

Prairie Solar Farm

Planning Application

Appendix 9 – Traffic Impact Assessment

June 2018



Prairie Solar Farm

Pacific Hydro Developments Pty Ltd

Traffic Impact Assessment

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Appendix A. Data from Pacific Hydro

**Appendix B. SIDRA analysis results – Bendigo-Pyramid Road / New Access (Worst Case Scenario –
All daily vehicles using 1 access in 1 hour)**

Executive Summary

Jacobs has been engaged by Pacific Hydro Australia Developments Pty Ltd ("Pacific Hydro") to prepare a high level, preliminary traffic impact assessment (TIA) report for the proposed Prairie Solar Farm located near the rural township of Mitiamo.

The purpose of this report is to support the planning permit application for the proposed solar farm and to understand the expected quantity of traffic and turning movements.

The Prairie Solar Farm is proposed to provide up to approximately 240 MW (AC) capacity. The proposal involves the installation of approximately one (1) million solar photovoltaic (PV) panels mounted on tracking systems, inverters, a single substation (one of two location options shown) and Operations and Maintenance (O&M) Facility within the core development area, and construction of a 4.5 km transmission line extension and terminal station located to the west of the core development area.

The analysis shows:

- Daily construction vehicle trips to site range from 99 to 343 trips per day, with an average of 212 daily trips across 13 months.
- If the maximum daily construction movements (343 vehicles) attended and departed site within a peak hour, Bendigo-Pyramid Road would be operating at 40% of its capacity, if the only access point to site was from Bendigo-Pyramid Road. If other access points were also used (i.e. Echuca-Serpentine Road, McCreas Road and Bucklands Road) this impact could be further reduced, and would have negligible impact on the other access roads due to their low existing traffic volumes (<520 vehicles daily). The Sidra assessment contained within this report modelled the worst case scenario of all construction traffic arriving and departing in the peak hour at a single access point from Bendigo-Pyramid Road, and shows that the intersection will still operate with spare capacity.
- Only basic turn treatments will be required at the proposed site access points. However, a swept path analysis and haulage route inspection will be required for the transport of over-dimensioned vehicles to site.

Based on the site visit and this traffic impact assessment, Jacobs is of the opinion that the proposed Prairie Solar Farm located near the rural township of Mitiamo will not have an adverse impact on the operation of the existing road network adjacent to the site. However, upgrades to the local road network may be required to cater for the construction vehicles. These upgrades (if required) will be determined at the Traffic Management Plan stage.

A more detailed Traffic Management Plan will be required at a later stage when a haulage contractor has been selected and finer details of the solar farm have been designed (i.e. construction approach, methodology, and schedule).

The condition of public roads to be used for the delivery of materials should be established prior to commencement of works and then regularly monitored during the period of the works. The road and intersection conditions should be established by field surveys and joint site inspections by an independent civil engineer, Loddon Shire Council and VicRoads Officers with agreed intervention levels documented prior to commencement.

1. Introduction

1.1 Background

Jacobs has been engaged by Pacific Hydro Australia Developments Pty Ltd (“Pacific Hydro”) to prepare a preliminary traffic impact assessment (TIA) report for the proposed Prairie Solar Farm located near the rural township of Mitiamo.

The purpose of this report is to support the planning permit application for the proposed solar farm and to understand the expected quantity of traffic and turning movements.

1.2 Scope

The subject site is a parcel of land approximately 2.0 km west of Mitiamo, on the southern side of Bendigo-Pyramid Road, bounded by Bucklands Road, Echuca-Serpentine Road and Pyramid-Yarraberb Road. Refer to Figure 1-1 for the site location.

This TIA assesses the operational performance of the road network in the vicinity of the proposed site to understand any traffic and road safety implications of the development on the existing surrounding area and transport network.

Information regarding the expected construction, operations and maintenance activities associated with the proposed development have been provided by Pacific Hydro. This data has been included in Appendix A.

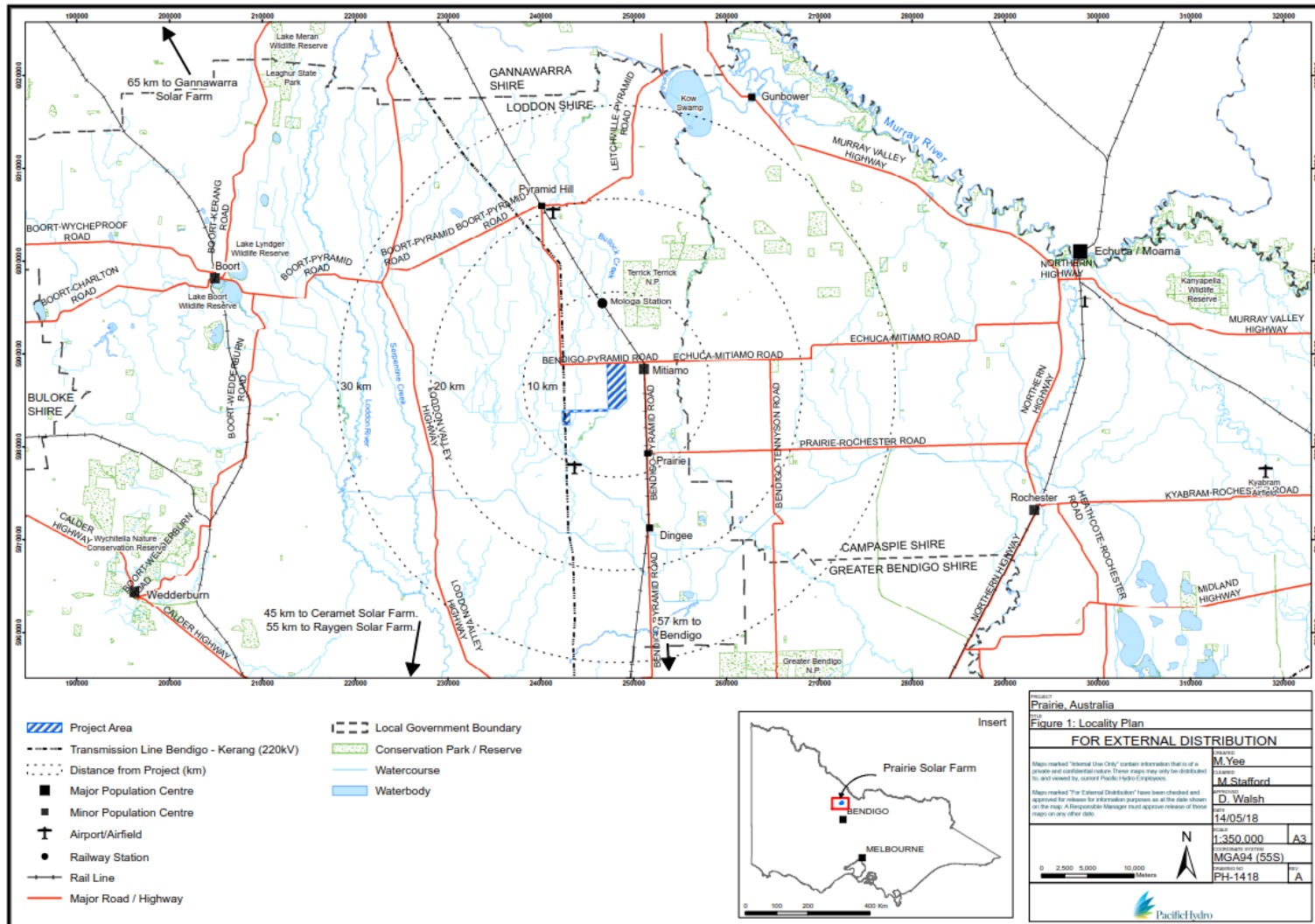


Figure 1-1 : Proposed solar farm development location (source: Pacific Hydro)

1.3 References

The following reference documents were used to assist in the preparation of this report:

- Austroads Guide to Traffic Management, Part 3: Traffic Studies and Analysis
- Austroads Guide to Road Design, Part 4A: Unsignalised and Signalised Intersections
- Austroads Guide to Traffic Management, Part 6: Intersections, Interchanges and Crossings
- VicRoads Standard Drawing SD2064-A
- VicRoads Standard Drawing SD2065-A

2. Existing transport environment

2.1 Land use

Prairie Solar Farm is proposed to be situated on land to the south-west of Mitiamo in Loddon Shire. At present, the site is zoned Farming Zone with parts of the site affected by the Floodway Overlay (FO), Land Subject to Inundation Overlay (LSIO), and Vegetation Protection Overlay (VP01). The site is generally flat, with some agricultural infrastructure such as dams and (unused) irrigation channels. Bullock Creek, located on Crown land, traverses the centre of the site in a meandering north-south orientation.

2.2 Road network

The surrounding main road network consists of Bendigo-Pyramid Road, Echuca-Serpentine Road and Pyramid-Yarraberb Road near the proposed development site. Local access tracks are also present throughout the farm land, with Bucklands Road forming the eastern boundary of the proposed site.

A number of unconstructed and unused Government Roads cross the site in an east-west direction, and generally located at the extension of Hardimans Road, Bath Lane, and Creek Road. These roads are designated Crown land and are unlikely to be required by Council within the next 30 years.

