hour traffic is 10 % of the daily traffic*

*** Increase in traffic on Kamilaroi Highway based on Scenario 3*

Peak hour traffic volumes

A summary of the additional morning and afternoon peak hour increase in traffic associated with the absolute peak (scenario 1) construction activities are shown in Table 7-5 and Table 7-6 respectively. The proposal would have an increase in traffic along local roads including X-Line Road, Old Mill Road, Yarrie Lake Road, Mooloobar Street and Old Gunnedah Road. However,

this increase at these locations is due to existing low traffic volumes along these roads. Based on this analysis, the project would have acceptable impacts to the daily traffic volumes along the roads within the Study Area.

The absolute peak construction activities are expected to result in a percentage increase in traffic of around 160 percent at the Newell Highway.

The Newell Highway and the Kamilaroi Highway are both two-lane two-way rural roads (one lane per direction). The Highway Capacity Manual (HCM) 2000 states that the capacity of a two-lane highway is 3,200 passenger cars per hour (pc/h) for both directions of travel combined.

The expected peak hour two-way traffic flow along these roads during peak construction of the project is expected to be around 280 along the Newell Highway (south of Narrabri) and around 160 along the Kamilaroi Highway. Based on these forecast traffic volumes and the LoS criteria shown in Table 2-1, both the Newell Highway and Kamilaroi Highway are expected to operate at Los A during peak periods. This analysis indicates that the forecast traffic volumes along the Newell Highway and Kamilaroi Highway would operate within the Roads and Maritime recommended operating performance standards.

Table 7-5 Forecast increase in AM peak hour two-way traffic volumes – Scenario 1

Location	Existing Traffic Volumes (vph/h)*	Additional Construction Traffic (veh)	With Dev Traffic Volumes (vph/h)*	Percent Increase in Traffic	Capacity Vehicles per hour (total)
Tibbereena Street (east of Newell Highway)	411	109	520	27	3,200
Newell Highway (west of Tibbereena Street)	847	24	871	3	3,200
Newell Highway (south of Tibbereena Street)	1,060	133	1193	13	3,200
Old Gunnedah Road, South of Regent Street*	282	109	391	39	3,200
Newell Highway (north of Mooloobar Street)	583	133	716	23	3,200
Mooloobar Street (west of Newell Highway)	169	81	250	48	3,200
Yarrie Lake Road, east of Bohena Creek*	50	81	131	164	1,800
Old Turrawan Road (east of Newell Highway)	180	0	180	0	1,800
Newell Highway (south of Mooloobar Street)	420	171	591	41	1,800
Kamilaroi Highway (east of Newell Highway)**	145	22**	167	15	1,800
Newell Highway (south of Kamilaroi Highway)	107	171	278	159	1,800
X-Line Road*	30	100	130	333	1,800
Old Mill Road*	30	88	118	292	1,800

tes: **Assumed peak hour traffic is 10 % of the daily traffic*

*** Increase in traffic on Kamilaroi Highway based on Scenario 3*

Table 7-6 Forecast increase in PM peak hour two-way traffic volumes – Scenario 1

Location	Existing Traffic Volumes (vph/h)*	Additional Construction Traffic (veh)	With Dev Traffic Volumes (vph/h)*	Percent Increase in Traffic	Capacity Vehicles per hour (total)
Tibbereena Street (east of Newell Highway)	470	109	579	23	3,200
Newell Highway (west of Tibbereena Street)	990	24	1014	2	3,200
Newell Highway (south of Tibbereena Street)	1,156	133	1289	12	3,200
Old Gunnedah Road, South of Regent Street*	282	109	391	39	3,200
Newell Highway (north of Mooloobar Street)	519	131	650	25	3,200
Mooloobar Street (west of Newell Highway)	162	73	235	45	3,200
Yarrie Lake Road, east of Bohena Creek*	50	73	123	147	1,800
Old Turrawan Road (east of Newell Highway)	58	0	58	0	1,800
Newell Highway (south of Mooloobar Street)	401	164	565	41	1,800
Kamilaroi Highway (east of Newell Highway)**	155	22	177	14	1,800
Newell Highway (south of Kamilaroi Highway)	131	164	295	125	1,800
X-Line Road*	30	100	130	333	1,800
Old Mill Road*	30	88	118	292	1,800

Notes: **Assumed peak hour traffic is 10 % of the daily traffic*
*** Increase in traffic on Kamilaroi Highway based on Scenario 3*

7.3 Intersection performance

Based on the traffic generation and traffic assignment provided in Section 7.1, SIDRA modelling has been undertaken with the additional generated traffic, resulting from the construction activities. The site access intersection to Leewood and Bibblewindi (X-Line Road) has been assessed based on the most conservative surveyed peak hour traffic counts at Newell Highway from the midblock “tube” traffic counts.

A summary of the SIDRA intersection assessment results is shown in Table 7-7 under the most conservative traffic generation associated with the proposal (Scenario 1). Detailed SIDRA outputs are provided in Appendix B. As shown, all intersections would continue to operate at an acceptable LoS A with good operation and spare capacity during the absolute peak traffic generation of the project.

Table 7-7 SIDRA results – 2014 surveyed and construction traffic flows - Scenario 1

Intersection	AM Peak		PM Peak	
	Ave Delay (s)	LoS	Ave Delay (s)	LoS
Newell Highway/Tibbereena Street	7	A	7	A
Newell Highway/Mooloobar Street/Old Turrawan Road	6	A	5	A
Kamilaroi Highway/Newell Highway	8	A	8	A
Newell Highway/Old Mill Road	10	A	10	A
Newell Highway/X-Line Road	12	A	9	A

7.4 Intersection treatments

This section provides an understanding of the recommended intersection treatments at the following locations:

- Newell Highway/X-Line Road intersection; and
- Newell Highway/Old Mill Road.

Existing traffic volumes outlined in Section 4.3 have been used in this to determine the appropriate intersection treatments.

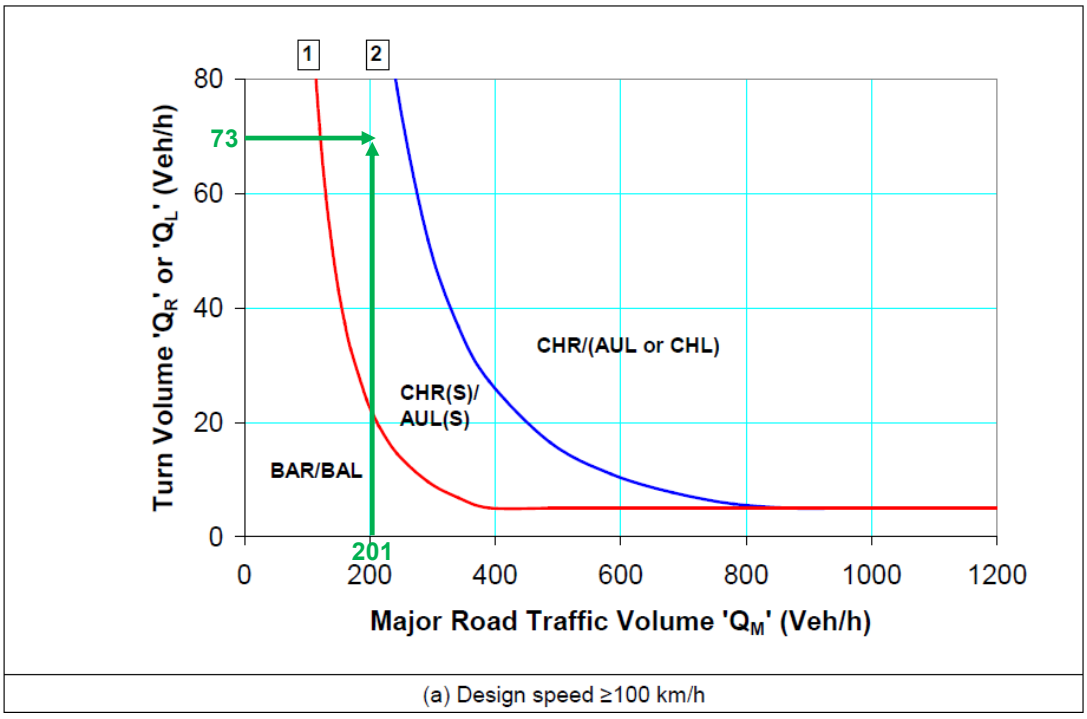
7.4.1 Intersection treatment warrant criteria

The warrant provides guidance on the required intersection design based on traffic volume.

Figure 7-1 has been sourced from the *Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections - Figure 4.9.* This figure contains two graphs for the selection of turn treatments on roads with a design speed, for the purpose of this assessment we have used the graph for a speed of greater than or equal to 100 km/h, which is appropriate for the Newell Highway. We have also used the graph for a speed of less than 100 km/h, which is appropriate for the NOC access at Yarrie Lake Road.

Leewood access at Old Mill Road

The project proposal indicates that 73 proposed vehicles will turn right from Newell Highway into Leewood. Based on the existing highest peak hour on Newell Highway of 107 vehicles per hour (vph), with the addition of the proposed 94 vehicles continuing through to Bibblewindi or turning left into Leewood, the Newell Highway would carry 201 vehicles per hour.



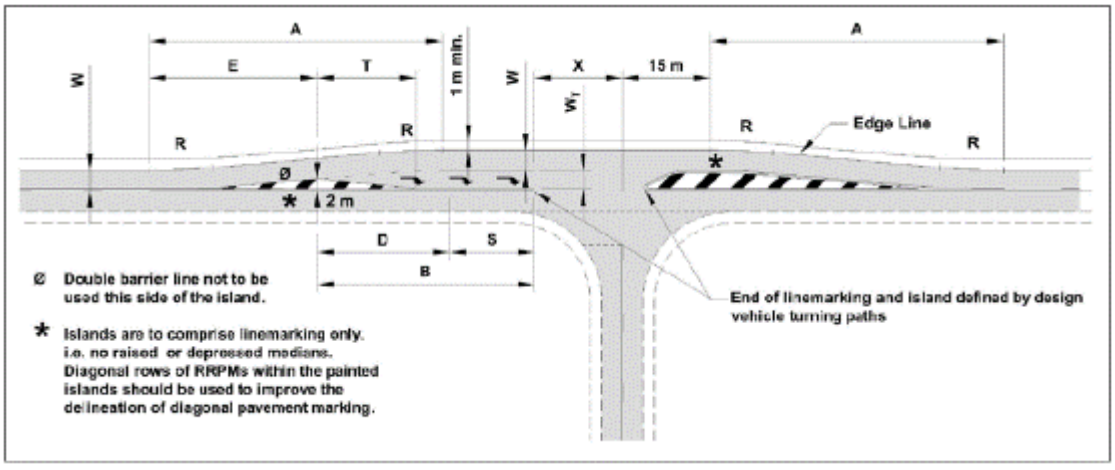
(a) Design speed ≥100 km/h

Source: Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections - Figure 4.9, modified by GHD

Figure 7-1 Warrants for turn treatments on major roads (design speed >100 km/h)

As indicated in Figure 7-1 the intersection of the access from the Newell Highway to Leewood via Old Mill Road would require a channelised right turn treatment on the Newell Highway.

Figure 7-2 provides an example of a right turn channelised intersection.

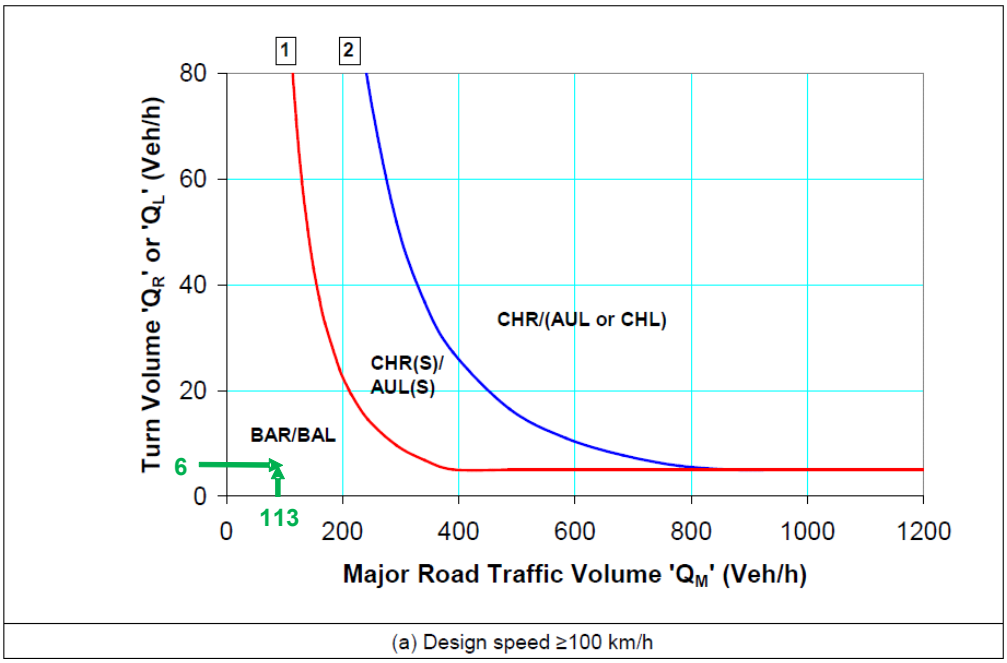


Source: Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections - Figure 7.6

Figure 7-2 Channelised right turn treatment with a short turn slot [CHR(S)] two lane rural road

The project proposal indicates that around 6 proposed vehicles will turn left from Newell Highway into Leewood. The forecast highest peak hour northbound movement on the Newell Highway is around 133 vehicles per hour (vph), with the addition of the proposed through vehicle continuing through to Narrabri.

As indicated in Figure 7-3, the intersection of the access from the Newell Highway to Leewood via Old Mill Road would not require an auxiliary left turn on the Newell Highway.

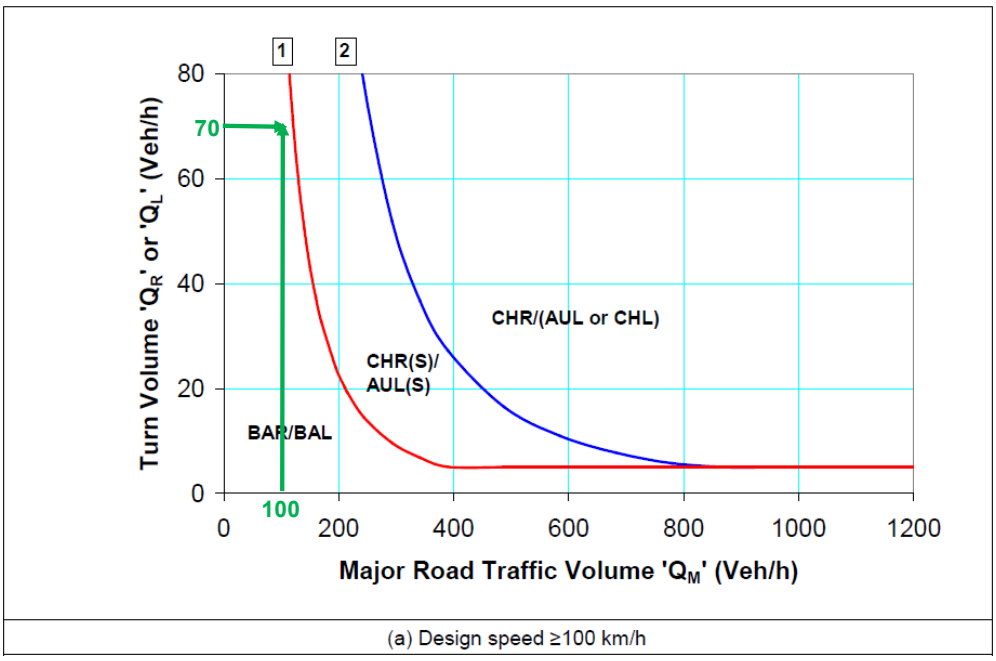


Source: Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections - Figure 4.9, modified by GHD

Figure 7-3 Warrants for turn treatments on major road (design speed >100 km/h)

Forest access at X-Line Road

The project proposal indicates that around 70 proposed vehicles will turn left from Newell Highway into X-Line Road. This warrant has been based on the existing highest peak hour on Newell Highway of around 100 vph for the southbound through movement.

