Stockyard Hill Wind Farm Pty Ltd

Stockyard Hill Wind Farm

Traffic impact assessment to accompany an application to amend Planning Permit no. PL-SP/05/0548

April 2016

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Executive summary

Stockyard Hill Wind Farm Pty Ltd (SHWFPL) (a subsidiary of Origin Energy) is developing a wind farm project in south-west Victoria, known as the Stockyard Hill Wind Farm (SHWF).

Planning Permit No. PL-SP/05/0548 (Pyrenees Planning Scheme) (the Permit) was issued by the Minister for Planning in October 2010 to enable the use and development of the SHWF Wind Energy Facility (WEF).

SHWFPL has now decided to progress the preparation of an application to amend the Permit to seek approval for taller turbines to achieve more efficient generation of energy. Additionally, as a result of the proposed taller turbines and to ensure the Permit reflects current standards, guidelines and departments, there are a number of other amendments proposed as part of the application.

This document has been prepared for the purpose of accompanying an application to amend the Permit, and inform a self-assessment (and referral, if deemed required) under the Environment Effects Act 1978.

This document provides an assessment of the overall traffic impact of the proposed amended WEF, whilst also describing the resulting change in potential impact from the permitted WEF.

Approach

In broad terms the approach that has been taken is as follows:

- Review legislation, standards, policy documents and guidelines to determine any changes since the original planning permit was issued.
- Calculate the amount of traffic generated by the currently permitted development.
- Calculate the amount of traffic generated by three potential development scenarios.
- Assign the traffic generated in each scenario to the road network.
- Assess the impacts of the assigned traffic in each scenario at a number of locations against published capacity thresholds.

Reference documents

A number of documents have been referred to in the preparation of this assessment. These are generally the Austroads guidelines for traffic impact assessments and the VicRoads Guidelines for Assessing Wind Farms, Major Energy Projects and Associated Traffic Management Plans. Other publications have been referred to, but not used in the development of this report.

Assessment findings

On an average workday, the construction phase of the proposed WEF is expected to generate no more than 102 one-way trips in the peak hour periods (80 light vehicles and 22 heavy vehicles). This occurs in the permitted without quarry scenario.

From a network and intersection capacity perspective, the impact of WEF construction traffic under any scenario is not expected to warrant any upgrades to road infrastructure, although some measures are expected to be necessary to accommodate the swept paths of specific vehicle types, or to protect the physical condition of road infrastructure. Such measures are expected to be primarily confined to Council roads, plus the four access intersections on Skipton Road. This will be dealt with separately in a traffic management plan.

Anticipated change (Permitted without quarry vs. Amended without quarry)

Over the construction phase of the WEF, the amended WEF scenario is expected to generate marginally less over-dimensional and heavy vehicle traffic when compared to the permitted WEF scenario (7% reduction in over dimensional, 4% reduction in other heavy vehicles).

Effect of the provision of an on-site quarry

The provision of an on-site quarry decreases the total number of heavy vehicle trips on the surrounding network over the course of an average workday by approximately 70 vehicles under both the amended and permitted scenarios.

Conclusion and recommendations

The overall conclusion of this report is that the amended scenario has a positive traffic impact compared to the permitted scenario. The addition of an on-site quarry has a similarly positive impact.

The traffic impacts that have been identified can be adequately addressed in a traffic management plan.

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1. Introduction

1.1 Project background

Stockyard Hill Wind Farm Pty Ltd (SHWFPL) (a subsidiary of Origin Energy) is developing a wind farm project in south-west Victoria, known as the Stockyard Hill Wind Farm (SHWF).

The project has three components - a Wind Energy Facility (WEF), a grid connection (approximately 75km of overhead powerlines and terminal station) and a quarry. This document relates to the WEF component of the project.

Planning Permit No. PL-SP/05/0548 (Pyrenees Planning Scheme) (the Permit) was issued by the Minister for Planning on 26 October 2010 to enable the use and development of the SHWF WEF.

SHWFPL has now decided to progress the preparation of an application to amend the Permit under Section 97I of the *Planning and Environment Act 1987*.

The primary driver for the amendment application is to seek approval for taller turbines to achieve more efficient generation of energy. However, as a result of the proposed taller turbines and to ensure the Permit reflects current standards, guidelines and departments, there are a number of other amendments proposed as part of the application. The proposed amendments to the Permit are discussed in Section 2 of this document.

1.2 Purpose of this report

This document has been prepared to accompany an application to amend the Permit and to inform a self-assessment (and referral, if deemed required) under the Environmental Effects Act 1978 (EE Act), including the assessment of:

- The amount of traffic generated by the permitted WEF (under two scenarios – with and without the use of an on-site quarry);
- The amount of traffic generated by the proposed amended WEF (under two scenarios – with and without the use of an on-site quarry); and
- The impact this traffic will have on the surrounding road network.

This document provides an assessment of the overall traffic impact of the proposed amended WEF, while describing the resulting change in potential traffic impact from the permitted WEF.

1.3 Assumptions

This assessment has necessarily relied on a number of assumptions, which are key to some of the results obtained. The assumptions are as follows:

- The quantity of materials and number of personnel are as shown in Table 5 and Section 4.1.2 respectively.
- Trips will be distributed to the road network as described in Section 4.3.1.
- In scenarios with an on-site quarry, a fleet of seven vehicles will service the quarry. These will be based on-site and will remain on-site overnight (i.e. they will not commute to and from the site each day).
- In the absence of hourly traffic volume data it has been assumed that peak hourly volumes are equal to 10% of the daily volumes.
- Background traffic growth on the road network is 2% per annum.

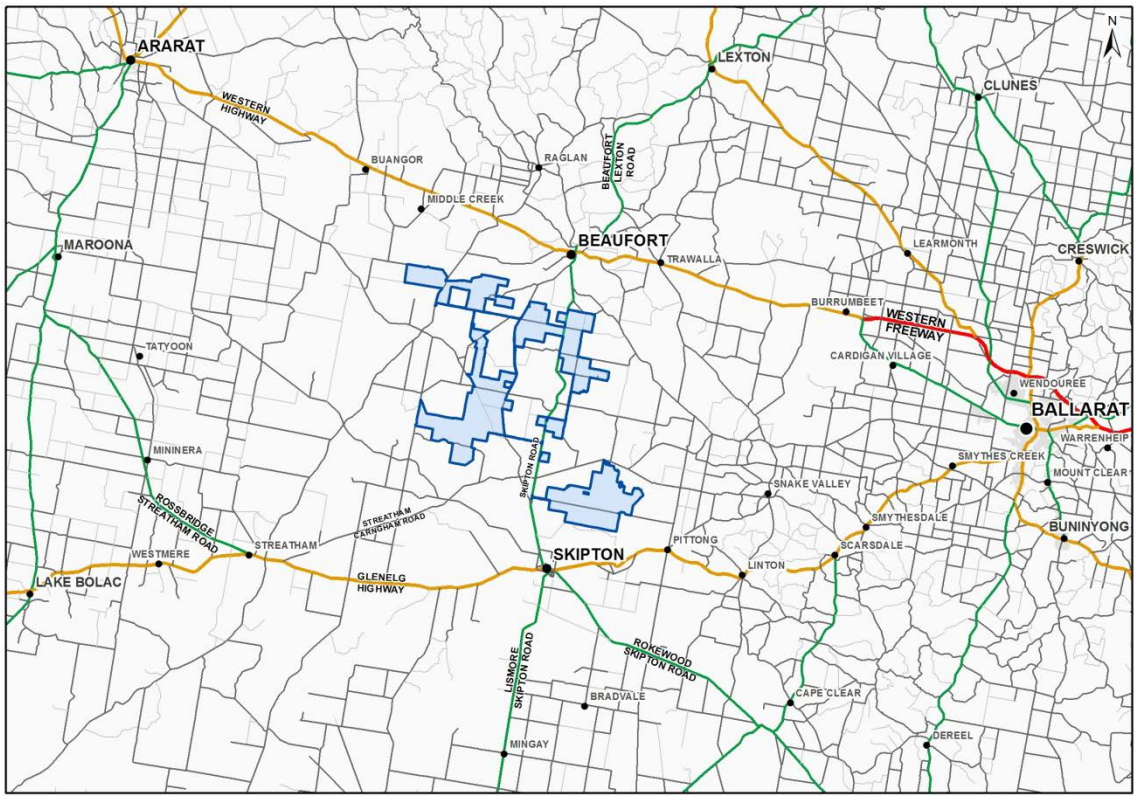
- In the absence of turning movement data at the intersections along Skipton Road to be used by construction traffic, it has been assumed that volumes on Skipton Road are through volumes only (this is based on on-site observations which indicate that volumes on the side roads accessing Skipton Road are extremely low).
- Water used in the manufacture of concrete and for dust suppression will be sourced from on-site bores.

2. The Project

2.1 WEF site

The WEF site is located in the Pyrenees Shire Council, approximately 150 km west, north-west of Melbourne and approximately 35 km west of Ballarat (see Figure 1).

Figure 1 – WEF site location[1]



The closest townships to the WEF site include Beaufort (approximately 4.5 km north of the site) and Skipton (approximately 4 km south of the site).

The site area for the amended WEF is approximately 155.3 km^2 (approximately 45.8 km^2 less than the permitted WEF) and is generally bound by Eurambeen-Streatham Road and Beaufort-Carranballac Road to the west, Stockyard Hill Road and Mt Emu Settlement Road in the south, Mount Emu Creek in the east and Ballrogan Road, Long Gully Road and Dalgleishs Road in the north. This area is referred to in this report as 'the WEF site'. Skipton Road bisects the WEF site.

2.2 Existing conditions

2.2.1 Site accesses

The WEF will be accessible via four intersections on Skipton Road. From south to north:

- Skipton Road / Mount Emu Settlement Road;
- Skipton Road / Dunnets Road;
- Skipton Road / Dooleys Road; and

[1] Figure provided by SHWFPL

- Skipton Road / Thompsons Road

Inter-site traffic for the amended WEF will also use the following roads:

- Skipton Road;
- Stockyard Hill Road;
- Mt Emu Settlement Road;
- Dunnets Road;
- Thompsons Road; and
- Toppers Road.

Sight distance requirements

Austroads' Guide to Road Design Part 3: Geometric Design and *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* specify that sight distances should comply with a number of requirements:

- Stopping sight distance (SSD);
- Safe intersection sight distance (SISD);
- Approach sight distance (ASD); and
- Minimum gap sight distance (MGSD).

The access intersections on Skipton Road are located in areas generally free of significant grades, bends or obstacles which might impair drivers' sight lines. Based on a design speed of 110 km/h and a reaction time of 2.5 seconds, Austroads provides the minimum values for SSD, SISD, ASD and MGSD as recorded in Table 1.

Table 1 also lists the available distance of each type at each of the four access intersections, as recorded by GHD staff during a site visit on 9 December 2015.

Table 1 – Available site distance at site access intersections

Location	SSD	SISD	ASD	MGSD
Minimum criteria	241 m (Part 3, Table 5.5)	300 m (Part 4A, Table 3.2)	209 m (Part 4A, Table 3.1)	153 m (Part 4A, Tables 3.4 and 3.5)
Mount Emu Settlement Road	>300 m	>300 m	>300 m	>300 m
Dunnets Road	>300 m	>300 m	>300 m	>300 m
Dooleys Road	>300 m	>300 m	>300 m	>300 m
Thompsons Road	>200 m	>200 m	>300 m	>200 m

Sight distance is ample in all locations with the exception of the southern leg of the Thompsons Road intersection. This approach should be assessed in more detail to determine whether amelioration of some kind (temporary warning signage or speed limit reduction) will be necessary during construction.

