APPENDIX K

Traffic impact assessment

New England Solar Farm

Traffic impact assessment

Prepared for UPC Renewables Australia Pty Ltd | 16 November 2018

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New England Solar Farm

Final

Report J17300RP1 | Prepared for UPC Renewables Australia Pty Ltd | 16 November 2018

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Executive Summary

ES1 Overview

UPC Renewables Australia Pty Ltd proposes to develop the New England Solar Farm; a significant grid-connected solar farm and battery energy storage system (BESS) along with associated infrastructure, approximately 6 kilometres east of the township of Uralla, which lies approximately 19 km south of Armidale in the Uralla Shire local government area (LGA) (the project).

The project is a State Significant Development under the State Environmental Planning Policy (State and Regional Development) 2011. Therefore, a development application for the project is required to be submitted under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979*. The NSW Minister for Planning (Minister), or the Minister's delegate, is the consent authority.

An environmental impact statement (EIS) is a requirement of the approval process. This traffic impact assessment (TIA) forms part of the EIS. It documents the traffic impact assessment methods and results, the initiatives built into the project design to avoid and minimise associated traffic impacts, and the additional mitigation and management measures proposed to address any residual impacts not able to be avoided.

This assessment of the road network and traffic generated impacts for the project has considered all the existing major and minor roads in the Uralla Shire LGA that are likely to be used for vehicle access during project construction, operations and decommissioning.

ES2 Access from the existing road network

The project will be developed across three separate arrays of photovoltaic (PV) modules (commonly referred to as 'solar panels'); incorporating transmission infrastructure between each of the three arrays and a centralised grid-interfacing substation (grid substation) to enable connection into the existing electricity transmission network.

Access to the three array areas will be from the following local roads:

- Barleyfields Road and Big Ridge Road (northern array);
- Barleyfields Road, Big Ridge Road and Munsies Road (central array); and
- Thunderbolts Way, Gostwyck Road and Hillview Road or Thunderbolts Way, Salisbury Plains Road and The Gap Road (southern array).

These access routes consist of a wide range of road types and cross sections. Other roads which may be used include urban roads within Uralla township and surrounds and for regional access, the New England Highway. The New England Highway, Thunderbolts Way and other major roads proposed to be used for access to the three array areas are sealed to varying widths. The minor local roads, which are mainly proposed to be used for access over short sections in the immediate vicinity of each array area, are generally unsealed.

ES3 Existing traffic volumes and capacity standards

The current Austroads (2016) rural road design standards define a range of daily traffic volumes for which a given road design standard (and sealed width) is usually required. For each range of the daily traffic volumes in the Austroads (2016) rural road design standards, the design standard is currently applicable to the following roads:

- daily traffic volume range 1-150 vehicles - Munsies Road, Hillview Road, Salisbury Plains Road and The Gap Road;
- daily traffic volume range 150-500 vehicles - Big Ridge Road and Gostwyck Road;
- daily traffic volume range 500-1,000 vehicles - Barleyfields Road and Thunderbolts Way (rural sections);
- daily traffic volume range 1,000-3,000 vehicles - Thunderbolts Way (urban sections); and
- daily traffic volume range >3,000 vehicles - New England Highway.

The current daily traffic volumes from recent RMS, Uralla Shire Council and EMM traffic surveys show both the New England Highway and Thunderbolts Way generally meet the current Austroads (2016) rural road design standard widths at all locations. However, the other local rural roads, which are generally maintained by Uralla Shire Council, do not currently meet the Austroads (2016) rural road design standards in terms of the required sealed or unsealed width based on the existing daily traffic volume.

Four rural intersections have also been assessed for existing traffic conditions and the future peak hourly construction peak traffic volumes using the Austroads warrant design charts for rural intersection turning lanes. These intersections are:

- New England Highway/Barleyfields Road (north);
- New England Highway/Barleyfields Road (south) including Wood Street;
- Barleyfields Road/Big Ridge Road; and
- Thunderbolts Way/Salisbury Plains Road.

In consideration of the Austroads (2017) warrant design charts, and based on the current peak hourly traffic volumes at the intersections of New England Highway/Barleyfields Road (north) and New England Highway/Barleyfields Road (south) and Wood Street, the current configuration of these intersections would warrant modification/improvement; while the Barleyfields Road/Big Ridge Road and Thunderbolts Way/Salisbury Plains Road intersections adequate in their current design based on the current peak hourly traffic volumes.

ES4 Traffic generation

ES4.1 Overview

Construction will take approximately 32-36 months to complete, with peak construction activity anticipated to occur during months 13-16 and months 22-25, when a peak project workforce of up to 700 people may be required. Subject to construction staging, outside of these peak periods, the project's construction workforce will be in the order of 300 people.

During peak construction, this assessment has assumed that there will be an on-site construction accommodation village (CAV) provided within the northern array area, with access via Barleyfields Road and Big Ridge Road. It has been assumed that the CAV will be used to accommodate 50% of the project's construction workforce during peak construction. Positioning the CAV within the development footprint for the northern array area will minimise workforce travel times and reduce the project's impacts on the local and regional road network. The CAV will generate some additional locally-based service vehicle traffic from either the Uralla Shire or Armidale Regional LGA. It is anticipated that this will be in the order of 25 vehicle visits (or 50 vehicle movements) daily.

During operations, the project workforce will be much lower (up to 15 people) and the total generated daily traffic movements travelling to the three array areas will be in the order of 30 daily light vehicle movements. It is anticipated that project decommissioning will also have lower total daily vehicle movements than construction. Heavy vehicles would only be required for infrequent repairs and maintenance (eg replacement of inverters).

ES4.2 Construction

The proposed project construction daily traffic movements will be much greater than during longer term operations, with up to 494 total daily vehicle movements (380 by light vehicles and 114 by heavy vehicles) forecast to occur during the average construction periods and up to 912 daily vehicle movements (760 by light vehicles and 152 by heavy vehicles) forecast to occur during the peak construction periods.

Project-related vehicle movements during construction will be distributed between a number of different access routes (depending on the array area). Subsequently, the maximum forecast additional daily traffic volumes using any specific local access route will be significantly lower than the overall daily peak totals described above.

Maximum forecast daily project-related vehicle movements (including CAV servicing traffic) along select unsealed local roads during peak construction will be as follows:

- Big Ridge Road, east of Munsies Road - 635 peak daily vehicle movements;
- Munsies Road - 69 peak daily vehicle movements;
- Hillview Road - 115 peak daily vehicle movements;
- Salisbury Plains Road - 120 peak daily vehicle movements; and
- The Gap Road - 40 peak daily vehicle movements (also using Salisbury Plains Road).

These daily project-related vehicle movements should be considered as a limited duration construction traffic impact as they are anticipated to occur across two four-month periods (ie between months 13 to 16; and 22 to 25). Local traffic management and mitigation procedures are likely to be required, including a range of enhanced and more frequent road maintenance treatments along these unsealed local roads.

On the sealed sections of the other local roads proposed to be used east of Uralla township, including Big Ridge Road (west of Munsies Road), Barleyfields Road, Gostwyck Road and other urban roads within the township of Uralla and surrounds, these roads are currently sealed to varying widths. The latest traffic count survey results suggest these roads do not generally meet the current Austroads (2016) rural road design standards.

Project-related peak and average construction vehicle movements for these roads will have a short-term impact on traffic conditions and usability, which is proposed to be managed by road condition inspections and maintenance procedures. These additional road maintenance procedures will be negotiated and agreed between UPC and Uralla Shire Council as part of the project's traffic management plan (TMP). The TMP will include as a minimum requirement, restoring the road surface of each of these roads to its pre-existing condition as at the commencement of construction.

During peak construction, the forecast project-related regional traffic movements (including CAV servicing traffic) which have been assessed for the New England Highway route to the north and south of Uralla, and through the township where the route is known as Bridge Street, will be as follows:

- New England Highway north of Uralla - 390 peak daily vehicle movements;
- New England Highway south of Uralla - 365 peak daily vehicle movements; and
- Bridge Street (and other potential routes) through Uralla - 630 peak daily vehicle movements.

On the New England Highway route, these additional daily traffic movements will generally result in +5.95% daily traffic volume increases north of Uralla (towards Armidale) and +9.16% daily traffic volume increases south of Uralla (towards Tamworth).

ES4.3 Operation

During the project operations, the forecast traffic increases will not change the Austroads (2016) rural road design and capacity standards for any rural roads. Therefore, the existing capacity and condition of the affected local roads should remain adequate to accommodate future project-related daily operations traffic.

ES4.4 Cumulative impacts

The Uralla Solar Farm is proposed on a site approximately 11 km north of Uralla and between the New England Highway to the east, and Mount Butler Road to the west. If both projects are constructed, the common regional road used for the two projects will be the New England Highway. The proposed Uralla Solar Farm access point is likely to be primarily via Arding Road to the south. Arding Road intersects with the New England Highway approximately 11 km north of Uralla.

In order to assess potential cumulative impacts with the proposed Uralla Solar Farm, it has been conservatively assumed that the combined construction of both projects could occur over a maximum timeframe of 12-16 months.

The predicted daily traffic increases from the concurrent construction of the two projects will be a peak traffic increase of between +8.69% to +13.68% along the New England Highway. These increases are considered minimal as the New England Highway is well-constructed and designed to accommodate all types of heavy vehicle movements.

ES5 Mitigation measures

A TMP will be prepared in consultation with RMS and Uralla Shire Council, which will include a commitment to perform a dilapidation survey, implement a Driver Code of Conduct, undertake swept path analyses and further investigate any alternative heavy vehicle routes that could be utilised to bypass the township of Uralla. The TMP will also contain the details of the road maintenance program proposed for rural roads impacted by the project.

The following road and intersection improvement works, which will be confirmed in consultation with RMS and Uralla Shire Council, are proposed to maintain the safety of the road network and to accommodate the swept paths of the largest trucks that are proposed to require access to the three array areas:

- New England Highway/Barleyfields Road (north) and New England Highway/Barleyfields Road (south) including Wood Street intersections require left and right turn traffic lanes (CHR/CHL), particularly during periods of peak construction activity. The TMP will also consider the temporary conversion of the New England Highway/Barleyfields Road (north) intersection to seagull type operation to ease right turning movements by large trucks entering and departing from Barleyfields Road (north).

- Consider implementation of temporary traffic control at the Barleyfields Road level crossing, particularly during the peak construction period.

- Gravel shoulder widening at the Thunderbolts Way/Salisbury Plains Road intersection, pending the results of the swept path analysis of this intersection during the preparation of the TMP.

Parking for the project's construction and operations workforce will be provided within the development footprint for the three array areas in suitably surfaced parking areas with appropriate dimensions to accommodate the number and size of vehicles.

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1 Introduction

1.1 Overview

UPC Renewables Australia Pty Ltd (UPC) proposes to develop the New England Solar Farm, a significant grid-connected solar farm and battery energy storage system (BESS) along with associated infrastructure, approximately 6 kilometres (km) east of the township of Uralla, which lies approximately 19 km south of Armidale in the Uralla Shire local government area (LGA). The regional and local location of the project is presented in Figure 1.1 and Figure 1.2.

The project is a State Significant Development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). The reference number is SSD 9255. A development application (DA) for the project is required to be submitted under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The NSW Minister for Planning (Minister), or the Minister's delegate, is the consent authority.

An environmental impact statement (EIS) is a requirement of the approval process. This traffic impact assessment (TIA) forms part of the EIS. It documents the traffic impact assessment methods and results, the initiatives built into the project design to avoid and minimise associated traffic impacts, and the additional mitigation and management measures proposed to address any residual impacts not able to be avoided.

1.2 Assessment guidelines and requirements

This TIA has been prepared in accordance with the relevant governmental assessment requirements, guidelines and policies, and in consultation with the relevant government agencies.

The assessment is based on the following general scope for matters to consider in a TIA, which is defined by NSW Roads and Maritime Services (RMS), *Guide to Traffic Generating Developments* (RTA 2002):

- the existing locality and surrounding land uses;
- the existing road network and intersections;
- traffic and car parking generation characteristics of the project;
- traffic and car parking impacts of the project; and
- a summary of the assessed traffic impacts and any traffic management or mitigation measures.

The TIA has also considered the following Austroads Guides:

- *Austroads Guide to Road Design Part 3: Geometric Design* (Austroads 2016);
- *Austroads Guide to Road Design Part 4: Intersections and Crossings:* General (Austroads 2017); and
- *Austroads Guide to Traffic Management Part 12: Traffic Impacts of Development* (Austroads 2016).

The TIA addresses the requirements of the NSW Department of Planning and Environment (DPE). These were set out in the Secretary's Environmental Assessment Requirements (SEARs) for the project, issued on 8 May 2018 and updated on 11 October 2018.

The SEARs must be addressed in the EIS. A copy of the SEARs is attached to the EIS as Appendix A, while Table 1.1 lists the individual requirements relevant to this TIA and where they are addressed in this report.

Table 1.1 Transport/traffic related matters raised in SEARs

Requirement	Section addressed
An assessment of the site access route (including Barleyfields Road, Big Ridge Road, Saumarez War Service Road, Munsies Road, Elliots Road, The Gap Road, Carlon Menzies Road, Gostwyck Road, Hillview Road, Salisbury Plains Road, Thunderbolts Way and the New England Highway);	Sections 2.2, 2.3 and 2.4
Site access points;	Sections 3.1
Rail safety issues (including the adjacent Main Northern Railway) and likely transport impacts (including peak and average traffic generation, over-dimensional vehicles and construction worker transportation) of the development on the capacity and condition of roads (including on any Crown land);	Chapters 3 and 4
A description of the measures that would be implemented to mitigate any impacts during construction (including cumulative impacts from nearby developments);	Chapter 6
A description of any proposed road upgrades developed in consultation with the relevant road and rail authorities (if required).	Section 6.2

To inform preparation of the SEARs, DPE invited other government agencies to recommend matters to be addressed in the EIS. These matters were taken into account by the Secretary for DPE when preparing the SEARs. Copies of the RMS advice to DPE were attached to the SEARs and matters relevant to the TIA are listed in Table 1.2.

Table 1.2 RMS traffic impact assessment recommendations

Requirement	Section addressed
Traffic Impact Assessment (TIA) prepared by a suitably qualified person in accordance with the Austroads Guide to Traffic Management Part 12, the complementary Roads and Maritime Supplement and RTA Guide to Traffic Generating Developments, which addresses:	In this report, the format of the assessment generally follows the structure which is requested by the *Guide to Traffic Generating Developments* (RTA 2002).
• the total impact of existing and proposed development on the road network with consideration for a 10 year horizon;	Chapter 4 A 10 year timeframe is not specifically relevant to this project as the majority of the project generated traffic movements will occur during the approximate 36 month construction period, and traffic movements generated during operations would be significantly lower.
• the volume and distribution of traffic generated by the proposed development and existing land uses;	Sections 3.3 and 3.4.
• sight distances at key intersections along primary access routes;	Section 3.1
• provide details of turning paths of the largest vehicle that will use the access routes;	As committed in Section 6.2, swept path analysis will be undertaken for each of the relevant intersections along the proposed access routes for each of the three array areas as part of the construction traffic management plan (TMP) and prior to commencement of construction.
• details of proposed improvements to affected intersections;	Section 6.2
• impact of rail corridors on the road network and details of proposed interface treatments;	Section 4.5
• review of crash records along the proposed access routes;	Section 2.8
• details of existing, proposed site access standards, servicing and parking arrangements;	Sections 3.1 and 4.3.
• impact on public transport (public and school bus routes) and consideration for alternative transport modes such as walking and cycling;	Sections 2.5, 2.6 and 2.7. This assessment has assumed that a construction accommodation village (CAV) will be constructed and will house 50% of the project's peak construction workforce. No impact on public transport is anticipated. UPC is proposing to provide shuttle bus services, where required, to transport workers from Armidale, Tamworth, Uralla and the project's CAV to the relevant work areas every morning and afternoon before and after the shift. UPC also proposes to avoid heavy vehicles travelling along the designated school bus routes during the operation times of these school bus services, wherever possible.
• impacts of road traffic noise and dust generated along the primary access routes;	Section 4.9 A noise and vibration impact assessment has been prepared as part of the EIS (Appendix J) and includes an assessment of road traffic noise.
• consideration of potential glare/reflectivity generated from on-site infrastructure towards public roads;	Section 4.8

Table 1.2 RMS traffic impact assessment recommendations

Requirement	Section addressed
• details of a Transport Management Plan (TMP) to identify and manage impacts of construction and operational traffic on the safety and efficiency of the affected road network. The TMP may include temporary measures such as Traffic Control Plans to address construction related traffic at specific locations;	Section 6.1
• TMP to include a Driver Code of Conduct, which may include, but not limited to the following:	Section 6.1
o a map of the primary access routes highlighting critical locations;	A Driver Code of Conduct will be prepared by UPC in consultation with Uralla Shire Council as part of the TMP prior to commencement of construction, and will include consideration of the requirements listed here.
• safety initiatives for transport through residential areas and/or school zones;	
• consideration for coordination of construction traffic with seasonal agricultural haulage;	
• an induction process for vehicle operators & regular toolbox meetings;	
• a compliant resolution and disciplinary procedure;	
• any community consultation measures for the peak construction period; and	
• targeted Road Safety Audit undertaken by suitably qualified persons;	This assessment will be undertaken for each of the proposed access routes for each of the three array areas as part of the TMP and prior to commencement of construction.

1.3 Consultation

This TIA has been prepared with consultation and contribution from the following government agencies:

- Armidale Regional Council;
- Tamworth Regional Council;
- Uralla Shire Council;
- John Holland – Country Regional Network; and
- RMS.

1.4 Site description

The project will be developed within the Uralla Shire LGA. At its closest point, the project boundary is approximately 6 km east of the township of Uralla, and the northern array area starts approximately 8.6 km south of Armidale.

The project boundary, which is defined as the entirety of all of the involved lots, encompasses a total area of 8,380 ha. The project boundary encompasses 61 lots, the majority of which have been modified by historical land use practices and past disturbances associated with land clearing, cropping and intensive livestock grazing. The properties within the project boundary are currently primarily used for sheep grazing for production of wool and lambs, with some cattle grazing for beef production.

The development footprint is the area within the project boundary on which infrastructure will be located. The development footprint encompasses a total area of 2,787 ha, which includes 1,418 ha within the northern array area, 625 ha within the central array area and 653 ha within the southern array area. Within the development footprint, approximately 1,000 ha will be required for the rows of PV modules. The remaining area is associated with power conversion units (PCUs), space between the rows, internal access tracks and associated infrastructure (including substations BESSs). The development footprint also includes land required for connection infrastructure between the three array areas as well as land required for new internal roads to enable access to the three array areas from the surrounding road network. Subject to detailed design and consultation with the project landholders, security fencing and creek crossings may be required on land outside of the development footprint, but within the project boundary.

1.5 Project description

The project involves the development, construction and operation of a solar PV electricity generation facility and BESS, which consists of PV modules, batteries, inverters, transformers and associated infrastructure.

The development footprint provided on Figure 1.2 incorporates the land required for:

- the three solar array areas;
- up to three internal solar array substations and a single grid substation;
- associated BESS(s);
- operations and maintenance (O&M) infrastructure, including:
    - O&M buildings (namely meeting facilities, a temperature-controlled spare parts storage facility, supervisory control and data acquisition (SCADA) facilities, a workshop and associated infrastructure); and
    - car parking facilities;
- connection infrastructure between the three array areas (including electricity transmission lines (ETLs) and underground or overhead cabling); and
- a new internal road network to enable access from surrounding local roads to the three array areas during construction and operations.

In addition, security fencing and creek crossing (should they be required) will be placed within the project boundary.

The project will have a targeted 'sent out' electricity generating capacity of up to 800 MW (AC) and up to 200 MW (AC) two-hour energy storage. The final number of PV modules within the three array areas will be dependent on detailed design, availability and commercial considerations at the time of construction.

Electricity generated by the project will be injected into the grid via a new cut-in to TransGrid's 330 kV transmission line that traverses the northern and central array areas (refer Figure 1.2).

A construction accommodation village (CAV) for non-local construction employees may be established to absorb the surge in accommodation demand that may arise as the influx of workers increases. The intent is to scale the accommodation – in terms of number of people accommodated – such that the correct balance is achieved between off-site and on-site accommodation.

The CAV will be on part of Lot 2 of DP 174053 in the northern array area (refer to Figure 1.2). The exact location of the CAV within Lot 2 of DP 174053 will be determined during the detailed design stage of the project.

Source: EMM (2018); DFSI (2017); GA (2015)

0 10 20 km

GDA 1994 MGA Zone 56

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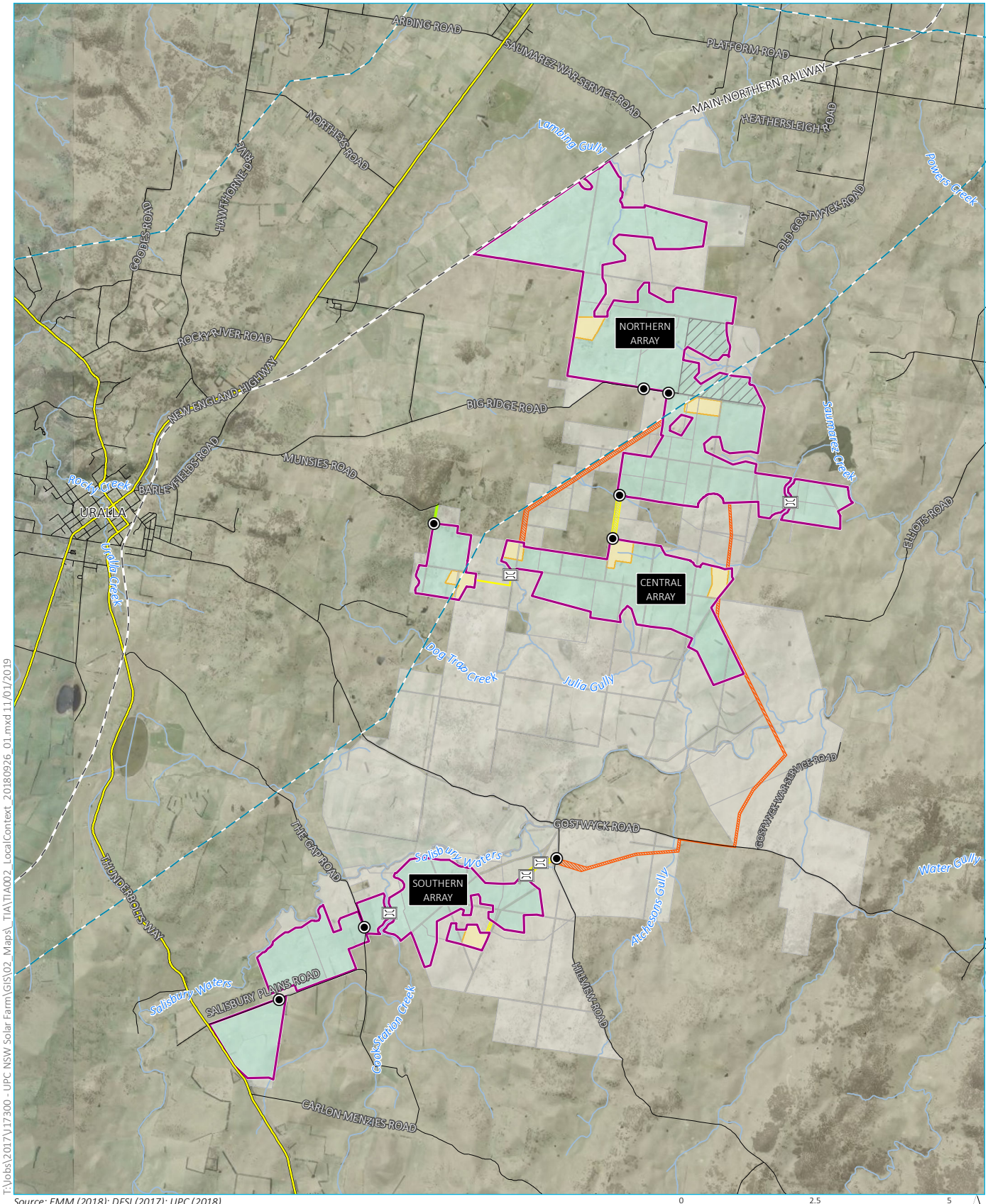
KEY

- Development footprint
- Project boundary
- Other SSD solar development
- Airport
- Rail line
- Main road
- Local road
- Watercourse/drainage line
- Waterbody
- Local government area
- NPWS reserve
- State forest

Regional context

New England Solar Farm
Traffic Impact Assessment
Figure 1.1

EMM
creating opportunities



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Source: EMM (2018); DFSI (2017); UPC (2018)

0 2.5 5 km

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KEY

- 330 kV transmission line
- Rail line
- Main road
- Local road
- Watercourse/drainage line
- Project boundary

Development footprint

- Solar array
- Potential ETL easement
- Potential site access corridor
- Potential site access/ETL easement
- Potential substation/BESS footprint
- Potential electrical cabling
- Potential creek crossing
- Primary site access point
- Potential site for construction accommodation village

Location of the New England Solar Farm

New England Solar Farm
Traffic Impact Assessment
Figure 1.2

EMM
creating opportunities

2 Existing traffic conditions

2.1 Road network

The main transport routes that connect the township of Uralla to a range of other areas throughout regional NSW are shown in Figure 1.2. The New England Highway will be the main transport route that is utilised by project-generated traffic during both the construction and operation periods.