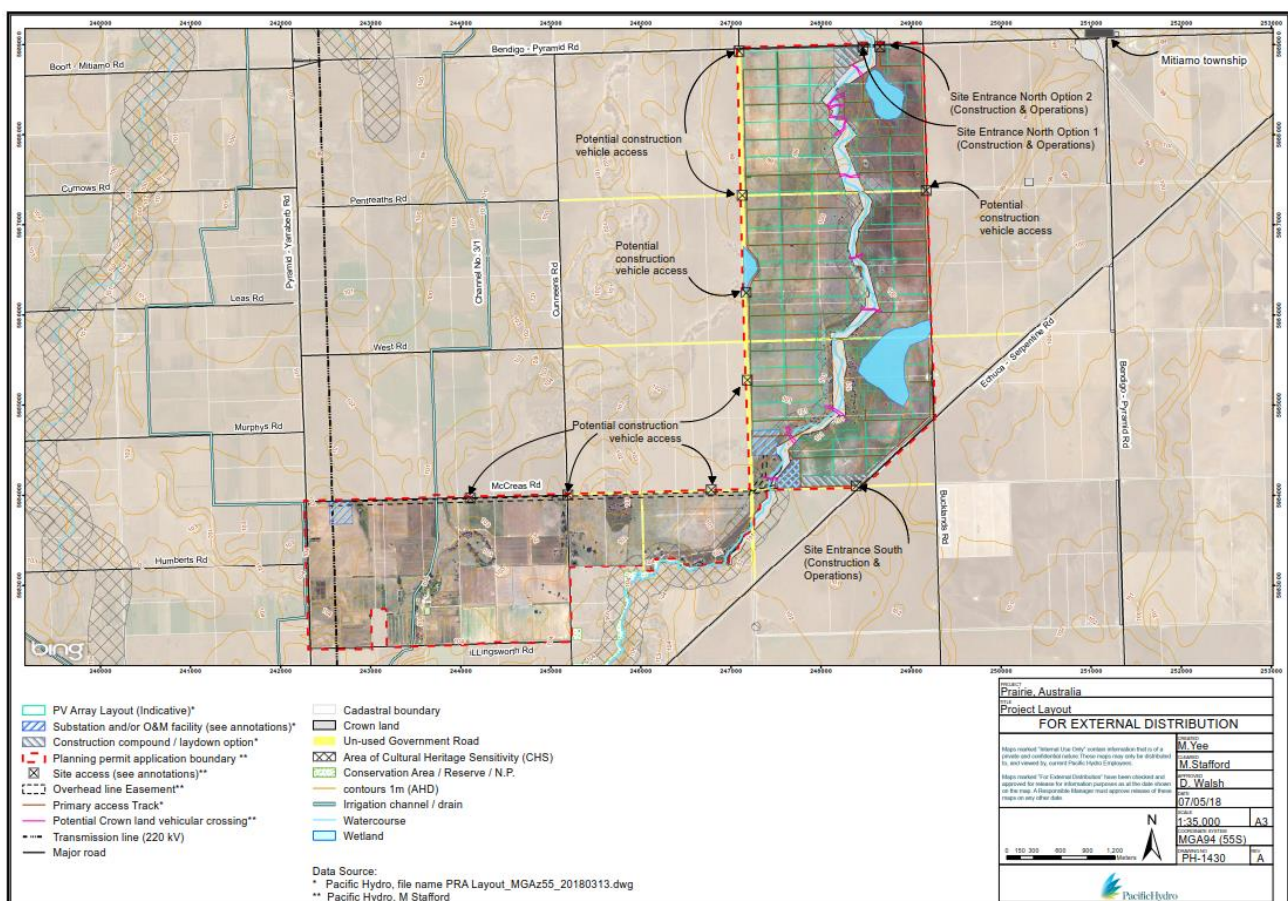


Figure 2-1: Proposed Prairie Solar Farm location and surrounding road network (Source: Pacific Hydro)

2.2.1 Bendigo-Pyramid Road

Bendigo-Pyramid Road (C334/C336) is a declared road classified under the *Roads Management Act 2004* as an arterial road, and is managed and maintained by VicRoads. It is a sealed two-lane, two-way road that provides an important link to Bendigo in the south and between regional population centres. It runs in a north-south direction to the east of the site between Mitiamo and Bendigo and in an east-west direction between Echuca-Mitiamo Road and Boort-Mitiamo Road, forming the northern boundary of the site. The east-west section of the road is designated as a school bus route.

Bendigo-Pyramid Road has a 6.0m wide carriageway with grassed verges. No formalised drainage facilities are present within the road reserve. The pavement is generally in good condition with minimal cracking or rutting present. A bridge is present over Bullock Creek, with 3.0m wide traffic lanes. This bridge is along the northern boundary of the proposed solar farm site. The road alignment is straight and flat adjacent to the site.

There are bridges over creeks and irrigation channels on Bendigo-Pyramid Road between Pyramid-Yarraberb Road and Mitiamo. The load limits of these bridges are unknown, however, Bendigo-Pyramid Road is a gazetted route for B-Doubles, Higher Mass Limit, Oversize/ Overmass, PBS Level 1 and PBS Level 2A vehicles.

A speed limit of 100km/h applies to Bendigo-Pyramid Road.



Figure 2-2: Bendigo-Pyramid Road



Figure 2-3: Bendigo-Pyramid Road, Bullock Creek Bridge

2.2.2 Echuca-Serpentine Road

Echuca-Serpentine Road runs along the south-eastern diagonal boundary of the site. It is a local access road managed by Council.

Echuca-Serpentine Road varies between one and two sealed traffic lanes throughout its length. Carriageway width varies between 3.5m (one-lane) and 6.5m (two-lane, two way), with unsealed shoulders and grassed verges. No formalised drainage facilities are present within the road reserve. To the west of the site, Echuca-Serpentine Road narrows to 5.6m wide over Bullocks Creek. The road alignment is straight and flat adjacent to the site.

There is no posted speed limit on Echuca-Serpentine Road. Therefore, the default rural speed limit of 100km/h applies to the road.



Figure 2-4: Echuca-Serpentine Road, west of Bendigo-Pyramid Road



Figure 2-5: Echuca-Serpentine Road (approximately 1km from Bendigo-Pyramid Road)

2.2.3 Pyramid-Yarraberb Road

Pyramid-Yarraberb Road runs in a north-south direction to the west of the site, between Bendigo-Pyramid Road and Loddon Valley Highway. It is a local connector road managed by Council and is a designated bus route.

Pyramid-Yarraberb Road consists of a 6.4m wide carriageway with 2.2m unsealed shoulders and grassed verges. No formalised drainage facilities are present within the road reserve. The road alignment is straight and flat adjacent to the site.

There is no posted speed limit on Pyramid-Yarraberb Road. Therefore, the default rural speed limit of 100km/h applies to the road.



Figure 2-6: Pyramid-Yarraberb Road, near Illingsworths Road

2.2.4 McCreas Road

McCreas Road is an existing single lane gravel road running east-west along the northern edge of the proposed transmission line. There is an existing bridge crossing over irrigation channel 3/1, and numerous existing farm gates providing access to McCreas Road. The load limit for the bridge over the irrigation channel is currently unknown, and may require upgrading if used as a construction material transport route.



Figure 2-7 McCreas Road, near Pyramid-Yarraberb Road (looking east)



Figure 2-8 Bridge on McCreas Road over Irrigation Channel 3/1

2.2.5 Bucklands Road

Bucklands Road is an existing single lane gravel road running north-south along the eastern edge of the development site. It has an irrigation channel parallel to it for two thirds of the distance between Echuca-Serpentine Road and Bendigo-Pyramid Road.



Figure 2-9 Bucklands Road, near Echuca-Serpentine Road (looking north)



Figure 2-10 Bucklands Road, near Bendigo-Pyramid Road (looking south)

2.3 Traffic data

2.3.1 Crash data

Crash data obtained from the VicRoads CrashStats database for the most recent five-year time period, reveals that there have been no recorded crashes on the road network in the vicinity of the proposed development site.

2.3.2 Traffic volumes

Traffic volume data obtained from VicRoads open data in February 2018 indicates Bendigo-Pyramid Road, near the development site, carries approximately 300 vehicles per day, two-way. A breakdown is shown in Table 2.1.

Table 2.1 : Annual Average Daily Traffic Data

Road	Direction	AADT one-way (2017)	% Heavy vehicles	Peak hour volume*
Bendigo-Pyramid Road (West of Mitiamo)	Eastbound	148	23% (34)	15
	Westbound	154	25% (39)	15
Bendigo-Pyramid Road (South of Mitiamo)	Northbound	154	12% (19)	15
	Southbound	130	14% (18)	13
*For this traffic impact assessment, peak hour volumes are assumed to equal 10% of the corresponding AADT Peak hour volumes equal the 'peak' volume across a 24-hour period				

Echuca-Serpentine Road and Pyramid-Yarraberb Road are local access/ collector roads that carry low levels of traffic. The most recent traffic count information provided by Loddon Shire Council indicates Echuca-Serpentine Road (between Prairie Road and Bendigo-Pyramid Road) carries approximately 211 vehicles per day, two-way, of which 48% are commercial vehicles. Pyramid-Yarraberb Road carries approximately 532 vehicles per day, two-way of which 16% are commercial vehicles. Council doesn't have any traffic count information about McCreas Road and Bucklands Road, but since they are generally only going to be used by property owners in the immediate area, the volumes on these roads would be very low (i.e. less than 100 vehicles per day).

2.4 Public transport network

2.4.1 Rail

The proposed development site is situated approximately 2.0 km west of Mitiamo railway station. While the V/Line regional railway link and freight network operate along this line between Melbourne and Swan Hill via Bendigo, Mitiamo station closed to passengers in the 1980s.

