

APPENDIX

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DUNGOWAN DAM AND PIPELINE EIS

Traffic Impact Assessment



Dungowan Dam and pipeline project

Traffic Impact Assessment

Prepared for Water Infrastructure NSW

September 2022

Dungowan Dam and pipeline project

Traffic Impact Assessment

Water Infrastructure NSW

J200042 DUN-EMM-EN-RPT-0018

September 2022

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Executive Summary

The Peel River, part of the Namoi River catchment, provides water for irrigation as well as being the primary water supply for the city of Tamworth. Prompted by the millennium drought, investigations into the future water supply and demand for bulk water were undertaken for the regional city of Tamworth and the Peel Valley water users. The Dungowan Dam and pipeline project (the project) is a critical project to improving long-term water security for the region. The project includes a new dam at Dungowan (new Dungowan Dam) approximately 3.5 km downstream of the existing Dungowan Dam and a new section of pipeline about 32km long between the proposed Dam outlet and the tie in point to an existing pipeline from Dungowan Showground to the Calala Water Treatment Plant (WTP).

In September 2022, the Minister for Planning and Homes declared the project to be Critical State Significant Infrastructure (CSSI) as it is a development that is essential for the State for economic and social reasons. This requires Schedule 5 of the *State Environmental Planning Policy (Planning Systems) 2021* to be updated to reflect the CSSI status of the project. As CSSI, the project is subject to Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), which requires the preparation of an environmental impact statement (EIS) and the approval of the NSW Minister for Planning and Homes. The EIS has been prepared for the planning approval application for the project. The Traffic Impact Assessment has been prepared to support the EIS.

The construction and operational traffic impacts are predicted primarily in terms of the intersection Level of Service (LOS). The performance criteria used and assessment of these impacts are provided in Section 4.1 of this report. The construction and operational traffic impacts are predicted as follows:

- a large part of the primary transport route will be affected by a reduced speed limit for the majority of the construction period;
- there were no potential impacts identified to traffic flow on major roads;
- all key intersections currently operate LOS A in the peak hours, except for the New England Highway/Nundle Road/Railway Street intersection where LOS B and LOS C is experienced in the AM and PM peak respectively. With construction traffic, all the key intersections will remain at the same LOS;
- the operational traffic volumes would be much lower than the construction traffic. Therefore, during operation all the key intersections are expected remain at the same LOS;
- the mid-block capacity of Nundle Road has LOS C near the New England Highway and near O'Briens Lane, and LOS A near Duri-Dungowan Road. With the addition of the proposed construction traffic all the key road sections will remain at the same LOS;
- the intersection turn treatments at all the key intersections comply with the Austroads Guide to Road Design Part 4A: Unsignalised & Signalised Intersections (2017); and
- the impacts to public transport, pedestrian and cyclist operations would be negligible.

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1 Introduction

1.1 The project

The Peel River, part of the Namoi River catchment, provides water for irrigation as well as being the primary water supply for the city of Tamworth. Prompted by the millennium drought, investigations into the future water supply and demand for bulk water were undertaken for the regional city of Tamworth and the Peel Valley water users. The Dungowan Dam and pipeline project (the project) is a critical project to improving long-term water security for the region. The project includes a new dam at Dungowan (new Dungowan Dam) approximately 3.5 km downstream of the existing Dungowan Dam and a new section of pipeline about 32km long between the proposed Dam outlet and the tie in point to an existing pipeline from Dungowan Showground to the Calala Water Treatment Plant (WTP).

In September 2022, the Minister for Planning and Homes declared the project to be Critical State Significant Infrastructure (CSSI) as it is a development that is essential for the State for economic and social reasons. This requires Schedule 5 of the *State Environmental Planning Policy (Planning Systems) 2021* to be updated to reflect the CSSI status of the project. As CSSI, the project is subject to Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), which requires the preparation of an environmental impact statement (EIS) and the approval of the NSW Minister for Planning and Homes.

The EIS has been prepared for the planning approval application for the project. This Traffic Impact Assessment has been prepared to support the EIS.

In addition to requiring approval from the NSW Minister for Planning and Homes, the project has been deemed a controlled action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and requires approval from the Commonwealth Minister for the Environment. The Minister for the Environment has accredited the NSW planning process for the assessment of the project. Therefore, a single EIS has been prepared to address the requirements set out by the NSW Department of Planning and Environment (DPE) and the Commonwealth Department of Agriculture, Water and Environment.

1.2 Project location

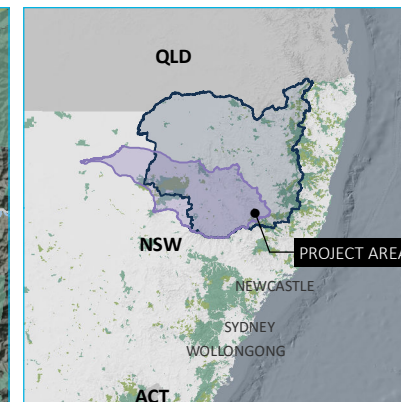
The project is located in the Tamworth Regional local government area (LGA), the New England Tablelands bioregion and part of the New England and North West region of NSW, west of the Great Dividing Range (DPE 2017). The New England and North West region is home to approximately 186,900 people and has a total area of around 99,100 km² (ABS 2018).

The city of Tamworth is the nearest (and largest) town to the project with over 40,000 residents. Other nearby regional towns include Quirindi (70 km west), Manilla (90 km north-west), Gloucester (90 km south-east), Armidale (100 km north) and Gunnedah (110 km west of the project).

The existing Dungowan Dam is in the Namoi River catchment approximately 50 km south-east of Tamworth in NSW. The Namoi catchment covers 4,700 km² and borders the Gwydir and Castlereagh catchments and is bounded by the Great Dividing Range in the east, the Liverpool Ranges and Warrumbungle Ranges in the south, and the Nandewar Ranges and Mount Kaputar to the north.

The existing Dungowan Dam is on Dungowan Creek, which is a tributary of the Peel River. Dungowan Creek is confined by the existing Dungowan Dam, while the Peel River system is regulated by Chaffey Dam, located in the upper catchment near the town of Woolomin, approximately 45 km from Tamworth.

The project's regional setting is shown in Figure 1.1.



- KEY**
- █ Project footprint
 - Major road
 - Named watercourse
 - █ Named waterbody
 - █ NPWS reserve
 - █ State forest
 - █ Tamworth Regional local government area
- INSET KEY**
- █ Namoi River catchment
 - █ New England North West region

Regional setting

Dungowan Dam and pipeline project
Figure 1.1

1.3 Project impact areas

In outlining the project, a project footprint has been defined to facilitate the assessment of direct impacts from the project:

- Project footprint: all areas where direct impacts may be experienced during construction and/or operation.

The project footprint has an area of 315 ha and is comprised of the construction and operational footprints, of which there is some overlap:

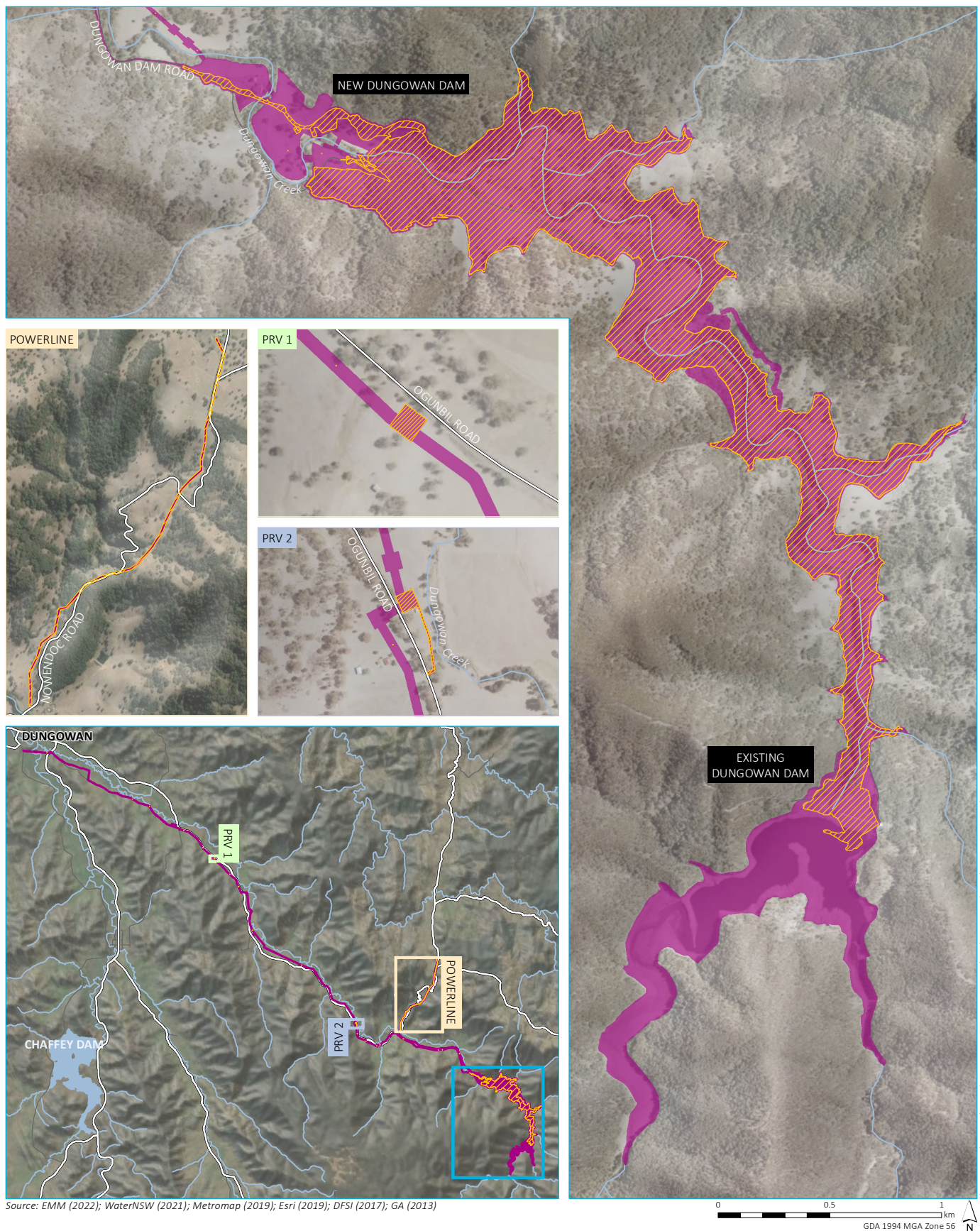
- Construction footprint: areas where vegetation clearing and/or ground disturbance is required for construction of the dam, pipeline and ancillary facilities, including the area needed to decommission and rehabilitate the existing dam.
- Operational footprint: areas where there will be permanent operational elements or easements, including infrastructure needed to operate the new Dungowan Dam and pipeline. The operation footprint includes the inundation area, being the area defined by the proposed full supply level (FSL) for the project.

Additional areas outside the project footprint have also been considered where relevant to the assessment of project impacts and include:

- Upstream flood extent: An area above the FSL to the level of a probable maximum flood (PMF) event that would be inundated for relatively short periods during operation associated with extreme rainfall events.
- Project area: A 10 km buffer around the project footprint defined to allow for assessment of potential indirect impacts.
- Downstream impact area: the area where hydrological changes may occur due to the project. This area is discussed in detail in the Surface Water Assessment (EMM 2022) as well as other technical reports subject to changed flow regimes as a result of the new Dungowan Dam operation. The downstream impact area includes Dungowan Creek and also the Peel River downstream of Chaffey Dam.

1.3.1 Traffic Impact Assessment study area

The Traffic Impact Assessment (TIA) mainly focuses on the local road network between the New England Highway and the new Dungowan Dam and pipeline alignment, which includes Nundle Road, Ogunbil Road, and Dungowan Dam Road. An overview of the project footprint is provided in Figure 1.2 below.



- KEY**
- Construction footprint
 - Operational footprint
 - Existing environment
 - Major road
 - Minor road
 - Named watercourse
 - Named waterbody

Project footprint

Dungowan Dam and pipeline project
Figure 1.2

1.4 Purpose of this report

This TIA assesses the likely traffic impacts of the new Dungowan Dam and pipeline project. It documents the assessment methods and results, the initiatives built into the project design to avoid and minimise associated traffic impacts, and the mitigation and management measures proposed to address any unavoidable residual impacts.

The specific objectives of the assessment are to:

- determine existing background traffic conditions (types and number of movements) on the surrounding road network that would be used for access to construction sites;
- determine the likely traffic generation (volumes and scheduling) associated with the construction works and operations;
- determine the adequacy of the local road network to accommodate the predicted traffic volume;
- provide mitigation measures to reduce the traffic impacts from the project wherever possible; and
- where impacts are unavoidable, consider compensatory measures that are appropriate for the project.

1.4.1 Assessment guidelines and requirements

This TIA has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) for the new Dungowan Dam and pipeline project, as well as relevant government assessment requirements, guidelines and policies, and in consultation with the relevant government agencies. This TIA has been prepared in accordance with the requirements of the NSW Roads and Traffic Authority (RTA) (now Transport for NSW (TfNSW)) (2002) *Guide to Traffic Generating Developments*.

Table 1.1 lists the matters relevant to this assessment and where they are addressed in this report.

Table 1.1 Traffic related SEARs items

SEARs	Section addressed
40. Provide a Traffic Impact Assessment (TIA) addressing construction and operational traffic impacts prepared by a suitably qualified person in accordance with the Austroads Guide to Traffic Management, TfNSW Supplements to Austroads and the RTA Guide to Traffic Generating Developments. The TIA is to be developed in consultation with Transport for NSW.	This TIA has been prepared by appropriately qualified and experienced staff. During preparation of the TIA EMM contacted TfNSW to seek input regarding assessment requirements and key issues. A response was received to clarify that no further consultation would be provided in addition to previous TfNSW input to the project SEARs.
41. For identified road safety concerns at specific locations along the proposed haulage routes, the TIA should be supported by a targeted Road Safety Audit, including construction phase traffic, undertaken by suitably qualified persons.	A Road Safety Audit has been undertaken by an independent contractor as part of the project worksite construction traffic access planning. Details of proposed road upgrades for the project access are provided in Chapter 2 of this report and also in Chapter 4 (Project Description) of the EIS.
42. Identify controls for transport and use of any dangerous goods in accordance with <i>State Environmental Planning Policy No. 33 – Hazardous and Offensive Development</i> , the Australian Dangerous Goods Code and Australian Standard 4452: Storage and Handling of Toxic Substances.	Details of the dangerous goods transport is outlined in Section 4.8.

Table 1.1 **Traffic related SEARs items**

SEARs	Section addressed
43. Provide details of any temporary or permanent river closures, or exclusion zones during construction and operation of the project identified in consultation with Transport for NSW.	No navigable waterways are affected by the proposed project construction. River closure works for the new dam construction, will occur downstream of the existing dam. Preliminary construction activity details are shown in Chapter 2.

To inform preparation of the SEARs, DPE invited relevant government agencies to advise on matters to be addressed in the EIS. These matters were taken into account by the Secretary for DPE when preparing the SEARs.

2 Description of the project

This chapter provides a summary of the Dungowan Dam and pipeline project. It outlines the permanent infrastructure required to operate the project, as well as the key construction elements and activities required to construct the project. A comprehensive and detailed description of the project is provided as Appendix B1 of the EIS, which has been relied upon for the basis of this technical assessment.

2.1 Project overview

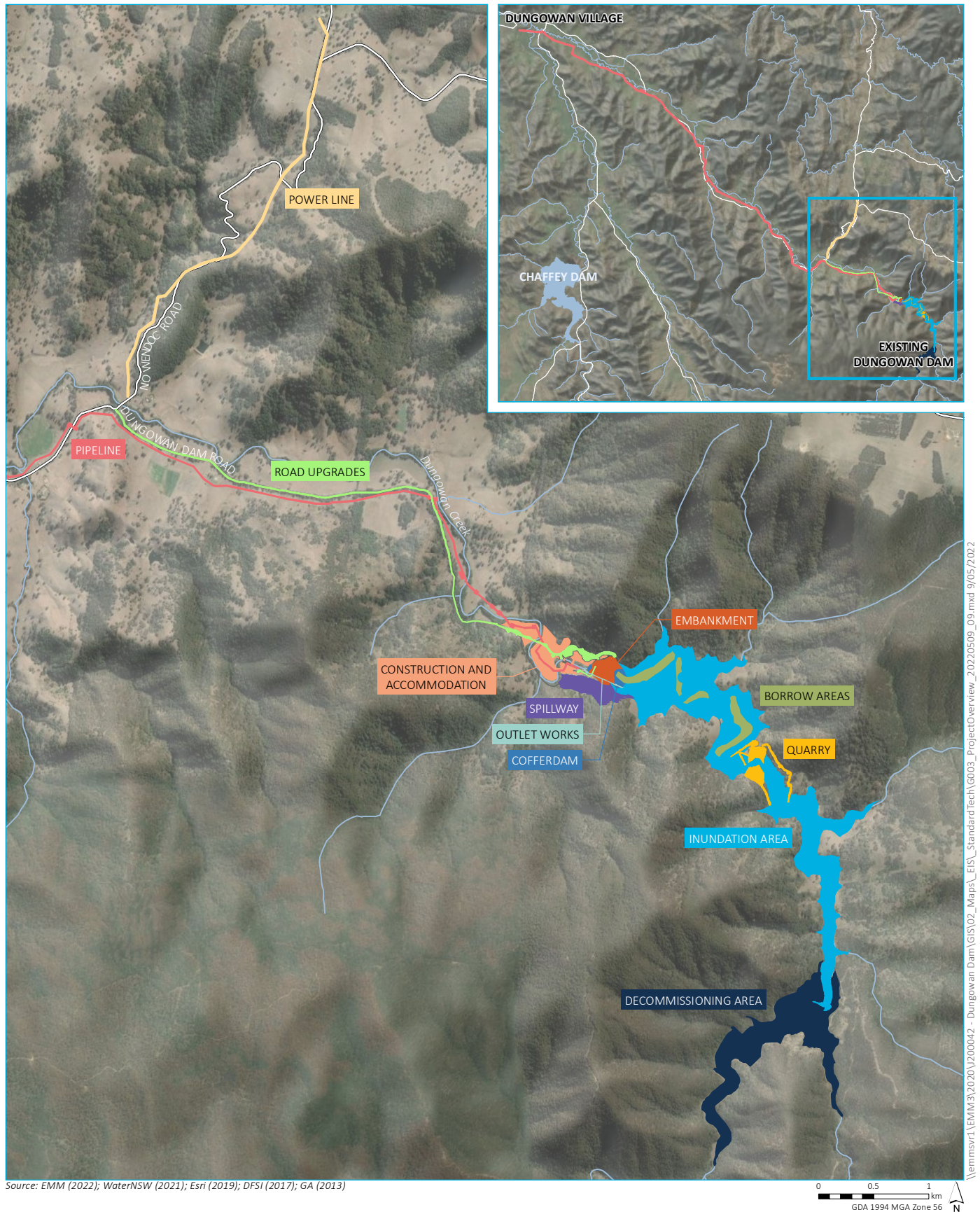
Water Infrastructure NSW proposes to build a new dam at Dungowan (new Dungowan Dam) about 3.5 km downstream of the existing Dungowan Dam and an enlarged delivery pipeline from the new Dungowan Dam outlet to the tie in point to the existing pipeline from Dungowan Showground to the Calala WTP. The existing pipeline from Dungowan Showground to the Calala WTP is not part of the Dungowan Dam and pipeline project. A summary of project elements is provided in Table 2.1. An overview of the project is provided in Figure 2.1.

Table 2.1 Overview of the project

Project element	Summary of the project
New Dungowan Dam infrastructure	<p>Earth and rockfill embankment dam with height of ~58 m and a dam crest length of ~270 m.</p> <p>Storage capacity of 22.5 GL at full supply level (FSL) of RL 660.2 m AHD.</p> <p>The new Dungowan Dam on Dungowan Creek has a catchment size of 175 km² and is part of the Peel Valley and Namoi River catchment.</p> <p>Inundation extent (to FSL) of 130 ha (1.3 km²)</p> <p>Spillway to the south of the dam wall including an approach channel, uncontrolled concrete ogee crest, chute and stilling basin. Free standing multiple-level intake tower connected with a bridge to the embankment, diversion tunnel with outlet conduit, valve house and associated pipework and valves.</p> <p>A permanent access road over the Dam crest to the valve house for operation and maintenance.</p> <p>Water diversion works including a diversion tunnel and temporary pipeline and upstream and downstream cofferdams to facilitate construction of the dam wall embankment.</p>
Pipeline infrastructure	<p>31.6 km of buried high density polyethylene (HDPE) pipe between 710 mm to 900 mm nominal diameter.</p> <p>Maximum 71 ML/day from the proposed dam to the junction with the pipeline from Chaffey Dam to the Calala Water Treatment Plant, to replace the existing 22 ML/day pipeline. The pipeline would connect to the valve house on the left abutment of the embankment. Valve infrastructure would include control valves installed in two above ground buildings along the pipeline.</p> <p>10 m wide easement for the 31.6 km length of the pipeline. The replacement pipeline extends from the new Dungowan Dam to a connection point with the existing pipeline between Dungowan Showground and Calala WTP.</p>
Ancillary infrastructure and works	<p>Road works to improve existing roads to provide construction access, temporary establishment and use of a construction compound, an accommodation camp, two upstream quarries and four borrow areas within the inundation area.</p> <p>A new 4.2 km long 11 kV overhead powerline (including a new easement and access track) connecting to an existing overhead line approximately 6 km north west of the dam. The existing overhead line that extends approximately 13.2 km to the Niangala area would also require minor upgrades, including re-stringing of new overhead wiring and replacement of some poles.</p>
Decommissioning of existing Dungowan Dam	<p>Dewatering of existing dam, removal of existing Dungowan Dam infrastructure and full height breach of the existing Dungowan Dam wall. Rehabilitation of inundation area of existing Dungowan Dam.</p>

Table 2.1 **Overview of the project**

Project element	Summary of the project
Disturbance	<p>Areas of disturbance have been identified based on the direct impacts of the project. There is some overlap in the areas disturbed during construction and operation, with a resulting total disturbance area proposed for the project of 315 ha (project footprint).</p> <p>Disturbance would occur in a staged manner, with construction requiring disturbance of approximately 315 ha (construction footprint). Following construction and once rehabilitation is completed, there would be a permanent disturbance of approximately 158 ha comprising the inundation area and permanent infrastructure (operational footprint).</p>
Construction	<p>Construction duration of approximately 6 years.</p> <p>Construction workforce of approximately 125 workers at construction peak.</p>
Operation	<p>WaterNSW will be responsible for management, operation and general maintenance of the new dam. Tamworth Regional Council will be responsible for the management, operation and general maintenance of the pipeline. Public use and access to the dam would not be permitted and there would be no public facilities available during operation.</p> <p>One to two new full time workers plus part time work for existing WaterNSW operations team.</p> <p>Due to the new Dungowan Dam being prioritised over Chaffey Dam for Tamworth's future water supply, the water reserved for town water in Chaffey Dam would increase from 14.3 GL to 30 GL to ensure that water is set aside to meet Tamworth's town water supply water demand in years when rainfall is low.</p>
Design life	100 years for zoned earthen embankment, structural concrete elements of the dam and the pipeline. 15 to 50 years for other non-structural project elements and pavements.
Assessment period (operational)	The assessment end point is when the water system performance reaches a level when an additional water supply option or change to the Water Sharing Plan is required. This has been estimated to be when the mean average annual water demand from Tamworth increases to 11 GL/year.



KEY

- | | | |
|--|--|--|
| ■ Inundation area | ■ Quarries | Existing environment |
| ■ Borrow areas | ■ Spillway | — Major road |
| ■ Construction and accommodation camp | ■ Road upgrade | — Minor road |
| ■ Outlet works | ■ Decommissioning area | — Named watercourse |
| ■ Cofferdams | ■ Power line footprint | ■ Named waterbody |
| ■ Embankment | ■ Pipeline construction footprint | |

Project overview

Dungowan Dam and pipeline project
Figure 2.1

2.2 Construction activities and sequencing

2.2.1 Construction staging and sequencing

The key steps to constructing the new Dungowan Dam and pipeline include:

- relocating services and structures affected by the construction and inundation areas;
- mobilisation and construction of the ancillary infrastructure, including the construction of accommodation camp, construction compounds and quarries;
- construction of the pipeline infrastructure;
- construction of access roads, coffer dams and diversion;
- construction of the embankment, spillway and outlet works; and
- decommissioning works at the existing Dungowan Dam.

Construction of the project would take approximately 6 years to complete. The project development would involve different phases and activities, the indicative construction sequencing is shown in Figure 2.2.



Figure 2.2 Indicative construction sequencing

2.2.1 Workforce

The project would require a construction workforce of approximately 125 full time workers during the peak construction period. The indicative distribution of the workforce over the construction program is shown in Figure 2.3. It is expected that the contractor would preference recruitment of the workforce locally where suitable skills and capacity are available.

The workforce would be housed in a combination of existing accommodation in Tamworth or in the accommodation camp for the project. Buses are likely to be provided for workers to be transported to site each day.