2.1.1 Access from the New England Highway and Thunderbolts Way

The New England Highway (HW9) is the state's inland north-south corridor, which connects the Hunter region at its southern end starting from the Pacific Highway at Hexham via Maitland, Singleton, Muswellbrook, Murrurundi, Wallabadah, Tamworth, Uralla, Armidale, Glen Innes and Tenterfield to the Queensland border at Wallangarra. RMS is responsible for the ongoing maintenance and management of the New England Highway.

The New England Highway has a two-lane sealed 11 m wide carriageway with a speed limit of 100 km/h generally on the rural sections and 50 km/h when entering the township of Uralla from both the northern and southern ends. It has a relatively straight and level alignment between Uralla, Armidale and Tamworth, with good visibility on most sections. Both the centre line and edge lines of the road are marked on all sections. Overtaking is permitted intermittently on certain sections of the highway.

A number of the intersections between the New England Highway and major local roads in the vicinity of the project, including Barleyfields Road (north of Big Ridge Road), currently have additional left and/or right turning lanes provided. At the intersection of the New England Highway with Barleyfields Road (south) the project-related light vehicles will also travel via a short section (approximately 20 m) of Wood Street before turning onto Barleyfields Road (south) then onto Big Ridge Road (Figure 2.1).

Thunderbolts Way is a two-lane country road, approximately 290 km long, connecting Copes Creek, Uralla, Walcha and Gloucester. The road is fully sealed and the centre line and edge lines are generally marked. It passes through thickly forested mountain areas with many nearby national parks and nature reserves. Project-related traffic may be required to use this road during the construction and operational stages of the project. The majority of project-related traffic accessing the southern array area will use Thunderbolts Way from Uralla to the Salisbury Plains Road intersection. Heavy vehicles accessing the southern array area will travel via Thunderbolts Way, Gostwyck Road and Hillview Road or via Thunderbolts Way, Salisbury Plains Road and The Gap Road.

2.1.2 Local roads

There will be a number of primary access points for project-generated traffic, which are shown in Figure 2.1. The proposed vehicle routes to these access points are via the following local roads:

- two access points to the northern array area via Barleyfields Road (north or south), then onto Big Ridge Road;
- one access point to the central array area via Barleyfields Road (north or south), then onto Big Ridge Road and turning right onto Munsies Road (the access points for the northern array area will also be used by vehicles that require access to the central array area as part of Stage 2);
- one access point to the southern array area via Gostwyck Road, then turning right onto Hillview Road;

- one access point with dual access to the southern array area via Thunderbolts Way then onto Salisbury Plains Road; and

- one access point with dual access to the southern array area via Thunderbolts Way, then onto Salisbury Plains Road and turning left onto The Gap Road.

Photographs of local roads that will be used to access the three array areas are provided in Appendix B.

No vehicles associated with the construction of the project will turn onto The Gap Road directly from Thunderbolts Way in the north. However, a limited number of light vehicles may use this route to access the southern array area during operations.

Emergency access points to enable access to the three array areas from the local road network may also be required. The exact location of these access points will be determined during detailed design.

Barleyfields Road is a two-way 6.4 m wide local road connecting the New England Highway at the north-eastern end to Wood Street at the south-western end. The road is approximately 3 km in length and is fully sealed. Barleyfields Road (north) (north of the Big Ridge Road intersection) will be used by the project's light and heavy vehicles, while Barleyfields Road (south) (south of the Big Ridge Road intersection) will be used by the project's light vehicles only. All heavy vehicles that require access to the northern and central array areas will travel to and from these areas via Barleyfields Road (north). Both sections of Barleyfields Road will be used for project-related light vehicle traffic during the construction and operational stages of the project. All intersections of Barleyfields Road with other local roads are basic T-intersections. No project-related traffic is expected to need to turn at these intersections, with the exception of Big Ridge Road and Wood Street.

Big Ridge Road is a two-way local road extending from Barleyfields Road to the access points for the northern array. The centre line and edge lines of the road are not marked. The road is sealed from the intersection with Barleyfields Road for approximately 3.8 km to the east. The sealed section of Big Ridge Road finishes approximately 3 km west of the access points for the northern array. The 6.8 km length of Big Ridge Road, including both sealed and unsealed sections, will be used by project-related traffic during both the construction and operational stages of the project. All intersections on Big Ridge Road are basic T-intersections generally for access to other rural residential properties. No project-related traffic will turn at these rural intersections, with the exception of Munsies Road.

Munsies Road is a two-way local road that connects from Big Ridge Road and terminates at one of the project landholder's properties. The proposed access point for the central array area is directly off Munsies Road. The centre line and edge lines of the road are not marked. The road is only sealed at the intersection of Big Ridge Road/Munsies Road, and then unsealed for approximately 3.3 km until the proposed access point. This road will be used by project-related traffic during the construction and operational stages of the project. All intersections on Munsies Road are to other rural residential properties and are basic T-intersections. No project-related traffic will turn at these rural intersections.

Gostwyck Road is a two-way local road connecting from East Street at Uralla to Mihi Road at Mihi. Gostwyck Road will be used by project-related traffic accessing the southern array area via Hillview Road. The centre line and edge lines of the road are not marked. The road is sealed for the entire length from the township of Uralla to the Gostwyck Road/Hillview Road intersection; a distance of approximately 10 km. This road will be used by project-related traffic during the construction and operational stages. There are a number of residential dwellings along Gostwyck Road between East Street and the intersection with Hillview Road. All intersections on Gostwyck Road are basic T-intersections. No project-related traffic is expected to need to turn at these intersections, with the exception of Hillview Road.

Heavy vehicles accessing the southern array area will travel via Thunderbolts Way, Gostwyck Road and Hillview Road or via Thunderbolts Way, Salisbury Plains Road and The Gap Road.

Hillview Road is a two-way unsealed local road that extends south from Gostwyck Road to its intersection with Gills Road, and then continues south and west to Thunderbolts Way. Project-related traffic will use approximately 600 m of Hillview Road from the intersection of Hillview Road/Gostwyck Road to reach the proposed access point for the southern array area during both the construction and operational stages of the project. Project-related traffic is not expected to use other sections of Hillview Road.

Salisbury Plains Road is a two-way local road, approximately 3 km long, connecting Thunderbolts Way to The Gap Road. The road is unsealed and centre line and edge lines are not marked. Salisbury Plains Road will be used during the construction and operational stages of the project to access two access points to the southern array area. – a dual access point direct from Salisbury Plains Road and a second dual access point on The Gap Road).

The Gap Road is a two-way local road, approximately 11.5 km long, connecting Thunderbolts Way to Carlon Menzies Rd. The road is unsealed and centre line and edge lines are not marked. Approximately 800 m of The Gap Road (ie north of The Gap Road/Salisbury Plains Road intersection) will be used by project-related vehicles during the construction and operational stages of the project. The majority of The Gap Road will not be utilised by project-related traffic due to its proximity to and use by rural residential landholders and school buses particularly during the morning and afternoon school run. No vehicles associated with the construction of the project will turn onto The Gap Road directly from Thunderbolts Way in the north. However, a limited number of light vehicles each day may use this route to access the southern array area during operations.

During consultation with Uralla Shire Council, it was noted that all local roads outside of the township of Uralla have a speed limit of 100 km/hr, unless signposted otherwise.

2.2 Traffic volumes and capacity standards

2.2.1 Baseline daily traffic volume

Baseline daily traffic volumes for the main project access routes have been determined from published RMS daily traffic surveys for the years where the data is available (which is generally between 2007 and 2011) and are summarised in Table 2.1. To establish base 2018 daily traffic volumes, it is standard practice in most rural areas of NSW to add +1% annual (linear) traffic growth to the most recent annual survey.

The historical RMS traffic data for major roads in NSW over the past 30-40 years shows that the ratio of peak hourly to daily traffic volume is normally between one tenth (approximately 10%) to one twelfth (approximately 8%). Within the study area considered as part of this TIA, it has been conservatively assumed that the peak hour to daily traffic ratio for the New England Highway and other major roads is at the higher end of this range (ie one tenth of daily traffic), and this ratio has been adopted for all the major roads and local roads where daily traffic volumes have been estimated for this TIA.

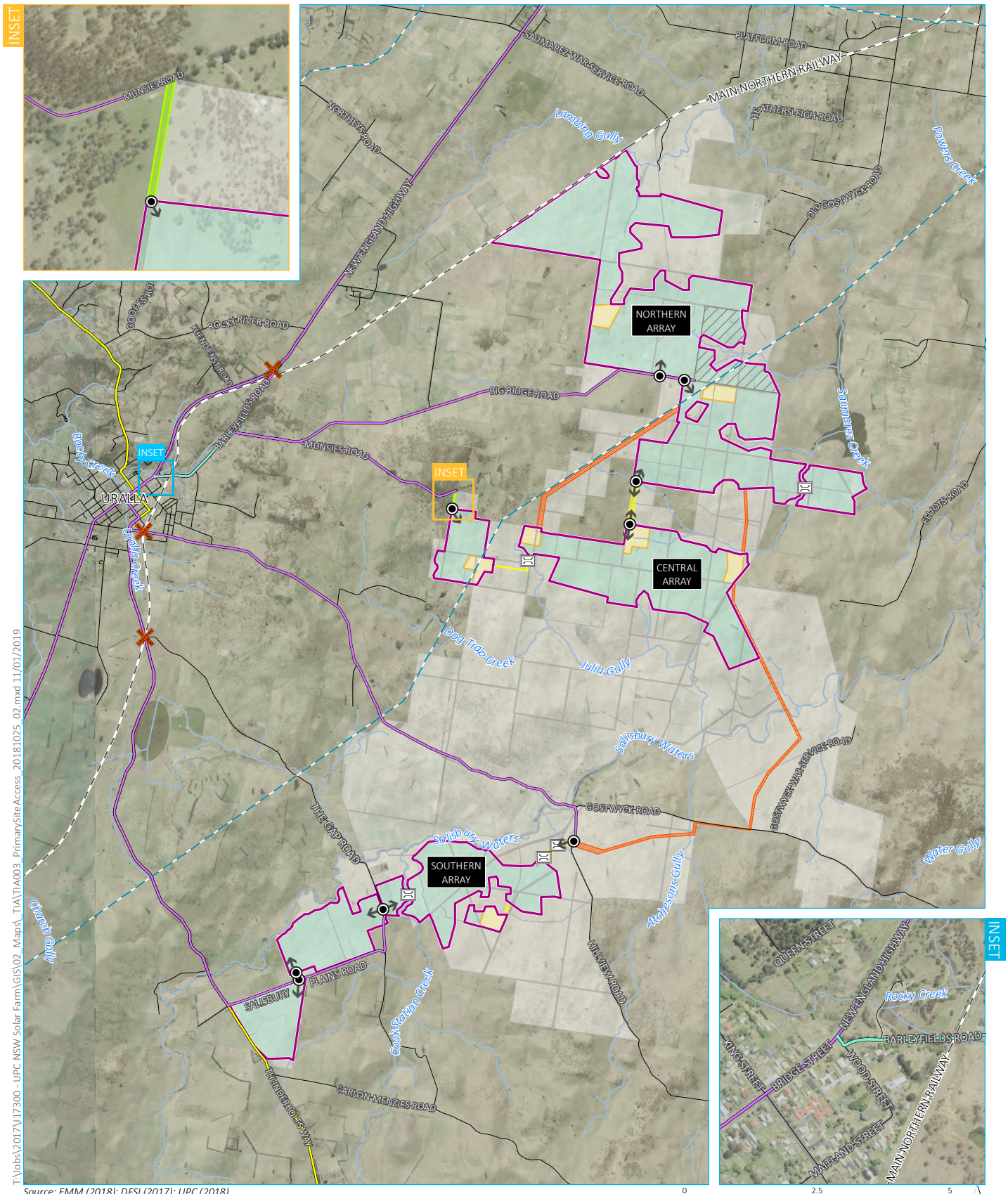
Table 2.1 Historic and projected daily traffic volumes

Station ID	Road (NB – northbound) (SB – southbound)	2007	2008	2011	2018 projected daily traffic volume[1]	Approximate peak hourly volume	Average proportion of heavy vehicle
92060	New England Highway (Arding) – NB	2,912	-	3,079	3,295[1]	330	10%[2]
	New England Highway (Arding) – SB	2,930	-	3,049	3,262[1]	330	10%[2]
92502	Bridge Street (Uralla) – NB	3,804	-	3,935	4,210[1]	420	-
	Bridge Street (Uralla) – SB	4,159	-	4,158	4,449[1]	440	-
92503	Bridge Street (Uralla) – NB	-	-	-	-		-
	Bridge Street (Uralla) – SB	-	3,040	-	3,344[1]	330	-
92057	New England Highway (Kentucky) – NB	1,475	2,111	-	2,322[1]	230	18%[2]
	New England Highway (Kentucky) – SB	1,523	1,512	-	1,663[1]	170	18%[2]
92677	Thunderbolts Way (Walcha) – NB	436	-	-	484[1]	48	10%[2]
	Thunderbolts Way (Walcha) – SB	457	553	-	608[1]	61	10%[2]

Notes: *1. +1% annual (linear) traffic growth has been adopted, which gives a growth factor x 1.07 from the 2011 volumes; x 1.10 from the 2008 volume; and x 1.11 from the 2007 volumes.*

2. Average proportion of heavy vehicles on the New England Highway and Thunderbolts Way are assumed based on 2007 and 2011 statistics.

Source: RMS Traffic Volume Viewer (RMS 2018)



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Source: EMM (2018); DFSI (2017); UPC (2018)

0 2.5 5 km

GDA 1994 MGA Zone 56

N

KEY

- 330 kV transmission line
- Rail line
- Main road
- Local road
- Watercourse/drainage line
- Project boundary
- Potential site for construction accommodation village

Development footprint

- Solar array
- Potential ETL easement
- Potential site access corridor
- Potential site access/ETL easement
- Potential substation/BESS footprint
- Potential electrical cabling/site access corridor
- Potential creek crossing

- Proposed primary site access point
- Access direction
- Level crossing
- Light vehicle traffic route
- Light / heavy vehicle traffic route

Primary access points for three arrays

New England Solar Farm
Traffic Impact Assessment
Figure 2.1

EMM
creating opportunities

The RMS traffic data is very limited for minor rural roads. However, traffic count data relating to the following intersections was gathered during survey undertaken by EMM during the morning and afternoon traffic peak hours over 14-17 August 2018. This is shown below in Table 2.2.

Table 2.2 Hourly traffic count data at intersections within proximity of the three arrays

Intersection	Date and time	Major road (1)			Minor road (2)		
		Total vehicles	Heavy vehicles	% of heavy vehicles	Total vehicles	Heavy vehicles	% of heavy vehicles
Thunderbolts Way (1) / Salisbury Plains Road (2)	17 August 2018 7:00 am – 8:00 am	96	8	8.33%	3	0	0%
Thunderbolts Way (1) / Salisbury Plains Road (2)	14 August 2018 3:00 pm – 4:00 pm	80	5	6.25%	2	1	50%
Gostwyck Road (1) / Hillview Road (2)	16 August 2018 7:00 am – 8:00 am	12	1	8.33%	7	0	0%
Gostwyck Road (1) / Hillview Road (2)	14 August 2018 5:00 pm – 6:00 pm	6	0	0%	4	0	0%
Barleyfields Road (1) / Big Ridge Road (2)	15 August 2018 7:00 am – 8:00 am	57*	6*	10.53%	16*	2*	12.5%
Barleyfields Road (1) / Big Ridge Road (2)	15 August 2018 4:00 pm – 5:00 pm	82*	8*	9.76%	19*	2*	10.53%
Big Ridge Road (1) / Munsies Road (2)	15 August 2018 8:00 am – 9:00 am	11	4	36.36%	4	0	0%
Big Ridge Road (1) / Munsies Road (2)	15 August 2018 3:00 pm – 4:00 pm	12	5	41.67%	1	1	100%

*Note: *During the Barleyfields Road/Big Ridge Road intersection traffic surveys, it was observed that due to road works on the parallel traffic route via the New England Highway north of Uralla, which diverted traffic through this road, surveyed traffic volumes using Barleyfields Road are likely to have been higher than would normally be using this route.*

2.2.2 Daily traffic volumes on local roads

Daily traffic volumes for each local road and Thunderbolts Way (north of Salisbury Plains Road) have been estimated based from the intersection traffic survey data counts in Table 2.2. In general, daily traffic volumes are approximately ten times the average hourly traffic volume for each approach road to an intersection, where the traffic volumes are normally surveyed during both the morning and afternoon traffic peak hours.

The estimated daily traffic volumes for the relevant roads are summarised in Table 2.3.

Table 2.3 Daily traffic volumes for local roads and Thunderbolts Way

Road	Location	Total vehicles	Heavy vehicles	% of heavy vehicles
Barleyfields Road	North of Big Ridge Road	645	60	9.30%
Barleyfields Road	South of Big Ridge Road	740	80	10.81%
Big Ridge Road	East of Barleyfields Road	175	20	11.43%
Big Ridge Road	East of Munsies Road	115	45	39.13%
Munsies Road	East of Big Ridge Road	25	5	20%
Hillview Road	South of Gostwyck Road	55	0	0%
Gostwyck Road	West of Hillview Road	115	5	4.35%
Gostwyck Road	East of Hillview Road	60	5	8.33%
Gostwyck Road*	Near McCrossin Street*	218*	39*	18%
Salisbury Plains Road	East of Thunderbolts Way	25	5	20%
The Gap Road*	Approximately 2 km from the Thunderbolts Way intersection*	46*	4*	8%
Thunderbolts Way**	North of Salisbury Plains Road**	880**	65**	7.39%

*Note: *Uralla Shire Council Traffic Survey (+1% annual (linear) traffic growth adopted).*

***Major road included in EMM traffic survey.*

As project-related light vehicles are only expected to utilise approximately 20 m of Wood Street (namely to access Barleyfields Road - south from the New England Highway), the daily traffic volumes for the other sections of this local road (Wood Street) have not been considered as part of this assessment.

The remaining section of Wood Street provides access to St Josephs School and is used by school traffic, including a school bus and local residential traffic. However, the normal weekday hours of the project construction traffic movements using Barleyfields Road, will generally be earlier in the mornings and later in the afternoons than the times of the peak school or residential traffic usage. This will generally minimise the extent of future possible interactions between the project construction traffic and either the school or the local residential traffic. In addition, the project related construction traffic that will be permitted to use Barleyfields Road-(south), will be restricted to light vehicle traffic only and all the heavy vehicle traffic to and from the northern and central array worksites will be directed to travel via Barleyfields Road (north) and its intersection with the New England Highway, which is approximately 3 km further to the north.

2.2.3 Road design standard

Road width design standards for low volume (generally rural) roads are defined by the Austroads *Guide to Road Design* (Austroads 2016) and are based on daily traffic volumes. The existing road width measurements and conditions for each proposed access route considered as part of this TIA are shown in Table 2.4.

Table 2.4 Locations of the existing road width and condition measurements

Road	Measurement	2 km	4 km	6 km	8 km	10 km
Thunderbolts Way	Measured from New England Hwy	9.0 m[1] / sealed	8.6 m[1] / sealed	7.2 m[1] / sealed	7 m[1] / sealed	7.9 m[1] / sealed
Wood Street	Measured from New England Hwy	10.9 m[1] / sealed	Only 20 m of Wood Street has been measured as other parts of this road will not be used by project-related traffic.			
Barleyfields Road	Measured from New England Hwy	6.4 m[1] / sealed	-	-	-	-
Big Ridge Road	Measured from Barleyfields Road	6.6 m / sealed	4.3 m / unsealed	3.8 m / unsealed	3.9 m / unsealed	-
Munsies Road	Measured from Big Ridge Road	3.4 m / unsealed	3.5 m[1] / unsealed	-	-	-
Gostwyck Road	Measured from Thunderbolts Way (Duke Street)	5.8 m / sealed	5.9 m / sealed	5.2 m / sealed	3.4 m / sealed	4.3 m / sealed
Salisbury Plains Road	Measured from Thunderbolts Way	4.7 m[1] / unsealed	6.6 m[1] / unsealed	-	-	-

Note: 1. Desktop measurement via Google Earth.

The width and condition of each local road at the location of the proposed site access points are as follows:

- Big Ridge Road: easement width 20 m / unsealed (no formed road; currently only vehicular access track);
- Munsies Road: 3.5 m / unsealed;
- Hillview Road: 4 m / unsealed at cattle grid / 3.8 m at Gostwyck Road intersection;
- Salisbury Plains Road: 4.5 m / unsealed; and
- The Gap Road: 4.5 m / unsealed.

Photographs from each of the proposed site access points for the three array areas are provided in Appendix C.

Road width and conditions for the sections of The Gap Road and Hillview Road that will be used by vehicles associated with the construction and ongoing operation of the project were generally consistent with the details recorded at the proposed site access points.

The current Austroads (2016) design road width standards, which are applicable to the major and minor roads that will be used by project-related traffic within the Uralla Shire LGA, are presented in Table 2.5.

Table 2.5 Daily traffic volumes and corresponding design standards

Daily traffic volume	Austroads (2016) design standard	Applicable roads	Road width	Daily traffic volume	Currently meets Austroads design standard?
1 – 150	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal	Munsies Road	3.4 m – 3.5 m unsealed	25	No
		Hillview Road	3.8 m – 4 m unsealed	55	No
		Salisbury Plains Road	4.7 m – 6.6 m unsealed	25	No
		The Gap Road	4.5 m unsealed	46	No
150 – 500	Minimum 7.2 m wide seal	Gostwyck Road	3.4 m – 5.9 m sealed	Between 60-218	No
		Big Ridge Road	3.8 m – 4.3 m unsealed; 6.6 m sealed	Between 115-175	No
500 – 1,000	Minimum 7.2 m – 8 m wide seal	Barleyfields Road	6.4 m sealed	Between 645-740	No
		Thunderbolts Way	7 m – 9 m sealed	880	Yes
1,000 – 3,000	Minimum 9 m wide seal	-	-	-	-
>3,000	Minimum 10 m wide seal	New England Highway	11 m sealed	Between 3,985-6,557	Yes

2.3 Warrants for road improvements

The current design of the New England Highway and Thunderbolts Way meet the Austroads (2016) design standard. No road improvements are currently required on these roads based on existing traffic volumes.

A number of the minor roads that are proposed to be utilised by project-related traffic do not currently meet the Austroads (2016) design standard according to the existing daily traffic volumes. The relevant road widening and improvement compliance works that would be required to meet the Austroads (2016) design standard based on current traffic volumes are summarised as follows:

- Barleyfields Road - widen the road to a minimum of 7.2 m and apply sealed pavement to the widening area;
- Big Ridge Road - widen the road to a minimum of 7.2 m and apply sealed pavement to the unsealed section;
- Munsies Road - widen the road to 3.7 m and apply sealed pavement;
- Gostwyck Road - widen the road to a minimum of 7.2 m and apply sealed pavement to the widening area;
- Hillview Road - apply 3.7 m wide sealed pavement;
- Salisbury Plains Road - apply 3.7 wide sealed pavement; and

- The Gap Road – apply 3.7 m wide sealed pavement.