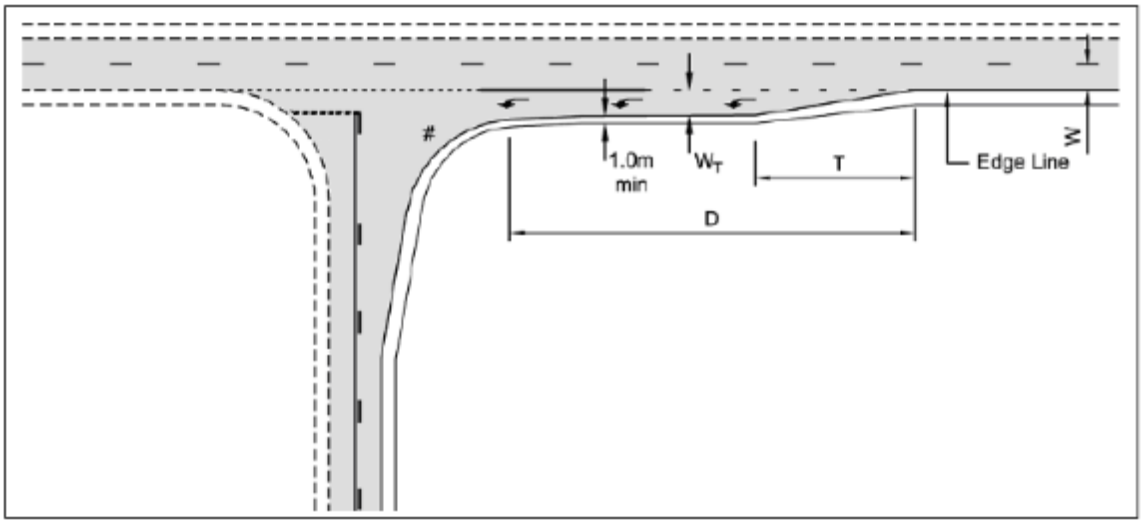


Source: Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections - Figure 4.9, modified by GHD

Figure 7-4 Warrants for turn treatments on major road (design speed >100 km/h)

As indicated in Figure 7-4, application of the Austroads Guide indicates that the forecast number of vehicles turning left from the Newell Highway to Bibblewindi is reaching the requirement for an auxiliary left turn treatment. A minor variation in increased traffic at this location will require the provision of an auxiliary left turn treatment.

Consideration of the Austroads Guide in relation to forecast traffic volumes and warrant criteria would guide the need for provision of an Auxiliary Left (AUL) turn treatment at this intersection. An example of the intersection treatment is shown at Figure 7-5.



Source: Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections - Figure 8.3

Figure 7-5 Rural AUL(S) treatment with a short left turn lane

Acceleration Lane – Newell Highway

An assessment for the provision of acceleration lanes has been undertaken with reference to headway calculations provided in Commentary 8 in the *Austroads Guide to Traffic Management Part 2: Traffic Theory* (Austroads, 2015). Acceleration lanes may be provided at major intersections depending on traffic analysis. However, they are usually provided only where:

- insufficient gaps exist for vehicles to enter a traffic stream
- turning volumes are high (e.g. 300 to 500 vph)
- the observation angle falls below the requirements of the minimum gap sight distance model (for example, inside of horizontal curves)
- heavy vehicles pulling into the traffic stream would cause excessive slowing of major road vehicles.

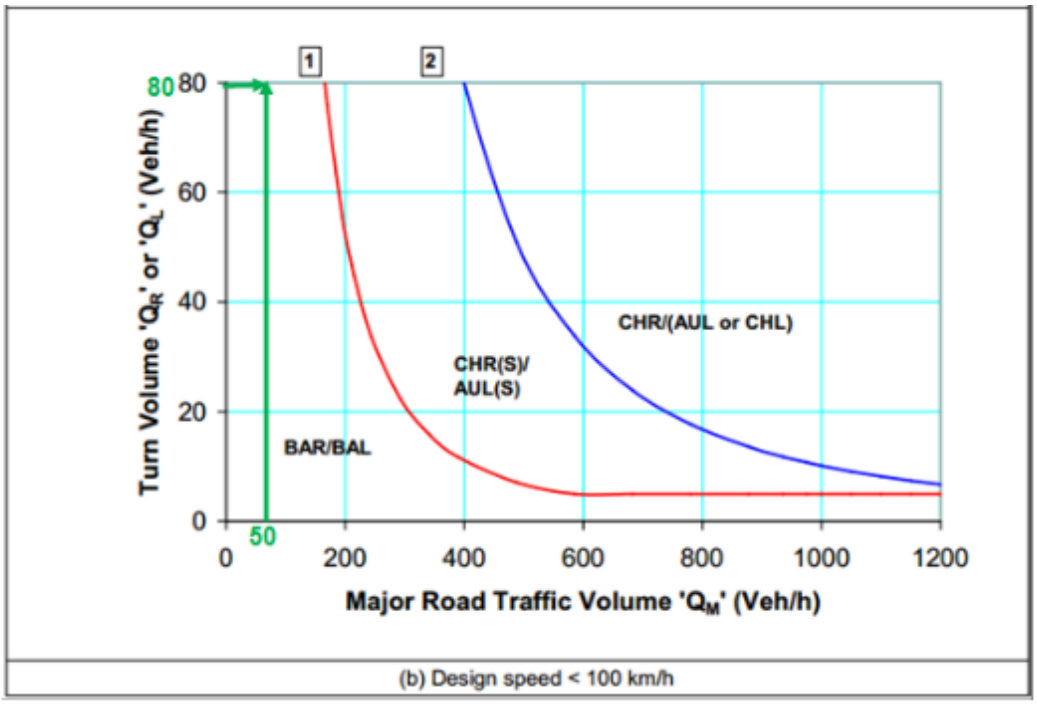
An assessment of requirements for acceleration lanes has been undertaken for the left turn movement from the Leewood access during the PM peak, as this intersection is expected to have the highest traffic volumes in Scenario 1. With a forecast 113 vehicles travelling northbound along the Newell Highway through the Leewood access intersection, the average gap length between vehicles would be around 32 seconds. This is enough time for a vehicle to turn left into the Newell Highway and accelerate without requiring northbound through traffic to slow.

Based on the above analysis, it is expected that there will be sufficient gaps in traffic to allow traffic to turn out onto the Newell Highway without requiring acceleration lanes.

NOC access at Yarrie Lake Road

The project proposal indicates that around 80 proposed vehicles will turn right from Yarrie Lake Road into the NOC access. This warrant has been based on the existing highest peak hour on Yarrie Lake Road of around 50 vph.

As indicated in Figure 7-5 the intersection of the NOC access driveway from Yarrie Lake Road would not require a channelized right turn treatment. No upgrade would be required to the existing access to the NOC.



Source: Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections - Figure 4.9, modified by GHD

Figure 7-6 Warrants for turn treatments on major road (design speed <100 km/h)

7.5 Parking

Parking for all construction vehicles will be contained on site within the project area. There would be no impact to the existing road network.

7.6 Public transport

7.6.1 Impact on public transport routes

Public transport routes have been identified within the study area. The potential impact of the construction traffic on public transport operations is considered to be minimal. However, this will be addressed as part of developing a construction and operational traffic management plan. Site specific traffic management plans will be prepared to mitigate potential impact on the public transport operation.

7.6.2 Impact on school bus routes

School bus routes along roads within the study area include:

- Newell Highway
- Kamilaroi Highway
- Yarrie Lake Road
- Old Gunnedah Road
- Maitland Street.

School bus routes along other local roads within the study area have not been identified as part of this study. It is possible that construction traffic routes may overlap with school bus routes along local roads. However, given the relatively low number of school bus services in the area, and the likely short period of time of operation within the day, it is expected that there would be a minimal impact on the safe operation of current school bus services.

Potential impacts will be addressed in detail when traffic management plans for construction and operation are prepared. Communication and promoting awareness to the community of the proposed project and construction activity will be critical to managing impacts on school bus services during both construction and operation. Bus operators will be made aware of the project and schools should be consulted.

7.7 Impact on Crashes

Analysis of crash data supplied by NSW Road and Maritime Services over a five-year period indicated that 46 crashes had occurred within the study area. The study area covers a mixture of rural highway with speed environments greater than 100 km/h as well as through the Narrabri town centre where the speed reduces to 50 km/h. It should be noted that crash data was not provided for the forestry roads, including X-Line Road and Old Mill Road.

There were 37 crashes that occurred along the Newell Highway over a five-year period. Of these, 26 occurred at intersections throughout the Narrabri town centre. The crashes recorded were spread out along the route and not concentrated to one particular intersection or section of road way.

The project would have acceptable impacts to mid-block capacity along Newell Highway, Kamilaroi Highway and local roads within the study area, while intersections within the study area would continue to operate satisfactorily. As such, the project is not considered to significantly impact safety of the existing road network or result in increasing crashes along these roads.

Two intersections on Newell Highway are planned to be upgraded to provide access to Leewood (via Old Mill Road) and Bibblewindi (via X-Line Road). A channelised right-turn would be constructed at the intersection of Newell Highway and Old Mill Road to provide access to and from Leewood and the gas field, while a channelised left-turn treatment would be constructed at the intersection of Newell Highway and X-Line Road to provide access to and from Bibblewindi and the gas field. These intersection upgrades will improve safety by allowing traffic accessing Old Mill Road and X-Line Road using the proposed turn bays, removing turning traffic from the southbound through lane on the highway.

Traffic generated by the project has the potential to affect road condition, which can have safety implications as well as accelerate the rate of ongoing maintenance and renewals incurred by the relevant road authorities. However, the Newell Highway is a national highway and is an RMS approved higher mass limit (HML) A-double road train (36.6 metre vehicle) route, and the

proportional increase increase in traffic associated with the proposal is not expected to impact the quality of the pavement of this road.

The proportional increase in traffic generated by the project on major roads like the Newell Highway or Kamilaroi Highway is not expected to significantly impact on the safety or condition of these roads, which are designed to carry heavy vehicles.

Many of the forestry roads are unsealed and have poor site distance in some sections. These roads have low traffic volumes, so drivers may not always expect other traffic along these roads which can potentially result in crashes. No crash data for forestry roads was available for this study. Mitigation measures, such as driver behaviour programs, low traffic speeds and the implementation of a Traffic Management Plan to take effect during both the construction and operational stages of the project; would reduce these safety risks, as detailed in Section 9.2.

Fog and night time conditions can reduce visibility along roads, which can potentially result in crashes. Mitigation measures, such as safety inductions for vehicle drivers and the implementation of a Traffic Management Plan would reduce these safety risks, as detailed in Section 9.2.

Given the existing low traffic volumes along roads within the study area, the proposed construction and operation of the project is not expected result in an increase in crashes along these roads.

7.8 Maintenance

Santos would monitor and report on evident deterioration of road conditions over the peak construction period and would consult with the relevant road authorities regarding potential maintenance liability where the deterioration is attributable to project activities. For Narrabri Shire Council, there would be potential for ongoing maintenance and renewals to be funded (in part) through the Gas Community Benefit Fund. For the Forestry Corporation of NSW, maintenance would be in accordance with the agreed Occupation Permit held by Santos.

7.9 Cumulative impacts

Cumulative traffic impacts associated with other developments in the vicinity of the project are considered in the following sections. A summary of these projects, including their location and development status is provided in Table 7-8.

Table 7-8 Projects in the vicinity of Narrabri

Project	Proponent	Project Type	Status	Local government area	Location	Source	River Basin
Maules Creek Coal Mine	Whitehaven Coal	Mining	Construction	Narrabri Shire Council	Off Therribri Road, Maules Creek	NSW Planning & Environment 2014	Gunnedah Basin
Vickery Coal Mine	Whitehaven Coal	Mining	Proposed (DA recently determined)	Gunnedah Shire Council Narrabri Shire Council	22 kilometres north of Gunnedah, 18 kilometres south-east of Boggabri	NSW Planning & Environment 2014	Namoi Basin
Boggabri Mine	Idemitsu Australia	Mining	Existing	Narrabri Shire Council	386 Leard Forest Road, Boggabri	NSW Planning & Environment 2014	Namoi Basin
Narrabri North Mine	Narrabri Coal Operations	Mining	Existing - expansion	Narrabri Shire Council	25 km, south-east of Narrabri	NSW Planning & Environment 2014	Namoi Basin
Watermark Coal Mine	Shenhua Watermark Coal Pty Limited	Mining	Proposed (under PAC review)	Gunnedah Shire Council	Kamilaroi Highway, Breeza	NSW Planning & Environment 2014	Namoi Basin

Maules Creek Coal Mine

The Whitehaven Coal website identified that Construction of the Maules Creek Coal Mine began in January 2014 with first coal produced in January 2015. Maules Creek is expected to employ about 450 people sourced predominantly from the local region in North Western New South Wales. On average there are some 430 people engaged on site construction activity.

Hyder Consulting (2010) prepared a traffic and transport impact assessment as part of the Maules Creek Project Environmental Assessment. That assessment estimated that the Maules Creek Project would result in the following additional vehicle movements:

- 470 operational employees would generate approximately 78 vehicle trips per day during peak production (2020)
- 340 construction employees would generate approximately 128 vehicle trips per day during peak construction (2012)
- Heavy vehicles would generate approximately 66 vehicle trips per day during peak construction (2012).

Access to the project will be via Manilla Road, Therribri Road and a proposed 15 km Mine Access Road. The EIS report for the project states that around 90% of employees in both the construction and operational phase of the project would use a shuttle bus system to and from the township of Boggabri.

The nominated heavy vehicle route to and from the project is via Blue Vale Road, Braymont Road, Barbers Lagoon Road and Manilla Road, Therribri Road and the Mine Access Road. Production coal would be transported via rail and as such, there will be no traffic generated on public roads by coal transportation.

Based on the above, there would be very little traffic associated with Maules Creek Coal Mine development at roads within Narrabri study area. In addition, as this development is already under construction, construction traffic volumes within the study area would be accounted for in the intersection traffic surveys undertaken in October 2014. As such, the Maules Creek Coal Mine development is expected to have negligible cumulative traffic impacts to roads within the Narrabri Gas Field study area.

Vickery Coal Mine

The Vickery Coal Mine project site is located approximate 22 km north of Gunnedah and 18 km south-east of Boggabri. The project would involve the recommencement of open cut mining activities and would operate for around 30 years. Transport of coal would be by haulage trucks via a proposed private haul road leading to the Whitehaven Coal Handling and Processing Plant located on the outskirts of Gunnedah (approximately 20 km to the south of the Vickery Coal Mine open cut).

The Road Transport Assessment (GTA Consultants, 2012) prepared in support of the EIS for the project states that the construction phase would occur during Year 1, when there would also be operational traffic associated with the Boggabri Coal Mine project.

The project is expected to attract approximately 60 full time contractors during the peak construction phase. The operational workforce is expected to be 80 employees in Year 1, increasing to approximately 250 employees thereafter.

In terms of traffic accessing the Vickery Coal Mine project to/from Narrabri, the Transport Assessment (GTA Consultants, 2012) states that:

- 13% of construction workforce would come from Narrabri
- 10% of delivery and visitor vehicle trips would be from/to Narrabri, accessed via Rangari Road, Whitehaven ROM coal road transport route, Shannon Harbour Road

Deliveries and visitors are assumed to generate:

- 58 light vehicle trips per day and 10 heavy vehicle trips per day during Year 1
- 178 light vehicle trips per day and 32 heavy vehicle trips per day after Year 1.

Based on the above, the expected deliveries and visitor trips to/from Narrabri to the Vickery Coal Mine project site is expected to be in the order of:

- 6 light vehicle trips per day and 1 heavy vehicle trips per day during Year 1
- 18 light vehicle trips per day and 3 heavy vehicle trips per day after Year 1.

These trips are expected to be spread throughout the day. As such, the Vickery Coal Mine development is expected to have negligible cumulative traffic impacts to roads within the Narrabri Gas Field study area.

Boggabri Mine

The Boggabri Coal Mine is located 15 km north-east of Boggabri in NSW within the Narrabri Shire Council local government area. The project comprises of continuation of coal mining operations via open cut methods and construction of mine infrastructure and service facilities including a rail spur.

The Traffic Impact Assessment for the Boggabri Coal Mine Environmental Assessment (Parsons Brinckerhoff, 2010) estimated that the Boggabri Coal Mine would result in the following additional vehicle movements:

- Additional 353 operational employees would generate approximately 527 vehicle trips per day during peak production (2016)
- 150 construction employees would generate approximately 224 vehicle trips per day during peak construction (2016).

The study area for the Boggabri Coal Mine Traffic Impact Assessment does not includes roads within the Narrabri Gas Project study area. In addition, as this development is already operational, traffic associated with this development within the Narrabri Gas Project study area has been be accounted for in the intersection traffic surveys undertaken in October 2014. As such, the Boggabri Coal Mine development is expected to have negligible cumulative traffic impacts to roads within the Narrabri Gas Project study area.