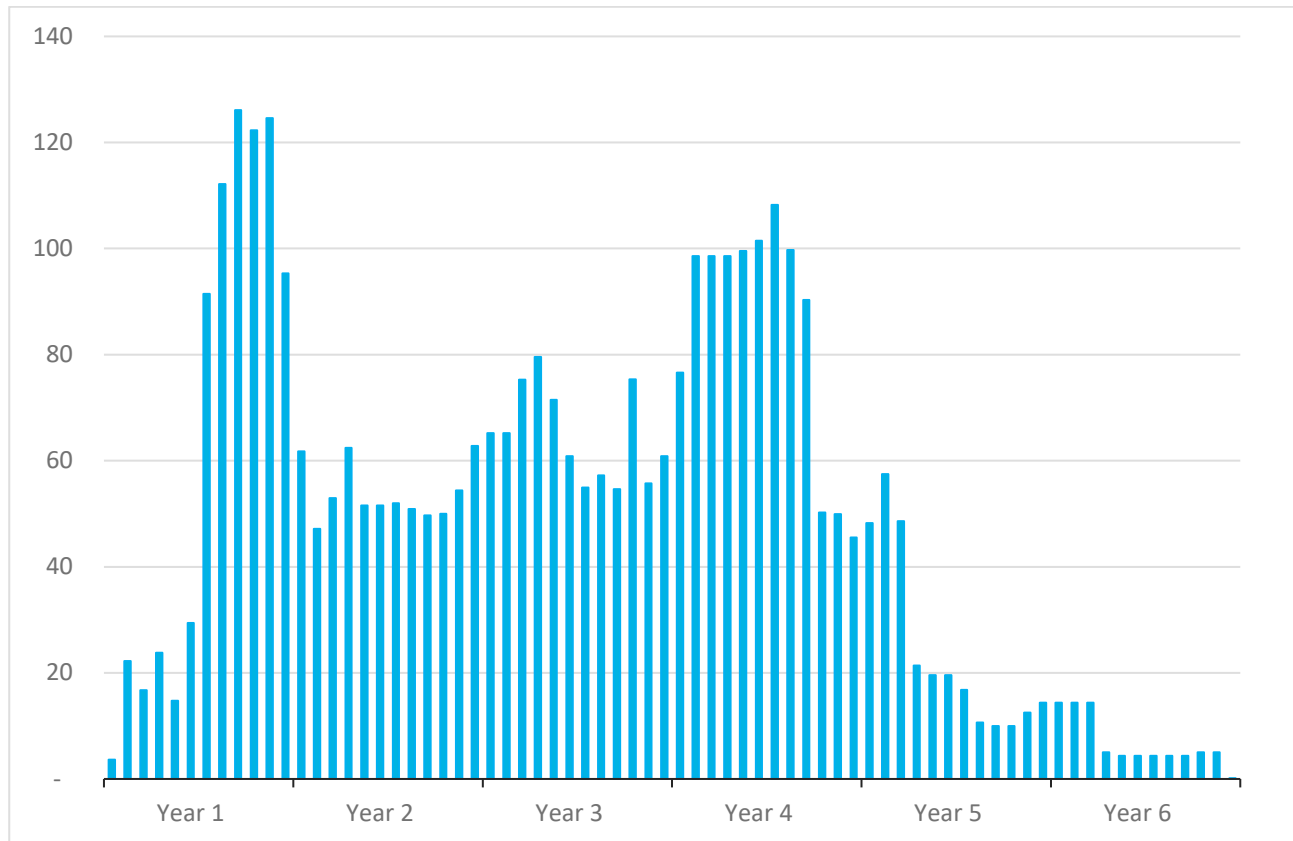


Figure 2.3 Indicative workforce histogram

2.2.2 Transport route

Transport of construction materials, equipment and personnel to the project area would use one main transport route and is shown in Figure 2.4. The primary transport route follows the New England Highway to Nemingha (about 7 km south-east of Tamworth) and turns onto the Tamworth-Nundle Road to Dungowan. Vehicles would then turn off Tamworth-Nundle Road at Dungowan onto Ogunbil Road followed by Dungowan Dam Road.

The following road sections would not be used by the project construction traffic:

- Duri Dungowan Road west of Back Woolomin Road (which connects from Nundle Road to the New England Highway south of Tamworth);
- Nundle Road south of Dungowan Creek Road (to and from the Nundle direction);
- any access to and from the East from the Niangala/Nowendoc Road direction.



- KEY
- █ Project footprint
 - █ Primary transport route
 - Major road
 - Minor road
 - Named watercourse
 - █ State forest
 - █ Named waterbody

Primary transport route

Dungowan Dam and pipeline project
Traffic impact assessment
Figure 2.4

2.2.3 Construction traffic volumes

Traffic would be generated during the project construction due to the transport of construction materials, equipment, personnel and waste on the main transport route. The project construction traffic is expected to consist predominantly of Heavy Vehicle (HV) movements. An estimate of the average daily HV movements during the project construction is provided in Figure 2.5 below. The traffic volumes provided are round trips or the number of vehicles visiting the site each day. Each round trip would comprise both a 'to' and a 'from' movement.



Figure 2.5 Average daily traffic volumes (total round trips per day)

2.2.4 Construction hours

Construction activities would be carried out during the hours outlined in Table 2.2 below.

Table 2.2 Construction work hours

Work type	Recommended standard hours of work
Normal construction	Monday to Saturday 7 am to 6 pm
	Sundays or public holidays – low noise and low traffic generating work may be carried out 9 am to 5 pm
Blasting	Monday to Saturday 9 am to 5 pm
	No work on Sundays or public holidays

It is likely that some activities needed to support construction such as spillway concreting (in summer months) would be undertaken outside these hours (OOH), and could include work 24 hours a day, seven days a week. The project construction environmental management plan (CEMP) will include measures to manage potential impacts of construction activities during non-standard work hours.

2.3 Traffic generation and distribution

2.3.1 Main works construction area

The daily and peak hourly traffic movements generated by the project on the regional and local road networks and at individual worksites are determined by the number of personnel and daily truck movements to each worksite for the supply of construction equipment and materials and waste removal.

As outlined in Section 2.2.1, the project is expected to require up to approximately 125 construction workforce during peak construction. It is expected that the contractor would preference recruitment of the workforce locally where they would be housed either in existing accommodation in Tamworth or in the proposed accommodation camp. In addition, workers would be transported to site each day by bus. Therefore, the light vehicle trips generated would be significantly less than the staff numbers. It is assumed that the peak hourly light vehicle trips would comprise approximately 10% of the workforce (ie 13 inbound movements in the AM peak hour and 13 outbound movements in the PM peak hour)

Table 2.3 presents the project daily traffic generation throughout the construction phase. The traffic volumes provided are round trips.

The approvals for any access by B-double vehicles or larger vehicles, are the responsibility of the actual vehicle owner or operator, and would be confirmed with the National Heavy Vehicle Regulator (NHVR) prior to any such access being approved. Oversize or overmass vehicle access requirement for the project would be confirmed as part of the detailed construction and operations stage traffic management plans which will be prepared for the project.

Table 2.3 shows the daily heavy vehicle trips will be at the maximum at the tenth and eleventh quarter of construction. The average daily heavy vehicles at peak construction periods (60 trips) would generate six trips or 12 in and out movements in the peak hours, assuming 10% of the daily traffic occurs in the peak hours based on typical peak hours for comparable construction projects.

As identified in Section 2.2.1, all project related construction heavy vehicles will travel via the New England Highway via Tamworth (including deliveries of sand and crushed rock), then via Nundle Road, Ogunbil Road and Dungowan Dam Road. The project related traffic volumes are provided in Section 2.2.3 of this report.

As construction is proposed to be completed in approximately six years, background traffic growth will not be significant during this period, and the project traffic volumes can be obtained by combining the surveyed traffic volumes with the additional forecast construction traffic volumes, as presented in Table 2.3.

Table 2.3 Daily traffic generation

Quarterly periods	Mob/Demob	General Delivery (Supplies/Fuel)	Zone 2A Truck & Dog	Zone 2B/FCR Truck & Dog	Zone 2C Truck & Dog	Concrete 5m3 Agg	Total heavy vehicle trips
Q1	0.53	2					2.5
Q2	0.07	2					2.1
Q3	0.07	2					2.1
Q4	0.40	5				5	10.4
Q5	0.67	5				5	10.7
Q6	0.67	5				5	10.7
Q7	0.67	15				20	35.7

Table 2.3 **Daily traffic generation**

Quarterly periods	Mob/Demob	General Delivery (Supplies/Fuel)	Zone 2A Truck & Dog	Zone 2B/FCR Truck & Dog	Zone 2C Truck & Dog	Concrete 5m3 Agg	Total heavy vehicle trips
Q8	0.67	15	2		4	20	41.7
Q9	0.93	15	5		4	25	49.9
Q10	1.00	20	5	4	5	25	60.0
Q11	1.00	20	5	4	5	25	60.0
Q12	1.00	20	5	4	4	25	59.0
Q13	1.00	20	5	4	4	25	59.0
Q14	0.93	15	5	4		25	49.9
Q15	0.93	15	5	4		25	49.9
Q16	0.67	15	5	4		20	44.7
Q17	0.27	10		3		20	33.3
Q18	0.27	5				20	25.3
Q19	0.07	5				5	10.1
Q20	0.07	5				5	10.1
Q21	0.07	2					2.1
Q22	0.07	2					2.1
Q23	0.00	2					2.0
Q24	0.00	2					2.0
Q25	0.00						0.0

2.3.2 Pipeline construction

A nine month construction period is anticipated for the pipeline construction work. It is expected that the pipeline construction staff would primarily reside within Tamworth or the surrounding locality and would travel to and from construction sites daily, from central locations near key accommodation points. It is not anticipated that any accommodation will be built specifically for any members of the workforce who are not from the local area.

Based on similar scale construction projects and subject to confirmation by the construction contractor, it is anticipated that construction would require the following daily traffic movements:

- approximately 10 light vehicles (20 movements) per day for construction workers; and
- approximately five heavy vehicles (10 movements) per day for earthmoving, refuelling and pipe deliveries from ancillary facilities along the pipeline route.

In addition to the above, smaller daily numbers of other heavy vehicle movements would also be required over the duration of the construction period such as:

- low-loaders for delivery and removal of heavy plant;

- articulated trucks for the delivery of pipe sections to the pipeline route;
- ready mix concrete trucks;
- truck'n'dog trailers for the import of material including bedding sand etc to site; and
- truck'n'dog trailers for the disposal of excavated material unable to be reused.

These numbers would be confirmed by the construction contractor through detailed design and construction planning but are estimated to represent one or two additional truck deliveries per day (three truck movements per day) on average over the nine month construction program.

The likely traffic distribution for this traffic between the New England Highway and pipeline related worksites would generally follow the pipeline route as follows:

- 50% via Nundle Road, to Duri-Dungowan Road and then Back Woolomin Road; and
- 50% via Nundle Road, via Dungowan and then via Dungowan Creek Road to Ogunbil Road and then Dungowan Dam Road.

During the peak hours, it is estimated that the pipeline construction traffic will generate approximately 10 light vehicle movements and one heavy vehicle return trip (one inbound and one outbound movement) distributed equally between the above routes after travelling via Nundle Road, from the New England Highway to the Duri-Dungowan Road intersection on Nundle Road.

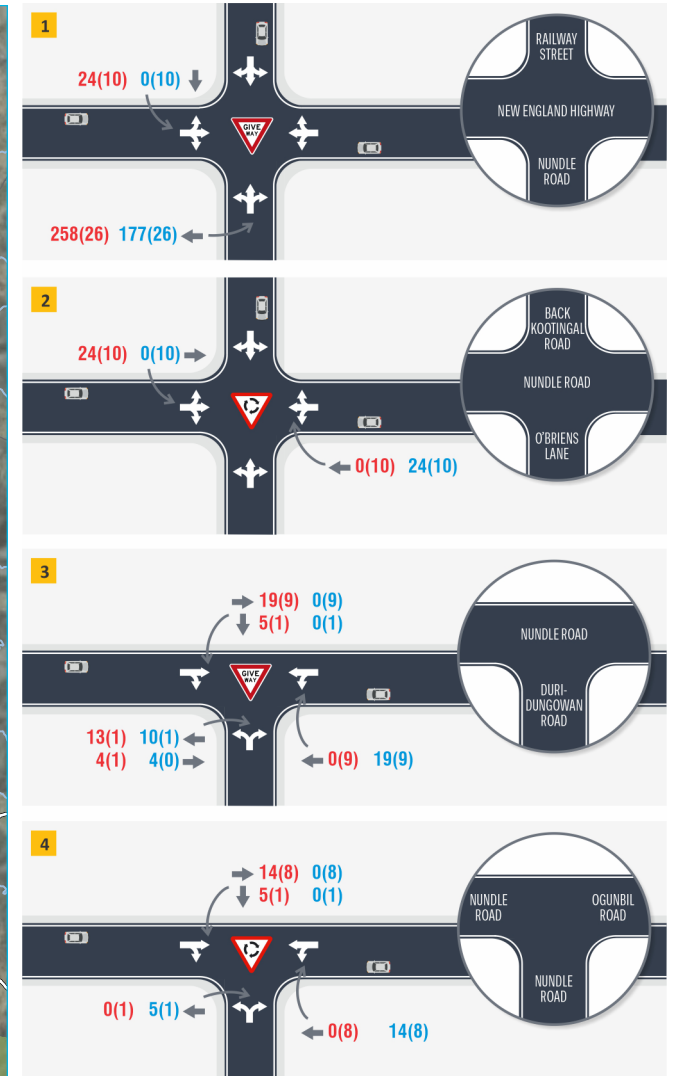
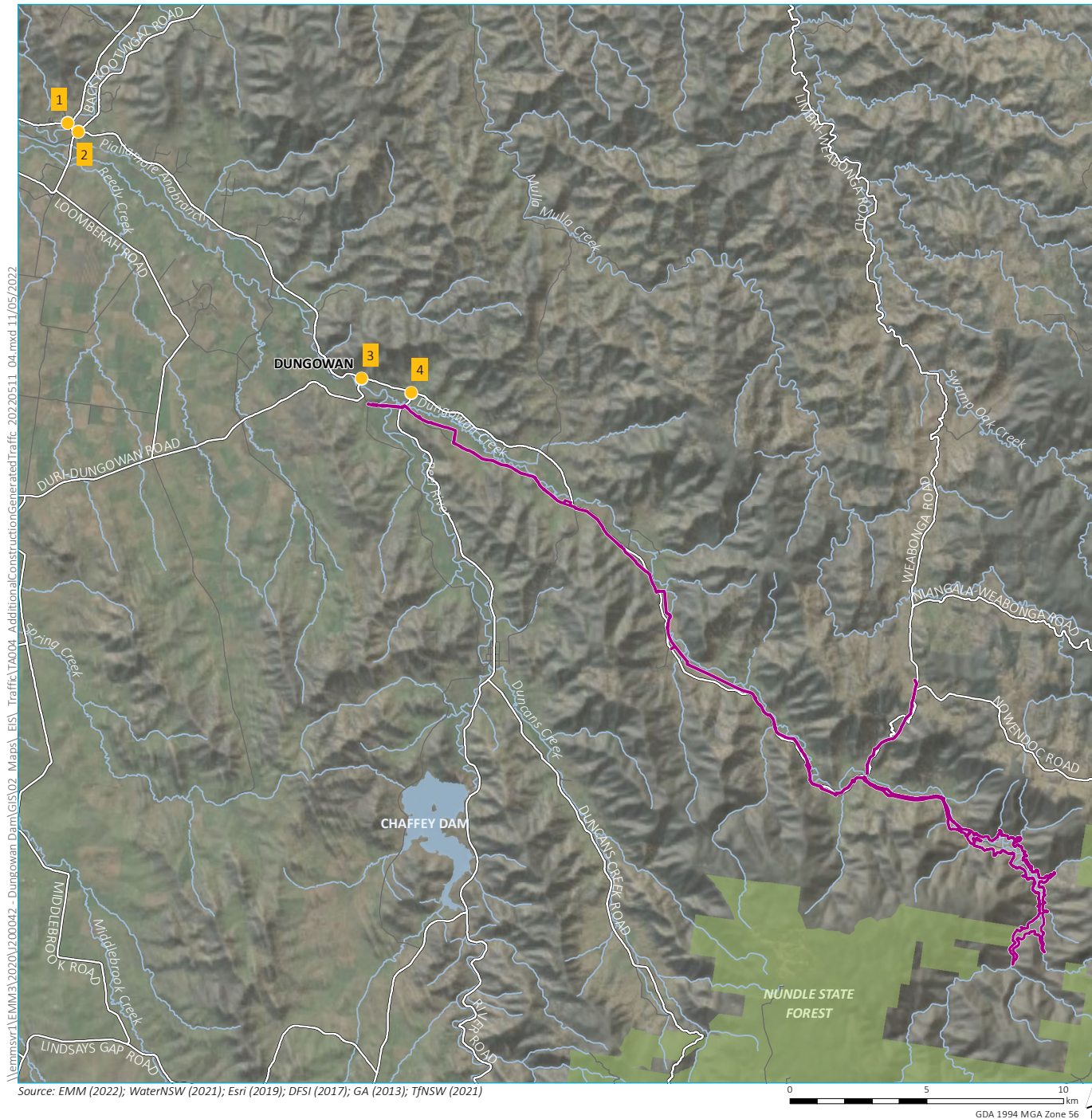
An overview of the additional construction generated traffic volumes at key intersections is shown in Figure 2.6, with the total development traffic volumes shown in Figure 2.7.

2.3.3 Operation

The project operational traffic movements would be much lower than the proposed construction traffic movements. Based upon the proposed operational workforce (identified in Table 2.1) and operational requirements, the operational traffic volumes would be minimal and are expected to have only negligible traffic impacts. In addition, the volumes and types of vehicles used during operation would be the same as that currently used for the operation of the existing dam and pipeline.

Therefore, detailed consideration of the project operational traffic movements (including volumes and types) and their related traffic impacts are not considered required for further assessment.

\\lemssvr1\EMM3\2020\U2000042 - Dungowan Dam\GIS\02 Maps\ EIS\ Traffic\TA004 AdditionalConstructionGeneratedTraffic_20220511_04.mxd 11/05/2022

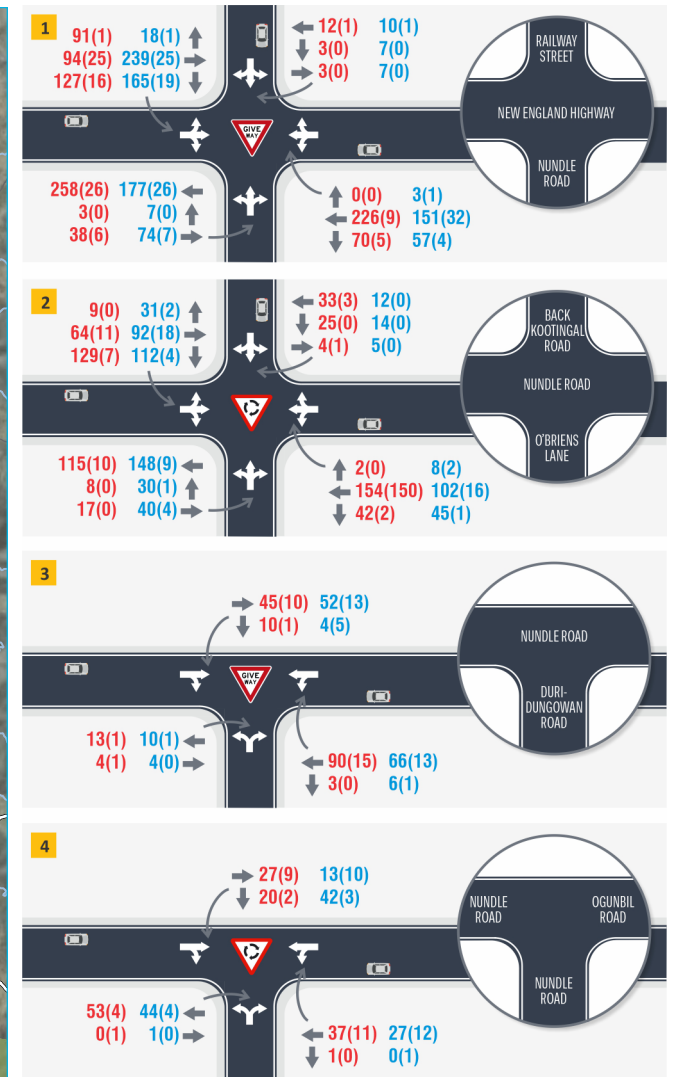
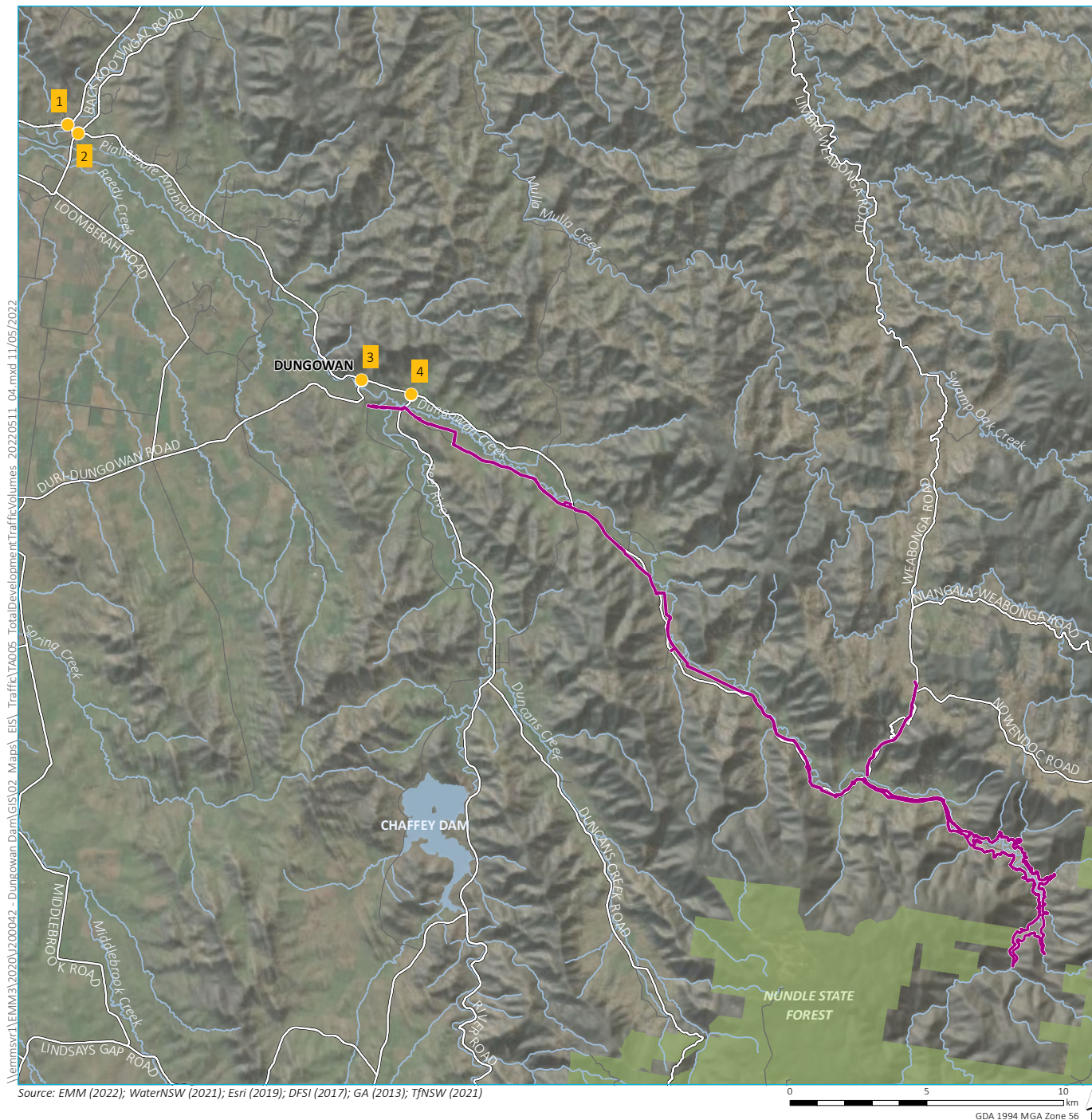


KEY

- █ Project footprint
- Key intersection
- Existing environment
- Major road
- Minor road
- Named watercourse
- █ State forest
- █ Named waterbody

Additional construction generated traffic volumes

Dungowan Dam and pipeline project
Traffic impact assessment
Figure 2.6



KEY

- Project footprint
- Key intersection
- Existing environment
- Major road
- Minor road
- Named watercourse
- State forest
- Named waterbody

Total development traffic volumes

Dungowan Dam and pipeline project
Traffic impact assessment
Figure 2.7

2.4 Access roads

New access roads and access road upgrades are required to allow construction and operational access to the project. The following sections provide a description of the proposed new and upgraded access road works.

2.4.1 Dungowan Dam Road

Dungowan Dam Road would be the main access and haul road for the construction and operation of the new Dungowan Dam. Upgrading and widening of Dungowan Dam Road from Ogunbil Road to the proposed new dam access road would be required to ensure the safe use by construction vehicles and local residents. The road upgrade would involve widening to 8 m where practical along about 3.5 km of the 5 km length of road. In the sections where the road cannot be widened, sight distance would be improved and pull over areas would be established. The entire length of the road may also be re-surfaced to mitigate dust and damage to the road.

2.4.2 Dam crest access road

A new road would be constructed to provide permanent access to the new dam crest. The new road would provide private access only and would cross Dungowan Creek downstream of the dam site to allow access from the right (northern) abutment of the dam. The permanent access would require a bridge over the creek and a two-way, two lane, sealed road to the dam crest suitable for heavy vehicles. Access to the left abutment of the dam and spillway would be via the dam crest and intermediate berms (benches) on the downstream face of the dam.

2.4.3 Temporary access to existing Dungowan Dam

There may also be some road realignment or upgrade required to Dungowan Dam Road between the new dam wall and the existing Dungowan Dam. These upgrades would only be required to provide access during the project construction including access to the quarry and borrow areas and to provide access for vehicles and equipment required for operation and maintenance of the existing Dungowan Dam during construction of the new Dungowan Dam, as well as decommissioning of the existing Dungowan Dam. To minimise the project footprint, any road realignment or widening outside the existing roadway would be entirely within the inundation area for the proposed dam or within areas already disturbed such as the quarry area. The road would no longer be needed following decommissioning of the existing dam and would be inundated during operation.