2.2.2 Surrounding road network

Appendix A contains a layout of the WEF site showing the permitted WEF and the surrounding road network.

Skipton Road runs north-south between Beaufort and Skipton on the east side of Lake Goldsmith and bisects the WEF area. It is a VicRoads road and is classified as Arterial – Other. Skipton Road is a two-lane two-way sealed road with a typical speed limit of 100 km/h. No

significant bends or grades have been identified along these roads that would cause difficulties for the transport of the proposed wind farm equipment during construction.

Skipton Road is bounded in the north by a signalised intersection with the Western Highway (A8) at Beaufort, and in the south by an unsignalised T-intersection with the Glenelg Highway (B160) at Skipton.

Glenelg Highway runs generally east-west between Hamilton and Ballarat. It is a VicRoads road and is classified as Arterial – Highway. In the vicinity of Skipton it is a two-lane, two-way road.

Western Highway runs generally east-west between Ballarat and the South Australian border. It is a VicRoads road and is classified as Arterial – Highway. Between Ballarat and Trawalla the road has a four-lane cross-section, but west of Trawalla (including through Beaufort and the study area) the road has a two-lane cross-section.

Stockyard Hill Road also runs north-south between Beaufort and Skipton, but on the west side of Lake Goldsmith. It is a local road under the management of Pyrenees Shire Council. The road intersects with Skipton Road just south of Beaufort and just south of Mount Emu Settlement Road. It therefore does not provide a completely alternate route to Skipton Road between Skipton and Beaufort. It is an unsealed two-lane, two-way road with a carriageway width of approximately 5.0 m.

Mt Emu Settlement Road runs east-west between Skipton Road and Chepstowe-Pittong Road. It is a single track sealed road under the management of Pyrenees Shire Council.

Dunnets Road runs east-west between Stockyard Hill Road and Skipton Road. It is a single track unsealed road under the management of Pyrenees Shire Council. While technically a public road, it appears to have very little use as the road surface is overgrown with grass and there is a gate (unlocked) across the road close to the intersection with Skipton Road.

Thompsons Road runs east-west between Stockyard Hill Road and Skipton Road. It is a single track unsealed road under the management of Pyrenees Shire Council.

Toppers Lane runs east-west Eurambeen-Streatham Road and Stockyard Hill Road. It is a single track unsealed road under the management of Pyrenees Shire Council.

Stockyard Hill Road, Mt Emu Settlement Road, Dunnets Road, Thompsons Road and Toppers Lane are currently not suitable for heavy construction vehicles. These roads would need to be upgraded (widened and sealed) prior to construction commencing. This would be addressed in a traffic management plan.

Table 2 contains annual average daily traffic (AADT) counts sourced from the VicRoads Open Data website, at locations around the WEF area.

Table 2 – AADT on surrounding road network

Location	2015 AADT (CV[2])
Skipton Road (btw. Glenelg Highway & Western Highway)	890 (350)
Glenelg Highway (east of Skipton Road)	1,900 (410)
Glenelg Highway (west of Skipton Road)	1,600 (350)
Western Highway (in the vicinity of Skipton Road)	7,900 (1,620)
Local roads including Stockyard Hill Road[3]	n/a (local road)

[2] CV = commercial vehicles (i.e. trucks)
[3] Attempts have been made to obtain traffic data from Pyrenees Shire Council

2.3 Permitted WEF

The Permit was issued by the Minister for Planning in October 2010 to enable the use and development of the SHWF WEF, subject to 48 conditions. In summary, the Permit allows for:

- Up to 157 turbines (with a maximum tower height of 80 m, blade length of 52 m and tip height of 132 m);
- Underground electrical reticulation network;
- Access track network;
- Up to five electricity substations;
- 132 kV overhead powerlines;
- A maintenance facility;
- Three temporary staging areas allowing for three temporary concrete batching plants;
- Up to eight anemometers (monitoring masts);
- Removal of native vegetation; and
- Car parking and bicycle facilities.

The permitted layout is shown on the map contained in Appendix A[4], whilst the Permit conditions (including the preparation of a Traffic Management Plan), as relevant to traffic impacts are outlined in the Appendix B.

2.4 Amended WEF

The amendment is proposed to enable physical changes to the WEF and amendments to the permit conditions.

Non-physical changes proposed include amendments to the Permit conditions as a result of the proposed physical changes and/or administrative improvements (departmental name changes, changes to guidelines etc.). The proposed changes to the Permit conditions, as relevant to traffic impacts, are outlined in Appendix B.

The 'physical' amendments proposed to be undertaken to the permitted WEF are described in Table 3 and shown on the map contained in Appendix C.

The layout of the amended WEF, shown in Appendix C, also includes the revised road network to be used by construction traffic. When compared to the roads to be used by the permitted WEF, shown in Appendix A, it is clear that the amended WEF affects a much smaller network of public roads and hence has a smaller footprint of impacts.

[4] For the purposes of this assessment, the permitted layout is considered to be the layout shown on the indicative layout plan referenced within condition 1 of PL-SP/05/0548 (*Map No. WF 02C; Rev. 01; dated 23/05/2010*), but modified to show the deletion of turbines, removal of other infrastructure associated with the deleted turbines and resiting of turbines as required by condition 1(a), (b) and (c).

Table 3 – Summary of proposed 'physical' amendments to the SHWF WEF

Proposed amendments		Reason for amendment
Turbine dimensions	The turbine envelope proposed includes: • overall maximum tip height must not exceed 180 m above natural ground level; • hub-height of no greater than 120 m above natural ground level; and • rotor diameter no greater than 140 m.	• To allow for taller turbines to achieve more efficient generation of energy.
Layout	*Turbine locations* • Ultimate design for up to 149 wind turbine locations, consisting of the following changes: – Relocation of three turbines onto three new titles within the centre of the WEF site (adjoining existing permitted address of lands). – Addition of four new turbine locations within the existing permit address of lands. – Deletion of 12 turbine locations. • Movement of most turbine positions, but generally limiting movement to 250m from the original permitted layout. *Civil and electrical infrastructure* • Optimisation and relocation of the associated civil and electrical infrastructure within the WEF area.	• In response to the spacing required for larger turbines. • To ensure compliance with shadow flicker and noise conditions of PL-SP/05/0548.
WEF boundary	Deletion and addition of land parcels in the Address of Lands.	• Re-design / optimisation process. • Relocation of three turbines onto land currently not included in the Address of Lands.

3. Approach

This assessment has been prepared to support an application to amend Planning Permit No. PL-SP/05/0548, and to inform a self-assessment (and referral, if deemed required) under the EE Act. It provides an assessment of the overall impact of the WEF proposal, while describing the resulting change in impact from the permitted WEF to the amended WEF.

The methodology and scope of works for the traffic assessment is as follows:

- Review the existing conditions of roads to be used by construction traffic;
- Determine the amount of traffic the permitted WEF will generate. This will set the benchmark for the assessment, as the intention is to understand the difference between the permitted and amended scenarios. This is discussed in Section 4;
- Determine the amount of traffic generated by the proposed amended WEF under three scenarios (permitted WEF with on-site quarry, amended WEF without on-site quarry and amended WEF with on-site quarry). These will be compared to the permitted WEF (without on-site quarry) to determine the relative amount of impact in each scenario. This is discussed in Section 4;
- Assign the generated traffic to the road network in each scenario according to the origin and destination of construction vehicles and knowledge of the intended haul routes. This is discussed in Section 4;
- Visit the site and surrounding area, including proposed haul routes within the study area only, to assess the impacts of the generated traffic and to take measurements such as site distance; and
- Determine the impacts to the road network in each scenario (qualitative assessment) and thus the changes relative to the permitted WEF.
- Recommend road upgrades to mitigate or offset the identified impacts.

4. Traffic impact assessment

4.1 Transport requirements

This section details the transport requirements for personnel and materials during the construction phase of the SHWF WEF. Although there will be traffic generated throughout the operational life of the WEF, the construction phase is expected to involve the highest intensity of vehicle movements, and as such, is the focus of this analysis.

Two versions of the WEF are to be considered: “permitted” and “amended”. A brief comparison of differing features with relevance to the transport task is presented in Table 4.

Table 4 - Transport relevant comparison of permitted WEF and amended WEF

Component	Permitted	Amended	Secondary effects
Number of Wind Turbine Generators (WTGs)	157	149	Size of WTGs will affect foundations and hardstands.
Number of substations/switch yards	5	4	
Total length of underground cable	142.2 km	138.3 km	
Total length of overhead cable	41.8 km	10.7 km	Length of overhead cable will determine how many supporting poles are required.
Total length of access tracks	116.2 km	110.0 km	

4.1.1 Materials

Table 5 contains a summary of material movement required by each element of permanent infrastructure on site. Quantities for both the amended WEF and permitted WEF have been included. The expected origin of each material (internal or external) is also shown, and will be used later to appropriately distribute trips.

Table 5 - Construction materials and delivery methods

Material	Quantity (Permitted)	Quantity (Amended)	Vehicle Type	Origin
WTG Structures and Access				
Foundation concrete (mixed)	91,987 m³	97,000 m³	Concrete agitator	Batch plants on site
Foundation concrete materials (sand/aggregate/cement)^	1,707 B-Double loads*	1,800 B-Double loads*	B-Double	Glenelg Highway
Foundation steel	4,599 t	4,850 t	Semi- trailer	Glenelg Highway
Tower sections	471	447	OD trailer	Portland
Nacelles	157	149	OD trailer	Portland
Hubs	157	149	OD trailer	Portland
Blades	471	447	OD trailer	Portland
Transformers	157	149	OD trailer	Portland
Access track & Hardstand gravel	960,291 t	920,000 t	Truck & trailer	Glenelg Highway, on-site quarry
Water for dust suppression	33,000 kL	33,000 kL	Rigid truck	Water source on site
Public Road Upgrade				
Gravel	271,000 t	271,000 t	Truck & trailer	Glenelg Highway
Catcon 150 B-Doubles	150 B-Double loads*	150 B-Double loads*	B-Double	Glenelg Highway
Water for dust suppression	3,500 kL	3,500 kL	Rigid truck	Water source on site

Material	Quantity (Permitted)	Quantity (Amended)	Vehicle Type	Origin
Electrical Network				
Underground cable	178 spindles	173 spindles	OD trailer	Glenelg Highway
Overhead cable	52 spindles	13 spindles	OD trailer	Glenelg Highway
Overhead power pole sections	835 t	214 t	Semi- trailer	Glenelg Highway
Temporary access track gravel	153,587	149,375	Rigid truck	Glenelg Highway, on-site quarry
Power pole footing concrete (mixed)	18,685 t	4,782 t	Concrete agitator	Glenelg Highway
Power pole footing concrete materials (sand/aggregate/cement)	347 B-Double loads*	89 B-Double loads*	B-Double	Glenelg Highway
Power pole footing steel	934	239	Semi- trailer	Glenelg Highway
Substation foundation concrete (mixed)	10,775 t	8,031 t	Concrete agitator	Batch plants on site
Substation foundation concrete materials (sand/aggregate/cement)	200 B-Double loads*	149 B-Double loads*	B-Double	Glenelg Highway
Substation foundation steel	539 t	402 t	Semi- trailer	Glenelg Highway
33/132 kV transformers	5	3	OD trailer	Glenelg Highway
Balance of substation equipment	3,711 t	2,853 t	Semi- trailer	Glenelg Highway

^ Water for concrete will be sourced from on-site bores

* Quantities not explicitly stated in estimates.