Narrabri North Mine

The Narrabri North Mine site is located approximately 28 km to the south east of Narrabri, accessed off the Kamilaroi Highway.

This is an existing mine, which is currently operational. As such, traffic volumes associated with the Narrabri North Mine on roads within the study area are accounted for in the intersection traffic surveys undertaken in October 2014. Based on the results of the SIDRA intersection analysis discussed in 7.3, there would be minor cumulative impacts associated with the Narrabri North Mine as all intersections within the study area would operate at an acceptable level of service.

Watermark Coal Mine

The Watermark Coal Mine project site is located approximately 25 km southeast of the township of Gunnedah, within the Gunnedah Local Government Area. The project involves the construction of an open cut mining operation with a forecast extraction rate of 10 Million tonnes per annum of Run of Mine coal over a 30-year period.

The project will generate traffic movements during both the construction and operational phases of the project. The Traffic and Transport Impact Assessment report (DC Traffic Engineering, 2013) prepared in support of the EIS assessed the impacts of construction and operational traffic on roads to the south of Gunnedah, including the Kamilaroi Highway. No assessment of traffic impacts was provided at roads within the Narrabri Gas Project study area.

Based on this, the traffic associated with the construction and operation of the Watermark Coal Mine is expected to have minimal cumulative traffic impacts to roads within the Narrabri Gas Project study area.

7.10 Decommissioning

Traffic generated during decommissioning would mainly comprise trips by workers to and from the decommissioning sites and the haulage of waste materials to offsite locations for reuse, recycling or disposal. Decommissioning of gas field infrastructure would occur over the life of the project, while decommissioning of major facilities would occur toward the end of the project. The volume of traffic generated during decommissioning would be significantly less than during the peak construction period. Given that traffic volumes generated during construction would be accommodated on the road network without significantly impacting road network efficiency or safety, traffic during operation would also be accommodate to an acceptable standard and would not be a significant safety hazard.

8. Mitigation measures

A summary of the recommended mitigation measures is provided below.

8.1 Construction and operation mitigation measures

The expected increase in traffic associated with the construction stage of the Narrabri Gas Project can be accommodated within the surrounding road network that provides access to the sites. However, a number of mitigating measures have been identified to ensure that transport and traffic impacts arising from the construction are minimised. These measures will be incorporated through the development of the Traffic Management Plan (TMP).

An important measure relating to construction traffic impacts is the implementation of a community information awareness program. This program will be initiated prior to construction commencing and throughout the entire construction period to ensure that local residents are aware of the construction activities, with particular regard to construction traffic issues.

Other initiatives that will be undertaken as part of the TMP include:

- consultation with Narrabri Shire Council, Roads and Maritime, NSW Police Services and schools which may have school bus routes in and around the roads accessing the Narrabri Gas Project
- reviewing speed restrictions along key transport corridors in the surrounding area
- install specific warning signs at access roads to the construction corridor to warn road users of entering and exiting traffic
- provide advance notice of road/lane closures and advice on alternative routes
- provide appropriate traffic control and warning signs for areas identified where potential safety risk issues exist
- managing the transportation of construction materials to maximise vehicle loads in order to minimise vehicle movements
- manage the transportation of construction materials, using the NSW Police Services and Pilots to maximise vehicle loads in order to minimise vehicle movements.

In addition to the TMP the following intersection improvements would be required to provide a safe access arrangement to both Leewood and Bibblewindi:

- as indicated in Figure 7-4 the intersection of the access from the Newell Highway to Bibblewindi would require an auxiliary left turn treatment and on the Newell Highway
- as indicated in Figure 7-1 the intersection of the access from the Newell Highway to Leewood would require a channelised right turn treatment on the Newell Highway.

9. Risk management – traffic

This section identifies and assesses risks that may be associated with this proposal that relate to transporting materials and deliveries to and from site.

9.1 Criteria used to assess the levels of risk

Risk levels have been assigned for each deficiency identified within the study area and are based on the criteria set out in the *Austroads Guide to Road Safety, Part 6: Road Safety Audit* (Austroads 2009). These risk levels have been determined based on the deficiency's frequency and severity. Definitions of the different levels of frequency and severity have been reproduced in Table 9-1 and Table 9-2 below from the *Austroads Guide to Road Safety, Part 6: Road Safety Audit*.

Table 9-1 Summary of frequency descriptions

Frequency	Description
Frequent (F)	Once or more per week
Probable (P)	Once or more per year (but less than once a week)
Occasional (O)	Once every five or ten years
Improbable (I)	Less often than once every ten years

Table 9-2 Summary of severity description

Severity	Description	Examples
Catastrophic (C)	Likely multiple deaths	High speed, multi vehicle crash on congested roads Bus and fuel vehicle collide Vehicle runs into bus stop
Serious (S)	Likely death or serious injury	High or medium speed vehicle / vehicle collision High or medium speed collision with road-side object Pedestrian or cyclist hit by a vehicle
Minor (Mi)	Likely minor injury	Some low speed collisions Left-turn rear end crashes
Limited (Li)	Likely trivial injury or property damage only	Some low speed vehicle collisions Vehicle reversing into an object

Austroads *Guide to Road Safety, Part 6: Road Safety Audit, 2009*, provides definitions for four different levels of risk, namely, "intolerable", "high", "medium" or "low". Extracts of the risk assessment matrix from Austroads are provided in Table 9-3.

Table 9-3 Summary of levels of risk

		Frequency			
Severity		Frequent	Probable	Occasional	Improbable
	Catastrophic	Intolerable	Intolerable	Intolerable	High
	Serious	Intolerable	Intolerable	High	Medium
	Minor	Intolerable	High	Medium	Low
	Limited	High	Medium	Low	Low

Of the four possible risk ratings levels (i.e. Intolerable, high, medium or low) a description of their priority are defined in Table 9-4.

Table 9-4 Priority to levels of risk

Level of Risk	Description of Priority to Risk Rating
Intolerable (In):	A significant road safety risk requiring immediate urgent attention.
High (H):	A high road safety risk requiring immediate or urgent attention.
Medium (Me):	A road safety risk that may lead to crashes and that requires attention as soon as reasonably practicable.
Low (Lo):	A lower road safety risk that requires attention. Remedial action may be carried out on a non-urgent basis, such as in conjunction with routine road maintenance or other planned work.

9.2 Risk register

The initial risk assessment has been undertaken on the basis of the project being undertaken without any additional mitigation measures above the proponent's safety systems and reflects the potential risks associated with the introduction of additional braking, and the turning of light and heavy vehicles into a high speed rural road environment and the resultant interactions with other road users.

Crash data supplied by Transport for NSW over a five-year period has been used to determine the likelihood and severity of an incident and the initial risk rating is based on the assessment of this alone (within the context of the location and road type – midblock, intersection, rural or urban).

Table 9-5 outlines the risks identified in the risk management workshop relating to transport and the initial risk ratings which have been determined from the criteria outlined in Section 9.1.

Table 9-5 Risk register

Risk area	Initial assessment	Project phase	Inherent design standards and operational practices applied	Initial risk			Site / activity specific mitigation measure to reduce risk	Residual risk		
				Frequency	Severity	Risk		Frequency	Severity	Risk
Vehicles entering / exiting from high speed rural (110 km/h limit) environment (left and right turns to / from access roads)	Vehicles turning in high speed environments are required to slow prior to turning and crashes can occur due to misjudgements in relative speed between vehicles.	Construction Operation Decommissioning	Santos safety systems Driver behaviour program	O	S	H	The intersections of Old Mill Road and X-Line Road with the Newell Highway will be upgraded (designed in accordance with Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections) A Traffic Management Plan will be implemented In car vehicle monitoring systems for Santos staff and contractor vehicles Safety inductions for vehicle drivers	I	S	Me
Large vehicles using urban roads (50 km/h limit) environment	An increased number of large vehicles travelling on urban roads (e.g. in Narrabri) could increase the number of crashes (rear end, opposed turn) based on crash rates	Construction Operation; Decommissioning	Santos safety systems Driver behaviour program	O	S	H	A Traffic Management Plan will be implemented In car vehicle monitoring systems for Santos staff and contractor vehicles Safety inductions for vehicle drivers	O I	Mi Mi	Me Lo
Road surface / geometry unsuitable for planned use	The existing road surface and geometry on forestry roads may not be wide enough to accommodate a truck and other vehicle to pass and surface condition may be unsuitable for intended volumes	Construction Operation Decommissioning	Santos safety systems Driver behaviour program	O	S	H	A Traffic Management Plan will be implemented In car vehicle monitoring systems for Santos staff and contractor vehicles Safety inductions for vehicle drivers Consultation with the Forestry Corporation of NSW and landholders in relation to road conditions will be undertaken in accordance with the agreed Occupation Permit and Land Access Agreements	I	Li	Lo

Risk area	Initial assessment	Project phase	Inherent design standards and operational practices applied	Initial risk			Site / activity specific mitigation measure to reduce risk	Residual risk		
				Frequency	Severity	Risk		Frequency	Severity	Risk
Livestock / animal interactions	Livestock movements (planned and unplanned) can result in animals being in locations where sight distance is limited	Construction Operation Decommissioning	Santos safety systems Driver behaviour program.	O	S	Hi	A Traffic Management Plan will be implemented. Driving from dusk through to dawn will be minimised, due to high faunal activity	O	Li	Lo
Night / fog driving	Potential for crashes caused by reduced visibility, driver fatigue and animals	Construction Operation Decommissioning	Santos safety systems Driver behaviour program.	O	S	H	A Traffic Management Plan will be implemented. Driving from dusk through to dawn will be minimised, due to high faunal activity	O	Li	Lo

Table 9-5 shows that while the risks associated with vehicles operating in high speed environments which can be reduced through the introduction of appropriate traffic management measures, but cannot be fully eliminated. The application of the 'As Low As Reasonably Practicable (ALARP)' (refer to Figure 9-1) principle is achieved through the implementation of the measures outlined in section 8, including the design of intersection treatments in accordance with Austroads guidance.

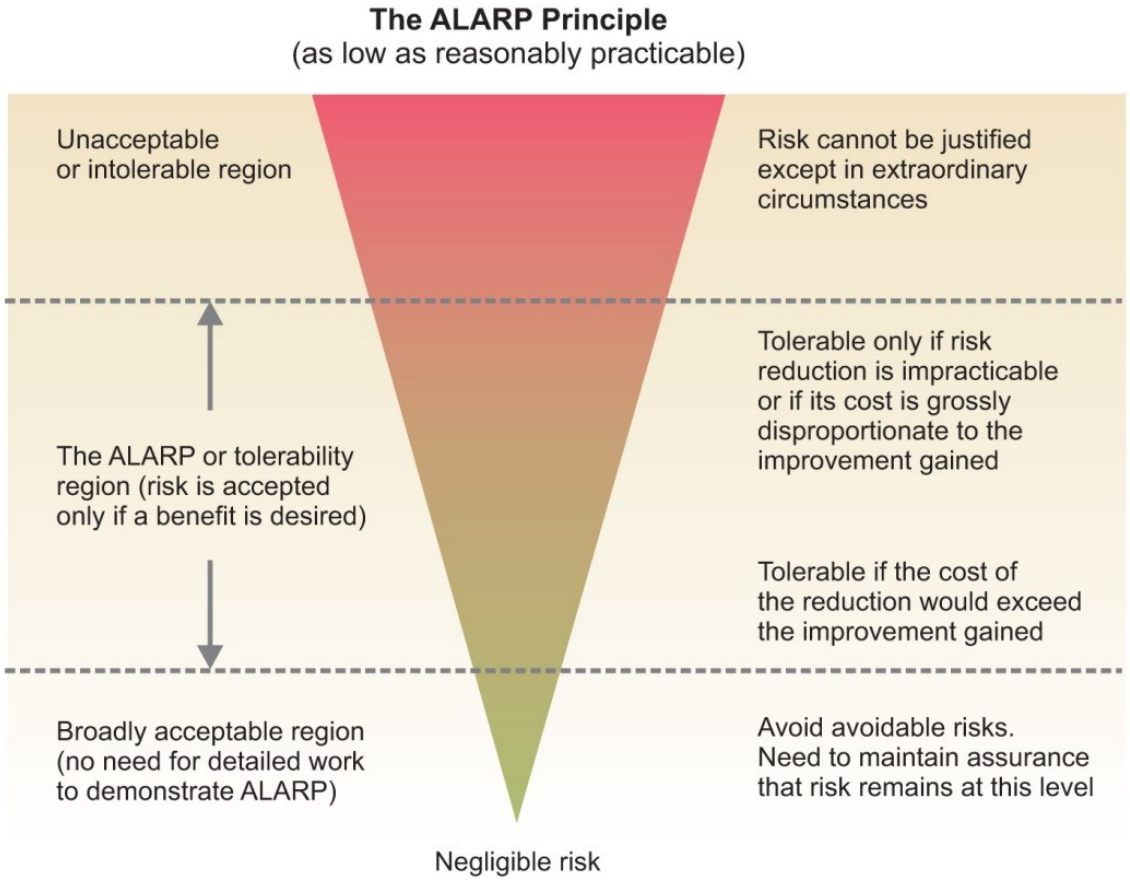


Figure 9-1 ALARP Principle

Source: NSW Department of Planning (2011)

9.3 Key findings

A risk-based traffic management plan would be implemented to:

- manage the efficiency of the road network impacted by the Project, state controlled roads and local government roads
- ensure road-user safety and safe operation of project vehicles on-site and off-site
- minimise impacts on road infrastructure
- minimise traffic-related complaints and incidents.

Mitigation measures and the implementation of the Traffic Management Plan would reduce the risks associated with the project activities.

10. Conclusion

10.1 Summary of key findings

The key findings of this traffic impact assessment are summarised in the sections below.

10.1.1 Existing conditions

The existing road network surrounding the Narrabri Gas Project, particularly the Newell Highway in the vicinity of X-Line Road and through the town centre of Narrabri appears to have good operation and spare capacity when assessed against the *Guide to Traffic Generating Developments* (Roads and Maritime 2002).

Crash analysis over a five-year period indicated that 46 crashes had occurred within the study area. The study area covers a mixture of rural highway with speed environments greater than 100 km/h as well as through the Narrabri town centre where the speed reduces to 50 km/h. There were 37 crashes that occurred along the Newell Highway. Of these, 26 occurred at intersections throughout the Narrabri town centre. The crashes recorded outside the town centre were spread out along the route and not concentrated to one particular intersection or section of road way.

10.1.2 Construction schedule

The project will be constructed over a period of three to four years, commencing in 2018. The gas field drilling works will be undertaken in stages over a time period of around 20 years with the first stages commencing in 2018. The Construction Plan for the project indicates that traffic volumes generated by the construction of the project will vary and depend on the drilling timetable.

10.1.3 Construction traffic impact

This assessment focuses on the ultimate peak scenario in terms of traffic generation and the overall effect on the higher order road network potential impacts associated with the project. This represents the most conservative assessment in terms of traffic generated by the proposal.

Intersection upgrades would be undertaken at the Newell Highway / Leewood access road and also the Newell Highway / X-Line Road to provide appropriate intersection design as specified in the *Austroads Guide to Road Design – Part 4A.*

Both intersections would continue to operate at Level of Service (LoS) A with good operation and spare capacity during the construction and operation of the Narrabri Gas Project. Intersections within Narrabri Town Centre would continue to operate at an acceptable level of service during peak construction periods.

The project would have acceptable impacts to mid-block capacity along roads within the study area. Although a high percentage increase in daily and peak hour traffic is expected for some roads, including X-Line Road and Yarrie Lake Road, this expected high increase is due to the relatively low existing traffic volumes along these roads.

10.1.4 Risk management

Mitigation measures and the implementation of Traffic Management Plans would reduce the risk associated with the project activities.

10.2 Recommended mitigation measures

A number of mitigating measures have been identified to ensure that transport and traffic impacts associated with the construction and operation of the Narrabri Gas Project are minimised. These measures will be incorporated into the Traffic Management Plan. An important mitigation measure relating to construction traffic impacts is the implementation of a community information and awareness program.

This program would be initiated prior to construction commencing and continue throughout the entire construction period to ensure that local residents are aware of the construction activities, including traffic considerations. The awareness program would identify communication protocols for community feedback on issues relating to construction vehicle driver behaviour and construction-related matters.

Other initiatives that may be undertaken as part of the Traffic Management Plan include:

- consultation with Roads and Maritime and Narrabri Shire Council to ensure that general signposting of construction access roads is appropriate and provides adequate warning of heavy vehicle and construction activity
- review signposted and non-signposted speed restrictions along the road network and where necessary, provide additional signposting of speed limitations associated with project activities
- advise local road users of scheduled construction activities, and road closures, and alternative routes as required
- consultation with school bus services to identify routes and determine the most appropriate response to minimising the potential for traffic impacts
- manage the transportation of construction materials to maximise vehicle movement efficiencies, in consultation with Roads and Maritime and Narrabri Shire Council and the NSW Police Services, as appropriate
- ensuring that appropriate permits are in place for over dimension vehicle movements
- project induction training for truck and vehicle operators.

