Tragowel BESS

Transport Impact Assessment

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20 April 2026

onemile**grid**

ABN: 79 168 115 679

(03) 9939 8250
Wurundjeri Woiworung Country
56 Down Street
COLLINGWOOD, VIC 3066
www.onemilegrid.com.au

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one*mile****grid*** *operates from Wurundjeri Woiworung Country of the Kulin nation. We acknowledge and extend our appreciation to the Wurundjeri People, the Traditional Owners of the land. We pay our respects to leaders and Elders past, present and emerging for they hold the memories, the traditions, the culture, and the hopes of all Wurundjeri Peoples.*

Cover image courtesy of Nearmap

ABBREVIATIONS

Term	Definition
AV	20 m articulated vehicle
AUL	Full-length auxiliary left turn treatment
AUL(s)	Short auxiliary left turn treatment
BAL	Basic left turn treatment
BAR	Basic right turn treatment
CHL	Channelised left turn treatment
CHR	Full-length channelised right turn treatment
CHR(s)	Short channelised right turn treatment
BD	26 m B-Double
BESS	Battery Energy Storage System
CTMP	Construction Traffic Management Plan
DELWP	Department of Environment, Land, Water and Planning, Victoria (dissolved 31 December 2022)
DTP	Department of Transport and Planning, Victoria
FZ	Farming Zone
HRV	12.5 m heavy rigid vehicle
HV	Heavy Voltage
MW	Megawatts
MWh	Megawatt hours
NHVR	National Heavy Vehicle Regulator
OSOM	Oversize and/or Overmass
SISD	Safe intersection sight distance
TIA	Transport Impact Assessment
TRZ1	Transport Zone 1 – State Transport Infrastructure
TRZ1	Transport Zone 2 – Principal Road Network
vpd	Vehicles per day

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1 INTRODUCTION

onemile**grid** has been requested by Green Switch Australia and Potentia Energy to undertake a Transport Impact Assessment of the proposed Battery Energy Storage System (BESS) in Tragowel on the Loddon Valley Highway.

This analysis has been undertaken in accordance with *Solar Energy Facilities Design and Development Guideline* (October 2022) and aims to identify key traffic impacts associated with the construction and operation of the proposed BESS, and identify any infrastructure necessary to support the use and mitigate potential impacts.

As part of this assessment the subject site has been inspected with due consideration of the development proposal, traffic data has been sourced, and relevant background information has been reviewed.

2 DESIGN AND DEVELOPMENT GUIDELINES

The Department of Environment, Land, Water and Planning (DELWP), now dissolved and succeeded by the Department of Energy Environment and Climate Action (DEECA) and Department of Transport and Planning (DTP), prepared the *Solar Energy Facilities Design and Development Guidelines* in October 2022.

This document outlines the fundamentals of energy facilities within Victoria in regard to policies, legislative and statutory planning arrangements. The document also includes provisions for the inclusion of battery storage facilities which are broadly considered to be applicable to the Tragowel BESS.

It is intended to guide both proponents and decision makers, by providing best practice guidance and an overview of documentation that should be provided with any application.

Relevant to traffic engineering matters, the guidelines identify a requirement for a Traffic Impact Assessment, that should:

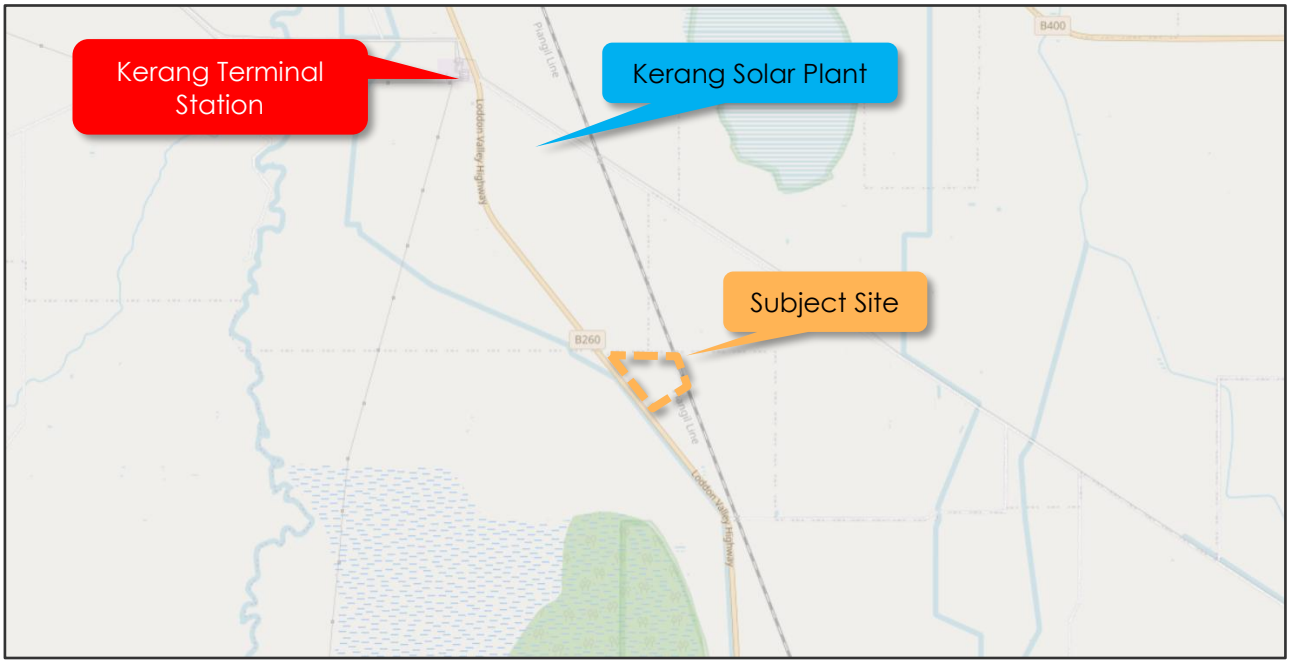
- Identify access routes and all roads that will be used to transport construction materials;
- Identify access routes, types of vehicles and traffic generation when the facility operates;
- Specify the timing, type of vehicle, daily volume and scheduled delivery times of construction materials;
- Provide timelines for the whole construction stage; and
- Identify intersection upgrades and any road works required to accommodate access to the site, and specify if these are temporary arrangements.

3 EXISTING CONDITIONS

3.1 Site Location

The subject site has no formal street address, though is addressed as Loddon Valley Highway, Tragowel. The site has a road frontage to Loddon Valley Highway along its western boundary with the Swan Hill Train Line alongside the eastern boundary as shown in Figure 1.

Figure 1 Site Location



Source: OpenStreetMap

The site is currently used for agricultural purposes, including grazing sheep and the production of fodder, hay and silage.

It is understood that access to the site is currently via a concealed crossover approximately 500 m south of the site, with an internal access track running through the paddocks and alongside the railway line, leading to the south-east portion of the site.

Figure 2 Existing Access Track

Copyright Nearmap

A gate is provided along the site's frontage to Loddon Valley Highway, though is understood not to be used by the existing farm operations. The gate is not provided with a formal crossover. While some roadside vegetation has been cleared adjacent the gate, existing trees to the north heavily restrict vehicular access. A view of the existing access arrangement is shown below in Figure 3, which illustrates the existing vegetation in the vicinity of the gate / site access.

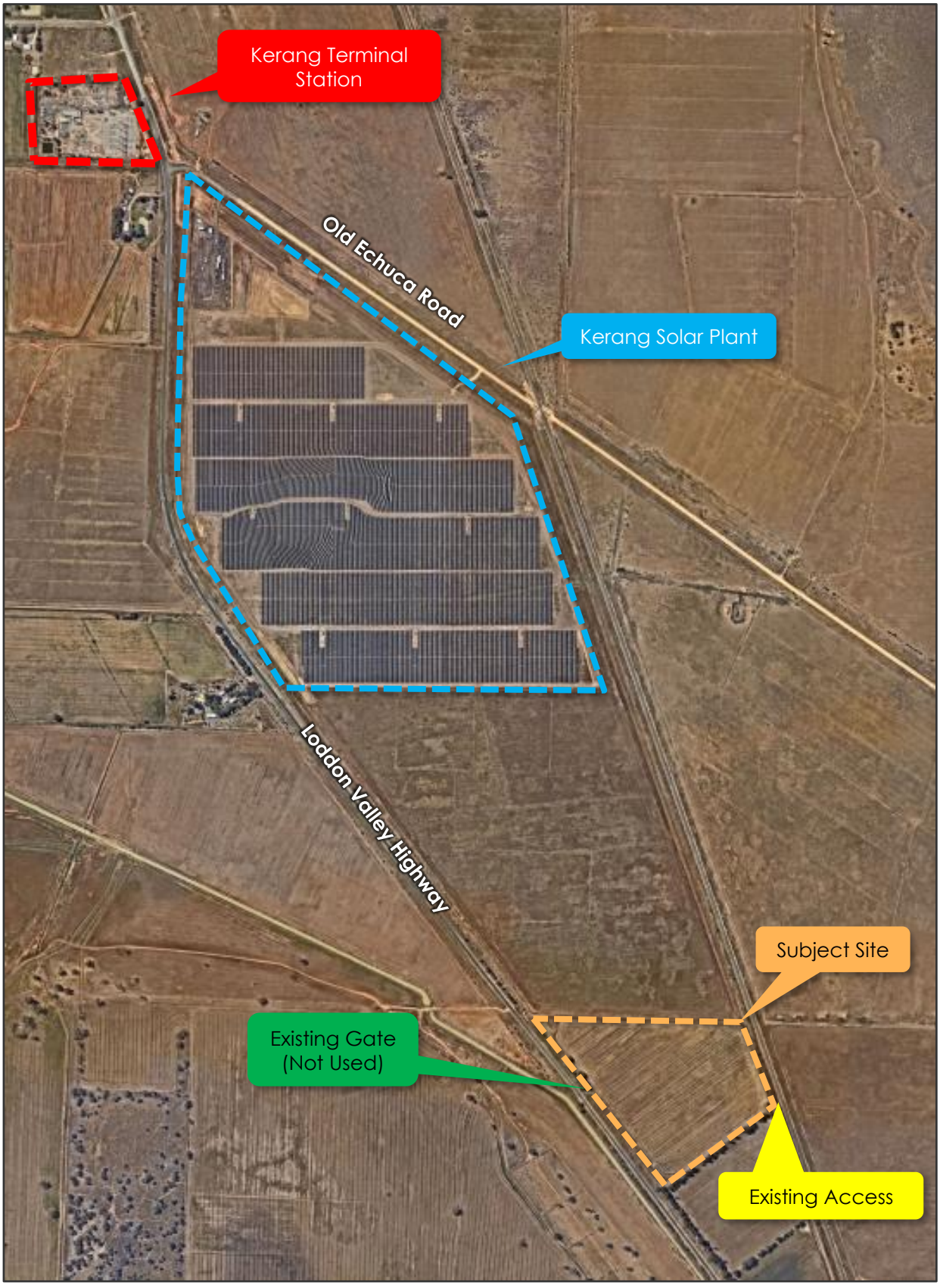
Figure 3 Existing Site Access

Copyright Nearmap

Land use in the immediate vicinity of the site is generally similar agricultural uses, though the recently constructed Kerang Solar Plant is located to the north of the site, and the Kerang Terminal Station is further north.