The V/Line link runs adjacent to Bendigo-Pyramid Road, with level crossings present at Echuca-Serpentine Road and Bendigo-Pyramid Road.

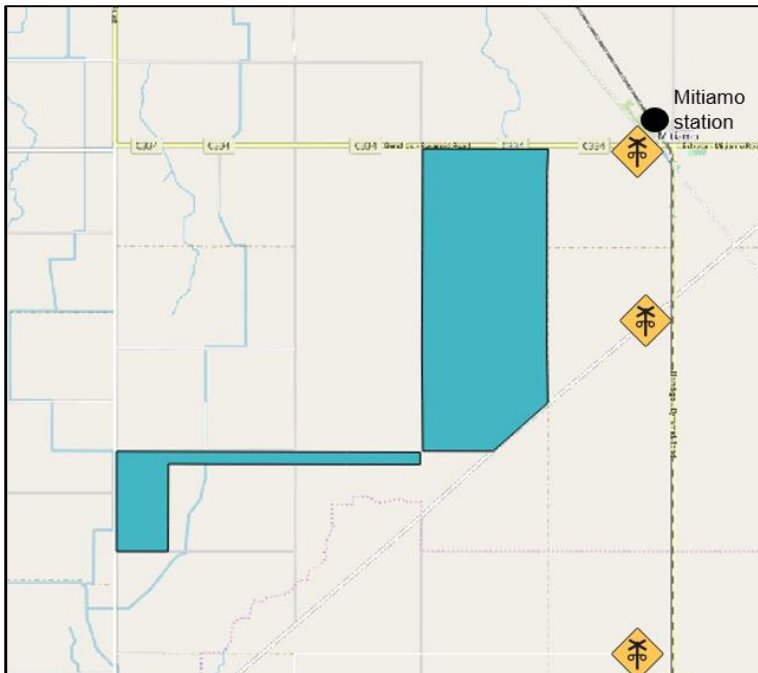


Figure 2-11: Proposed Prairie Solar Farm location and surrounding rail network (Open Street Map, Feb 2018)

2.4.2 Bus

The V/Line regional coach network operates through Mitiamo to the east of the development site. The coach stop is located at Glossop Street/ Bendigo-Pyramid Road (Mitiamo), which is approximately 2.0km from the eastern boundary of the site.

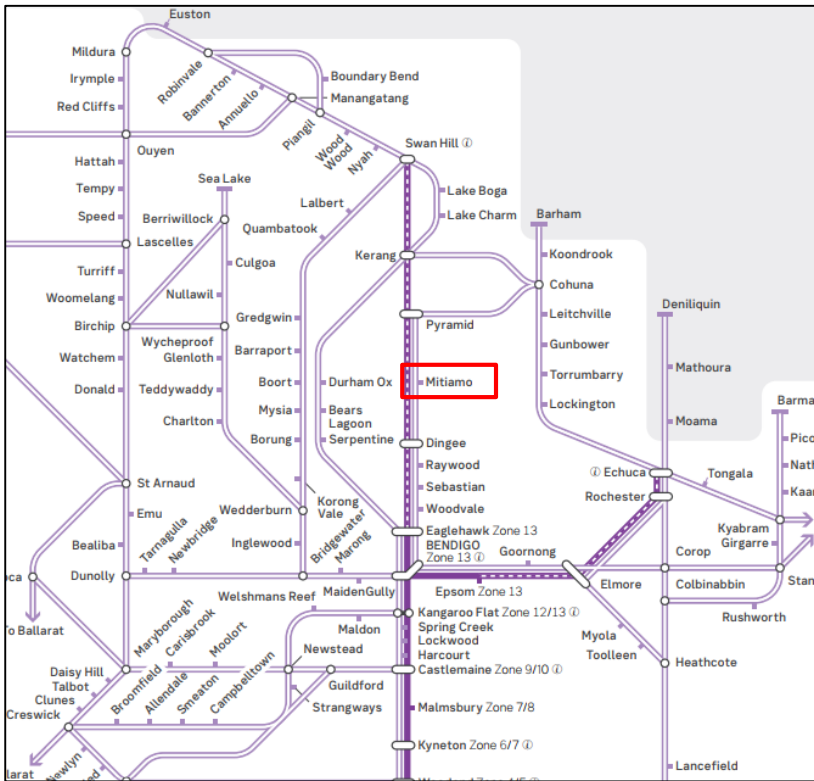


Figure 2-12: V/Line regional rail and coach network

There is currently no regional bus network operating within the vicinity of the proposed development site. School bus routes, however, do operate via Bendigo-Pyramid Road (between Echuca-Mitiama Road and Boort-Mitiama Road) and Bendigo-Pyramid Road (south of Prairie-Rochester Road).

2.5 Active transport network

2.5.1 Walking and cycling facilities

There are currently no dedicated pedestrian facilities provided in the vicinity of the proposed development site. Also, there are no formal on-road or off-road bicycle lanes/ paths provided within close proximity of the site.

3. Development traffic impacts

3.1 Development proposal

The Prairie Solar Farm is proposed to provide up to approximately 240 MW (AC) capacity. An indicative layout is shown in Figure 3-1. Features of the development proposal include:

- The proposal involves the installation of approximately one (1) million solar photovoltaic (PV) panels mounted on tracking systems, inverters, a single substation (one of two location options shown) and Operations and Maintenance (O&M) Facility within the core development area, and construction of a 4.5 km transmission line extension and terminal station located to the west of the core development area.
- Five (5) vehicular crossings and underground cabling are proposed across Bullock Creek Crown land Water Frontage. The vehicular crossings will be used during construction and operation phases.
- Vehicular access from the surrounding road network during construction and operation is proposed to be via the following roads:
 - **Bendigo-Pyramid Road** along the northern boundary. Only one of the two options shown will ultimately be adopted.
 - **Echuca-Serpentine Road**, which runs along the south-eastern diagonal boundary.
 - **McCreas Road**, which runs east-west adjacent to the transmission line extension. Access from McCreas Road into the transmission line extension area is proposed to be via existing farm gates.
 - **Bucklands Road**, which runs along the eastern boundary.
- The solar farm will connect into the power lines running north-south to the east of Pyramid-Yarraberb Road.

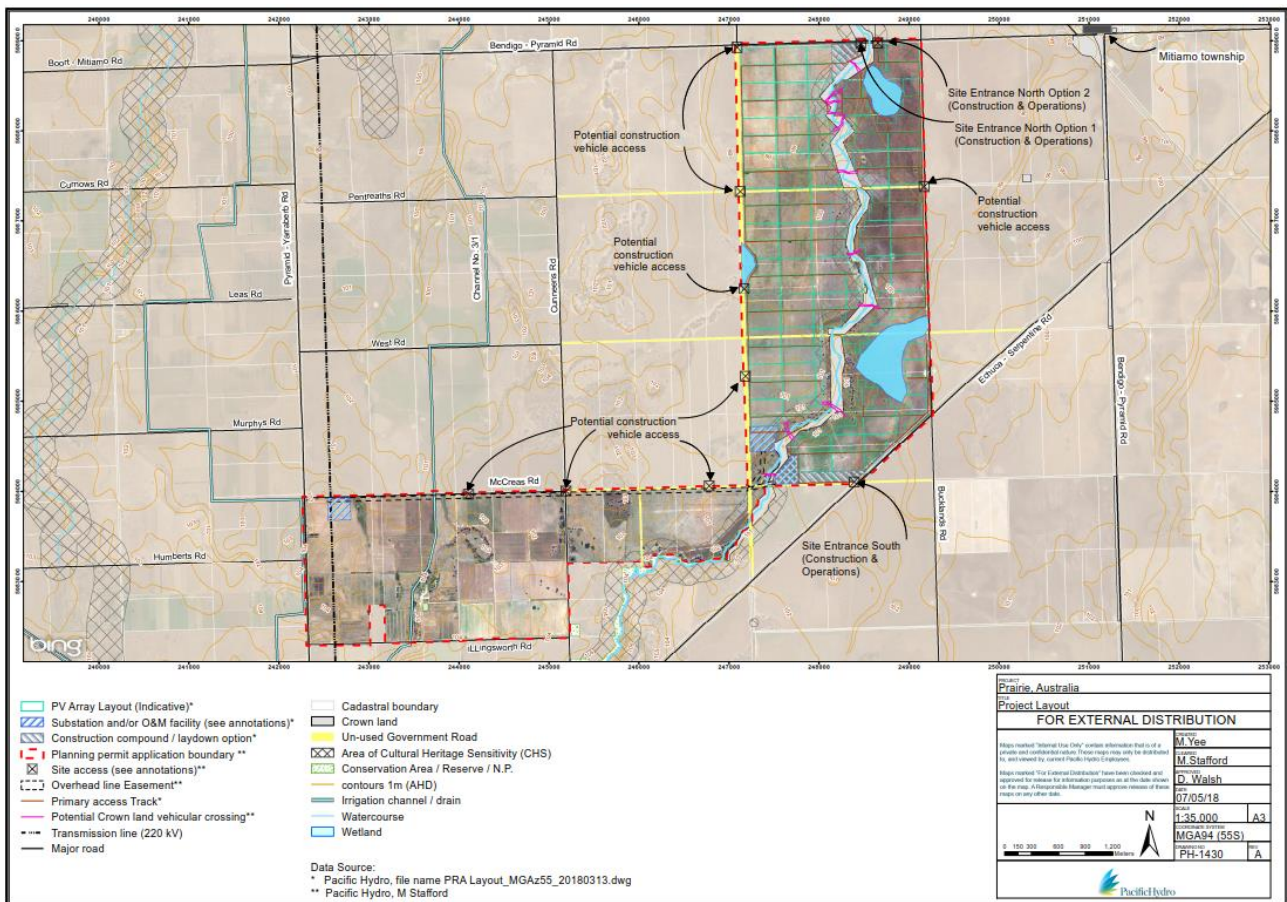


Figure 3-1: Indicative Solar Farm Layout (source: Pacific Hydro)

The main off-site traffic impacts of the proposed Prairie Solar Farm will arise during the construction period due to the required deliveries of construction material and equipment to the site and the transportation of construction staff to/from site.