Road improvements are currently not required on Thunderbolts Way and the New England Highway based on existing traffic volumes.

2.4 Warrants for intersection improvements

Rural intersection operations are assessed from the combination of the peak hourly through and turning traffic movements that are occurring at each intersection. This determines the need for additional intersection turning lanes in accordance with the current Austroads (2017) Part 4 intersection design standards, which are shown in Appendix A and the Austroads (2017) warrant design charts shown in Figure 2.2.

There are separate design charts for roads with design speeds either 100 km/hr and greater, or lower than 100 km/hr. For design speeds 100 km/hr or greater, additional left or right turn traffic lanes are only required where the major road peak hourly traffic volume exceeds 120 vehicles per hour and the minor road traffic also exceeds the level shown in the upper warrant chart in Figure 2.2.

For design speed lower than 100 km/hr, additional left or right turn traffic lanes are only required where the major road peak hourly traffic volume exceeds 170 vehicles per hour and the minor road traffic also exceeds the level shown in the lower warrant chart in Figure 2.2.

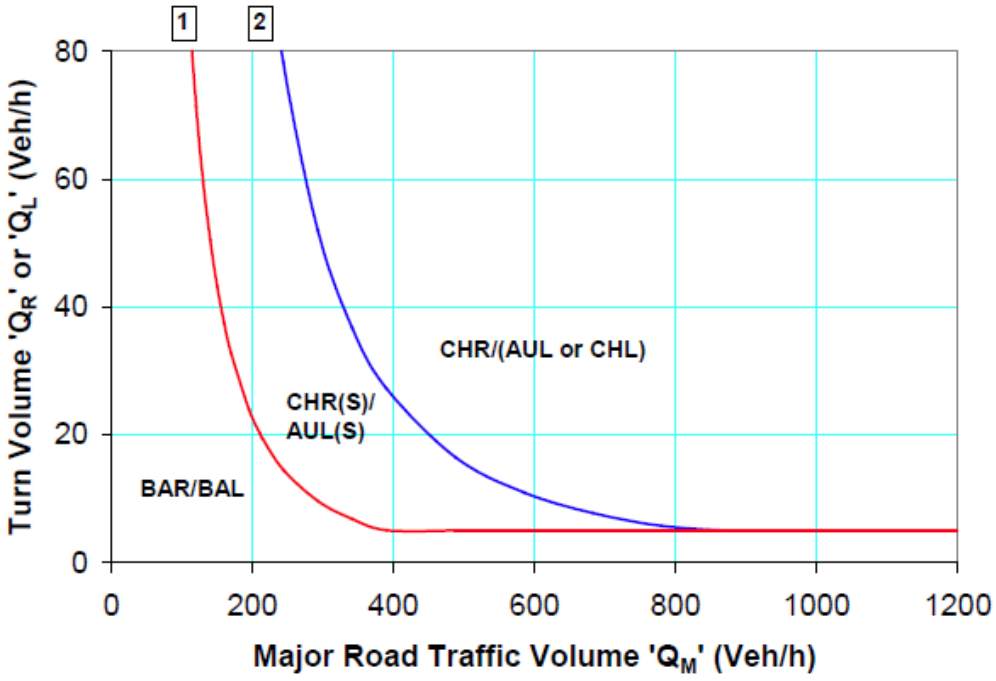
These minimum hourly traffic volume thresholds correspond to daily traffic volumes of between 1,200 and 1,700 vehicles, which means that the Austroads turning lane requirements only need to be assessed at the five intersections between the major roads and major local roads as listed below:

- New England Highway / Barleyfields Road (north) - 100 km/hr;
- New England Highway / Barleyfields Road (south) - less than 100 km/hr;
- Barleyfields Road / Big Ridge Road - less than 100 km/hr;
- Thunderbolts Way (Duke Street) / Gostwyck Road (East Street) - this is considered to be an urban intersection, therefore, the rural standards do not apply; and
- Thunderbolts Way / Salisbury Plains Road - 100 km/hr.

Further consideration of each of these intersections is provided below.

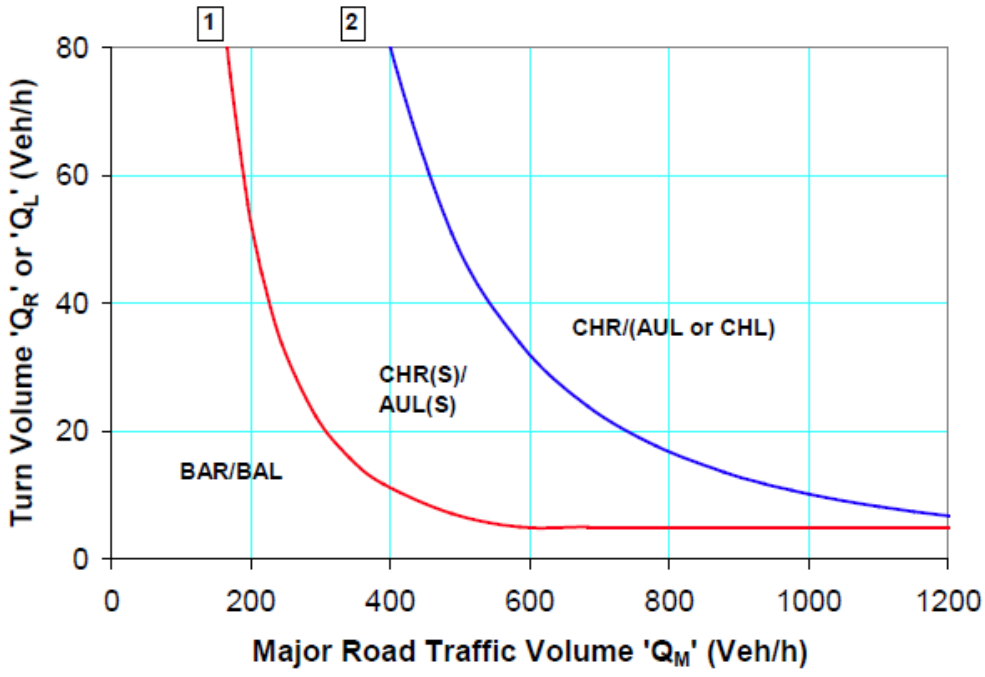
At other intersections between two minor local roads, including Big Ridge Road/Munsies Road and Gostwyck Road/Hillview Road, the future minimum hourly or daily traffic volume requirements are unlikely to be reached.

Details of the relevant standard road designs (Austroads 2017) for rural intersection widening (type BAR/BAL shoulder widening) and other intersection widening designs, are included in the relevant extracts from the Austroads (2017) *Road Design Guide* in Appendix A.



(a) Design speed ≥ 100 km/h

Warrant Chart for additional turning lanes for traffic volumes for design speeds 100 km/hr or greater.



(b) Design speed < 100 km/h

Warrant Chart for additional turning lanes for traffic volumes for design speeds lower than 100 km/hr.

Figure 2.2 Austroads warrant design charts for rural intersection turning lanes

2.4.1 New England Highway/Barleyfields Road (north)

At this location, which is approximately 3 km north of Uralla, the current year 2018 baseline hourly traffic volume for the New England Highway north from the township of Uralla (see Table 2.1) has been calculated to be 660 peak hourly vehicles.

The current year 2018 baseline daily traffic volume for Barleyfields Road (north), north of Big Ridge Road, running as a bypass route for traffic turning off to access local roads on the east of the New England Highway (see Table 2.3) has been calculated to be 645 daily vehicles, which corresponds to approximately 65 vehicles per hour (30-35 vehicles per hour in each direction) during the peak hourly traffic periods.

The current configuration of this intersection is a basic T intersection with no designated right or left turning lane. Therefore, the current design requirement for the New England Highway/Barleyfields Road (north) intersection would warrant additional left and right turn traffic lanes (CHR/CHL), as the combination of major road and minor road peak hourly volume is within the range for this type of intersection (refer upper warrant chart in Figure 2.2).

2.4.2 New England Highway/Barleyfields Road (south) and Wood Street

At this intersection, Barleyfields Road south and Wood Street merge for a distance of approximately 20 m before connecting to the New England Highway, near the northern limit of the town of Uralla. The current year 2018 baseline hourly traffic volume for the New England Highway north from the township of Uralla (see Table 2.1) has been calculated to be 660 peak hourly vehicles.

The current year 2018 baseline daily traffic volume for Barleyfields Road (south) including Wood Street at the New England Highway intersection (see Table 2.3) has been calculated to be approximately 740 daily vehicles, which corresponds to approximately 74 vehicles per hour (35-40 vehicles per hour in each direction) during the peak hourly traffic periods.

The current configuration of the New England Highway at this intersection is a multi-leg intersection with no designated right or left turning lane. Therefore, the current design requirement for the New England Highway/Barleyfields Road (south) and Wood Street intersection would warrant additional left and right turn traffic lanes (CHR/CHL), as the combination of major road and minor road peak hourly volume is within the range for the CHR/CHL type of intersection (refer lower warrant chart in Figure 2.2).

2.4.3 Barleyfields Road/Big Ridge Road

The current year 2018 baseline daily traffic volume for Barleyfields Road south of Big Ridge Road, running as a bypass route for traffic turning off to access local roads on the east of the New England Highway (see Table 2.3) has been calculated to be 740 daily vehicles, which corresponds to approximately 74 vehicles per hour during the peak hourly traffic periods.

The current design of the Barleyfields Road/Big Ridge Road intersection is acceptable without additional left or right turn traffic lanes, as the major road peak hourly traffic volume is under 170 vehicles along Barleyfields Road (south) (refer lower Warrant Chart in Figure 2.2).

2.4.4 Thunderbolts Way (Duke Street)/Gostwyck Road (East Street)

This is an urban intersection; therefore, the rural standards do not apply.

The sealed road width through the intersection is approximately 12 m which provides for separation of the through, left and right turning traffic movements at the intersection.

2.4.5 Thunderbolts Way/Salisbury Plains Road

The current 2018 baseline daily traffic volume for Thunderbolts Way south of the township of Uralla (see Table 2.1) has been calculated to be 109 peak hourly vehicles. The existing Thunderbolts Way/Salisbury Plains Road intersection design is therefore acceptable without additional left or right turn traffic lanes, as the major road peak hourly traffic volume is under 120 vehicles along Thunderbolts Way (refer upper Warrant Chart in Figure 2.2).

2.5 Rail infrastructure and services

The Main Northern Railway (refer Figure 2.1), an active railway line, is adjacent to the northern boundary of the northern array area.

Uralla is situated on the Sydney to Armidale (NP23 and NP24) regional trains network. The train route extends from Sydney to Armidale via Uralla. The train operates one service daily from Central to Armidale, leaving Central at 9:30 am and arriving at Armidale approximately 5:35 pm, stopping at Uralla at 5:12 pm. The opposite direction service (Armidale to Sydney) also operates one service daily, leaving Armidale at 8:40 am, stopping at Uralla 8:56 am and arriving at Central approximately 4:45 pm.

John Holland Country Regional Network runs maintenance trains, as required, and hi-rail inspections every 72 hours. These are not timetabled. Freight trains may also operate in the harvest season using the same rail track for transportation of agricultural products.

This railway line would potentially be affected by project-generated traffic movements at three existing railway level crossings, they are: Barleyfields Road, Gostwyck Road and Thunderbolts Way (refer Figure 2.1). Further details regarding safe use of these level crossings is outlined in Section 4.6.

2.6 Coach services

Uralla regional station is not an interchange station with other regional train or coach services. The closest interchange station is in Armidale, which connects further north and north-west NSW to Grafton, Tenterfield and Moree via coach services.

Other public transport in Uralla includes Edwards Coaches, which operate extensive services in the Armidale and Uralla LGAs.

2.7 School bus services

There are two schools in the township of Uralla, namely St Joseph's Catholic School and Uralla Central School. The main school bus route is Route 480. Operating hours for the school bus service are from 8:00 am to 8:50 am (morning) and 3:30 pm to 3:50 pm (afternoon) on school days.

Route 480 travels on main roads in the township of Uralla, particularly on the New England Highway, Thunderbolts Way, Duke Street, Salisbury Street and Rowan Avenue.

These local roads, aside from Rowan Avenue, also form part of the project's heavy vehicle routes when travelling through the township of Uralla and cannot be avoided.

Another rural school bus operator travels along The Gap Road and operates between 7:55 am to 8:10 am (morning) and 3:55 pm to 4:10 pm (afternoon) on school days.

Mitigation strategies to address shared use of local roads with the school bus operators described above are proposed as outlined in Chapter 6.

2.8 Traffic safety

Traffic safety conditions in the vicinity of the township of Uralla and along the New England Highway are considered to be acceptable, with good intersection visibility at all locations along the New England Highway and the assessed local roads.

The general traffic safety conditions on the New England Highway, Thunderbolts Way and the local roads in the Uralla Shire LGA, including Gostwyck Road and Hillview Road have been reviewed for the most recent five year accident history (2013 to 2017 inclusive) using the Transport for NSW (TfNSW) interactive accident history database (TfNSW 2018). Only reported accidents are recorded within the TfNSW interactive accident history database. The accident history is categorised into four sections and results are provided in Table 2.6 and illustrated in Figure 2.3 to Figure 2.6. Accidents involving heavy vehicles are highlighted in **bold** in the following table.

Table 2.6 Summary of accident history for Uralla LGA 2013 to 2017

Location	Year	Degree of crash	Type of location
Township of Uralla	2013	Minor/other injury	X-intersection
		Moderate injury	X-intersection
		Moderate injury	X-intersection
	2014	Moderate injury	T-junction
		Moderate injury	X-intersection
		Moderate injury	Divided road
	2015	Minor/other injury	2-way undivided
		Serious injury	2-way undivided
		Moderate injury	X-intersection
	2016	Moderate injury	X-intersection
		Moderate injury	X-intersection
		Serious injury	X-intersection
	2017	Moderate injury	2-way undivided
		Moderate injury	X-intersection
		Serious injury	2-way undivided
North of New England Highway from Uralla	2013	Fatal	2-way undivided
		Fatal	2-way undivided
	2014	Moderate injury	2-way undivided
		Moderate injury	2-way undivided
		Moderate injury	2-way undivided
	2015	Fatal	2-way undivided
	2016	Serious injury	2-way undivided
	2017	Moderate injury	2-way undivided
		Serious injury	2-way undivided
South of New England Highway from Uralla	2013	No accident	Not applicable
	2014	**Serious injury**	**2-way undivided**
		Moderate injury	2-way undivided
		Fatal	2-way undivided
	2015	**Moderate injury**	**2-way undivided**
		Serious injury	2-way undivided
		Moderate injury	T-junction
		Moderate injury	**2-way undivided**
	2016	**Moderate injury**	**T-junction**
		Minor/other injury	2-way undivided
	2017	Serious injury	2-way undivided
Thunderbolts Way south from Uralla and the project	2013	Moderate injury	2-way undivided
		Serious injury	2-way undivided
		Minor/other injury	2-way undivided
		Minor/other injury	2-way undivided
		Moderate injury	2-way undivided
		Moderate injury	2-way undivided
	2014	Minor/other injury	2-way undivided
		Serious injury	2-way undivided

Table 2.6 Summary of accident history for Uralla LGA 2013 to 2017

Location	Year	Degree of crash	Type of location
		Moderate injury	2-way undivided
	2015	Moderate injury	2-way undivided
		Moderate injury	2-way undivided
		Serious injury	2-way undivided
		Serious injury	2-way undivided
	2016	Moderate injury	2-way undivided
	2017	Serious injury	2-way undivided
		Serious injury	T-junction
		Serious injury	2-way undivided

Source: TfNSW Centre for Road Safety – Interactive crash statistics – LGA view

The results show that heavy vehicle accidents occurred predominantly on the section of the New England Highway south of the township of Uralla towards Tamworth. None of the heavy vehicle accidents identified were fatal.

There were four fatal accidents reported across the area, two of these involved speeding and the others were related to driver fatigue. None involved heavy vehicles.

There were a total of 19 reported traffic accidents on the New England Highway in the Uralla Shire LGA over the five year period. When considering this is a 28 km route length, it represents 1.47 accidents per km of road. Of the 19 reported accidents, four resulted in fatalities (21%). This is a relatively high proportion of fatal accidents in comparison with Uralla Shire LGA and NSW averages. However, these fatal accidents involved either speeding or fatigue, both of which are driver behaviour factors that can potentially be avoided.

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Source: EMM (2018); DFSI (2017); UPC (2018)

0 250 500 m

GDA 1994 MGA Zone 56

N

KEY

- Rail line
- Main road
- Local road
- Watercourse/drainage line
- Waterbody

Incident results

- Minor injury
- Moderate injury
- Serious injury

Accident history within the township of Uralla

New England Solar Farm
Traffic Impact Assessment
Figure 2.3

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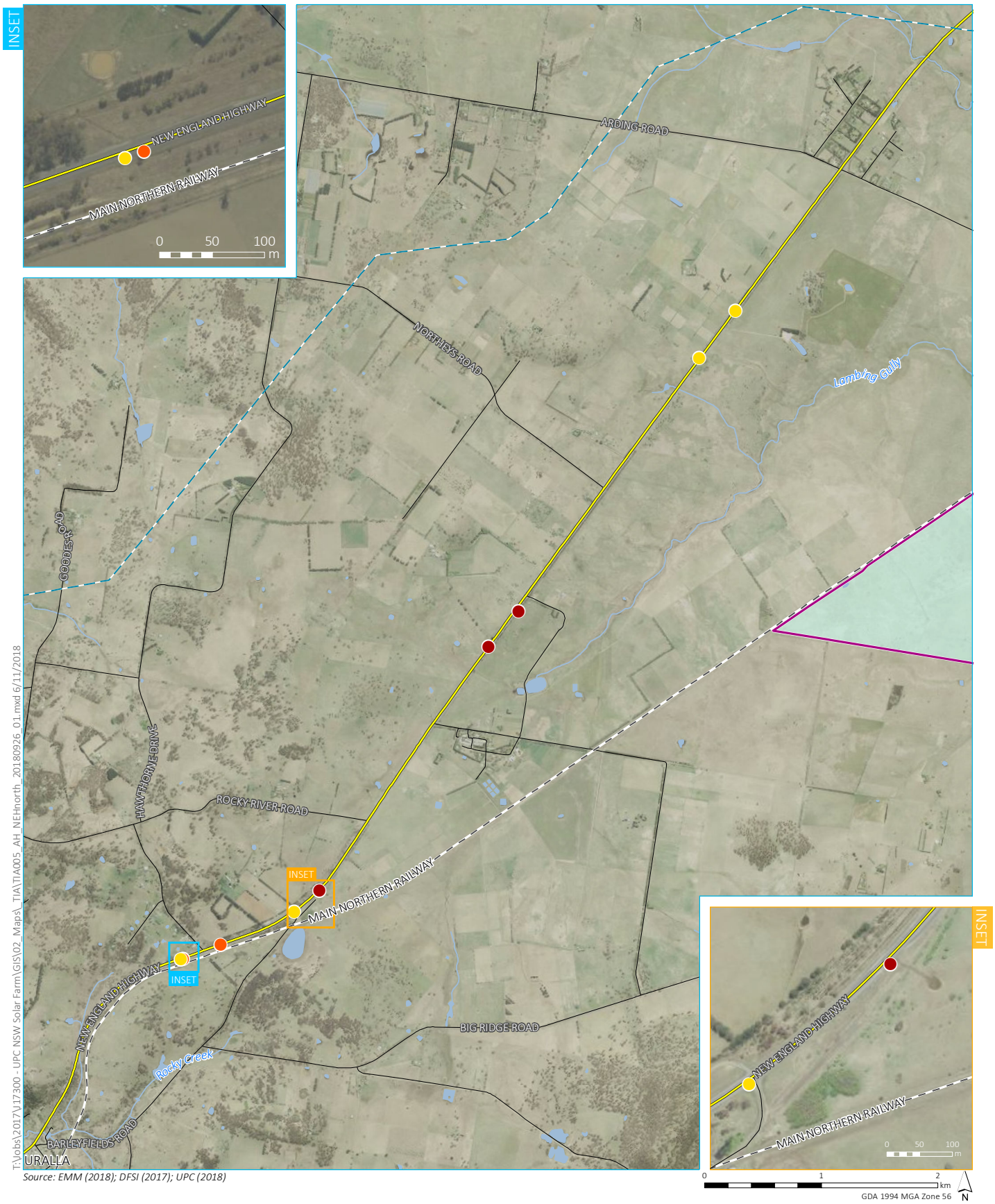

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Source: EMM (2018); DFSI (2017); UPC (2018)

KEY

- 330 kV transmission line
- Rail line
- Main road
- Local road
- Watercourse/drainage line
- Waterbody

Development footprint

- Solar array

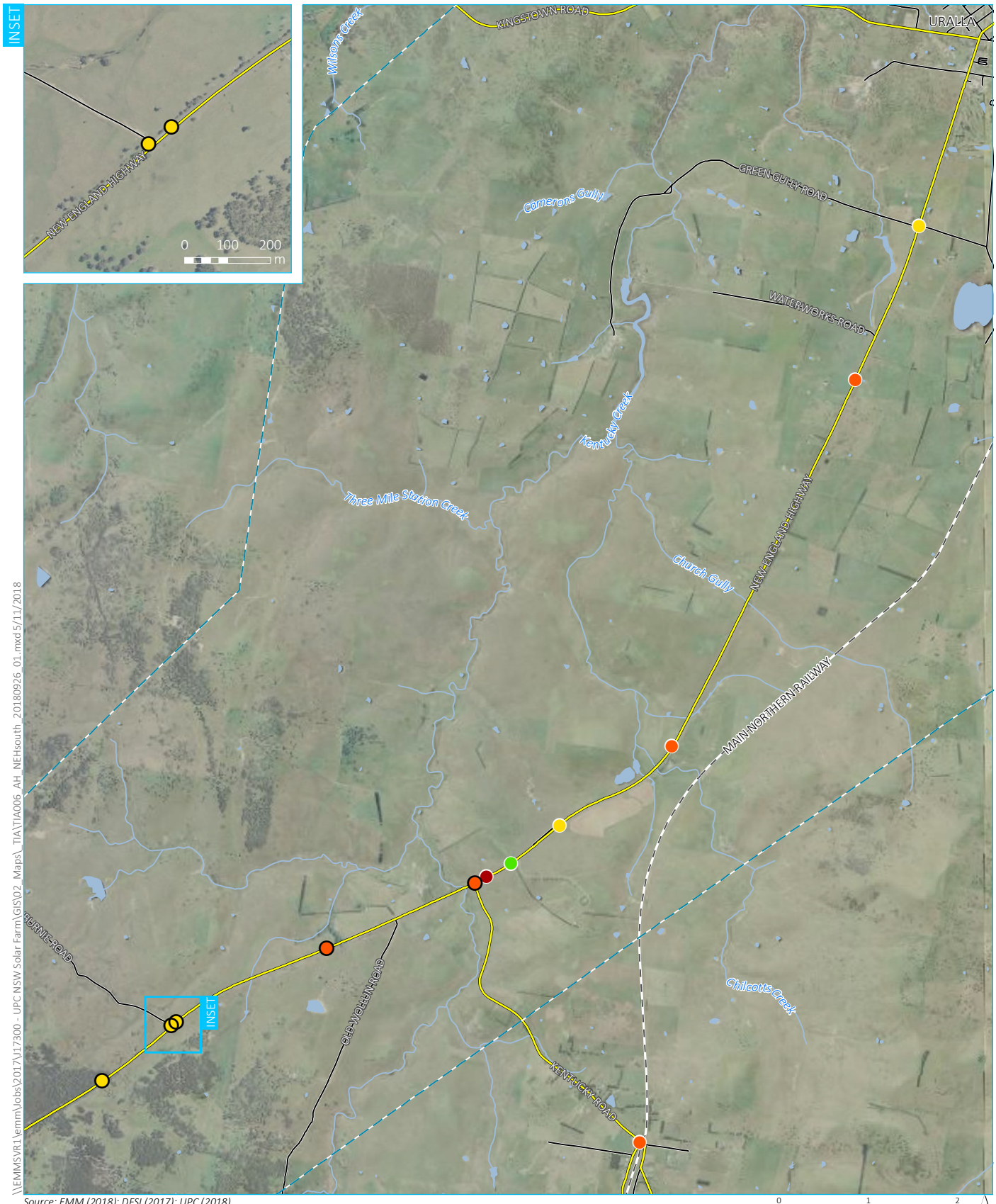
Incident results

- Moderate injury
- Serious injury
- Fatal

Accident history on New England Highway (north of Uralla)