10.3 Conclusion

In conclusion, the overall traffic increase on the Newell Highway south of the Narrabri town centre is minimal and the road network has the capacity to deal with the increase. The Narrabri Gas Project should not adversely impact the road network as long as the mitigation measures are implemented.

11. References

Austroads 2009, Guide to Road Safety, Part 6: Road Safety Audit

Austroads 2010, Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections

Austroads 2013, Guide to Traffic Management – Part 6 Interchanges, Intersections and Crossings

Austroads 2015, Guide to Traffic Management – Part 2 Traffic Theory

GTA Consultants 2013, Dewhurst Gas Exploration Traffic and Transport Assessment

NSW Department of Planning, 2011, Hazardous Industry Planning Advisory Paper No 4 – Risk Criteria for Land Use Safety Planning

NSW Government 2011, State Environmental Planning Policy (State and Regional Development)

NSW Government 2007, State Environmental Planning Policy (SEPP) Infrastructure

NSW Roads and Maritime Authority 2002, Guide to Traffic Generating Development

Transportation Research Board (TRB) 2000, Highway Capacity Manual (HCM).

Appendices

Appendix A – Traffic Count Data

TTM Data

TTM Reference: 14SYD172
Location: Newell Hwy / Mooloobar St
Suburb: Narrabri
Date: Wednesday, 8 October 2014
Survey Duration: 0700-1000 & 1600-1900
AM Peak: 0830-0930
Weather: Fine
PM Peak: 1600-1700
Notes:

Time	Northern Approach: Newell Hwy												Southern Approach: Newell Hwy												Eastern Approach: Old Turrawan Rd							
15 min	Left			Straight			Right			U-turns	TOTAL	Peds	Left			Straight			Right			U-turns	TOTAL	Peds	Left			Straight			Right	
time start	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total				Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total				Light	Heavy	Total	Light	Heavy	Total	Light	Heavy
7:00	4	0	**4**	44	5	**49**	6	3	**9**	**0**	**62**	0	1	0	**1**	18	6	**24**	1	0	**1**	**0**	**26**	0	0	0	**0**	3	0	**3**	2	3
7:15	8	1	**9**	23	3	**26**	5	2	**7**	**0**	**42**	0	2	0	**2**	19	7	**26**	0	0	**0**	**0**	**28**	0	0	0	**0**	1	0	**1**	5	0
7:30	4	0	**4**	22	6	**28**	6	1	**7**	**0**	**39**	0	9	3	**12**	39	11	**50**	1	0	**1**	**0**	**63**	0	0	0	**0**	3	1	**4**	5	1
7:45	4	0	**4**	36	10	**46**	2	1	**3**	**0**	**53**	0	4	0	**4**	29	8	**37**	1	0	**1**	**0**	**42**	0	0	0	**0**	0	2	**2**	5	0
8:00	7	0	**7**	26	6	**32**	5	4	**9**	**0**	**48**	0	3	0	**3**	52	10	**62**	1	1	**2**	**0**	**67**	0	0	0	**0**	1	0	**1**	4	0
8:15	14	0	**14**	22	4	**26**	8	2	**10**	**2**	**52**	0	3	0	**3**	40	11	**51**	2	0	**2**	**0**	**56**	0	0	0	**0**	2	0	**2**	5	0
8:30	21	2	**23**	38	13	**51**	2	0	**2**	**0**	**76**	0	5	0	**5**	46	7	**53**	4	0	**4**	**0**	**62**	0	0	0	**0**	3	0	**3**	15	2
8:45	28	6	**34**	36	6	**42**	9	0	**9**	**0**	**85**	0	4	2	**6**	38	9	**47**	5	1	**6**	**0**	**59**	0	3	0	**3**	7	2	**9**	18	4
9:00	36	4	**40**	41	17	**58**	8	2	**10**	**1**	**109**	0	3	1	**4**	28	7	**35**	5	1	**6**	**0**	**45**	0	1	0	**1**	2	1	**3**	28	3
9:15	36	1	**37**	19	11	**30**	9	0	**9**	**1**	**77**	0	1	0	**1**	38	11	**49**	3	1	**4**	**0**	**54**	0	3	1	**4**	8	0	**8**	28	0
9:30	6	0	**6**	31	7	**38**	11	0	**11**	**1**	**56**	0	2	1	**3**	31	12	**43**	0	0	**0**	**0**	**46**	0	3	2	**5**	7	0	**7**	33	1
9:45	9	0	**9**	36	14	**50**	8	0	**8**	**1**	**68**	0	1	1	**2**	29	5	**34**	0	1	**1**	**0**	**37**	0	1	0	**1**	0	0	**0**	10	1
TOTAL	**177**	**14**	**191**	**374**	**102**	**476**	**79**	**15**	**94**	**6**	**767**	**0**	**38**	**8**	**46**	**407**	**104**	**511**	**23**	**5**	**28**	**0**	**585**	**0**	**11**	**3**	**14**	**37**	**6**	**43**	**158**	**15**
AM Peak	121	13	134	134	47	181	28	2	30	2	347	0	13	3	16	150	34	184	17	3	20	0	220	0	7	1	8	20	3	23	89	9
16:00	5	1	**6**	42	18	**60**	14	2	**16**	**0**	**82**	0	7	1	**8**	25	10	**35**	0	0	**0**	**0**	**43**	0	1	0	**1**	1	0	**1**	3	0
16:15	5	1	**6**	38	15	**53**	12	0	**12**	**0**	**71**	0	9	1	**10**	40	8	**48**	0	0	**0**	**0**	**58**	0	0	0	**0**	2	0	**2**	5	1
16:30	6	1	**7**	30	12	**42**	6	3	**9**	**0**	**58**	0	5	0	**5**	33	14	**47**	0	0	**0**	**0**	**52**	0	1	0	**1**	1	1	**2**	4	0
16:45	4	0	**4**	38	12	**50**	10	1	**11**	**0**	**65**	0	5	0	**5**	29	11	**40**	0	0	**0**	**0**	**45**	0	0	0	**0**	4	0	**4**	13	0
17:00	6	0	**6**	38	5	**43**	12	2	**14**	**0**	**63**	0	10	0	**10**	32	9	**41**	0	0	**0**	**0**	**51**	0	0	0	**0**	2	0	**2**	6	0
17:15	7	1	**8**	30	7	**37**	14	0	**14**	**0**	**59**	0	1	1	**2**	26	18	**44**	1	2	**3**	**0**	**49**	0	0	0	**0**	4	0	**4**	3	0
17:30	2	0	**2**	41	7	**48**	12	0	**12**	**0**	**62**	0	2	0	**2**	37	12	**49**	0	0	**0**	**0**	**51**	0	0	0	**0**	2	0	**2**	8	0
17:45	5	0	**5**	40	8	**48**	14	1	**15**	**1**	**69**	0	6	0	**6**	38	16	**54**	0	0	**0**	**0**	**60**	0	0	0	**0**	0	0	**0**	3	0
18:00	2	1	**3**	26	5	**31**	9	1	**10**	**0**	**44**	0	1	0	**1**	15	12	**27**	0	0	**0**	**0**	**28**	0	1	0	**1**	0	0	**0**	3	0
18:15	2	1	**3**	26	11	**37**	9	2	**11**	**1**	**52**	0	1	0	**1**	28	10	**38**	0	0	**0**	**0**	**39**	0	1	0	**1**	1	0	**1**	5	0
18:30	3	1	**4**	21	11	**32**	7	0	**7**	**0**	**43**	0	3	1	**4**	29	7	**36**	0	0	**0**	**0**	**40**	0	0	0	**0**	1	0	**1**	4	0
18:45	6	0	**6**	16	10	**26**	9	0	**9**	**0**	**41**	0	2	0	**2**	21	9	**30**	0	0	**0**	**0**	**32**	0	0	0	**0**	2	0	**2**	2	0
TOTAL	**53**	**7**	**60**	**386**	**121**	**507**	**128**	**12**	**140**	**2**	**709**	**0**	**52**	**4**	**56**	**353**	**136**	**489**	**1**	**2**	**3**	**0**	**548**	**0**	**4**	**0**	**4**	**20**	**1**	**21**	**59**	**1**
PM Peak	20	3	23	148	57	205	42	6	48	0	276	0	26	2	28	127	43	170	0	0	0	0	198	0	2	0	2	8	1	9	25	1

				Western Approach: Mooloobar St											
	U-turns	TOTAL	Peds	Left			Straight			Right			U-turns	TOTAL	Peds
Total				Light	Heavy	**Total**	Light	Heavy	**Total**	Light	Heavy	**Total**			
5	**0**	**8**	0	5	2	**7**	1	0	**1**	9	0	**9**	**0**	**17**	0
5	**0**	**6**	0	5	1	**6**	0	1	**1**	5	1	**6**	**0**	**13**	0
6	**0**	**10**	0	12	1	**13**	1	0	**1**	5	1	**6**	**0**	**20**	0
5	**0**	**7**	0	13	0	**13**	1	0	**1**	1	1	**2**	**0**	**16**	0
4	**0**	**5**	0	11	2	**13**	2	0	**2**	3	1	**4**	**0**	**19**	0
5	**0**	**7**	0	19	1	**20**	4	0	**4**	6	1	**7**	**0**	**31**	0
17	**0**	**20**	0	13	5	**18**	9	0	**9**	5	1	**6**	**0**	**33**	0
22	**0**	**34**	0	9	3	**12**	7	0	**7**	5	0	**5**	**0**	**24**	0
31	**0**	**35**	0	13	1	**14**	12	1	**13**	2	0	**2**	**0**	**29**	0
28	**0**	**40**	0	9	4	**13**	15	0	**15**	4	1	**5**	**0**	**33**	0
34	**0**	**46**	0	10	3	**13**	2	2	**4**	0	1	**1**	**0**	**18**	0
11	**0**	**12**	0	7	1	**8**	2	0	**2**	2	0	**2**	**0**	**12**	0
173	**0**	**230**	**0**	**126**	**24**	**150**	**56**	**4**	**60**	**47**	**8**	**55**	**0**	**265**	**0**
98	0	129	0	44	13	57	43	1	44	16	2	18	0	119	0
3	**0**	**5**	0	13	1	**14**	1	0	**1**	4	2	**6**	**0**	**21**	0
6	**0**	**8**	0	9	1	**10**	0	0	**0**	4	1	**5**	**0**	**15**	0
4	**0**	**7**	0	12	3	**15**	2	1	**3**	4	0	**4**	**0**	**22**	0
13	**0**	**17**	0	11	2	**13**	4	0	**4**	6	0	**6**	**0**	**23**	0
6	**0**	**8**	0	14	2	**16**	2	0	**2**	3	0	**3**	**0**	**21**	0
3	**0**	**7**	0	13	0	**13**	2	1	**3**	3	1	**4**	**0**	**20**	0
8	**0**	**10**	0	17	0	**17**	0	0	**0**	2	0	**2**	**0**	**19**	0
3	**0**	**3**	0	12	1	**13**	1	0	**1**	5	0	**5**	**0**	**19**	0
3	**0**	**4**	0	14	1	**15**	2	0	**2**	1	2	**3**	**0**	**20**	0
5	**0**	**7**	0	18	0	**18**	0	0	**0**	3	0	**3**	**0**	**21**	0
4	**0**	**5**	0	7	0	**7**	0	0	**0**	2	1	**3**	**0**	**10**	0
2	**0**	**4**	0	6	1	**7**	2	0	**2**	2	0	**2**	**0**	**11**	0
60	**0**	**85**	**0**	**146**	**12**	**158**	**16**	**2**	**18**	**39**	**7**	**46**	**0**	**222**	**0**
26	0	37	0	45	7	52	7	1	8	18	3	21	0	81	0

TTM Data

TTM Reference: 14SYD172
Location: Newell Hwy / Kamilaroi Hwy
Suburb: Narrabri
Date: Wednesday, 8 October 2014
Survey Duration: 0700-1000 & 1600-1900
Weather: Fine
Notes:

AM Peak: 0830-0930
PM Peak: 1600-1700

Time	Northern Approach: Newell Hwy															North-East Approach: Site Access																Southern Approach: Newell Hwy						
15 min	Hard Left			Left			Straight			Right			U-turns	TOTAL	Peds	Hard Left			Left			Right			Hard Right			U-turns	TOTAL	Peds	Left			Straight			
time start	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total				Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total				Light	Heavy	Total	Light	Heavy	Total	Light
7:00	24	0	**24**	3	3	**6**	18	2	**20**	4	0	**4**	**1**	**55**	0	0	0	**0**	0	0	**0**	0	0	**0**	0	1	**1**	**0**	**1**	0	0	0	**0**	5	3	**8**	2
7:15	10	0	**10**	5	0	**5**	10	4	**14**	1	0	**1**	**0**	**30**	0	0	0	**0**	0	0	**0**	0	0	**0**	4	2	**6**	**0**	**6**	0	3	0	**3**	8	3	**11**	0
7:30	6	0	**6**	8	0	**8**	10	4	**14**	0	0	**0**	**1**	**29**	0	1	1	**2**	1	0	**1**	0	0	**0**	14	3	**17**	**0**	**20**	0	0	0	**0**	17	4	**21**	0
7:45	1	0	**1**	13	1	**14**	21	10	**31**	5	0	**5**	**1**	**52**	0	0	0	**0**	0	0	**0**	0	0	**0**	4	0	**4**	**1**	**5**	0	0	0	**0**	5	7	**12**	0
8:00	1	1	**2**	7	3	**10**	16	3	**19**	4	0	**4**	**0**	**35**	0	1	0	**1**	0	2	**2**	0	0	**0**	10	4	**14**	**0**	**17**	0	0	0	**0**	23	5	**28**	0
8:15	2	0	**2**	8	3	**11**	17	4	**21**	1	0	**1**	**0**	**35**	0	0	1	**1**	0	0	**0**	0	0	**0**	6	0	**6**	**0**	**7**	0	0	1	**1**	15	9	**24**	0
8:30	3	0	**3**	9	5	**14**	22	7	**29**	2	0	**2**	**0**	**48**	0	0	0	**0**	1	0	**1**	0	0	**0**	1	1	**2**	**0**	**3**	0	1	0	**1**	19	5	**24**	0
8:45	6	0	**6**	15	3	**18**	17	4	**21**	2	0	**2**	**0**	**47**	0	0	0	**0**	0	1	**1**	0	0	**0**	4	0	**4**	**0**	**5**	0	0	0	**0**	15	8	**23**	0
9:00	3	0	**3**	12	2	**14**	18	12	**30**	6	1	**7**	**0**	**54**	0	1	0	**1**	0	0	**0**	0	0	**0**	1	1	**2**	**0**	**3**	0	0	0	**0**	11	4	**15**	0
9:15	1	1	**2**	7	1	**8**	8	10	**18**	2	0	**2**	**2**	**32**	0	1	0	**1**	1	0	**1**	0	0	**0**	2	1	**3**	**0**	**5**	0	0	0	**0**	12	5	**17**	0
9:30	2	2	**4**	12	4	**16**	13	6	**19**	5	0	**5**	**0**	**44**	0	0	1	**1**	0	1	**1**	1	0	**1**	0	0	**0**	**0**	**3**	0	0	0	**0**	11	11	**22**	1
9:45	2	0	**2**	12	5	**17**	15	12	**27**	1	0	**1**	**3**	**50**	0	1	0	**1**	0	0	**0**	0	0	**0**	2	1	**3**	**0**	**4**	0	0	0	**0**	7	2	**9**	0
TOTAL	**61**	**4**	**65**	**111**	**30**	**141**	**185**	**78**	**263**	**33**	**1**	**34**	**8**	**511**	**0**	**5**	**3**	**8**	**3**	**4**	**7**	**1**	**0**	**1**	**48**	**14**	**62**	**1**	**79**	**0**	**4**	**1**	**5**	**148**	**66**	**214**	**3**
AM Peak	13	1	14	43	11	54	65	33	98	12	1	13	2	181	0	2	0	2	2	1	3	0	0	0	8	3	11	0	16	0	1	0	1	57	22	79	0
16:00	7	2	**9**	14	6	**20**	18	9	**27**	7	0	**7**	**0**	**63**	0	0	0	**0**	0	0	**0**	0	0	**0**	3	0	**3**	**0**	**3**	0	0	0	**0**	10	0	**10**	1
16:15	6	1	**7**	13	7	**20**	15	5	**20**	9	0	**9**	**0**	**56**	0	0	0	**0**	0	0	**0**	2	0	**2**	22	1	**23**	**0**	**25**	0	1	0	**1**	10	0	**10**	0
16:30	3	0	**3**	7	1	**8**	15	9	**24**	8	0	**8**	**0**	**43**	0	0	0	**0**	0	0	**0**	0	0	**0**	9	0	**9**	**0**	**9**	0	0	0	**0**	12	0	**12**	0
16:45	1	0	**1**	23	4	**27**	17	7	**24**	5	1	**6**	**0**	**58**	0	0	0	**0**	0	0	**0**	0	0	**0**	2	1	**3**	**0**	**3**	0	2	0	**2**	10	0	**10**	0
17:00	3	0	**3**	17	3	**20**	14	3	**17**	4	0	**4**	**0**	**44**	0	0	0	**0**	0	0	**0**	1	1	**2**	8	0	**8**	**0**	**10**	0	0	0	**0**	13	0	**13**	0
17:15	0	0	**0**	15	0	**15**	15	6	**21**	4	0	**4**	**0**	**40**	0	0	0	**0**	0	0	**0**	0	0	**0**	1	1	**2**	**0**	**2**	0	1	0	**1**	7	0	**7**	0
17:30	2	1	**3**	17	3	**20**	15	5	**20**	7	0	**7**	**0**	**50**	0	0	0	**0**	0	0	**0**	1	0	**1**	3	0	**3**	**0**	**4**	0	2	0	**2**	12	0	**12**	0
17:45	1	0	**1**	12	3	**15**	15	5	**20**	4	0	**4**	**0**	**40**	0	0	0	**0**	0	0	**0**	0	0	**0**	1	0	**1**	**0**	**1**	0	1	0	**1**	20	0	**20**	0
18:00	0	0	**0**	13	2	**15**	18	6	**24**	4	0	**4**	**0**	**43**	0	1	0	**1**	0	0	**0**	0	0	**0**	0	0	**0**	**0**	**1**	0	0	0	**0**	4	0	**4**	0
18:15	0	0	**0**	11	3	**14**	21	8	**29**	2	0	**2**	**1**	**46**	0	1	0	**1**	0	0	**0**	0	0	**0**	1	0	**1**	**0**	**2**	0	2	0	**2**	11	0	**11**	0
18:30	0	0	**0**	11	3	**14**	7	10	**17**	1	0	**1**	**0**	**32**	0	0	0	**0**	0	0	**0**	0	0	**0**	1	0	**1**	**0**	**1**	0	0	0	**0**	9	0	**9**	0
18:45	0	0	**0**	7	0	**7**	9	7	**16**	3	0	**3**	**0**	**26**	0	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	**0**	**0**	0	0	0	**0**	10	0	**10**	0
TOTAL	**23**	**4**	**27**	**160**	**35**	**195**	**179**	**80**	**259**	**58**	**1**	**59**	**1**	**541**	**0**	**2**	**0**	**2**	**0**	**0**	**0**	**4**	**1**	**5**	**51**	**3**	**54**	**0**	**61**	**0**	**9**	**0**	**9**	**128**	**0**	**128**	**1**
PM Peak	17	3	20	57	18	75	65	30	95	29	1	30	0	220	0	0	0	0	0	0	0	2	0	2	36	2	38	0	40	0	3	0	3	42	0	42	1