Once the solar farm is operational, associated traffic movements will consist of those associated with general maintenance and operational functions. These are expected to require an operational team of approximately eight (8) staff. Maintenance activities will be ongoing throughout the operation of the solar farm, however there will be some maintenance activities which will occur biannually, which may generate short term increases in staff trips to the solar farm.

3.2 Construction traffic

3.2.1 Traffic volumes

The development site is expected to provide capacity for a solar farm of up to 240MW. The project may be developed in a single stage or in two 100+MW stages. However, for the purposes of this TIA a 'maximum impact' scenario has been assessed and presented, focusing on the overall possible traffic movements for a single-stage 240MW project.

The design through to commissioning period for a 240MW solar farm would be expected to take up to 24 months, with the following activities leading to increased traffic movements:

- Delivery of solar panel components and equipment
- Delivery of construction materials and equipment
- Travel of construction labour and site activities

The estimated trip numbers and associated timeframes for the construction of the solar farm are based on the information provided by Pacific Hydro, and their experience during the construction of similar projects across Australia. Table 3.1 provides a breakdown of the total estimated heavy vehicle trips required to deliver the components, construction materials and equipment for a solar farm of up to 240MW.

Most materials will be transported to site in 40ft containers with the exception of quarried materials which are assumed to arrive in tri-axle semi-trailers, and two over-dimensioned vehicle trips for the transformer units. Table 3.2 provides a breakdown of the total estimated light and heavy vehicle trips required to transport construction labour to the site.

Table 3.1 : Total heavy vehicle one-way trips for a 240MW solar project (Source: Pacific Hydro)

Material	Estimated total trips
PV panel components	1,260
Inverter container units	48
Support and fixing system	1,200
Electrical switchgear	5
Transformer units	2
Transmission towers	100
Miscellaneous Items	120
Access tracks	23,200
Raised pads	10,250
Fuel trucks	144
Water Cart	1,440
Total heavy vehicle movements	37,769

Table 3.2 : Total construction labour one-way trips (Source: Pacific Hydro)

Construction labour	Estimated total trips
Daily on-site labour	39
Administration traffic	60
Total daily labour related movements	99
Total light vehicle movements during entire construction period	33,264

The total light vehicle movements comprise of an average 99 trips per day, for an assumed 6 working days per week for 56 weeks.

As outlined above, the construction of a 240MW solar project would be expected to take up to 14 months, during which there would be differing levels of activity. Table 3.3 provides a breakdown of the expected deliveries during the construction period by month. The table also presents the average daily heavy vehicle and construction labour movements based on the following anticipated, typical hours of construction:

- 6am - 6pm Monday - Saturday
- Sundays (if allowed and site is remote)

From the information in Table 3.3, the typical daily traffic volume attending the site during the construction period is approximately 213 vehicles (one-way) with a peak of 343 vehicles (one-way) in months 12 and 13 (construction month 6 and 7).

Table 3.3 : Total one-way construction movements (Source: Pacific Hydro)

Material	Design Phase	Procurement Phase	Construction Phase														Commissioning Phase	Total
	Months 1-4	Months 5-6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Months 21-24	
PV panel components	-	-	-	-	-	-	-	180	180	180	180	180	180	180	-	-	-	1,260
Inverter container units	-	-	-	-	-	-	-	-	-	-	16	16	16	-	-	-	-	48
Support and fixing system	-	-	-	-	171	172	171	171	171	172	172	-	-	-	-	-	-	1,200
Electrical switchgear	-	-	-	-	-	-	-	2	2	2	-	-	-	-	-	-	-	6
Transformer units	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	2
Transmission towers	-	-	-	-	-	-	-	-	-	20	80	-	-	-	-	-	-	100
Miscellaneous items	-	-	-	-	-	12	12	12	12	12	12	12	12	12	12	-	-	120
Access tracks	-	-	1,934	1,934	1,934	1,934	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	1,933	-	-	23,200
Raised pads	-	-	-	-	-	-	3,417	3,417	3,417	-	-	-	-	-	-	-	-	10,250
Fuel trucks	-	-	12	12	12	12	12	12	12	12	12	12	12	12	-	-	-	144
Water cart	-	-	120	120	120	120	120	120	120	120	120	120	120	120	-	-	-	1,440
Heavy vehicle movements per month	-	-	2,066	2,066	2,237	2,250	5,665	5,847	5,847	2,452	2,526	2,273	2,273	2,257	12	-	-	37,771
Average daily heavy vehicle movements (assumes 24 working days per month)	0	0	86	86	93	94	236	244	244	102	105	95	95	94	1	0	0	
Total daily labour related movements	0	0	99	99	99	99	99	99	99	99	99	99	99	99	99	99	0	
Typical daily traffic movements	0	0	185	185	192	193	335	343	343	201	204	194	194	193	100	99	0	

3.2.2 Traffic route considerations

The site is proposed to be accessed via Bendigo-Pyramid Road, Echuca-Serpentine Road, McCreas Road and Bucklands Road.

It is still to be determined where the components for the solar farm will be transported from, but likely locations would be Geelong and/or Melbourne Port. Once confirmed, suitable routes to site would be identified in consultation with VicRoads and Loddon Shire Council.

In the case of components travelling from Geelong or Melbourne, it is expected that vehicles would travel via routes such as the Calder Freeway and Midland Highway to Bendigo, before joining Bendigo-Pyramid Road to access the site (i.e. gazetted B-Double routes).

Quarry materials for the construction of access tracks and the raised pads for the terminal station and substation/O&M/battery storage area would be sourced locally, most likely arriving in the study area via Bendigo-Pyramid Road, and then either McCreas Road, Bendigo-Pyramid Road or Echuca-Serpentine Road into site.



Figure 3-2 : Potential gazetted B-Doubles routes

Light and commercial vehicles associated with the solar farm are likely to be associated with locally or regionally sourced construction materials and labour. Key regional centres include Echuca, Kerang and Bendigo, with access provided by the VicRoads maintained Echuca-Mitiamo Road (C334), Bendigo-Pyramid Road (C338) and Bendigo-Pyramid Road (C336) respectively.

3.2.3 Impact on the road network

For this TIA, peak hour volumes equate to the 'peak' volume across a 24-hour period. Accordingly, this represents a 'worst case scenario'. Off-peak scenarios have not been assessed.

The one-way midblock capacity of a traffic lane on an undivided road with interrupted traffic flow is 900 vehicles per hour (source: Austroads Guide to Traffic Management, Part 3: Traffic Studies and Analysis, Section 5.2). As previously indicated in Section 2.3.2, the current daily traffic volume on Bendigo-Pyramid Road is approximately 300 vehicles per day, comprising about 150 vehicles in each direction.

Assuming that 10% of vehicle trips occur in a peak hour, the current peak one-way traffic volume equates to approximately 15 vehicles per hour. Therefore, Bendigo-Pyramid Road is currently operating at less than 3% of its capacity.

If a 'worst case' scenario was assessed, assuming all construction trips to/from the site for a typical day were made in the same one-hour peak period (i.e. all vehicles arrive and depart in the AM peak) the one-way traffic flows would increase to 358 vehicles each direction.

This is still less than 40% of Bendigo-Pyramid Road's capacity. Therefore, the impact on capacity from the additional traffic generated by the solar farm is considered negligible. A SIDRA analysis of the intersection of the new access with Bendigo-Pyramid Road was also conducted, with detailed results located in Appendix B. The analysis of an extreme worst case scenario shows that there would be short delays and queues on the solar farm approach only. These queues and delays would be extremely unlikely to occur as construction vehicles would arrive throughout the day, rather than all in one-hour period.

If multiple entrances are used to access the site (i.e. Echuca-Serpentine Road, McCreas Road and Bucklands Road) this impact would also be considered negligible, as traffic would be split across multiple accesses.

3.3 Operational and maintenance traffic

3.3.1 Traffic volumes

The solar farm is designed to function as autonomously as possible. Once operational, traffic movements associated with the solar farm will predominantly consist of general maintenance and operational functions. A solar farm of this size is expected to require an operational team of approximately eight (8) staff, with an operational period (economic life of the panels and facility) of 25 years. Staff will generally visit the site using light weight service vehicles or private cars.

3.3.2 Impact on the road network

Eight one-way daily trips to site is estimated for the operation phase. This would increase one-way peak hour traffic volumes to 23 vehicles on Bendigo-Pyramid Road. This is still less than 3% of Bendigo-Pyramid Road's capacity. Therefore, the impact on capacity from additional traffic generated by this project during the operational and maintenance phase is considered negligible.