An aerial view of the subject site is provided in Figure 4.

Figure 4 Site Context (19 October 2024)



Copyright Nearmap

3.2 Planning Zones and Overlays

It is shown in Figure 5 that the site is located within a Farming Zone (FZ).

Figure 5 Planning Scheme Zones

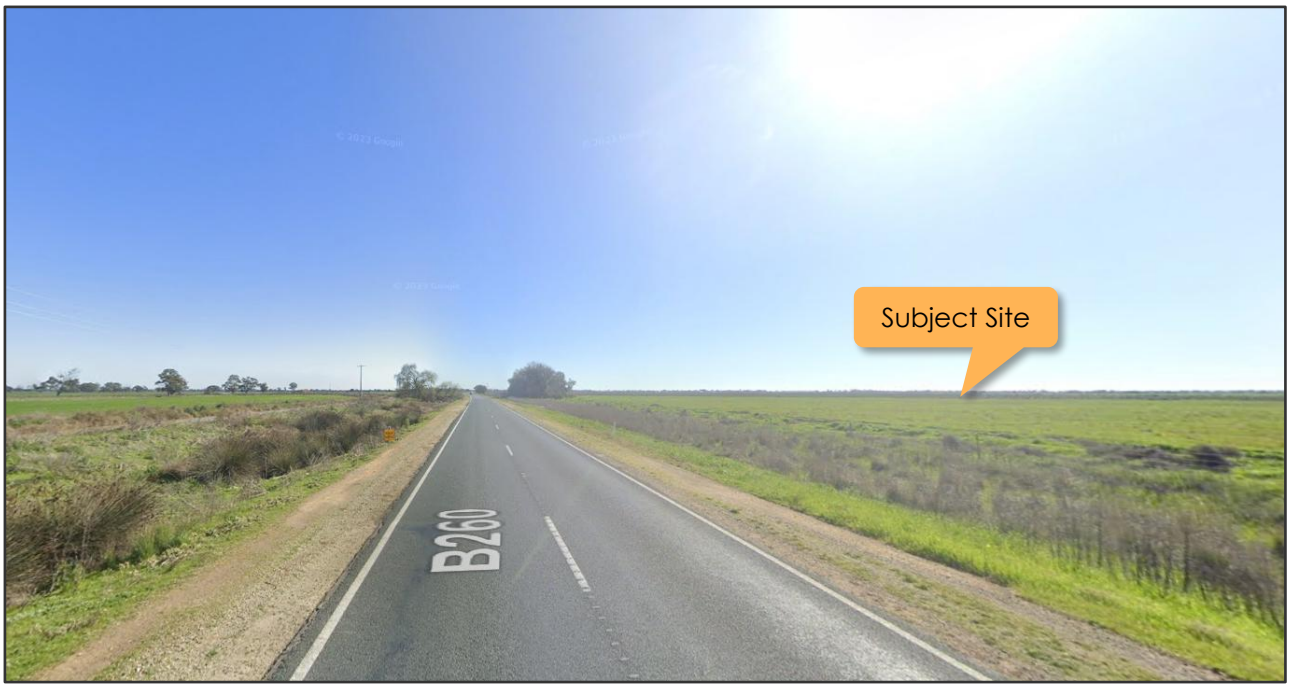
Additionally, the site abuts Loddon Valley Highway, which is within a Transport Zone (TRZ2), designating the Principal Road Network, and the Swan Hill Train Line, which is within a Transport Zone (TRZ1), designating the railway line as State Transport Infrastructure.

3.3 Road Network

Loddon Valley Highway is an arterial road (named Highway) aligned north-south, running between Murray Valley Highway in Kerang, and Calder Highway in Ironbark, a suburb of Bendigo. Loddon Valley Highway provides a single traffic lane in each direction adjacent to the site. Grassed verges are provided on each side of the road in the vicinity of the site.

The cross-section of Loddon Valley Highway at the frontage of the site is shown in Figure 6.

Figure 6 Loddon Valley Highway, looking north adjacent to the subject site



Copyright Google (Image date: August 2023)

A 100 km/h speed limit applies to Loddon Valley Highway in the vicinity of the site.

3.4 Existing Traffic Volumes

Traffic volume, speed and classification surveys were undertaken by Trans Traffic Survey on behalf of **one**mile**grid** on Loddon Valley Highway adjacent the site, for a one-week period from Tuesday 19th November 2024 to Monday 26th November 2024 inclusive. The results of the surveys are summarised in Table 1.

Table 1 Traffic Volume and Speed Surveys

Time Period	Direction	Traffic Volume (vpd)	Average Speed (km/h)	85th Percentile Speed (km/h)
Weekday Average	Northbound	1,132	98.0	103.7
	Southbound	1,141	100.9	106.9
	Both Directions	2,273	99.5	105.3
7 Day Average	Northbound	1,082	98.9	104.3
	Southbound	1,115	100.8	106.9
	Both Directions	2,197	99.8	105.6

The data was further assessed to determine the traffic volumes during the weekday peak periods, which are shown below. The peak periods were defined as the AM and PM hours with the highest observed traffic volumes.

Table 2 Weekday Peak Hour Averages

Period	Northbound (vehicles)	Southbound (vehicles)	Both Directions (vehicles)
AM Peak (9:00 AM to 10:00 AM)	74	122	196
PM Peak (2:00 PM to 3:00 PM)	93	79	172

Over the survey period, heavy vehicles comprised 21.8% of the combined northbound and southbound traffic.

4 PROPOSAL

4.1 General

It is proposed to develop the site for the purposes of a 200MW/800MWh BESS, including associated switching station and underground transmission line connecting to the Kerang Terminal Station.

In addition to the key components outlined above, there will be temporary infrastructure required to facilitate the construction and decommissioning phases of the proposed BESS. The construction compound would likely include:

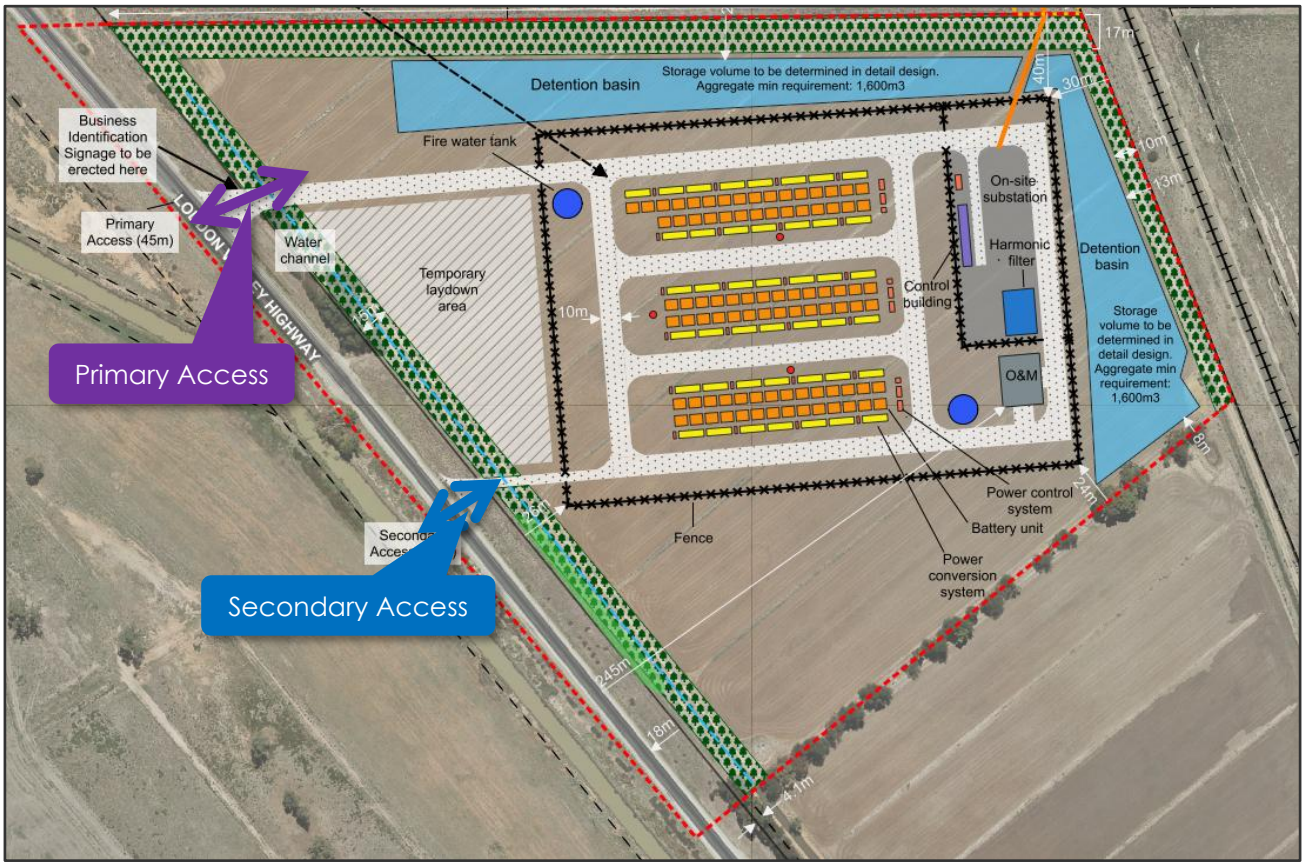
- Temporary construction offices;
- A site office; and
- Laydown areas.