New England Solar Farm
Traffic Impact Assessment
Figure 2.4

EMM
creating opportunities



KEY

- 330 kV transmission line
- Rail line
- Main road
- Local road
- Watercourse/drainage line
- Waterbody

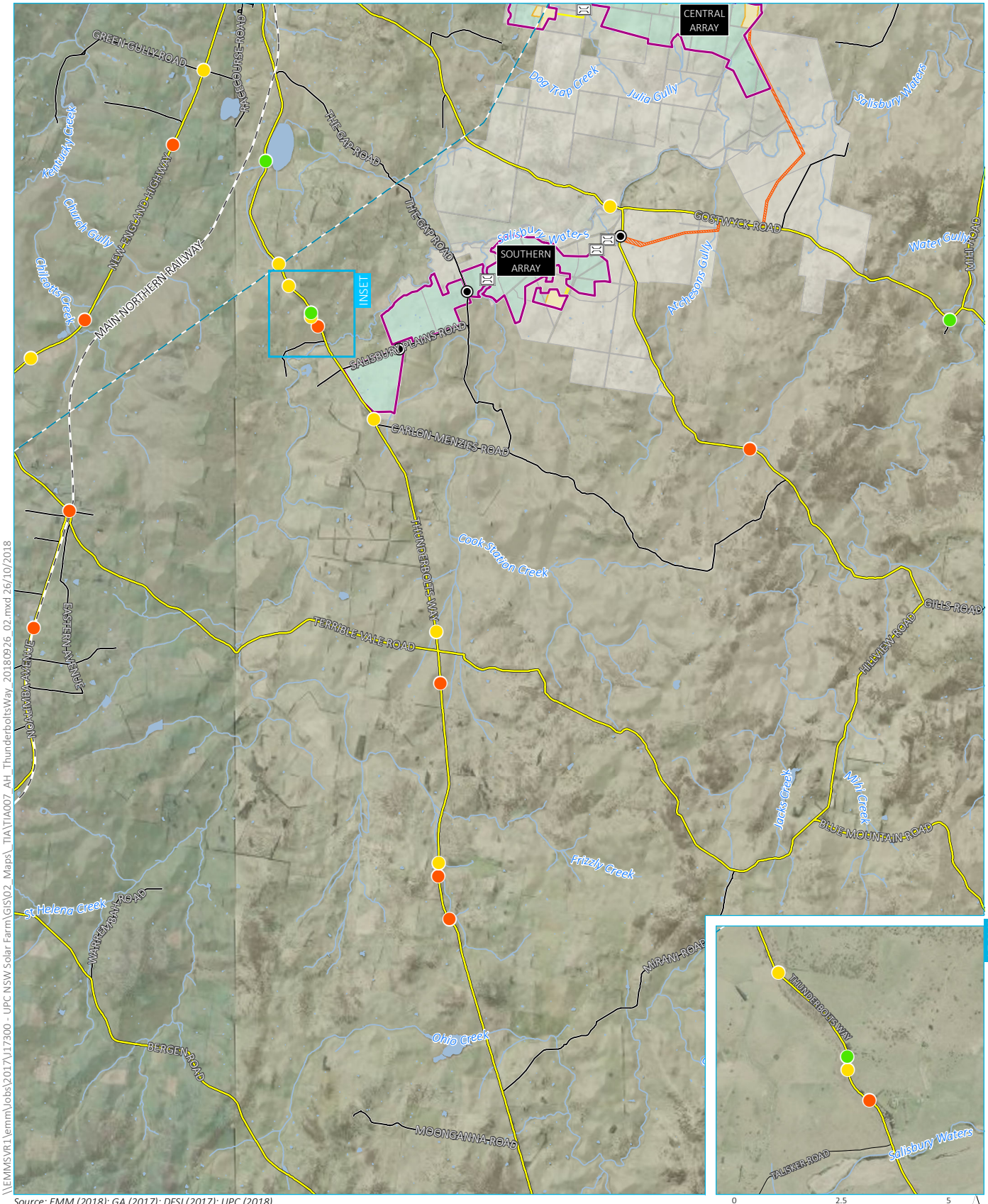
Incident results

- Minor injury
- Moderate injury
- Serious injury
- Fatal
- Heavy truck crash

Accident history on New England Highway (south of Uralla)

New England Solar Farm
Traffic Impact Assessment
Figure 2.5

EMM
creating opportunities



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Source: EMM (2018); GA (2017); DFSI (2017); UPC (2018)

0 2.5 5 km

GDA 1994 MGA Zone 56

N

KEY

- 330 kV transmission line
- Rail line
- Main road
- Local road
- Watercourse/drainage line
- Waterbody

Development footprint

- Solar array
- Potential ETL easement
- Potential site access/ETL easement
- Potential substation/BESS footprint
- Potential creek crossing
- Primary site access point

Incident results

- Minor injury
- Moderate injury
- Serious injury

Accident history on Thunderbolts Way and surrounds

New England Solar Farm
Traffic Impact Assessment
Figure 2.6

EMM
creating opportunities

2.9 Road condition

Photographs taken by EMM in August 2018 show the typical existing condition of the local roads within the Uralla Shire LGA with a focus on the proposed primary access routes and surrounds. These photographs are shown in Appendix B.

2.10 Planned road improvement works

A number of future road improvement works are scheduled to be carried out by RMS on the New England Highway, between Uralla and Armidale. These road improvement works commenced in 2018 and will continue into 2019. The works include:

- installation of a new roundabout at Armidale Airport;
- widening the centreline of the highway from the new roundabout near Armidale Airport to Uralla;
- widening of the bridge over Saumarez Creek;
- additional northbound overtaking lane on the highway, between Arding Road and Northeys Road;
- a right hand turning lane to Northeys Road (southbound);
- additional southbound overtaking lane on the Highway, between Northeys Road and Rocky River Road;
- a designated left hand turning lane to Barleyfields Road (north) (southbound);
- a right hand turning lane to Kliendienst Road (southbound); and
- general road widening and drainage improvements along the New England Highway.

These future road works will improve traffic flow and safety on the New England Highway, between Uralla and Armidale. The majority of the works will be completed within the next five years and may be available for use by project-related vehicles.

As part of stakeholder engagement during preparation of this assessment, UPC and EMM discussed the use of the New England Highway with representatives from RMS (refer Appendix B of the EIS). During this engagement, RMS noted that they will continue with the proposed safety upgrade works listed above, including the construction of a left turn lane to Barleyfields Road (north). This decision was based on the traffic data available under the current use of this intersection.

It was noted that as part of this work, RMS will ensure that the intersection of Barleyfields Road (north) and the New England Highway will be suitable for conversion to a CH(R) layout without significant construction work (ie implementation of a right turn lane for traffic turning right into Barleyfields Road (north) from the New England Highway). It was noted that this will likely require reseal to remove existing line marking and the installation of revised line markings.

3 Traffic and parking demands for the project

3.1 Primary access routes

There will be a number of primary access points for project-generated traffic, which are shown in Figure 2.1. The proposed vehicle routes to these access points are via the following local roads:

- two access points to the northern array area via Barleyfields Road (north and south), then onto Big Ridge Road;
- one access point to the central array area via Barleyfields Road (north and south), then onto Big Ridge Road and turning right onto Munsies Road;
- one access point to the southern array area via Gostwyck Road, then turning right onto Hillview Road;
- one dual access point to the southern array area via Thunderbolts Way then onto Salisbury Plains Road; and
- one dual access point to the southern array area via Thunderbolts Way, then onto Salisbury Plains Road and turning left onto The Gap Road.

The sight distances for approaching traffic along each of the above roads at each nominated access point are generally good. The frontage roads at these locations are straight and level. The excellent visibility at each proposed access location can be seen in the photos presented in Appendix C.

Appropriate locations for emergency access points will be determined during detailed design.

3.2 Construction and other traffic generating activities

Construction of the project will take approximately 32 to 36 months from the commencement of site establishment works to commissioning of the three array areas. It is anticipated that the project will be constructed in two stages.

Stage 1 will include complete construction of the northern array area including the grid substation and is anticipated to take approximately 25 months to complete.

Stage 2 will include complete construction of the central array area and southern array area and is anticipated to take approximately 20 months to complete. Stage 2 also includes the construction of a new transmission line connecting the southern and central arrays to the grid substation and the BESS, which is also anticipated to take approximately 20 months to complete.

Stage 2 will commence approximately 12 months after the commencement of site establishment works planned as part of Stage 1.

The construction of the project will generally require a workforce which begins at a modest size then progressively builds over several months to a peak of up to 700 people, and then declines relatively quickly.

The first six months of the project will generally require less than 100 workers on-site at a given time. The growth in worker numbers is then anticipated to increase to a peak period around months 22 to 25 when over 600 workers are required.

The workforce is then anticipated to reduce to less than 100 within a period of approximately five months, and is anticipated to remain under 100 for the remainder of the project's construction.

Throughout operations, a workforce of up to 15 full-time equivalents (FTEs) will be required.

3.3 Traffic generation

3.3.1 Construction

As mentioned above, the project will be constructed in two stages. The peak construction months will occur when the Stage 1 and Stage 2 construction works overlap, as is shown on Figure 3.1, which identifies the combined peak construction months for vehicle movements. These are months 13 – 16 and months 22 – 25.

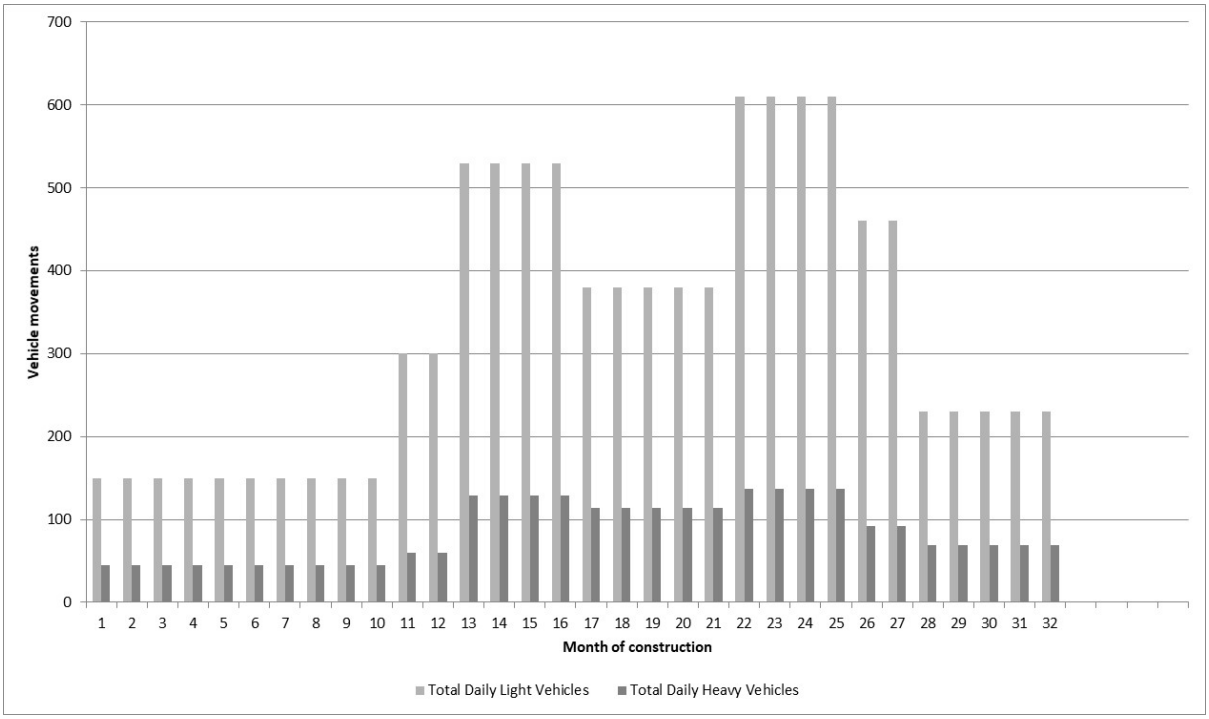


Figure 3.1 Daily traffic movements for each month of construction

The Stage 1 and Stage 2 vehicle movement routes are described as follow:

- Stage 1:
  - Route A (1A): Barleyfields Road (north) turning onto Big Ridge Road and travelling to the primary site access points for the northern array. Light vehicles travelling south along the New England Highway from Armidale and all heavy vehicles from the north and south that require access to the northern array area will travel via Barleyfields Road (north); and
  - Route B (1B): Woods Street turning onto Barleyfields Road (south) and then onto Big Ridge Road and travelling on to the primary site access points the northern array. Only light vehicles that require access to the northern array area travelling north along the New England Highway from Uralla will travel via Woods Street and Barleyfields Road (south).

- Stage 2:
    - Route A (2A): Barleyfields Road (north) turning onto Big Ridge Road and then onto Munsies Road for access to the central array. Light vehicles travelling south along the New England Highway from Armidale and all heavy vehicles from the north and south that require access to the central array area will travel via Barleyfields Road (north).
    - Route B (2B): Wood Street turning into Barleyfields Road (south) and then onto Big Ridge Road and Munsies Road for access to the central array. Only light vehicles that require access to the central array area travelling north along the New England Highway from Uralla will travel via Woods Street and Barleyfields Road (south).
    - Route C (2C): Vehicle movements via Barleyfields Road (north and south) will be the same as described above for Route A (1A) and Route B (1B). Vehicles will travel from the Big Ridge Road site access points for the northern array to the central array via an internal site access road between the northern and central array areas (this route also accounts for light vehicle movements from the CAV and heavy vehicle deliveries for the BESS).
    - Route D (2D): Thunderbolts Way turning onto Salisbury Plains Road to access the primary site access points for the southern array on Salisbury Plains Road or The Gap Road.
    - Route E (2E): Gostwyck Road (originates at East St) and turning right onto Hillview Road to access the primary site access point for the southern array.

It is of note that throughout the construction of the project, all project-related heavy vehicles will access Big Ridge Road via the northern intersection of Barleyfields Road and the New England Highway. No heavy vehicles are proposed to utilise Barleyfields Road (south) via Wood Street to access Big Ridge Road. The only exception to this could be in the unforeseeable need to access the northern and central array areas during an emergency or other temporary road closure of Barleyfields Road (north) (eg as part of local road maintenance or improvement works), for which an alternative access approval will be sought. The framework for such exceptions will be identified in consultation with RMS and Uralla Shire Council during preparation of the TMP.

The forecast daily light and heavy vehicle movements using each route across the two stages are shown in Table 3.1.

Table 3.1 Light and heavy vehicle movements

Stage	Average daily light vehicle movements	Peak daily light vehicle movements	Average daily heavy vehicle movements	Peak daily heavy vehicle movements
1A	64	129	45	60
1B	86	171	0	0
2A	12	24	9	12
2B	18	36	0	0
2C	100	200	30	40
2D	50	100	15	20
2E	50	100	15	20

3.3.2 Operation

During operation, there will be much lower daily traffic movements, which are estimated to be up to 30 daily light vehicle movements, assuming that the maximum workforce of 15 FTEs is employed and each of these workers travels to and from site in a separate vehicle each day. Heavy vehicles would only be required for infrequent repairs and maintenance (eg replacement of inverters). The frequency of heavy vehicles is predicted to be very low compared to the number of light vehicles during operation.

3.3.3 Decommissioning

During project decommissioning, the project generated daily and peak hourly traffic movements have not been specifically calculated and assessed as these movements are likely to be significantly lower than the daily and peak hourly project-related light vehicle and truck traffic movements generated during the construction stage, accounting for anticipated mechanical decommissioning processes and associated significantly reduced labour force.

3.4 Traffic distribution

3.4.1 Construction

To accommodate workers during peak construction, a CAV for non-local construction employees (where skills cannot be sourced locally) may be established. The CAV will be on part of Lot 2 of DP 174053 in the northern array area (refer Figure 1.2). Positioning the CAV within the development footprint for the northern array area will minimise workforce travel times and reduce the project's impacts on the local and regional road network.

For the purposes of this assessment, it is assumed that 20% of the peak construction workforce will travel from both Armidale and Tamworth, respectively, and 10% will travel from within the township of Uralla and surrounds. The remaining 50% will be from outside of these areas and will be accommodated in the CAV (which will only be operated during the peak construction period).

For the purposes of this assessment, during the average construction period, it is assumed that the non-local workforce, which will be smaller, will be able to reside within available temporary accommodation within the Armidale (40%), Tamworth (40%) and Uralla Shire (20%) LGAs and will commute to and from these areas on a daily basis.

During both the peak and the average construction periods, shuttle buses will be utilised to transport the construction workforce to and from the three array areas. It is expected that up to 80% of construction workers from the regional centres of Armidale and Tamworth, up to 50% of construction workers from areas within the Uralla Shire and 100% of the construction workers housed in the CAV could make use of the proposed shuttle bus services.

The proposed construction hours for the project are from 6:00 am to 6:00 pm, 7 days per week. Where possible, shuttle buses will transport workers to and from the three array areas prior to 6:00 am and after 6:00 pm to avoid peak hour traffic, school bus services and also to minimise disruption to existing traffic using the local and regional road network.

UPC has consulted with Armidale Regional Council, Tamworth Regional Council and Uralla Shire Council with regards to potential pick up/muster points for shuttle bus services operating to and from Armidale, Tamworth and Uralla, respectively. The exact locations of these muster points will be determined in consultation with the relevant council as part of the TMP.

The distribution of the project's workforce generated light vehicle traffic movements (which will include both private cars/utes and shuttle buses) during the average and the peak construction periods has been assumed as follows:

- for light vehicle traffic during the average construction period:
    - 40% originating in Armidale and travelling south along the New England Highway (this will include both cars/utes and shuttle buses from selected accommodation locations and/or a designated muster point);
    - 40% originating in Tamworth and travelling north along the New England Highway (this will include both cars/utes and shuttle buses from selected accommodation locations and/or a designated muster point); and
    - 20% originating in Uralla (this will include both cars/utes and shuttle buses from selected accommodation locations and/or a designated muster point).
- for light vehicle traffic during the peak construction period:
    - 38% originating in Armidale and travelling south along the New England Highway (this will include shuttle buses from a muster point);
    - 38% originating in Tamworth and travelling north along the New England Highway (this will include shuttle buses from a muster point);
    - 19% originating in Uralla (this will include shuttle buses from a muster point); and
    - 5% originating from the CAV (this traffic will primarily be shuttle buses).
- for heavy vehicle traffic during the average and peak construction periods:
    - 50% originating from the Port of Brisbane and travelling to site along the New England Highway north of Uralla; and
    - 50% originating from the Port of Sydney and travelling to site along the New England Highway south of Uralla.

Subject to further investigation, project infrastructure may also be delivered via the Port of Newcastle. Should this occur, heavy vehicles would likely use a combination of either the Pacific Highway or Hunter Expressway and the New England Highway to travel to Uralla and the three array areas. Should project infrastructure be delivered via the Port of Newcastle, the split of heavy vehicles between the Port of Brisbane and Port of Sydney would subsequently be revised.

As noted in Section 3.2, Stage 1 and Stage 2 construction works are anticipated to overlap between months 13 to 25. Stage 1 is anticipated to commence from month 1 and end in month 25, while Stage 2 is anticipated to commence during month 13 and end by either month 32 or 36.

It should be noted that the exact timing of each stage, including the commencement of Stage 1, the commencement of Stage 2 and the subsequent duration of the overlap between the two stages will be determined during the contracting, detailed design and financing stage of the project following project approval. Similarly, the overall duration of the project's construction will also be confirmed at this time once the preferred engineering, procurement and construction (EPC) contractor is selected and the detailed construction schedule is confirmed.

The timeframes assumed as part of this assessment are indicative only and reflect a conservative upper limit or 'worst-case scenario' in terms of potential impacts from the project on the local and regional road network.

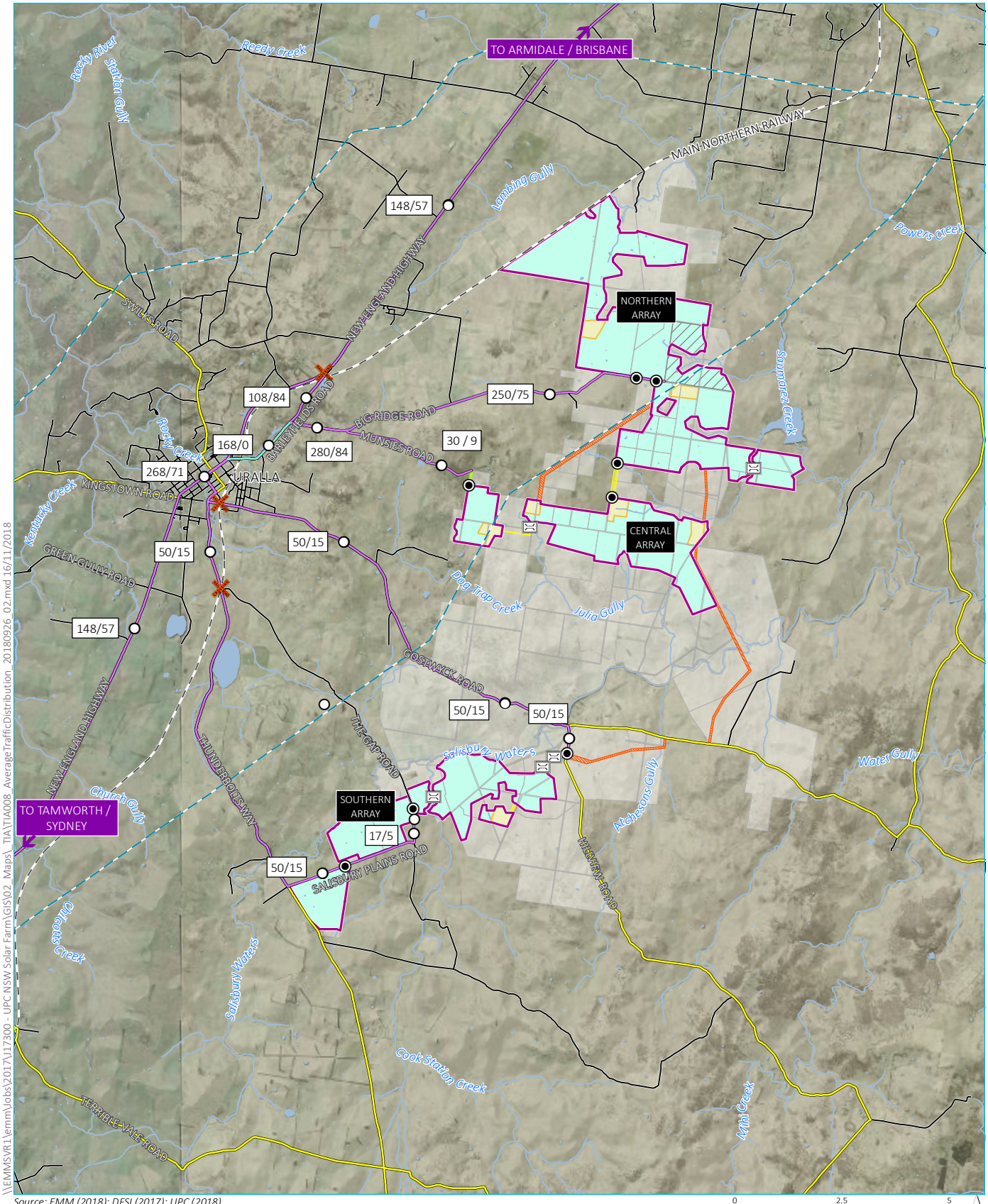
The proposed traffic distribution routes for the project's light vehicle traffic (mainly workforce cars and shuttle buses) and heavy vehicle traffic (mainly delivery trucks) for Stage 1 and Stage 2 combined are illustrated in Figure 3.2 (average daily traffic distribution) and Figure 3.3 (peak daily traffic distribution).