If multiple entrances are also used to access the site, the traffic impact would also be considered to be negligible, as traffic would be split across multiple accesses.

3.4 Decommissioning/Re-powering traffic

The Prairie Solar Farm may either be decommissioned or re-powered at the end of its economic life (25 years). If decommissioned, the site will be restored to its present state. The traffic generated during decommissioning is expected to be at a similar level to the construction phase as it would essentially be "construction in reverse".

While traffic on the surrounding roads will experience some growth over the period of decommissioning or re-powering, the traffic impacts of decommissioning are expected to be of a similar scale to those occurring during the construction phase. If the site is to be repowered, it would be reasonable to estimate that the traffic generated could be double the construction traffic from this assessment (i.e. decommission then construction).

A decommissioning/re-powering traffic management plan will be required to assess and manage the traffic impacts at that time.

3.5 Austroads intersection configuration warrants

3.5.1 Site distance requirements

The Austroads publication, Guide to Road Design Part 4A: Unsignalised and Signalised Intersections, 2017 defines Safe Intersection Sight Distance (SISD) as '*the minimum sight distance which should be provided on the major road at any intersection*'. SISD provides sufficient distance for a driver of a vehicle on the major road to observe a vehicle on a minor road approach moving into a collision situation (e.g. in the worst case, stalling across the traffic lanes), and to decelerate to a stop before reaching the collision point. It is:

- Measured along the carriageway from the approaching vehicle to the conflict point; the line of sight having to be clear to a point 7.0 m (5.0 m minimum) back along the side road from the conflict point
- Viewed between two points to provide inter-visibility between drivers and vehicles on the major road and minor road approaches. It is measured to an object height of 1.25m.
- Assumes the driver on the minor road is situated at a distance of 7.0 m (minimum of 5.0 m) from the conflict point on the major road. SISD allows for a 3 sec observation time for a driver on the priority legs of the intersection to detect a problem ahead (e.g. car from minor road stalling in through lane), plus the SSD.
- Provides sufficient distance for a vehicle to cross the non-terminating movement on two-lane two-way roads, or undertake two-stage crossings of dual carriageways, including those with design speeds of 80 km/h or more
- Should also be provided for drivers of vehicles stored in the centre of the road when undertaking a crossing or right-turning movement
- Enables approaching drivers to see an articulated vehicle, which has properly commenced a manoeuvre from a leg without priority, but its length creates an obstruction.

The terrain at each of the intersections surrounding the development site are considered to be on level ground. These intersections are:

- Bendigo-Pyramid Road / New entrance to site near Bullock Creek (exact location to be determined at detailed design and to be addressed in a Traffic Management Plan to be prepared at that stage)
- Pyramid-Yarraberb Road / McCreas Road
- Echuca-Serpentine Road / New entrance to site (exact location to be determined at detailed design and to be addressed in a Traffic Management Plan to be prepared at that stage)
- Bucklands Road / potential new access to site (exact location to be determined at detailed design and to be addressed in a Traffic Management Plan to be prepared at that stage)

The sight distance from the potential access points onto these roads have been determined based on site inspection and the desktop review, and are summarised in Table 3.4.

Table 3.4 : Available sight distance

Criteria	Bendigo-Pyramid Road		Echuca-Serpentine Road		Pyramid-Yarraberb Road		Bucklands Road*	
	East	West	North-East	South-West	North	South	North*	South*
Available sight distance	>262	>262	>262	>262	>262	>262	>262	>262

*The exact location of a potential access from Bucklands Road is yet to be determined, however due to the length of Bucklands Road and its flat terrain, an access could be created along Bucklands Road which would be able to satisfy this sight distance criterion. An existing access point would most likely be used.

The Austroads required sight distance of a 100 km/h road is provided in Table 3.5.

Table 3.5 : Austroads Sight Distance

Austroads requirement	Metres
Absolute minimum SISD (100 km/h)	248
Desirable SISD (100 km/h)	262
Absolute minimum ASD (100 km/h)	165
Desirable ASD (100 km/h)	179
Minimum Gap Sight Distance (100 km/hr)	139

It can be seen that the available sight distance requirements meet with Austroads requirements for a prevailing vehicle speed of 100km/h.

Due to alignment and grade, there is generally unobstructed sight distance on to each of the aforementioned roads of over the desired SISD.

Based on site investigations and a desktop review, access to the proposed development site from the four previously mentioned locations is considered appropriate.

3.5.2 Turn warrants

Warrants for turn treatments are set out in Section 2.3.6 of the Austroads Guide to Traffic Management, Part 6: Intersections, Interchanges and Crossings. These warrants provide guidance on preferred minimum turn treatments for major roads, including basic, auxiliary lane and channelised layouts.

Figure 2.26 of the Austroads guide has been used to assess if turn treatments are required at the proposed access points on Bendigo-Pyramid Road, Echuca-Serpentine Road, Pyramid-Yarraberb Road (existing intersection), Bucklands Road and McCreas Road. The values of the following traffic volume parameters; Q_M , Q_L and Q_R , are calculated using Figure 2.27 of the Austroads guide. These are shown in Figure 3-3 and Figure 3-4 below.

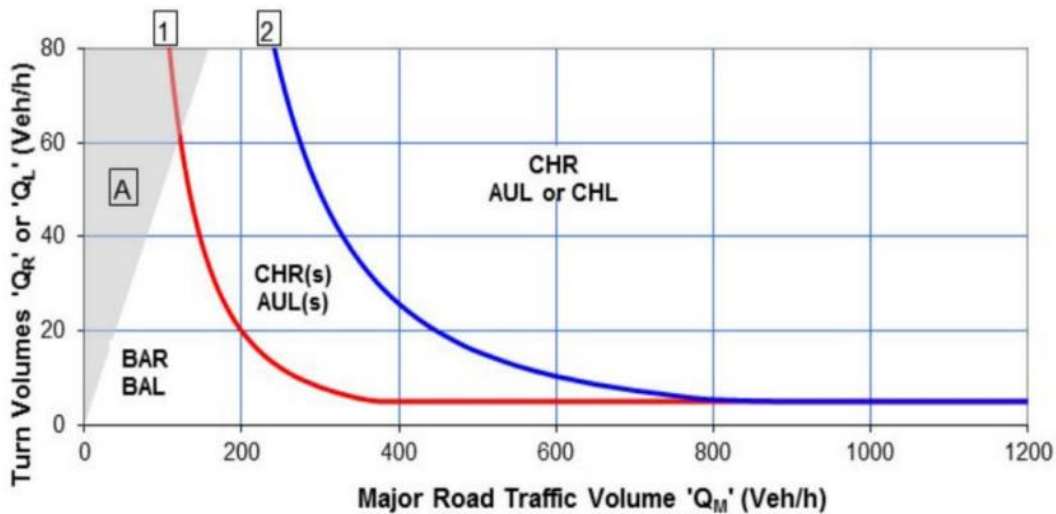
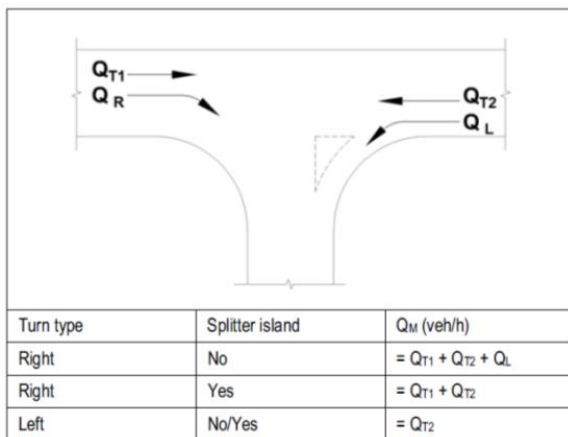
(a) Design Speed ≥ 100 km/h

Figure 3-3 : Warrants for turn treatments on major roads at unsignalised intersections

Figure 3-4 : Calculation of the major road traffic volume Q_M

It is assumed that access to the site will be via Bendigo-Pyramid Road, Echuca-Serpentine Road, McCreas Road and Bucklands Road and so each has been assessed individually (i.e. if all construction traffic were to use one access) as a 'worst case' scenario. Assessments have been based on the volume of traffic expected during peak construction of the subject site only.

The traffic volumes utilising the existing road network are detailed in Section 2.3.2. Assuming a design hour volume of 16% of AADT (as per section 2.3.6 of Austroads Guide to Traffic Management, Part 6: Intersections, Interchanges and Crossings), the following design hour volumes can be assumed.

- Bendigo-Pyramid Road – 24 design hour vehicles (one-way)
- Echuca-Serpentine Road – 17 design hour vehicles (one-way)
- Pyramid-Yarraberb Road – 43 peak hour vehicles (one-way)
- Bucklands Road and McCreas Road - <16 peak hour vehicles (one-way)

The calculation of Q_M, Q_L and Q_R values is shown in Table 3.6.