These will all be accommodated within the subject site.

The proposed BESS units are to be located in the middle of the parcel of land.

The concept layout plan for the site is provided below.

Figure 7 Concept Layout Plan



4.2 Construction / Installation

4.2.1 Overview

Construction of the facility is expected to take place over an 18-month period. This can be broken up into two distinct phases, a typical construction phase and a peak construction phase, as discussed below.

Additionally, construction hours are to be limited to the following:

Monday to Friday: 7:00 AM to 5:00 PM;

Saturday: 8:00 AM to 3:00 PM.

4.2.2 Deliveries

The operator has advised that the largest vehicles that will access the site will be OSOM vehicles between 30 and 40 metres in length associated with the transformers. It is expected that a maximum of 25 OSOM vehicle deliveries will occur over the course of the construction of the facility. This includes vehicles transporting transformers and other oversized loads such as the switch room and operation and maintenance facility.

The majority of heavy vehicle deliveries are expected to be via 20 m tandem tipper and trailers (truck and dogs) or 19/20 m articulated vehicles (semi-trailers).

The heavy vehicle classifications are summarised below:

Table 3 Heavy Vehicle Types

Vehicle	*Description*	*Notes*
12.5 m heavy rigid vehicle (HRV)	Single unit truck	N/A
19/20 m articulated vehicle (AV)	Prime mover towing 1 semitrailer	The BESS units are expected to be transported via typical semi-trailers.
19/20 m Truck and Dog Trailer	Rigid truck pulling a trailer with one axle group or single axle at the front connected by a drawbar	Bulk fill and engineering to be transported by truck and dog trailers.
26 m B-Double (BD)	Prime mover towing 2 semitrailers	N/A
Oversized and/or Overmass (OSOM) vehicles	Mobile Crane – Dimensions vary	The proponent has advised a maximum of 8 crane deliveries are expected
	Transformers – 30 to 40 m length low loader	The proponent has advised a maximum of 2 deliveries are expected associated with the main power transformer
	Earthmoving plant – Includes excavators, dumpers and bulldozers, likely to be transported to the site on low loaders	The proponent has advised a maximum of 10 deliveries are expected associated with delivery of earthmoving plant

	Other OSOM vehicles such as large low loaders – Dimensions vary	The proponent has advised a maximum of five additional oversized vehicles are expected

4.2.3 Typical Construction Phase

During the typical construction period associated with the facility, up to 40 personnel are expected on-site at any given time. Additionally, up to 30 heavy vehicle deliveries are expected per day, with the timing of these deliveries distributed throughout the day.

4.2.4 Peak Construction Phase

Included within the 18 month construction period, a 6 month peak construction phase has been designated. During this peak phase, the site is expected to accommodate a maximum of 120 staff on-site, and up to a maximum of 75 heavy vehicle deliveries per day, evenly distributed throughout the day.

4.2.5 Temporary Speed Limit Reduction

The existing speed limit along Loddon Valley Highway is 100 km/hr. It is proposed that a temporary speed limit reduction to 80 km/hr will be sought along Loddon Valley Highway during the construction of the facility, in consultation with DTP. This will be implemented in conjunction with any other construction traffic management measures required for the development.

4.3 Operation

The operator has indicated that the site may accommodate up to two maintenance staff on-site daily during typical operations.

Occasional access to the site will be necessary for major maintenance and inspections, which will require additional staff and heavy vehicles to access the site.

4.4 Access

Access to the site is proposed to be established from Loddon Valley Highway via a primary and secondary access point, connecting to access tracks which lead to the BESS Area. The proposed primary access is 10 m wide and splays out to provide a width of 45 m at the Loddon Valley Highway interface. The design/layout of the access will be finalised during detailed design, though will facilitate fully directional vehicle movements into and out of the site to Loddon Valley Highway. The proposed secondary access is 6 m wide, and will be located approximately 180 m south of the primary access. The secondary access is intended for emergency access only.

It is anticipated that the site access will be secured against unauthorised access outside of construction hours/days, and at all times once operational.

The existing internal farm track through the paddocks to the south will not be used as part of this proposal.

4.5 Car Parking

Car parking for construction staff will be provided within a parking area on-site, which is expected to be in the northwest corner of the site. Given the large area of the overall site all car parking demands are expected to be comfortably accommodated on-site.

For the operational phase of the project a smaller car parking area will be provided, with the design and provision of car parking to be finalised during detailed design.

5 DESIGN ASSESSMENT

5.1 Access Route

5.1.1 Standard Heavy Vehicles

The operator has advised that the BESS units are likely to originate / depart from Melbourne in the south, whilst the bulk fill / engineering fill could originate from both north and south of the site.

Based on the location of the site, it is anticipated that all standard sized heavy vehicles will access the site via Loddon Valley Highway.

5.1.2 OSOM Vehicles

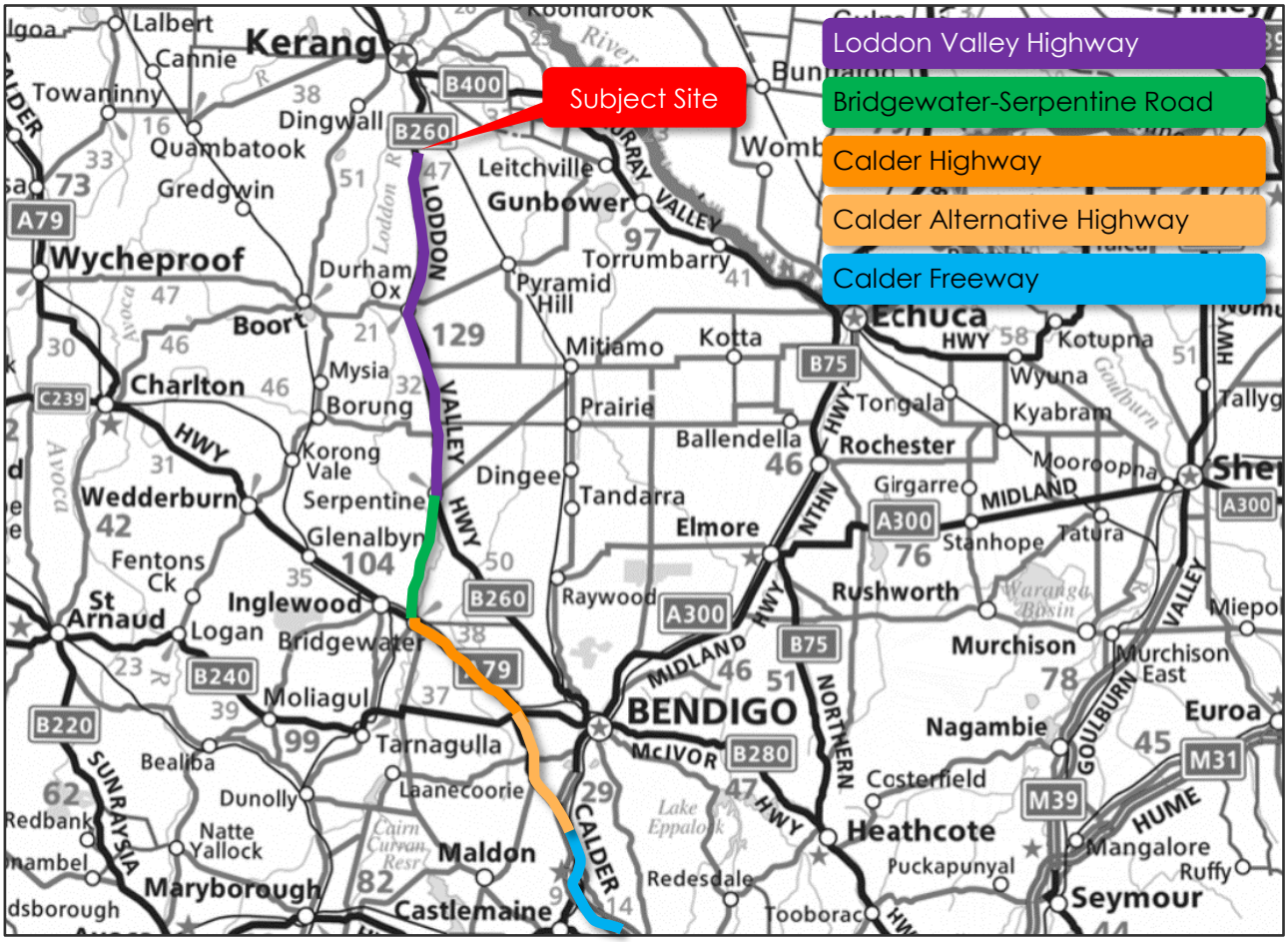
The operator has advised that all OSOM vehicles are anticipated to originate / depart from Melbourne.

onemile**grid** has reviewed Victoria's Oversize and Overmass (OSOM) Network in the vicinity of the site and prepared the following recommended access routes for OSOM vehicles to the site. Eligible vehicles up to 5m wide, 5m high, 30m long, and 100t mass are permitted to travel on the OSOM network, subject to meeting all relevant eligibility requirements. All roads nominated in the access route are arterial roads managed by the Department of Transport and Planning (DTP). It is expected that vehicles will utilise Loddon Valley Highway, Bridgewater-Serpentine Road and Calder Highway/ Freeway, to bypass west of Bendigo.