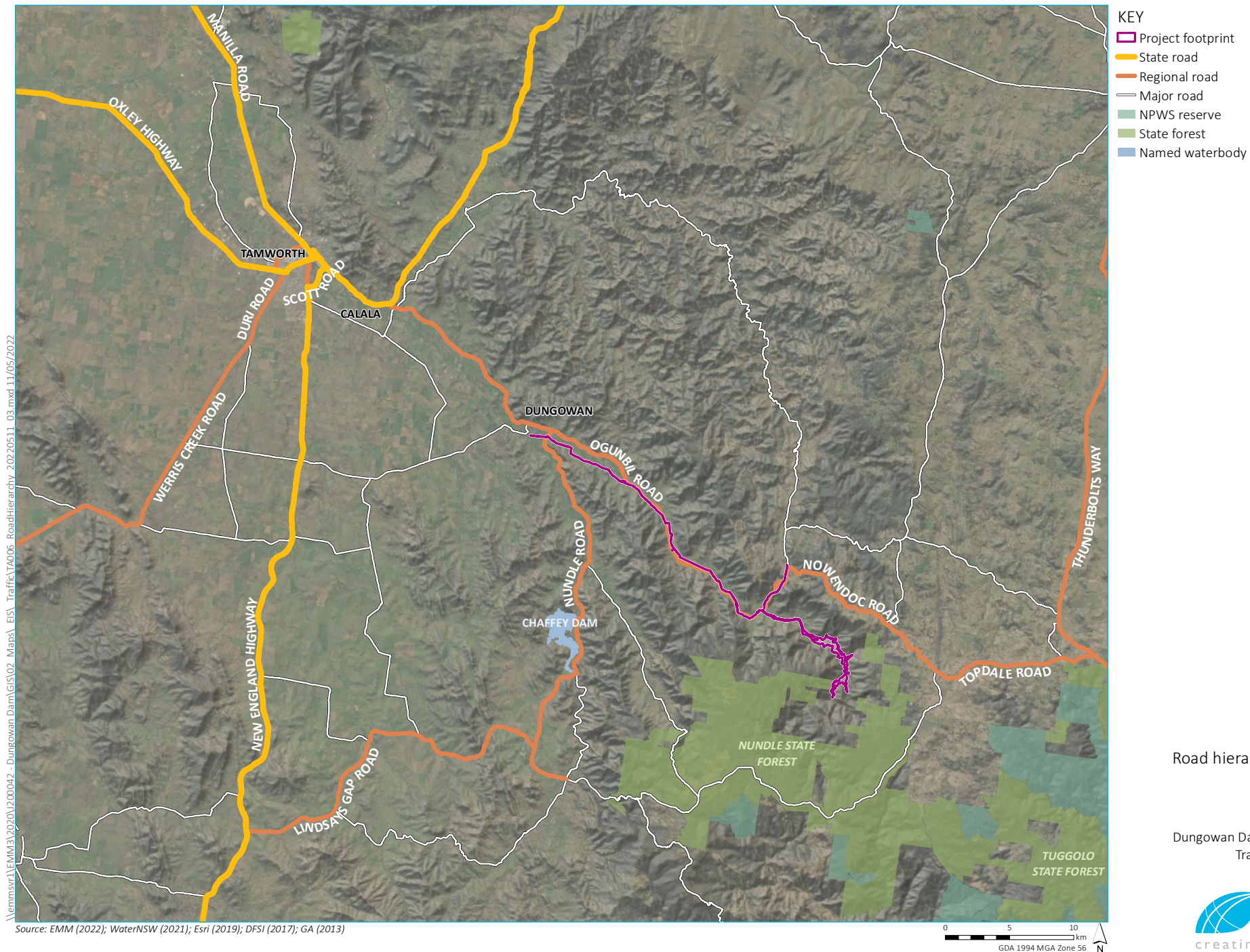
3 Existing transportation facilities

3.1 Road hierarchy

The NSW administrative road hierarchy comprises the following road classifications, which align with the generic road hierarchy (Figure 3.1):

- where a road is classified as an Auslink-National Highway, the responsible road management agency is usually either the State or the Commonwealth Government;
- where a road is classified as a Regional Road, the responsible road management agency is usually either the NSW Government or the local Council; and
- where a road is classified as a local road, the responsible road management agency is usually the local Council.

Typical details of the key roads that that would be used by the project construction traffic are provided in Table 3.1–Table 3.7.



Road hierarchy showing state and regional roads

Dungowan Dam and pipeline project
Traffic impact assessment
Figure 3.1

Table 3.1 **New England Highway**

Aspect	Description
Road classification and connectivity	National Highway
Alignment	Northwest/Southeast towards Tamworth CBD; Southwest/northeast towards Kootingal
Number of lanes	At least two lanes (one lane each way), more lanes in urban areas and at intersections
Carriageway type	Sealed road
Carriageway width	Approximately 7 m with 3.5 m travel lanes
Posted speed limit	60 km/h near Nundle Road
Heavy vehicle access	26 m B-double approved
Traffic function	Provides arterial connection between townships



Source: Google StreetView

Photograph 3.1 **New England Highway looking west from Nundle Road**

Table 3.2 **Nundle Road**

Aspect	Description
Road classification and connectivity	Regional road
Alignment	Northwest/Southeast
Number of lanes	Two lanes (one lane each way)
Carriageway type	Sealed road
Carriageway width	Approximately 7 m with 3.5 m travel lanes
Posted speed limit	Varies. 60 km/h near New England Highway, O'Briens Lane, and Ogunbil Road; 80 km/h near Duri-Dungowan Road; 100 km/h elsewhere
Heavy vehicle access	26 m B-double approved
Traffic function	Provides regional and local access

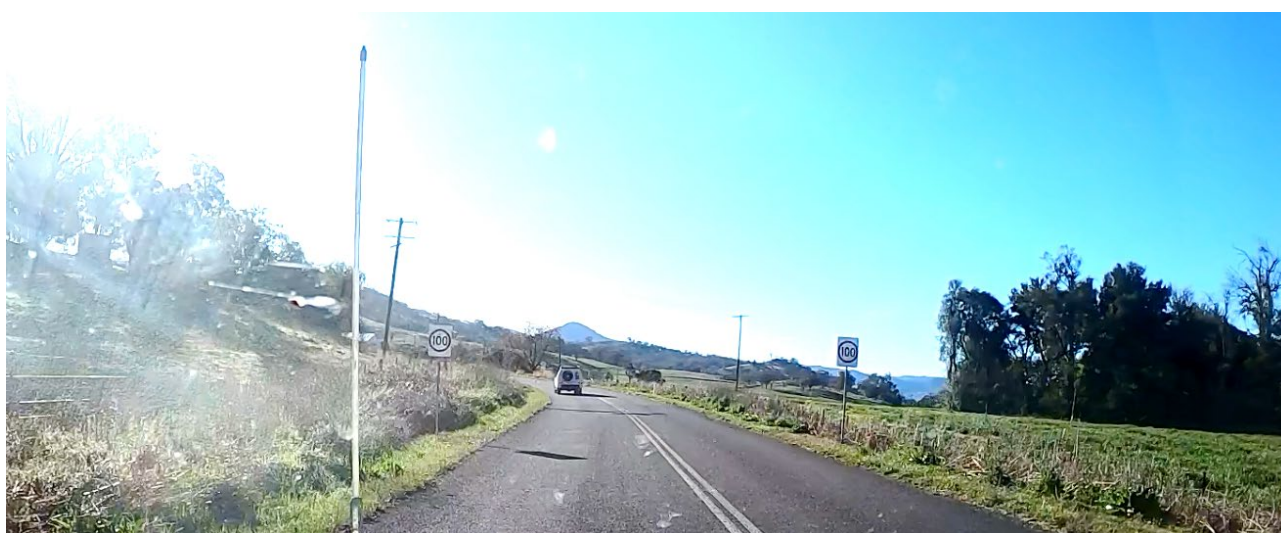


Source: Google StreetView

Photograph 3.2 **Nundle Road looking east from New England Highway**

Table 3.3 **Ogunbil Road**

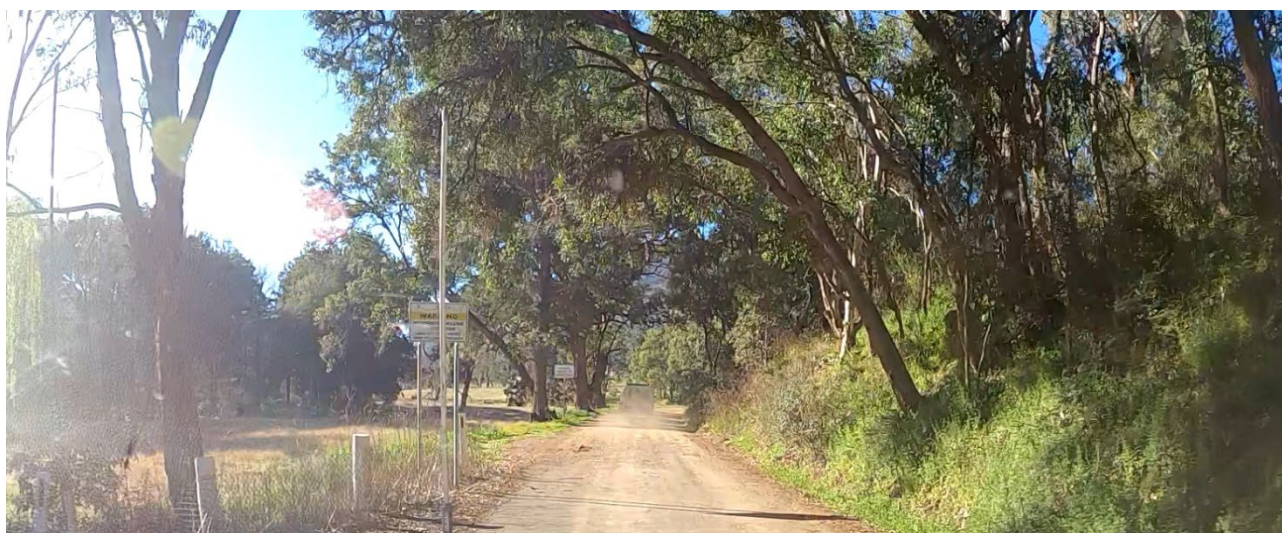
Aspect	Description
Road classification and connectivity	Regional road
Alignment	West/east
Number of lanes	Two lanes (one lane each way)
Carriageway type	Sealed road
Carriageway width	Approximately 7 m with 3.5 m travel lanes
Posted speed limit	Varies. 60 km/h west of Dungowan Public School and 100 km/h east of the School
Heavy vehicle access	19 m long vehicles only, access not approved for B-Doubles
Traffic function	Provides regional and local access



Photograph 3.3 **Ogunbil Road looking east from Dungowan Public School**

Table 3.4 **Dungowan Dam Road**

Aspect	Description
Road classification and connectivity	Local road
Alignment	East/west
Number of lanes	Two lanes (one lane each way)
Carriageway type	Unsealed road
Carriageway width	Approximately 6 m with 3 m travel lanes
Posted speed limit	100 km/h
Heavy vehicle access	19 m long vehicles only, access not approved for B-Double
Traffic function	Provides local access



Photograph 3.4 **Dungowan Dam Road looking east from Nowendoc Road**

Table 3.5 **Duri-Dungowan Road**

Aspect	Description
Road classification and connectivity	Local road
Alignment	Generally east/west
Number of lanes	Two lanes (one lane each way)
Carriageway type	Sealed road
Carriageway width	Approximately 7 m with 3.5 m travel lanes
Posted speed limit	100 km/h
Heavy vehicle access	19 m long vehicles only, access not approved for B-Double
Traffic function	Provides local access



Source: Google streetview

Photograph 3.5 **Duri-Dungowan Road looking south from Nundle Road**

Table 3.6 **Back Woolomin Road**

Aspect	Description
Road classification and connectivity	Local road
Alignment	Northwest/southeast
Number of lanes	Two lanes (one lane each way)
Carriageway type	Unsealed road
Carriageway width	Approximately 6 m with 3 m travel lanes
Posted speed limit	100 km/h
Heavy vehicle access	19 m long vehicles only, access not approved for B-Double
Traffic function	Provides local access



Source: Google streetview

Photograph 3.6 **Back Woolomin Road looking southeast from Duri-Dungowan Road**

Table 3.7 **Dungowan Creek Road**

Aspect	Description
Road classification and connectivity	Local road
Alignment	Northwest/southwest
Number of lanes	Two lanes (one lane each way)
Carriageway type	Sealed road
Carriageway width	Approximately 6 m with 3 m travel lanes
Posted speed limit	100 km/h
Heavy vehicle access	19 m long vehicles only, access not approved for B-Double
Traffic function	Provides local access



Source: Google streetview

Photograph 3.7 **Dungowan Creek Road looking southeast from Nundle Road**

3.2 Key intersection surveys

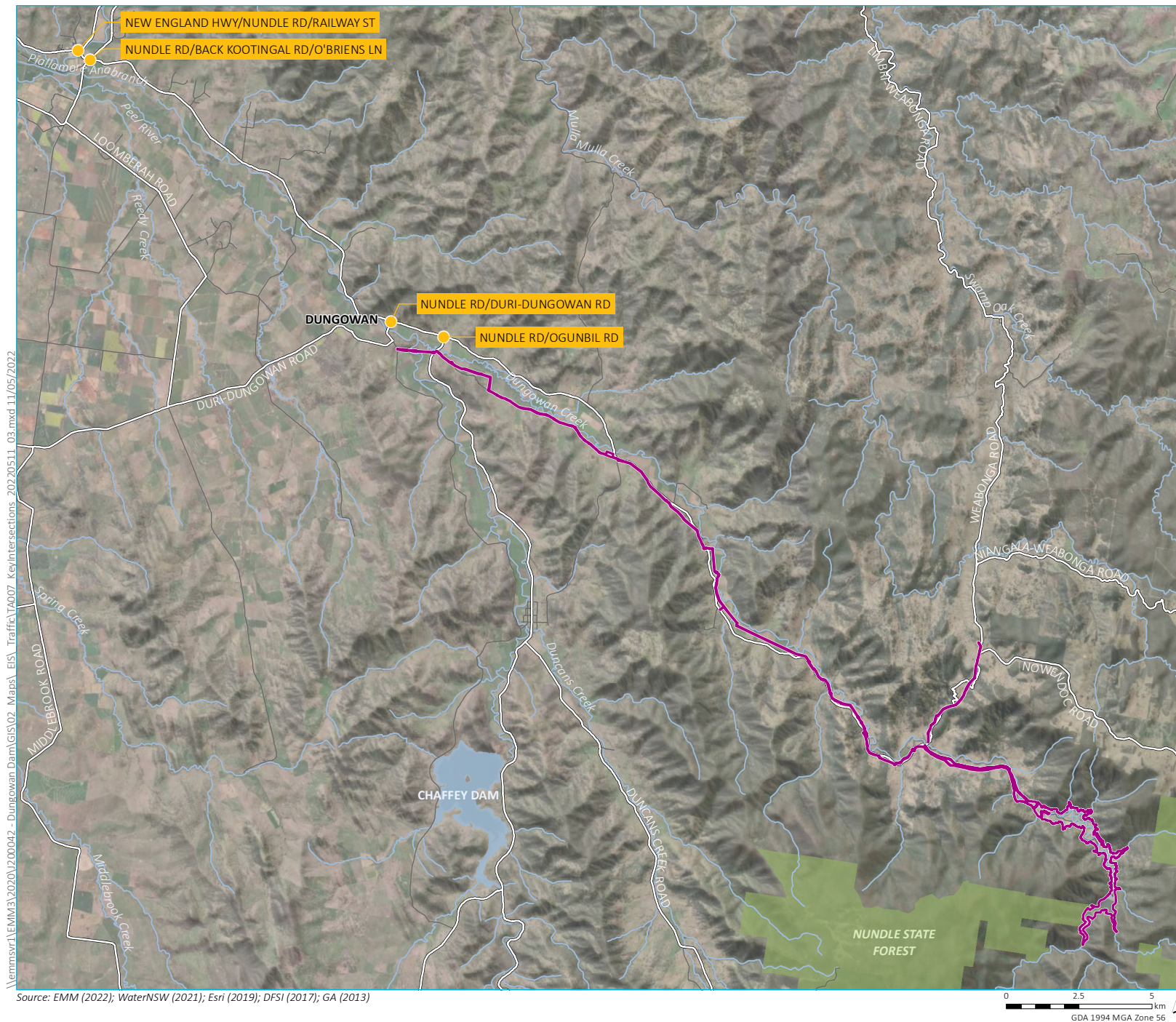
The following four intersections (Figure 3.2) were identified as the key intersections for the project construction access and traffic impacts assessment:

- New England Highway/Nundle Road/Railway Street;
- Nundle Road/Back Kootingal Road/O'Briens Lane;
- Nundle Road/Duri-Dungowan Road; and
- Nundle Road/Ogunbil Road.

An intersection survey has been undertaken for the four subject intersections on 17 June 2020 from 6 am to 9 am and from 3 pm to 6 pm. The respective network peak hours were as follows:

- 7.45 am to 8.45 am; and
- 3.15 pm to 4.15 pm.

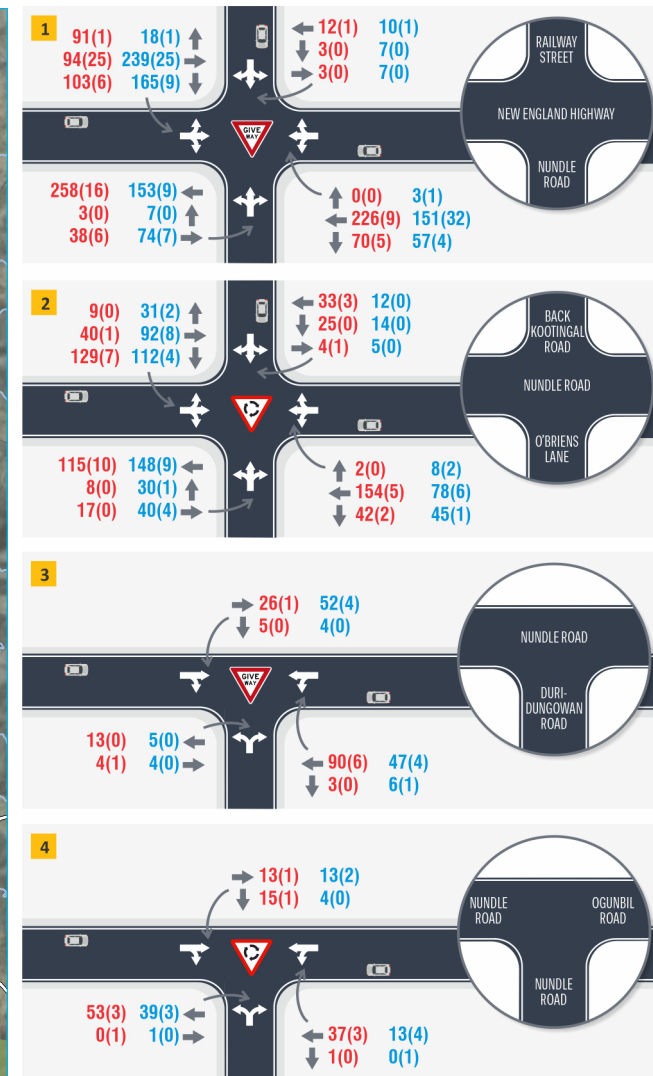
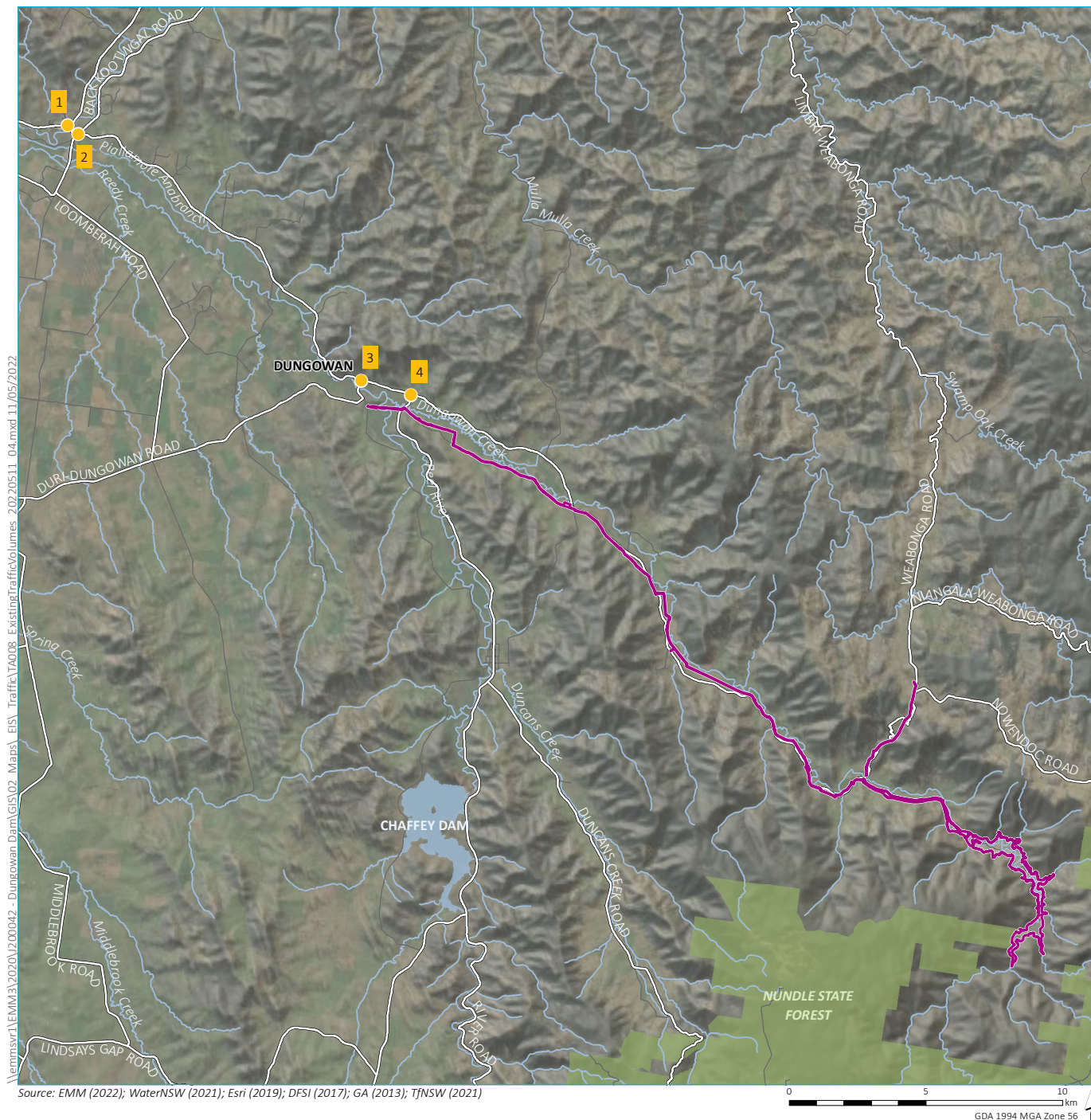
Figure 3.3 presents the peak hour traffic volumes at these intersections.



- KEY
- Project footprint
 - Key intersection
 - Major road
 - Minor road
 - Named watercourse
 - State forest
 - Named waterbody

Key intersections

Dungowan Dam and pipeline project
Traffic impact assessment
Figure 3.2



KEY

- Project footprint
- Key intersection
- Existing environment
 - Major road
 - Minor road
 - Named watercourse
 - State forest
 - Named waterbody

Existing traffic volumes

Dungowan Dam and pipeline project
Traffic impact assessment
Figure 3.3

3.3 TfNSW crash data analysis

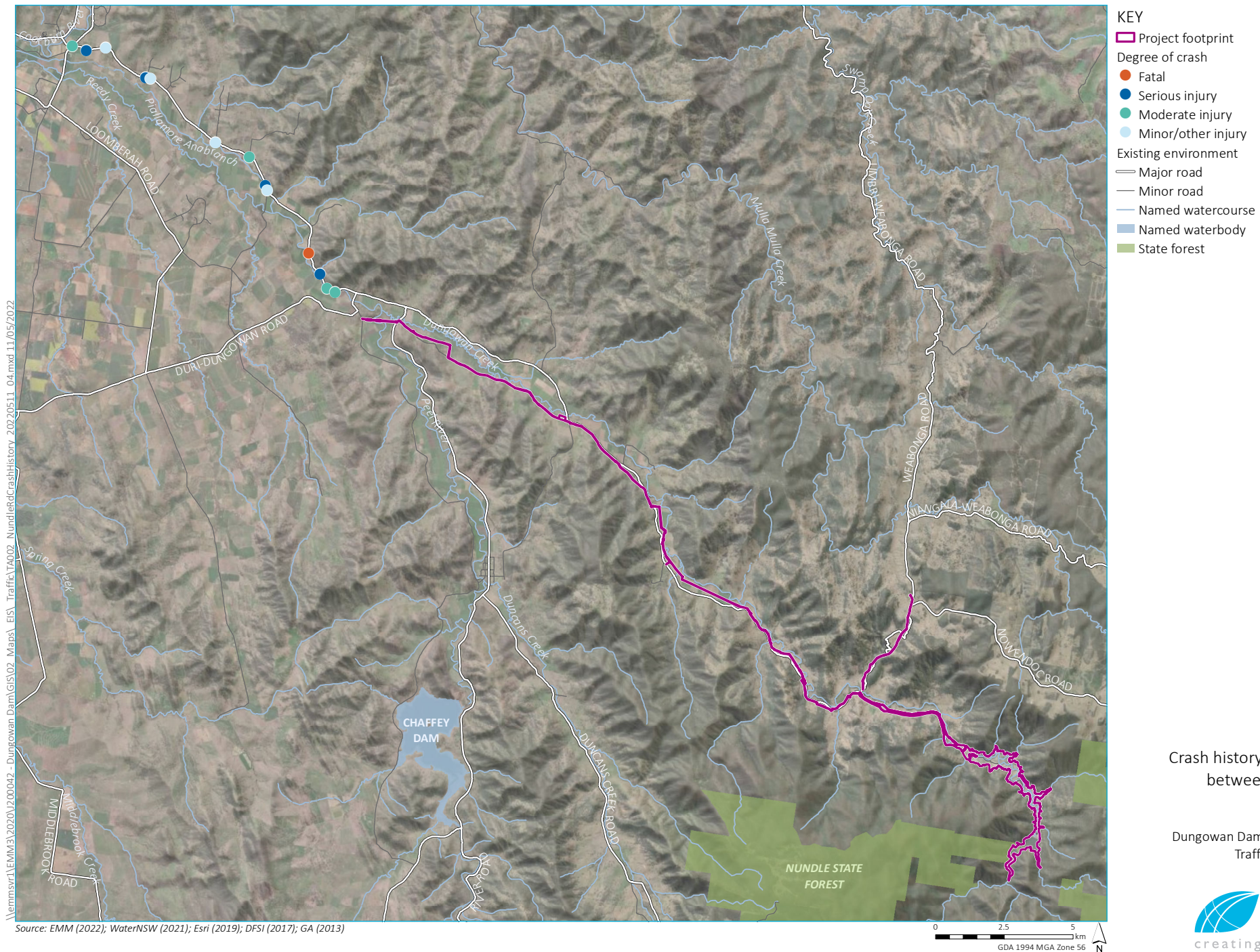
Crash data from TfNSW Centre for Road Safety interactive history database between 2014 and 2018 has been studied along the proposed haulage route and is presented in Figure 3.4 and Figure 3.5 The crashes are categorised based on the severity of the crashes as follows:

- fatal;
- serious injury;
- moderate injury;
- minor/other injury; or
- non-casualty (eg towaway).