4.1.2 Personnel

For either scenario, it is expected that approximately 80 return trips per day will be needed to transport the construction workforce to and from the site.

Over the 780 day construction period, this represents a total demand of 62,400 two way trips.

4.2 Trip generation

4.2.1 External trips

Based on the information in Section 4.1, Table 6 contains a summary of vehicle movements to and from the WEF site, aggregated by vehicle type and origin.

A number of trips will be confined to the WEF site, namely trips made by concrete agitators from on-site batch plants, and trips made by water trucks from on-site water sources. These vehicles will be stored on site overnight and will not register a significant impact on the broader road network under typical operation (a small number of trips off site may still be required for maintenance and/or repairs).

Table 6 - Trip generation by vehicle type

Vehicle Type	Two way trips (Permitted)	Two way trips (Amended)	Origin	Comments
Concrete agitator	Sourced on-site (not counted in calculations)		Batch plants on site	Foundation/footings
B-Double	2,405	2,189	Glenelg Highway	Concrete supplies
Semi- trailer	672	408	Glenelg Highway	Reinforcement, OH power poles & SS equipment
OD trailer	1,413	1,341	Portland	WTG parts
OD trailer	236	190	Glenelg Highway	Transformers & cable spindles
Rigid truck (12 kL water)	Sourced on-site (not counted in calculations)		Water sources on site	Water for dust suppression
Rigid truck (12 t)	12,799	12,448	Glenelg Highway	Temp. access track gravel
Truck and trailer	43,976	42,537	Glenelg Highway	Access track, hardstands & public road upgrade
Light vehicle	62,400	62,400	Western Highway / Glenelg Highway	Workforce
Total public road trips (OD trailers*)	**1,649**	**1,531**		**Reduction in 118 public road trips (OD trailers)**
Total public road trips (heavy vehicles)	**59,852**	**57,582**		**Reduction in 2270 public road trips (heavy vehicles)**
Total public road trips (light vehicles)	**62,400**	**62,400**		**No change in light vehicle trips**

* OD = over-dimensional

4.2.2 Internal (or inter-site) trips

The concrete batching plant and the on-site quarry will generate additional trips when material is distributed to the relevant locations. These trips will be confined to Skipton Road and Stockyard Hill Road. The quantum of these trips is calculated below.

Batch plant trips

The batching plant will produce concrete for the WTG footings and the substation footings.

Each foundation needs to be poured in a day. The volume of concrete in each footing is 597 m^3 in the permitted scenarios and 651 m^3 in the amended scenarios.

Concrete agitators can carry 6 m^3 each, resulting in 100 daily deliveries in the permitted scenario and 109 deliveries in the amended scenario. Assuming that these are evenly distributed throughout the day (10 hours) there will be approximately 10 deliveries per hour in the permitted scenario and 11 deliveries per hour (rounding up) in the amended scenario.

It should be noted that at least half of the WTGs can be served by a concrete batching plant without vehicles needing to access the public road network (this is because these turbines are accessible using only the temporary access tracks). Therefore, the number of deliveries using public roads has been halved to five and six deliveries per hour in the permitted and amended scenarios respectively. This is equivalent to 10 and 12 one-way trips per hour respectively.

Quarry trips

The on-site quarry will produce material for the access track and hardstand construction. From Table 5, 960,291 tonnes are required in the permitted scenarios and 920,000 tonnes are required in the amended scenarios.

Over the 519-day access track construction period there will be approximately 1,850 tonnes and 1,773 tonnes of gravel to be delivered each day in the permitted and amended scenarios respectively.

A truck and trailer combination can carry approximately 28 tonnes of material, resulting in 66 daily deliveries in the permitted scenario and 63 deliveries in the amended scenario. Assuming that these are evenly distributed throughout the day (10 hours) there will be approximately seven deliveries (rounding up) per hour in all scenarios.

It should be noted that approximately 35% of the WTGs can be served by the quarry without vehicles needing to access the public road network (this is because these turbines are accessible using only the temporary access tracks). Therefore, the number of deliveries using public roads has been reduced by 35% to five deliveries (rounding up) per hour. This is equivalent to 10 one-way trips per hour.

Summary of inter-site traffic

The additional trips generated by the on-site concrete batching plants and quarry are summarised in Table 7.

Table 7 – Inter-site traffic generation (one waytrips per hour)

Trip generator	Permitted scenarios	Amended scenarios
Concrete batching plant	10	12
On-site quarry	10	10
Total	20	22

4.3 Trip distribution

4.3.1 Network distribution

The following knowledge and assumptions are used to inform network distribution of trips:

- All WTG parts, transformers and cable spindles will be delivered from Portland on Over Dimensional (OD) trailers;
- It is assumed that the balance of materials and equipment will be delivered via the Glenelg Highway through Skipton, originating evenly from the east and west.
- Workforce movements to and from the site will be split as follows: 20% from Beaufort, 20% from Skipton and 60% from Ballarat. Trips from Beaufort and Skipton will be split evenly from the east and west directions on the Western and Glenelg Highways

4.3.2 On-site quarry

There is the potential for an on-site quarry to supply material for the permanent access tracks and vehicle hardstands (other quarried material, for example for any public road upgrades required, will be sourced from external quarries). In this event, the trips associated with these elements would become internal to the WEF site (similar to the concrete agitators and water

trucks), thereby reducing demand on the extended public road network. This reduction is quantified in Table 8, assuming the quarry would be serviced by a fleet of seven vehicles which would remain on-site.

Table 8 – Reduction in heavy vehicle trips resulting from an on-site quarry

	Permitted with quarry	Amended with quarry
Reduction in trips to off-site quarry	34,297	32,858
Increase in trips due to quarry trucks commuting to and from site each day	519-day quarry operation period x 7 trucks = 3,633 two way trips	519-day quarry operation period x 7 trucks = 3,633 two way trips
Resultant overall reduction in two way trips	30,664	29,225

Note that there is the possibility (not explored in this report) that the on-site quarry may be able to provide material for applications beyond just the access tracks and hardstands (e.g. for the public road upgrades as well). If this was possible, the total number of gravel trucks on external roads (i.e. Glenelg and Western Highways) would decrease and the number of internal site trips would increase. This would be a further benefit to the wider road network.

4.3.3 Peak hour traffic volumes

Existing peak hourly volumes are not available. In this instance it is common practice to assume that peak hour traffic volumes are equal to 10% of the daily volumes. This applies to both background traffic as well as heavy traffic generated by the site.

Workforce movements generated by the SHWF WEF are assumed to take place entirely within peak hour periods. As hourly volume data is not available, the actual peak periods are not known. However, this does not affect the assessment, which assumes a nominal peak period representative of a typical commuter peak.

In the event that permanent access track and vehicle hardstand material is sourced from an on-site quarry, it is assumed that quarry trucks will remain on-site overnight, and not commute to and from the site each day.

4.3.1 Inter-site traffic

The internal trips generated by the concrete batching plants and the on-site quarry (discussed in Section 4.2.2) would be split between Skipton Road and Stockyard Hill Road and to a lesser extent between Thompsons Road and Dunnets Road. As the pattern of these trips is difficult to know it has been assumed that they are split evenly between these four roads (i.e. half to each road rather than a quarter to represent the possibility that some trips would use two roads). This results in approximately six additional trips per hour on each of Skipton Road, Stockyard Hill Road, Thompsons Road and Dunnets Road (but not Western Highway or Glenelg Highway).

4.3.2 Summary of WEF generated traffic

Table 9 contains average weekday daily one way trips expected to be generated during the construction phase of the WEF. One way peak hour movements are shown in brackets.

Table 9 – Construction related traffic

	Permitted	Permitted w/ on site quarry	Amended	Amended w/ on site quarry	Interacting with:
OD trailer	6 (0)*	6 (0)*	4 (0)*	4 (0)*	Portland.(via Glenelg Highway west)
Heavy vehicles	202 (22)	68 (8)	194 (20)	66 (8)	Glenelg Highway east (50%) and west (50%).
Light vehicles	160 (80)	160 (80)	160 (80)	160 (80)	Glenelg Highway east (25%) and west (25%). Western Highway east (25%) and west (25%).
Total	368 (102)	234 (88)	358 (100)	230 (88)	

* OD trips are expected to be scheduled outside peak periods.

4.4 Traffic impacts

Table 10 shows the peak hour impact of the traffic generated by SHWF WEF construction activities on the surrounding public roads in 2018, the year in which SHWF WEF construction is expected to commence.

The 2015 AADT information sourced from the Vicroads Open Data website includes a growth rate for each road link. The highest growth rate for any of the AADT data in the study area is 5.5% (on Skipton Road). For simplicity, background traffic volumes for 2018 have been estimated by increasing 2015 AADT volumes by 5.5% per annum in all locations. As discussed in Section 4.3.3, peak hour volumes are assumed to constitute 10% of daily traffic. Table 10 includes the additional inter-site traffic generated by the concrete batching plants and the on-site quarry.

OD movements have been omitted from the table as they are expected to take place outside of peak periods.

Table 10 – Peak hour impact of WEF construction traffic (two way volumes)

Location	2018 Background volumes LV (HV)	Overall 2018 volumes LV (HV)			
		Permitted	Permitted w/ on site quarry	Amended	Amended w/ on site quarry
Skipton Road (btw. Glenelg Highway & Western Highway)	64 (42)	144 (74)	144 (70)	144 (74)	144 (72)
Glenelg Highway (east of Skipton Road)	175 (49)	183 (60)	183 (53)	183 (59)	183 (53)
Glenelg Highway (west of Skipton Road)	147 (42)	155 (53)	155 (46)	155 (52)	155 (46)
Western Highway (in the vicinity of Skipton Road)	738 (191)	802 (191)	802 (191)	802 (191)	802 (191)
Stockyard Hill Road (btw. Dunnets Rd and Thompsons Rd), Thompsons Rd and Dunnets Rd.	Unknown (assume close to nil)	28 (18)	28 (23)	39 (20)	39 (25)

Austroads publishes guidance on the capacity of roads and traffic lanes (Austroads, 2009). The capacity of a traffic lane is expressed as a number of vehicles per hour (vph). In uninterrupted flow conditions (such as those found on Skipton Road and the Glenelg Highway) a traffic lane can carry about 1,600 vph (although volumes on rural roads in Australia rarely get that high). It can be seen that the projected volumes in Table 10 for Skipton Road and the Glenelg Highway represent less than 10% of theoretical capacity.

Similarly, in interrupted flow conditions (such as the Western Highway at its signalised intersection with Skipton Road), Austroads guidance suggests that a traffic lane can carry about 900 vph. The projected volumes on the Western Highway represent approximately 50% of its theoretical capacity.

In the context of spare capacity of the existing public road network, the construction of the SHWF WEF is not expected to cause a significant increase in congestion or delay in any of the four scenarios examined. For the OD movements required, a detailed traffic management plan should be prepared in order to assess the suitability of potential routes to the site from Portland. This is a requirement of the existing planning permit (condition 35 of the permit).