3.4.2 Operation

Throughout operations, a workforce of up to 15 FTEs will be required. During the project's operations, the overall project traffic distribution is predicted to be as follows:

- 1/3 originating in Armidale and travelling south along the New England Highway;
- 1/3 originating in Tamworth and travelling north along the New England Highway; and
- 1/3 originating in Uralla.

During operation, there will be much lower daily traffic movements, which are estimated to be an average of 30 daily light vehicle movements (ie 10 daily light vehicle movements to/from Armidale, Tamworth and Uralla, respectively). Heavy vehicles would only be required for infrequent repairs and maintenances. The frequency of heavy vehicles is predicted to be very low compared to the number of light vehicles during operations.



Source: EMM (2018); DFSI (2017); UPC (2018)

0 2.5 5 km

GDA 1994 MGA Zone 56

N

KEY

- 330 kV transmission line
- Rail line
- Main road
- Local road
- Watercourse/drainage line
- Waterbody
- Project boundary
- Potential site for construction accommodation village

Development footprint

- Solar array
- Potential ETL easement
- Potential site access corridor
- Potential site access/ETL easement
- Potential substation/BESS footprint
- Potential creek crossing
- Primary site access point

- Level crossing
- Light vehicle traffic route
- Light / heavy vehicle traffic route
- Traffic distribution count
- 0/0 Light / heavy vehicle count

Average daily traffic distribution for Stage 1 and Stage 2 combined

New England Solar Farm
Traffic Impact Assessment
Figure 3.2

EMM
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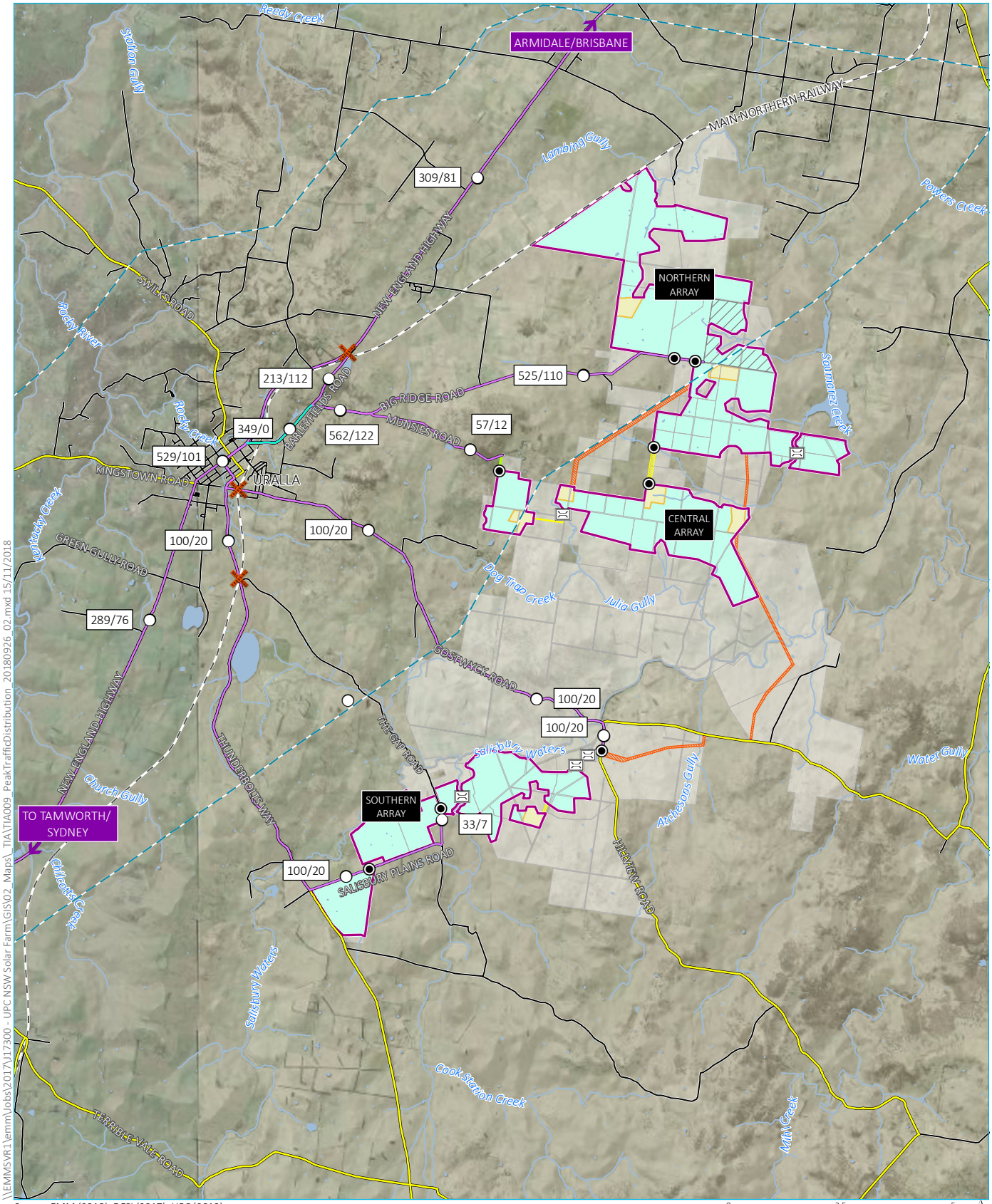

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Source: EMM (2018); DFSI (2017); UPC (2018)

0 2.5 5 km

GDA 1994 MGA Zone 56

N

KEY

- 330 kV transmission line
- Rail line
- Main road
- Local road
- Watercourse/drainage line
- Waterbody
- Project boundary
- Potential site for construction accommodation village

Development footprint

- Solar array
- Potential ETL easement
- Potential site access corridor
- Potential site access/ETL easement
- Potential substation/BESS footprint
- Potential creek crossing
- Primary site access point

- Level crossing
- Light vehicle traffic route
- Light / heavy vehicle traffic route
- Traffic distribution count
- 0/0 Light / heavy vehicle count*

*Peak daily vehicle count is inclusive of construction accommodation village service vehicles.

Peak daily traffic distribution for Stage 1 and Stage 2 combined

New England Solar Farm
Traffic Impact Assessment
Figure 3.3

EMM
creating opportunities

3.5 Car parking and laydown areas

Parking for the project's construction and operations workforces will be provided within the development footprint for the three array areas in suitably prepared (ie passable during wet weather) parking areas with appropriate dimensions to accommodate the number and size of vehicles.

As discussed above, muster points have been discussed at a preliminary level with Uralla Shire Council, Tamworth Regional Council and Armidale Regional Council, which would allow for reduced light vehicle numbers travelling to and from the three array areas, with subsequent reductions to the required size of car parking facilities on-site. The specific locations for any such muster points are yet to be determined. Any associated car parking facilities that may be needed at each muster point will be selected in consultation with the relevant councils.

Laydown areas will likely be in close proximity to the primary site access points and will be placed away from environmentally sensitive areas, where possible.

3.6 Other developments in the locality

Neoen Australia Pty Ltd (Neoen) is seeking to develop the Uralla Solar Farm (SSD 18_9534) within the Uralla Shire LGA, approximately 4.9 km north-west of the project (Figure 1.1). SEARs for the Uralla Solar Farm were not available at the time of writing; however, based on the information provided within the preliminary environmental assessment (PEA), it is understood that if constructed, the proposed Uralla Solar Farm would cover an area of up to 1,800 ha and have a targeted capacity of around 400 MWac (GHD 2018). The proposed site for the Uralla Solar Farm is identified on Figure 1.1. Consideration of potential cumulative impacts from the project and the Uralla Solar Farm is provided in Chapter 5 of this report.

The proposed site for the Uralla Solar Farm is approximately 11 km north of Uralla and lies between the New England Highway to the east and Mount Butler Road to the west. The proposed site for the Uralla Solar Farm and the project's northern array area are separated by approximately 4.9 km, which includes the New England Highway.

If both projects are constructed, the common regional road used for the two projects will be the New England Highway.

The proposed site access point for the Uralla Solar Farm is likely to be via Arding Road to the south. Arding Road intersects with the New England Highway approximately 11 km north of Uralla (refer Figure 2.1).

Based on the information presented in the PEA, the proposed capacity for the Uralla Solar Farm is 400 MW AC, which is equivalent to Stage 1 of the project.

Construction of the Uralla Solar Farm is expected to take about 12-16 months and the project is expected to have a peak construction workforce of about 500-600. It is proposed that these workers would primarily be accommodated within Armidale. Further details on the assessment of cumulative traffic impacts for both projects (should concurrent construction of these two projects occur) are discussed in Chapter 5.

Clenergy proposes to develop a 100 MW PV solar farm at Metz, approximately 18 km east of Armidale (Figure 1.1). This project was approved by the Minister for Planning on 18 July 2017. Due to the distance between the development footprint for the northern array area and the approved site for the Metz Solar Farm (Figure 1.1), as well as the likely timing of construction of the Metz Solar Farm (understood to be commencing in early 2019 and extend for up to 12 months), an assessment of potential cumulative traffic impacts from this project has not been provided as part of this assessment.

In addition, Enerparc is seeking to develop the Tilbuster Solar Farm (SSD 18_9619) within the Armidale Regional LGA, approximately 22 km north of the project. SEARs for the Tilbuster Solar Farm were released on 12 October 2018. Based on the information provided within the PEA, it is understood that if constructed, the proposed Tilbuster Solar Farm would cover an area of up to 150 ha and have a targeted capacity of around 300 MW (NGH 2018). The PEA for the Enerparc project at Tilbuster does not provide anticipated construction timing or workforce requirements. Due to the distance between the development footprint for the project and the proposed Tilbuster Solar Farm, an assessment of potential cumulative traffic impacts from this project has not been provided as part of this assessment.

4 Impact assessment

4.1 Traffic volumes on the road network

The existing daily traffic volumes (projected baseline traffic volumes for the year 2018 based on historical data) for the New England Highway, Thunderbolts Way and various local roads, along with the existing adequacy of the road design standards for these roads are discussed in Section 2.2.

The majority of the existing local road network in the Uralla Shire LGA that would be used by project-related traffic does not currently meet Austroads (2016) *Road Design Guide* standards to accommodate existing baseline traffic volumes. This is indicated by data provided by Uralla Shire Council and the data collected as part of EMM's traffic survey at the relevant intersections on the roads surrounding the three array areas.

The daily traffic capacity for the urban sections of the New England Highway and Thunderbolts Way, which travel through Uralla, is determined by other urban road capacity standards, which generally allow significantly higher daily traffic volumes than the rural capacity standards, depending on the number of lanes on the road. A desktop review has confirmed this premise.

The additional daily traffic volumes generated by the project during average and peak construction (for the combined Stage 1 and Stage 2 construction overlap) and the subsequent operations stage are assessed for the relevant access routes in Sections 4.1.1 to 4.1.3 of this report.

The cumulative traffic impact assessment under a concurrent construction scenario for the project and the Uralla Solar Farm is addressed in Chapter 5.

4.1.1 Average construction traffic

Table 4.1 summarises the current baseline traffic conditions within the local road network and includes the predicted future average daily traffic during the combined Stage 1 and Stage 2 construction stages of the project. Where the predicted future average daily traffic volume results in a change in the applicable Austroads standard, this is in **bold**.

Table 4.1 Future daily traffic assessment for project average construction traffic

Project-related traffic route	Projected baseline daily traffic volume (year 2018)	Average daily traffic from the project	Future total daily traffic	Percent traffic increase	Future Austroads rural daily traffic volume standard	Road width required by Austroads (2016) design standard
New England Highway (north of Uralla)	6,557	205	6,762	+3.13%	> 3,000 daily vehicles	Minimum 10 m wide seal
Bridge Street (Uralla)	8,659	339	8,998	+3.92%	> 3,000 daily vehicles	Minimum 10 m wide seal
New England Highway (south of Uralla)	3,985	205	4,190	+5.14%	> 3,000 daily vehicles	Minimum 10 m wide seal
Barleyfields Road* (north of Big Ridge Road)	645	192	837	+29.77%	500 – 1,000 daily vehicles	Minimum 7.2 m – 8 m wide seal
Barleyfields Road* (south of Big Ridge Road)	740	168	908	+22.70%	500 – 1,000 daily vehicles	Minimum 7.2 m – 8 m wide seal
Big Ridge Road (east of Barleyfields Road)	175	364	539	+208%	**500 – 1,000 daily vehicles**	Minimum 7.2 m – 8 m wide seal
Big Ridge Road (east of Munsies Road)	115	325	440	+283%	**150 – 500 daily vehicles**	Minimum 7.2 m wide seal
Munsies Road (east of Big Ridge Road)	25	39	64	+156%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal
Gostwyck Road (near McCrossin Street)	218	65	283	+29.82%	150 – 500 daily vehicles	Minimum 7.2 m wide seal
Gostwyck Road (west of Hillview Road)	115	65	180	+56.21%	**150 – 500 daily vehicles**	Minimum 7.2 m wide seal
Hillview Road (south of Gostwyck Road)	55	65	120	+118%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal

Table 4.1 Future daily traffic assessment for project average construction traffic

Project-related traffic route	Projected baseline daily traffic volume (year 2018)	Average daily traffic from the project	Future total daily traffic	Percent traffic increase	Future Austroads rural daily traffic volume standard	Road width required by Austroads (2016) design standard
Thunderbolts Way (north of Salisbury Plains Road)	880	65	945	+7.40%	500 – 1,000 daily vehicles	Minimum 7.2 m – 8 m wide seal
Salisbury Plains Road (east of Thunderbolts Way)	25	65	90	+260%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal
The Gap Road (north of Salisbury Plains Road)	46	22	68	+47.83%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal

*Note: *During the Barleyfields Road/Big Ridge Road intersection traffic surveys, it was observed that due to road works on the parallel traffic route via the New England Highway north of Uralla, surveyed traffic volumes using Barleyfields Road are likely to have been higher than would normally be using this route.*

The results in Table 4.1 show the estimated proportional increases on the current baseline traffic volumes for 2018 on relevant roads for average daily construction traffic.

The highest proportional daily traffic increases from the project will be on Big Ridge Road east of Munsies Road (+283%), followed by Salisbury Plains Road (+260%), Big Ridge Road east of Barleyfields Road (+208%), Munsies Road (+156%) and Hillview Road (+118%).

While these increases are proportionally quite significant, they would only apply temporarily during the project's construction and the traffic volumes would subsequently decrease significantly following the completion of construction. The predicted daily traffic increases in Table 4.1 will cause the following sections of road to move into a higher band in the Austroads rural daily traffic volume capacity standards, during the average construction period:

- Big Ridge Road (east of Barleyfields Road) from 150–500 daily vehicles to 500–1,000 daily vehicles;
- Big Ridge Road (east of Munsies Road) from 1–150 daily vehicles to 150–500 daily vehicles; and
- Gostwyck Road (west of Hillview Road) from 1–150 daily vehicles to 150–500 daily vehicles.

No heavy vehicles are proposed to travel on Barleyfields Road south of the Big Ridge Road intersection. This section of Barleyfields Road will be used for light vehicle movements only throughout the project's construction period.

On the other local routes, the increases are proportionally lower: The Gap Road (+47.83%), Gostwyck Road west of Hillview Road (+56.21%), Barleyfields Road south of Big Ridge Road (+22.70%), Gostwyck Road near McCrossin Street (+29.82%) and Barleyfields Road north of Big Ridge Road (+29.77%).

On all other assessed traffic locations, which are all on major roads, the increases in daily traffic volumes are much lower (+7.4% on Thunderbolts Way, and less than 6% on Bridge Street and rural and urban sections of the New England Highway). These increases are minimal when comparing against the current levels of daily traffic volumes.

Generally, with the exception of the New England Highway and certain sections of Thunderbolts Way, the forecast 'average construction' daily traffic volumes for the assessed routes in Table 4.1 will not be within the Austroads (2016) rural road design and capacity standards. However, the forecast project-related daily traffic increases will be relatively short-term, and will have no longstanding effect on the future traffic capacity, level of service or traffic safety for these roads once construction work is completed.

4.1.2 Peak construction traffic

Table 4.2 summarises the current baseline traffic conditions within the local road network and includes the predicted future maximum daily traffic during the combined Stage 1 and Stage 2 construction stages of the project. The peak construction period is anticipated to occur across two four month periods separated by approximately 6 months (ie between months 13 to 16; and 22 to 25), which is relatively short when comparing to the overall project construction period (ie up to 36 months). Where the predicted future peak daily traffic volume results in a change in the applicable Austroads standard, this is in **bold**.

During the peak construction period, it has been assumed that the CAV will accommodate 50% of the project's workforce. For the purposes of this assessment, it has been assumed that 20 light vehicle deliveries and 5 heavy vehicle deliveries per day will be required to and from the CAV in the northern array area. These vehicle movements would include delivery of food and consumables (including potable water), diesel/LPG deliveries, waste/wastewater collection and locally-based cleaning and maintenance services. Traffic associated with deliveries to the CAV and provision of support services are assumed to be travelling to and from either Uralla or Armidale (50% each).

Table 4.2 summarises the current baseline traffic conditions within the local road network and includes the predicted future maximum daily traffic associated with deliveries to the CAV and provision of support services.

Table 4.2 Future daily traffic assessment for project peak construction traffic

Project-related traffic route	Projected baseline daily traffic volume (year 2018)	Peak construction daily traffic from the project	Daily CAV service vehicle traffic during peak construction period	Future total daily traffic	Percent traffic increase	Austroads rural daily traffic volume standard	Road width required by Austroads (2016) design standard
New England Highway (north of Uralla)	6,557	365	25	6,947	+5.95%	> 3,000 daily vehicles	Minimum 10 m wide seal
Bridge Street (Uralla)	8,659	605	25	9,289	+7.28%	> 3,000 daily vehicles	Minimum 10 m wide seal
New England Highway (south of Uralla)	3,985	365	-	4,350	+9.16%	> 3,000 daily vehicles	Minimum 10 m wide seal
Barleyfields Road* (north of Big Ridge Road)	645	325	30	1,000	+55.04%	500 – 1,000 daily vehicles	Minimum 7.2 m – 8 m wide seal
Barleyfields Road* (south of Big Ridge Road)	740	329	20	1,089	+47.16%	**1,000 – 3,000 daily vehicles**	Minimum 9 m wide seal
Big Ridge Road (east of Barleyfields Road)	175	654	50	879	+402%	**500 – 1,000 daily vehicles**	Minimum 7.2 m – 8 m wide seal
Big Ridge Road (east of Munsies Road)	115	585	50	750	+552%	**500 – 1,000 daily vehicles**	Minimum 7.2 m – 8 m wide seal
Munsies Road (east of Big Ridge Road)	25	69	-	94	+276%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal
Gostwyck Road (near McCrossin Street)	218	120	-	338	+55%	150 – 500 daily vehicles	Minimum 7.2 m wide seal
Gostwyck Road (west of Hillview Road)	115	120	-	235	+104%	**150 – 500 daily vehicles**	Minimum 7.2 m wide seal

Table 4.2 Future daily traffic assessment for project peak construction traffic

Project-related traffic route	Projected baseline daily traffic volume (year 2018)	Peak construction daily traffic from the project	Daily CAV service vehicle traffic during peak construction period	Future total daily traffic	Percent traffic increase	Austroads rural daily traffic volume standard	Road width required by Austroads (2016) design standard
Hillview Road (south of Gostwyck Road)	55	120	-	175	+218%	**150 – 500 daily vehicles**	Minimum 7.2 m wide seal
Thunderbolts Way (north of Salisbury Plains Road)	880	120	-	1,000	+14%	500 – 1,000 daily vehicles	Minimum 7.2 m – 8 m wide seal
Salisbury Plains Road (east of Thunderbolts Way)	25	120	-	145	+480%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal
The Gap Road (north of Salisbury Plains Road)	46	40	-	86	+87%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal

Note: **During the Barleyfields Road/Big Ridge Road intersection traffic surveys, it was observed that due to road works on the parallel traffic route via the New England Highway north of Uralla, surveyed traffic volumes using Barleyfields Road are likely to have been higher than would normally be using this route.*

The results in Table 4.2 show the estimated proportional increases on the current baseline daily traffic volumes for 2018 on relevant roads during peak construction.

The highest proportional daily traffic increases from the project will be on Big Ridge Road east of Munsies Road (+552%), followed by Salisbury Plains Road (+480%), Big Ridge Road east of Barleyfields Road (+402%), Munsies Road (+276%), Hillview Road (+218%), Gostwyck Road west of Hillview Road (+104%) and The Gap Road (+87%).

On the other roads assessed such as Barleyfields Road south of Big Ridge Road (+47.16%), Gostwyck Road (+55.04%), Barleyfields Road north of Big Ridge Road (+55.04%) and Thunderbolts Way north of Salisbury Plains Road (+13.64%), the proportional daily traffic increases will be lower.

On the New England Highway and Bridge Street, the proportional increases in daily traffic are expected to be much lower (5.95% to 9.16%). These increases will be minimal when compared against the current levels of daily traffic volumes.

No project-related heavy vehicles will travel on Barleyfields Road south of the Big Ridge Road intersection. This section of Barleyfields Road will be used for light vehicle movements only throughout the project construction period.

The predicted traffic increases in Table 4.2 will cause the following roads/section of roads to move into a higher band in the Austroads rural daily traffic volume capacity standards:

- Barleyfields Road (south of Big Ridge Road) from 500–1,000 daily vehicles to 1,000–3,000 daily vehicles;
- Big Ridge Road (east of Barleyfields Road) from 150–500 daily vehicles to 500-1,000 daily vehicles;
- Big Ridge Road (east of Munsies Road) from 1–150 daily vehicles to 500–1,000 daily vehicles;
- Gostwyck Road (west of Hillview Road) from 1–150 daily vehicles to 150–500 daily vehicles, and
- Hillview Road (south of Gostwyck Road) from 1–150 daily vehicles to 150–500 daily vehicles.

While the forecast traffic increases in Table 4.2 are proportionally quite significant, they would only apply for the peak construction periods (which are anticipated to be during months 13-16 and 22-25 - as shown in Figure 3.1). The traffic volumes would subsequently decrease after these two peak construction periods.

With the exception of the New England Highway and sections of Thunderbolts Way, the peak construction stage traffic volumes for the assessed routes in Table 4.2 will not be within the Austroads (2016) rural road design and capacity standards. However, the forecast traffic increases will not have a significant long-term effect on the future traffic capacity, level of service or traffic safety for these roads as the peak construction period is only temporary.

4.1.3 Operational traffic

During operations, there will be much lower daily traffic movements based on the upper end of the 10-15 FTE workers expected for the project. All of these would generally be light vehicle traffic movements. Heavy vehicles may be required for infrequent repairs and maintenance (eg inverter replacement, which typically occurs every 7-10 years). However, the frequency of heavy vehicles is predicted to be very low compared to numbers of light vehicles during operations. The daily traffic distribution during operations is predicted to be:

- 1/3 originating in Armidale and travelling south along the New England Highway;
- 1/3 originating in Tamworth and travelling north along the New England Highway; and
- 1/3 originating in Uralla.

Table 4.4 summarises the current baseline traffic conditions within the local road network and the longer-term predicted future daily traffic volumes during the operational stage of the project.

It should be noted that the assumptions below reflect traffic movements spread evenly throughout the northern, central and southern array areas. This is a conservative assumption, given the relatively higher impact that is assumed on local roads such as Munsies Road and Hillview Road compared with what is arguably a more realistic scenario whereby the majority of daily traffic movements are to and from the operations and control room that is most likely to be located within the development footprint for the northern array area with access via Big Ridge Road.

No change to the Austroads rural daily traffic volume standard is predicted for any road during project operations.