Table 3.8 presents the details of the crashes. It is noted that almost half of all crashes were caused by speeding and approximately 30% involved a truck.

Table 3.8 Summary of crash history

Road	Report year	Degree of crash		Speed	Fatigue	Involving a truck
Nundle Road	2014	Non-casualty (towaway)	1	1	0	1
		Moderate injury	1	1	0	0
		Serious injury	1	0	0	0
	2015	Moderate injury	1	1	0	0
		Serious injury	1	0	1	1
		Fatal	1	1	0	1
	2016	Moderate injury	2	1	0	1
		Serious injury	2	0	0	1
	2017	Moderate injury	1	0	0	0
	2018	Non-casualty (towaway)	1	0	0	0
		Minor/other injury	1	1	0	1
		Moderate injury	1	0	0	0
Ogunbi I Road	2014	Non-casualty (towaway)	1	0	0	1
		Serious injury	2	1	0	0
	2015	Moderate injury	1	1	0	0
	2016	Non-casualty (towaway)	1	1	0	0
	2017	Moderate injury	1	1	0	0
	2018	Fatal	1	0	0	0
Total			21	10	1	7





- KEY**
- █ Project footprint
 - ▬ Major road
 - ▬ Minor road
 - ▬ Named watercourse
 - █ State forest
 - ▬ Named waterbody
- Degree of crash**
- Fatal
 - Serious injury
 - Moderate injury
 - Minor/other injury

Crash history on Ogunbil Road
between 2014 and 2018

Dungowan Dam and pipeline project
Traffic impact assessment
Figure 3.5

3.4 Road safety review

A safety inspection of the primary transport route between Nundle Road at New England Highway and the new Dungowan Dam (ie Nundle Road, Ogunbil Road, and Dungowan Dam Road) has been undertaken. The existing road safety conditions are generally good along most sections of this route with good sight distances at all the major intersections. However, a number of potential traffic road safety concerns have been identified at multiple locations along the route, namely:

- potential traffic safety conflicts with school bus operations;
- limited road shoulder width or opportunities for emergency stopping clear of the traffic lanes;
- culvert headwalls and other structures within 2 m of the traffic lanes;
- rock cuttings affecting visibility (stopping sight distance) for approaching traffic at bends;
- no pavement widening at some intersections;
- high grass affecting visibility along the road verges;
- limited visibility of the traffic islands at roundabouts;
- gravel spreading onto the sealed road at the intersections with unsealed minor roads;
- narrow pavement in poor condition on Ogunbil Road;
- large trees close to the road on Ogunbil Road;
- unprotected drop-offs at the road edges;
- deficient safety barriers at some bridges;
- confusing intersection priority at Nowendoc Road; and
- narrow unsealed road conditions along most of Dungowan Dam Road.

An additional road safety audit (RSA) has been undertaken (SMEC 2020) for the key haulage route and is provided in Annexure B. The issues identified in the RSA have been addressed in the project's traffic safeguards and mitigation measures as outlined in Section 4.7.

For the pipeline construction work, some additional local roads will also be used for construction vehicle access, namely Duri-Dungowan Road, Back Woolomin Road and Dungowan Creek Road. The assessment of the project construction traffic impacts along the pipeline route has been discussed and assessed separately to the new Dungowan Dam construction works and is described and summarised in Section 4.6 of this report.

3.5 Public transport facilities

There are public bus services connecting the Tamworth CBD and surrounding suburbs. However, these do not extend to the proposed construction areas or the pipeline route, which will be used by construction traffic for the project (Nundle Road, Ogunbil Road and Dungowan Dam Road for the new Dungowan Dam and Duri-Dungowan Road, Back Woolomin Road and Dungowan Creek Road for the pipeline route).

Nemingha Public School, located on Nundle Road in the vicinity of the Nundle Road/O'Briens Lane/Back Kootingal Road intersection, is serviced by school buses during the drop off/pick up hours. There are two morning services to the School and three services in the afternoon departing from the School.

There are also other secondary school bus services operating via the proposed construction access key transport routes (Nundle Road, Ogunbil Road and Dungowan Dam Road) of the project. During preparation of the Construction Traffic Management Plan (CTMP), consultation will be undertaken with the locality school bus operators, to ensure that proposed project construction traffic will be appropriately managed when travelling during school bus operating times.

3.6 Bicycle network

The construction access routes near the new Dungowan Dam including Nundle Road and Ogunbil Road provides only limited bicycle access infrastructure, which reflects the general rural nature of the locality.

3.7 Pedestrian facilities

The construction access route near the new Dungowan Dam including Nundle Road and Ogunbil Road provides limited pedestrian infrastructure, which reflects the general rural nature of the locality.

4 Traffic impact assessment

4.1 Intersection performance

The key intersections have been modelled with the SIDRA Intersection 9.0 software; a micro-analytical tool for individual intersections and linked intersection-network modelling. The modelling is based on the traffic survey data detailed in Section 3.2 and provided in Annexure C and the traffic generated by the project as identified in Section 2.3.

SIDRA provides the following performance indicators:

- Degree of saturation (DOS) – the total usage of the intersection expressed as a factor of 1 with 1 representing 100% use/saturation (eg 0.8 = 80% saturation);
- Average delay (DEL) – the average delay in seconds encountered by all vehicles passing through the intersection. It is often important to review the average delay of each approach as a side road could have a long delay time, while the large free flowing major traffic will provide an overall low average delay;
- Level of service (LOS) – this is a categorisation of average delay, intended for simple reference; and
- 95% queue lengths (Q95) – is defined to be the queue length in metres that has only a 5% probability of being exceeded during the analysed time period. It transforms the average delay into measurable distance units.

The LOS is a good indicator of overall performance for individual intersections, with each level summarised in Table 4.1.

Table 4.1 Intersection LOS standards

Level of service	Average delay (seconds per vehicle)	Traffic signals, roundabout	Priority intersection ('Stop' and 'Give Way')
A	<14	Good operation	Good operations
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At traffic signals, incidents will cause extensive delays. Roundabouts require other control mode.	At capacity; required other control mode
F	>71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; required other control mode

Source: RTA Guide to Traffic Generating Development (RTA 2002).

The SIDRA results for the key intersections are presented in Table 4.2 to Table 4.5. The details of the SIDRA results are attached in Annexure D.

Table 4.2 SIDRA modelling result for New England Highway/Nundle Road/Railway Street

Control/Scenarios		AM Peak				PM Peak				
Priority controlled (giveaway)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)
1. Existing (survey)	889	24.5	B	0.287	9.0 (south)	980	29.6	C	0.474	15.1 (south)
2. Future (with development traffic)	926	27.0	B	0.298	9.6 (south)	1018	31.8	C	0.484	15.4 (south)

The key findings for the New England Highway/Nundle Road/Railway Street intersection are:

- the intersection currently operates LOS B and LOS C in the AM and PM peak hours respectively without traffic generated by the project;
- with traffic generated by the project, the intersection will continue to operate at the same LOS;
- the intersection currently has, and will continue to have, over 50% spare capacity; and
- the longest delay (31.8 seconds) will occur in Nundle Road during the peak hours.

Table 4.3 SIDRA modelling result for Nundle Road/Back Kootingal Road/O'Briens Lane

Control/Scenarios		AM Peak				PM Peak				
Roundabout	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)
1. Existing (survey)	607	10.4	A	0.196	7.6 (east)	652	10.4	A	0.207	8.7 (west)
2. Future (with development traffic)	644	10.4	A	0.207	8.3 (east)	690	10.4	A	0.216	9.4 (west)

The key findings for the Nundle Road/Back Kootingal Road/O'Briens Lane intersection are:

- the intersection currently operates LOS A on all approaches without traffic generated by the project;
- with traffic generated by the project, the intersection will continue to operate at LOS A;
- the intersection currently has, and will continue to have, approximately 78% spare capacity; and
- the longest delay (10.4 seconds) will occur in Nundle Road during the peak hours.

Table 4.4 SIDRA modelling result for Nundle Road/Duri-Dungowan Road

Control/Scenarios		AM Peak				PM Peak				
Priority controlled (giveaway)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)
1. Existing (survey)	149	7.6	A	0.056	0.4 (south)	127	7.2	A	0.034	0.2 (south)

Table 4.4 SIDRA modelling result for Nundle Road/Duri-Dungowan Road

Control/Scenarios	AM Peak					PM Peak				
2. Future (with development traffic)	186	7.7	A	0.061	0.6 (west)	164	7.4	A	0.048	0.3 (west)

The key findings for the Nundle Road/Duri-Dungowan Road intersection are:

- the intersection currently operates LOS A on all approaches without traffic generated by the project;
- with traffic generated by the project, the intersection will continue to operate at LOS A;
- the intersection currently has, and will continue to have, over 90% spare capacity; and
- the longest delay (7.7 seconds) will occur in Duri-Dungowan Road during the peak hours.

Table 4.5 SIDRA modelling result for Nundle Road/Ogunbil Road

Control/Scenarios	AM Peak					PM Peak				
Roundabout	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)
1. Existing (survey)	128	9.6	A	0.049	1.7 (south)	120	8.0	A	0.039	1.4 (west)
2. Future (with development traffic)	158	9.6	A	0.051	1.8 (south)	150	8.1	A	0.045	1.7 (west)

The key findings for the Nundle Road/Ogunbil Road intersection are:

- the intersection currently operates LOS A on all approaches without traffic generated by the project;
- with traffic generated by the project, the intersection will continue to operate at LOS A;
- the intersection currently has, and will continue to have, over 95% spare capacity; and
- the longest delay (9.6 seconds) will occur in Nundle Road during the peak hours.

Overall, there will be negligible change upon the key intersections potentially impacted by the project.

4.2 Mid-block capacity

Table 4.5 of *Guide to Traffic Generating Developments* (RTA 2002) provides the two-way hourly traffic capacities (ie number of vehicles per hour) for two-lane roads for different Levels of Service with a design speed of 100 km/h based on different terrain types. The capacities assume 60% of traffic is travelling in one direction and 40% is travelling in the other direction. For an 80 km/h design speed, the capacities are between 85–95% of the capacity for a 100 km/h design speed.

The existing posted speed limit along Nundle Road and Obungil Road is generally 80 km/h, except near Duri-Dungowan Road where Nundle Road has a posted speed limit of 60 km/h.

The capacities for each LOS transition (ie the combined number of vehicles travelling in both directions at the location where the LOS decreases) for 60 km/hr and 80 km/hr speed limit roads are provided in Table 4.6. The capacities are 80% and 95% respectively of the capacity for a 100 km/h design speed road.

Table 4.6 RTA roadway hourly capacity for a two-lane two-way rural road (level terrain)

Speed limit	Level of service transition	Effect of percentage of heavy vehicles (in traffic flow)			
		0%	5%	10%	15%
60	A/B*	252	236	224	212
	B/C	504	472	448	424
	C/D	824	776	736	696
	D/E	1304	1240	1184	1128
	E/F	2104	2000	1912	1832
80	A/B*	299	280	266	252
	B/C	599	561	532	504
	C/D	979	922	874	827
	D/E	1549	1473	106	1340
	E/F	2499	2375	2271	2176

Notes: *Assumed to be 50% of upper limit of B/C LOS.

The existing and proposed project hourly traffic and their mid-block capacity and LOS operation for roads along the haulage route has been calculated using the survey data and forecast project construction traffic volumes in Section 2.3 and Section 3.2 and results are presented in Table 4.7.

Table 4.7 Mid-block capacity LOS

Location	Traffic Situation	Traffic volumes	Heavy vehicle percentage	LOS
Nundle Road at New England Highway (60 km/h)	Existing	508 (AM)/492 (PM)	6.5% (AM)/5.9% (PM)	C
	Proposed	545 (AM)/530 (PM)	8.6% (AM)/8.1% (PM)	C
Nundle Road at O'Briens Lane (60 km/h)	Existing	506 (AM)/502 (PM)	5.1% (AM)/5.8% (PM)	C
	Proposed	543 (AM)/540 (PM)	7.4% (AM)/8.0% (PM)	C
Nundle Road at Duri-Dungowan Road (80 km/h)	Existing	141 (AM)/116 (PM)	5.0% (AM)/6.9% (PM)	A
	Proposed	178 (AM)/153 (PM)	11.8% (AM)/14.4% (PM)	A
Ogunbil Road at Nundle Road (60 km/h)	Existing	126 (AM)/118 (PM)	6.3% (AM)/9.3% (PM)	A
	Proposed	156 (AM)/148 (PM)	12.8% (AM)/15.5% (PM)	A

4.3 Intersection turning lanes

Priority-controlled intersection operations are assessed from a combination of the peak hourly through and turning traffic movements that occur at each intersection. This determines the need for additional intersection turning lanes (eg basic, auxiliary lane and channelised) in accordance with the current intersection design standards (Austroads 2017b) *Guide to Road Design Part 4, Intersections and Crossings General* (Figure A 10), where:

- Curve 1 (red line) represents the boundary between a basic right turn (BAR) and a channelised short right turn (CHR(S)) turn treatment and between a basic left turn (BAL) and an auxiliary short left turn (AUL(S)) turn treatment; and
- Curve 2 (blue line) represents the boundary between a CHR(S) and a full length CHR treatment and between an AUL(S) and a full length AUL or CHL treatment. The choice of CHL over an AUL will depend on factors such as the need to change the give way rule in favour of other manoeuvres at the intersection and the need to define more appropriately the driving path by reducing the area of bitumen surfacing.

Figure 4.1 presents the selection of turn treatments on roads with a design speed less than 100 km/h.

If a particular turn from a major road is associated with some geometric minima (for example, limited sight distance, steep grade), consideration should be given to the adoption of a turn treatment of a higher order than that indicated by the warrants. For example, if the warrants indicate that a BAR turn treatment is acceptable for the relevant traffic volumes, but limited visibility to the right-turning vehicle is available, consideration should be given to the adoption of a CHR(S) or CHR turn treatment instead. Another example is a major road on a short steep downgrade where numerous heavy vehicles travel quickly down the grade, in which case it would not be appropriate to adopt a BAL turn treatment. Instead, an AUL(S) or an AUL would be a preferred treatment.

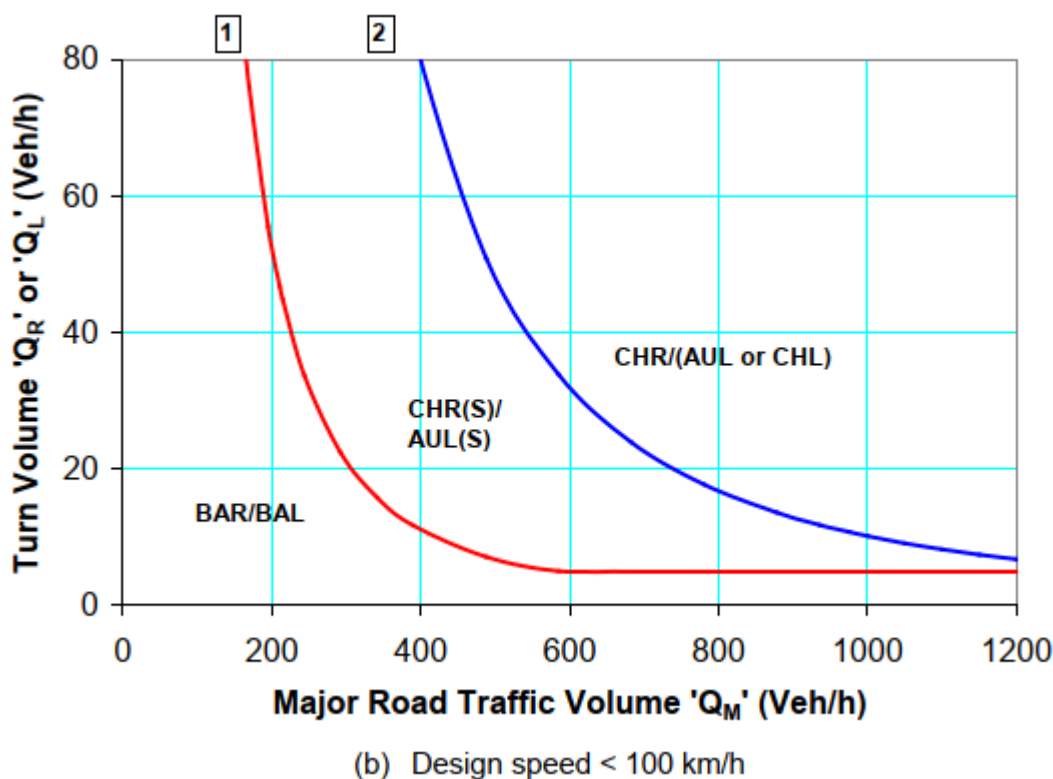


Figure 4.1 Austroads warrant design charts for rural intersection turning lanes

The key intersections include two priority-controlled intersections:

- New England Highway/Nundle Road/Railway Street; and
- Nundle Road/Duri-Dungowan Road.

TfNSW recommends intersections should be designed for a travel speed 10 km/h greater than the posted speed limit. As New England Highway and Nundle Road at Duri-Dungowan Road have posted speed limits of 60 km/h and 80 km/h, respectively, their intersections should be designed for 70 km/h and 90 km/h, respectively.

4.3.1 New England Highway/Nundle Road/Railway Street

The turn treatment warrant analysis for the New England Highway/Nundle Road/Railway Street intersection for the existing and proposed project construction traffic volumes is presented in Table 4.8.

Table 4.8 Turn treatment warrant for the New England Highway/Nundle Road/Railway Street intersection

Turn Movement	Traffic situation	Major road traffic	Turning volume	Turn treatment
Right turning movement	Existing	429 (AM)/508 (PM)	109 (AM)/174 (PM)	CHR
	Proposed	429 (AM)/508 (PM)	139 (AM)/181 (PM)	CHR
Left turning movement	Existing	235 (AM)/183 (PM)	75 (AM)/61 (PM)	AUL(S)
	Proposed	235 (AM)/183 (PM)	75 (AM)/61 (PM)	AUL(S)

In accordance with Austroads *Guide to Road Design Part 4A Unsignalised and Signalised Intersections* (Austroads 2017), a total of 81-m-long right turn lane (32 m deceleration lane plus 23 m taper and 26 m storage) is required. The intersection currently provides a 100 m right turn lane, which complies with Austroads requirements.

In addition, the existing configuration of the intersection provides AUL(S) treatment and complies with Austroads warrant.

4.3.2 Nundle Road/Duri-Dungowan Road

The turn treatment warrant for the Nundle Road/Duri-Dungowan Road intersection is presented in Table 4.9.

Table 4.9 Turn treatment warrant for the Nundle Road/Duri-Dungowan Road intersection

Turn Movement	Traffic situation	Major road traffic	Turning volume	Turn treatment
Right turning movement	Existing	126 (AM)/114 (PM)	5 (AM)/4 (PM)	BAR
	Proposed	156 (AM)/144 (PM)	11 (AM)/5 (PM)	BAR
Left turning movement	Existing	96 (AM)/51 (PM)	3 (AM)/7 (PM)	BAL
	Proposed	102 (AM)/75 (AM)	3 (AM)/7 (PM)	BAL

Based on the existing and proposed project construction traffic volumes, the Nundle Road/Duri-Dungowan Road intersection does not warrant any additional intersection turn treatments.

4.4 Road safety

4.4.1 New England Highway/Nundle Road/Railway Street

In accordance with Austroads Guide to Road Design Part 4A (Unsignalised and Signalised Intersections) (Austroads 2017), for a 60 km/h road, the minimum safe intersection sight distance (SISD) required for a general minimum 2 second driver reaction time is 123 m.

The sight distances on New England Highway at Nundle Road have been estimated based on the line of sight, as shown in Photograph 4.1. Based on the sight distance analysis, the sight distances to the left and right meets the minimum requirement (123 m) as stipulated in Austroads Guide to Road Design Part 4A (Unsignalised and Signalised Intersections) (Austroads 2017).



Sight distance to the left (252 m)



Sight distance to the right (148 m)

Photograph 4.1 Sight distance from Nundle Road on New England Highway

4.4.2 Nundle Road/Duri-Dungowan Road

The Austroads Guide to Road Design Part 4A (Unsignalised and Signalised Intersections) (Austroads 2017) stipulates, the minimum safe intersection sight distance (SISD) required for a general minimum 2 second driver reaction time on an 80 km/h road is 181 m.

The sight distances on Nundle Road at Duri-Dungowan Road have been estimated based on the line of sight, as shown in Figure 4.3. Based on the sight distance analysis, the sight distances to the left and right meets the minimum requirement (181 m) as stipulated in the Austroads Guide to Road Design.

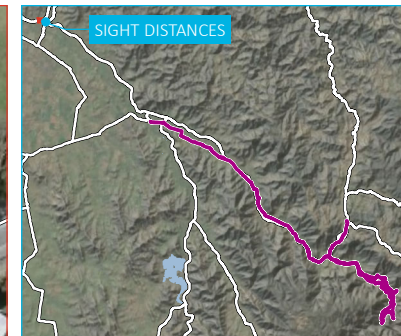


Sight distance to the left (311 m)



Sight distance to the right (242 m)

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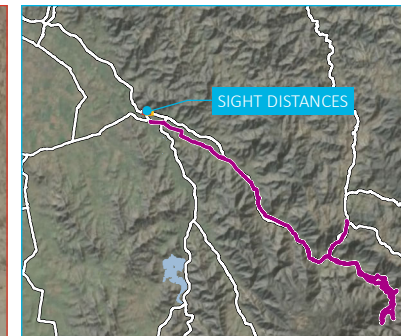


- KEY
- Project footprint
 - Sight distance to the left (252 m)
 - Sight distance to the right (148 m)
 - Major road
 - Minor road
 - Named watercourse
 - Named waterbody

Sight distance from Nundle Road
on New England Highway

Dungowan Dam and pipeline project
Traffic impact assessment
Figure 4.2

\\lemmsvr1\EMM3\2020\U200042 - Dungowan Dam\GIS\02 Maps\ EIS\ Traffic\TAO10 SightDistance\DurDungowanRdNundleRd 20220511_03.mxd 26/08/2022



KEY

- Project footprint
- Sight distance to the left (311 m)
- Sight distance to the right (242 m)
- Major road
- Named watercourse
- Named waterbody (refer to inset)

Sight distance from Duri Dungowan Road on Nundle Road

Dungowan Dam and pipeline project
Traffic impact assessment
Figure 4.3

4.5 Impacts on public transport, pedestrians and cyclists

The project is located in a remote area with no general public transport coverage. Therefore, there are no associated impacts of the project upon public transport. Detailed traffic management measures will be specified during development of the CTMP to manage and reduce potential traffic safety conflicts with other road users including with school buses along the primary transport route. Pedestrian and cycling infrastructure are not provided in the vicinity of the new Dungowan Dam.

4.6 Impacts during pipeline construction work

Along the pipeline construction route, the potential traffic impacts would primarily be limited to locations where the project construction activities or access points would interact with existing roads. At these locations there may be temporary disruptions to traffic flows through lane or road closures or other access impacts. The number of locations where the pipeline is required to cross existing roads will be kept to a minimum and the work will be undertaken by either open cut, trenching or boring to ensure minimal potential disruptions to either existing local traffic or the project construction traffic. Further details of the proposed pipeline construction work traffic mitigation measures including work site traffic controls and measures for any temporary road closures are provided in Section 5.

The combined effect of the additional pipeline construction generated daily traffic movements in terms of proportional daily traffic increases on the additional local roads potentially affected is summarised in Table 4.10.

Table 4.10 Forecast daily traffic increases for pipeline construction access

Road name	Existing daily traffic usage (movements)	Additional daily construction traffic (movements)	Proportional increase in daily traffic movements for each route
Duri-Dungowan Road (south of Nundle Road)	280*	16	5.7%
Back Woolomin Road (east of Duri-Dungowan Road)	120	16	13.3%
Dungowan Creek Road (east of Nundle Road)	70	17	24.3%

Note* Daily Traffic volume estimated from peak hourly intersection traffic surveys

For local roads potentially affected by the pipeline construction traffic (Duri-Dungowan Road, Back Woolomin Road and Dungowan Creek Road), the forecast pipeline construction traffic increases are likely to be noticeable but would have minimal impact in relation to existing traffic flow conditions or safety standards for these roads.

Where the pipeline route traverses private property, there will be a range of potential rural property access issues and impacts to be considered including:

- the potential severance of vehicle and livestock access between different areas of a rural property while the construction work is being undertaken;
- increased need for management of livestock and fencing controls while the construction work is being undertaken;
- temporary disruptions to rural property access to and from local roads for vehicles and/or livestock; and
- increased ground disturbance and potential spreading of weeds by contractor vehicles moving along the pipeline route.

Access agreements; which are to be negotiated with rural property landowners impacted by the pipeline construction activity; will detail any restrictions to access (ie along tracks, across paddocks etc) and the details of these agreements will be included in the pipeline CTMP and further management plan documentation.