It is acknowledged that the proposed OSOM vehicle for the site exceeds the dimensions detailed within the vehicle register and further coordination and permits will be required with NHVR during the detailed design phase.

The access route from the site to Calder Freeway is shown below.

Figure 8 OSOM Access Route Review



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As part of the detailed design process, a swept path assessment using a suitable OSOM vehicle shall be undertaken to ensure suitable path for the site access and route to the site. Noting large / wide loads will be escorted and planned in advance, it is not expected that there would be any impassable locations along the route.

5.2 Site Access

5.2.1 Sight Lines

As part of **one**mile**grid**'s investigations, Google Streetview imagery was reviewed to assess the sight lines along the frontage of the site. The safe intersection sight distance (SISD) requirements, as outlined within *Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections*, is summarised below in Figure 9.

Figure 9 Austroads SISD

Design speed (km/h)	Based on safe intersection sight distance for cars[1] h_1 = 1.1; h_2 = 1.25, d = 0.36[2]; Observation time = 3 sec					
	R_T = 1.5 sec[3]		R_T = 2.0 sec		R_T = 2.5 sec	
	SISD (m)	K	SISD (m)	K	SISD (m)	K
40	67	4.9	73	6	–	–
50	90	8.6	97	10	–	–
60	114	14	123	16	–	–
70	141	22	151	25	–	–
80	170	31	181	35	–	–
90	201	43	214	49	226	55
100	234	59	248	66	262	74
110	–	–	285	87	300	97
120	–	–	324	112	341	124
130	–	–	365	143	383	157

Source: Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections

Noting the observed 85th percentile speed of 105.6 km/hr on Loddon Valley Highway as demonstrated in Table 1, the design speed of 110 km/r applies to the site access. Regardless, it is expected that the minimum sight distance of 300 m can comfortably be achieved at the site access locations, with sight lines being sufficient in both directions on Loddon Valley Highway.

5.2.2 Access Design

Detailed designs for the site access points have not been undertaken at this stage. The site access should be designed to accommodate the largest typical vehicles that will access the site during the construction phase of the facility (up to an AV). In relation to the OSOM vehicles it is expected that movements will be managed under traffic management and accordingly additional widening at the site access will be limited.

onemile**grid** has prepared swept path diagrams for the primary site access using an articulated vehicle with a total length of 36.95 metres, including a 4 m wide trailer and a 5.3 m wide payload (representing the materials such as the main power transformer to be transported). It is expected that movements for the OSOM vehicles will be managed by traffic management and accordingly it is appropriate for the vehicle to cross over the opposite side of the road. The swept paths demonstrate body overhang to the western side of the road, however this is considered appropriate as there is only low lying vegetation in this area.

Furthermore, swept path diagrams have been prepared demonstrating simultaneous two way movements at the site access for both 20 m articulated vehicles (AV) and 20 m tandem tipper + trailers.

The swept path diagrams are attached in Appendix A.

5.3 Clause 52.29 – Land Adjacent to the Principal Road Network

The development proposal is subject to the requirements of Clause 52.29 of the Gannawarra Planning Scheme which applies to land adjacent to the Principal Road Network (Loddon Valley Highway) and aims to ensure appropriate access is provided to identified roads.

Relevant to the proposed development, the Clause states that a permit is required to create or alter access to, or subdivide land adjacent to, a road in a Transport Zone 2, and that the proposal is to be referred to the relevant referral authority (in this case the Department of Transport and Planning (VicRoads)).

The proposed development includes access crossovers to Loddon Valley Highway, and therefore requires referral of the application to the Department of Transport and Planning.

Before deciding on the appropriateness or otherwise of an application to create or alter access to the Principal Road Network, the responsible authority must consider the following:

- *The Municipal Planning Strategy and the Planning Policy Framework.*
- *The views of the relevant road authority.*
- *The effect of the proposal on the operation of the road and on public safety.*
- *Any policy made by the relevant road authority pursuant to Schedule 2, Clause 3 of the Road Management Act 2004 regarding access between a controlled access road and adjacent land.*

The proposal seeks to provide two crossovers to Loddon Valley Highway. The operations of the site are largely automated, with a maximum of two staff on-site, with the traffic impacts of the proposal being confined to the short construction period, as discussed in Section 7. The proposal will provide adequate sight distances at the property boundary as discussed in Section 5.2.1. As such, the development is not expected to have any material impact on the operation of the road or any impacts on public safety.

Furthermore, the subject site has no alternative vehicular access given Loddon Valley Highway is its only road frontage.

In relation to the number of access points it is noted that the secondary access is for emergency access only.

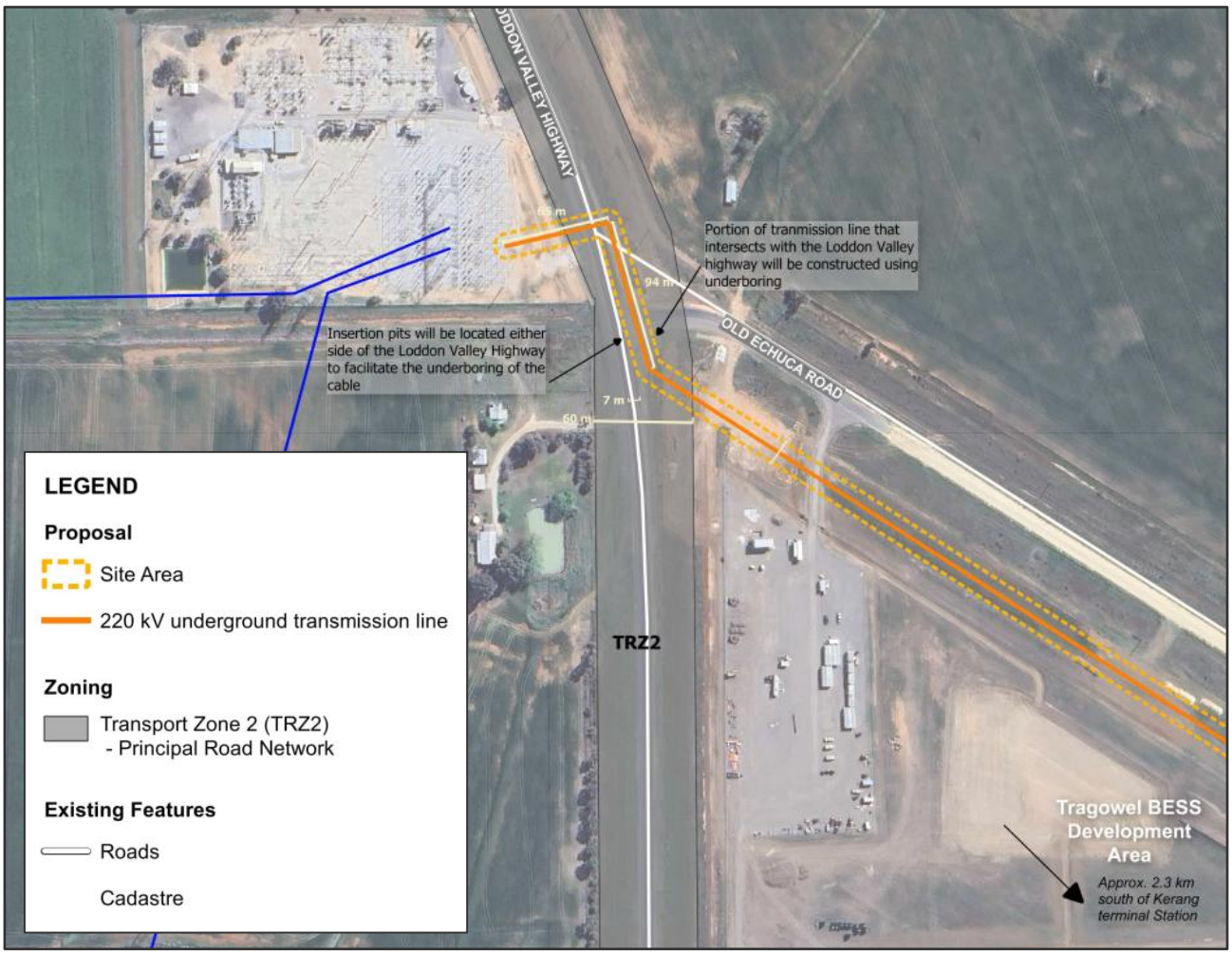
In light of the above, it is considered that the proposed development will satisfy the requirements of Clause 52.29.

6 WORKS WITHIN LODDON VALLEY HIGHWAY ROAD RESERVE

To facilitate construction of the grid connection to the Kerang Terminal Station, works will be required within the Loddon Valley Highway road reserve. Under the Road Management Act 2004 (Victoria), Head, Transport for Victoria (HTfV) consent is required for specific works within or near a road reserve managed by the coordinating road authority, including roads under HTfV's jurisdiction.

The transmission line is proposed to be underground and will cross over Loddon Valley Highway in the vicinity of Old Echuca Road and the Kerang terminal station, approximately 2.3 km north of the site, as shown below in Figure 10.

Figure 10 Transmission Line Works Plan



The intended construction methodology for the underground transmission line will be via underground boring. Through this method, the transmission line will be installed underneath the road, avoiding disruption to the road surface. Insertion pits will be required on either side of the highway to allow the cable to be threaded through the bore. The final alignment and depth of the transmission line, in addition to the number of intersection pits will depend on ground conditions and will be confirmed during detailed design.

The proponent has advised that the proposed works associated with the underground transmission line is anticipated to take 1-2 weeks to complete.

While the carriageway will remain open, workers will operate within the road reserve to manage the process. Appropriate traffic management measures such as temporary speed reductions and construction warning signage may be required to ensure safety for both workers and motorists

during the works. These measures will be detailed in the Construction Traffic Management Plan prepared specifically for the transmission line works.