Table 3.6 : Worst case scenario turn warrant calculations (all daily vehicles arriving in one hour, at each individual access)

Access	Left turn	Right turn	Requirement	Comment
Bendigo-Pyramid Road	Q _M = 24 Q _L = 343	Q _M = 391 Q _R = 0	BAL (basic left turn) BAR (basic right turn)	Assuming all vehicles travelling from Melbourne direction via Mitiamo to site
Bucklands Road or McCreas Road	Q _M = 16 Q _L = 0	Q _M = 375 Q _R = 343	BAL CHR (Channelised right turn) *	Bucklands Road: Assuming all vehicles travelling to site from Bendigo-Pyramid Road, north of this access. McCreas Road: Assuming all vehicles travelling to site from Pyramid-Yarraberb Road, west of this access. *Whilst this assessment shows a channelized right turn could be required, this is an exaggerated worst case scenario where all daily construction vehicles are assumed to arrive within the same hour at the same access. As this site will have at least 3 accesses, and that construction vehicles will arrive sporadically throughout the day this CHR treatment would be highly unlikely to be required.
Echuca-Serpentine Road	Q _M = 17 Q _L = 0	Q _M = 377 Q _R = 343	BAL CHR*	Assuming all vehicles travelling to site from the east along Echuca-Serpentine Road. *Whilst this assessment shows a channelized right turn could be required, this is an exaggerated worst case scenario where all daily construction vehicles are assumed to arrive within the same hour at the same access. As this site will have at least 3 accesses, and that construction vehicles will arrive sporadically throughout the day this CHR treatment would be highly unlikely to be required.
Pyramid-Yarraberb Road	Q _M = 43 Q _L = 343	Q _M = 429 Q _L = 0	BAL BAR	Assuming all vehicles travelling to site from Bendigo-Pyramid Road north of the access.

If a more realistic spread of vehicles to the accesses is applied in the peak scenario, with half of all daily trips arriving and departing in the peak hour (as a still slight over exaggeration), the turn warrants for Bucklands/McCreas Roads and Echuca-Serpentine Road are as follows:

Table 3.7 : Turn warrant calculations (trips distributed across all accesses, half of all daily trips arrive/depart in peak hour)

Access	Left turn	Right turn	Requirement	Comment
Bucklands Road or McCreas Road	Q _M = 16 Q _L = 0	Q _M = 75 Q _R = 43	BAL BAR	Bucklands Road: Assuming all vehicles travelling to site from Bendigo-Pyramid Road, north of this access. McCreas Road: Assuming all vehicles travelling to site from Pyramid-Yarraberb

Access	Left turn	Right turn	Requirement	Comment
				Road, west of this access.
Echuca-Serpentine Road	$Q_M = 17$ $Q_L = 0$	$Q_M = 114$ $Q_R = 80$	BAL BAR	Assuming all vehicles travelling to site from the east along Echuca-Serpentine Road.
Bendigo-Pyramid Road and Pyramid-Yarraberb Road				Table 3.6 showed that these roads could handle the worst case scenario volumes.

Assumptions used to generate these trip values:

- Construction and delivery vehicles for the core development area enter the site 50% from Bendigo-Pyramid Road, 50% from Echuca-Serpentine Road (i.e. PV arrays, access tracks in the core development area)
- 100% of all construction vehicles importing/exporting fill for the substation/O&M/battery storage area will enter via Echuca-Serpentine Road
- 100% of all construction vehicles importing/exporting fill for the terminal station area will enter via McCreas Road
- Peak construction period only

Given these relatively low existing through volumes, and a maximum daily construction vehicle volume of 343 vehicles, Figure 3-3, Table 3.6 and Table 3.7 indicate only basic turn treatments would be required at the proposed site access points. Figure 3-5 shows the typical basic left and right turn treatments for a rural road. VicRoads standard drawings SD2064 and SD2065 also detail the typical treatment required on the driveway access approach. The need for turn warrants will be revised at the Traffic Management Plan stage when more detailed information about the design of the solar farm is known.

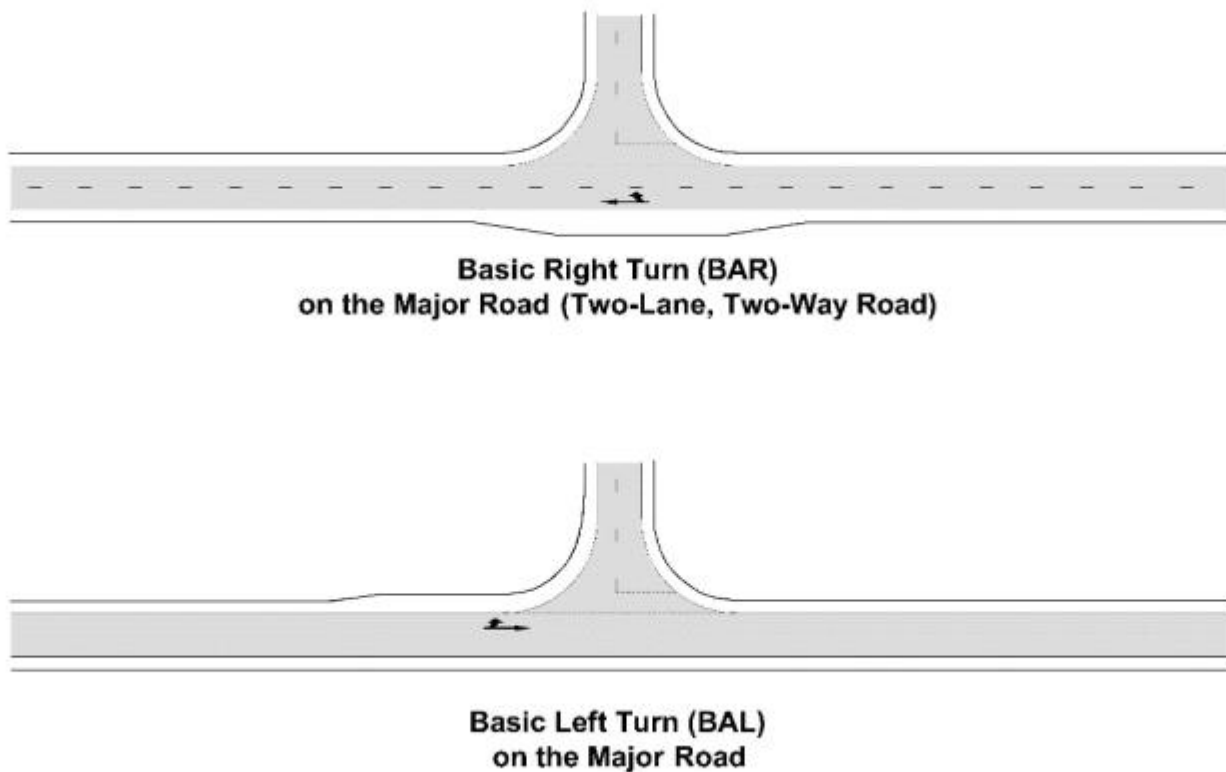


Figure 3-5 : Rural basic (BA) turn treatments

4. Restrictions and Approvals

Pacific Hydro and the contractor will ensure that all construction organisations and personnel comply with all permitting requirements related to the movement of construction vehicles on public roads surrounding the Prairie Solar Farm. The requirements will be documented in the Traffic Management Plan prepared by the contractor for the Prairie Solar Farm development.

A detailed traffic management plan will need to assess the sufficiency of all intersections along the preferred transport routes, to determine if any mitigating works or upgrades are required to accommodate the delivery vehicles. This may include details of any temporary road closures, additional turning lanes or one way workings that might be required. Consideration should also be given to avoiding large truck movements during school bus operating hours on school days, and V/Line coach service times.

4.1 Road haulage routes

To address road safety issues associated with construction traffic, and reduce the social impact associated with additional heavy vehicles in local communities, the detailed Traffic Management Plan will depict all project transport routes. These routes will be on roads that are acknowledged to be fit for purpose, and avoid roads that represent potential road safety risks due to increased heavy vehicle movements e.g. roads with existing fragile and narrow seals, and roads that travel through local townships.

The detailed Traffic Management Plan will also include the operating hours and speed limits for oversize vehicles and other heavy vehicles on routes accessing the site so as to avoid interference with the passage of school buses, and to provide for resident safety and the safe management of stock. The detailed Traffic Management Plan will also establish effective and regular communication methods to discuss transport schedules, changing road conditions and address any social issues.

The detailed Traffic Management Plan will depict agreed transport routes from the arterial road network, to the local road network which provides access to the Prairie Solar Farm and detail all appropriate and necessary upgrades. If Bucklands Road and McCreas Road are to be used as access routes, upgrades to these roads may be required.

4.1.1 Gazetted routes for heavy vehicles

To facilitate the efficient movement of freight through Victoria's road network, VicRoads have developed heavy vehicle route maps which identify the approved heavy vehicle routes for which various heavy vehicle types can use. The map also identifies prohibited roads that various heavy vehicle types cannot use. These maps should be consulted when developing the traffic management plan.

The transport of the materials used for construction will be subject to the Victorian Statutory Load Limits set out in Part 4 of the Road Safety (Vehicles) Regulations 1999.