4.7 Road safety audit proposed actions

In response to the Road Safety Audit (RSA) recommendations, as documented in the RSA report (SMEC 2020), which is included in Annexure B, a number of road safety actions have been identified for the Dungowan Dam Road section of the primary transport route. These include the following actions:

- an alternative road layout with appropriate safety barriers is to be provided at the Ogunbil Road/Nowendoc Road/Dungowan Dam Road intersection;
- Dungowan Dam Road will be resheeted and widened;
- where one lane sections are unavoidable along Dungowan Dam Road, a lower speed limit and Traffic Control will apply to these sections;
- additional safety barriers will be installed at a number of locations along Dungowan Dam Road, at creek edges and where there are steep slopes at the road edge; and
- along the majority of the primary transport route between Nemingha and the new Dungowan Dam, where speed limits are posted at 100 km/h, the maximum speed limit is proposed to be reduced to a maximum of 80 km/h for the duration of construction of the project. This will include installing additional 80 km/h signage and pavement marking as part of the project traffic management mitigation works.

It is noted that existing safety issues such as substandard infrastructure and road furnishing including bridge/culvert barriers with fishtail ends and rock cut faces close the edge of lane on the inside of curves will still pose a risk on the Council roads regardless of the posted speed.

4.8 Transportation of dangerous goods

For any transportation of dangerous goods, necessary approval will be sought from National Heavy Vehicle Regular (NHVR). The NHVR website stipulates that it is a legislative requirement that all road tank vehicles intended to transport dangerous goods must meet the requirements set out in Chapter 6.9 of the ADG. Operators must obtain a PBS vehicle approval from the NHVR and approval from the Competent Authority in the jurisdiction they wish to operate for the carriage of dangerous goods. NHVR (2018) describes the requirements for PBS approved tankers carrying dangerous goods.

The transport of hazardous or dangerous goods generated during construction would be in accordance with *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* with relevant mitigation and management measures to be provided within management plans for the project including the CTMP.

5 Safeguards and mitigation measures

Construction traffic mitigation measures for the project, which have been identified in the assessment to mitigate potential impacts, are listed in Table 5.1.

Table 5.1 Proposed mitigation measures for Dam and Pipeline Construction

Impact	Ref#	Mitigation Measure	Timing
Traffic and Transport	TT_01	<p>A Construction Traffic Management Plan (CTMP) will be prepared and implemented. The CTMP will be prepared in accordance with the TfNSW Traffic Control at Work Sites Technical Manual (2022) and QA Specification G10 Control of Traffic (TfNSW). The TMP will include:</p> <ul style="list-style-type: none"> • identify haulage routes and communicate, along with site access requirements and restrictions, to all relevant drivers • measures to maintain access to local roads and properties • communicate changes to roads or paths to emergency services, public transport operators, other road user groups and any other affected stakeholders. • site specific traffic control measures (including signage) to manage and regulate traffic movement • measures to maintain pedestrian and cyclist access • requirements and methods to consult and inform the local community of impacts on the local road network • access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • a response plan for any construction traffic incident • consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • monitoring, review and amendment mechanisms. • ensure all stakeholders are considered during all stages of the project 	Pre-construction Construction
Traffic and Transport	TT_02	During construction, monitoring of heavy vehicle movements to and from sites will occur to ensure compliance with road traffic noise criteria at night.	Pre-construction Construction
Impact on property access	TT_03	Manage local road closures and maintain adequate property access. This will be undertaken in consultation with TfNSW, local councils and property owners likely to be impacted.	Pre-construction Construction
Construction compound access	TT_04	<p>Construction vehicle access plans will be prepared for the largest type of truck (using vehicle swept path diagrams) for each identified construction compound site.</p> <p>A separate application will be required to NHVR for the approval of access by any oversize or overmass vehicle, which may require access to any construction site.</p>	Pre-construction
Road condition	TT_05	A Road Condition Report will be prepared before construction commences in consultation with the relevant road authorities. The Road Condition Report would contain details of the condition of roads potentially used during construction and would be used as the basis for reinstating roads to their condition before construction commenced after the completion of construction.	Pre-construction Construction

Table 5.1 **Proposed mitigation measures for Dam and Pipeline Construction**

Impact	Ref#	Mitigation Measure	Timing
Road Safety Audit proposed actions	TT_06	<p>The posted speed limit along the transport route between Nemingha and the new Dungowan Dam will be reduced from 100 km/h to a maximum 80 km/h for the duration of construction of the project.</p> <p>Frequent signage of the new road speed limits will be provided by road pavement numerals at the entry point to each section of the affected roads from all significant side road entry points and additional new speed limit sign will be installed at regular intervals along the route in both the eastbound and westbound directions.</p> <p>Upgrades and traffic management of Dungowan Dam Road from Ogunbil Road to the proposed new Dungowan Dam access road will be completed as described in Section 2.4 of this report.</p>	Pre-construction Construction

6 Conclusion

The construction and operational traffic impacts are as follows:

- a large part of the primary transport route will be affected by a reduced speed limit for the majority of the construction period;
- there were no potential impacts identified to traffic flow on major roads;
- all key intersections currently operate at LOS A in the peak hours, except for the New England Highway/Nundle Road/Railway Street intersection where LOS B and LOS C is experienced in the AM and PM peak respectively. With construction traffic, all the intersections will remain at the same LOS;
- the operational traffic volumes would be much lower than the construction traffic. Therefore, during operation all the key intersections are expected remain at the same LOS;
- the mid-block capacity of Nundle Road has LOS C near the New England Highway and near O'Briens Lane, and LOS A near Duri-Dungowan Road. With the addition of the proposed construction traffic all the key road sections will remain at the same LOS;
- the intersection turn treatments at the key intersections complies with Austroads Design Guide requirements; and
- impacts to public transport, pedestrian and cyclist movements will be negligible. Detailed traffic management requirements will be specified in the project CTMP to manage and mitigate potential traffic safety conflicts with road users including school buses along the primary transport route.

7 References

Austroads. 2020. Guide to Traffic Management.

Austroads 2017, *Guide to Road Design Part 4A: Unsignalised & Signalised Intersections*.

RTA 2002, *Guide to Traffic Generating Developments*.

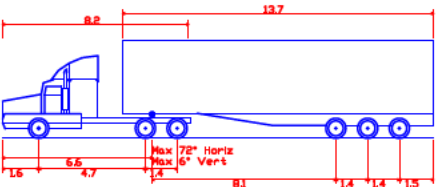
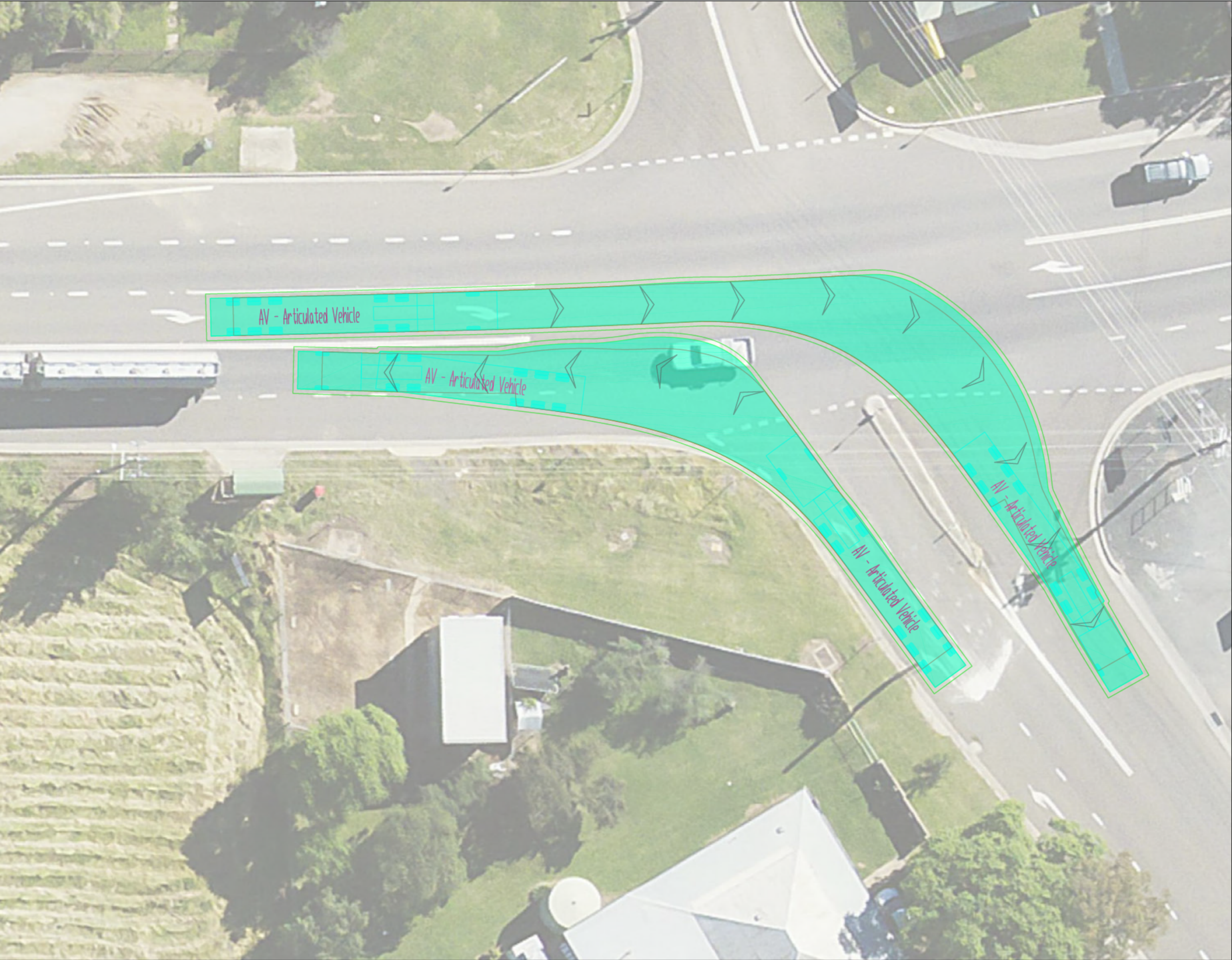
SMEC. 2020. Road Safety Audit Report – Construction vehicle access from Nemingha to the proposed dam site

Abbreviations

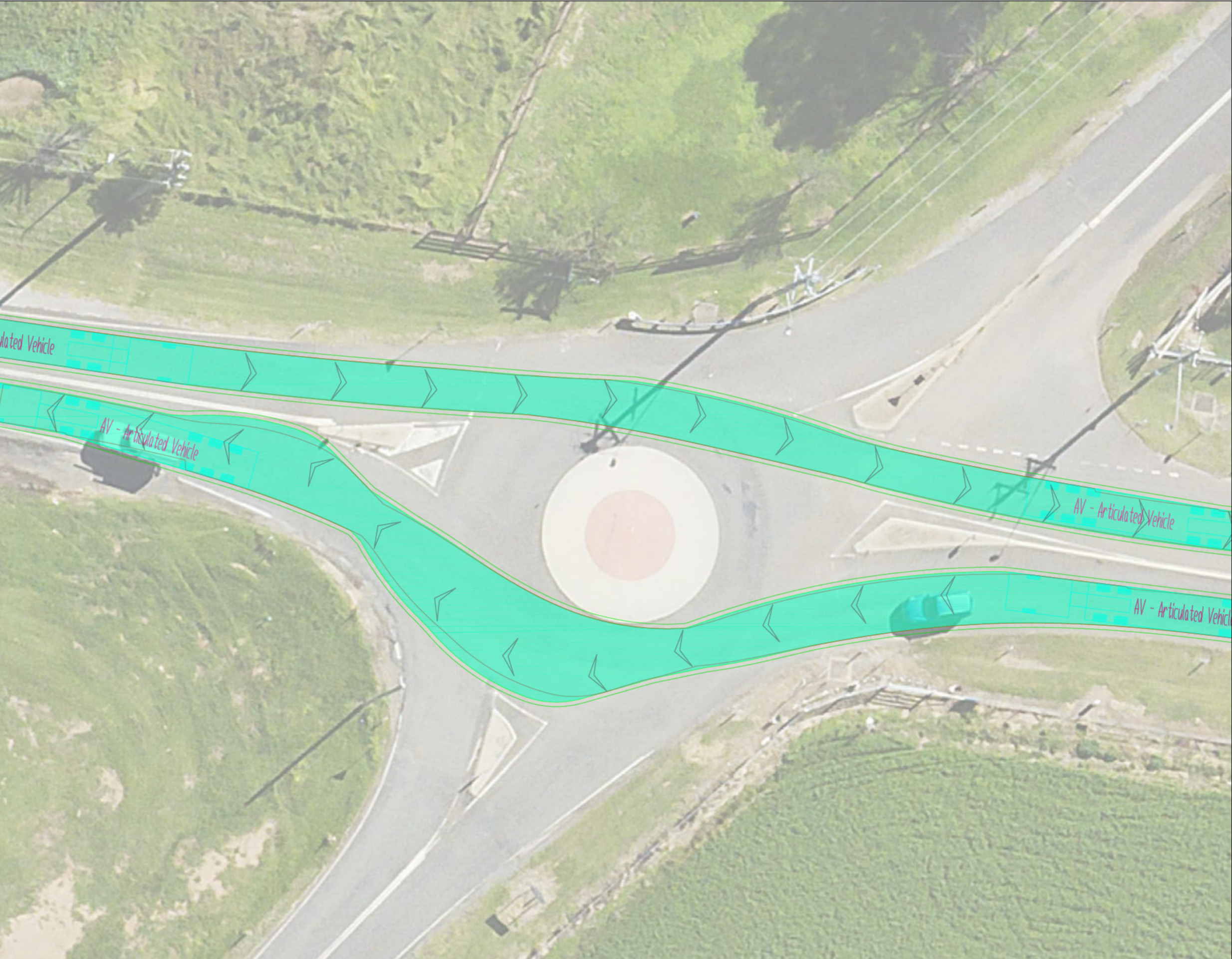
ABS	Australian Bureau of Statistics
AHD	Australian height datum
BCA	Building Code of Australia
CEMP	Construction environment management plan
CTMP	Construction traffic management plan
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental impact statement
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
EP&A Regulation	<i>NSW Environmental Planning and Assessment Regulation 2000</i>
EPA	NSW Environment Protection Authority
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FSL	Full supply level
ha	Hectares
HDPE	High density polythene
kL	Kilolitre
km	Kilometre
km ²	square kilometre
L	Litres
LGA	Local government area
LOS	Level of Service
m	Metre
m ²	Square metre
m ³	Cubic metre
ML	Megalitre
MSCL	Mild steel cement lined
NHVR	National Heavy Vehicle Regulator
NSW	New South Wales
OOH	Out of hours
RMS	NSW Roads and Maritime Services
SEARs	Secretary's environmental assessment requirements
SEPP	State Environmental Planning Policy
SSI	State Significant Infrastructure
TfNSW	Transport for New South Wales

Annexure A

Swept path

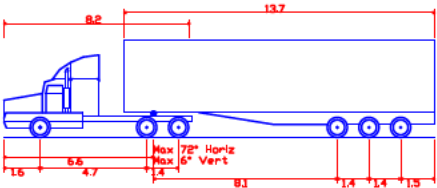


AV - Articulated Vehicle	19.000m
Overall Length	19.000m
Overall Width	2.500m
Overall Body Height	4.301m
Min Body Ground Clearance	0.418m
Track Width	2.500m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12.500m




COMMENTS

A3




AV - Articulated Vehicle	
Overall Length	19.00m
Overall Width	2.50m
Overall Body Height	4.30m
Min Body Ground Clearance	0.418m
Track Width	2.50m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12.500m



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1	07/12/20	FOR INFORMATION	EL	TB					
1	30/10/20	FOR INFORMATION	EL	AU					



PROJECT:
Dungowan Dam EIS

DRAWING TITLE:
19 m AV Swept Path

Intersection of Nundle Road with
O'Briens Lane and Back Kootingal Road

CLIENT: WaterNSW

DRG. #: EMM-002

PROJECT #: J200042

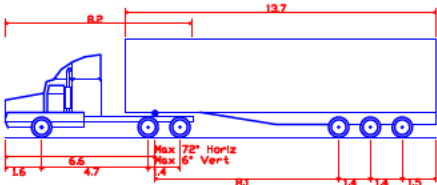
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COMMENTS

A3



AV - Articulated Vehicle	
Overall Length	19.000m
Overall Width	2.500m
Overall Body Height	4.301m
Min Body Ground Clearance	0.418m
Track Width	2.500m
Lock-to-lock time	6.00s
Curb to curb Turning Radius	12.500m

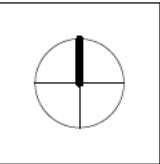


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PROJECT:
Dungowan Dam EIS

DRAWING TITLE:
19 m AV Swept Path

Intersection of Nundle Road with
Duri-Dungowan Road

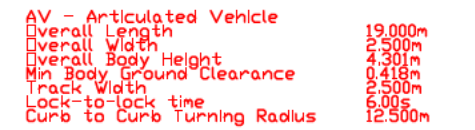
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DRG. #: EMM-003

PROJECT #: J200042

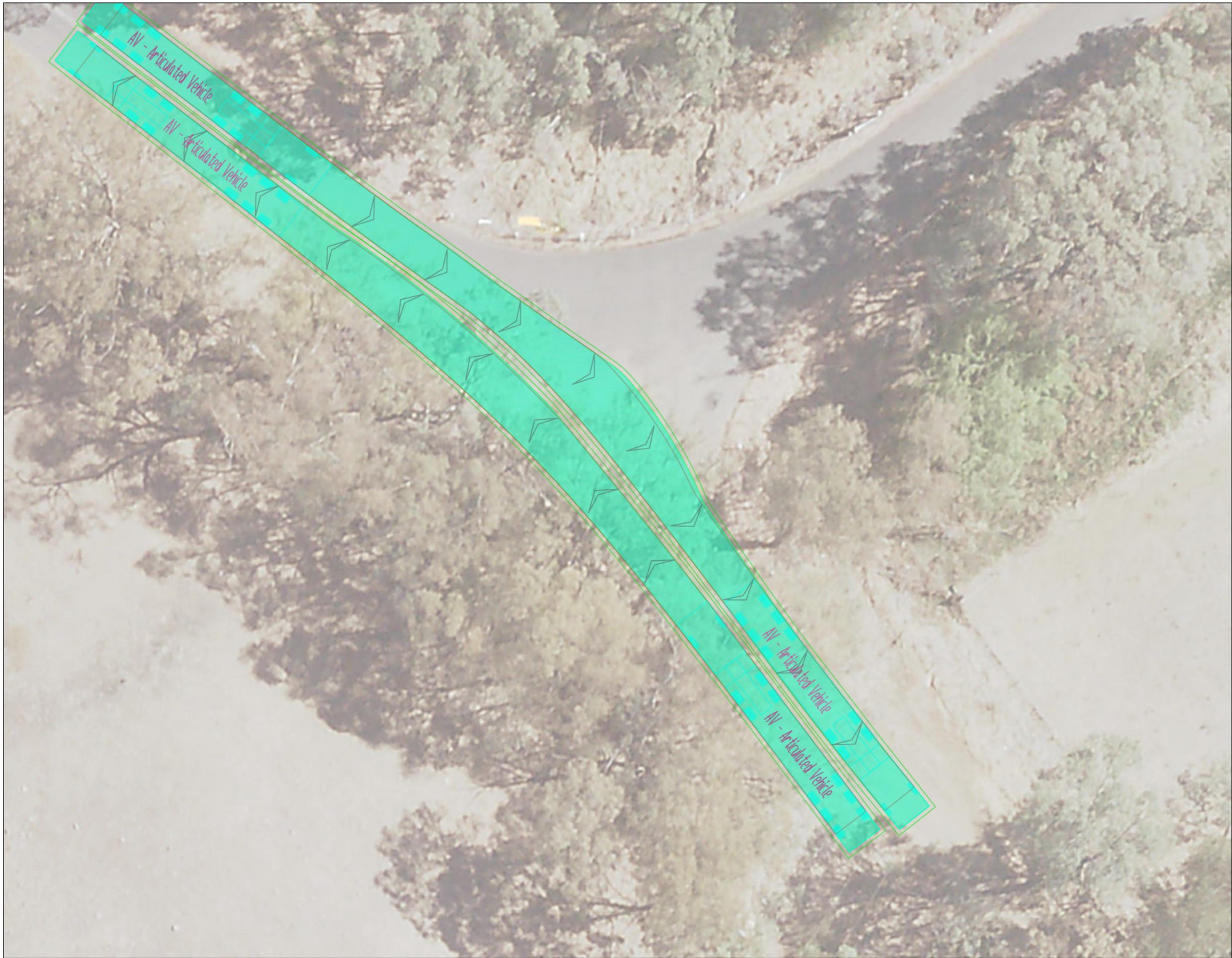
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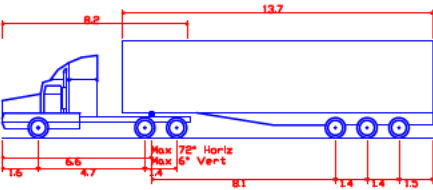
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COMMENTS

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Overall Width	2.500m
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Min Body Ground Clearance	0.418m
Track Width	2.500m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12.500m

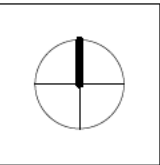


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PROJECT:
Dungowan Dam EIS

DRAWING TITLE:
19 m AV Swept Path

Intersection of Ogunbil Road with
Dungowan Dam Road

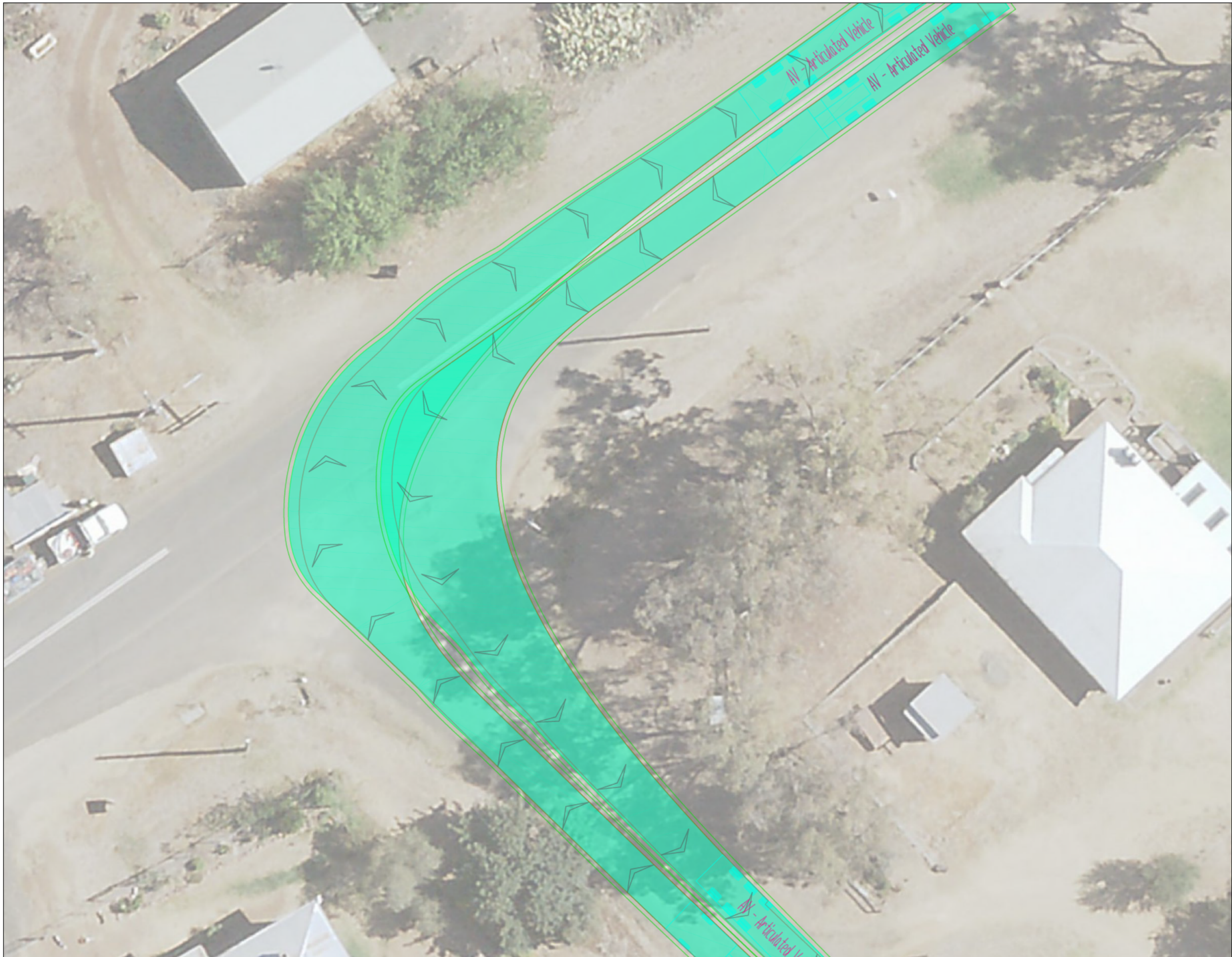
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DRG. #: EMM-005

PROJECT #: J200042

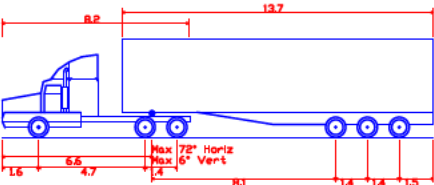
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COMMENTS

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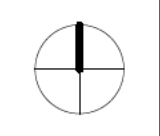


AV - Articulated Vehicle	
Overall Length	19.000m
Overall Width	2.500m
Overall Body Height	4.301m
Min Body Ground Clearance	0.418m
Track Width	2.500m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12.500m



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1	30/10/20	FOR INFORMATION	EL	AU					



PROJECT:
Dungowan Dam EIS

DRAWING TITLE:
19 m AV Swept Path
Intersection of Nundle Road with
Dungowan Creek Road

CLIENT: WaterNSW

DRG. #: EMM-006

PROJECT #: J200042

SCALE: 1:250

REV: 2

Annexure B

Road Safety Audit



Road Safety Audit Report – Construction vehicle
access from Nemingha to the proposed dam site

Dungowan Dam and Pipeline Design

Reference No. DUN-SMC-PM-RPT-0007
Prepared for Water NSW
10 November 2020

Document Control

Document:	Road Safety Audit Report – Construction vehicle access from Nemingha to the proposed dam site
File Location:	SharePoint
Project Name:	Dungowan Dam and Pipeline Design
Project Number:	30013407
Revision Number:	01

Revision History

Revision No.	Date	Prepared by	Reviewed by	Approved for Issue by
01	10 November 2020	Trevor Ferris – Lead Road Safety Auditor	Stephen Williamson	Jonathon Reid

Issue Register

Distribution List	Date Issued	Number of Copies
Water NSW	10 November 2020	01

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1 Introduction

1.1 Project Description

The Dungowan Dam is a part of the critical water infrastructure projects passed in the Water Supply (Critical Needs) Bill 2019 by the NSW Government. It is part of a preferred scheme that provides the greatest improvement in drought security, flood management and water reliability. SMEC and EMM has been engaged by WaterNSW to undertake the Planning and Development Phase of a new dam on Dungowan Creek, approximately 3.5 km downstream of the existing Dungowan Dam and 48 km south east of Tamworth, NSW

The new Dungowan Dam is WaterNSW's chosen option from a series of investigations into the future supply and demand for bulk water undertaken for the regional city of Tamworth and Peel Valley water users. The current system cannot support the projected Tamworth growth and future 50-year bulk water demands, which will exceed current water availability in less than 20 years. The new Dungowan Dam Project is to secure the long-term water supply security for the regional city of Tamworth and Peel Valley water users. Further, the project will provide incremental flood protection as a secondary benefit to downstream residents.