In comparison with the permitted scenarios, the amended scenarios are expected to have a marginally lower impact on the existing public road network. While the addition of an on-site quarry generates slightly more heavy vehicle traffic during the peak periods (due to quarry trucks commuting to and from the site), the number of heavy vehicle trips required over the course of an average workday is substantially lower.

4.4.1 Intersection treatments

The inter-site distribution of construction related traffic has been estimated on the following basis:

- The amount of traffic interacting with each construction area is expected to broadly reflect the number of WTGs to be located in that area;
- As mentioned in Section 4.3.1, 20% of workforce is assumed to originate in Beaufort, 20% in Skipton and 60% in Ballarat. For the WEF site, this means 80% of light vehicle movements are assumed to arrive and depart via Beaufort, with the remaining 20% arriving and departing through Skipton.
- All heavy vehicle traffic is assumed to arrive and depart the WEF site via the Glenelg Highway;
- In the Permitted and Amended scenarios, all vehicles travelling between the Glenelg Highway and the northern most WTG construction areas are expected to use Skipton Road and Thompsons Road; and
- In the Amended scenarios, vehicles travelling between the Western Highway and the central WTG construction area are expected to be split evenly across Thompsons Road and Dunnets Road.

Recent turning movement survey data is not available at any of the intersections, but on-site observations suggest that the access roads carry very low volumes, so it is reasonable and conservative to assume Skipton Road AADT data represents through traffic only. An overall model of turning movement volumes has been produced by adding background traffic to the distributed construction traffic for each scenario.

Figure 2, Figure 3, Figure 4 and Figure 5 contain schematics of peak period overall turning movement volumes at the four access intersections along Skipton Road for each of the four scenarios.

Note that the volumes on the schematic are total vehicle numbers (light and heavy summed).

Figure 2 – Turning movement volumes for "Permitted" scenario (background plus construction)

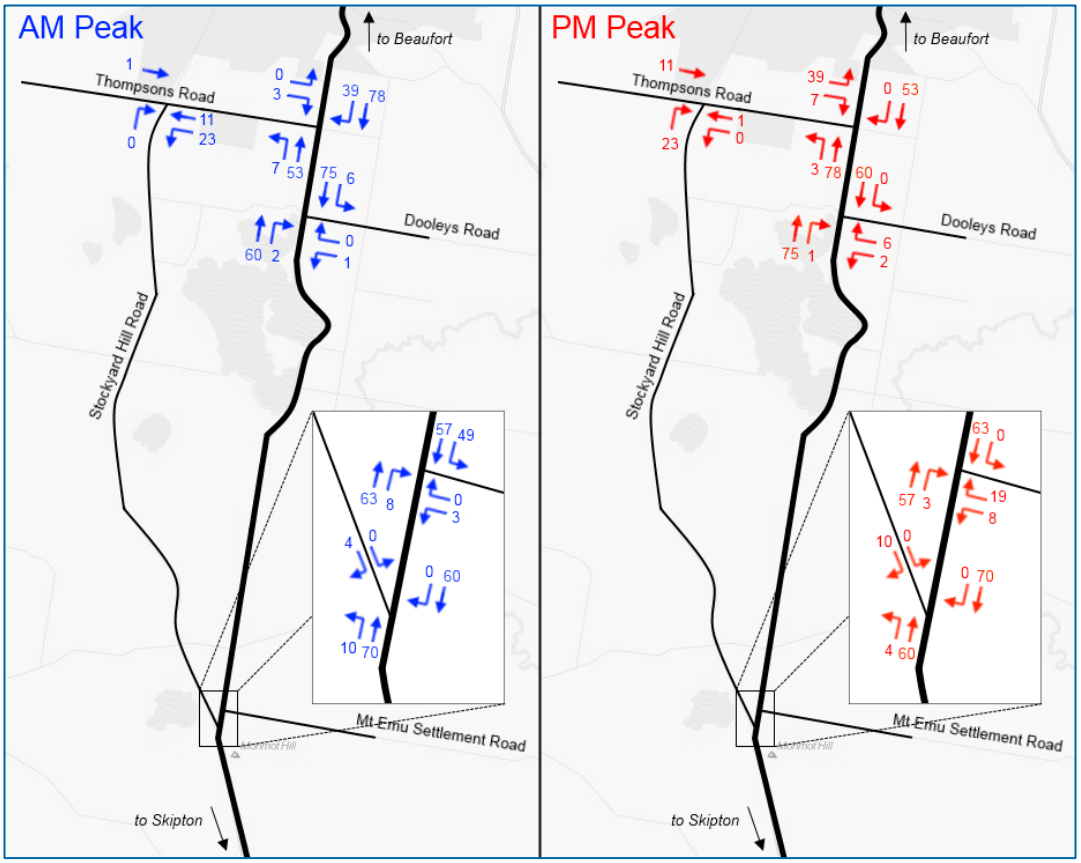


Figure 3 – Turning movement volumes for "Permitted with on-site quarry" scenario (background plus construction)

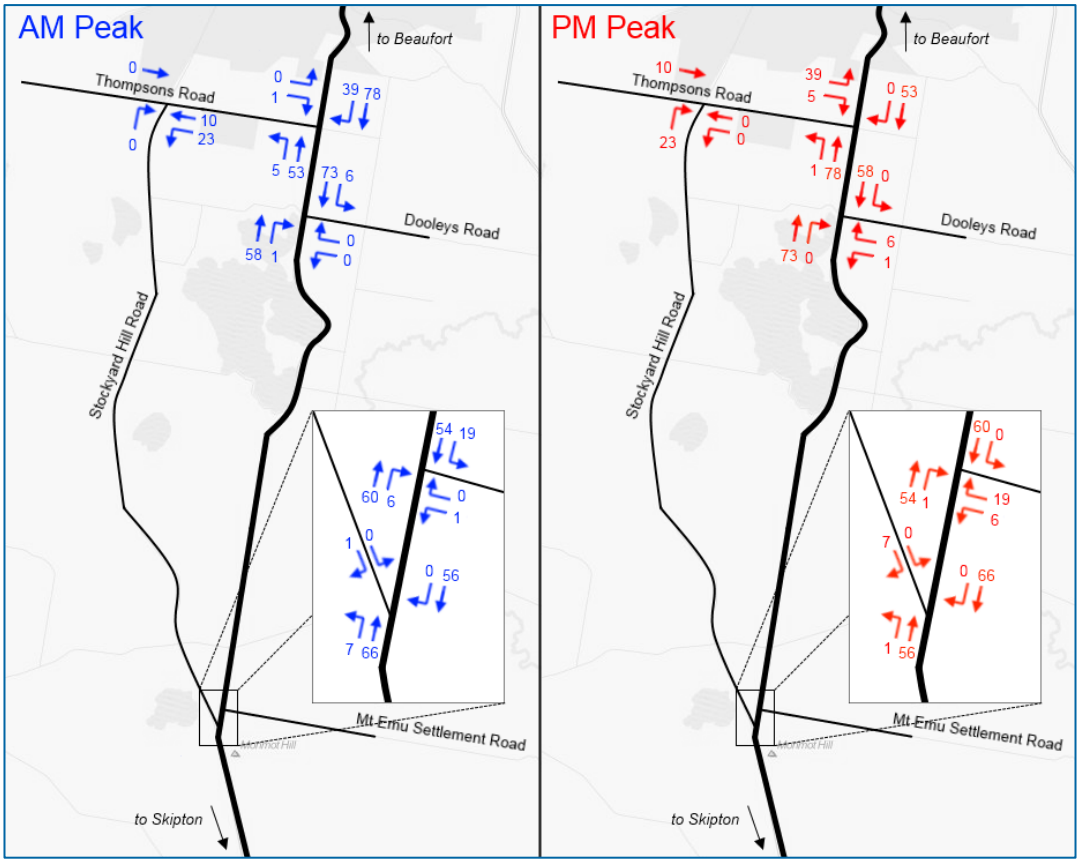


Figure 4 – Turning movement volumes for "Amended" scenario (background plus construction)