Table 4.3 Future daily traffic assessment for project operations traffic

Project-related traffic route	Projected baseline daily traffic volume (year 2018)	Average daily traffic from operation	Future total daily traffic	Percent traffic increase	Austroads rural daily traffic volume standard	Austroads (2016) design standard
New England Highway (north of Uralla)	6,557	10	6,567	+0.15%	> 3,000 daily vehicles	Minimum 10 m wide seal
Bridge Street (Uralla)	8,659	10	8,669	+0.12%	> 3,000 daily vehicles	Minimum 10 m wide seal
New England Highway (south of Uralla)	3,985	10	3,995	+0.25%	> 3,000 daily vehicles	Minimum 10 m wide seal
Barleyfields Road (north of Big Ridge Road)	645	7	652	+1.09%	500 – 1,000 daily vehicles	Minimum 7.2 m – 8 m wide seal
Barleyfields Road (south of Big Ridge Road)	740	13	753	+1.76%	500 – 1,000 daily vehicles	Minimum 7.2 m – 8 m wide seal
Big Ridge Road (east of Barleyfields Road)	175	20	195	+11.43%	150 – 500 daily vehicles	Minimum 7.2 m wide seal
Big Ridge Road (east of Munsies Road)	115	10	125	+8.70%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal
Munsies Road (east of Big Ridge Road)	25	10	35	+40%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal
Gostwyck Road (near McCrossin Street)	218	5	223	+2.29%	150 – 500 daily vehicles	Minimum 7.2 m wide seal
Gostwyck Road (west of Hillview Road)	115	5	120	+4.35%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal

Table 4.4 Future daily traffic assessment for project operations traffic

Project-related traffic route	Projected baseline daily traffic volume (year 2018)	Average daily traffic from operation	Future total daily traffic	Percent traffic increase	Austroads rural daily traffic volume standard	Austroads (2016) design standard
Hillview Road (south of Gostwyck Road)	55	5	60	+9.09%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal
Thunderbolts Way (north of Salisbury Plains Road)	880	5	885	+0.57%	500 – 1,000 daily vehicles	Minimum 7.2 m – 8 m wide seal
Salisbury Plains Road (east of Thunderbolts Way)	25	5	30	+20%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal
The Gap Road (north of Salisbury Plains Road)	46	2	48	+4.35%	1 – 150 daily vehicles	8.7 m wide total carriageway (if unsealed); or minimum 3.7 m wide seal

The results in Table 4.3 show that during operations, project traffic will increase between 0.15% to 40%. The greatest percentage increase will be on Munsies Road (40%). While the percentage increase seems significant, the actual light vehicle volumes travelling along Munsies Road during operations are only anticipated to increase by 10 light vehicles per day.

During operations, these minor traffic increases will not change the Austroads (2016) rural road design and capacity standards for any rural roads. Therefore, the existing capacity and condition of these roads should remain adequate to accommodate future daily operations traffic needs for the project.

4.2 Traffic impact at intersections

Five relevant major road access intersections in the locality of the three array areas are described in Section 2.4. Four out of five of these intersections are rural intersections which have been assessed for the future peak construction peak hourly traffic volumes using the Austroads warrant design charts for rural intersection turning lanes. These intersections are:

- New England Highway/Barleyfields Road (north);
- New England Highway/Barleyfields Road (south) including Wood Street;
- Barleyfields Road/Big Ridge Road; and
- Thunderbolts Way/Salisbury Plains Road.

4.2.1 New England Highway/Barleyfields Road (north)

The peak hourly traffic volume for the New England Highway between Uralla and Armidale (refer Table 4.2) has been estimated from the daily volume (6,785 vehicles) to be 679 vehicles per hour.

The future peak daily traffic volume for Barleyfields Road (north) running as a bypass route for traffic turning off to access local roads on the east of the New England Highway (refer Table 4.2) is 869 daily vehicles, which corresponds to approximately 87 vehicles per hour during peak hourly traffic periods.

The New England Highway/Barleyfields Road (north) intersection therefore requires additional left and right turn traffic lanes (CHR/CHL) as the combination of major road and minor road peak hourly traffic volumes are within the range for this type of intersection (refer upper Warrant Chart in Figure 2.2). Importantly, it is noted that this widening is also a requirement of the existing peak hourly traffic movements using the intersection, which has been assessed in Section 2.4.1 (ie regardless of whether or not the project were to proceed).

Also, for the future ease of right turning traffic movements by long trucks at this intersection, it may be desirable to temporarily convert this intersection to a seagull type intersection priority (with a right turning acceleration lane for northbound traffic), particularly during the peak times of construction (refer Appendix A). This approach will be discussed in consultation with RMS and Uralla Shire Council during preparation of the TMP prior to the commencement of construction.

4.2.2 New England Highway/Barleyfields Road (south) including Wood Street

The future peak daily traffic volume for Barleyfields Road (south) including Wood Street, for traffic turning off the New England Highway to access these local roads on the east side (refer Table 4.2) is 1,089 daily vehicles, which corresponds to approximately 109 vehicles per hour during peak hourly traffic periods.

The New England Highway/Barleyfields Road (south) and Wood Street intersection therefore requires additional left and right turn traffic lanes (CHR/CHL) on the New England Highway, as the combination of major road and minor road peak hourly traffic volumes are within the range for this type of intersection (refer lower Warrant Chart in Figure 2.2). However, this widening is also a requirement of the existing peak hourly traffic movements using the intersection, which has been assessed in Section 2.4.2 (ie regardless of whether or not the project were to proceed).

4.2.3 Barleyfields Road/Big Ridge Road

The future peak daily traffic volume for Barleyfields Road running as a bypass route for traffic turning off to access local roads on the east of the New England Highway (refer Table 4.2) has been calculated to be 1,089 daily vehicles, which corresponds to approximately 109 vehicles per hour during the peak hourly traffic periods.

This future traffic for the Barleyfields Road/Big Ridge Road intersection is therefore acceptable without additional left or right turn traffic lanes, as the major road peak hourly traffic volume will be less than 170 vehicles along Barleyfields Road (refer lower Warrant Chart in Figure 2.2).

4.2.4 Thunderbolts Way/Salisbury Plains Road

The future peak daily traffic volume for Thunderbolts Way within proximity of the development footprint for the southern array area (refer Table 4.2) has been calculated to be 1,000 daily vehicles, which corresponds to approximately 100 vehicles per hour during the peak hourly traffic periods.

The future Thunderbolts Way/Salisbury Plains Road intersection is therefore acceptable without additional left or right turn traffic lanes, as the major road peak hourly traffic volume is less than 120 vehicles along Thunderbolts Way (refer upper Warrant Chart in Figure 2.2).

Modification of this intersection is not required from a serviceability perspective. However, the current condition of the minor road approach to the intersection may require attention due to the increased volume of project-related heavy vehicle movements using this intersection in combination with the existing road users. The required future road improvement works at this intersection may include gravel shoulder widening to improve safety of road users. Recommended improvement works are outlined in Section 6.2.

4.2.5 Swept path analysis

As part of the preparation of the TMP and prior to the commencement of construction, detailed analysis of the project construction traffic access requirements along the local and regional road network will be performed, which will be likely to include swept path analyses (for the largest type of vehicle proposed to be used) at the following intersections:

- New England Highway/Barleyfields Road (north) (primarily for vehicles turning right onto Barleyfields Road);
- Barleyfields Road/Big Ridge Road;
- Thunderbolts Way/Salisbury Plains Road;
- New England Highway/Salisbury Street and then onto Duke Street (for vehicles coming from the south turning right onto Salisbury Street from the New England Highway and for vehicles coming from the north turning left onto Salisbury Street from the New England Highway); and
- potential alternate heavy vehicle routes that could alleviate the volume of project-related vehicles travelling through the township of Uralla (should it be required).

Following the swept path analysis, additional sealed or gravel shoulder widening may need to be provided at all of the identified intersection locations to facilitate the turning movements for large vehicles to and from each road. Any proposed shoulder widening will accommodate the swept path turning requirements for the largest type of vehicle that would be required to utilise the relevant route.

Potential alternate heavy vehicle routes that could alleviate the volume of project-related vehicles travelling through the township of Uralla (particularly for vehicles coming from the south) will be discussed in consultation with Uralla Shire Council and RMS during preparation of the TMP prior to the commencement of construction.

4.3 Site access road traffic impact

There are five local roads connecting the primary access points for the three array areas to the local road network. It is anticipated that the maximum project generated daily vehicle volumes using each of these roads will be:

- Big Ridge Road (east of Munsies Road)- 635 peak daily vehicle movements during Stage 1 and Stage 2 combined;
- Munsies Road - 69 peak daily vehicle movements during Stage 2 construction period;

- Hillview Road - 115 peak daily vehicle movements during Stage 2 construction period;
- Salisbury Plains Road - 120 peak daily vehicle movements during Stage 2 construction period; and
- The Gap Road - 40 peak daily vehicle movements during Stage 2 construction period.

For these additional daily traffic volumes, in combination with the existing generally low daily traffic movements, a variable lane width, unsealed rural road will generally remain acceptable. However, for the currently unsealed sections of Big Ridge Road, where up to 635 additional daily vehicle movements are predicted to occur, more intensive traffic management measures will be required, including travel speed restrictions for both light and heavy vehicles and regular watering of the unsealed section of this road near residences (or other dust suppression treatments) throughout the project construction period.

4.4 Emergency access points

Emergency access points to enable access to the three array areas from the local road network may also be required. The exact location of these access points will be determined during detailed design.

The local roads required for travel to and from these emergency access points will only be used in case of emergency.

The other project-related access routes considered as part of this TIA will also be able to be used by emergency vehicles.

Consultation with emergency service providers (including NSW Rural Fire Service (RFS) and Fire and Rescue NSW (FRNSW) will be required as part of the finalisation of the TMP of the project.

4.5 Rail safety

An active railway line (Main Northern Railway) originating from Tenterfield, travels south through Armidale and Uralla and to Tamworth. This is the only railway line that would potentially be affected by project-generated traffic movements.

The project-generated traffic routes assessed as part of this TIA will cross at three existing railway level crossings for the Main Northern Railway, including:

- Barleyfields Road;
- Gostwyck Road; and
- Thunderbolts Way.

These level crossings are shown on Figure 3.2 and Figure 3.3.

A number of level crossing control protection strategies are currently installed at these locations as shown in Table 4.5.

Table 4.5 Level crossing control protection

Level crossing	Control type	Controls
Barleyfields Road	Active	Flashing lights
Gostwyck Road	Passive	Stop signs
Thunderbolts Way	Active	Flashing lights

Source: NSW Public Level Crossing Finder (RMS)

Extra care will be taken by the project-generated traffic when using these level crossings. UPC recognises the importance of driver's wellbeing and level of awareness at level crossings. Relevant safety tips by TfNSW for heavy vehicles using level crossings will be utilised as a guideline in the Driver Code of Conduct to be implemented as part of the TMP. Given the low level of utilisation of the Main Northern Railway line, with adequate driver awareness training, the level crossings identified in Table 4.4 are not anticipated to present a material safety risk to project-related vehicles.

As part of the preparation of this assessment, EMM has consulted with John Holland Country Regional Network (as the operator of the Main Northern Railway line). As part of this consultation, no alterations to any of these level crossings have been recommended. It should be noted that as part of this consultation, project-related vehicle movements at each of these level crossings have not been discussed. Further consultation may be required as part of the TMP once the future forecast maximum project-related traffic volumes (including CAV vehicle movements) and the largest types of heavy vehicles using each crossing have been confirmed.

4.6 Summary of the effect of project-generated traffic increases on roads

The New England Highway is a two-lane sealed 11 m width carriageway, which is appropriate for daily vehicle movements of >3,000 vehicles. This road is adequate to accommodate the proposed future route daily traffic volumes including the peak construction stage traffic for the project. The inclusion of a CAV during the peak construction period will reduce the volume of light vehicles utilising the New England Highway north or south of Uralla. During the Stage 1 and Stage 2 construction overlap period, the additional average and peak daily traffic movements travelling on the rural sections of the New England Highway will be +205 and +365 vehicles, respectively. This represents an increase of 4.14% (average) and 7.37% (peak). Improvements to the New England Highway/Barleyfields Road (north) intersection are discussed in Chapter 6.

Thunderbolts Way is a two-lane sealed country road link, which is appropriate for daily vehicle movements of 500 – 1,000 vehicles. This road is adequate to accommodate the proposed future route daily traffic volumes including the peak construction stage traffic for the project. It is expected that during the construction overlap period, the additional average and peak daily traffic travelling on Thunderbolts Way will be +65 and +115 vehicles, respectively. This represents an increase of 7.4% (average) and 13.64% (peak). The current sealed width of Thunderbolts Way is between 7 m-9 m. The current road width and condition is generally sufficient for the proposed traffic increases.

Barleyfields Road is a two-way sealed local road, total length approximately 3 km. This road is adequate to accommodate the proposed future route daily traffic volumes including the construction overlap period for the project when it is expected that the additional average and peak daily traffic travelling on Barleyfields Road (south) will be approximately +180 and +349 respectively, which represent increases of 22.17% and 47.16%.

These additional traffic increases will be temporary and restrictions on heavy vehicles travelling south of Big Ridge Road will be implemented. All heavy vehicles requiring access to the northern and central array areas will be directed to use the northern end of Barleyfields Road with access direct from the New England Highway. Additional light vehicle traffic increases will cause Barleyfields Road (south) to move into a higher band in the Austroads rural daily traffic volume classification system during the peak construction period. However, during months 13-16 and 22-25 (ie those times when the capacity standard for the route changes), the daily vehicle volumes travelling south on Barleyfields Road will only marginally exceed the existing band level of 1,000 daily vehicles. As indicated above, the New England Highway/Barleyfields Road (north) intersection requires improvement works. These works are discussed further in Chapter 6.

The proposed increase resulting from project construction traffic travelling on Big Ridge Road (east of Barleyfields Road) is approximately 208% during the average construction period (approximately 364 vehicle movements per day) and approximately 402% during the peak construction period (approximately 704 vehicle movements per day). These vehicle increases are likely to feel significant to existing users and the additional vehicle movements will cause this road to move into a higher band in the Austroads rural daily traffic volume capacity standards. However, the road itself is a low volume rural road and located away from the township of Uralla. In relation to the unsealed section of Big Ridge Road, it is recommended that consideration be given to temporary travel speed reductions and improved traffic safety, along with regular watering (for dust suppression) of the unsealed section of the road near residential dwellings – in particular, near the corner of Big Ridge Road and Munsies Road. Management of the unsealed section of Big Ridge Road is discussed further in Chapter 6.

Munsies Road is a low volume rural road with only 25 daily vehicles in year 2018. The proposed construction traffic volumes utilising Munsies Road would generate a high percentage increase in the traffic volume (average 156% and peak 276% respectively). The real vehicle number increases will be only very minor at +39 and +69 daily vehicles during average and peak construction periods, respectively. In relation to the residential dwellings on the unsealed section of Munsies Road near the corner of Big Ridge Road, it is recommended that consideration be given to temporary travel speed reduction and regular watering (for dust suppression). Traffic controls and mitigation strategies for Munsies Road are discussed in Chapter 6.

The average and peak construction related daily traffic using Gostwyck Road (west of Hillview Road) will be approximately +65 and +120 vehicles respectively, representing increases of 56% (average) and 104% (peak). However, the future total daily traffic will be below 180 vehicles during the average construction period and below 235 vehicles during the peak construction period. The northern section of Gostwyck Road (near McCrossin Street) has a higher daily traffic volume than the southern section of Gostwyck Road (closer to Hillview Road). However the existing sealed width of the road progressively increases as the road gets closer to Uralla, in line with the increased traffic usage.

Hillview Road is another low volume rural road with only 55 daily vehicles in year 2018. The proposed traffic utilising Hillview Road during construction would seem to have a significant percentage increase (ie 118% (average) and 218% (peak)) on the use of this local road; however, the actual increase is only minor at +65 and +120 daily vehicles during average and peak construction, respectively.

Salisbury Plains Road currently has the same utilisation rate as Munsies Road at only 25 daily vehicles in year 2018. The proposed traffic utilising Salisbury Plains Road is +65 and +120 daily vehicles during the average and peak construction periods, respectively. These increases would not change the road's classification under the Austroads rural daily traffic volume standard. The peak increase of traffic volume travelling on Salisbury Plains Road will be temporary and only occur during Stage 2 of the project's construction.

4.7 Summary of the effect of project-generated traffic increases at intersections

The future peak hourly traffic at the New England Highway/Barleyfields Road (north) intersection does require additional left and right turn traffic lanes as the combination of major road and minor road peak hourly traffic volumes are within the range for the CHR/CHL type of intersection.

As noted in Section 2.10, as part of their upcoming scheduled works, RMS propose the construction of a left turn lane to Barleyfields Road from the New England Highway. This decision was based on the traffic data available under the current use of this intersection. It was noted that as part of this work, RMS will ensure that the intersection of Barleyfields Road and the New England Highway will be suitable for conversion to a CH(R) layout without significant construction work (ie implementation of a right turn lane for traffic turning right into Barleyfields Road from the New England Highway).

The Barleyfields Road/Big Ridge Road intersection does not require additional left or right turn traffic lanes as the peak hourly traffic volumes will continue to satisfy the standard AUR/AUL intersection design requirements without additional left or right turn traffic lanes.

The Thunderbolts Way/Salisbury Plains Road intersection does not require additional left or right turn traffic lanes as the peak hourly traffic volumes will continue to satisfy the standard AUR/AUL intersection design requirements without additional left or right turn traffic lanes.

However, the current condition of this intersection is likely to require some road improvement works as a result of the maximum construction vehicle size swept path analysis that is proposed to be undertaken. These works may include gravel shoulder widening.

4.8 Driver distraction from glare

The potential for low angled reflected sunlight to cause a distraction to drivers travelling either northbound or southbound along the New England Highway (which is approximately 1.9 km from the development footprint for the northern array area at its closest point) and Thunderbolts Way (within proximity of the southern array area), as well as a number of local roads (including Big Ridge Road, Hillview Road, Gostwyck Road, The Gap Road and Salisbury Plains Road) was considered. Due to the low level of reflectivity properties of the PV modules, they are not expected to cause a distraction to motorists travelling along the local and regional road network.

PV modules are designed to absorb sunlight and, subsequently, the amount of reflectivity is low. As little as 2% of the light received is reflected by PV modules, which is less than the reflectivity produced by a wide variety of surfaces in the environment surrounding and within the development footprint.

Due to the significant distance of the development footprint from the New England Highway, the potential for low angled reflected sunlight to cause a distraction to drivers travelling along the New England Highway is considered negligible.

Based on the findings of previous assessments prepared for PV solar energy facilities, glint and glare from the project's PV modules and other project infrastructure are not expected to significantly impact motorists travelling along the local road network and regional road network.

Visual impacts of the project are addressed in the EIS (refer Section 5.6 and Appendix I). The visual impact assessment includes consideration of impacts on motorists along the local and regional road network. Undulation within the landscape, favourable topography and existing remnant vegetation in the landscape (including planted wind breaks and roadside vegetation) will reduce both the duration and location from project infrastructure may be visible.

4.9 Dust and noise generation impacts

The project-related construction traffic using the unsealed sections of Big Ridge Road, Munsies Road, Hillview Road, The Gap Road and Salisbury Plains Road may cause dust generation.

However, for the currently unsealed sections of Big Ridge Road, where additional maximum daily traffic volumes of up to 625 vehicle movements are predicted to occur during peak construction, additional consideration should be given to travel speed and regular watering of the unsealed section of the road, particularly near residences.

UPC will apply appropriate mitigation strategies to reduce potential dust generation by the project-related construction traffic. This may include measures within the TMP such as speed reduction along the unsealed portions of these local roads as well as consideration of localised sealing of the road adjacent to any residential property (eg Munsies Road near the corner of Big Ridge Road).

Further, it is noted that along the sections of a number of the local roads likely to be used by project-generated traffic, including Salisbury Plains Road and Hillview Road, potentially affected residences are limited to project landholders.

Road traffic noise impacts have been assessed as part of the noise and vibration impact assessment (refer Section 5.7 and Appendix J of the EIS).

Potential air quality impacts have also been considered in Section 5.14 of the EIS.

5 Cumulative impact assessment

5.1 Other developments in the locality

As noted in Section 3.6 of this report, there is another solar farm proposed to be constructed in the Uralla Shire LGA, namely the Uralla Solar Farm. At the time of writing, the SEARs for the Uralla Solar Farm had not been released.

The Uralla Solar Farm is proposed on a site approximately 11 km north of Uralla and between the New England Highway to the east and Mount Butler Road to the west.

The proposed site for the Uralla Solar Farm is approximately 11 km north of Uralla and lies between the New England Highway to the east and Mount Butler Road to the west. The proposed site for the Uralla Solar Farm and the project's northern array area are separated by approximately 4.9 km, which includes the New England Highway.

If both projects are constructed, the common regional road used for the two projects will be the New England Highway. The proposed Uralla Solar Farm access point is likely to be primarily via Arding Road to the south. Arding Road intersects with the New England Highway approximately 11 km north of Uralla.

Construction of the Uralla Solar Farm is expected to take about 12-16 months and the project is expected to have a peak construction workforce of about 500-600. It is proposed that these workers would primarily be accommodated within Armidale.

5.2 Future cumulative traffic impacts

It has been conservatively assumed that the proposed Uralla Solar Farm (north-west of the northern array area) could also be constructed during a similar time period as the project, but at a reduced timeframe of 12-16 months.

This cumulative traffic assessment assumes the peak stage of construction for both projects may occur simultaneously. However, the only shared road network route with Uralla Solar Farm is the New England Highway. Therefore, the cumulative traffic impacts only generally need to be considered for the New England Highway route to the north and south of, and through the township of, Uralla.

It is assumed, based on the information provided within the PEA for the Uralla Solar Farm (GHD 2018) that the construction vehicle movements required over the 12-16 month construction period for the Uralla Solar Farm will be similar to Stage 1 of the project's construction.

A maximum of 360 daily construction vehicle movements for the Uralla Solar Farm has been assumed. As these movements could potentially be occurring concurrently with the peak daily construction traffic movements from both Stage 1 and Stage 2 of the project, a summary of the combined cumulative traffic movements from both projects is presented in Table 5.1.

Table 5.1 Future cumulative construction traffic assessment

Route	Projected baseline daily traffic volume (year 2018)	New England Solar Farm	Uralla Solar Farm[1]	Future total daily traffic	Percent traffic increase	Austroads rural daily traffic volume standard	Austroads (2016) design standard
New England Highway (north of Uralla)	6,557	390	180	7,127	8.69%	>3,000 daily vehicles	Minimum 10 m wide seal
Bridge Street (Uralla)	8,659	630	180	9,469	9.35%	>3,000 daily vehicles	Minimum 10 m wide seal
New England Highway (south of Uralla)	3,985	365	180	4,530	13.68%	>3,000 daily vehicles	Minimum 10 m wide seal

Notes: 1. Traffic distribution amongst major roads is assumed to be 50% from the north via Armidale and 50% from the south via Uralla for the Uralla Solar Farm.

The results in Table 5.1 show the potential daily traffic increases from the concurrent construction of the two projects will be at peak between 8.69% to 13.68% traffic increases on the New England Highway. These traffic increases are considered of minimal impact as the New England Highway is a well-constructed sealed 11 m wide carriageway.

The New England Highway has generally been constructed to accommodate all types of heavy vehicle movements. Furthermore, the forecast peak daily traffic increases on the New England Highway will only occur for up to 12-16 months under the concurrent construction scenario for both projects. Thereafter, it will return to a peak daily traffic increase of 5.95% to 9.16% (ie project-generated construction vehicle movements only).

6 Mitigation measures

6.1 Construction traffic management

A TMP and Driver Code of Conduct will be prepared prior to commencement of construction.

To address RMS's input on the SEARs and in line with UPC's desire to construct a safe driving and working environment, the following requirements are to be included in the TMP and Driver Code of Conduct for the project prior to commencement of construction:

- a dilapidation survey to be conducted to assess condition of the proposed vehicle routes - this survey should be prepared by a qualified person in consultation with RMS and Uralla Shire Council, and include consideration of haulage weights and potential impacts on bridges and culverts;
- a swept path analysis of the following intersections:
  - New England Highway/Barleyfields Road (primarily for vehicles turning right onto Barleyfields Road);
  - Barleyfields Road/Big Ridge Road;
  - Thunderbolts Way/Salisbury Plains Road;
  - New England Highway/Salisbury Street and then onto Duke Street (for vehicles coming from the south turning right onto Salisbury Street from the New England Highway and for vehicles coming from the north turning left onto Salisbury Street from the New England Highway); and
  - potential alternate heavy vehicle routes that could alleviate the volume of project-related vehicles travelling through the township of Uralla (should it be required);
- a map of the primary access routes highlighting critical locations;
- the framework for handling/approval of exceptions (for emergency or other unforeseen circumstances) to the exclusion of heavy vehicles utilising the Barleyfields Road (south) intersection via Wood Street to access Big Ridge Road during construction of the northern and central array areas;
- safety initiatives for transport through residential areas and/or school zones;
- consideration for coordination of construction traffic with seasonal agricultural haulage;
- an induction process for vehicle operators and regular toolbox meetings;
- a complaint resolution and disciplinary procedure; and
- community consultation measures for the peak construction period.