								Eastern Approach: Kamilaroi Hwy															Western Approach: Kelvin Vickery Ave																	
Right		Hard Right			U-turns	TOTAL	Peds	Left			Straight			Right			Hard Right			U-turns	TOTAL	Peds	Hard Left			Left			Straight			Right			U-turns	TOTAL	Peds		
Heavy	Total	Light	Heavy	Total				Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total				Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total					
0	**2**	0	1	**1**	**0**	**11**	0	0	0	**0**	0	0	**0**	8	0	**8**	0	0	**0**	**0**	**8**	0	6	0	**6**	2	0	**2**	1	0	**1**	0	0	**0**	**0**	**9**	0
0	**0**	4	0	**4**	**0**	**18**	0	0	0	**0**	1	0	**1**	9	0	**9**	2	0	**2**	**0**	**12**	0	3	0	**3**	0	0	**0**	0	0	**0**	0	0	**0**	**0**	**3**	0
0	**0**	0	1	**1**	**0**	**22**	0	0	0	**0**	0	0	**0**	12	0	**12**	0	0	**0**	**0**	**12**	0	5	0	**5**	0	0	**0**	0	0	**0**	0	0	**0**	**0**	**5**	0
0	**0**	0	0	**0**	**0**	**12**	0	1	0	**1**	1	0	**1**	19	0	**19**	0	0	**0**	**0**	**21**	0	4	0	**4**	0	0	**0**	1	0	**1**	0	0	**0**	**0**	**5**	0
0	**0**	2	1	**3**	**0**	**31**	0	2	0	**2**	2	0	**2**	15	0	**15**	1	0	**1**	**0**	**20**	0	8	0	**8**	0	0	**0**	0	0	**0**	0	0	**0**	**0**	**8**	0
0	**0**	1	1	**2**	**0**	**27**	0	1	0	**1**	0	0	**0**	15	0	**15**	0	0	**0**	**0**	**16**	0	7	0	**7**	0	0	**0**	1	0	**1**	0	0	**0**	**0**	**8**	0
0	**0**	1	2	**3**	**0**	**28**	0	1	0	**1**	0	0	**0**	24	0	**24**	0	0	**0**	**0**	**25**	0	7	0	**7**	0	0	**0**	0	0	**0**	0	1	**1**	**0**	**8**	0
0	**0**	0	1	**1**	**0**	**24**	0	1	0	**1**	1	0	**1**	22	0	**22**	0	0	**0**	**0**	**24**	0	8	0	**8**	0	0	**0**	0	0	**0**	1	0	**1**	**0**	**9**	0
0	**0**	0	1	**1**	**0**	**16**	0	1	0	**1**	0	0	**0**	16	0	**16**	0	0	**0**	**0**	**17**	0	7	2	**9**	0	0	**0**	0	0	**0**	0	0	**0**	**0**	**9**	0
0	**0**	2	1	**3**	**0**	**20**	0	0	0	**0**	0	0	**0**	24	0	**24**	0	0	**0**	**0**	**24**	0	8	0	**8**	0	0	**0**	2	0	**2**	0	0	**0**	**0**	**10**	0
0	**1**	3	0	**3**	**0**	**26**	0	0	0	**0**	0	0	**0**	11	0	**11**	0	0	**0**	**0**	**11**	0	7	0	**7**	1	0	**1**	1	0	**1**	0	0	**0**	**0**	**9**	0
0	**0**	1	0	**1**	**0**	**10**	0	0	0	**0**	0	0	**0**	15	0	**15**	0	0	**0**	**0**	**15**	0	2	0	**2**	0	0	**0**	0	1	**1**	1	0	**1**	**0**	**4**	0
0	**3**	**14**	**9**	**23**	**0**	**245**	**0**	**7**	**0**	**7**	**5**	**0**	**5**	**190**	**0**	**190**	**3**	**0**	**3**	**0**	**205**	**0**	**72**	**2**	**74**	**3**	**0**	**3**	**6**	**1**	**7**	**2**	**1**	**3**	**0**	**87**	**0**
0	0	3	5	8	0	88	0	3	0	3	1	0	1	86	0	86	0	0	0	0	90	0	30	2	32	0	0	0	2	0	2	1	1	2	0	36	0
9	**10**	0	0	**0**	**0**	**20**	0	2	0	**2**	1	0	**1**	14	2	**16**	0	0	**0**	**0**	**19**	0	5	0	**5**	2	0	**2**	2	1	**3**	0	0	**0**	**0**	**10**	0
9	**9**	1	1	**2**	**0**	**22**	0	0	2	**2**	3	0	**3**	10	2	**12**	0	0	**0**	**0**	**17**	0	3	0	**3**	1	0	**1**	1	0	**1**	0	0	**0**	**0**	**5**	0
9	**9**	1	1	**2**	**0**	**23**	0	1	1	**2**	2	0	**2**	9	2	**11**	0	0	**0**	**0**	**15**	0	4	0	**4**	0	0	**0**	0	0	**0**	1	0	**1**	**0**	**5**	0
8	**8**	4	1	**5**	**0**	**25**	0	2	0	**2**	0	0	**0**	20	2	**22**	0	0	**0**	**0**	**24**	0	2	0	**2**	0	0	**0**	2	0	**2**	0	0	**0**	**0**	**4**	0
8	**8**	0	0	**0**	**0**	**21**	0	0	0	**0**	2	0	**2**	16	2	**18**	0	0	**0**	**0**	**20**	0	3	0	**3**	0	0	**0**	0	0	**0**	0	0	**0**	**0**	**3**	0
13	**13**	1	0	**1**	**0**	**22**	0	1	2	**3**	0	0	**0**	15	6	**21**	0	0	**0**	**0**	**24**	0	5	0	**5**	0	0	**0**	0	0	**0**	2	0	**2**	**0**	**7**	0
11	**11**	0	1	**1**	**0**	**26**	0	0	0	**0**	0	0	**0**	15	2	**17**	0	0	**0**	**0**	**17**	0	5	0	**5**	0	0	**0**	2	0	**2**	0	0	**0**	**0**	**7**	0
13	**13**	0	0	**0**	**0**	**34**	0	0	0	**0**	1	0	**1**	19	3	**22**	0	0	**0**	**0**	**23**	0	5	0	**5**	0	0	**0**	0	0	**0**	0	0	**0**	**0**	**5**	0
8	**8**	0	0	**0**	**0**	**12**	0	0	0	**0**	0	0	**0**	9	4	**13**	0	0	**0**	**0**	**13**	0	1	0	**1**	0	0	**0**	1	0	**1**	0	0	**0**	**0**	**2**	0
9	**9**	2	0	**2**	**0**	**24**	0	0	0	**0**	1	0	**1**	12	0	**12**	0	0	**0**	**0**	**13**	0	6	0	**6**	0	0	**0**	1	0	**1**	1	0	**1**	**0**	**8**	0
7	**7**	1	0	**1**	**0**	**17**	0	2	1	**3**	0	0	**0**	18	1	**19**	0	0	**0**	**0**	**22**	0	4	0	**4**	0	0	**0**	2	0	**2**	1	0	**1**	**0**	**7**	0
6	**6**	0	1	**1**	**0**	**17**	0	2	0	**2**	1	0	**1**	10	4	**14**	0	0	**0**	**0**	**17**	0	3	0	**3**	0	0	**0**	0	0	**0**	1	0	**1**	**0**	**4**	0
110	**111**	**10**	**5**	**15**	**0**	**263**	**0**	**10**	**6**	**16**	**11**	**0**	**11**	**167**	**30**	**197**	**0**	**0**	**0**	**0**	**224**	**0**	**46**	**0**	**46**	**3**	**0**	**3**	**11**	**1**	**12**	**6**	**0**	**6**	**0**	**67**	**0**
35	36	6	3	9	0	90	0	5	3	8	6	0	6	53	8	61	0	0	0	0	75	0	14	0	14	3	0	3	5	1	6	1	0	1	0	24	0

TTM Data

TTM Reference: 14SYD172
Location: Newell Hwy / Tibbereena St
Suburb: Narrabri
Date: Wednesday, 8 October 2014
Survey Duration: 0600-1000 & 1600-1900
Weather: Fine
Notes:

AM Peak: 0730-0830
PM Peak: 1630-1730

Time	Northern Approach: Newell Hwy									Southern Approach: Newell Hwy									Western Approach: Tibbereena St								
15 min	Straight			Right			U-turns	TOTAL	Peds	Left			Straight			U-turns	TOTAL	Peds	Left			Right			U-turns	TOTAL	Peds
time start	Light	Heavy	Total	Light	Heavy	Total				Light	Heavy	Total	Light	Heavy	Total				Light	Heavy	Total	Light	Heavy	Total			
6:00	8	0	**8**	30	5	**35**	**0**	**43**	0	34	0	**34**	5	0	**5**	**0**	**39**	0	32	10	**42**	23	0	**23**	**0**	**65**	0
6:15	4	0	**4**	35	6	**41**	**0**	**45**	0	22	0	**22**	7	2	**9**	**0**	**31**	0	55	8	**63**	29	0	**29**	**0**	**92**	0
6:30	3	0	**3**	38	8	**46**	**0**	**49**	0	17	1	**18**	3	1	**4**	**0**	**22**	0	73	10	**83**	25	0	**25**	**0**	**108**	0
6:45	10	0	**10**	43	9	**52**	**0**	**62**	0	28	2	**30**	10	1	**11**	**0**	**41**	0	93	13	**106**	31	0	**31**	**0**	**137**	0
7:00	10	0	**10**	37	13	**50**	**0**	**60**	0	27	2	**29**	3	0	**3**	**0**	**32**	0	70	6	**76**	35	1	**36**	**0**	**112**	0
7:15	17	2	**19**	40	10	**50**	**0**	**69**	0	40	1	**41**	6	1	**7**	**0**	**48**	0	102	15	**117**	50	0	**50**	**0**	**167**	0
7:30	25	6	**31**	55	11	**66**	**0**	**97**	0	38	1	**39**	8	1	**9**	**0**	**48**	0	97	9	**106**	38	1	**39**	**0**	**145**	0
7:45	25	0	**25**	67	18	**85**	**0**	**110**	0	42	1	**43**	5	0	**5**	**0**	**48**	1	109	13	**122**	49	2	**51**	**0**	**173**	0
8:00	18	0	**18**	88	25	**113**	**0**	**131**	0	54	2	**56**	3	0	**3**	**0**	**59**	0	89	11	**100**	36	4	**40**	**0**	**140**	0
8:15	14	0	**14**	64	11	**75**	**0**	**89**	0	41	0	**41**	4	1	**5**	**0**	**46**	1	94	11	**105**	45	1	**46**	**0**	**151**	0
8:30	20	0	**20**	69	10	**79**	**0**	**99**	0	28	0	**28**	3	1	**4**	**0**	**32**	0	95	14	**109**	34	2	**36**	**0**	**145**	0
8:45	26	0	**26**	70	14	**84**	**0**	**110**	0	34	2	**36**	9	0	**9**	**0**	**45**	0	77	6	**83**	28	1	**29**	**0**	**112**	0
TOTAL	**180**	**8**	**188**	**636**	**140**	**776**	**0**	**964**	**0**	**405**	**12**	**417**	**66**	**8**	**74**	**0**	**491**	**2**	**986**	**126**	**1112**	**423**	**12**	**435**	**0**	**1547**	**0**
AM Peak	82	6	88	274	65	339	0	427	0	175	4	179	20	2	22	0	201	2	389	44	433	168	8	176	0	609	0
16:00	30	16	**46**	89	0	**89**	**0**	**135**	0	44	2	**46**	3	1	**4**	**0**	**50**	0	81	9	**90**	14	1	**15**	**0**	**105**	0
16:15	27	15	**42**	86	0	**86**	**0**	**128**	0	35	3	**38**	3	0	**3**	**0**	**41**	0	54	12	**66**	23	0	**23**	**0**	**89**	0
16:30	34	13	**47**	103	0	**103**	**0**	**150**	0	45	1	**46**	4	0	**4**	**0**	**50**	0	106	13	**119**	43	3	**46**	**0**	**165**	0
16:45	27	10	**37**	103	1	**104**	**0**	**141**	0	50	3	**53**	2	0	**2**	**0**	**55**	1	75	12	**87**	9	1	**10**	**0**	**97**	0
17:00	36	8	**44**	124	2	**126**	**0**	**170**	0	51	0	**51**	5	0	**5**	**0**	**56**	0	77	12	**89**	26	0	**26**	**0**	**115**	0
17:15	18	6	**24**	105	3	**108**	**0**	**132**	0	53	0	**53**	4	0	**4**	**0**	**57**	0	69	18	**87**	33	1	**34**	**0**	**121**	0
17:30	22	8	**30**	131	3	**134**	**0**	**164**	0	54	3	**57**	4	1	**5**	**0**	**62**	0	80	9	**89**	29	1	**30**	**0**	**119**	0
17:45	23	13	**36**	109	0	**109**	**0**	**145**	0	41	1	**42**	4	0	**4**	**0**	**46**	1	77	19	**96**	25	0	**25**	**0**	**121**	0
18:00	19	9	**28**	76	0	**76**	**0**	**104**	0	27	1	**28**	6	0	**6**	**0**	**34**	0	45	9	**54**	34	2	**36**	**0**	**90**	0
18:15	16	14	**30**	61	0	**61**	**0**	**91**	0	22	0	**22**	3	0	**3**	**0**	**25**	0	64	10	**74**	24	0	**24**	**0**	**98**	0
18:30	15	16	**31**	62	0	**62**	**0**	**93**	0	25	1	**26**	5	0	**5**	**0**	**31**	0	50	8	**58**	24	1	**25**	**0**	**83**	0
18:45	16	5	**21**	53	0	**53**	**0**	**74**	0	17	2	**19**	4	0	**4**	**0**	**23**	1	43	8	**51**	25	0	**25**	**0**	**76**	0
TOTAL	**283**	**133**	**416**	**1102**	**9**	**1111**	**0**	**1527**	**0**	**464**	**17**	**481**	**47**	**2**	**49**	**0**	**530**	**3**	**821**	**139**	**960**	**309**	**10**	**319**	**0**	**1279**	**0**
PM Peak	115	37	152	435	6	441	0	593	0	199	4	203	15	0	15	0	218	1	327	55	382	111	5	116	0	498	0