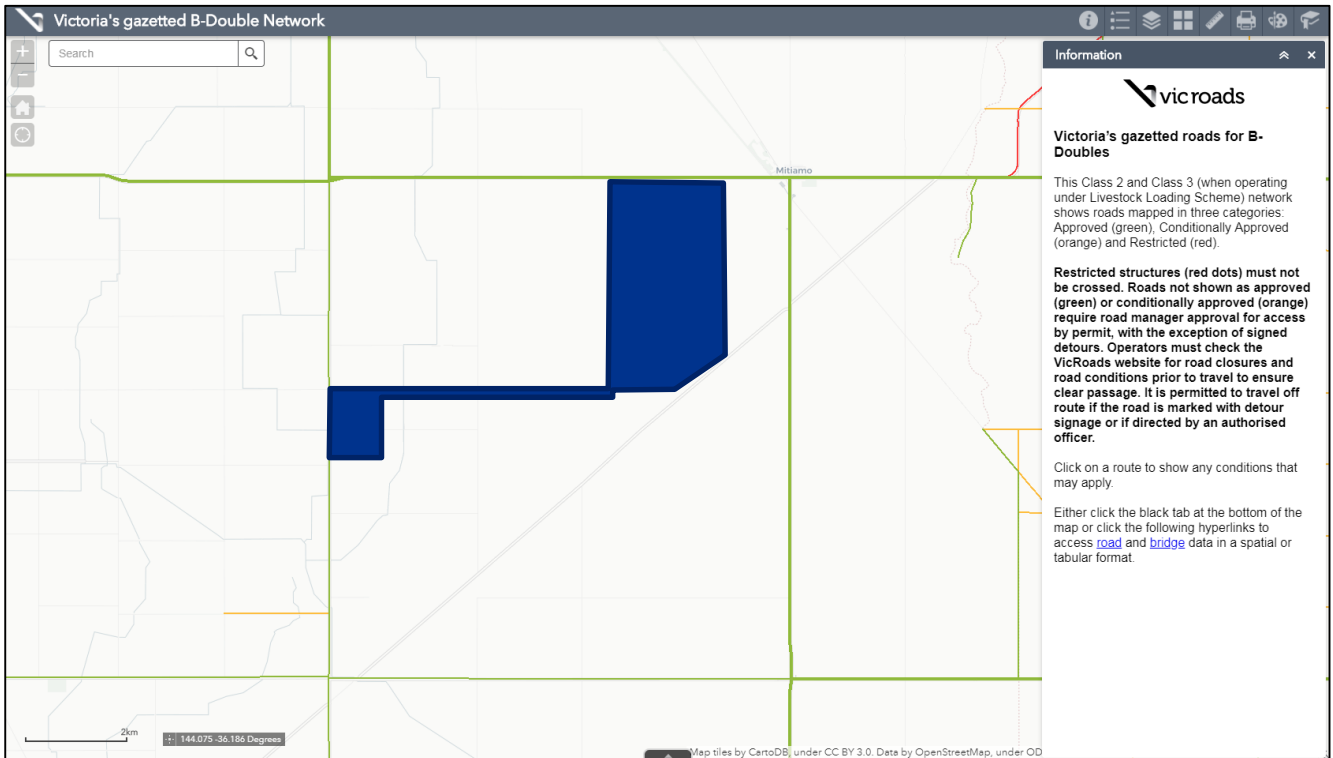


Figure 4-1 : Example of heavy vehicle (B-Double) map developed by VicRoads (with proposed solar farm site overlaid)
<https://www.vicroads.vic.gov.au/business-and-industry/heavy-vehicle-industry/heavy-vehicle-map-networks-in-victoria>

Loddon Shire Council was consulted about preferred access points to proposed solar farm site. Loddon Shire Council's preferred access point was from the gazetted road to the north (Bendigo-Pyramid Road) however other access points such as Echuca-Serpentine Road, McCreas Road and potentially Bucklands Road could be used.

4.2 Rehabilitation of Public Roads used as access routes

The condition of public roads to be used for the delivery of materials should be established prior to commencement of works and then regularly monitored during the period of the works. The road and intersection conditions should be established by field surveys and joint site inspections by an independent civil engineer, Loddon Shire Council and VicRoads Officers with agreed intervention levels documented prior to commencement. When required, rehabilitation of the pavement and/or edges of seal, shoulders and verges will be carried out in accordance with arrangements agreed with the relevant authority. At the completion of the works, the access roads should be an equivalent condition to that existing at the commencement of the works and all costs associated with the maintenance and repair works will be met by Pacific Hydro.

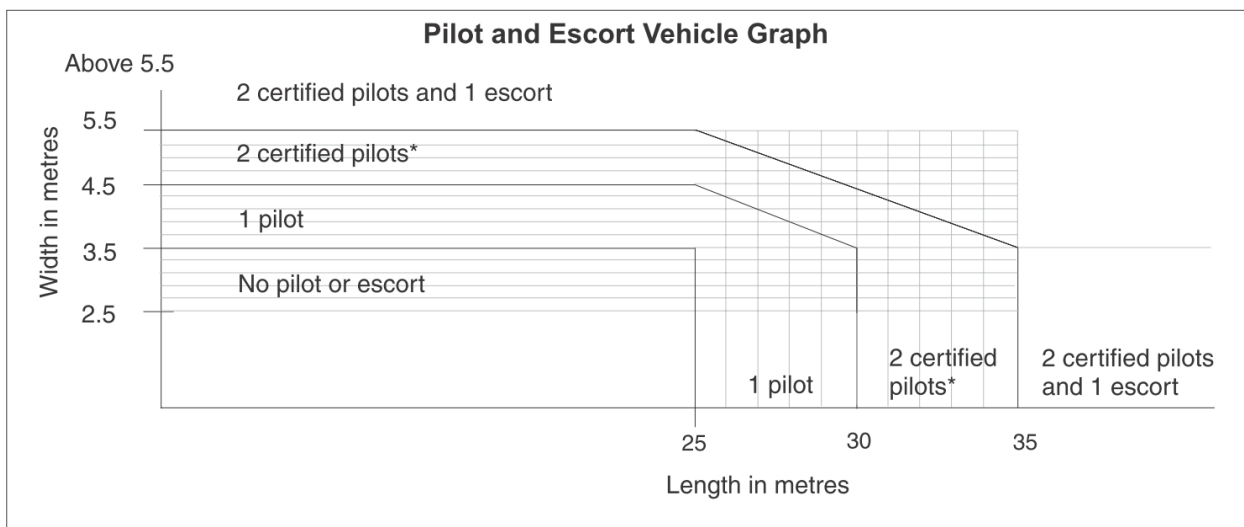
The most appropriate inspection plan during construction depends on the current condition of the pavements and on the expected loads to be carried by the construction vehicles. The following guidelines should be used to determine the proposed inspection plan as part of the detailed Traffic Management Plan prepared by the contractor:

- VicRoads: Codes of Practice for VicRoads pavement requirements
- Austroads: Guide to Pavement Technology Part 1 and Part 2 (2010) for pavement materials and design
- RTA Heavy Vehicle Mass, Loading and Access for maximum allowable loading per axle for heavy vehicles

4.3 Over Dimension Vehicle Permits

OD Load permits may be required for the transportation of the two transformers.

The OD loads will require pilot and escort vehicles. The number of pilot and escort vehicles is dependent upon the length or width as outlined in the Pilot and Escort Vehicles Graph (refer to Figure 4.2) contained in VicRoads Publication Additional Permit Conditions. The hours of movement outside built up areas are also contained within the publication and are summarised in Table 4.1 however additional restrictions may be included within any OD permit issued by VicRoads.



Note: *When travelling on a Freeway outside the Melbourne and Geelong Urban areas, only one certified pilot vehicle is required.

Figure 4.2 : VicRoads pilot and escort vehicle graph (Source: VicRoads Publication Number 0083 "Additional Permit Conditions")

An individual OD permit is not required from VicRoads if the length of the vehicle is less than 25 metres and the width is less than 3.1m (Road Safety (Vehicles) Regulations 1999, Schedule 1). If the vehicle is longer than 25m and is travelling outside the Melbourne area, it must be accompanied by a pilot vehicle. VicRoads may require the presence of their own escort vehicles in addition to the pilot vehicles.

Table 4.1 : VicRoads specified Class 1 vehicle travel time restrictions in rural areas

Vehicle Dimensions	Travel time restrictions
Up to 3.1m wide and/ or 22.0m long	No travel restrictions
Up to 3.5m wide and/ or 25.0m long	Sunset – Sunrise
Over 3.5m wide and/ or 25.0m long	Sunset – Sunrise

Source: Oversize Load Carrying Vehicles Information Bulletin, VicRoads, October 2007

5. Conclusion

The analysis above shows:

- Daily construction vehicle trips to site range from 99 to 343 trips per day, with an average of 212 daily trips across 13 months.
- If the maximum daily construction movements (343 vehicles) attended and departed site within a peak hour, Bendigo-Pyramid Road would be operating at 40% of its capacity, if the only access point to site was from Bendigo-Pyramid Road. If other access points were also used (i.e. Echuca-Serpentine Road, McCreas Road and Bucklands Road) this impact could be further reduced, and would have negligible impact on the other access roads due to their low existing traffic volumes (<520 vehicles daily).
- Only basic turn treatments would be required at the proposed site access points. However, a swept path analysis and haulage route inspection would be required for the transport of over-dimensioned vehicles to site.

Based on the site visit and this traffic impact assessment, Jacobs is of the opinion that the proposed Prairie Solar Farm located near the rural township of Mitiamo will not have an adverse impact on the operation of the existing road network adjacent to the site. However, upgrades to the local road network may be required to cater for the construction vehicles. These upgrades (if required) will be determined at the Traffic Management Plan stage.

A more detailed Traffic Management Plan will be required at a later stage when a haulage contractor has been selected and finer details of the solar farm have been designed.

The condition of public roads to be used for the delivery of materials should be established prior to commencement of works and then regularly monitored during the period of the works. The road and intersection conditions should be established by field surveys and joint site inspections by an independent civil engineer, Loddon Shire Council and VicRoads Officers with agreed intervention levels documented prior to commencement.