It is therefore considered that the proposed transmission line works are expected to have only a minor and temporary impact on the arterial road network, with Loddon Valley Highway expected to remain open to through traffic throughout the process.

7 TRAFFIC

7.1 Traffic Generation

The majority of traffic generated by the proposed development will be generated during the construction / installation phase associated with trade persons, facility staff and deliveries. During the future operational phase, the level of traffic generated will be significantly reduced due to the low employee intensity requirements of the facility. Notwithstanding an assessment of the anticipated traffic generated by the site during each phase of the project follows.

7.1.1 Typical Construction Phase

As noted in Section 4.2.3, a maximum of 40 staff will be on-site at any time during the typical construction phase. Due to the location of the site, carpooling will be necessary and can be managed by the operator and individual trades. A driver ratio of 1.5 staff per vehicle will be applied, equating to 27 private vehicles accessing the site each day (equivalent to 54 movements – 27 in, 27 out), and it will be assumed that all staff arrive and depart during a single peak hour.

During the typical construction phase, it is expected that the 30 heavy vehicle deliveries will occur at regular intervals throughout the day (equivalent to 60 movements – 30 in, 30 out). It is common for 10% of movements to occur during the peak periods, equating to 3 trucks arriving and departing (equivalent to 6 movements – 3 in, 3 out).

7.1.2 Peak Construction Phase

The peak construction phase is anticipated to accommodate a maximum of 120 construction staff on-site.

Due to the large volume of staff travelling to the site during the 6 month peak construction phase, it is expected that a higher proportion of staff will carpool to the site. For the purposes of analysis a driver ratio of 1/2 will be applied, and it will be assumed that all staff arrive and depart during a single peak hour. This equates to 60 vehicle movements during the AM and PM peak hours. It is noted that this is considered conservative as it is likely staff arrivals and departures will be spread across the morning and afternoon period depending on work flow and shifts.

It will again be assumed that 10% of the 75 heavy vehicle deliveries occur during the peak periods, equating to 8 trucks arriving and departing during the peak periods (equivalent to 16 movements – 8 in, 8 out).

7.1.3 Anticipated Daily Traffic Generation

Based on the above, the anticipated daily traffic generation of the proposed development is shown below. For clarity the traffic generation of the operational phases, as discussed in Section 4.3 has been included.

Table 4 Anticipated Daily Traffic Movements

Stage	*Light Vehicles*	*Heavy Vehicles*	*Total*
Typical Construction	27 vehicles = 54 movements	30 vehicles = 60 movements	**57 vehicles = 114 movements**
Peak Construction	60 vehicles = 120 movements	75 vehicles = 150 movements	**135 vehicles = 270 movements**
Typical Operation	2 vehicles = 4 movements	0	**2 vehicles = 4 movements**
Occasional Inspections	6 vehicles = 12 movements	2 vehicles = 4 movements	**8 vehicles = 16 movements**

As shown above, the peak period for traffic generation of the site is during the peak construction period, when the site is expected to generate 270 daily movements.

7.1.4 Peak Hour Traffic Generation

Based on the above, the following traffic generation is expected during the AM and PM peak periods.

Table 5 Anticipated Peak Hour Traffic Movements

Stage	*Light Vehicles*	*Heavy Vehicles*	*Total*
Typical Construction	27	6 (3 arrivals 3 departures)	33
Peak Construction	**60**	**16** (8 arrivals 8 departures)	**76**
Typical Operation	2	0	2
Occasional Inspections	6	2	8

As detailed above, during the peak period for construction the site is anticipated to generate a maximum of 76 vehicle movements during the AM and PM peak periods.

7.2 Traffic Distribution

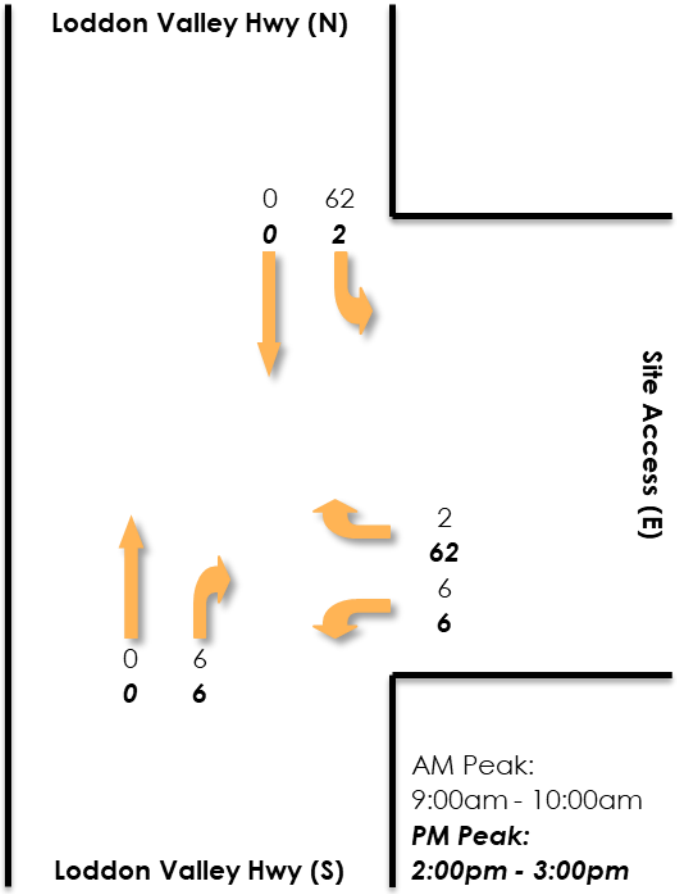
All traffic movements to and from the site will be distributed via the proposed primary access point to Loddon Valley Highway.

The site is approximately 7 km south of the town of Kerang, though is generally isolated from other major population centres, with the site being approximately an hour from the regional cities of Bendigo and Echuca, and three hours from Melbourne. It is therefore anticipated that temporary accommodation will be arranged in Kerang, and therefore all private vehicle movements will originate and depart to/from the north via Loddon Valley Highway. This equates to 60 arrivals from the north in the AM peak, and 60 departures towards the north during the PM peak.

As noted in Section 5.1, heavy vehicles are anticipated to originate and depart to/from the south and the north. For the purposes of analysis, it will be assumed that 75% of heavy vehicle trips will be to/from the south, with the remaining 25% to/from the north. This equates to 6 arrivals and 6 departures to/from the south during the AM and PM peaks, and 2 arrivals and 2 departures to/from the north during the AM and PM peaks.

Applying the above assumptions and combining both light and heavy vehicle movements yields the anticipated turning movements at the proposed site access, as shown in Figure 11.

Figure 11 Generated Traffic Volumes – Peak Construction Phase

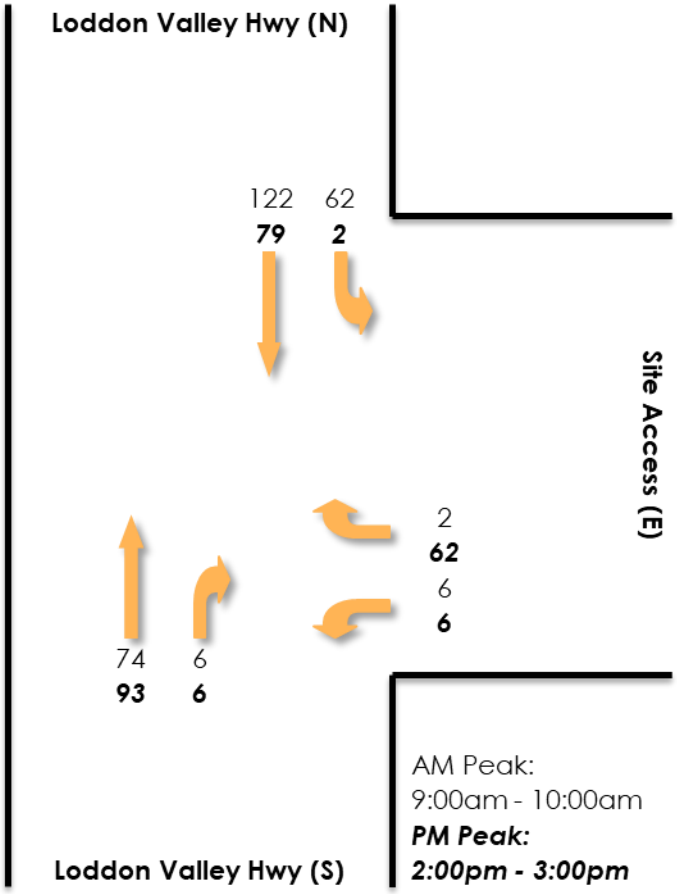


7.3 Resultant Traffic Volumes

Based on the above, the resultant future volumes at the site access are determined by superimposing the existing volumes (Table 2) with the anticipated development generated traffic (Figure 11).

The resultant peak hour traffic volumes during the peak construction period are shown in Figure 12.

Figure 12 Resultant Future Traffic Volumes – Peak Construction Phase



7.4 Traffic Impact

7.4.1 Peak Hours

During the peak construction phase of the proposed development, the anticipated traffic generation of the development is 76 vehicle movements during the peak periods. This is considered low in traffic engineering terms, and is equivalent to approximately one vehicle movement every minute. Even when focussed into one access point, the traffic volumes generated by the proposed development are low, and Loddon Valley Highway and the surrounding road network are expected to be able to accommodate the traffic generated by the proposed development.

In evaluating the suitability of the proposed access design along Loddon Valley Highway, reference is made to the *Austroads Guide for Road Design Part 4A: Unsignalised and Signalised Intersections* which outlines what physical form of turn treatment will provide an appropriate level of safety at priority controlled intersections, balanced with additional construction costs associated with higher level treatments.

Consequently, it is considered that the design process should initially decide whether a turn lane is actually required, and then, if it is decided that a turn lane is required, the Austroads Turn Lane Warrants may be used as guidance as to what turn lane design may be the most appropriate

A review of the warrants for Basic, Auxiliary and Channelised turn treatments has been undertaken for the intersection, based on the existing traffic volumes and the generated construction traffic volumes presented above.