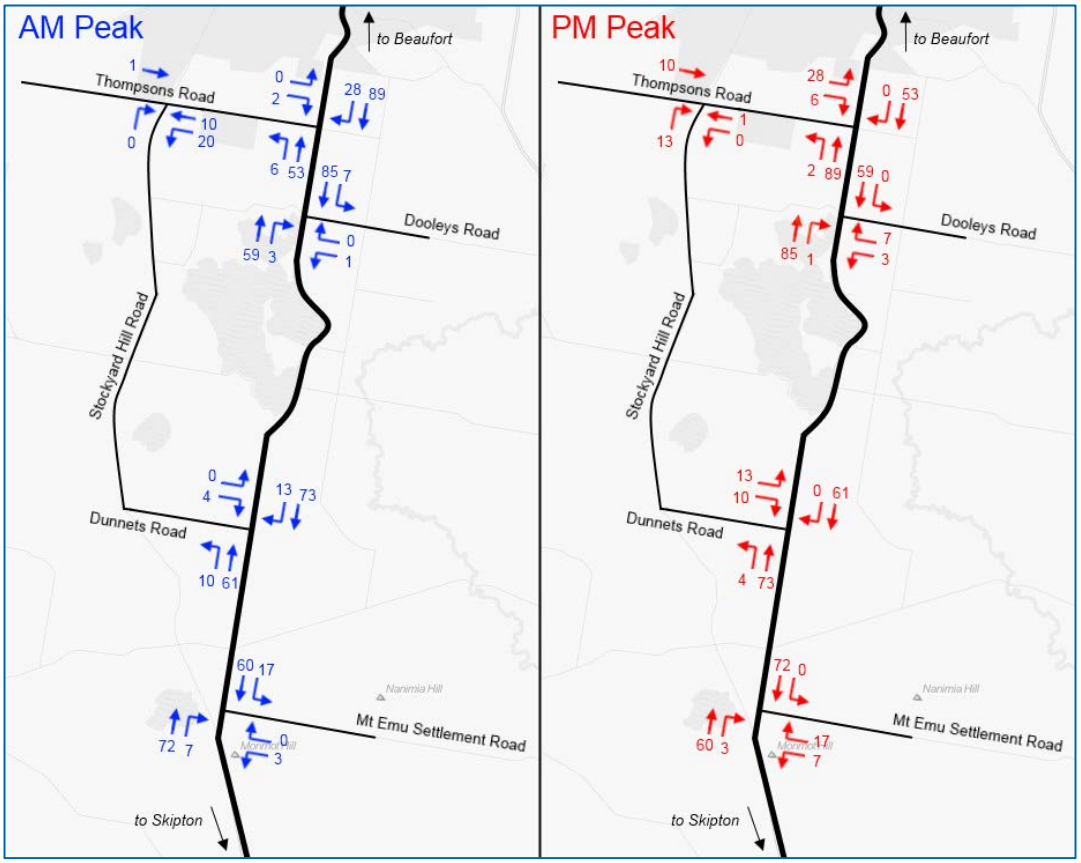
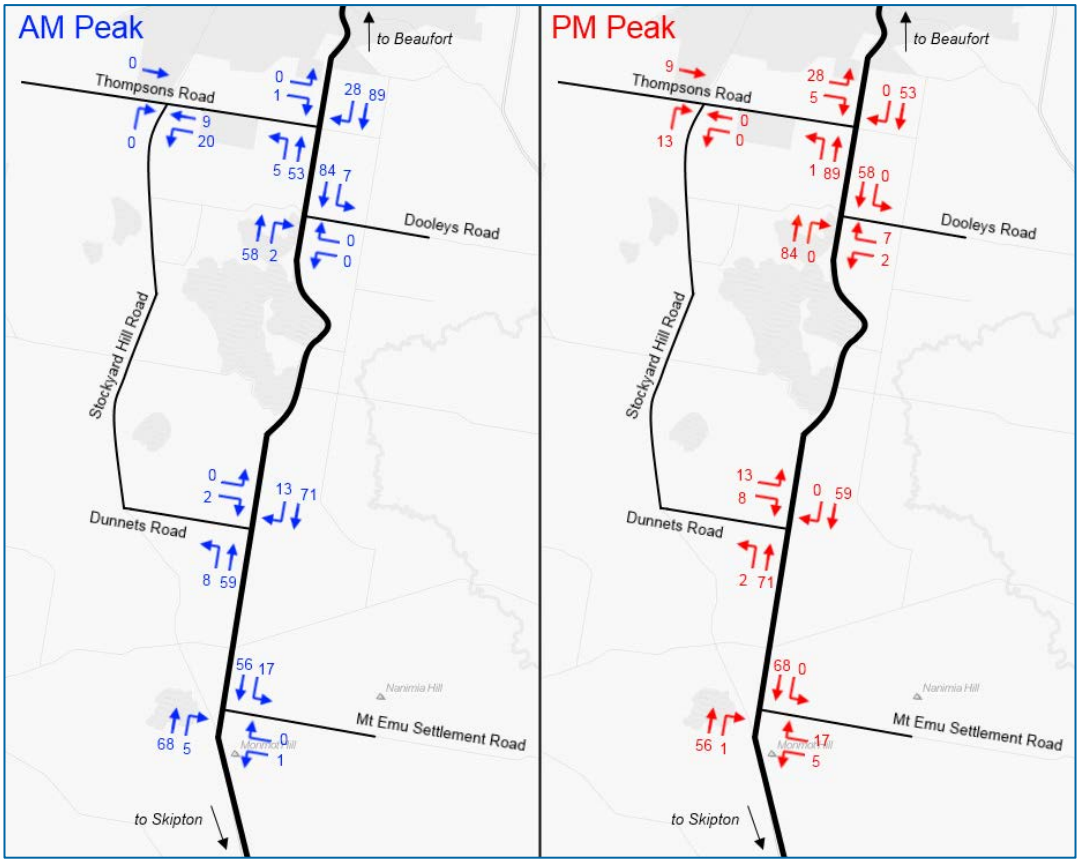
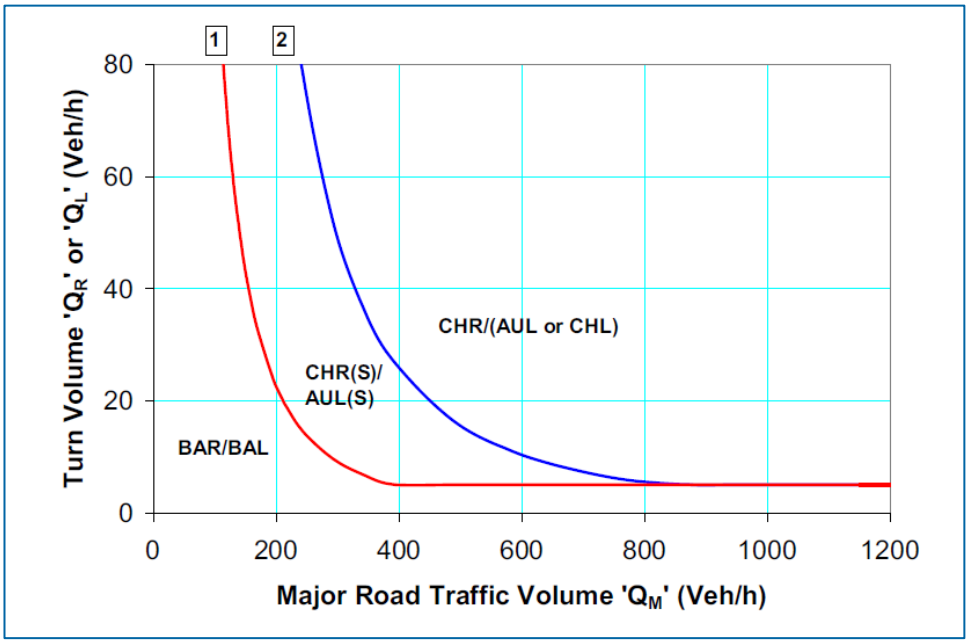


Figure 5 – Turning movement volumes for "Amended with on-site quarry" scenario (background plus construction)



With reference to Austroads' Guide to Road Design: Part 4A (Un-signalised and Signalised Intersections), an analysis has been undertaken to determine what turn treatments are warranted for access intersections. Figure 6 contains the turn warrants for rural roads with design speeds of 100 km/h. Each line in Figure 6 represents the threshold between one type of treatment and the next, with the standard of treatment increasing from bottom-left to top-right.

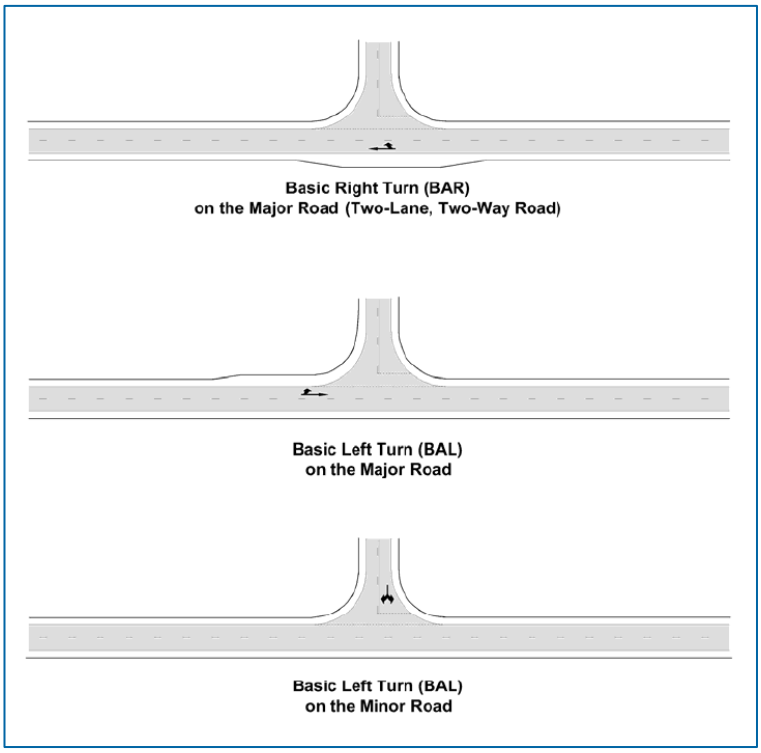
Figure 6 – Austroads Guide to Road Design part 4A – Figure 4.9



The volumes in Figure 2 to Figure 5 are used for the assessment. By cross-referencing the traffic volume on the major road (maximum about 130 vph) with the volume turning off the road (maximum about 40 vph), it is clear that the projected turning movements for any of the four scenarios are not high enough to warrant any treatment beyond the minimum BAR/BAL ("basic auxiliary right" and "basic auxiliary left") which are shown in Figure 7.

Although this analysis has shown that intersection upgrades are not warranted by turning movement volumes, some upgrades are expected to be required to accommodate the swept path requirements of specific heavy or over dimensional vehicle types. Although that assessment will be undertaken in detail separately as part of the TMP, preliminary designs (completed by Wallbridge & Gilbert Consulting Engineers for Catcon) have been included in Appendix D.

Figure 7 – Austroads Guide to Road Design part 4A – Figure 4.1



5. Conclusions and recommendations

This report details the findings of a traffic impact assessment of the SHWF under four distinct scenarios:

- Permitted WEF (157 WTGs);
- Amended WEF (149 WTGs);
- Permitted WEF with on-site quarry; and
- Amended WEF with on-site quarry;

The conclusions of the study are as follows:

- The scenario which generates both the greatest volume of daily and peak hour trips is the permitted scenario (without on-site quarry).
- The scenario which generates both the lowest volume of daily and peak hour trips is the amended with on-site quarry. This is therefore the preferred scenario.
- On an average workday, the construction phase of the SHWF WEF is expected to generate no more than 102 trips in the peak periods (80 light vehicles and 22 heavy vehicles). This occurs only in the permitted without quarry scenario;
- The surrounding road network (Skipton Road, Western Highway, Glenelg Highway) has ample spare capacity to accommodate WEF construction traffic with negligible impact in terms of congestion or delays. This is true for all four scenarios.
- The site access intersections (Emu Settlement Road, Dunnets Road, Dooleys Road and Thompsons Road) currently appear to carry very little traffic. Under turning movement volumes generated by superimposing site construction traffic on background traffic, there is no warrant to upgrade any of the intersections from a capacity perspective. Some changes to geometry are expected to be required to accommodate the swept path requirements of specific heavy or over dimensional vehicle types.

5.1 Comparison of permitted WEF to amended WEF

The study has determined that the traffic impact of the amended WEF construction would be marginally less than that of the permitted WEF.

Although the amended WEF includes fewer WTGs, the resulting reduction in heavy vehicle trips is partly counteracted by the increased size of each WTG (requiring larger footings).

The size of the workforce has been assumed to be the same for either WEF. As such, there is no difference in light vehicle movements.

Table 11 summarises the changes in trips generated, using the permitted (without quarry) scenario as the base position.

Table 11 – Summary of impacts compared to permitted scenario (vpd/vph)

Change	Permitted w/ quarry	Amended	Amended w/ quarry
LVs generated	0/0	0/0	0/0
HVs generated	-134/-14	-8/-2	-136/-14
Ods generated	0/0	-2/0	-2/0

5.2 Effect of the provision of an on-site quarry

The provision of an on-site quarry results in an overall reduction in daily heavy vehicle traffic generated on the surrounding road network. This is due to heavy vehicle quarry trips becoming internal to the site and not impacting on the external public road network.

It is considered that the traffic impacts identified can be adequately addressed in the traffic management plan.