In addition to the above requirements and in order to minimise impacts on traffic flow in the township of Uralla and surrounds during the operation of school bus services, the project's construction material deliveries and other heavy vehicle movements will avoid peak hour and school bus times, whenever possible.

UPC is also mindful of the safety of drivers at level crossings in the Uralla Shire LGA and, subsequently, additional RMS tips and safety guidelines will be included in the Driver Code of Conduct as part of the TMP.

Due to the significant increase of vehicles travelling on Barleyfields Road, there is potential for queuing to occur over the level crossing at Barleyfields Road (north) during peak construction. The level crossing is located approximately 115 m south of the New England Highway intersection. It is recommended that temporary traffic control be considered during peak construction. This level crossing should also be included in driver inductions and the Driver Code of Conduct.

Generally, during the construction period, the largest vehicles which are anticipated to require access to the three array areas for construction deliveries on a regular basis will be 25 m long semi-trailers.

Temporary traffic control arrangements may be required at the proposed primary access intersections during the peak stages of construction traffic activity and/or on days when deliveries by oversize vehicles are required for the delivery of larger construction items such as transformers. At this stage it is anticipated that approximately five 90 t deliveries and two 220 t deliveries may be required for the transformers that will form part of the solar array and grid substations, respectively. These will be delivered under permit and in consultation with RMS and Uralla Shire Council.

Potential seasonal/campaign-based agricultural transport activities will be identified during further consultation with project landholders and nearby landholders. Any required mitigation measures (eg temporary alternate construction vehicle access routes and/or revisions to construction scheduling) will be identified in consultation with landholders and included in the TMP.

Project-related and nearby landholders may move stock between paddocks and across roads proposed to be utilised for access to the three array areas, therefore there is potential for conflict with project-related construction traffic movements. Potential stock crossing locations will be identified through further consultation with project-related and nearby landholders. Any required mitigation measures (eg direct line of communications between landholder and site construction manager and/or temporary traffic control at stock movement locations) will be identified in consultation with landholders and included in the TMP for the project.

6.2 Road and intersection improvements

The New England Highway/Barleyfields Road (north) intersection and New England Highway/Barleyfields Road (south) including Wood Street intersection both require left and right turn traffic lanes (CHR/CHL), currently as the combination of major road and minor road peak hourly volume is within the range for this type of intersection. These intersection upgrade works are required at these intersections currently and the need will become more apparent when the proposed project construction traffic is operating.

Additionally, the TMP will consider the temporary conversion of the New England Highway/Barleyfields Road (north) intersection to seagull type operation during the peak construction period to ease right turning movements by large trucks entering and departing from Barleyfields Road (north).

For the current unsealed sections of Big Ridge Road, where future maximum daily traffic volumes of up to 672 vehicle movements are predicted to occur, it is recommended that consideration be given to temporary travel speed reduction and regular watering of the unsealed section of the road. This is also applicable to Munsies Road where two residential properties are in close proximity to the road. UPC may consider speed limits, dust suppression with water spraying or localised sealing or treatment of the road with dust suppression polymers adjacent to the residential properties along these roads.

The Thunderbolts Way/Salisbury Plains Road intersection does not require additional left or right turn traffic lanes as the forecast future peak hourly traffic volumes satisfy the standard AUR/AUL intersection design requirement without additional left or right turn traffic lanes. However, following the construction swept path analysis for the largest vehicles using this intersection, some improvement works may be required for the safe operation of the project construction traffic in combination with existing road users. This may include additional gravel shoulder widening at the intersection.

UPC will be required to lodge a Section 138 Certificate (Work on Public Lands) for approval before any future road work for the intersection improvement is carried out.

6.3 Road maintenance program

During the project's construction period, which is estimated to continue for approximately 36 months, a road maintenance program will be implemented for the affected local roads near the development footprint for the three array areas.

The program will be based around bi-monthly route inspections of all the affected roads and may include items such as:

- regrading of the road surface to repair potholes and road corrugations at regular intervals and in response to identified serviceability and safety concerns; and
- a commitment by UPC to restore the road surfaces to their pre-construction condition at the completion of construction.

The road maintenance program will be prepared in consultation with Uralla Shire Council and its effectiveness will be reviewed during the construction period.

Should it be required, UPC will also regularly treat the road surface of the unsealed sections of a number of local roads to reduce potential dust impacts by project-related traffic during the construction period.

7 Summary and conclusions

The traffic impacts from the proposed New England Solar Farm have been assessed and the key findings are as follows:

- The northern, central and southern array areas are at least 5 km east of the township of Uralla. The two regional roads used to access the three arrays will be the New England Highway and Thunderbolts Way. From these regional roads, the following rural roads will be used to access the site access points for the three array areas: Barleyfields Road, Big Ridge Road, Munsies Road, Gostwyck Road, Hillview Road, Salisbury Plains Road and The Gap Road.

- The traffic count and survey results suggest both the New England Highway and Thunderbolts Way meet the current Austroads (2016) design standard; however, the following rural roads currently do not meet the Austroads (2016) design standard:

  - Barleyfields Road;
  - Big Ridge Road;
  - Munsies Road;
  - Gostwyck Road;
  - Hillview Road;
  - Salisbury Plains Road; and
  - The Gap Road.

- The predicted daily traffic increases on the roads surrounding the project during the average construction period will be variable and range between +283% and +3.13%. The large variations in percentage growth are primarily due to proportionally low traffic growth on major highways where the current traffic flows are already high and significant traffic growth on low use rural roads where the current traffic flow is minimal. The additional forecast traffic growth as a result of the project's average construction traffic would change the future Austroads rural daily traffic volume standard of two roads, namely Big Ridge Road and Gostwyck Road (west of Hillview Road). These predicted additional daily traffic increases should not have a significant long-term effect on the future traffic capacity, level of service or traffic safety for these roads.

- The predicted daily traffic increases on the roads surrounding the project during the peak construction period will also be variable and range between +552% and +5.95%. Similar to the average construction period described above, the variations in percentage growth are primarily due to proportionally small traffic growth on major highways where the current traffic flow is already high and significant traffic growth on low use rural roads where the current traffic flow is minimal. The additional forecast traffic growth as a result of the project's peak construction traffic would change the future Austroads rural daily traffic volume standard of four roads, namely Barleyfields Road (south) (due to light vehicle movements only), Big Ridge Road, Gostwyck Road (west of Hillview Road) and Hillview Road (south of Gostwyck Road – prior to the proposed site access point). The predicted additional daily traffic increases during peak construction would only occur during months 13-16 and 22-25 and should not have a significant long-term effect on the future traffic capacity, level of service or traffic safety for these roads.

- It has been assumed that the CAV will be used to accommodate 50% of the project's construction workforce during the peak stage of construction. Positioning the CAV within the development footprint for the northern array area will minimise workforce travel times and reduce the project's impacts on the local and regional road network.

- During operations, there will be much lower daily traffic movements along the local and regional road network and the additional project-related daily traffic will make no change to the Austroads rural daily traffic volume standard.

- In order to assess potential cumulative impacts, it has been conservatively assumed that the proposed Uralla Solar Farm will also be constructed during a similar time period to the project but at a reduced timeframe of 12-16 months. The only shared road used would be the New England Highway. The predicted daily traffic increases from the concurrent construction of the two projects will be a peak traffic increase of between +8.69% to +13.68% along the New England Highway. These increases are considered minimal as the New England Highway is well-constructed and designed to accommodate all types of heavy vehicle movements.

- Parking for the project's construction and operations workforce will be provided within the development footprint for the three array areas in suitably surfaced parking areas with appropriate dimensions to accommodate the number and size of vehicles.

- The following road and intersection improvement works are proposed to maintain the safety of the road network and to accommodate the swept paths of the largest trucks which are proposed to require access to the three array areas:

    - New England Highway/Barleyfields Road (north) and New England Highway/Barleyfields Road (south) including Wood Street intersections require left and right turn traffic lanes (CHR/CHL), particularly during periods of peak construction activity. The TMP will also consider the temporary conversion of the New England Highway/Barleyfields Road (north) intersection to seagull type operation to ease right turning movements by large trucks entering and departing from Barleyfields Road (north).

    - Consider implementation of temporary traffic control at the Barleyfields Road level crossing, particularly during the peak construction period.

    - Gravel shoulder widening at the Thunderbolts Way/Salisbury Plains Road intersection, pending the results of the swept path analysis of this intersection during the preparation of the TMP.

- A TMP will be prepared in consultation with RMS and Uralla Shire Council, which will include a commitment to perform a dilapidation survey, a Driver Code of Conduct, results of the swept path analysis and reference to any alternative heavy vehicle routes that could be utilised to bypass the township of Uralla. The TMP will also contain the details of the road maintenance program proposed for rural roads impacted by the project.

Abbreviations

DA	development application
EIS	environmental impact statement
EMM	EMM Consulting Pty Ltd
LGA	local government area
RMS	Roads and Maritime Services
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SRD	State and Regional Development
SSD	State Significant Development
TIA	traffic impact assessment
TfNSW	Transport for New South Wales
TMP	traffic management plan
UPC	UPC Renewables Australia Pty Ltd

References

Austroads 2016, *Guide to Road Design Part 3: Geometric Design*.

Austroads 2017, *Guide to Road Design Part 4: Intersections and Crossings: General.*

Austroads 2016, *Guide to Traffic Management Part 12: Traffic Impacts of Developments*.

GHD 2018, *Neoen Uralla Solar Farm Preliminary Environmental Investigation*.

NGH Environmental (NGH) 2018, *Tilbuster Solar Farm Preliminary Environmental Assessment.*

RMS 2017, *Schedule of Classified Roads and Unclassified Regional Roads,* NSW Roads and Maritime Services.

RMS 2018, *Traffic Volume Viewer,* viewed 28 August 2018, http://www.rms.nsw.gov.au/about/corporate-publications/statistics/traffic-volumes/aadt-map/index.html#/?z=6

RTA 2002, *Guide to Traffic Generating Developments*, NSW Roads and Maritime Services.

TfNSW (Transport for NSW) 2018, *Crashes Map – Uralla*, viewed 27 August 2018, http://roadsafety.transport.nsw.gov.au/statistics/interactivecrashstats/lga_stats.html?tablga=1

Appendix A

Austroads design standards for intersection turning lanes

A.5 Basic Turn Treatments (Type BA)

BA turn treatments comprise:

- basic right-turn treatment (BAR) on the major road (two-lane undivided roads only)
- basic left-turn treatment (BAL) on the major road (two-lane undivided roads and multilane roads)
- basic left-turn treatment (BAL) on the minor road (lane also used for right-turn movements).

These type of turn treatments (Figure A 2) are:

- the simplest layouts
- designed to be as compact (and inexpensive) as possible
- most appropriately used where the volume of turning and through traffic is low
  The BAR turn treatment is only used on two-lane, two-way roads (i.e. it does not apply to multilane roads).
- comprised of carriageways that intersect with an appropriate corner radius and taper to suit the swept path of the design vehicle
- used with any wearing surface
- required to be located where good perception of the treatment is provided (e.g. BAR turn treatments should not be located on small to moderate sized crests as insufficient visibility to the treatment will be provided).

A.5.1 Rural Basic (BA) Turn Treatments

Figure A 2 shows the features of rural BA turn treatments at T-intersections, namely:

- The BAR treatment features a widened shoulder on the major road that allows through vehicles, having slowed, to pass to the left of turning vehicles.
- The BAL treatment on the major road has a widened shoulder, which assists turning vehicles to move further off the through carriageway making it easier for through vehicles to pass.
- The BAL turn treatment on the minor road allows turning movements from a single lane with a shoulder that is too narrow to be used by left-turning vehicles (to prevent drivers from standing two abreast at the holding line).

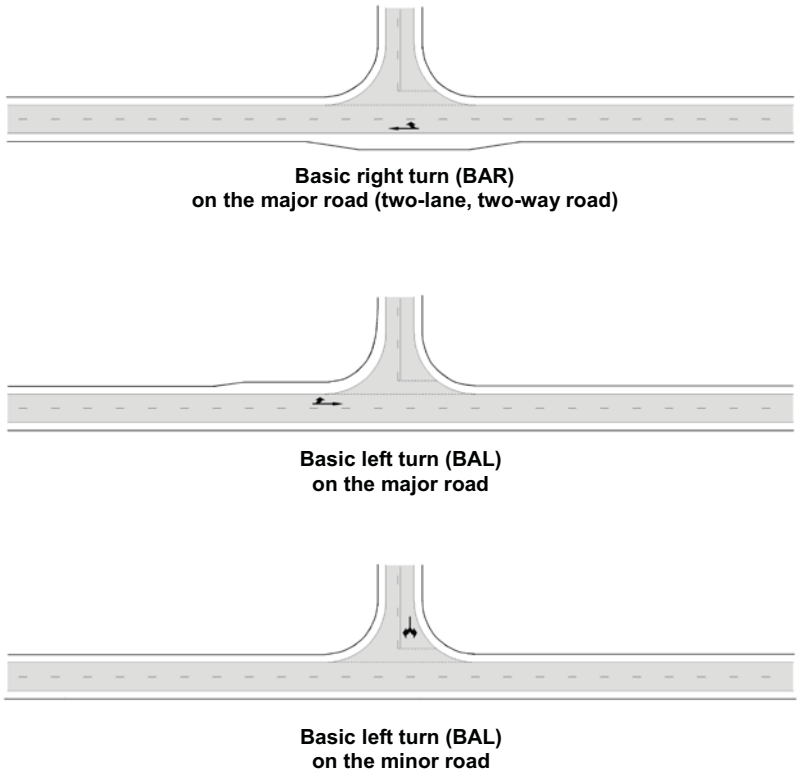
Where the major road is sealed it is preferred that the widened shoulders are also sealed, unless the shoulders can be maintained with a sound and even surface in all weather conditions. Research (Arndt 2004) has shown that BAR turn treatments record a rear-end major vehicle crash rate 52 times higher than do CHR turn treatments. The research also found that the rear-end major vehicle crash rate decreases substantially with increased median width, regardless of the type of median (painted, raised or depressed). Commentary 4 provides some more information in relation to the findings in Arndt (2004).

[see Commentary 4]

For design details of rural basic turn treatments refer to:

- Figure A 28 for a BAR treatment on the major road
- Figure 8.2 of *AGRD Part 4A* (Austroads 2017a) for BAL treatments on major and minor roads.

Figure A 2: Rural basic BA turn treatments



Note: Arrows indicate movements relevant to the turn type. They do not represent actual pavement markings.

Source: Department of Main Roads (2006)[15].

Figure A 2 shows only basic T-intersection treatments because unsignalised and signalised crossroads should not be provided because of road safety risk in high speed situations (e.g. > 80 km/h) unless treated with channelisation (e.g. roundabout, wide median treatment) and/or traffic management devices. However, CHR treatments may be applied to existing crossroads where there is a need to shelter turning vehicles on the major road and the risk associated with crossing traffic is considered to be low (e.g. no crashes recorded, very low approach speeds, negligible traffic crossing). This treatment is implemented under extended design domain principles (*AGRD Part 2* (Austroads 2015b) and *AGRD Part 4A* (Austroads 2017a).

A.5.2 Urban Basic (BA) Turn Treatments

Figure A 3 shows the features of urban BA turn treatments. It can be seen that:

- The basic right-turn treatment and basic left-turn treatments are achieved by resuming parking space at and near the intersection.
- A bicycle lane on the major road may be incorporated into the treatment and should always be continued through unsignalised intersections.

15 Department of Main Roads has been superseded and Figure A 2 has not been carried forward into Queensland Department of Transport and Main Roads (2016).

For design details of urban auxiliary turn treatments refer to:

- Figure A 39 for an AUL(S) treatment on the major road comprising a shorter turning lane
- Figure 8.6 of *AGRD Part 4A* (Austroads 2017a) for an AUL treatment on the major road comprising a full-length lane.

A.7 Channelised Turn Treatments (Type CH)

The CH turn treatment has conflicting vehicle travel paths separated by raised, depressed, or painted medians and/or islands. Auxiliary lanes are often used in conjunction with channelisation.

Channelised turn treatments comprise (Figure A 8) a:

- right-turn treatment (CHR) on the major road
- left-turn treatment (CHL) on the major road
- left-turn treatment (CHL) on the minor road.

Often, not all the treatments will be used together at a single intersection. A CHR treatment may have full-length deceleration turning lanes or it may have a reduced length in which case it is referred to as a CHR(S) treatment (see Appendix A.8 for warrants).

The advantages of using CHR turn treatments in lieu of AUR treatments include:

- reduction in 'rear-end major road' crashes and 'overtaking-intersection' vehicle crashes (where a right-turn vehicle is hit by an overtaking vehicle (Appendix D)
  With an AUR treatment a stationary right-turning vehicle on a tight horizontal curve or over a crest is vulnerable whereas the island in a CHR treatment guides through drivers past the right-turning vehicle.
- provision of fewer types of turn treatments and thus more consistent intersection layouts
- provision of a refuge for pedestrians crossing the major road
- increase in the average design life of turn treatments compared to AUR turn treatments; CHR(S) treatments will be able to function for longer periods before an upgrade is required
- allaying concerns from the motoring public that more CHR turn treatments should be provided on high-speed roads to improve safety.

CHR(S) turn treatments can only be used with linemarking. The good safety performance of the CHR(S) occurs by removing potentially stationary turning vehicles from the through traffic stream.

This treatment is suitable where there are low to moderate through and turning volumes. For higher volume sites, and sites where there is limited visibility of the treatment (e.g. over smaller to moderate size crests), a full-length CHR turn treatment is preferred which should have the same longitudinal dimensions to a rural CHR as shown in Table A 5 (these lengths being based on the application of Tables 5.2 and 5.3 of *AGRD Part 4A* (Austroads 2017a)).

The CHR(S) treatment is not intended to be used with raised or depressed islands. Right-turning drivers often travel onto the painted chevron to exit the through traffic stream as soon as possible.

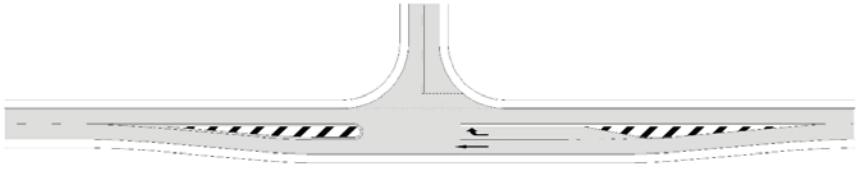
This is a desirable feature, as it reduces the likelihood of rear-end-major vehicle accidents as all through traffic is required to deviate through an alignment designed to suit the operating speed.

Because of this deviation, parking limits are likely to be needed as shown in Figure 7.7 of *AGRD Part 4A* (Austroads 2017a).

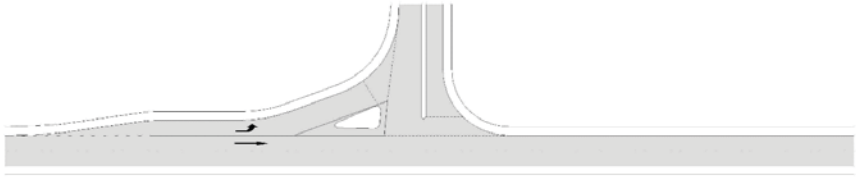
A.7.1 Rural Channelised (CH) Turn Treatments

Figure A 8 shows rural CH turn treatments at T-intersections.

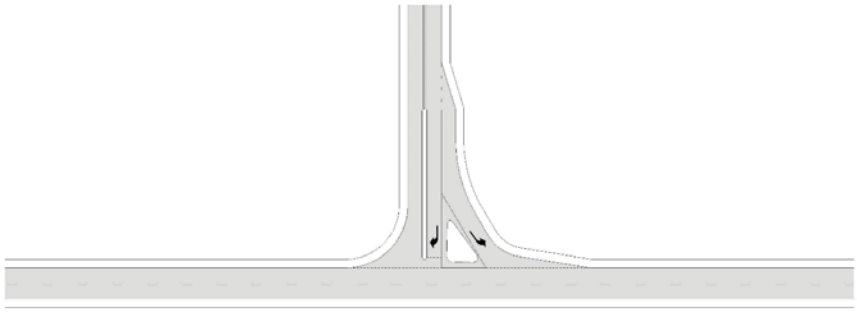
Figure A 8: Rural channelised (CH) intersection turn treatments



Channelised right turn (CHR) on the major road



Channelised left turn (CHL) on the major road



Channelised left turn (CHL) on the minor road

Note: Arrows indicate movements relevant to the turn type. They do not represent actual pavement markings.

Source: Based on Department of Main Roads (2006)[19]*.*

For design details of rural channelised turn treatments refer to:

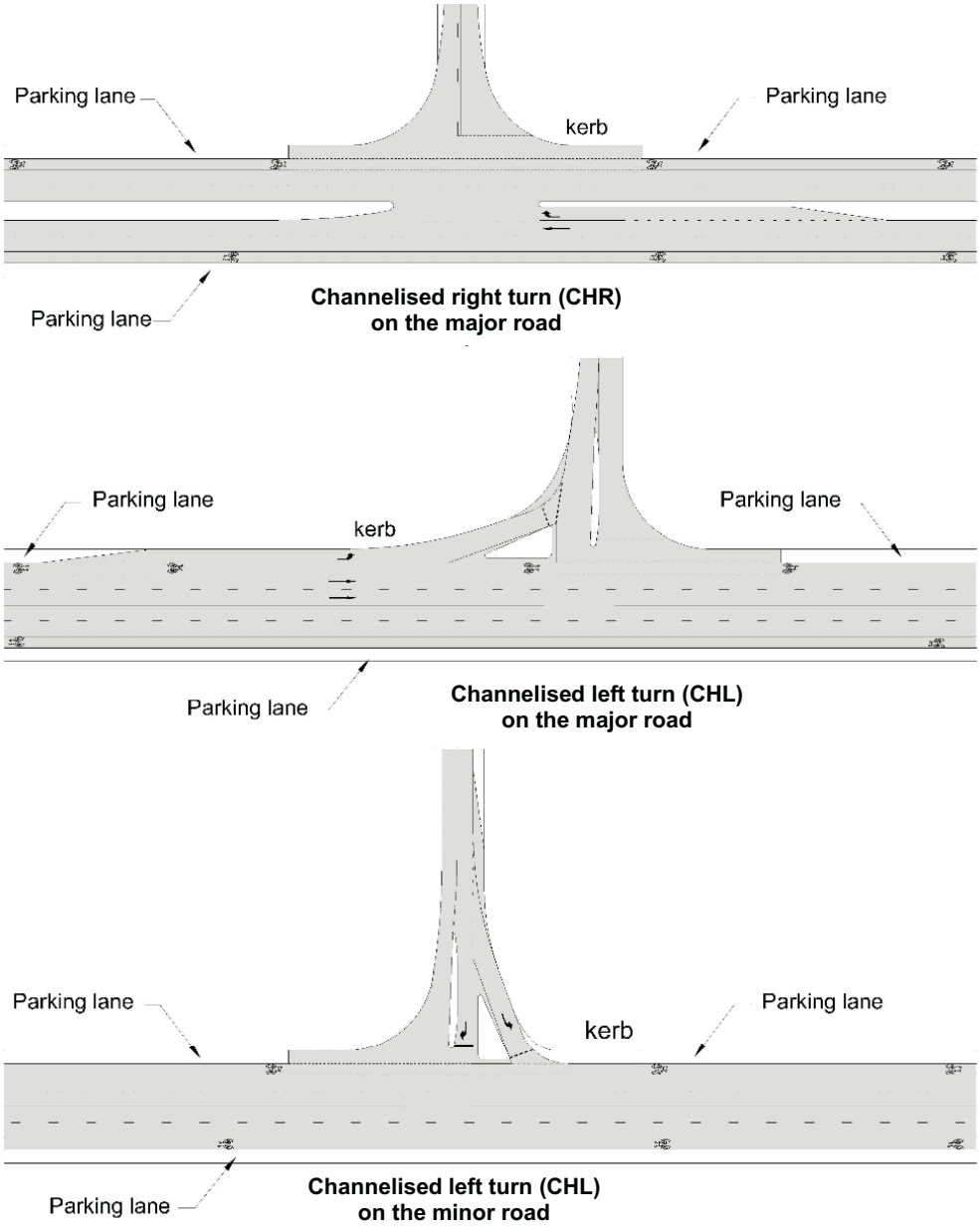
- Figure A 29 for a CHR(S) treatment on the major road comprising a shorter turning lane
- Figure A 30 for a CHR treatment on the major road comprising a full-length lane
- Figure 8.5 of *AGRD Part 4A* (Austroads 2017a) for high entry angle CHL treatments on major and minor roads
- Figure A 35 for CHL treatments with an acceleration lane on major and minor roads.