Noting the temporary speed limit reduction proposed on Loddon Valley Highway, reducing the speed limit to 80 km/hr, the turn lane requirements are demonstrated in Figure 13.

The turn lane treatments referenced in Figure 13 are defined as follows:

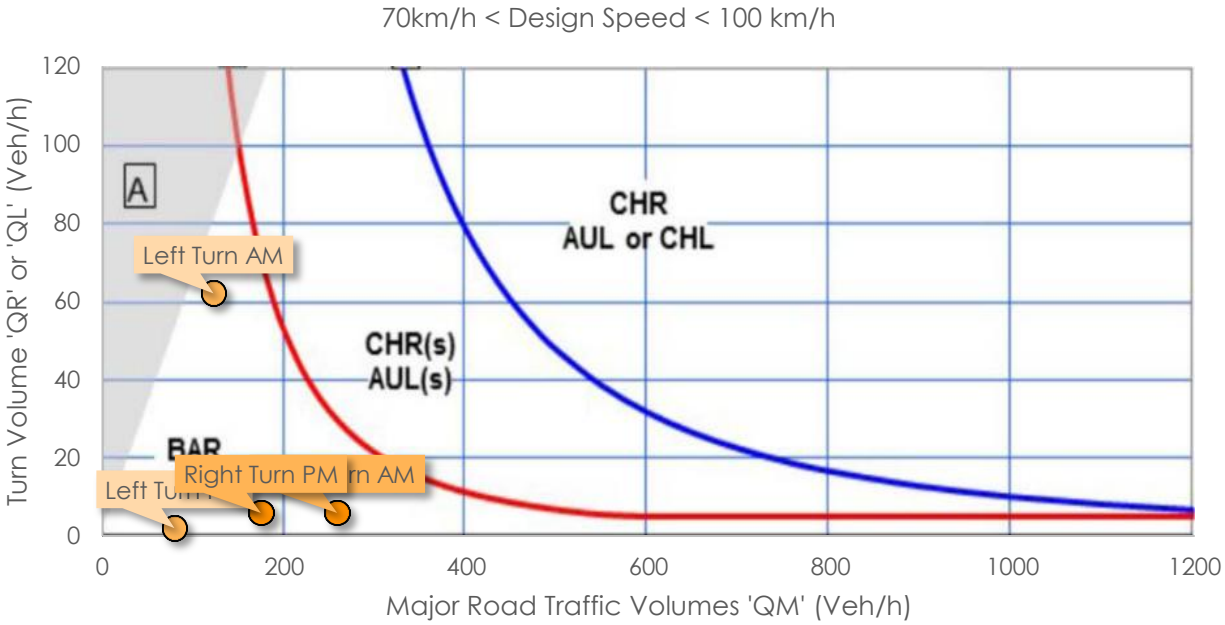
- BAR: Basic right turn treatment;
- CHR(s): Short channelised right turn treatment;
- CHR: Full-length channelised right turn treatment;
- BAL: Basic left turn treatment;
- AUL(s): Short auxiliary left turn treatment;
- AUL: Full-length auxiliary left turn treatment;
- CHL: Channelised left turn treatment.

The red curve represents the boundary between a BAR and a CHR(s) and between a BAL and an AUL(s).

The blue curve represents the boundary between a CHR(s) and a CHR, and between an AUL(s) and an AUL or CHL.

It should be noted that the warrants only apply to turning movements from the major road (the approach with priority). Turn treatments for the minor approach should be determined through an operational performance evaluation.

Figure 13 Austroads Turn Treatment Warrants – Peak Construction Phase



The figure above suggests that peak hour traffic volumes to and from the development would warrant provision of at most a basic right turn treatment (BAR) and basic left turn treatment (BAL) into the site.

It is noted that these warrants effectively balance the additional construction cost of higher-order treatments against the reduction in estimated crash costs. Commentary within the associated Austroads Guide to Traffic Management Part 6 does however note that these warrants are based on the construction of intersections on **new** roads (i.e., greenfield sites), and are not strictly applicable for the construction of new intersections on existing roads, where construction costs of these treatments may be higher due to the presence of existing infrastructure or other site constraints.

Furthermore, it is noted that the warrants do not allow any consideration of the duration of traffic impacts, instead assuming that traffic volumes continue in perpetuity. In the case of the proposed BESS, the access will only be trafficked for an 18-month period, after which the use will be operational and volumes generated through the access will effectively cease, leaving any upgrades disused.

Having regard to the above, the number of turning vehicles is expected to be relatively low during the peak hours, with 6 right turning and 62 left turning movements projected at peak construction. Traffic generation to the site is expected to consist primarily of light vehicles during these periods and only during the relatively short (6 months) peak construction period.

The diagrams above show that the generated turning volumes and the observed through traffic volumes are low and the operation of the intersection is not expected to be compromised under this scenario.

It is therefore found that right and left turn lanes are not required to be provided at the proposed site access, with the existing Loddon Valley Highway carriageway considered appropriate to cater for traffic generated by the proposed development.

Nevertheless, separate to the alignment of the site access, it is recommended to implement advanced warning signage along Loddon Valley Highway on the approaches to the proposed site access during the construction period to assist with vehicle access. The full set of recommendations informing the construction traffic management strategy for the proposed development are provided in Section 8 below.

7.4.2 Daily Traffic Volumes

When reviewing the future daily traffic volumes along Loddon Valley Highway, reference is made to Austroads Guide to Road Design Part 3: Geometric Design. The desired rural lane widths are reproduced below.

Figure 14 Austroads Single Carriageway rural road widths

Element	Design AADT				
	1–150	150–500	500–1000	1000–3000	> 3000
Traffic lanes[1]	3.7 (1 x 3.7)	6.2 (2 x 3.1)	6.2–7.0 (2 x 3.1/3.5)	7.0 (2 x 3.5)	7.0 (2 x 3.5)
Total shoulder	2.5	1.5	1.5	2.0	2.5
Minimum shoulder seal [2],[3],[4],[5],[6]	0	0.5	0.5	1.0	1.5
Total carriageway	8.7	9.2	9.2–10.0	11.0	12.0

1 *Traffic lane widths include centrelines but are exclusive of edge-lines.*
2 *Where significant numbers of cyclists use the roadway, consideration should be given to fully sealing the shoulders. Suggest use of a maximum size 10 mm seal within a 20 km radius of towns.*
3 *Wider shoulder seals may be appropriate depending on requirements for maintenance costs, soil and climatic conditions or to accommodate the tracked width requirements for Large Combination Vehicles.*
4 *Short lengths of wider shoulder seal or lay-bys to be provided at suitable locations to provide for discretionary stops.*
5 *Full width shoulder seals may be appropriate adjacent to safety barriers and on the high side of superelevation.*
6 *A minimum 7.0 m seal should be provided on designated heavy vehicle routes (or where the AADT contains more than 15% heavy vehicles).*

The proposed development is expected to generate a maximum of 270 vehicle movements per day during the peak construction period. When superimposing existing traffic and peak construction traffic, Loddon Valley Highway is expected to carry approximately 2,500 vehicles per day. Accordingly, it should provide a minimum sealed width of 9 metres, comprising two 3.5-metre-wide traffic lanes and 1-metre-wide sealed shoulders on each side. Loddon Valley Highway provides an approximately 8.5 to 9 m wide seal, with grassy shoulders and therefore is considered appropriate to cater for the traffic volumes generated by the proposed development.

Notwithstanding, it is recommended that the pavement be monitored by the proponent to identify any maintenance requirements during or following the construction phase. This process may be supported through the preparation of a pre-construction condition report and a post-construction dilapidation report, undertaken by a suitably qualified professional.

8 TRAFFIC MANAGEMENT PLAN

8.1 General

As demonstrated in the above assessment, the proposed development is not anticipated to have an adverse impact on the operation of the surrounding road network, and has been designed to allow for appropriate vehicle access to the site.

Regardless, it is expected that a detailed Construction Traffic Management Plan (CTMP) will be prepared for all stages of the construction period, to be submitted by the construction contractor as part of the overall Construction Management Plan.

Broadly, the CTMP should include the following information:

- Detailed construction timeframes and phases;
- Number of construction vehicles and personnel on-site per day;
- Construction vehicle ingress and egress routes;
- Swept paths at pinch points along the entirety of the construction access route;
- Proposed construction traffic management measures (see below) for all relevant stages and scenarios, and including site hoarding, construction loading areas and traffic management equipment and signage; and
- A Worksite Hazards Assessment.

8.2 Traffic Management Recommendations

In accordance with the assessments included within this report, and based on **one**mile**grid**'s experience it is recommended that the CTMP considers the following traffic management measures:

- Temporary speed limit reduction along Loddon Valley Highway in the vicinity of the site, recommended speed limit: 80 km/hr (to be finalised in consultation with DTP);
- Radio communications between construction vehicles at all times;
- All movements by OSOM vehicles to be controlled via Traffic controllers; and
- Truck warning signage to be installed on Loddon Valley Highway in the vicinity of the site.