Appendices

Appendix A – Permitted WEF indicative traffic routes

695000 700000 705000 710000 715000

5855000 5850000 5845000 5840000 5835000 5830000

Beaufort

Skipton

WESTERN HIGHWAY

GLENELG HIGHWAY

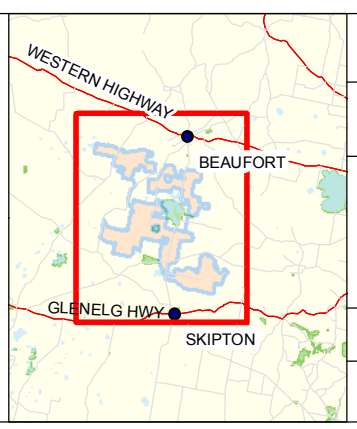
SUMMER RD
MIDDLE CREEK
GOULD'S LN
MIDDLE CREEK RD
FIERY CREEK
CARMICHAELES RD
OLD SHIRLEY RD
BALLYROGAN RD
BACK RAGLAN RD
SAWPIT GULLY LN
CAMP HILLS RD
TRAWALLA-WATERLOO RD
TRAWALLA-RACECOURSE RD
BUTTS RD
BALDWYNS LN
TRAWALLA RD
NERRING-TRAWALLA RD
EURAMBEEN-SETTLEMENT RD
LONG GULLY RD
STOCKYARD HILL RD
DALGLEISHS ROAD
CARAMUIR ROAD
ELLISS RD
TOPPERS RD
GEELONG ROAD
BEAUFORT CARRANBALLAC RD
THOMPSONS RD
MILLAR'S RD
CARLAND RD
FROG HOLLOW RD
CHEESEMANS RD
SKIPTON ROAD
DOOLEYS ROAD
CROSS'S RD
ROSS'S RD
BEAUFORT CARNGHAM ROAD
SPRING HILL CREEK
LAKE GOLDSMITH
BLACK LAKE
CARNGHAM LAKE GOLDSMITH ROAD
DUNNET'S RD
TRAWALLA WEST RD
MT WILLIAM RD
PRETTY TOWER RD
STONELEIGH SETTLEMENT RD
STREATHAM CARNGHAM ROAD
ODDIES RD
MORTCHUP-MT EMU RD
BAILLIE CREEK
WONGAN RD
SLATER LAKE
MT EMU SETTLEMENT ROAD
CHEPSTOWE-PITTONG RD
BLACKS CREEK
BROKEN CREEK
LISTONS RD
MOORAMONG RD
West Boundary Road
MOUNT EMU CREEK
LISMORE PITTONG ROAD
FRANCIS LN
EURAMBEEN STREATHAM ROAD
MAWOLLOK LANE
GEELONG ROAD
BEAUFORT-CARRANBALLAC RD

T1 T2 T4 T7 T10 T16 T20 T22
T3 T8 T9 T11 T19 T24
T27 T30
T33
T37 T39 T40 T41 T43 T44 T45 T46 T48 T50 T52 T53 T55 T56 T58 T59 T60 T61 T62 T63 T64 T65 T66 T67 T68 T69 T70 T71 T72
T74 T75 T76 T77 T78 T79 T81 T82 T85 T86 T88 T92 T93
T80 T84 T87 T89 T90 T91 T94 T95 T96 T97 T98 T99 T101 T103 T104 T106 T107 T110 T111 T112 T114 T116 T117 T119 T120 T124 T126 T129 T130 T136 T148
T122 T125 T131 T132 T135 T138 T141 T142 T147 T149 T151 T154 T155 T156 T157 T158 T163 T167 T168 T169 T173 T177 T179 T182
T188 T191 T192 T193 T194 T195 T196 T197 T198 T199 T200 T201 T202 T203 T204 T205 T206 T207 T208 T209 T210 T211 T212 T213 T214 T215 T216 T217 T219 T220 T223 T225 T226 T229 T232 T233 T235 T238 T240 T241 T242

Turbine Layout	Watercourses
Access Track	Rail
Public Road for Access Use	Wetlands or waterbodies
WEF Boundary	Major vegetation areas
Roads	Local government areas
Highway	Townships
Major Roads	Parcels
Minor Roads	Contours 10m

Origin Energy
321 Exhibition Street
Melbourne
VIC 3000

Source:



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- TITLE: Public Road Network Use for Access - Permitted Project
- DATE: 09/12/2015
- PRODUCED: ALiu
- SCALE: 1:100,000 @ A3
- CHECKED: PMarriott
- STATUS: Draft
- APPROVED: <TEXT>

0 1.25 2.5 5 Kilometres

N

- DRAWING No.: SHWF_0_0079_0A_Public Road network Use for Access-Permitted Project
- REV: 0A

Appendix B – Planning permit conditions

Condition	Proposed Amendments (**Bold** = insertions, ~~Strikethrough~~ = proposed deletion)	Reason
Condition 35 Traffic Management Plan	1. Before the development starts, a traffic management plan must be prepared by a suitably qualified and experienced road and traffic engineer in consultation with Pyrenees Shire Council, Corangamite Shire Council and VicRoads to the satisfaction of the Minister for Planning. When approved, the plan will be endorsed and will then form part of this permit. The plan must include: b. an existing conditions survey of public roads that may be used for access and designated construction transport vehicle routes in the vicinity of the wind energy facility, including details of the suitability, design, condition and construction standard of the roads; c. the designation of appropriate construction and transport vehicle routes to the wind energy facility site; d. details of the road works required to upgrade all roads identified in Condition 35 b) to a standard suitable to cater for the movement of heavy and over-dimensioned vehicles. All upgrade works identified in the plan are to be completed before construction works on the wind farm site begin, to the satisfaction of the relevant road authority; e. the identification and timetabling of any required construction works; f. the designation of all vehicle access points to the wind energy facility from surrounding roads. The location and detailed design of the connection between the internal access tracks and the public roads must ensure safe sight distances, turning movements, and avoid potential through traffic conflicts; g. recommendations on the need for road and intersection upgrades to accommodate any additional traffic or site access requirements, whether temporary or on-going and the timing of when these upgrades are to be undertaken. This is to include engineering plans demonstrating how truck movements can be accommodated on sealed roadways and turned where possible without encroaching onto the incorrect side of the road; h. measures to be used to manage traffic impacts associated with the ongoing operation of the wind energy facility on the traffic volumes and flows on surrounding roads, including the designation of operating hours and speed limits for trucks on routes accessing the site so as to avoid school bus routes and school bus times where relevant, and to provide for resident safety; i. a program of regular inspections to be carried out during the construction period to identify maintenance works necessary as a result of construction traffic; j. a program to rehabilitate roads to the condition identified by the surveys required above by Condition 35 a) above; and k. prior to the completion of the traffic management plan a site visit between VicRoads and the wind energy facility operator must be undertaken. l. if required by Pyrenees and/or Corangamite Shire Council, the payment of (a) security deposit(s) or bond(s) for a maintenance period of 24 months in respect of works covered by the traffic management plan in their respective shires. Such security deposit(s) or bond(s) is/are to be applied to roadworks not completed under the traffic management plan or to be released at the end of that period. The traffic management and road upgrade and maintenance works associated with the wind energy facility must be carried out in accordance with the traffic management plan to the satisfaction of the responsible authority and the cost of any works including maintenance are to be at the expense of the wind energy facility operator. All heavy and over-dimensioned vehicles are to be restricted to the haul routes identified in the traffic management plan unless with the prior written consent of VicRoads and the Shire of Pyrenees or Shire of Corangamite as relevant. Note: Once the traffic routes are finalised, it may be necessary to apply for further permission for native vegetation removal to accommodate road works – either by application to amend this permit under section 72 of the **Planning and Environment Act 1987** or by a new permit application.	Administrative Improvement – inclusion of full reference to the Planning and Environment Act 1987.

Appendix C – Amended WEF indicative traffic routes

695000 700000 705000 710000 715000

5855000 5850000 5845000 5840000 5835000 5830000

WESTERN HIGHWAY
Beaufort
SUMMER RD
MIDDLE CREEK
GOULD'S LN
MIDDLE CREEK RD
FIERY CREEK
EURAMBEEN STREATHAM ROAD
OLD SHIRLEY RD
BACK RAGLAN RD
CAMP HILLS RD
RACECOURSE RD
TRAWALLA RD
BALLYROGAN RD
EURAMBEEN-SETTLEMENT RD
LONG GULLY RD
STOCKYARD HILL RD
ELLIS'S RD
TOPPERS RD
MILLAR'S RD
CARLAND RD
CHEESEMANS RD
DOOLEYS ROAD
GEELONG ROAD
SKIPTON ROAD
LAKE GOLDSMITH
SPRING HILL CREEK
MAWOLLOK LANE
BEAUFORT-CARRANBALLAC RD
BLACK LAKE
DUNNET'S RD
TRAWALLA WEST RD
ODDIES RD
STREATHAM CARNGHAM ROAD
MT WILLIAM RD
BAILLIE CREEK
MOUNT EMU CREEK
SLATER LAKE
BLACKS CREEK
BROKEN CREEK
MT EMU SETTLEMENT ROAD
CHEPSTOWE-PITTONG RD
MOORAMONG RD
GLENELG HIGHWAY
Skipton
LISMORE PITTONG ROAD
FRANCIS LN

A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15
B1 B2 B3 B4 B5 B6 B7 C1 C2 C3 C4 C5 C6 C7
D1 D2 D3 D4 D5 D6 E1 E2 E3 E4 E5 E6 E7 F1 F2 F3 F4 F5 F6 F7 G1 G2 G3 G4 G5 G6 G7 H1 H2 H3 H4 H5 H6 H7 I1 I2 I3 I4 I5 I6 I7
J1 J2 J3 J4 J5 J6 K1 K2 K3 K4 K5 K6 L1 L2 L3 L4 L5 L6 L7 M1 M2 M3 M4 M5 M6 M7
N1 N2 N3 N4 N5 N6 N7 O1 O2 O3 O4 O5 O6 P1 P2 P3 P4
Q1 Q2 Q3 Q4 Q5 R1 R2 R3 R4 R5 R6 S1 S2 S3 S4 S5 S6 T1 T2 T3 T4 T5 T6 U1 U2 U3 U4 U5 U6 U7 V1 V2 V3 V4 V5 V6 V7

origin

Origin Energy
321 Exhibition Street
Melbourne
VIC 3000

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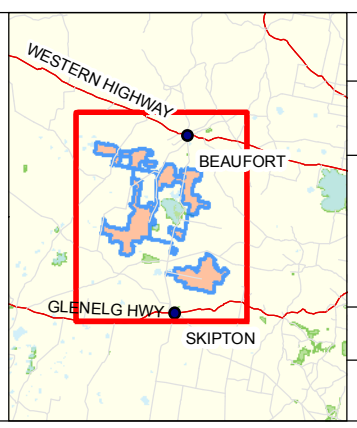
Source:

- Turbine Layout
- Site Compound/Batching Plant
- Substation
- Underground Cable
- Access Track
- Public Road for Access Use
- Internal Overhead Powerline
- Quarry
- WEF Boundary

Roads
- Highway
- Major Roads
- Minor Roads

- Watercourses
- Rail
- Wetlands or waterbodies
- Major vegetation areas
- Local government areas
- Townships
- Parcels
- Contours 10m



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STATUS	Draft
APPROVED	<TEXT>

0 1.25 2.5 5 Kilometres

N

DRAWING No.	SHWF_0_0078_0C_Public Road network Use for Access-Amended Project
REV	0C

Appendix D – Preliminary road upgrade designs

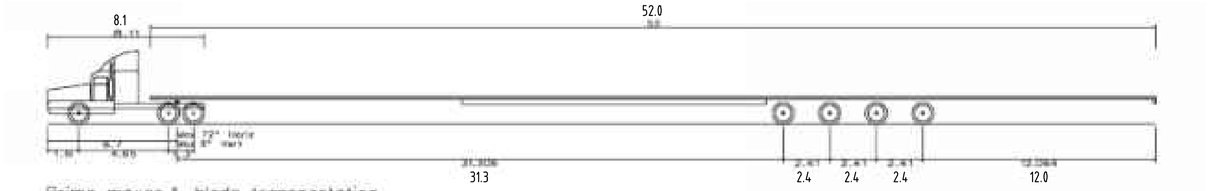


Figure 3: Blade Transportation Trailer – vehicle diagram

SKIPTON ROAD AND MOUNT EMU SETTLEMENT ROAD INTERSECTION

TYPICAL DETAIL

5 2.5 0 5 10
SCALE BAR (m)

INFORMATION ISSUE
NOT FOR CONSTRUCTION

REV	DETAIL OF REVISION	RVD	CHKD	APP'D	CLIENT	DATE
C	ISSUED FOR REVIEW	JJF	RB		SM	03.12.15
B	ISSUED FOR REVIEW	JJF	RB		SM	27.11.15
A	ISSUED FOR INFORMATION	JJF	RB		SM	13.11.15

REFERENCE DRAWING | DRAWING No.