19 Department of Main Roads (2006) has been superseded and Figure A 8 has not been carried forward into Queensland Department of Transport and Main Roads (2016).

A.7.2 Urban Channelised (CH) Turn Treatments

Figure A 9 shows channelised (CH) turn treatments for urban situations which may or may not be signalised. The treatments are similar to rural treatments except that the dimensions will reflect the lower speed environment, and kerb and channel, parking and bicycle lanes are likely to be included.

Figure A 9: Urban channelised (CH) intersection turn treatments



Note: Arrows indicate movements relevant to the turn type. They do not represent actual pavement markings.

Source: Department of Main Roads (2006)[20].

20 Department of Main Roads (2006) has been superseded and Figure A 9 has not been carried forward into Queensland Department of Transport and Main Roads (2016).

For design details of urban channelised turn treatments refer to:

- Figure A 29 for a CHR(S) treatment on the major road comprising a shorter turning lane
- Figure A 30 for a CHR treatment on the major road comprising a full-length lane
- Figure A 40 for high entry angle CHL treatments on major and minor roads
- Figure A 41 for CHL treatments with an acceleration lane on major and minor roads.

A.8 Warrants for BA, AU and CH Turn Treatments

These warrants apply to major road turn treatments for the basic, auxiliary lane and channelised layouts illustrated in Appendices A.5, A.6 and A.7 respectively. The warrants are shown in Figure A 10 and provide guidance on where a full-length deceleration lane must be used and where a shorter lane, designated AUL(S) and CHR(S), may be acceptable based on traffic volume. Figure A 10 contains two graphs for the selection of turn treatments on roads with a design speed:

- greater than or equal to 100 km/h
  Figure A 10a is appropriate for high speed rural roads.
- less than 100 km/h.
  Figure A 10b is appropriate for urban roads, including those on the urban fringe and lower speed rural roads.

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.

Development of the warrants in this section is detailed in Arndt and Troutbeck (2006) and briefly discussed in Commentary 6.

[see Commentary 6]

Rural channelised T-junction – short lane type CHR(S)

The CHR(S) turn treatment shown in Figure A 29 is a more desirable treatment than the BAR treatment because it provides greater protection for vehicles waiting to turn right from the centre of the road. This treatment is suitable where there are low to moderate through and turning volumes.

For higher volume sites, a full-length CHR turn treatment (Figure A 30) is preferred. This type of intersection can only be used with linemarking. It is not to be used with raised or depressed islands as the turn lane is short and it is desirable that right-turning drivers travel over the painted chevron to exit the through traffic stream as soon as possible.

For the CHR(S) turn treatment, all through traffic is required to deviate, hence the deviation must be designed to suit the operating speed. A minimum shoulder width of 1.0 m must be used on the through lane deviation.

The start of the right-turn taper occurs as a painted median width of 2.0 m, in lieu of the full turning lane width as per a full length CHR treatment.

The length of turn slot is based on a right-turning vehicle slowing to 80% of the design speed on the approach (i.e. a speed reduction of 20% in the through lane), prior to moving into the turn lane and decelerating. This is based on the assumption that drivers decelerate at a maximum value of 3.5 m/s^2 from the start of the taper to the start of the storage length.

Although some deceleration of the right-turning vehicles occurs in the through lane, this treatment records far fewer rear-end crashes than do BAR turn treatments. The good safety performance occurs by removing stationary turning vehicles from the through traffic stream.

CHR(S) turn treatments should not be used where there is reduced visibility to the turn treatment.

Right-turning drivers on the major road need to perceive the location of the deceleration lane and the side road in time to make the necessary speed reduction in the through lane prior to diverging.

Table A 4 provides the dimensions of the CHR(S) treatment for various design speeds.

Table A 4: Dimensions of CHR(S) treatment for various design speeds

Design speed of major road approach (km/h)	Lateral movement length *A* (m)[1]	Diverge/ deceleration length *D* (m)[2]	Desirable radius *R* (m)	Taper length *T* (m)[3]
50	40[4]	15	110	15
60	50[4]	25	175	15
70	60	35	240	20
80	65	45	280	20
90	75	55	350	25
100	85	70	425	30
110	95	85	500	30
120	100	100	600	35

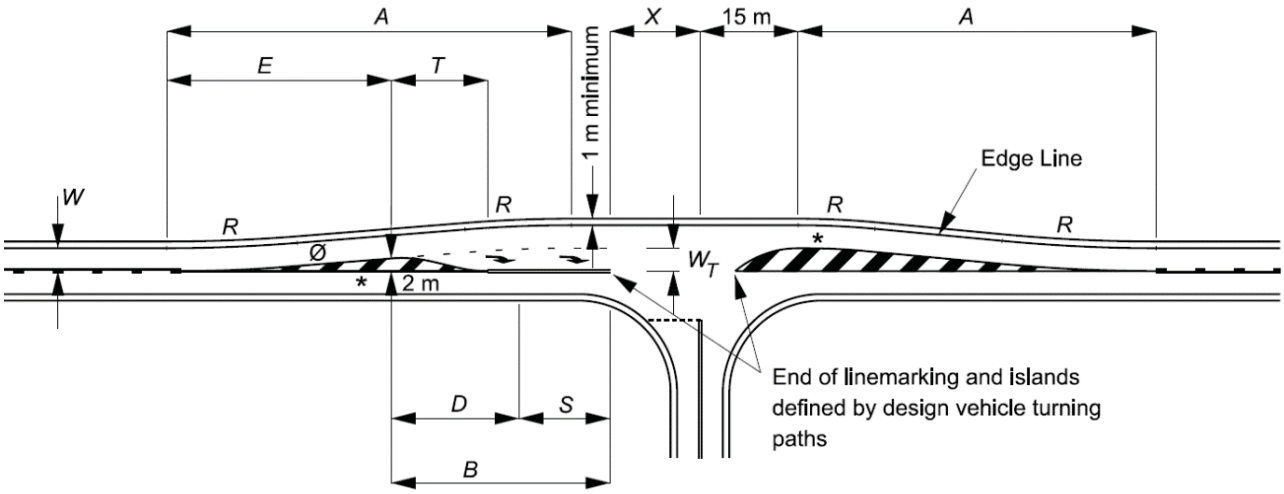
1 *Based on a diverge rate of 1 m/sec and a turn lane width of 3.0 m. Increase lateral movement length if the turn lane width >3 m. If the through road is on a tight horizontal curve (e.g. one with a side friction demand greater than the maximum desirable), the lateral movement length should be increased so that a minimal decrease in speed is required for the through movement.*

2 *Based on a 20% reduction in through road speed at the start of the taper to a stopped condition using a value of deceleration of 3.5 m/s^2 (Table 5.2 of AGRD Part 4A (Austroads 2017a)). Adjust for grade using the 'correction to grade' factor in Table 5.3 of AGRD Part 4A.*

3 *Based on a turn lane width of 3.0 m.*

4 *Where Type 2 road trains are required, minimum A = 60 m.*

Figure A 29: Channelised right-turn treatment with a short turn slot [CHR(S)] two-lane rural road



Notes:
Ø - double barrier line not to be used this side of the island.
** - Islands are to comprise linemarking only, i.e. no raised or depressed medians. Diagonal rows of RRPMs within the painted islands should be used to improve the delineation of diagonal pavement marking.*
The dimensions of the treatment are defined below and values of A, D, R and T are shown in Table A 4:

- W = Nominal through lane width (m) (including widening for curves). For a new intersection on an existing road, the width is to be in accordance with the current link strategy
- W_T = Nominal width of turn lane (m), including widening for curves based on the design turning vehicle = 3.0 m minimum
- A = Length of lateral movement (Table A 4)
- B = Total length of auxiliary lane including taper, diverge/deceleration and storage (m)
- E = Distance from start of taper to 2.0 m width (m) and is given by:
  $E = 2\left(\frac{A}{W_T}\right)$
- T = Taper length (m) and is given by:
  $T = \frac{0.33VW_T}{3.6}$
- S = Storage length to cater for one design turning vehicle (m)
- V = Design speed of major road approach (km/h)
- X = Distance based on design vehicle turning path, typically 10–15 m

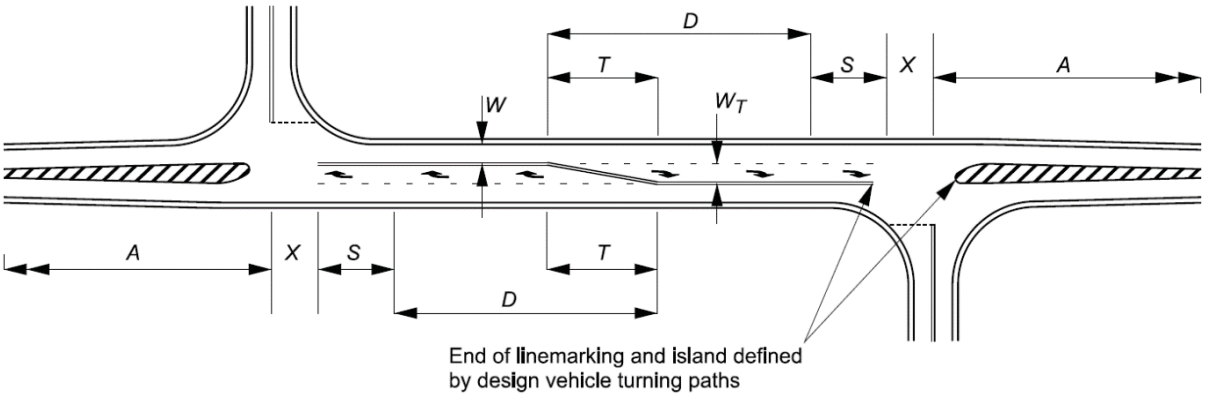
Source: Department of Main Roads (2006)[26].

26 Department of Main Roads (2006) has been superseded and Figure A 29 has not been carried forward into Queensland Department of Transport and Main Roads (2016).

Back-to-back right turns on a two-lane two-way road

This treatment is shown in Figure A 32. It results in a relatively narrow layout which requires shorter transitions than the overlapping layout. However, it requires a large stagger between intersections (e.g. about 300 m for a 100 km/h operating speed) which is often impracticable due to land acquisition and other constraints.

Figure A 32: Rural left-right staggered T with back-to-back turns on a two-lane road



Note: The dimensions of the treatment are:

- W = Nominal through lane width (m) (including widening for curves)
- W_T = Nominal width of turn lane (m), including widening for curves based on the design turning vehicle. Desirable minimum = W, absolute minimum = 3.0 m
- A = Design the through lane alignments in accordance with *AGRD Part 3* (Austroads 2016c).
- D = Diverge/deceleration length including taper (Table 5.2 of *AGRD Part 4A*, Austroads 2017a). Adjust for grade using the 'correction to grade' factor in Table 5.3 of *AGRD Part 4A*
- T = Physical taper length (m) is given by:
  $$T = \frac{0.33VW_T}{3.6}$$
- S = Storage length (m) is the greater of:
  1. the length of one design turning vehicle or
  2. (calculated car spaces –1) x 8 m (*AGTM Part 3* (Austroads 2013c), or use computer program e.g. aaSIDRA)
- V = Design speed of major road approach (km/h)
- X = Distance based on design vehicle turning path, typically 10–15 m

Rural seagull treatments

Preferred rural seagull treatment

A 'seagull' is a particular form of channelised layout that is only suitable for T-intersections. The preferred seagull treatment is shown in Figure A 33. It is used in situations where traffic analysis confirms that there is an operational advantage in right turners from the minor road being able to accept a gap at the first carriageway and merge with major road traffic at the second carriageway.

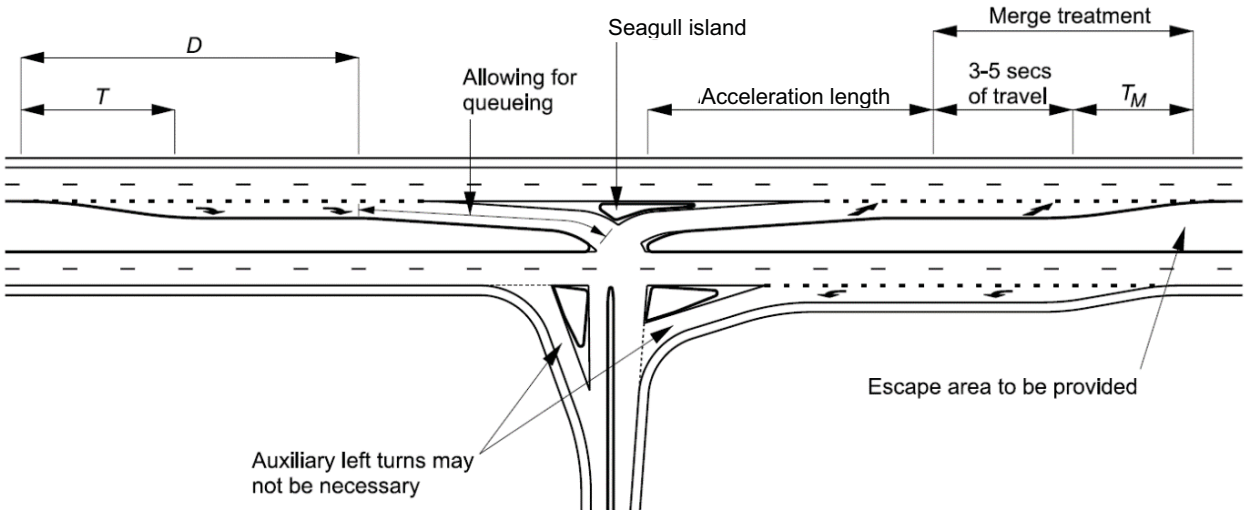
The paths for right turns into and from the minor road are channelised by a seagull island. The key features of the treatment are:

- Normal requirements for deceleration and storage apply to the turning lanes on the major road.
- The provision of an adequate acceleration lane for the merge into the second carriageway is critical to the successful operation of the treatment. The length should allow for
  - an adequate distance for acceleration
  - plus an observation time of 3 sec to 5 sec at the operating speed of the major road
  - plus a taper.

The safety of the treatment relies on the driver of the merging vehicle being able to observe vehicles in the median lane of the major road through the left-side rear-view mirror. Designers should ensure that road curvature and placement of road furniture in the seagull island do not impede the sight distance to the rear of the merging vehicle. Seagull treatments require a minimum width of median to ensure that median and island noses are located to provide adequate control and guidance for traffic. With seagull layouts, a minimum width between semi-mountable kerbs of 5.0 m is required to enable traffic to pass a disabled vehicle and thus prevent a blockage in the acceleration area. However, such widths between kerbs may encourage drivers to form two lanes and the provision of edge lines may be necessary to prevent this from happening.

Semi-mountable kerbs should be used throughout the treatment. Painted medians and islands should generally not be used.

Figure A 33: Preferred rural seagull layout (right side merge)



Note: Due to higher speeds in the median lane and the inherently more difficult right side merge, the acceleration lane length should allow design speed to be attained plus an observation time of 3 sec – 5 sec prior to the start of the taper and where:

D = Diverge/deceleration length including taper (Table 5.2 of *AGRD Part 4A* (Austroads 2017a)). Adjust for grade using the 'correction to grade' factor in Table 5.3 of *AGRD Part 4A*

T = Physical taper length (m) is given by:

$$T = \frac{0.33VW_T}{3.6}$$

S = Storage length (m) is the greater of:

1. the length of one design turning vehicle or
2. (calculated car spaces –1) x 8 m (*AGTM Part 3* (Austroads 2013c) or use computer program e.g. aaSIDRA)

T_M = Merge taper length, refer to Section 5 of *AGRD Part 4A* (Austroads 2017a)

Source: Department of Main Roads (2006)[29].

Alternative seagull layout

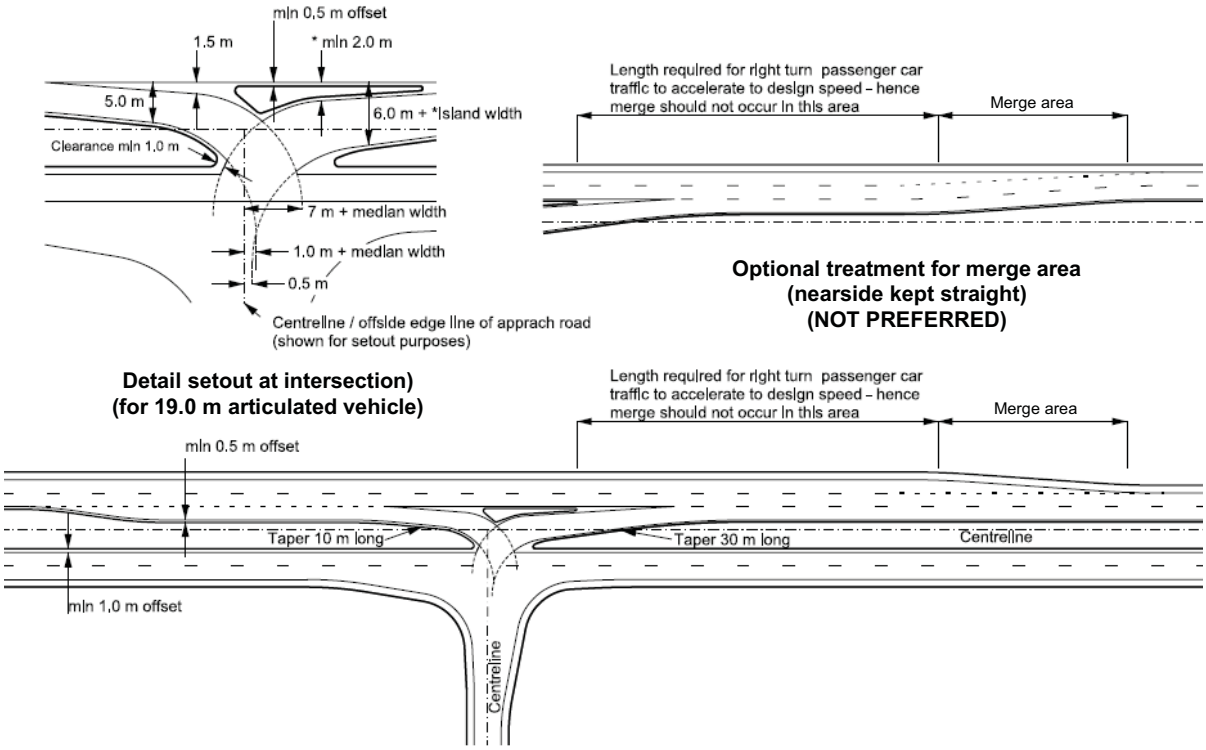
Where turning movements from the side road are high, or where the through traffic volumes and/or speed make gap acceptance in the merge area difficult, and a seagull treatment is still deemed to be the most appropriate treatment, then a dedicated exit lane should be provided. This alternative layout is shown in Figure A 34.

29 Department of Main Roads (2006) has been superseded and Figure A 33 has not been carried forward into Queensland Department of Transport and Main Roads (2016).

Where a seagull treatment provides a dedicated lane for exiting vehicles, the adjacent through lane(s) should be extended past the seagull to allow a passenger car vehicle to accelerate to the speed of through vehicles before the left to right merge is required. It should be noted that providing a straight near-side edge line is not preferred as it lacks the visual queue of the edge line marking deviating for the merge manoeuvre.

It should be noted that acceleration of the joining vehicles can require a substantial length, particularly if it occurs on an upgrade (Tables 5.5 and 5.6 of *AGRD Part 4A (*Austroads 2017a)). Where the major road operating speed is high this may require the termination of the left lane to be 700 m or more from the intersection.

Figure A 34: Alternative rural seagull layout (left side merge)



Source: Department of Main Roads (2006)[30.]

A.17 Left-Turn Treatments

A.17.1 General

Types of treatment and selection

The types of left-turn treatments, and volume warrants and safety considerations for their selection are discussed in Appendix A.6. The type of left-turn treatment used may depend on the:

- volume and type of traffic making the turn
- volume, speed and type of traffic with which the turn merges
- estimated speed at entry, and desirable speeds through and exiting from the turn
- local restrictions such as turn angles, property boundaries, service utilities and other structures
- provision for turning cyclists
- pedestrian movements.

30 Department of Main Roads (2006) has been superseded and Figure A 34 has not been carried forward into Queensland Department of Transport and Main Roads (2016).

Appendix B

Photographs of road condition

Photograph B.1 **Big Ridge Road looking east (2 km from Barleyfields Road)**

Photograph B.2 **Big Ridge Road looking west (6 km from Barleyfields Road)**

Photograph B.3 **Big Ridge Road / Munsies Road intersection**

Photograph B.4 **Munsies Road looking east (2 km from Big Ridge Road / Munsies Road intersection)**

Photograph B.5 **Munsies Road looking west (2 km from Big Ridge Road / Munsies Road intersection)**

Photograph B.6 **Gostwyck Road looking east (2 km from East Street)**

Photograph B.7 **Gostwyck Road looking east (8 km from East Street)**

Photograph B.8 **Hillview Road at Gostwyck Road intersection**

Photograph B.9 New England Highway / Thunderbolts Way intersection (looking south-east)

Photograph B.10 New England Highway / Thunderbolts Way intersection (looking south-west)

Photograph B.11 **New England Highway / Thunderbolts Way intersection (looking north-east)**

Photograph B.12 **Gostwyck Road at Thunderbolts Way intersection**

Photograph B.13 New England Highway / Barleyfields Road north intersection (looking south)

Photograph B.14 New England Highway / Barleyfields Road north intersection (looking north)

Photograph B.15 **Thunderbolts Way / Salisbury Plains Road intersection (looking south)**

Photograph B.16 **Thunderbolts Way / Salisbury Plains Road intersection (looking to Salisbury Plains Road)**

Photograph B.17 Thunderbolts Way / Salisbury Plains Road intersection (looking north)

Photograph B.18 Salisbury Plains Road

Photograph B.19 Rail crossing – Barleyfields Road

Photograph B.20 Rail crossing – Gostwyck Road

Photograph B.21 Rail crossing – Thunderbolts Way

Appendix C

Photographs of primary access locations

Photograph C.1 **Big Ridge Road access point (northern) – northern array**

Photograph C.2 **Big Ridge Road access point (northern) looking east – northern array**

Photograph C.3 **Big Ridge Road access point (northern) looking west – northern array**

Photograph C.4 **Big Ridge Road access point (southern) – northern array**

Photograph C.5 **Big Ridge Road access point (southern) looking east – northern array**

Photograph C.6 **Big Ridge Road access point (southern) looking west – northern array**

Photograph C.7 **Munsies Road access point – central array**

Photograph C.8 **Munsies Road access point looking east – central array**

Photograph C.9 **Munsies Road access point looking west – central array**

Photograph C.10 **Hillview Road access point – southern array**

Photograph C.11 **Hillview Road access point looking north – southern array**

Photograph C.12 **Hillview Road access point looking south – southern array**

Photograph C.13 Salisbury Plains Road access point looking south – southern array

Photograph C.14 Salisbury Plains Road access point looking north-east – southern array*

**Note: Dwelling is a rental property owned by one of the project landholders*

Photograph C.15 **Salisbury Plains Road access point looking east – southern array**

Photograph C.16 **Salisbury Plains Road access point looking west – southern array**

Photograph C.17 **The Gap Road access point looking west – southern array**

Photograph C.18 **The Gap Road access point looking east – southern array**

Photograph C.19 **The Gap Road access point looking south – southern array**

Photograph C.20 **The Gap Road access point looking north – southern array**

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