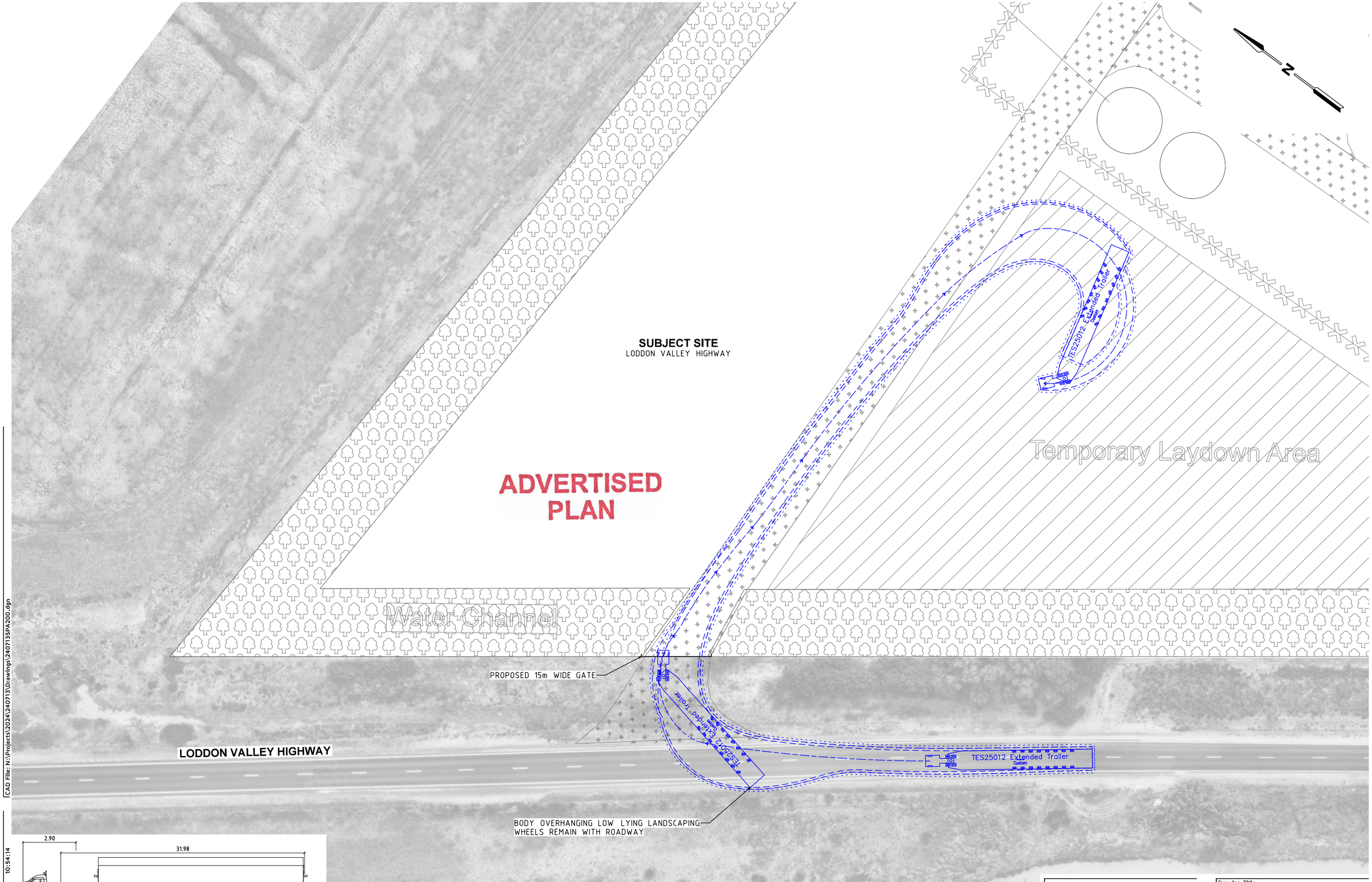
It should be noted the above is not intended to be exhaustive, and the final CTMP should comply with Austroads Guide to Temporary Traffic Management (AGTTM) and other relevant guidelines, and be prepared in consultation with Gannawarra Shire Council, Department of Transport and Planning (DTP), and other relevant stakeholders.

9 CONCLUSIONS

Based on the foregoing assessment, it is concluded as follows: -

- It is proposed to use the site in Tragowel for the purposes of a BESS;
- Based on the NHVR OSOM network, the recommended route for OSOM deliveries to bypass west of Bendigo is via Loddon Valley Highway, Bridgewater-Serpentine Road and Calder Highway/ Freeway;
- The proposed OSOM vehicle exceeds the dimensions detailed within the vehicle register and further coordination and permits will be required with NHVR during the detailed design phase;
- During the construction phase, the proposed BESS will create short-term, elevated levels of vehicle movements, though the level of traffic generated is expected to have a minimal impact on the operation of the external road network;
- During operation the site is expected to have a negligible impact on the surrounding road network;
- It is recommended that a temporary speed limit reduction and warning signage are implemented along Loddon Valley Highway as part of the construction traffic management plan;
- Car parking will be provided on-site as required; and
- Based on the foregoing analysis, the site is deemed appropriate to be developed for the purposes of a BESS.

Appendix A Swept Path Diagrams



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TES25012 Extended Trailer 36.95m Long

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Trailer Width	: 4.20	Steering Angle	: 19.6
First Unit Track	: 2.50	Articulating Angle	: 60.0
Trailer Track	: 4.620		

SWEPT PATH LEGEND

- — — — — DESIGN VEHICLE SWEPT PATHS SHOWN DASHED
- - - - - - - - - 500mm CLEARANCE ENVELOPE SHOWN DOTTED

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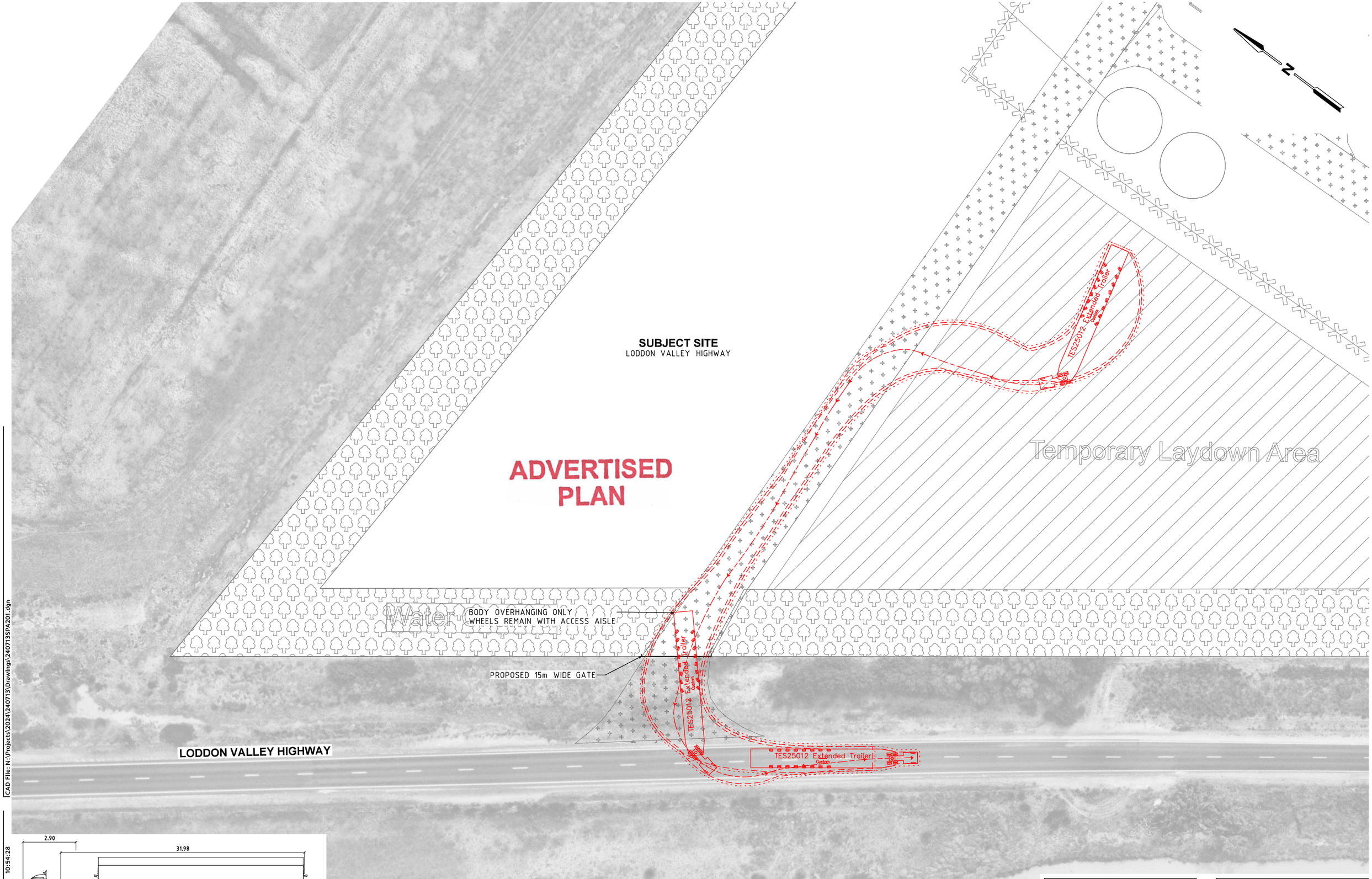
onemilegrid
Wurundjeri Woiwurung Country
56 Down Street, Collingwood, VIC 3066
Email:info@onemilegrid.com.au Web:www.onemilegrid.com.au
Phone (03) 9939 8250

Scale 1:750 @ A3 (0 3.75 7.5 15)