Appendix B – SIDRA Outputs

LANE SUMMARY

Site: Newell Hwy / Tibbereena St AM Base

Newell Hwy / Tibbereena St
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tibbereena St (S)													
Lane 1	161	2.5	1125	0.143	100	6.1	LOS A	0.6	4.2	Full	500	0.0	0.0
Lane 2	21	9.5	962	0.022	100	5.1	LOS A	0.1	0.6	Full	500	0.0	0.0
Approach	182	3.3		0.143		6.0	LOS A	0.6	4.2				
North: Tibbereena St (N)													
Lane 1	78	0.0	1950	0.040	100	3.4	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2	351	17.1	1655	0.212	100	4.7	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	429	14.0		0.212		4.5	NA	0.0	0.0				
West: Newell Hwy (E)													
Lane 1	397	10.6	1727	0.230	100	4.5	LOS A	0.0	0.0	Short	50	0.0	0.0
Lane 2	151	5.3	1606	0.094	100	4.9	LOS A	0.4	3.3	Full	500	0.0	0.0
Approach	548	9.1		0.230		4.6	NA	0.4	3.3				
Intersection	1159	10.0		0.230		4.8	NA	0.6	4.2				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE SUMMARY

Site: Newell Hwy / Tibbereena St PM Base

Newell Hwy / Tibbereena St
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tibbereena St (S)													
Lane 1	203	2.0	1006	0.202	100	6.7	LOS A	0.8	5.9	Full	500	0.0	0.0
Lane 2	18	5.6	849	0.021	100	5.7	LOS A	0.1	0.5	Full	500	0.0	0.0
Approach	221	2.3		0.202		6.6	LOS A	0.8	5.9				
North: Tibbereena St (N)													
Lane 1	134	26.1	1667	0.080	100	3.6	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2	477	1.7	1835	0.260	100	4.6	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	611	7.0		0.260		4.4	NA	0.0	0.0				
West: Newell Hwy (E)													
Lane 1	361	16.1	1666	0.217	100	4.5	LOS A	0.0	0.0	Short	50	0.0	0.0
Lane 2	115	1.7	1535	0.075	100	5.1	LOS A	0.3	2.5	Full	500	0.0	0.0
Approach	476	12.6		0.217		4.7	NA	0.3	2.5				
Intersection	1308	8.3		0.260		4.9	NA	0.8	5.9				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE SUMMARY

Site: Mooloobar St / Newell Hwy AM Base

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newell Hwy (S)													
Lane 1[d]	244	16.8	1222	0.200	100	2.1	LOS A	1.1	9.0	Full	400	0.0	0.0
Approach	244	16.8		0.200		2.1	LOS A	1.1	9.0				
East: Old Turrawan Rd (E)													
Lane 1[d]	66	12.1	1081	0.061	100	5.5	LOS A	0.3	2.3	Full	500	0.0	0.0
Approach	66	12.1		0.061		5.5	LOS A	0.3	2.3				
North: Newell Hwy (N)													
Lane 1[d]	259	16.6	1306	0.198	100	3.7	LOS A	1.2	9.2	Full	500	0.0	0.0
Approach	259	16.6		0.198		3.7	LOS A	1.2	9.2				
West: Mooloobar St (E)													
Lane 1[d]	107	13.1	1009	0.106	100	4.0	LOS A	0.5	4.3	Full	500	0.0	0.0
Approach	107	13.1		0.106		4.0	LOS A	0.5	4.3				
Intersection	676	15.7		0.200		3.3	LOS A	1.2	9.2				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Mooloobar St / Newell Hwy PM Base

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newell Hwy (S)													
Lane 1[d]	211	27.5	1185	0.178	100	1.9	LOS A	0.9	8.2	Full	400	0.0	0.0
Approach	211	27.5		0.178		1.9	LOS A	0.9	8.2				
East: Old Turrawan Rd (E)													
Lane 1[d]	29	0.0	1132	0.026	100	5.3	LOS A	0.1	0.9	Full	500	0.0	0.0
Approach	29	0.0		0.026		5.3	LOS A	0.1	0.9				
North: Newell Hwy (N)													
Lane 1[d]	252	12.3	1444	0.174	100	3.9	LOS A	1.0	7.8	Full	500	0.0	0.0
Approach	252	12.3		0.174		3.9	LOS A	1.0	7.8				
West: Mooloobar St (E)													
Lane 1[d]	79	6.3	1100	0.072	100	3.4	LOS A	0.4	2.7	Full	500	0.0	0.0
Approach	79	6.3		0.072		3.4	LOS A	0.4	2.7				
Intersection	571	16.5		0.178		3.2	LOS A	1.0	8.2				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Kamilaroi Hwy / Newell Hwy AM Base

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newell Hwy (S)													
Lane 1[d]	13	46.2	1068	0.012	100	7.8	LOS A	0.1	0.6	Full	500	0.0	0.0
Approach	13	46.2		0.012		7.8	LOS A	0.1	0.6				
SouthEast: Kamilaroi Hwy (SE)													
Lane 1[d]	81	0.0	1323	0.061	100	6.8	LOS A	0.3	2.1	Full	500	0.0	0.0
Approach	81	0.0		0.061		6.8	LOS A	0.3	2.1				
East: Site Access (E)													
Lane 1[d]	33	27.3	1109	0.030	100	7.4	LOS A	0.1	1.2	Full	200	0.0	0.0
Approach	33	27.3		0.030		7.4	LOS A	0.1	1.2				
North: Newell Hwy (N)													
Lane 1[d]	157	21.0	1445	0.109	100	2.1	LOS A	0.6	4.6	Full	400	0.0	0.0
Approach	157	21.0		0.109		2.1	LOS A	0.6	4.6				
West: Kelvin Vickery Ave (W)													
Lane 1[d]	34	2.9	1315	0.026	100	3.2	LOS A	0.1	0.9	Full	500	0.0	0.0
Approach	34	2.9		0.026		3.2	LOS A	0.1	0.9				
Intersection	318	15.4		0.109		4.2	LOS A	0.6	4.6				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Kamilaroi Hwy / Newell Hwy PM Base

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newell Hwy (S)													
Lane 1[d]	52	88.5	897	0.058	100	8.4	LOS A	0.3	3.4	Full	500	0.0	0.0
Approach	52	88.5		0.058		8.4	LOS A	0.3	3.4				
SouthEast: Kamilaroi Hwy (SE)													
Lane 1[d]	83	15.7	1242	0.067	100	6.9	LOS A	0.3	2.6	Full	500	0.0	0.0
Approach	83	15.7		0.067		6.9	LOS A	0.3	2.6				
East: Site Access (E)													
Lane 1[d]	17	5.9	1243	0.014	100	7.2	LOS A	0.1	0.5	Full	200	0.0	0.0
Approach	17	5.9		0.014		7.2	LOS A	0.1	0.5				
North: Newell Hwy (N)													
Lane 1[d]	156	18.6	1294	0.121	100	2.3	LOS A	0.6	5.2	Full	400	0.0	0.0
Approach	156	18.6		0.121		2.3	LOS A	0.6	5.2				
West: Kelvin Vickery Ave (W)													
Lane 1[d]	23	0.0	1288	0.018	100	3.7	LOS A	0.1	0.6	Full	500	0.0	0.0
Approach	23	0.0		0.018		3.7	LOS A	0.1	0.6				
Intersection	331	26.9		0.121		4.7	LOS A	0.6	5.2				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Newell Hwy / Tibbereena St AM Dev

Newell Hwy / Tibbereena St
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tibbereena St (S)													
Lane 1	266	6.8	1067	0.249	100	6.5	LOS A	1.1	8.0	Full	500	0.0	0.0
Lane 2	21	9.5	803	0.026	100	6.0	LOS A	0.1	0.7	Full	500	0.0	0.0
Approach	287	7.0		0.249		6.5	LOS A	1.1	8.0				
North: Tibbereena St (N)													
Lane 1	78	0.0	1950	0.040	100	3.4	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2	372	16.4	1663	0.224	100	4.7	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	450	13.6		0.224		4.5	NA	0.0	0.0				
West: Newell Hwy (E)													
Lane 1	398	10.8	1724	0.231	100	4.5	LOS A	0.0	0.0	Short	50	0.0	0.0
Lane 2	155	7.7	1617	0.096	100	4.9	LOS A	0.5	3.4	Full	500	0.0	0.0
Approach	553	9.9		0.231		4.6	NA	0.5	3.4				
Intersection	1290	10.5		0.249		5.0	NA	1.1	8.0				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE SUMMARY

Site: Newell Hwy / Tibbereena St PM Dev

Newell Hwy / Tibbereena St
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Tibbereena St (S)													
Lane 1	207	3.9	990	0.209	100	6.8	LOS A	0.9	6.2	Full	500	0.0	0.0
Lane 2	18	5.6	675	0.027	100	7.0	LOS A	0.1	0.7	Full	500	0.0	0.0
Approach	225	4.0		0.209		6.8	LOS A	0.9	6.2				
North: Tibbereena St (N)													
Lane 1	134	26.1	1667	0.080	100	3.6	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2	478	1.9	1833	0.261	100	4.6	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	612	7.2		0.261		4.4	NA	0.0	0.0				
West: Newell Hwy (E)													
Lane 1	382	15.4	1673	0.228	100	4.5	LOS A	0.0	0.0	Short	50	0.0	0.0
Lane 2	220	7.3	1512	0.145	100	5.2	LOS A	0.7	5.3	Full	500	0.0	0.0
Approach	602	12.5		0.228		4.8	NA	0.7	5.3				
Intersection	1439	8.9		0.261		4.9	NA	0.9	6.2				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE SUMMARY

Site: Mooloobar St / Newell Hwy AM Dev

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newell Hwy (S)													
Lane 1[d]	280	18.9	1184	0.237	100	2.2	LOS A	1.4	11.2	Full	400	0.0	0.0
Approach	280	18.9		0.237		2.2	LOS A	1.4	11.2				
East: Old Turrawan Rd (E)													
Lane 1[d]	66	12.1	941	0.070	100	6.4	LOS A	0.4	2.8	Full	500	0.0	0.0
Approach	66	12.1		0.070		6.4	LOS A	0.4	2.8				
North: Newell Hwy (N)													
Lane 1[d]	385	15.1	1266	0.304	100	4.0	LOS A	2.0	15.7	Full	500	0.0	0.0
Approach	385	15.1		0.304		4.0	LOS A	2.0	15.7				
West: Mooloobar St (E)													
Lane 1[d]	138	15.2	988	0.140	100	4.8	LOS A	0.7	5.9	Full	500	0.0	0.0
Approach	138	15.2		0.140		4.8	LOS A	0.7	5.9				
Intersection	869	16.1		0.304		3.8	LOS A	2.0	15.7				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Mooloobar St / Newell Hwy PM Dev

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newell Hwy (S)													
Lane 1[d]	347	22.8	1242	0.279	100	1.9	LOS A	1.7	13.9	Full	400	0.0	0.0
Approach	347	22.8		0.279		1.9	LOS A	1.7	13.9				
East: Old Turrawan Rd (E)													
Lane 1[d]	29	0.0	1092	0.027	100	5.4	LOS A	0.1	0.9	Full	500	0.0	0.0
Approach	29	0.0		0.027		5.4	LOS A	0.1	0.9				
North: Newell Hwy (N)													
Lane 1[d]	257	14.0	1320	0.195	100	4.1	LOS A	1.2	9.2	Full	500	0.0	0.0
Approach	257	14.0		0.195		4.1	LOS A	1.2	9.2				
West: Mooloobar St (E)													
Lane 1[d]	130	9.2	987	0.132	100	4.8	LOS A	0.7	5.3	Full	500	0.0	0.0
Approach	130	9.2		0.132		4.8	LOS A	0.7	5.3				
Intersection	763	16.6		0.279		3.3	LOS A	1.7	13.9				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Kamilaroi Hwy / Newell Hwy AM Dev

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newell Hwy (S)													
Lane 1[d]	47	36.2	1115	0.042	100	4.1	LOS A	0.2	1.9	Full	500	0.0	0.0
Approach	47	36.2		0.042		4.1	LOS A	0.2	1.9				
SouthEast: Kamilaroi Hwy (SE)													
Lane 1[d]	81	0.0	1193	0.068	100	7.4	LOS A	0.3	2.4	Full	500	0.0	0.0
Approach	81	0.0		0.068		7.4	LOS A	0.3	2.4				
East: Site Access (E)													
Lane 1[d]	33	27.3	988	0.033	100	8.1	LOS A	0.2	1.4	Full	200	0.0	0.0
Approach	33	27.3		0.033		8.1	LOS A	0.2	1.4				
North: Newell Hwy (N)													
Lane 1[d]	293	18.4	1502	0.195	100	2.1	LOS A	1.1	8.9	Full	400	0.0	0.0
Approach	293	18.4		0.195		2.1	LOS A	1.1	8.9				
West: Kelvin Vickery Ave (W)													
Lane 1[d]	34	2.9	1274	0.027	100	3.3	LOS A	0.1	0.9	Full	500	0.0	0.0
Approach	34	2.9		0.027		3.3	LOS A	0.1	0.9				
Intersection	488	16.6		0.195		3.7	LOS A	1.1	8.9				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Kamilaroi Hwy / Newell Hwy PM Dev

New Site
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newell Hwy (S)													
Lane 1[d]	187	35.8	1153	0.162	100	5.0	LOS A	0.9	8.0	Full	500	0.0	0.0
Approach	187	35.8		0.162		5.0	LOS A	0.9	8.0				
SouthEast: Kamilaroi Hwy (SE)													
Lane 1[d]	83	15.7	1200	0.069	100	7.0	LOS A	0.3	2.7	Full	500	0.0	0.0
Approach	83	15.7		0.069		7.0	LOS A	0.3	2.7				
East: Site Access (E)													
Lane 1[d]	17	5.9	1204	0.014	100	7.4	LOS A	0.1	0.5	Full	200	0.0	0.0
Approach	17	5.9		0.014		7.4	LOS A	0.1	0.5				
North: Newell Hwy (N)													
Lane 1[d]	191	20.9	1291	0.148	100	2.4	LOS A	0.8	6.6	Full	400	0.0	0.0
Approach	191	20.9		0.148		2.4	LOS A	0.8	6.6				
West: Kelvin Vickery Ave (W)													
Lane 1[d]	23	0.0	1156	0.020	100	4.3	LOS A	0.1	0.7	Full	500	0.0	0.0
Approach	23	0.0		0.020		4.3	LOS A	0.1	0.7				
Intersection	501	24.2		0.162		4.0	LOS A	0.9	8.0				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: Leewood S1 AM Construction

Scenario 1
Stop (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newwell Highway (S)													
Lane 1	93	47.3	1479	0.063	100	0.7	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	93	47.3		0.063		0.7	NA	0.0	0.0				
North: Newwell Highway (N)													
Lane 1	239	24.3	1562	0.153	100	3.1	LOS A	0.8	6.9	Full	500	0.0	0.0
Approach	239	24.3		0.153		3.1	NA	0.8	6.9				
West: Leewood Entrance													
Lane 1	48	31.3	878	0.055	100	10.4	LOS A	0.2	1.8	Full	500	0.0	0.0
Approach	48	31.3		0.055		10.4	LOS A	0.2	1.8				
Intersection	380	30.8		0.153		3.4	NA	0.8	6.9				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE SUMMARY