The scope of this engagement relates specifically to the Planning and Development of the new Dungowan Dam project, inclusive of water supply pipeline, as part of the CSSI Dams –Regional Priority Dams Projects. The initial phase of the project is aimed at providing the inputs required by WaterNSW for its submission of the Final Business Case

The proposed construction access to the Dungowan Dam will leave the New England Highway at Nemingha (approximately 7 km north of Tamworth) on the Tamworth-Nundle Road to Dungowan. Vehicles turn off Tamworth-Nundle Road at Dungowan onto Ogunbil Road followed by access on Dungowan Dam Road. Refer to Figure 1-1 below for a map showing the proposed Dungowan Dam site and surrounding roads and towns.



Figure 1-1: Proposed site location and access routes

1.2 Scope of this Road Safety Audit Report

This road safety report presents a review of the existing roads from Nemingha to the proposed dam site to identify the safety risks present when construction traffic is added to the existing traffic volumes. The safety issues and corresponding risks are listed in Section 3 of this report.

The report does not consider or propose remedial action to the identified risks.

2 Road Safety Audit Details

2.1 Road Safety Audit

Road Safety Auditing is a formalised procedure, which can be applied to all phases of a project or to an existing road system. The audit team must be independent of the designer, so that the design is viewed with “fresh eyes”. The purpose of the audit is not to rate the design, but rather to identify any safety concerns that may affect the general public as they move through the site.

In reviewing the safety aspects of a project, the reporting procedure is not intended as a redesign process, but to outline road safety issues, and establish a basis upon which ongoing works may produce an acceptable solution to the safety problem.

The objectives of a road safety audit are to

- Review the operational site, design and background information and form conclusions about the safety performance and accident potential for the project;
- Evaluate the operational site in terms of interaction with its surrounds and nearby roads and to visualise potential impediments and conflicts for users; and
- Identify and report on aspects of the site that may result in unnecessary or unreasonable hazards for all road users.

2.2 Auditors and Audit Process

This audit was undertaken by:

- Trevor Ferris Lead Road Safety Auditor (Road Safety Audit for Leaders C172580) an experienced Lead road safety auditor employed by SMEC Australia Pty Ltd, and
- Chris Weavers, an experienced Lead Road Safety Auditor and director of Weavers Consulting Group Pty Ltd.

A road safety audit site inspection was held on the 14-15th October 2020, commencing at 2:00 pm starting at Nemingha. A daytime site inspection, a night-time inspection and a day time inspection the following day were conducted. The weather conditions were clear and sunny for the site inspection.

Specific areas for review included:

- Suitability of the existing roads to carry additional truck and dog combinations delivering materials to the site
- Sight lines and pavement widths to allow trucks to pass safely.
- Condition of existing road furniture and structures.
- Safety of existing intersections and property accesses and
- Roadside hazards.

2.3 Previous Audits

No previous audit reports were available.

2.4 Supporting Information

A construction traffic estimate report.

2.5 Design Criteria

The posted speed limits varied from 40 km/h at school sites and 60 km/h in urban areas to 100 km/h in rural areas. Assessments were based on Austroads design standards for the relevant posted speed limits.

2.6 Engineering Standards

The following engineering standards are used as reference

- Austroads Guides to Road Design
- Austroads Guide to Road Safety, Part 6, August 2020

2.7 Risk Classification Methodology

2.7.1 Risk Assessment System

Identified issues and deficiencies have been rated in order of importance based on estimated crash frequency, crash severity and level of risk modified to comply with Austroads Guide to Road Safety Part 6A: Road Safety Audit.

2.7.2 Crash Frequency

The probable frequency of an incident or crash occurring has been estimated for each issue listed in the Road Safety Audit findings based on the criterion listed in Table 2.1.

Table 2.1: Crash Frequency

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

2.7.3 Crash Severity

The severity of a crash identified in the Road Safety Audit is assessed based on the criterion listed in Table 2.2.

Table 2.2: Crash Severity

Severity	Description	Examples of Incident
Catastrophic	Likely multiple deaths	<ul style="list-style-type: none"> High speed, multi-vehicle crash on freeway Car runs into crowded bus stop Bus and petrol tanker collide Collapse of a bridge or tunnel
Serious	The crash is likely to result in death or serious injury	<ul style="list-style-type: none"> High/medium speed vehicle collision High/medium speed collision with a fixed object Pedestrian/cyclist hit by a vehicle
Minor	The crash is likely to result in minor injury or major property damage	<ul style="list-style-type: none"> Low speed vehicle collision Pedestrian/cyclist fall with no head injury Low speed rear end collision in a slip lane
Limited	Likely trivial injury or property damage only	<ul style="list-style-type: none"> Minor vehicle collision, property damage only Car reverses into post Pedestrian/cyclist hits fixed object resulting in minor injury

2.7.4 Level of Risk

Deficiencies are rated for their risk according to a four tiered system based on the matrix in Table 2.3.

Table 2.3: Risk Matrix

	Frequent	Probable	Occasional	Improbable
Catastrophic	Intolerable	Intolerable	Intolerable	High
Serious	Intolerable	Intolerable	High	Medium
Minor	Intolerable	High	Medium	Low

	Frequent	Probable	Occasional	Improbable
Limited	High	Medium	Low	Low

2.7.5 Treatment Approach

The suggested treatment approach based on mitigation so far as reasonably practical is included in Table 2.4.

Table 2.4: Treatment Approach

Risk	Suggested Treatment Approach
Intolerable	Must be corrected.
High	Should be corrected or the risk significantly reduced, even if the treatment costs are high.
Medium	Should be corrected or the risk significantly reduced, if the treatment costs are moderate but not high.
Low	Should be corrected or the risk reduced if the treatment cost is low.

2.8 Safe System

“The Safe System approach is regarded as international best practice in road safety and provides an outcome whereby the likelihood of death and serious injury are virtually eliminated amongst users of the road system. Safe System is the “management and design of the road system such that impact energy on the human body is firstly avoided or secondly managed at tolerable levels by manipulating speed, mass and crash angles to reduce crash injury severity.” (Austroads 2018b – AP-R560-18).

With the adoption of the Safe System approach it is important that it is integrated into the Road Safety process. There is currently only limited guidance on how this integration should be done and Austroads (Guide to Road safety Part 6, 2019) suggest that “road safety auditors are given the freedom on how to go about meeting these requirements.

3 Road Safety Audit Findings – Nemingha to Dungowan Dam Construction Site

3.1 Stage 4, Existing Road Condition Road Safety Audit

The access alignment is part of an overall rural road network.

The first section from Nemingha to Dungowan is part of a transport route between Tamworth and Nundle. The road has one traffic lane in each direction, the lanes are approximately 3.5 m wide with grassed shoulders to a hinge point offset of less than 2.0 m.

Ogunbil Road is a lesser standard rural road with a 5.8 m to 6.0 m sealed pavement width linemarked with a double barrier line at small radius horizontal and vertical curves. Other areas are not linemarked. The alignment is posted at 100 km/h and 80 km/h and has numerous low speed horizontal curves with advisory speed signs below 80 km/h.

Dungowan Dam Road is a narrow low speed gravel road providing access to the existing Dungowan Dam and local farms. It does not have a posted speed limit. By default, the rural speed limit of 100 km/h would apply. Both the Tamworth Nundle Road and Ogunbil Road are school bus routes. The school bus was also seen to stop at the intersection of Ogunbil Road, Nowendoc Road and Dungowan Dam Road.

The speed limit varies along the route:

- 60 km/h through Nemingha
- 100 km/h Nemingha to Piallamore
- 80 km/h through Piallamore
- 100 km/h Piallamore to Trough Gully bridge
- 80 km/h Trough Gully bridge to Dungowan
- 60 km/h through Dungowan
- 100 km/h Dungowan to Woolamin Gap Road
- 80 km/h Woolamin Gap Road to the Dungowan Dam Road
- Dungowan Dam Road is signposted as “drive to the conditions”.

Traffic observed during the site inspection on the roads from Nemingha to Ogunbil carried a steady flow of traffic comprising both private and commercial vehicles including cruise buses on the school routes and B-double combinations carrying hay bales.







The proposed dam wall construction is estimated to take four years. Construction traffic is estimated to peak at 130 staff vehicles and 70 heavy vehicles per day each way to access the site and deliver construction material. A truck accessing the site from Nemingha would pass approximately 10 trucks traveling in the opposite direction plus existing local traffic. Construction staff will be oriented around shift changeover and work start/end times.

The increase in traffic volumes will vary for the duration of construction, post construction the route will revert to the existing conditions plus natural growth. A context sensitive review of the road safety audit findings should therefore consider short term alternatives to some issues such as reducing speed limits for trucks or all vehicles for the duration of construction. There are some findings that should be addressed as part of long term safety issues.

The road safety audit findings, relevant operational issues and observations are listed in the following Table 3.1 and are separated into sections from Nemingha to Dungowan, Ogunbil Road and Dungowan Dam Road.

Table 3.1: Road Safety Audit Findings

	Location	Audit Findings	Risk Level	Comments / Photos
3.1 Nemingha to Dungowan				
3.1.1	General	The road is a school bus route There are school bus warning signs but no provision for a bus to get fully off the road in 100 km/h and 80 km/h speed zones. There is a risk of rear end crashes as a bus stops partially within the traffic lane and interaction with other vehicles at the bus stops. This issue applies to both directions of travel at drop off locations.	Occasional Minor Medium	
3.1.2		There are limited opportunities for emergency stopping clear of the traffic lane. The same issue exists for roadside maintenance workers There is a risk of congestion resulting in vehicle crashes.	Occasional Minor Medium	 
3.1.3	General	Culvert headwalls are often within 2.0 m of the edge line. There is a risk that a vehicle may drop over the edge if a driver veers to the left to avoid oncoming traffic.	Occasional Minor Medium	
3.1.4	General	Property access cross drainage structures are constructed at 90° to the direction of travel in a 100 km/h speed zone.	Occasional Minor Medium	
3.1.5	General	Some rock cuttings are close to the edge of pavement restricting stopping sight distance in 100 km/h speed zones.	Occasional Serious High	
3.1.6	General	There is no pavement widening at intersections and property accesses to pass a right turning vehicle. An increase in traffic will create a greater risk of rear end crashes into turning vehicles.	Occasional Serious High	

	Location	Audit Findings	Risk Level	Comments / Photos
3.1.7	General	At the time of the site inspection the grass on the road verge was high, (over 1.0 m) restricting sight distance and hiding guide posts. It also hid a narrow verge with steep fill slopes over 1.0 m in height. There is a risk of a driver running over the edge not realising a drop exists.	Improbable Serious High	
3.1.8	O'Briens Lane roundabout	O'Briens Lane roundabout central island has a low kerb and is difficult to see in poor light.	Occasional Serious Medium	
3.1.9	Nemingha Public School	The westbound approach to the 60 km/h speed zone and Nemingha Public School is hidden around a blind curve with a property access on the inside of the curve. There is a short distance between the 60 km/h sign and the school zone with a risk of vehicles entering the school zone at speeds greater than 40 km/h. Consider extending the 60 km/h speed zone east to the speed change warning sign to reduce the risk of speeding in the school area.	Occasional Serious Medium	 Approach to curve  Concealed entrance warning  School zone ahead
3.2 Ogunbil Road				
3.2.1	General	There is no pavement widening at intersections and property accesses to pass a right turning vehicle. An increase in traffic will create a greater risk of rear end crashes into turning vehicles.	Occasional Serious High	

	Location	Audit Findings	Risk Level	Comments / Photos
3.2.2	General	Where gravel roads join the through lanes gravel is spread onto the seal. The gravel on seal is a sliding risk to light vehicles and motorbikes resulting in run-off road crashes and possible impact with roadside objects.	Occasional Serious High	
3.2.3	General	Ogunbil Road pavement is in poorer condition and is narrower than the Nemingha to Dungowan road with a higher risk of vehicle loss of control.	Note only	 
3.2.4	General	The right hand side (outbound) of the road is in a typical high fill with a 1.2 m verge to the hinge point. There is a risk of a vehicle roll over crash if it runs over the hinge point.	Occasional Serious High	
3.2.5	General	Steep rock cuts with narrow verges restrict sight distance around curves to approaching vehicles and objects on the road.	Occasional Serious High	
3.2.6	General	Areas with rock cut have restricted width available for drivers to avoid an incident or an object on the road. The reduced width will increase the risk of a crash.	Occasional Serious High	
3.2.7	General	There are areas where large trees are growing within the clear zone with 2.9 to 3.0 m wide traffic lanes. As the traffic volumes increase there is a risk of vehicles crashing into trees while avoiding other vehicles.	Occasional Serious High	 

	Location	Audit Findings	Risk Level	Comments / Photos
3.2.8	General	Westbound left hand curves in rock cut generally have reduced stopping sight distance due to the reduced offset to the rock face. There is a risk of not seeing an object on the road and having to swerve to avoid a hazard.	Occasional Serious High	
3.2.9	General	Curve warning chevrons placed in one direction are not always repeated for the opposite direction. The risk is the same in both directions.	Occasional Serious High	
3.2.10	General	There is no pavement widening for small radius curves. There is a risk that trucks meeting on the curves will have insufficient separation or will run wide causing damage to the grass shoulders and pulling debris into the traffic lanes.	Occasional Serious High	
3.2.11	Dungowan Public School	Students will cross Ogunbil Road to get to ovals and sports fields from the school precinct. There is a higher risk to students with the increase in traffic during construction.	Improbable Serious Medium	
3.2.12	Culvert 3.2 km east of Dungowan	The twin 750 mm dia. pipe culverts have a 2.4 m unprotected drop off the edge of the lane. There is a risk that if a vehicle runs off the road here it will result in major damage and injury.	Improbable Serious Medium	
3.2.13		Property access on right climbs up a steep fill. Vehicles will be hidden from approaching vehicles.	Occasional Serious High	

	Location	Audit Findings	Risk Level	Comments / Photos
3.2.14	5 km east of the Dungowan roundabout	<p>The existing bridge has a short section of safety barrier on either side with fishtail terminals and no approach barriers covering the point of need. There is a 3.4 m drop into the creek bed.</p> <p>The bridge pavement is 6.7 m wide and 11 m in length.</p> <p>There is a risk of serious injury if a vehicle leaves the road in this area.</p> <p>There is also a risk of the fish tail safety barrier terminal penetrating a vehicle cabin if it is hit end on.</p>	<p>Improbable</p> <p>Serious</p> <p>Medium</p>	
3.2.15	Echo Hills Road Intersection	<p>Entering sight distance is limited by the crest vertical curve with approximately 140 m of stopping sight distance to the intersection for westbound drivers</p>	<p>Improbable</p> <p>Serious</p> <p>Medium</p>	
3.2.16	Bridge over Dungowan Creek 7.6 km east of Dungowan	<p>The bridge over Dungowan Creek is in an unsafe condition.</p> <p>The eastbound approach has G4 safety barriers. The approach terminals are equivalent to trailing terminals and not suitable for a 100 km/h posted speed limit.</p> <p>The G4 safety barriers are attached to stand alone steel posts with tac-welding. If impacted the safety barrier will deflect leaving the bridge rails exposed to snag a vehicle resulting in a potential roll over crash.</p> <p>There are no delineators on the bridge.</p> <p>The westbound approach has no safety barrier protection. There is a risk of a vehicle crashing into the bridge rail or falling approximately 3.0 m to the creek bed.</p>	<p>Improbable</p> <p>Serious</p> <p>Medium</p>	 <p>Eastbound bridge approach</p>  <p>Eastbound approach terminal</p>  <p>Eastbound bridge barrier</p>

	Location	Audit Findings	Risk Level	Comments / Photos
				 <p>Westbound approach has no protection</p>
3.2.17	Woolomin Road intersection	The intersection is not easily seen when approaching it. Sight distance is limited to 110 m when approaching from Dungowan and does not satisfy safe intersection sight distance requirements. Sight distance is obstructed by a building and horizontal curve.	Improbable Serious Medium	
3.2.18	Thortons Road intersection 10.4 km to Dungowan	The intersection is not easily seen when approaching it. Sight distance is limited to 150 m when approaching from Dungowan and does not satisfy safe intersection sight distance requirements. Thorntons Road has a tourist monument so will be accessed by drivers not familiar with the road.	Improbable Serious Medium	
3.2.19	Property access 11.1 km to Dungowan	The property is hidden around a curve for traffic from Dungowan. There is a risk that a vehicle waiting to turn right into the property may be hit by a following vehicle. There is no shoulder or verge width to allow a vehicle to avoid a stationary vehicle.	Improbable Serious Medium	
3.2.20	Allawah Road intersection 14.5 km to Dungowan	Allawah Road intersection location is poorly defined and partially hidden by the tree shadow. Approach sight distance from Dungowan is 120 m and is stopping distance only for 80 km/h posted speed limit. It does not satisfy safe intersection sight distance requirements.	Improbable Serious Medium	
3.2.21	Intersection of Ogunbil Rd, Nowendoc Road and	There is limited sight distance between Ogunbil Road and Nowendoc Road due to vegetation growth. The intersection sight distance for vehicles turning right from the dam	T intersection with GIVE WAY (R1-2) control on Nowendoc Road but no	

	Location	Audit Findings	Risk Level	Comments / Photos
	Dungowan Dam Road	<p>access to Nowendoc Road is limited. Available sight distance to the intersection on Ogunbil Road is 100 m and 95 m on the dam access road.</p> <p>There will be a significant increase in vehicles straight ahead from Ogunbil Road to the dam access road. There is limited linemarking to guide drivers through the intersection. The intersection is also a school bus stop.</p> <p>The old chain wire safety fences on Nowendoc Road are damaged and should be replaced with an approved safety barrier and connection to the existing Dungowan Creek bridge.</p> <p>The intersection layout should be reviewed as part of the road upgrade.</p>	<p>dividing line and no dividing line.</p> <p>Tyre marks indicate that there is scant regard to the intersection priority</p> <p>Improbable Serious Medium.</p>	<p>Approach from Dungowan</p>  <p>Approach from Dungowan Dam</p>  <p>Nowendoc Road</p>
3.3 Dungowan Dam Road				
3.3.1	General	<p>Dungowan Dam Road is a gravel road providing access to the existing dam and private rural properties.</p> <p>Traffic volumes will increase to a maximum of 130 construction and 70 truck deliveries per day</p>	Note only	
3.3.2		<p>The vertical and horizontal alignment is to a low speed standard. The full length of the access road is unsealed gravel with parts showing high plasticity when wet. There are a number of single lane grids.</p> <p>Delineation is limited to occasional guideposts at cross culvert locations.</p> <p>There is a risk of crashes due to the alignment standards, lack of delineation, slippery surface, low pavement strength and narrow road cross section.</p> <p>The road would be unsuitable for truck traffic during wet weather.</p>	<p>Improbable Minor Low</p>	

	Location	Audit Findings	Risk Level	Comments / Photos
3.3.3		<p>The road cross section narrows to a one lane operation for trucks after 3 km.</p> <p>Either the road will require widening or the construction access will require managing with low speed limits and possibly radio control for platoon movements.</p>	<p>Improbable</p> <p>Minor</p> <p>Low</p>	
3.3.4	General	There are areas adjacent to the creek with no edge protection and steep fill slopes. There is a risk that the edge of road may collapse resulting in a vehicle rolling down the slope.	<p>Improbable</p> <p>Minor</p> <p>Low</p>	
3.3.5	General	Exiting the site, there are left hand bends cut into the side slope resulting in restricted sight distance to oncoming vehicles. There is a risk of vehicle crashes if the operating speed is too high.	<p>Improbable</p> <p>Minor</p> <p>Low</p>	
3.3.6		There is a concrete block retaining wall on the inside of the curve to control creek erosion. There is no associated safety barrier.	<p>Improbable</p> <p>Serious</p> <p>Medium</p>	

4 Conclusion

We have examined the section of the proposed construction traffic route referred to in Section 1.2. The audit has been carried out for the sole purpose of identifying any features of the site that could be a safety risk for all road users. The Audit findings are included in Section 3 of this report.

The findings should be considered by the design team to establish actions that minimise risk to all road users. Options may include speed and traffic control as well as construction safety options.



10/11/2020

Trevor Ferris

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10/11/2020

Chris Weavers

Lead Road Safety Auditor, Weavers Consulting Group Pty Ltd

local people
global experience

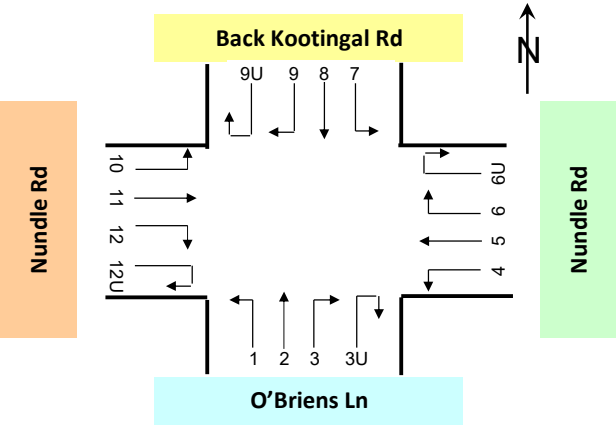
SMEC is recognised for providing technical excellence and consultancy expertise in urban, infrastructure and management advisory. From concept to completion, our core service offering covers the life-cycle of a project and maximises value to our clients and communities. We align global expertise with local knowledge and state-of-the-art processes and systems to deliver innovative solutions to a range of industry sectors.