Drawing Title
LODDON VALLEY HIGHWAY, TRAGOWEL
VEHICLE SITE ACCESS AND CIRCULATION
SWEPT PATH ANALYSIS

Designed	Approved	Melway Ref
DA	VG	X921 C4

Project Number	Drawing Number	Revision
240713	SPA200	A



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SWEPT PATH ANALYSIS

Designed	Approved	Melway Ref
DA	VG	X921 C4

Project Number	Drawing Number	Revision
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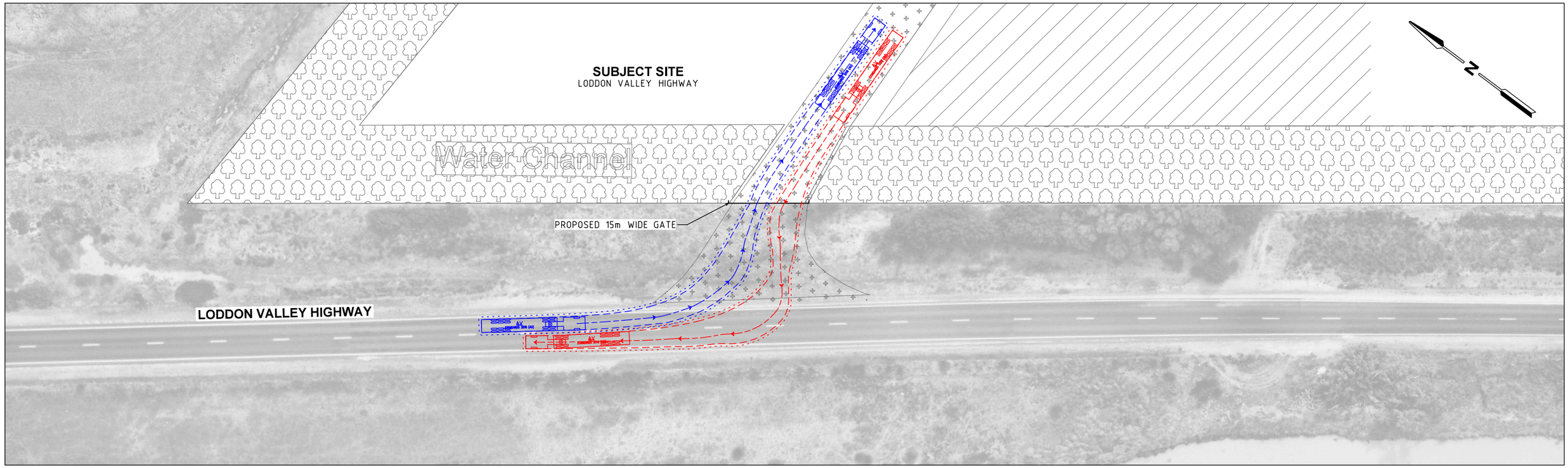

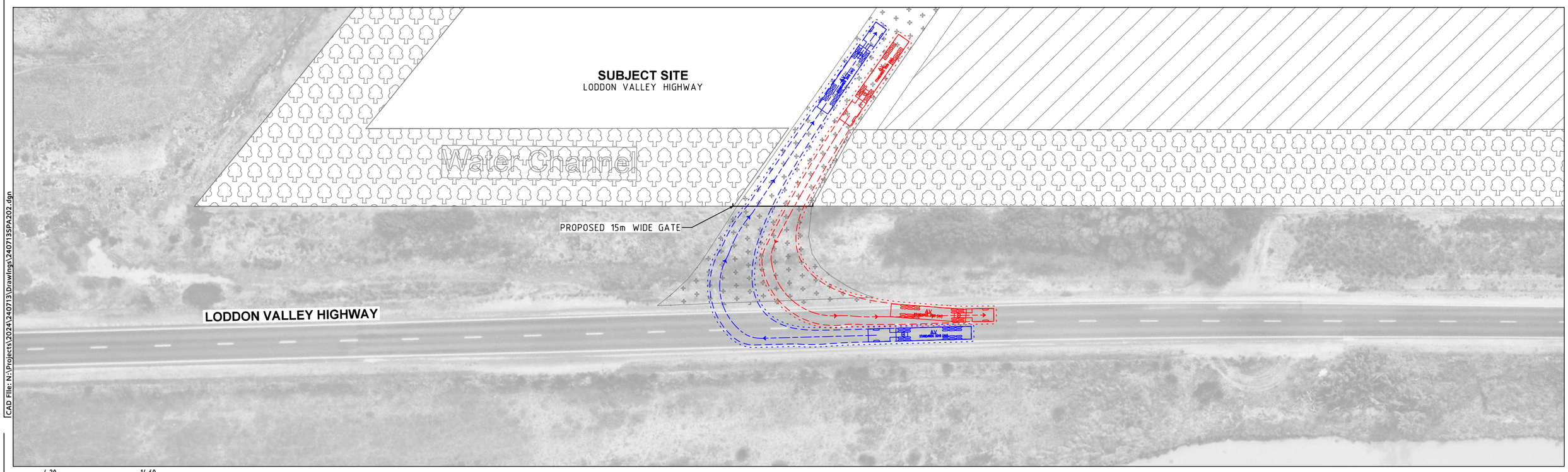

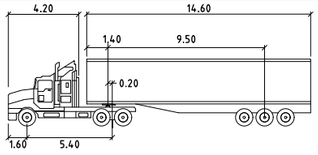

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Tractor Track	: 2.50	Articulating Angle	: 72.0
Trailer Track	: 2.50		

SWEPT PATH LEGEND

- — — — — DESIGN VEHICLE SWEPT PATHS SHOWN DASHED
- - - - - - - - - 500mm CLEARANCE ENVELOPE SHOWN DOTTED

ADVERTISED PLAN

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DA	VG	X921 C4

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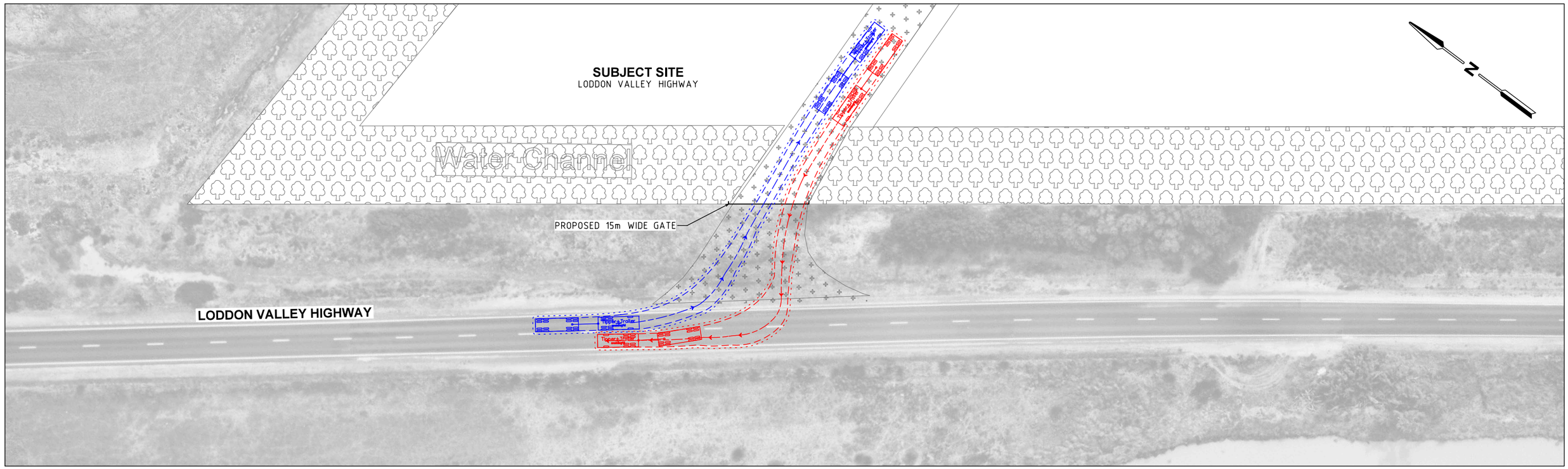

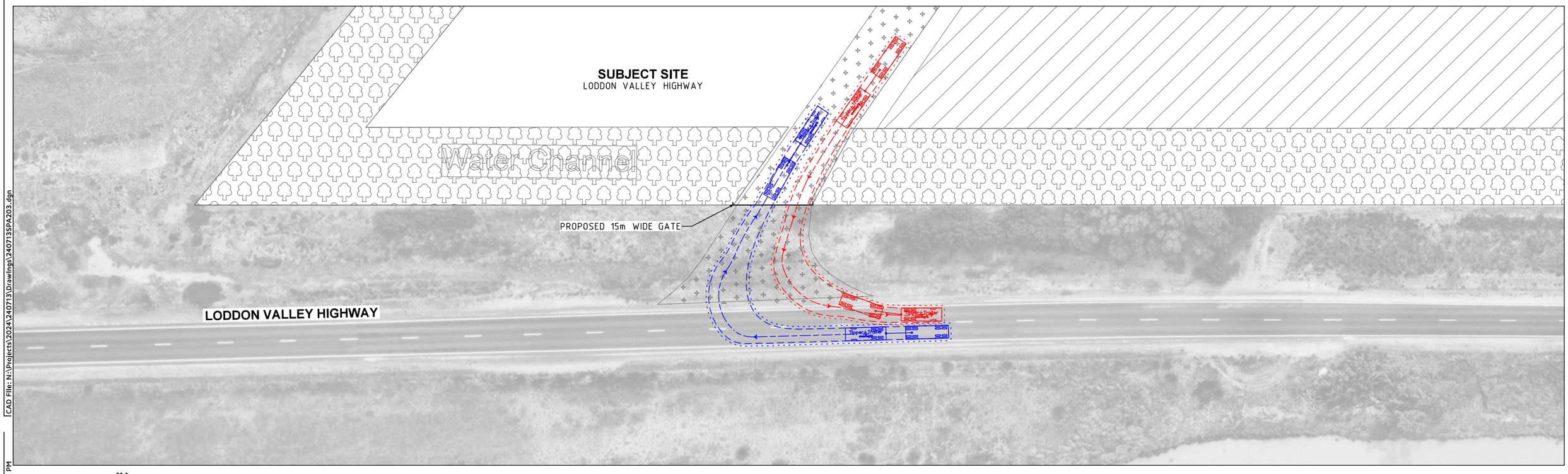

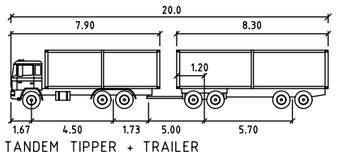

TANDEM TIPPER + TRAILER

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Trailer Width	: 2.50	Steering Angle	: 30.0
First Unit Track	: 2.50	Articulating Angle	: 70.0
Trailer Track	: 2.50		

SWEPT PATH LEGEND

- — — — DESIGN VEHICLE SWEPT PATHS SHOWN DASHED
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