Site: XLine S1 AM Construction

Scenario 1
Stop (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newwell Highway (S)													
Lane 1	75	40.0	1547	0.048	100	0.6	LOS A	0.2	2.1	Full	500	0.0	0.0
Approach	75	40.0		0.048		0.6	NA	0.2	2.1				
East: RoadName													
Lane 1	20	70.0	659	0.030	100	12.0	LOS A	0.1	1.1	Full	500	0.0	0.0
Approach	20	70.0		0.030		12.0	LOS A	0.1	1.1				
North: Newwell Highway (N)													
Lane 1	148	29.1	1584	0.093	100	3.5	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	148	29.1		0.093		3.5	NA	0.0	0.0				
Intersection	243	35.8		0.093		3.3	NA	0.2	2.1				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE SUMMARY

Site: Leewood S1 PM Construction

Scenario 1
Stop (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newwell Highway (S)													
Lane 1	165	30.3	1618	0.102	100	0.7	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	165	30.3		0.102		0.7	NA	0.0	0.0				
North: Newwell Highway (N)													
Lane 1	101	43.6	1416	0.071	100	2.6	LOS A	0.4	3.5	Full	500	0.0	0.0
Approach	101	43.6		0.071		2.6	NA	0.4	3.5				
West: Leewood Entrance													
Lane 1	119	21.0	1039	0.115	100	9.8	LOS A	0.5	3.8	Full	500	0.0	0.0
Approach	119	21.0		0.115		9.8	LOS A	0.5	3.8				
Intersection	385	30.9		0.115		4.0	NA	0.5	3.8				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE SUMMARY

Site: XLine S1 PM Construction

Scenario 1
Stop (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Newwell Highway (S)													
Lane 1	78	39.7	1550	0.050	100	0.4	LOS A	0.2	2.0	Full	500	0.0	0.0
Approach	78	39.7		0.050		0.4	NA	0.2	2.0				
East: RoadName													
Lane 1	89	21.3	869	0.102	100	9.4	LOS A	0.4	2.9	Full	500	0.0	0.0
Approach	89	21.3		0.102		9.4	LOS A	0.4	2.9				
North: Newwell Highway (N)													
Lane 1	81	48.1	1453	0.056	100	1.5	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	81	48.1		0.056		1.5	NA	0.0	0.0				
Intersection	248	35.9		0.102		4.0	NA	0.4	2.9				

Level of Service (LOS) Method: Delay (RTA NSW).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Appendix C – Crash Data

Narrabri

WEE WAA
NEWELL
FRANCIS
GEORGE
654630 31/01/2009 Off rd left => obj North
BARWAN
THE ISLAND ROAD
MILLICENT
ELIZABETH
1012716 24/11/2013 Right far East
682870 25/09/2009 Right rear South
745099 19/03/2011 Off rd rght => obj South
828724 2/03/2013 Cross traffic West
663366 1/04/2009 Cross traffic South
793780 20/04/2012 Ped nearside North
766376 4/09/2011 Off rt/lft bnd=>obj South
805739 26/04/2012 Right through North
WANDI
743304 28/02/2011 Ped far side South
848238 14/08/2013 Right near East
COLLINS
756007 6/06/2011 Off end of road East
767145 14/09/2011 Ped nearside West
659513 18/03/2009 Other same directio West
837408 17/05/2013 Off rd left => obj East
728502 4/10/2010 Cross traffic South
KATE
GENANAGIE
721512 18/08/2010 Rear end West
774032 5/11/2011 Rear end South
677163 13/07/2009 Off road to left South
805274 31/07/2012 Right rear North
SELINA
YARRIE LAKE
VILLARETTE
GUMBIDGUWA
LANTANA
UGOA
FORBES
LENORE
MANNING
BRIDGE
HUXLEY
GIBBONS
MORATH
BUKHAI
DERAN
KOGIL
YERAN
WALOWA
MEELEE
BURIGAL
680017 23/08/2009 Right through South
773056 27/10/2011 Ped other North
VIOLET
RAILWAY
BARANBAR
GOOBAR
BURI
758107 16/05/2011 Emerging from drive East
BELAR
722919 21/08/2010 Struck animal South
683986 26/08/2009 Head on North
COOMA
PEELE
KURRAJONG
HINDS PARK
GRACE
GOULD
MOOLOOBAR
FRASER
CEDAR
TAYLOR
ZIMMERMAN
RAILWAY
796590 20/05/2012 Off rd rght => obj North
749070 23/03/2011 Other straight South
PURCELL
MCKENZIE
KELVIN VICKERY
SARNIA
GATELY
710410 17/05/2010 Head on South
742840 8/02/2011 Head on South
QUINN
AVON
658598 4/03/2009 On road-out of cont North
OLD TURRAWAN
BOUNDARY
824838 28/01/2013 Off rd left => obj South
NEWELL
822319 6/01/2013 Off left/right bend North
671425 28/08/2009 Head on North
KAMILAROI

Crashes
2009 to 2013
DEGREE_OF_
Fatal
Injury
Non-casualty (towawa

0 270 540 Meters

Narrabri

WEE WAA
FRANCIS
FRANCIS
RAILWAY
SALEYARDS
GEORGE
NEWELL
ELIZABETH
SEGOL
NAMOI
KILLARNEY
LLOYD
BARWAN
NANDEWAR
MCDONALD
DOYLE
HENDRICH
TIBBEREENA
BALONNE
DEWHURST
MAITLAND
BOWEN
DANGAR
CAMERON
COLLINS
CAMPBELL
ANNE

654630 31/01/2009 Off rd left => obj North
682870 25/09/2009 Right rear South
1012716 24/11/2013 Right far East
792615 4/04/2012 Off rt/lft bnd=>obj South
745099 19/03/2011 Off rd rght => obj South
793780 20/04/2012 Ped nearside North
828724 2/03/2013 Cross traffic West
663366 1/04/2009 Cross traffic South
725352 22/08/2010 Off left/rt bnd=>ob North
766376 4/09/2011 Off rt/lft bnd=>obj South
805739 26/04/2012 Right through North
743304 28/02/2011 Ped far side South
756007 6/06/2011 Off end of road East
848238 14/08/2013 Right near East
829837 15/03/2013 Off rd left => obj South
793027 27/04/2012 Off end of road East
659513 18/03/2009 Other same directio West
767145 14/09/2011 Ped nearside West

Crashes
2009 to 2013
DEGREE_OF_
- Fatal
- Injury
- Non-casualty (towawa

0 100 200 Meters

Narrabri

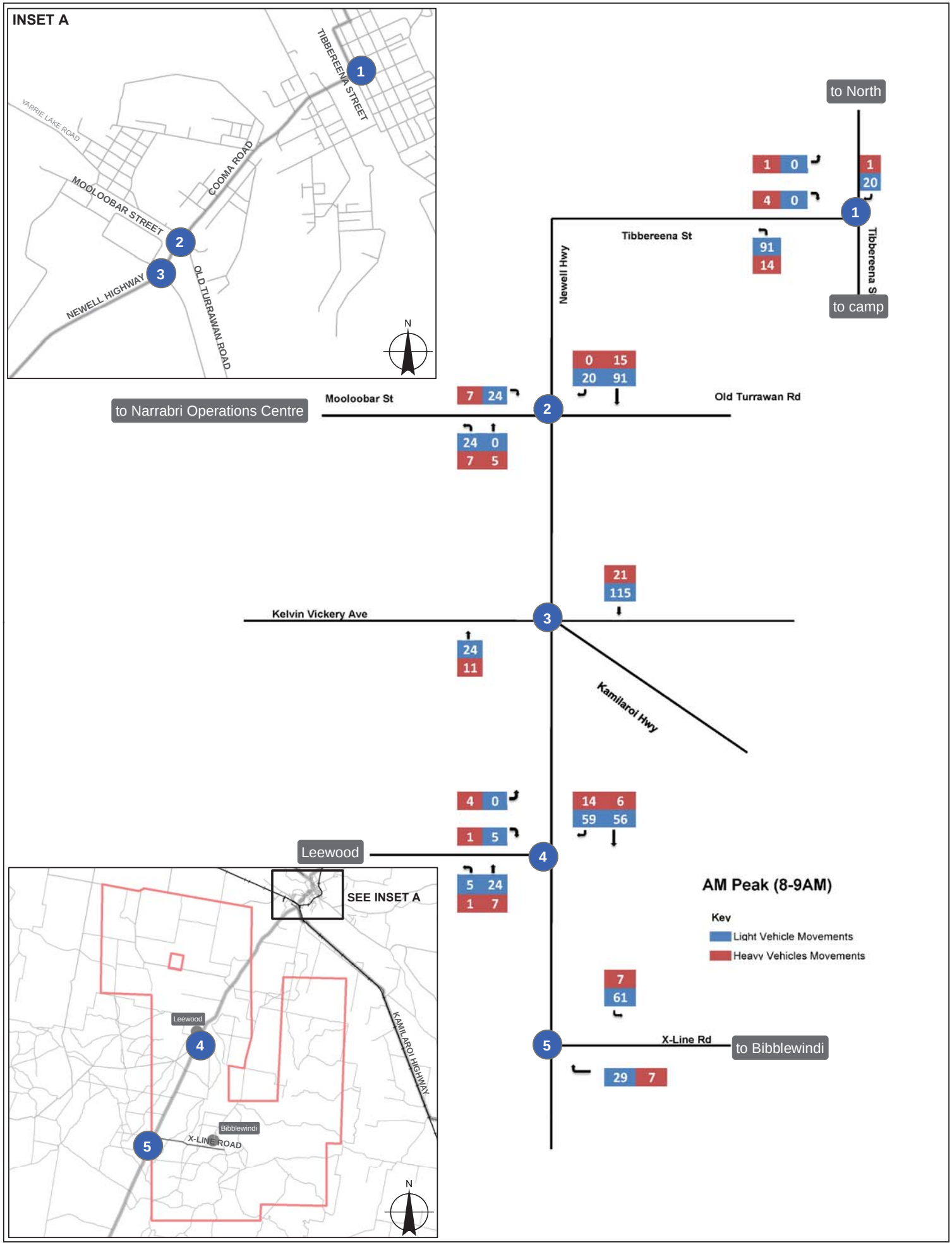
SEGOL
NAMOI
KILLARNEY
LLOYD
KAPUTAR
MCDONALD
DOYLE
REID
WANDI
DEWHURST
NANDEWAR
COLLINS
CAMERON
DANGAR
BALONNE
CAMPBELL
BOWEN
ELEANOR
TIBBEREENA
KATE
ANNE
BEATRICE
SELINA
DENISON
MARGARET
MAY
DOODY
FITZROY
HUXLEY
MCCLINTOCK
BARWAN
SPENCER
VIOLET
HINDS
GIBBONS
JENKINS

682870 25/09/2009 Right rear South
1012716 24/11/2013 Right far East
792615 4/04/2012 Off rt/lft bnd=>obj South
745099 19/03/2011 Off rd rght => obj South
793780 20/04/2012 Ped nearside North
828724 2/03/2013 Cross traffic West
663366 1/04/2009 Cross traffic South
725352 22/08/2010 Off left/rt bnd=>ob North
766376 4/09/2011 Off rt/lft bnd=>obj South
682504 20/09/2009 Cross traffic South
773957 2/11/2011 Cross traffic West
814623 2/10/2012 Right through East
805739 26/04/2012 Right through North
797827 3/08/2012 Ped far side South
806788 14/08/2012 Off rd left => obj North
800491 21/06/2012 Right turn sideswip West
739225 13/01/2011 Leaving parking North
786684 7/03/2012 Out of cont on bend West
743304 28/02/2011 Ped far side South
751757 9/05/2011 Rear end North
756007 6/06/2011 Off end of road East
848238 14/08/2013 Right near East
829837 15/03/2013 Off rd left => obj South
793027 27/04/2012 Off end of road East
738414 30/09/2010 Cross traffic East
671429 31/08/2009 From footpath East
695121 4/01/2010 Leaving parking North
781381 10/01/2012 Cross traffic East
659513 18/03/2009 Other same directio West
767145 14/09/2011 Ped nearside West
685853 14/10/2009 Cross traffic South
746707 31/03/2011 Cross traffic West
768775 23/09/2011 Off rd left => obj West
728502 4/10/2010 Cross traffic South
837408 17/05/2013 Off rd left => obj East
768800 24/09/2011 Ped on carriageway West
820505 12/12/2012 Right rear South
741989 17/02/2011 Leaving parking West
721512 18/08/2010 Rear end West
774032 5/11/2011 Rear end South
816436 7/11/2012 Off rd left => obj North
812982 15/09/2012 Off road to left South
677163 13/07/2009 Off road to left South
662336 27/02/2009 Off rd left => obj South
775515 22/10/2011 Cross traffic East
835397 27/04/2013 Cross traffic East
708155 25/04/2010 Cross traffic East
833713 17/04/2013 Ped nearside East
690150 22/11/2009 Cross traffic East
837192 3/05/2013 Cross traffic East
839170 29/05/2013 Fell in/from vehicl South
809078 26/08/2012 Overtake turning East
721020 10/08/2010 Cross traffic West
826229 30/01/2013 Right near South
823659 17/12/2012 Cross traffic West
816637 3/11/2012 Ped walk with West
819297 15/11/2012 Off road to left West

Crashes
2009 to 2013
DEGREE_OF_
Fatal
Injury
Non-casualty (towawa

0 100 200 Meters

Appendix D – Traffic Turning Diagrams



Not to scale

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Narrabri Gas Project
EIS Techincal Appendix Traffic and Transport

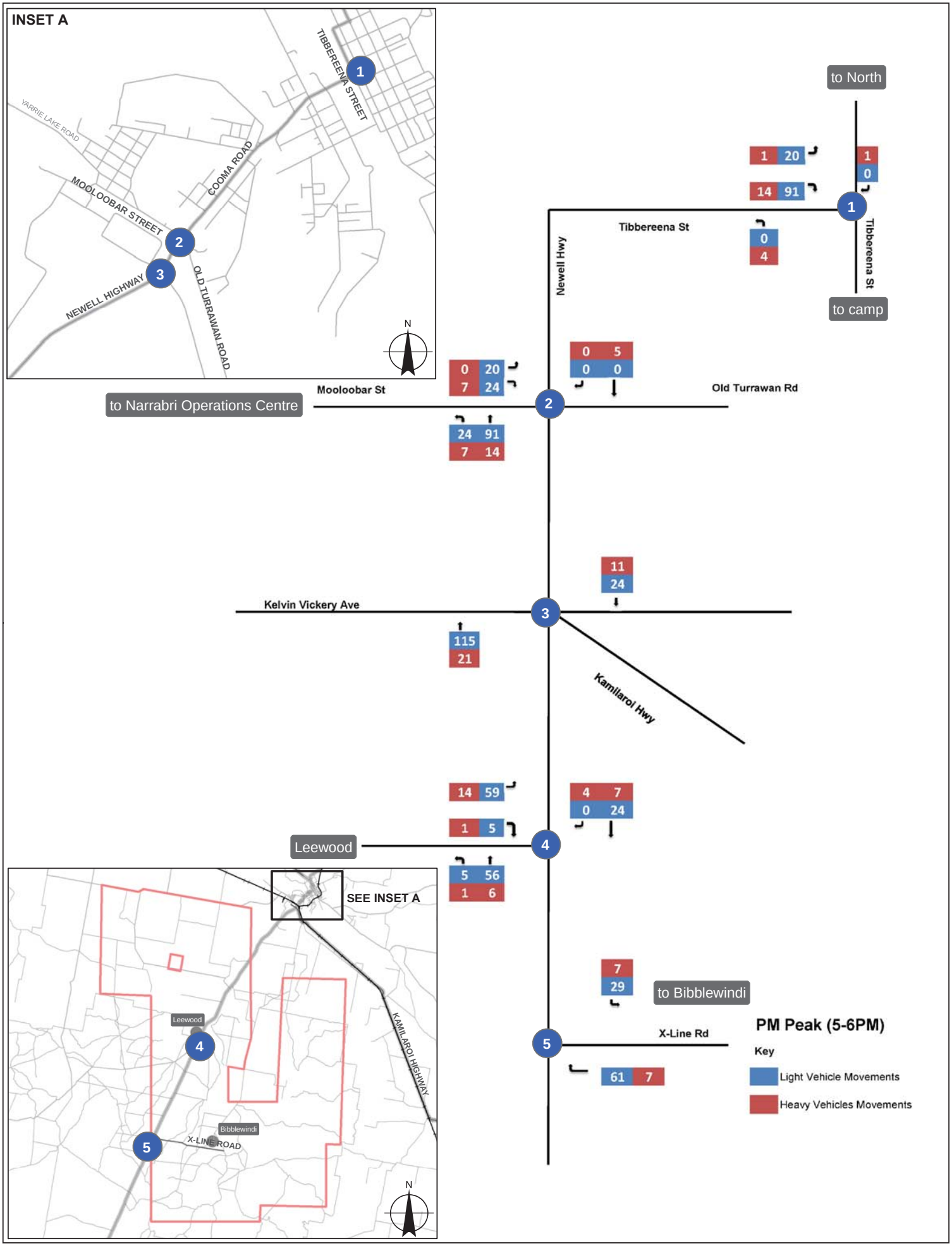
AM peak hour
Traffic Turning Volumes (Scenario 1)