WALLBRIDGE & GILBERT
Consulting Engineers
60 Wyatt Street, Adelaide
South Australia 5000
Telephone 08 8223 7433
Email adelaide@wga.com.au

catcon
civil & allied technical construction

DRAWN	JJF
DATE	13.11.15
CHECKED	RB
DATE	13.11.15
APPROVED	
DATE	
CONTRACTOR PROJ. No.	WAD120339

PROJECT: STOCKYARD HILL WIND FARM
TITLE: SKIPTON RD & MT EMU SETTLEMENT ROAD UPGRADE
SCALE: AS SHOWN | A1 | DRAWING No.: WAD120339 | SHT: C120 | REV: C

DO NOT SCALE DRAWINGS FOR WORKING DIMENSIONS

I:\2012\120301 - 120400\120339 - Stockyard hill Windfarm\WAD\120339-C120.dwg, C, 3/12/2015 4:12 PM, JFishburn

TOPPERS LANE

THOMPSONS ROAD

STOCKYARD HILL ROAD

UNSEALED SHOULDER. WIDTH VARIES.

REFER PLAN C101 & C105 FOR TOPPER LANE PAVEMENT UPGRADE WORKS

REFER PLAN C101 & C105 FOR THOMPSON LANE PAVEMENT UPGRADE WORKS

PM S 19M
AUSTROADS 2013 (AM)

R110

R15

36m

5m
SEALED

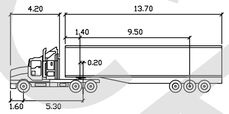
20m
ROAD RESERVE

LEGEND

UNSEALED ROAD WIDENING
(TO SUIT 19m SEMI ACCESS)

NEW INTERSECTION PAVEMENT
SEAL ONLY WHERE EXISTING ROADS
HAVE BEEN SEALED PREVIOUSLY.

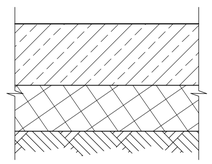
EXISTING SEALED ROAD



PM S 19M

	meters		
Tractor Width	2.50	Lock to Lock Time	6.0
Trailer Width	2.50	Steering Angle	27.8
Tractor Track	2.50	Articulating Angle	70.0
Trailer Track	2.50		

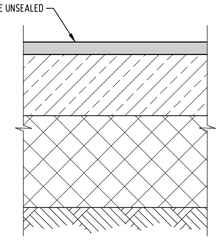
5km/h TURNING DESIGN SPEED



THICKNESS	TYPE	COMPACTION
200mm - 300mm	WEARING COURSE VIC ROADS CLASS 4	98% MODIFIED
VARIES	ENG FILL (IF IN FILL)	98% STANDARD
	SUBGRADE	98% STANDARD

UNSEALED PAVEMENT
SCALE 1:10 (CBR = 2.5%)

ONLY WHERE EXISTING OTHERWISE UNSEALED



THICKNESS	TYPE	COMPACTION
	14/7 SPRAY SEAL	
200mm	VIC ROADS CLASS 2	98% MODIFIED
300mm	VIC ROADS CLASS 4	98% MODIFIED
	SUBGRADE	98% STANDARD

SEALED INTERSECTION - PAVEMENT
SCALE 1:10 (CBR = 2.5%)

TYPICAL VIC ROADS INTERSECTION (FOUR-WAY)
TYPICAL DETAIL

DESIGN BASIS

AUSTROADS PART 4A:
-100km POSTED
-110km (DESIGN)
-TURN PATHS TO SUIT 19m SEMI
-NO BLADE TRUCK DELIVERIES THROUGH THIS INTERSECTION

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SCALE BAR (m)

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DRAWN	JJF	DATE	13.11.15
CHECKED	RB	DATE	13.11.15
APPROVED		DATE	
CONTRACTOR PROJ. No.	WAD120339		

PROJECT: STOCKYARD HILL WIND FARM
TITLE: COUNCIL ROADS 4-WAY INTERSECTION UPGRADE

SCALE		DRAWING No.	SHT	REV
AS SHOWN	A1	WAD120339	C119	C

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TOPPERS LANE

THOMPSONS ROAD

STOCKYARD HILL ROAD

UNSEALED SHOULDER WIDTH VARIES

REFER PLAN C101 & C105 FOR TOPPER LANE PAVEMENT UPGRADE WORKS

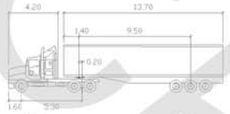
REFER PLAN C101 & C105 FOR THOMPSON LANE PAVEMENT UPGRADE WORKS

LEGEND

UNSEALED ROAD WIDENING
(TO SUIT 19m SEMI ACCESS)

NEW INTERSECTION PAVEMENT
SEAL ONLY WHERE EXISTING ROADS
HAVE BEEN SEALED PREVIOUSLY.

EXISTING SEALED ROAD



PM S 19M — meters

Tractor Width	2.50	Lock to Lock Time	6.0
Trailer Width	2.50	Steering Angle	27.8
Tractor Track	2.50	Articulating Angle	73.0
Trailer Track	2.50		

50km/h TURNING DESIGN SPEED

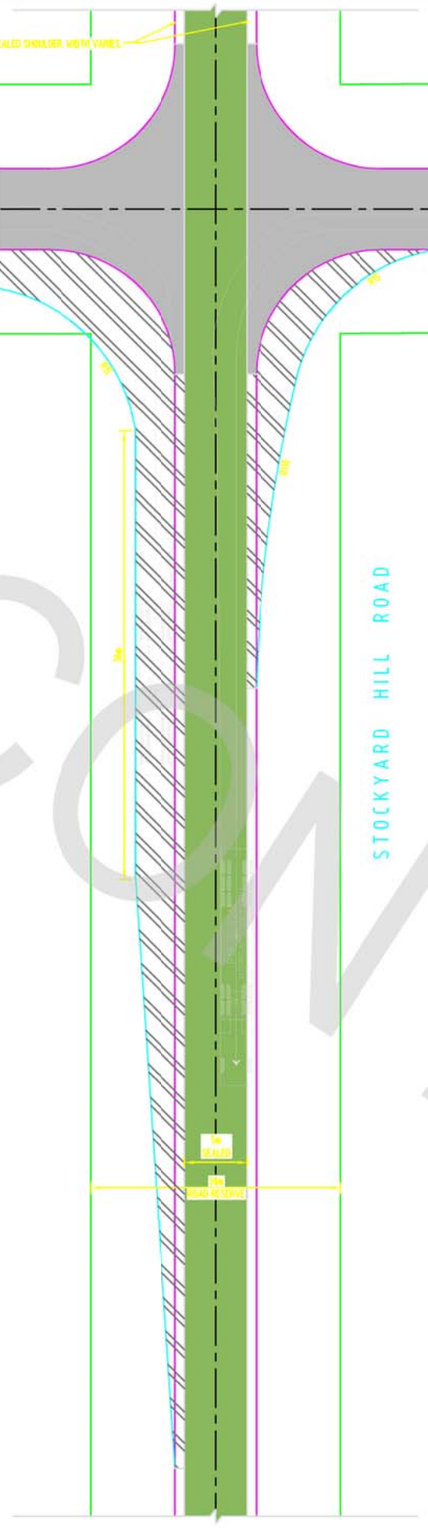
	THICKNESS	TYPE	COMPACTION
	200mm - 300mm	WEARING COURSE VIC ROADS CLASS 4	98% MODIFIED
	VARIES	ENG FILL (IF IN FILL)	98% STANDARD
		SUBGRADE	98% STANDARD

UNSEALED PAVEMENT
SCALE 1:10 (CBR = 2.5%)

ONLY WHERE EXISTING OTHERWISE UNSEALED

	THICKNESS	TYPE	COMPACTION
		14/7 SPRAY SEAL	
	200mm	VIC ROADS CLASS 2	98% MODIFIED
	300mm	VIC ROADS CLASS 4	98% MODIFIED
		SUBGRADE	98% STANDARD

SEALED INTERSECTION - PAVEMENT
SCALE 1:10 (CBR = 2.5%)



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PROJECT: STOCKYARD HILL WIND FARM

TITLE: COUNCIL ROADS
4-WAY INTERSECTION UPGRADE

CONTRACTOR PROJ. No.: WAD120339

SCALE: AS SHOWN | A1

DRAWING No.: WAD120339

SHT: C119 | REV: C

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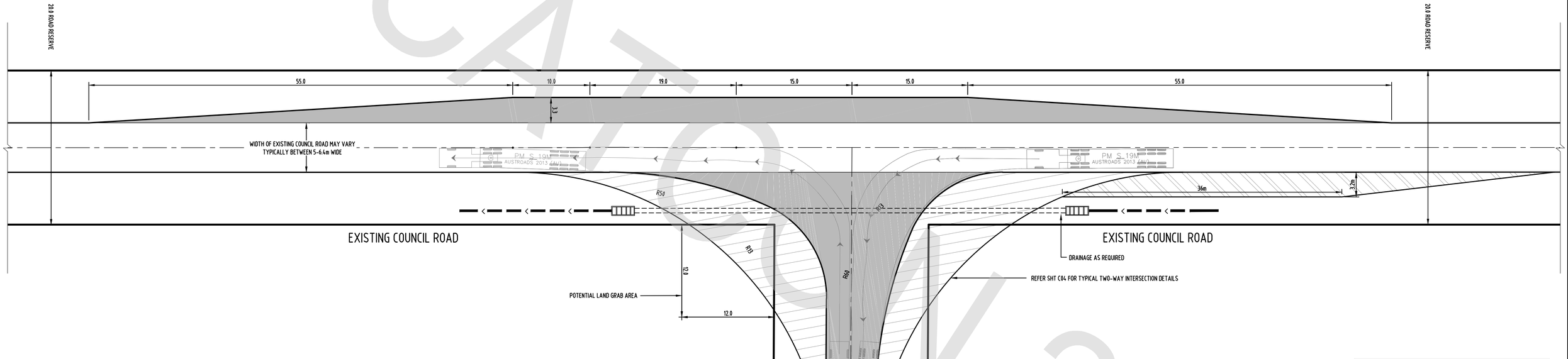


LEGEND

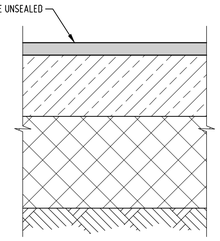
- UNSEALED ROAD WIDENING (TO SUIT BLADE TRUCK ACCESS) ONLY
- UNSEALED ROAD SHOULDER WIDENING (TO SUIT BLADE TRUCK ACCESS) ONLY
- NEW INTERSECTION PAVEMENT SEAL ONLY WHERE EXISTING ROADS HAVE BEEN SEALED PREVIOUSLY.
- EXISTING COUNCIL ROADS

UNSEALED PAVEMENT

SCALE 1:10 (CBR = 2.5%)

THICKNESS	TYPE	COMPACTION
200mm - 300mm	WEARING COURSE VIC ROADS CLASS 4	98% MODIFIED
VARIES	ENG FILL (IF IN FILL)	98% STANDARD
	SUBGRADE	98% STANDARD

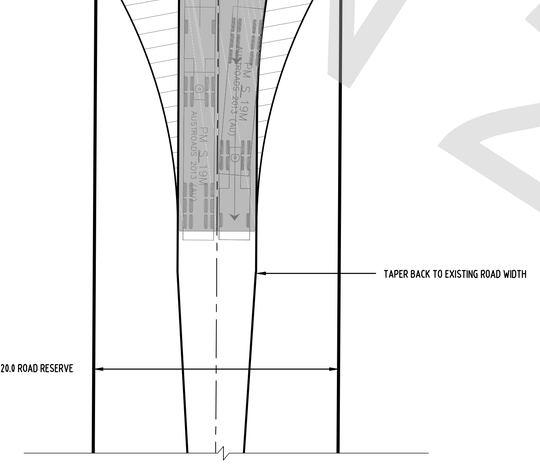
ONLY WHERE EXISTING OTHERWISE UNSEALED



SEALED INTERSECTION - PAVEMENT

SCALE 1:10 (CBR = 2.5%)

THICKNESS	TYPE	COMPACTION
	14/7 SPRAY SEAL	
200mm	VIC ROADS CLASS 2	98% MODIFIED
300mm	VIC ROADS CLASS 4	98% MODIFIED
	SUBGRADE	98% STANDARD



COUNCIL ROADS INTERSECTION (TWO-WAY)

TYPICAL DETAIL

DESIGN BASIS

AUSTROADS PART 4A:
- -100km POSTED
- -110km (DESIGN)
- -TURN PATHS TO SUIT 19m SEMI (SEALED SECTION ONLY)
- -TURNING PATH FOOTPRINT FROM VESTAS V126

ROADS AND TRANSPORT SPECIFICATION.