Appendix A. Data from Pacific Hydro

Traffic Impact Assessment



Expected MWp	240	Months within which deliveries will occur																							
		Design				Procurement		Construction Phase																	
		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Month 13	Month 14	Month 15	Month 16	Month 17	Month 18	Month 19	Month 20	Month 21	Month 22	Month 23	Month 24
PV panel components	1,262												14%	14%	14%	14%	14%	14%	14%						
Inverter cotainer units	48																33%	33%	34%						
Support and Fixing System	1,200									14%	14%	14%	14%	14%	14%	14%									
Electrical Switchgear	5												33%	33%	34%										
Transformer units	2														50%	50%									
Miscellaneous Items	120										10%	10%	10%	10%	10%	10%	10%	10%	10%						
Transmission Towers	100															20%	80%								
Fuel trucks	144								8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%					
Water cart	1,440								8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%					
Total Heavy Vehicle Movements	4,321																								
Construction Labour																									
Daily on Site Labour	39																								
Administration traffic	60																								
Total Daily Labour related movements	99																								
Total Light Vehicle Movements	33,264.00																								

Pavement and Pad Materials Estimation														
Primary access track						Secondary access track						Raised pad for terminal station and substation/O&M/battery storage area		
400	mm	Estimated thickness of road				0	mm	Estimated thickness of road				250	m	length of terminal station area
10	m	road width				5	m	road width				250	m	width of terminal station area
58	km	length of road				15.3	km	length of road				1	m	height of pad
232000	m3	pavement material				0	m3	pavement material				62500	m3	
2.3	tonnes / m3					2.3	tonnes / m3					200	m	length of substation/O&M/battery storage area
533600	tonnes of material					0	tonnes of material					200	m	width of substation/O&M/battery storage area
23	tonnes per vehicle load transporting material to site					23	tonnes per vehicle load transporting material to site					1	m	height of pad
23200	vehicle trips required					0	vehicle trips required					40000	m3	
						Pacific Hydro says this will just be compacted ground						102500	m3	total volume of material required
												2.3	tonnes / m3	
												235750	tonnes of material required	
												23	tonnes per vehicle load transporting material to site	
												10250	vehicle trips required	
Timeline														
Corresponds to the months given on the "Dev Generated Traffic Movements" tab														
	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Month 13	Month 14	Month 15	Month 16	Month 17	Month 18	Month 19	
Access tracks	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	0%	100% Check
Monthly trips	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	1933	0	<= Please enter the proportion of total trips required OK
Daily trips	81	81	81	81	81	81	81	81	81	81	81	81	0	
Raised pads	0%	0%	0%	0%	33.33%	33.33%	33.33%	0%	0%	0%	0%	0%	0%	100% Check
Monthly trips	0	0	0	0	3417	3417	3417	0	0	0	0	0	0	<= Please enter the proportion of total trips required OK
Daily trips	0	0	0	0	142	142	142	0	0	0	0	0	0	
Assumptions to model a 'worst-case scenario'														
- All materials delivered from quarry (i.e. not from existing materials at site)														
- Pavement design will be developed during detailed design phases														
- Truck volumes to bring materials to site will be further refined at the traffic management plan stages (Currently assuming single triaxle semitrailer carrying 23t)														
- No allowance for earthworks or subgrade treatment activities														
- Assume 3 water cart trips external to site per day for keeping dust down during construction														
- 10 additional daily onsite workers have currently been allowed for in the construction of the roads or pads														
- Construction and delivery vehicles for the core development area (i.e. access tracks, PV panels and racks, inverters, and substation/O&M/battery storage) will enter site: 50% from Bendigo-Pyramid Rd, 50% Echuca-Serpentine Road)														
- Construction and delivery vehicles for the transmission line extension (i.e terminal station, transmission towers, and access tracks along the transmission line extension) will enter site: 80% from McCreas Road and 20% from Echuca-Serpentine Road														
- 100% of construction vehicles importing/exporting fill for raised pad for substation/O&M/battery storage area will enter/exit site at Echuca-Serpentine Rd														
- 100% of construction vehicles importing/exporting fill for raised pad for terminal station will enter/exit from McCreas Rd														
- All excavated material will be removed from site using the same trucks importing material into site (worst-case scenario)														
- Construction of access tracks will be spread out over the construction timeline (i.e. not in a single stage), that is, they will be built as they are needed for construction of relevant components of the project														
- Secondary access tracks will be compacted earth, no need for excavation or imported fill														

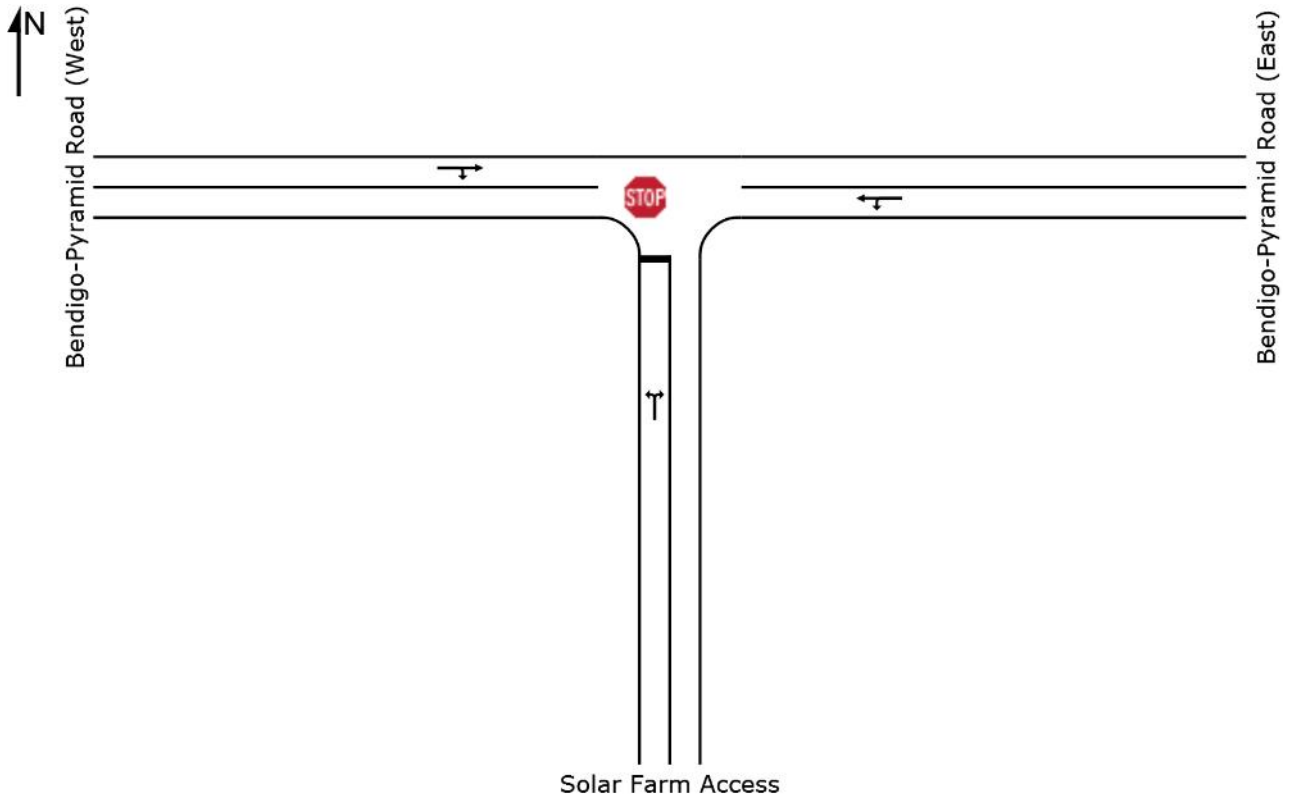
**Appendix B. SIDRA analysis results – Bendigo-Pyramid Road /
New Access (Worst Case Scenario – All daily
vehicles using 1 access in 1 hour)**

SITE LAYOUT



Site: [Solar Farm Access from Bendigo-Pyramid Road]

New Access to Bendigo-Pyramid Road
Stop (Two-Way)



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MOVEMENT SUMMARY



Site: [Solar Farm Access from Bendigo-Pyramid Road]

New Access to Bendigo-Pyramid Road
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Solar Farm Access											
1	L2	1	0.0	0.622	10.6	LOS B	5.1	57.5	0.63	1.17	54.5
3	R2	361	71.0	0.622	17.5	LOS C	5.1	57.5	0.63	1.17	42.4
Approach		362	70.8	0.622	17.5	LOS C	5.1	57.5	0.63	1.17	42.4
East: Bendigo-Pyramid Road (East)											
4	L2	361	71.0	0.302	9.7	LOS A	0.0	0.0	0.00	0.64	55.2
5	T1	16	25.0	0.302	0.1	LOS A	0.0	0.0	0.00	0.64	83.7
Approach		377	69.1	0.302	9.3	NA	0.0	0.0	0.00	0.64	56.0
West: Bendigo-Pyramid Road (West)											
11	T1	16	23.0	0.010	0.2	LOS A	0.0	0.1	0.08	0.04	97.3
12	R2	1	0.0	0.010	9.3	LOS A	0.0	0.1	0.08	0.04	70.3
Approach		17	21.6	0.010	0.8	NA	0.0	0.1	0.08	0.04	95.0
All Vehicles		756	68.8	0.622	13.0	NA	5.1	57.5	0.30	0.88	48.9

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

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

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

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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

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

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