Job Number 21-22463
Revision A
Date 23 Apr 2015

Figure D1

G:\21\22463\GIS\Maps\21_22463_Z079.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au



Not to scale

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

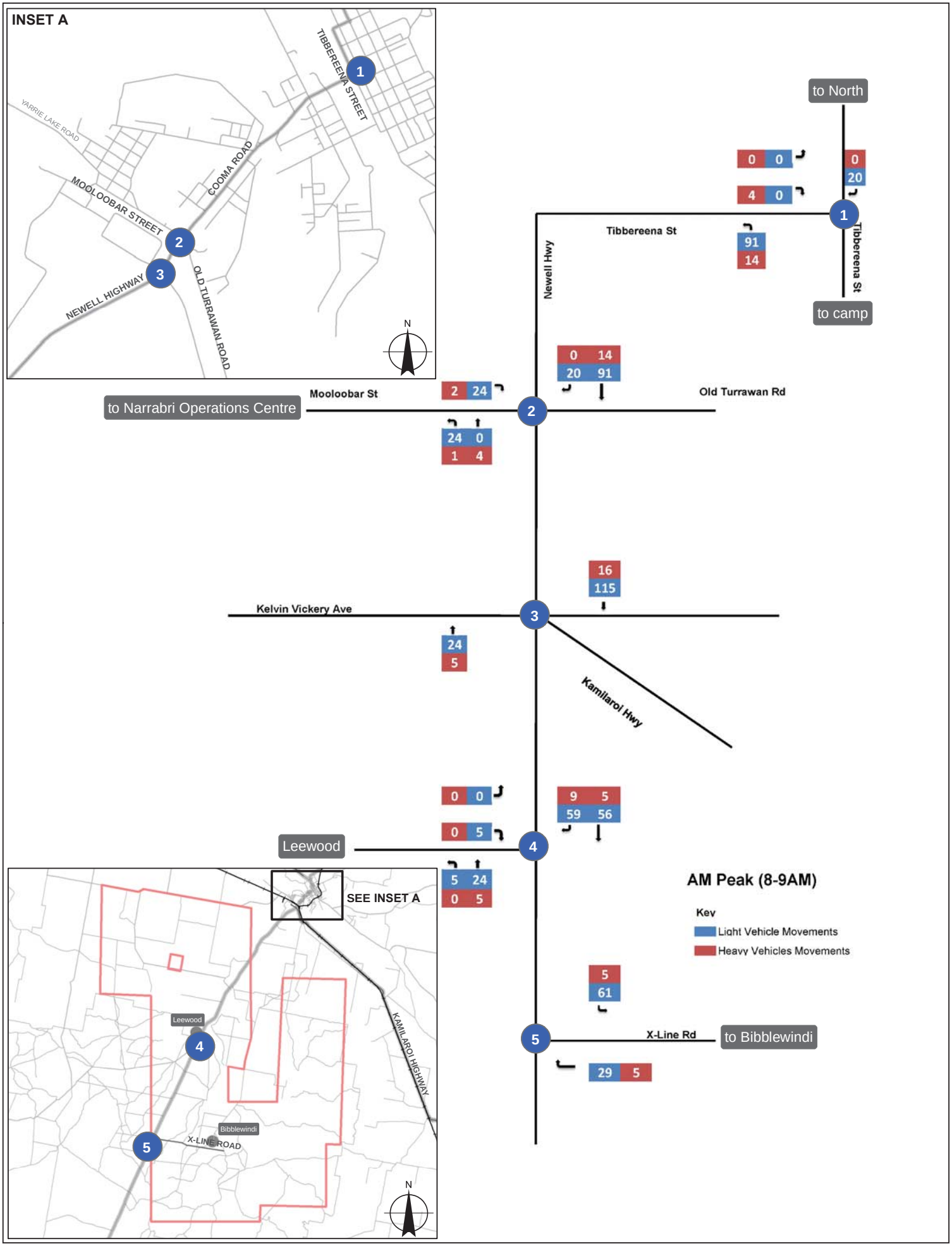
Narrabri Gas Project
EIS Technical Appendix Traffic and Transport

Job Number	21-22463
Revision	A
Date	23 Apr 2015

PM peak hour
Traffic Turning Volumes (Scenario 1)

Figure D2

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au



Not to scale

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

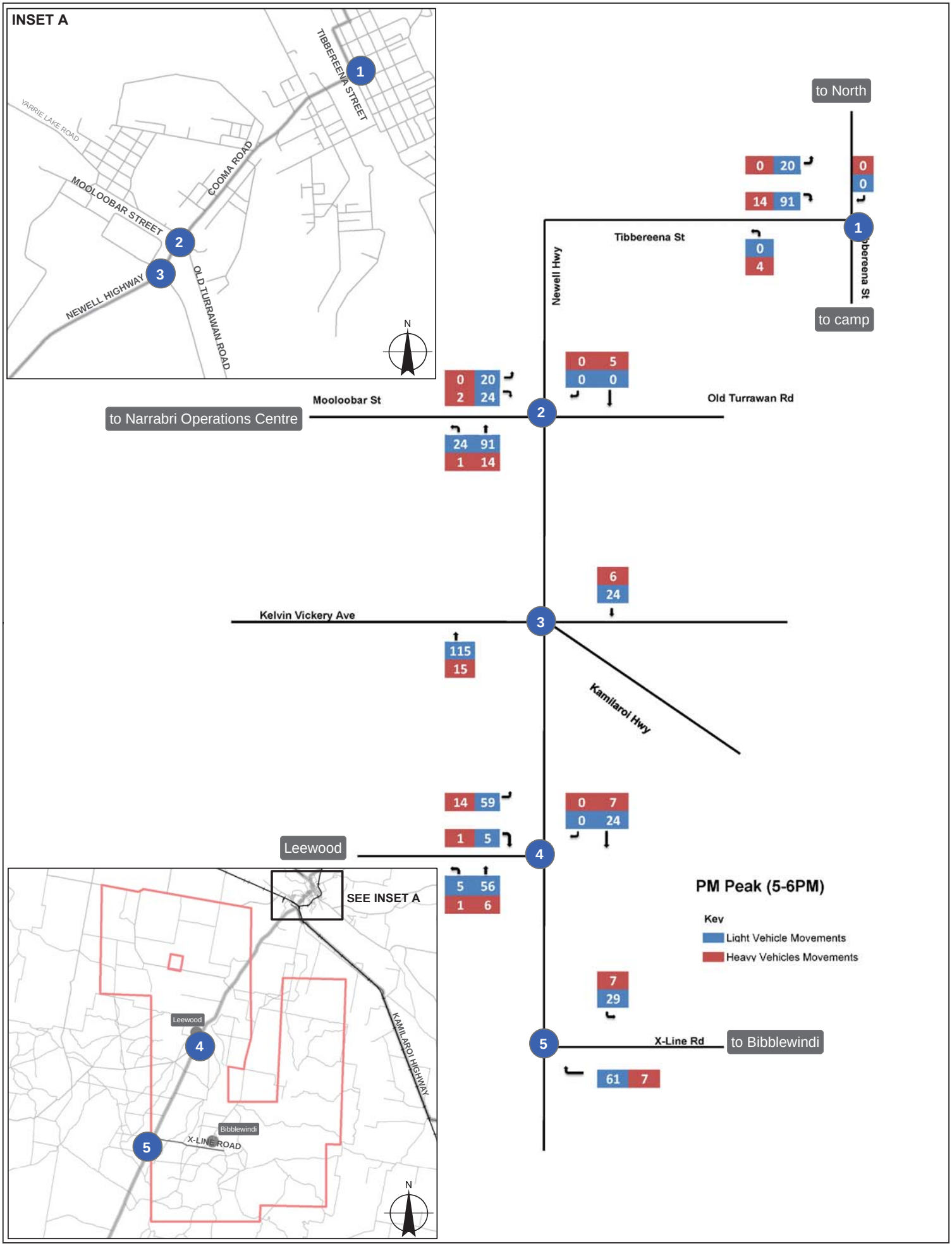
Narrabri Gas Project
EIS Technical Appendix Traffic and Transport

AM peak hour
Traffic Turning Volumes (Scenario 2)

Job Number 21-22463
Revision A
Date 23 Apr 2015

Figure D3

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au



Not to scale

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

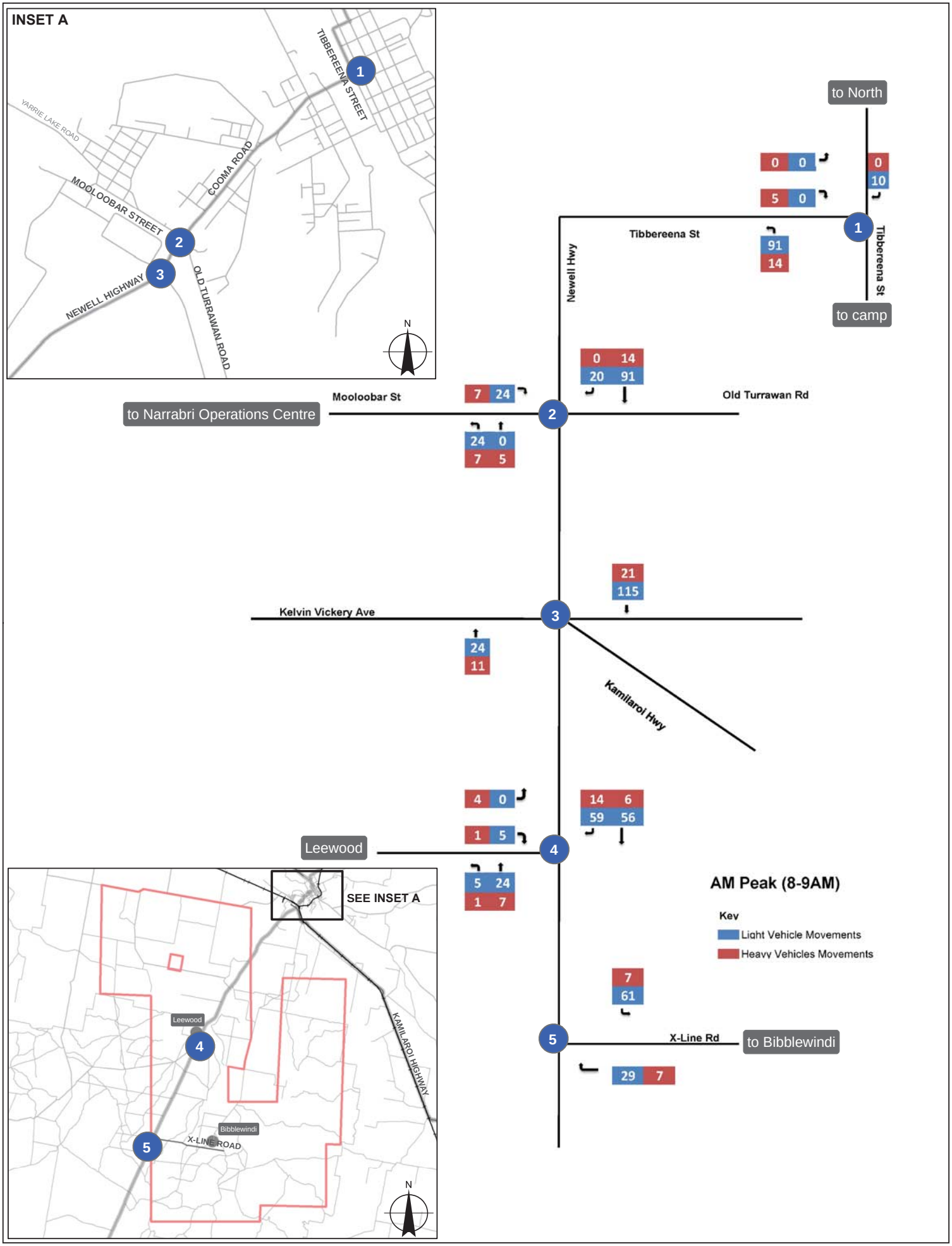
Narrabri Gas Project
EIS Technical Appendix Traffic and Transport

Job Number	21-22463
Revision	A
Date	23 Apr 2015

PM peak hour
Traffic Turning Volumes (Scenario 2)

Figure D4

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au



Not to scale

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Narrabri Gas Project
EIS Technical Appendix Traffic and Transport

AM peak hour
Traffic Turning Volumes (Scenario 3)

Job Number 21-22463
Revision A
Date 23 Apr 2015

Figure D5

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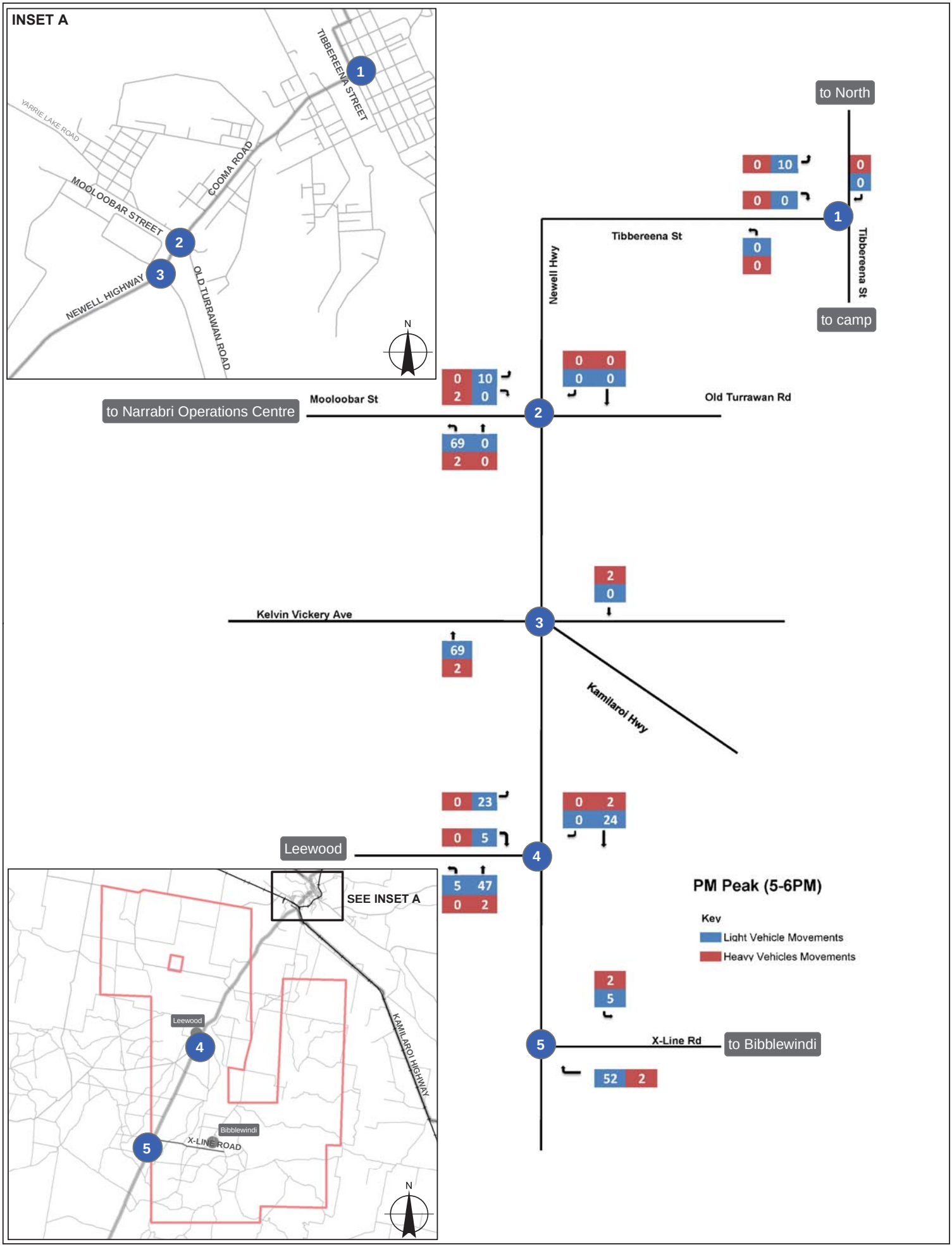
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au



Not to scale

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Narrabri Gas Project
EIS Technical Appendix Traffic and Transport

PM peak hour
Traffic Turning Volumes (Scenario 3)

Job Number 21-22463
Revision A
Date 23 Apr 2015

Figure D6

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

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