Annexure C

Traffic survey

Job No. : N5789
Client : EMM
Suburb : Dungowan
Location : 2. Back Kootingal Rd / Nundle Rd / O’Briens Ln

Day/Date : Wed, 17th June 2020
Weather : Fine
Description : Classified Intersection Count
: Hourly Summary

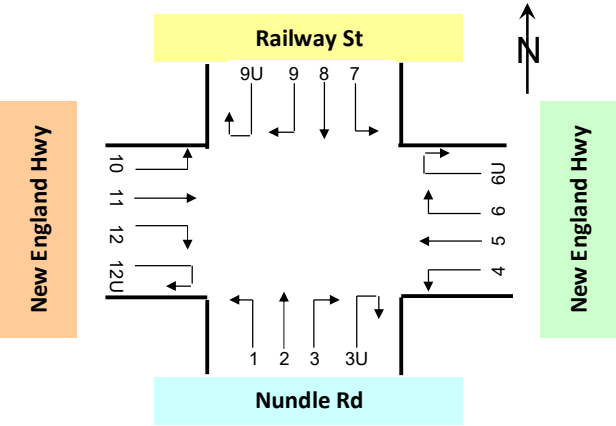


Approach	O’Briens Ln												Nundle Rd											
Direction	Direction 1 (Left Turn)			Direction 2 (Through)			Direction 3 (Right Turn)			Direction 3U (U Turn)			Direction 4 (Left Turn)			Direction 5 (Through)			Direction 6 (Right Turn)			Direction 6U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
6:00 to 7:00	49	7	56	4	0	4	5	0	5	0	0	0	12	0	12	47	5	52	0	0	0	0	0	0
6:15 to 7:15	46	6	52	2	0	2	6	0	6	0	0	0	14	0	14	54	6	60	0	0	0	0	0	0
6:30 to 7:30	50	5	55	3	0	3	8	0	8	0	0	0	19	0	19	58	2	60	0	0	0	0	0	0
6:45 to 7:45	54	2	56	5	0	5	9	0	9	0	0	0	21	0	21	74	3	77	0	0	0	0	0	0
7:00 to 8:00	67	3	70	5	0	5	11	0	11	0	0	0	22	1	23	92	3	95	1	0	1	0	0	0
7:15 to 8:15	81	4	85	6	0	6	12	0	12	0	0	0	33	2	35	128	5	133	2	0	2	0	0	0
7:30 to 8:30	99	7	106	6	0	6	13	0	13	0	0	0	34	2	36	150	6	156	2	0	2	0	0	0
7:45 to 8:45	115	10	125	8	0	8	17	0	17	1	0	1	42	2	44	154	5	159	2	0	2	0	0	0
8:00 to 9:00	119	12	131	11	1	12	27	2	29	1	0	1	45	1	46	139	6	145	6	0	6	0	0	0
AM Totals	235	22	257	20	1	21	43	2	45	1	0	1	79	2	81	278	14	292	7	0	7	0	0	0
15:00 to 16:00	134	7	141	27	1	28	41	3	44	0	0	0	44	1	45	73	7	80	9	2	11	0	0	0
15:15 to 16:15	148	9	157	30	1	31	40	4	44	0	0	0	45	1	46	78	6	84	8	2	10	0	0	0
15:30 to 16:30	123	8	131	23	1	24	29	4	33	0	0	0	34	3	37	60	9	69	8	1	9	0	0	0
15:45 to 16:45	107	5	112	26	1	27	25	5	30	1	0	1	25	4	29	46	10	56	3	1	4	0	0	0
16:00 to 17:00	98	5	103	24	1	25	27	2	29	1	0	1	20	3	23	52	10	62	2	0	2	0	0	0
16:15 to 17:15	87	5	92	21	1	22	36	1	37	1	0	1	15	3	18	45	12	57	1	0	1	0	0	0
16:30 to 17:30	90	3	93	21	0	21	43	1	44	1	0	1	12	1	13	38	10	48	0	0	0	0	0	0
16:45 to 17:45	80	5	85	24	0	24	38	0	38	0	0	0	10	1	11	39	10	49	2	0	2	0	0	0
17:00 to 18:00	78	4	82	23	0	23	36	0	36	0	0	0	5	1	6	45	9	54	3	0	3	0	0	0
PM Totals	310	16	326	74	2	76	104	5	109	1	0	1	69	5	74	170	26	196	14	2	16	0	0	0

Approach	Back Kootingal Rd												Nundle Rd											
Direction	Direction 7 (Left Turn)			Direction 8 (Through)			Direction 9 (Right Turn)			Direction 9U (U Turn)			Direction 10 (Left Turn)			Direction 11 (Through)			Direction 12 (Right Turn)			Direction 12U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
6:00 to 7:00	0	0	0	9	0	9	15	0	15	0	0	0	4	0	4	14	7	21	41	2	43	0	1	1
6:15 to 7:15	0	0	0	10	0	10	22	0	22	0	0	0	5	1	6	20	10	30	49	2	51	0	0	0
6:30 to 7:30	1	0	1	7	0	7	23	0	23	0	0	0	6	2	8	27	14	41	61	3	64	0	0	0
6:45 to 7:45	2	0	2	5	0	5	33	2	35	0	0	0	6	2	8	33	10	43	71	3	74	0	0	0
7:00 to 8:00	3	0	3	8	0	8	34	4	38	0	0	0	7	2	9	38	10	48	75	6	81	0	4	4
7:15 to 8:15	4	0	4	14	0	14	35	5	40	0	0	0	8	1	9	34	5	39	91	7	98	0	4	4
7:30 to 8:30	4	0	4	21	0	21	42	5	47	0	0	0	9	0	9	37	1	38	106	7	113	0	4	4
7:45 to 8:45	4	1	5	25	0	25	33	3	36	0	0	0	9	0	9	40	1	41	129	7	136	1	4	5
8:00 to 9:00	9	1	10	23	0	23	31	1	32	0	0	0	9	0	9	43	3	46	131	5	136	1	0	1
AM Totals	12	1	13	40	0	40	80	5	85	0	0	0	20	2	22	95	20	115	247	13	260	1	5	6
15:00 to 16:00	8	0	8	15	1	16	17	0	17	0	0	0	28	2	30	84	8	92	108	5	113	1	0	1
15:15 to 16:15	5	0	5	14	0	14	12	0	12	0	0	0	31	2	33	92	8	100	112	4	116	0	0	0
15:30 to 16:30	4	0	4	14	0	14	9	1	10	0	0	0	37	2	39	95	8	103	111	5	116	0	0	0
15:45 to 16:45	4	0	4	13	0	13	9	2	11	0	0	0	38	2	40	90	12	102	111	5	116	0	0	0
16:00 to 17:00	4	0	4	11	0	11	10	2	12	0	0	0	41	2	43	102	9	111	107	7	114	0	0	0
16:15 to 17:15	5	0	5	9	0	9	8	2	10	0	0	0	43	2	45	97	8	105	97	8	105	0	0	0
16:30 to 17:30	5	0	5	8	0	8	7	1	8	0	0	0	46	1	47	99	7	106	103	6	109	0	1	1
16:45 to 17:45	4	0	4	11	0	11	7	0	7	0	0	0	41	1	42	107	4	111	102	7	109	0	1	1
17:00 to 18:00	4	0	4	11	0	11	9	0	9	0	0	0	35	0	35	93	4	97	95	7	102	0	1	1
PM Totals	16	0	16	37	1	38	36	2	38	0	0	0	104	4	108	279	21	300	310	19	329	1	1	2

Job No. : N5789
Client : EMM
Suburb : Dungowan
Location : 3. Nundle Rd / New England Hwy / Railway St

Day/Date : Wed, 17th June 2020
Weather : Fine
Description : Classified Intersection Count
: Hourly Summary

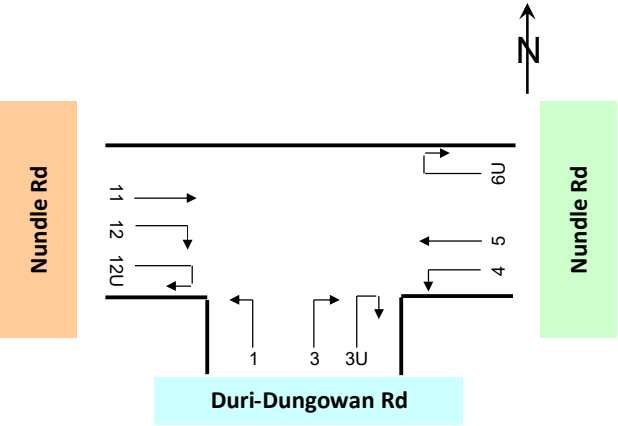


Approach	Nundle Rd												New England Hwy											
Direction	Direction 1 (Left Turn)			Direction 2 (Through)			Direction 3 (Right Turn)			Direction 3U (U Turn)			Direction 4 (Left Turn)			Direction 5 (Through)			Direction 6 (Right Turn)			Direction 6U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
6:00 to 7:00	72	11	83	2	0	2	30	2	32	1	0	1	31	1	32	109	17	126	0	0	0	0	0	0
6:15 to 7:15	84	11	95	2	0	2	29	1	30	1	0	1	32	0	32	122	17	139	1	0	1	0	0	0
6:30 to 7:30	95	5	100	4	0	4	30	2	32	1	0	1	41	1	42	119	15	134	1	0	1	0	0	0
6:45 to 7:45	120	5	125	3	0	3	29	1	30	0	0	0	49	1	50	145	15	160	3	0	3	0	0	0
7:00 to 8:00	145	8	153	3	0	3	33	1	34	0	0	0	49	5	54	166	10	176	3	0	3	0	0	0
7:15 to 8:15	201	16	217	4	0	4	28	2	30	0	0	0	60	5	65	192	12	204	2	0	2	0	0	0
7:30 to 8:30	238	18	256	2	0	2	34	3	37	0	0	0	63	4	67	233	13	246	2	0	2	0	0	0
7:45 to 8:45	258	16	274	3	0	3	38	6	44	0	0	0	70	5	75	226	9	235	0	0	0	0	0	0
8:00 to 9:00	247	14	261	2	0	2	36	8	44	0	0	0	68	2	70	224	12	236	0	0	0	0	0	0
AM Totals	464	33	497	7	0	7	99	11	110	1	0	1	148	8	156	499	39	538	3	0	3	0	0	0
15:00 to 16:00	151	7	158	9	0	9	65	7	72	0	0	0	54	2	56	157	31	188	2	1	3	0	0	0
15:15 to 16:15	153	9	162	7	0	7	74	7	81	0	0	0	57	4	61	151	32	183	3	1	4	0	0	0
15:30 to 16:30	124	9	133	5	0	5	67	8	75	0	0	0	60	5	65	156	35	191	4	1	5	0	0	0
15:45 to 16:45	100	11	111	4	0	4	61	4	65	0	0	0	60	5	65	139	31	170	4	1	5	0	0	0
16:00 to 17:00	92	15	107	2	0	2	58	2	60	0	0	0	56	6	62	121	27	148	4	0	4	0	0	0
16:15 to 17:15	83	14	97	3	0	3	56	3	59	0	0	0	44	6	50	121	23	144	5	0	5	0	0	0
16:30 to 17:30	75	14	89	2	0	2	56	2	58	0	0	0	42	4	46	115	21	136	4	0	4	0	0	0
16:45 to 17:45	70	14	84	2	0	2	53	2	55	0	0	0	41	5	46	109	20	129	4	0	4	0	0	0
17:00 to 18:00	79	9	88	4	0	4	53	3	56	0	0	0	41	5	46	110	19	129	4	0	4	0	0	0
PM Totals	322	31	353	15	0	15	176	12	188	0	0	0	151	13	164	388	77	465	10	1	11	0	0	0

Approach	Railway St												New England Hwy											
Direction	Direction 7 (Left Turn)			Direction 8 (Through)			Direction 9 (Right Turn)			Direction 9U (U Turn)			Direction 10 (Left Turn)			Direction 11 (Through)			Direction 12 (Right Turn)			Direction 12U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
6:00 to 7:00	0	1	1	0	0	0	2	0	2	0	0	0	3	0	3	70	37	107	23	9	32	0	0	0
6:15 to 7:15	0	1	1	1	0	1	3	0	3	0	0	0	3	0	3	65	40	105	35	12	47	0	0	0
6:30 to 7:30	0	1	1	2	0	2	3	0	3	0	0	0	7	1	8	69	34	103	48	18	66	0	0	0
6:45 to 7:45	0	2	2	3	1	4	5	1	6	0	0	0	7	2	9	64	34	98	53	14	67	0	0	0
7:00 to 8:00	0	1	1	4	1	5	6	2	8	0	0	0	6	2	8	66	39	105	63	14	77	1	0	1
7:15 to 8:15	0	1	1	4	1	5	10	2	12	0	0	0	9	2	11	87	34	121	68	12	80	1	0	1
7:30 to 8:30	0	1	1	3	1	4	12	2	14	0	0	0	8	2	10	98	30	128	83	7	90	1	0	1
7:45 to 8:45	3	0	3	3	0	3	12	1	13	0	0	0	9	1	10	94	25	119	103	6	109	1	0	1
8:00 to 9:00	3	0	3	4	0	4	10	0	10	0	0	0	10	1	11	105	21	126	114	7	121	0	0	0
AM Totals	3	2	5	8	1	9	18	2	20	0	0	0	19	3	22	241	97	338	200	30	230	1	0	1
15:00 to 16:00	5	0	5	3	0	3	8	0	8	0	0	0	14	1	15	241	21	262	162	12	174	0	0	0
15:15 to 16:15	7	0	7	7	0	7	10	1	11	0	0	0	18	1	19	239	25	264	165	9	174	0	0	0
15:30 to 16:30	6	0	6	8	0	8	14	2	16	0	0	0	21	1	22	244	20	264	168	9	177	0	0	0
15:45 to 16:45	5	0	5	9	0	9	11	2	13	0	0	0	17	1	18	238	23	261	178	12	190	0	0	0
16:00 to 17:00	3	0	3	11	0	11	8	2	10	0	0	0	18	0	18	257	23	280	184	11	195	0	0	0
16:15 to 17:15	3	0	3	7	0	7	8	1	9	0	0	0	12	0	12	251	18	269	189	11	200	0	0	0
16:30 to 17:30	3	0	3	4	0	4	5	0	5	0	0	0	10	0	10	244	17	261	207	9	216	0	0	0
16:45 to 17:45	3	0	3	3	0	3	5	0	5	0	0	0	10	0	10	243	12	255	204	7	211	0	0	0
17:00 to 18:00	3	1	4	3	0	3	5	0	5	0	0	0	10	0	10	227	12	239	182	5	187	0	0	0
PM Totals	11	1	12	17	0	17	21	2	23	0	0	0	42	1	43	725	56	781	528	28	556	0	0	0

Job No. : N5789
Client : EMM
Suburb : Dungowan
Location : 4. Nundle Rd / Duri-Dungowan Rd

Day/Date : Wed, 17th June 2020
Weather : Fine
Description : Classified Intersection Count
: Hourly Summary



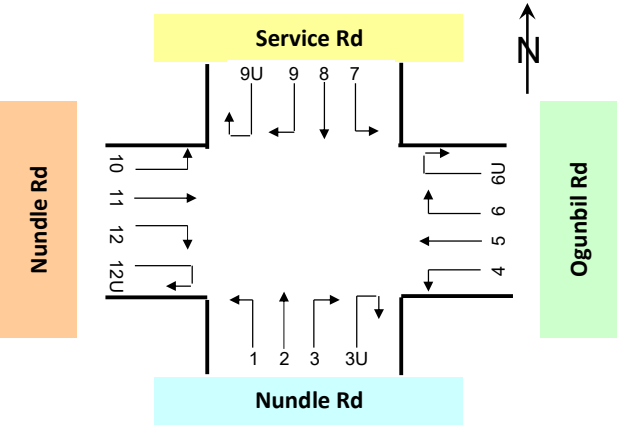
Approach	Duri-Dungowan Rd									Nundle Rd								
Direction	Direction 1 (Left Turn)			Direction 3 (Right Turn)			Direction 3U (U Turn)			Direction 4 (Left Turn)			Direction 5 (Through)			Direction 6U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
6:00 to 7:00	2	0	2	2	0	2	0	0	0	4	0	4	40	1	41	0	0	0
6:15 to 7:15	3	0	3	5	0	5	0	0	0	5	0	5	44	2	46	0	0	0
6:30 to 7:30	4	0	4	5	0	5	0	0	0	5	0	5	68	3	71	0	0	0
6:45 to 7:45	6	0	6	4	1	5	0	0	0	9	1	10	70	6	76	0	0	0
7:00 to 8:00	10	0	10	5	1	6	0	0	0	8	1	9	95	7	102	0	0	0
7:15 to 8:15	11	0	11	4	1	5	0	0	0	8	1	9	106	8	114	0	0	0
7:30 to 8:30	15	0	15	5	2	7	0	0	0	7	1	8	101	8	109	0	0	0
7:45 to 8:45	13	0	13	4	1	5	0	0	0	3	0	3	90	6	96	0	0	0
8:00 to 9:00	8	0	8	5	1	6	0	0	0	6	1	7	70	9	79	0	0	0
AM Totals	20	0	20	12	2	14	0	0	0	18	2	20	205	17	222	0	0	0
15:00 to 16:00	4	0	4	4	0	4	0	0	0	6	1	7	49	5	54	0	0	0
15:15 to 16:15	5	0	5	4	0	4	0	0	0	6	1	7	47	4	51	0	0	0
15:30 to 16:30	4	0	4	6	1	7	0	0	0	7	2	9	43	8	51	0	0	0
15:45 to 16:45	3	1	4	8	1	9	0	0	0	6	1	7	38	9	47	0	0	0
16:00 to 17:00	3	1	4	13	1	14	0	0	0	3	1	4	34	9	43	0	0	0
16:15 to 17:15	4	1	5	14	1	15	0	0	0	1	1	2	29	10	39	0	0	0
16:30 to 17:30	4	1	5	13	0	13	0	0	0	0	0	0	27	7	34	0	0	0
16:45 to 17:45	4	0	4	11	0	11	0	0	0	3	0	3	34	5	39	0	0	0
17:00 to 18:00	3	0	3	5	1	6	0	0	0	4	1	5	32	4	36	0	0	0
PM Totals	10	1	11	22	2	24	0	0	0	13	3	16	115	18	133	0	0	0

Approach	Nundle Rd								
Direction									
Time Period	Direction 11 (Through)			Direction 12 (Right Turn)			Direction 12U (U Turn)		
	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
6:00 to 7:00	14	7	21	0	1	1	0	0	0
6:15 to 7:15	15	7	22	1	1	2	0	0	0
6:30 to 7:30	16	11	27	2	0	2	0	0	0
6:45 to 7:45	23	14	37	3	0	3	0	0	0
7:00 to 8:00	24	9	33	4	0	4	0	0	0
7:15 to 8:15	32	9	41	3	0	3	0	0	0
7:30 to 8:30	33	4	37	4	0	4	0	0	0
7:45 to 8:45	26	1	27	5	0	5	0	0	0
8:00 to 9:00	25	2	27	4	0	4	0	0	0
AM Totals	63	18	81	8	1	9	0	0	0
15:00 to 16:00	44	3	47	4	0	4	0	0	0
15:15 to 16:15	52	4	56	4	0	4	0	0	0
15:30 to 16:30	62	4	66	7	0	7	0	0	0
15:45 to 16:45	66	6	72	7	0	7	0	0	0
16:00 to 17:00	80	8	88	5	0	5	0	0	0
16:15 to 17:15	84	6	90	5	0	5	0	0	0
16:30 to 17:30	88	5	93	3	0	3	0	0	0
16:45 to 17:45	84	3	87	2	0	2	0	0	0
17:00 to 18:00	78	0	78	5	0	5	0	0	0
PM Totals	202	11	213	14	0	14	0	0	0

Job No. : N5789
Client : EMM
Suburb : Dungowan
Location : 5. Nundle Rd / Ogunbil Rd

Day/Date : Wed, 17th June 2020
Weather : Fine
Description : Classified Intersection Count

: Hourly Summary



Approach	Nundle Rd												Ogunbil Rd											
Direction	Direction 1 (Left Turn)			Direction 2 (Through)			Direction 3 (Right Turn)			Direction 3U (U Turn)			Direction 4 (Left Turn)			Direction 5 (Through)			Direction 6 (Right Turn)			Direction 6U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
6:00 to 7:00	26	2	28	0	0	0	2	0	2	0	0	0	0	1	1	17	0	17	0	0	0	0	0	0
6:15 to 7:15	31	2	33	0	0	0	2	0	2	0	0	0	0	1	1	18	0	18	0	0	0	0	0	0
6:30 to 7:30	42	3	45	0	0	0	2	0	2	0	0	0	0	0	0	25	0	25	0	0	0	0	0	0
6:45 to 7:45	51	5	56	0	0	0	1	0	1	0	0	0	0	0	0	25	1	26	0	0	0	0	0	0
7:00 to 8:00	66	5	71	0	0	0	0	0	0	0	0	0	0	0	0	33	2	35	0	0	0	0	0	0
7:15 to 8:15	71	5	76	0	0	0	0	0	0	0	0	0	0	0	0	38	4	42	0	0	0	0	0	0
7:30 to 8:30	65	5	70	0	0	0	0	0	0	0	0	0	0	0	0	42	4	46	0	0	0	0	0	0
7:45 to 8:45	53	3	56	0	0	0	0	1	1	0	0	0	1	0	1	37	3	40	0	0	0	0	0	0
8:00 to 9:00	42	3	45	0	0	0	0	2	2	0	0	0	1	0	1	34	7	41	0	0	0	0	0	0
AM Totals	134	10	144	0	0	0	2	2	4	0	0	0	1	1	2	84	9	93	0	0	0	0	0	0
15:00 to 16:00	42	1	43	0	0	0	1	0	1	0	0	0	1	2	3	12	5	17	0	0	0	0	0	0
15:15 to 16:15	39	3	42	0	0	0	1	0	1	0	0	0	0	1	1	13	4	17	0	0	0	0	0	0
15:30 to 16:30	34	6	40	0	0	0	0	0	0	0	0	0	0	1	1	16	4	20	0	0	0	0	0	0
15:45 to 16:45	28	5	33	0	0	0	0	0	0	0	0	0	1	1	2	18	5	23	0	0	0	0	0	0
16:00 to 17:00	18	6	24	0	0	0	0	1	1	0	0	0	2	0	2	21	4	25	0	0	0	0	0	0
16:15 to 17:15	16	5	21	0	0	0	0	1	1	0	0	0	2	0	2	16	4	20	0	0	0	0	0	0
16:30 to 17:30	17	4	21	0	0	0	0	1	1	1	0	1	3	0	3	14	3	17	0	0	0	0	0	0
16:45 to 17:45	16	5	21	0	0	0	0	1	1	1	0	1	3	0	3	20	1	21	0	0	0	0	0	0
17:00 to 18:00	21	4	25	0	0	0	0	0	0	1	0	1	2	0	2	15	3	18	0	0	0	0	0	0
PM Totals	81	11	92	0	0	0	1	1	2	1	0	1	5	2	7	48	12	60	0	0	0	0	0	0

Approach	Service Rd												Nundle Rd											
Direction	Direction 7 (Left Turn)			Direction 8 (Through)			Direction 9 (Right Turn)			Direction 9U (U Turn)			Direction 10 (Left Turn)			Direction 11 (Through)			Direction 12 (Right Turn)			Direction 12U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
6:00 to 7:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	4	11	8	3	11	0	0	0
6:15 to 7:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	4	13	12	2	14	0	0	0
6:30 to 7:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	5	14	14	4	18	0	1	1
6:45 to 7:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	9	23	15	5	20	0	1	1
7:00 to 8:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	6	21	18	3	21	0	1	1
7:15 to 8:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	7	23	19	3	22	0	1	1
7:30 to 8:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	5	23	19	2	21	0	0	0
7:45 to 8:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	1	14	15	1	16	0	0	0
8:00 to 9:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	1	15	14	2	16	0	0	0
AM Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	11	47	40	8	48	0	1	1
15:00 to 16:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	2	13	35	0	35	1	0	1
15:15 to 16:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	2	15	42	2	44	0	0	0
15:30 to 16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	2	28	41	3	44	0	0	0
15:45 to 16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	2	31	45	4	49	0	0	0
16:00 to 17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	2	37	48	6	54	0	0	0
16:15 to 17:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	2	45	46	5	51	0	0	0
16:30 to 17:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	1	40	54	4	58	0	0	0
16:45 to 17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	1	39	51	3	54	0	0	0
17:00 to 18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0	33	52	2	54	0	0	0
PM Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	4	83	135	8	143	1	0	1

Annexure D

SIDRA results

MOVEMENT SUMMARY

Site: 101A [New England Hwy/Nundle Rd/Railway St AM (Site Folder: Existing (survey))]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Nundle Road (S)														
1	L2	274	16	288	5.8	0.287	7.1	LOS A	1.2	9.0	0.40	0.65	0.40	52.1
2	T1	3	0	3	0.0	0.184	13.1	LOS A	0.6	4.8	0.68	0.86	0.68	43.8
3	R2	44	6	46	13.6	0.184	17.0	LOS B	0.6	4.8	0.68	0.86	0.68	45.8
Approach		321	22	338	6.9	0.287	8.5	LOS A	1.2	9.0	0.44	0.68	0.44	51.1
East: New England Highway (E)														
4	L2	75	5	79	6.7	0.045	5.6	LOS A	0.0	0.0	0.00	0.57	0.00	53.3
5	T1	235	9	247	3.8	0.130	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
6	R2	1	0	1	0.0	0.001	5.9	LOS A	0.0	0.0	0.25	0.53	0.25	48.9
Approach		311	14	327	4.5	0.130	1.4	NA	0.0	0.0	0.00	0.14	0.00	58.2
North: Railway Street (N)														
7	L2	3	0	3	0.0	0.096	5.1	LOS A	0.3	2.2	0.66	0.78	0.66	41.4
8	T1	3	0	3	0.0	0.096	12.2	LOS A	0.3	2.2	0.66	0.78	0.66	41.8
9	R2	13	1	14	7.7	0.096	24.5	LOS B	0.3	2.2	0.66	0.78	0.66	41.3
Approach		19	1	20	5.3	0.096	19.5	LOS B	0.3	2.2	0.66	0.78	0.66	41.4
West: New England Highway (W)														
10	L2	10	1	11	10.0	0.006	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
11	T1	119	25	125	21.0	0.073	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
12	R2	109	6	115	5.5	0.115	7.2	LOS A	0.5	3.4	0.42	0.65	0.42	52.1
Approach		238	32	251	13.4	0.115	3.6	NA	0.5	3.4	0.19	0.32	0.19	55.8
All Vehicles		889	69	936	7.8	0.287	4.9	NA	1.2	9.0	0.23	0.40	0.23	54.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

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 movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101B [New England Hwy/Nundle Rd/Railway St PM (Site Folder: Existing (survey))]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Nundle Road (S)														
1	L2	162	9	171	5.6	0.161	6.6	LOS A	0.6	4.6	0.33	0.60	0.33	52.4
2	T1	7	0	7	0.0	0.474	24.1	LOS B	2.0	15.1	0.84	1.03	1.20	38.1
3	R2	81	7	85	8.6	0.474	29.6	LOS C	2.0	15.1	0.84	1.03	1.20	39.7
Approach		250	16	263	6.4	0.474	14.6	LOS B	2.0	15.1	0.51	0.75	0.63	47.0
East: New England Highway (E)														
4	L2	61	4	64	6.6	0.036	5.6	LOS A	0.0	0.0	0.00	0.57	0.00	53.3
5	T1	183	32	193	17.5	0.110	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
6	R2	4	1	4	25.0	0.005	7.3	LOS A	0.0	0.1	0.40	0.58	0.40	48.0
Approach		248	37	261	14.9	0.110	1.5	NA	0.0	0.1	0.01	0.15	0.01	57.9
North: Railway Street (N)														
7	L2	7	0	7	0.0	0.121	5.8	LOS A	0.4	2.8	0.71	0.80	0.71	41.6
8	T1	7	0	7	0.0	0.121	16.9	LOS B	0.4	2.8	0.71	0.80	0.71	42.0
9	R2	11	1	12	9.1	0.121	28.9	LOS C	0.4	2.8	0.71	0.80	0.71	41.4
Approach		25	1	26	4.0	0.121	19.1	LOS B	0.4	2.8	0.71	0.80	0.71	41.6
West: New England Highway (W)														
10	L2	19	1	20	5.3	0.011	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.4
11	T1	264	25	278	9.5	0.153	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
12	R2	174	9	183	5.2	0.172	7.0	LOS A	0.7	5.4	0.40	0.63	0.40	52.2
Approach		457	35	481	7.7	0.172	2.9	NA	0.7	5.4	0.15	0.26	0.15	56.4
All Vehicles		980	89	1032	9.1	0.474	5.9	NA	2.0	15.1	0.22	0.37	0.25	53.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

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 movements.


Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

 **Site: 102A [Nundle Rd/Back Kootingal Rd/O'Briens Ln AM
(Site Folder: Existing (survey))]**

Site Category: (None)
Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
East: Nundle Road (E)														
4a	L1	44	2	46	4.5	0.196	5.4	LOSA	1.1	7.6	0.41	0.53	0.41	53.7
5	T1	159	5	167	3.1	0.196	5.8	LOSA	1.1	7.6	0.41	0.53	0.41	54.0
6b	R3	2	0	2	0.0	0.196	10.4	LOSA	1.1	7.6	0.41	0.53	0.41	54.2
Approach		205	7	216	3.4	0.196	5.8	LOSA	1.1	7.6	0.41	0.53	0.41	53.9
NorthEast: Back Kootingal Road (NE)														
24b	L3	5	1	5	20.0	0.064	6.0	LOSA	0.3	2.3	0.36	0.58	0.36	51.3
25	T1	25	0	26	0.0	0.064	5.6	LOSA	0.3	2.3	0.36	0.58	0.36	53.4
26a	R1	36	3	38	8.3	0.064	8.5	LOSA	0.3	2.3	0.36	0.58	0.36	52.4
Approach		66	4	69	6.1	0.064	7.2	LOSA	0.3	2.3	0.36	0.58	0.36	52.7
West: Nundle Road (W)														
10a	L1	9	0	9	0.0	0.138	4.3	LOSA	0.8	5.6	0.13	0.61	0.13	52.5
11	T1	41	1	43	2.4	0.138	4.7	LOSA	0.8	5.6	0.13	0.61	0.13	52.8
12b	R3	136	7	143	5.1	0.138	9.4	LOSA	0.8	5.6	0.13	0.61	0.13	52.7
Approach		186	8	196	4.3	0.138	8.1	LOSA	0.8	5.6	0.13	0.61	0.13	52.7
SouthWest: O'Brien Lane (SW)														
30b	L3	125	10	132	8.0	0.147	5.9	LOSA	0.8	5.9	0.41	0.59	0.41	52.5
31	T1	8	0	8	0.0	0.147	5.7	LOSA	0.8	5.9	0.41	0.59	0.41	54.2
32a	R1	17	0	18	0.0	0.147	8.5	LOSA	0.8	5.9	0.41	0.59	0.41	53.6
Approach		150	10	158	6.7	0.147	6.2	LOSA	0.8	5.9	0.41	0.59	0.41	52.7
All Vehicles		607	29	639	4.8	0.196	6.7	LOSA	1.1	7.6	0.32	0.57	0.32	53.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

 **Site: 102B [Nundle Rd/Back Kootingal Rd/O'Briens Ln PM
(Site Folder: Existing (survey))]**

Site Category: (None)
Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
East: Nundle Road (E)														
4a	L1	46	1	48	2.2	0.130	5.0	LOS A	0.7	5.0	0.34	0.51	0.34	53.9
5	T1	84	6	88	7.1	0.130	5.5	LOS A	0.7	5.0	0.34	0.51	0.34	54.1
6b	R3	10	2	11	20.0	0.130	10.4	LOS A	0.7	5.0	0.34	0.51	0.34	53.5
Approach		140	9	147	6.4	0.130	5.6	LOS A	0.7	5.0	0.34	0.51	0.34	54.0
NorthEast: Back Kootingal Road (NE)														
24b	L3	5	0	5	0.0	0.031	5.9	LOS A	0.2	1.1	0.42	0.57	0.42	52.1
25	T1	14	0	15	0.0	0.031	5.9	LOS A	0.2	1.1	0.42	0.57	0.42	53.5
26a	R1	12	0	13	0.0	0.031	8.7	LOS A	0.2	1.1	0.42	0.57	0.42	52.9
Approach		31	0	33	0.0	0.031	7.0	LOS A	0.2	1.1	0.42	0.57	0.42	53.0
West: Nundle Road (W)														
10a	L1	33	2	35	6.1	0.207	4.7	LOS A	1.2	8.7	0.28	0.57	0.28	52.8
11	T1	100	8	105	8.0	0.207	5.2	LOS A	1.2	8.7	0.28	0.57	0.28	53.0
12b	R3	116	4	122	3.4	0.207	9.8	LOS A	1.2	8.7	0.28	0.57	0.28	53.2
Approach		249	14	262	5.6	0.207	7.2	LOS A	1.2	8.7	0.28	0.57	0.28	53.1
SouthWest: O'Brien Lane (SW)														
30b	L3	157	9	165	5.7	0.201	5.3	LOS A	1.1	8.4	0.31	0.55	0.31	52.7
31	T1	31	1	33	3.2	0.201	5.2	LOS A	1.1	8.4	0.31	0.55	0.31	54.2
32a	R1	44	4	46	9.1	0.201	8.1	LOS A	1.1	8.4	0.31	0.55	0.31	53.3
Approach		232	14	244	6.0	0.201	5.8	LOS A	1.1	8.4	0.31	0.55	0.31	53.0
All Vehicles		652	37	686	5.7	0.207	6.4	LOS A	1.2	8.7	0.31	0.55	0.31	53.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▼ Site: 103A [Nundle Rd/Duri-Dungowan Rd AM (Site Folder: Existing (survey))]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Duri-Dungowan Road (S)														
1	L2	13	0	14	0.0	0.014	7.2	LOS A	0.1	0.4	0.19	0.59	0.19	64.6
3	R2	5	1	5	20.0	0.014	7.6	LOS A	0.1	0.4	0.19	0.59	0.19	57.9
Approach		18	1	19	5.6	0.014	7.3	LOS A	0.1	0.4	0.19	0.59	0.19	62.6
East: Nundle Road (E)														
4	L2	3	0	3	0.0	0.056	7.0	LOS A	0.0	0.0	0.00	0.02	0.00	74.3
5	T1	96	6	101	6.3	0.056	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	79.6
Approach		99	6	104	6.1	0.056	0.2	NA	0.0	0.0	0.00	0.02	0.00	79.4
West: Nundle Road (W)														
11	T1	27	1	28	3.7	0.018	0.1	LOS A	0.0	0.2	0.07	0.10	0.07	77.6
12	R2	5	0	5	0.0	0.018	6.9	LOS A	0.0	0.2	0.07	0.10	0.07	72.0
Approach		32	1	34	3.1	0.018	1.1	NA	0.0	0.2	0.07	0.10	0.07	76.7
All Vehicles		149	8	157	5.4	0.056	1.3	NA	0.1	0.4	0.04	0.11	0.04	76.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

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 movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▼ Site: 103B [Nundle Rd/Duri-Dungowan Rd PM (Site Folder: Existing (survey))]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Duri-Dungowan Road (S)														
1	L2	5	0	5	0.0	0.007	7.1	LOS A	0.0	0.2	0.14	0.59	0.14	64.9
3	R2	4	0	4	0.0	0.007	7.0	LOS A	0.0	0.2	0.14	0.59	0.14	64.4
Approach		9	0	9	0.0	0.007	7.0	LOS A	0.0	0.2	0.14	0.59	0.14	64.7
East: Nundle Road (E)														
4	L2	7	1	7	14.3	0.033	7.2	LOS A	0.0	0.0	0.00	0.08	0.00	67.7
5	T1	51	4	54	7.8	0.033	0.0	LOS A	0.0	0.0	0.00	0.08	0.00	78.6
Approach		58	5	61	8.6	0.033	0.9	NA	0.0	0.0	0.00	0.08	0.00	77.1
West: Nundle Road (W)														
11	T1	56	4	59	7.1	0.034	0.0	LOS A	0.0	0.2	0.02	0.04	0.02	79.0
12	R2	4	0	4	0.0	0.034	6.8	LOS A	0.0	0.2	0.02	0.04	0.02	73.1
Approach		60	4	63	6.7	0.034	0.5	NA	0.0	0.2	0.02	0.04	0.02	78.6
All Vehicles		127	9	134	7.1	0.034	1.1	NA	0.0	0.2	0.02	0.10	0.02	76.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

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 movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

 Site: 104A [Nundle Rd/Ogunbil Rd AM (Site Folder: Existing (survey))]

Site Category: (None)
Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Nundle Road (S)														
1	L2	56	3	59	5.4	0.049	5.0	LOS A	0.2	1.7	0.16	0.53	0.16	53.3
3	R2	1	1	1	100.0	0.049	9.6	LOS A	0.2	1.7	0.16	0.53	0.16	49.8
Approach		57	4	60	7.0	0.049	5.1	LOS A	0.2	1.7	0.16	0.53	0.16	53.2
East: Ogunbil Road (E)														
4	L2	1	0	1	0.0	0.033	4.8	LOS A	0.1	1.1	0.09	0.47	0.09	53.7
5	T1	40	3	42	7.5	0.033	4.9	LOS A	0.1	1.1	0.09	0.47	0.09	54.4
Approach		41	3	43	7.3	0.033	4.9	LOS A	0.1	1.1	0.09	0.47	0.09	54.4
West: Nundle Road (W)														
11	T1	14	1	15	7.1	0.021	4.9	LOS A	0.1	0.7	0.02	0.60	0.02	53.4
12	R2	16	1	17	6.3	0.021	8.0	LOS A	0.1	0.7	0.02	0.60	0.02	53.0
Approach		30	2	32	6.7	0.021	6.5	LOS A	0.1	0.7	0.02	0.60	0.02	53.2
All Vehicles		128	9	135	7.0	0.049	5.4	LOS A	0.2	1.7	0.10	0.52	0.10	53.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

 Site: 104B [Nundle Rd/Ogunbil Rd PM (Site Folder: Existing (survey))]

Site Category: (None)
Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Nundle Road (S)														
1	L2	42	3	44	7.1	0.035	4.9	LOS A	0.2	1.2	0.10	0.53	0.10	53.4
3	R2	1	0	1	0.0	0.035	8.0	LOS A	0.2	1.2	0.10	0.53	0.10	54.3
Approach		43	3	45	7.0	0.035	5.0	LOS A	0.2	1.2	0.10	0.53	0.10	53.4
East: Ogunbil Road (E)														
4	L2	1	1	1	100.0	0.017	6.4	LOS A	0.1	0.7	0.17	0.47	0.17	49.5
5	T1	17	4	18	23.5	0.017	5.3	LOS A	0.1	0.7	0.17	0.47	0.17	53.5
Approach		18	5	19	27.8	0.017	5.3	LOS A	0.1	0.7	0.17	0.47	0.17	53.2
West: Nundle Road (W)														
11	T1	15	2	16	13.3	0.039	4.9	LOS A	0.2	1.4	0.02	0.64	0.02	52.7
12	R2	44	2	46	4.5	0.039	7.9	LOS A	0.2	1.4	0.02	0.64	0.02	52.6
Approach		59	4	62	6.8	0.039	7.2	LOS A	0.2	1.4	0.02	0.64	0.02	52.6
All Vehicles		120	12	126	10.0	0.039	6.1	LOS A	0.2	1.4	0.07	0.58	0.07	53.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101C [New England Hwy/Nundle Rd/Railway St AM (Site Folder: Future (with development traffic))]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Nundle Road (S)														
1	L2	281	23	296	8.2	0.298	7.2	LOS A	1.3	9.6	0.41	0.65	0.41	52.0
2	T1	3	0	3	0.0	0.197	14.1	LOS A	0.7	5.2	0.70	0.88	0.72	43.1
3	R2	44	6	46	13.6	0.197	18.3	LOS B	0.7	5.2	0.70	0.88	0.72	45.0
Approach		328	29	345	8.8	0.298	8.7	LOS A	1.3	9.6	0.45	0.68	0.45	50.9
East: New England Highway (E)														
4	L2	75	5	79	6.7	0.045	5.6	LOS A	0.0	0.0	0.00	0.57	0.00	53.3
5	T1	235	9	247	3.8	0.130	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
6	R2	1	0	1	0.0	0.001	5.9	LOS A	0.0	0.0	0.25	0.53	0.25	48.9
Approach		311	14	327	4.5	0.130	1.4	NA	0.0	0.0	0.00	0.14	0.00	58.2
North: Railway Street (N)														
7	L2	3	0	3	0.0	0.106	5.1	LOS A	0.3	2.4	0.69	0.79	0.69	40.6
8	T1	3	0	3	0.0	0.106	13.0	LOS A	0.3	2.4	0.69	0.79	0.69	40.9
9	R2	13	1	14	7.7	0.106	27.0	LOS B	0.3	2.4	0.69	0.79	0.69	40.4
Approach		19	1	20	5.3	0.106	21.3	LOS B	0.3	2.4	0.69	0.79	0.69	40.5
West: New England Highway (W)														
10	L2	10	1	11	10.0	0.006	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
11	T1	119	25	125	21.0	0.073	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
12	R2	139	13	146	9.4	0.151	7.4	LOS A	0.6	4.7	0.44	0.66	0.44	51.9
Approach		268	39	282	14.6	0.151	4.1	NA	0.6	4.7	0.23	0.36	0.23	55.2
All Vehicles		926	83	975	9.0	0.298	5.2	NA	1.3	9.6	0.24	0.41	0.24	54.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

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 movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

Site: 101D [New England Hwy/Nundle Rd/Railway St PM (Site Folder: Future (with development traffic))]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Nundle Road (S)														
1	L2	193	16	203	8.3	0.195	6.7	LOS A	0.8	5.9	0.34	0.61	0.34	52.2
2	T1	7	0	7	0.0	0.484	24.8	LOS B	2.1	15.4	0.85	1.03	1.22	37.8
3	R2	81	7	85	8.6	0.484	30.4	LOS C	2.1	15.4	0.85	1.03	1.22	39.4
Approach		281	23	296	8.2	0.484	14.0	LOS A	2.1	15.4	0.50	0.74	0.61	47.3
East: New England Highway (E)														
4	L2	61	4	64	6.6	0.036	5.6	LOS A	0.0	0.0	0.00	0.57	0.00	53.3
5	T1	183	32	193	17.5	0.110	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
6	R2	4	1	4	25.0	0.005	7.3	LOS A	0.0	0.1	0.40	0.58	0.40	48.0
Approach		248	37	261	14.9	0.110	1.5	NA	0.0	0.1	0.01	0.15	0.01	57.9
North: Railway Street (N)														
7	L2	7	0	7	0.0	0.131	5.8	LOS A	0.4	2.9	0.72	0.81	0.72	41.0
8	T1	7	0	7	0.0	0.131	17.3	LOS B	0.4	2.9	0.72	0.81	0.72	41.3
9	R2	11	1	12	9.1	0.131	31.8	LOS C	0.4	2.9	0.72	0.81	0.72	40.8
Approach		25	1	26	4.0	0.131	20.5	LOS B	0.4	2.9	0.72	0.81	0.72	41.0
West: New England Highway (W)														
10	L2	19	1	20	5.3	0.011	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.4
11	T1	264	25	278	9.5	0.153	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
12	R2	181	16	191	8.8	0.183	7.1	LOS A	0.8	6.0	0.40	0.64	0.40	52.0
Approach		464	42	488	9.1	0.183	3.0	NA	0.8	6.0	0.16	0.27	0.16	56.3
All Vehicles		1018	103	1072	10.1	0.484	6.1	NA	2.1	15.4	0.23	0.39	0.26	53.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

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 movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

 **Site: 102C [Nundle Rd/Back Kootingal Rd/O'Briens Ln AM
(Site Folder: Future (with development traffic))]**

Site Category: (None)
Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
East: Nundle Road (E)														
4a	L1	44	2	46	4.5	0.207	5.4	LOS A	1.1	8.3	0.41	0.54	0.41	53.6
5	T1	166	12	175	7.2	0.207	5.9	LOS A	1.1	8.3	0.41	0.54	0.41	53.9
6b	R3	2	0	2	0.0	0.207	10.4	LOS A	1.1	8.3	0.41	0.54	0.41	54.2
Approach		212	14	223	6.6	0.207	5.9	LOS A	1.1	8.3	0.41	0.54	0.41	53.8
NorthEast: Back Kootingal Road (NE)														
24b	L3	5	1	5	20.0	0.066	6.2	LOS A	0.3	2.3	0.39	0.59	0.39	51.2
25	T1	25	0	26	0.0	0.066	5.7	LOS A	0.3	2.3	0.39	0.59	0.39	53.3
26a	R1	36	3	38	8.3	0.066	8.7	LOS A	0.3	2.3	0.39	0.59	0.39	52.3
Approach		66	4	69	6.1	0.066	7.4	LOS A	0.3	2.3	0.39	0.59	0.39	52.6
West: Nundle Road (W)														
10a	L1	9	0	9	0.0	0.161	4.3	LOS A	0.9	6.8	0.14	0.59	0.14	52.8
11	T1	71	8	75	11.3	0.161	4.8	LOS A	0.9	6.8	0.14	0.59	0.14	52.8
12b	R3	136	7	143	5.1	0.161	9.4	LOS A	0.9	6.8	0.14	0.59	0.14	53.0
Approach		216	15	227	6.9	0.161	7.7	LOS A	0.9	6.8	0.14	0.59	0.14	52.9
SouthWest: O'Brien Lane (SW)														
30b	L3	125	10	132	8.0	0.148	5.9	LOS A	0.8	6.0	0.42	0.59	0.42	52.4
31	T1	8	0	8	0.0	0.148	5.7	LOS A	0.8	6.0	0.42	0.59	0.42	54.2
32a	R1	17	0	18	0.0	0.148	8.6	LOS A	0.8	6.0	0.42	0.59	0.42	53.5
Approach		150	10	158	6.7	0.148	6.2	LOS A	0.8	6.0	0.42	0.59	0.42	52.6
All Vehicles		644	43	678	6.7	0.207	6.7	LOS A	1.1	8.3	0.32	0.57	0.32	53.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

 **Site: 102D [Nundle Rd/Back Kootingal Rd/O'Briens Ln PM
(Site Folder: Future (with development traffic))]**

Site Category: (None)
Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
East: Nundle Road (E)														
4a	L1	46	1	48	2.2	0.160	5.0	LOS A	0.9	6.5	0.35	0.51	0.35	53.9
5	T1	115	13	121	11.3	0.160	5.6	LOS A	0.9	6.5	0.35	0.51	0.35	53.9
6b	R3	10	2	11	20.0	0.160	10.4	LOS A	0.9	6.5	0.35	0.51	0.35	53.5
Approach		171	16	180	9.4	0.160	5.7	LOS A	0.9	6.5	0.35	0.51	0.35	53.9
NorthEast: Back Kootingal Road (NE)														
24b	L3	5	0	5	0.0	0.031	5.9	LOS A	0.2	1.1	0.43	0.57	0.43	52.1
25	T1	14	0	15	0.0	0.031	5.9	LOS A	0.2	1.1	0.43	0.57	0.43	53.4
26a	R1	12	0	13	0.0	0.031	8.7	LOS A	0.2	1.1	0.43	0.57	0.43	52.8
Approach		31	0	33	0.0	0.031	7.0	LOS A	0.2	1.1	0.43	0.57	0.43	53.0
West: Nundle Road (W)														
10a	L1	33	2	35	6.1	0.216	4.7	LOS A	1.3	9.4	0.28	0.56	0.28	52.7
11	T1	107	15	113	14.0	0.216	5.2	LOS A	1.3	9.4	0.28	0.56	0.28	52.8
12b	R3	116	4	122	3.4	0.216	9.8	LOS A	1.3	9.4	0.28	0.56	0.28	53.2
Approach		256	21	269	8.2	0.216	7.2	LOS A	1.3	9.4	0.28	0.56	0.28	53.0
SouthWest: O'Brien Lane (SW)														
30b	L3	157	9	165	5.7	0.211	5.5	LOS A	1.2	8.9	0.36	0.57	0.36	52.5
31	T1	31	1	33	3.2	0.211	5.5	LOS A	1.2	8.9	0.36	0.57	0.36	54.1
32a	R1	44	4	46	9.1	0.211	8.4	LOS A	1.2	8.9	0.36	0.57	0.36	53.1
Approach		232	14	244	6.0	0.211	6.1	LOS A	1.2	8.9	0.36	0.57	0.36	52.9
All Vehicles		690	51	726	7.4	0.216	6.4	LOS A	1.3	9.4	0.33	0.55	0.33	53.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 103C [Nundle Rd/Duri-Dungowan Rd AM (Site Folder: Future (with development traffic))]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Duri-Dungowan Road (S)														
1	L2	14	1	15	7.1	0.016	7.4	LOS A	0.1	0.4	0.21	0.59	0.21	62.2
3	R2	5	1	5	20.0	0.016	7.7	LOS A	0.1	0.4	0.21	0.59	0.21	57.8
Approach		19	2	20	10.5	0.016	7.5	LOS A	0.1	0.4	0.21	0.59	0.21	61.0
East: Nundle Road (E)														
4	L2	3	0	3	0.0	0.061	7.0	LOS A	0.0	0.0	0.00	0.02	0.00	74.3
5	T1	102	12	107	11.8	0.061	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	79.6
Approach		105	12	111	11.4	0.061	0.2	NA	0.0	0.0	0.00	0.02	0.00	79.4
West: Nundle Road (W)														
11	T1	51	7	54	13.7	0.038	0.1	LOS A	0.1	0.6	0.09	0.11	0.09	77.2
12	R2	11	1	12	9.1	0.038	7.2	LOS A	0.1	0.6	0.09	0.11	0.09	67.9
Approach		62	8	65	12.9	0.038	1.3	NA	0.1	0.6	0.09	0.11	0.09	75.4
All Vehicles		186	22	196	11.8	0.061	1.3	NA	0.1	0.6	0.05	0.11	0.05	75.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Vehicle movement LOS values are based on average delay per movement.
 Minor Road Approach LOS values are based on average delay for all vehicle movements.
 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 movements.
 Delay Model: SIDRA Standard (Geometric Delay is included).
 Queue Model: SIDRA Standard.
 Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 103D [Nundle Rd/Duri-Dungowan Rd PM (Site Folder: Future (with development traffic))]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Duri-Dungowan Road (S)														
1	L2	11	1	12	9.1	0.012	7.4	LOS A	0.0	0.3	0.17	0.59	0.17	61.8
3	R2	4	0	4	0.0	0.012	7.1	LOS A	0.0	0.3	0.17	0.59	0.17	64.2
Approach		15	1	16	6.7	0.012	7.3	LOS A	0.0	0.3	0.17	0.59	0.17	62.4
East: Nundle Road (E)														
4	L2	7	1	7	14.3	0.048	7.2	LOS A	0.0	0.0	0.00	0.06	0.00	67.9
5	T1	75	10	79	13.3	0.048	0.0	LOS A	0.0	0.0	0.00	0.06	0.00	79.0
Approach		82	11	86	13.4	0.048	0.6	NA	0.0	0.0	0.00	0.06	0.00	77.9
West: Nundle Road (W)														
11	T1	62	10	65	16.1	0.041	0.0	LOS A	0.0	0.3	0.04	0.05	0.04	78.9
12	R2	5	1	5	20.0	0.041	7.3	LOS A	0.0	0.3	0.04	0.05	0.04	65.0
Approach		67	11	71	16.4	0.041	0.6	NA	0.0	0.3	0.04	0.05	0.04	77.7
All Vehicles		164	23	173	14.0	0.048	1.2	NA	0.0	0.3	0.03	0.10	0.03	76.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Vehicle movement LOS values are based on average delay per movement.
 Minor Road Approach LOS values are based on average delay for all vehicle movements.
 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 movements.
 Delay Model: SIDRA Standard (Geometric Delay is included).
 Queue Model: SIDRA Standard.
 Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

 **Site: 104C [Nundle Rd/Ogunbil Rd AM (Site Folder: Future (with development traffic))]**

Site Category: (None)
Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Nundle Road (S)														
1	L2	57	4	60	7.0	0.051	5.1	LOS A	0.2	1.8	0.17	0.53	0.17	53.2
3	R2	1	1	1	100.0	0.051	9.6	LOS A	0.2	1.8	0.17	0.53	0.17	49.7
Approach		58	5	61	8.6	0.051	5.2	LOS A	0.2	1.8	0.17	0.53	0.17	53.1
East: Ogunbil Road (E)														
4	L2	1	0	1	0.0	0.040	4.8	LOS A	0.2	1.5	0.11	0.47	0.11	53.6
5	T1	45	8	47	17.8	0.040	5.1	LOS A	0.2	1.5	0.11	0.47	0.11	54.0
Approach		46	8	48	17.4	0.040	5.1	LOS A	0.2	1.5	0.11	0.47	0.11	54.0
West: Nundle Road (W)														
11	T1	32	6	34	18.8	0.038	5.0	LOS A	0.2	1.4	0.02	0.58	0.02	53.3
12	R2	22	2	23	9.1	0.038	8.0	LOS A	0.2	1.4	0.02	0.58	0.02	53.1
Approach		54	8	57	14.8	0.038	6.2	LOS A	0.2	1.4	0.02	0.58	0.02	53.2
All Vehicles		158	21	166	13.3	0.051	5.5	LOS A	0.2	1.8	0.10	0.53	0.10	53.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

 **Site: 104D [Nundle Rd/Ogunbil Rd PM (Site Folder: Future (with development traffic))]**

Site Category: (None)
Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] veh/h	[Total veh/h	HV] %				[Veh. veh	Dist] m				
South: Nundle Road (S)														
1	L2	48	4	51	8.3	0.042	5.0	LOS A	0.2	1.5	0.16	0.53	0.16	53.2
3	R2	1	0	1	0.0	0.042	8.1	LOS A	0.2	1.5	0.16	0.53	0.16	54.1
Approach		49	4	52	8.2	0.042	5.1	LOS A	0.2	1.5	0.16	0.53	0.16	53.2
East: Ogunbil Road (E)														
4	L2	1	1	1	100.0	0.035	6.4	LOS A	0.2	1.4	0.17	0.47	0.17	49.5
5	T1	35	9	37	25.7	0.035	5.3	LOS A	0.2	1.4	0.17	0.47	0.17	53.4
Approach		36	10	38	27.8	0.035	5.4	LOS A	0.2	1.4	0.17	0.47	0.17	53.3
West: Nundle Road (W)														
11	T1	20	7	21	35.0	0.045	5.1	LOS A	0.2	1.7	0.02	0.63	0.02	52.0
12	R2	45	3	47	6.7	0.045	8.0	LOS A	0.2	1.7	0.02	0.63	0.02	52.5
Approach		65	10	68	15.4	0.045	7.1	LOS A	0.2	1.7	0.02	0.63	0.02	52.3
All Vehicles		150	24	158	16.0	0.045	6.0	LOS A	0.2	1.7	0.10	0.56	0.10	52.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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