DISCLAIMER

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SCALE BAR (m)

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CONTRACTOR PROJ. No.	WAD120339		

PROJECT: STOCKYARD HILL WIND FARM
TITLE: COUNCIL ROADS TYPICAL INTERSECTION UPGRADES

SCALE		DRAWING No.	SHT	REV
AS SHOWN	A1	WAD120339	C118	C

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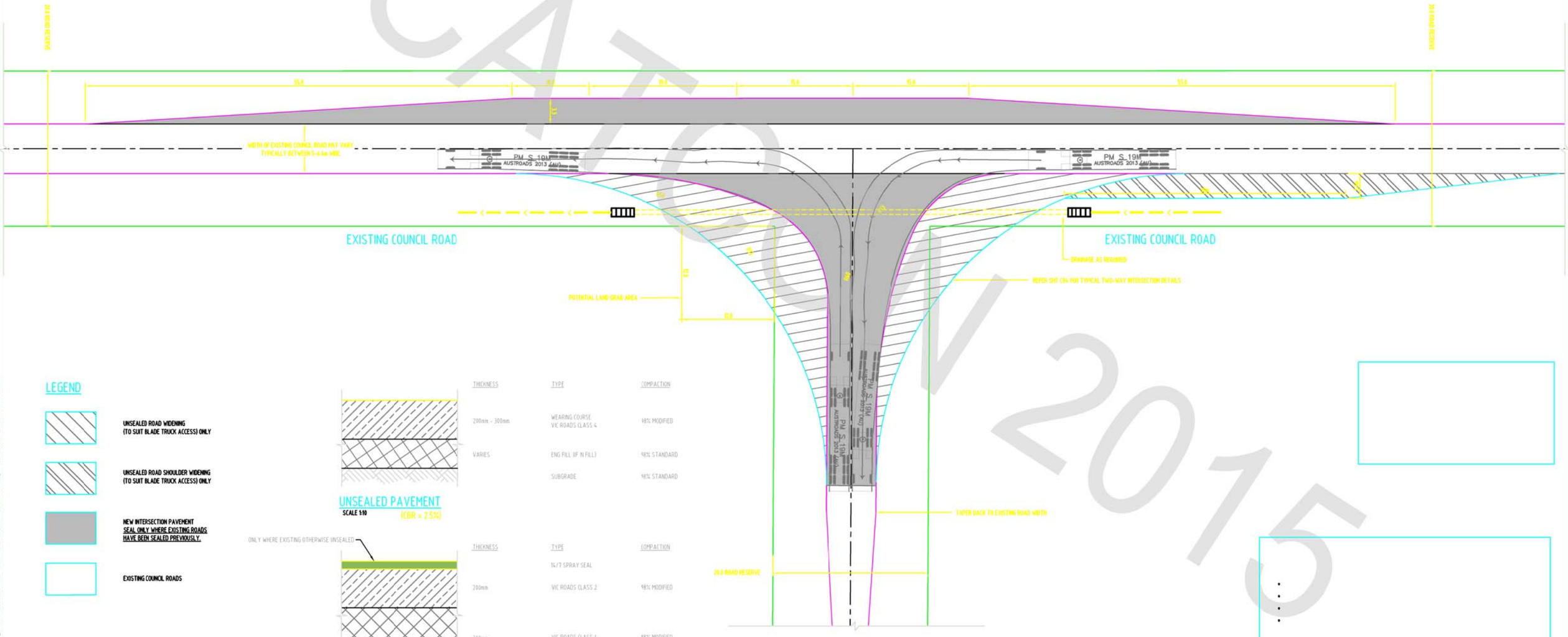

LEGEND

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- UNSEALED ROAD SHOULDER WIDENING (TO SUIT BLADE TRUCK ACCESS) ONLY
- NEW INTERSECTION PAVEMENT SEAL ONLY WHERE EXISTING ROADS HAVE BEEN SEALED PREVIOUSLY.
- EXISTING COUNCIL ROADS

UNSEALED PAVEMENT

SCALE 1:10 (CBR = 2.5%)

	THICKNESS	TYPE	COMPACTION
	200mm - 300mm	WEARING COURSE VIC ROADS CLASS 4	98% MODIFIED
	VARIES	ENG FILL (IF N FILL)	98% STANDARD
		SUBGRADE	98% STANDARD

ONLY WHERE EXISTING OTHERWISE UNSEALED

SEALED INTERSECTION - PAVEMENT

SCALE 1:10 (CBR = 2.5%)

	THICKNESS	TYPE	COMPACTION
		14/7 SPRAY SEAL	
	200mm	VIC ROADS CLASS 2	98% MODIFIED
	360mm	VIC ROADS CLASS 4	98% MODIFIED
		SUBGRADE	98% STANDARD

SCALE BAR (m): 5 2.5 0 5 10

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PROJECT: STOCKYARD HILL WIND FARM

TITLE: COUNCIL ROADS TYPICAL INTERSECTION UPGRADES

CONTRACTOR PROJ. No.	SCALE		DRAWING No.	SHT	REV
WAD120339	AS SHOWN	A1	WAD120339	C118	C

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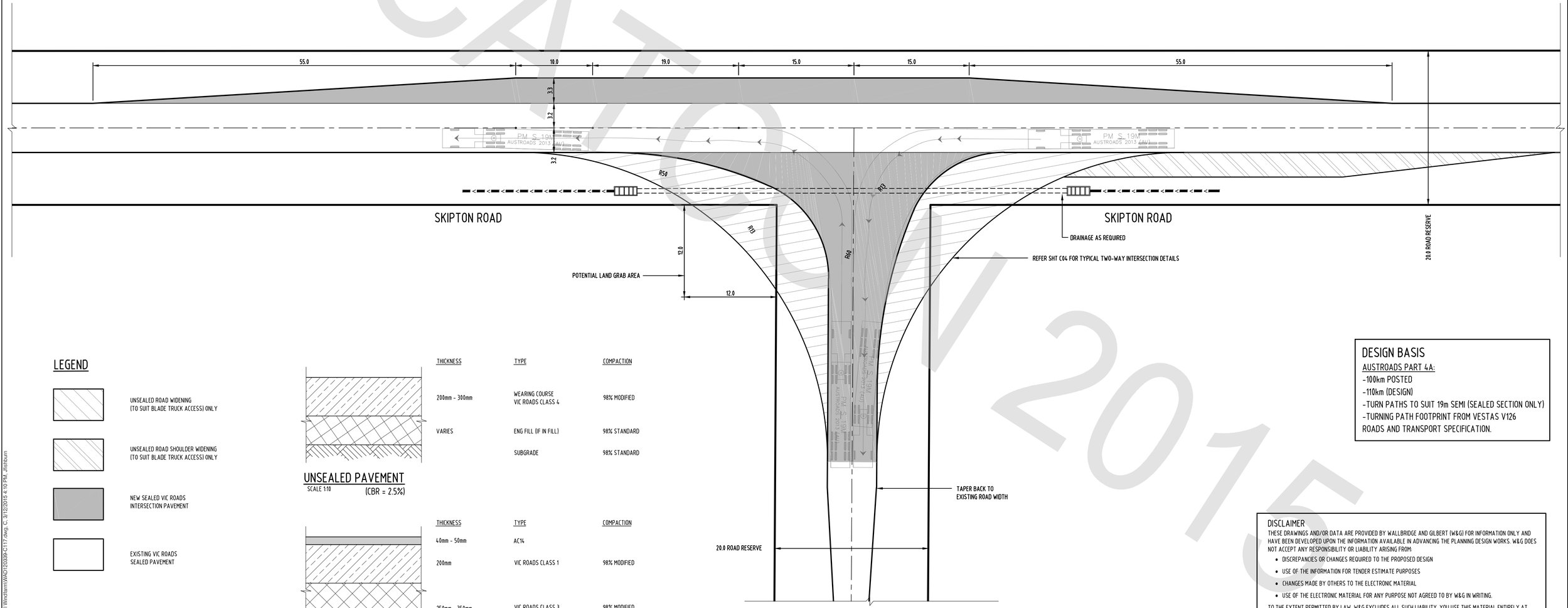

TYPICAL VIC ROADS INTERSECTION (TWO-WAY)
TYPICAL DETAIL

LEGEND

- UNSEALED ROAD WIDENING (TO SUIT BLADE TRUCK ACCESS) ONLY
- UNSEALED ROAD SHOULDER WIDENING (TO SUIT BLADE TRUCK ACCESS) ONLY
- NEW SEALED VIC ROADS INTERSECTION PAVEMENT
- EXISTING VIC ROADS SEALED PAVEMENT

UNSEALED PAVEMENT
SCALE 1:10 (CBR = 2.5%)

	THICKNESS	TYPE	COMPACTION
	200mm - 300mm	WEARING COURSE VIC ROADS CLASS 4	98% MODIFIED
	VARIES	ENG FILL (IF IN FILL)	98% STANDARD
		SUBGRADE	98% STANDARD

VIC ROADS SEALED INTERSECTION PAVEMENT
SCALE 1:10 (CBR = 2.5%)

	THICKNESS	TYPE	COMPACTION
	40mm - 50mm	AC14	
	200mm	VIC ROADS CLASS 1	98% MODIFIED
	250mm - 350mm	VIC ROADS CLASS 3	98% MODIFIED
		SUBGRADE	98% STANDARD

DESIGN BASIS

AUSTROADS PART 4A:
-100km POSTED
-110km (DESIGN)
-TURN PATHS TO SUIT 19m SEMI (SEALED SECTION ONLY)
-TURNING PATH FOOTPRINT FROM VESTAS V126
ROADS AND TRANSPORT SPECIFICATION.

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PROJECT: STOCKYARD HILL WIND FARM
TITLE: VIC ROADS TYPICAL INTERSECTION UPGRADES

SCALE		DRAWING No.	SHT	REV
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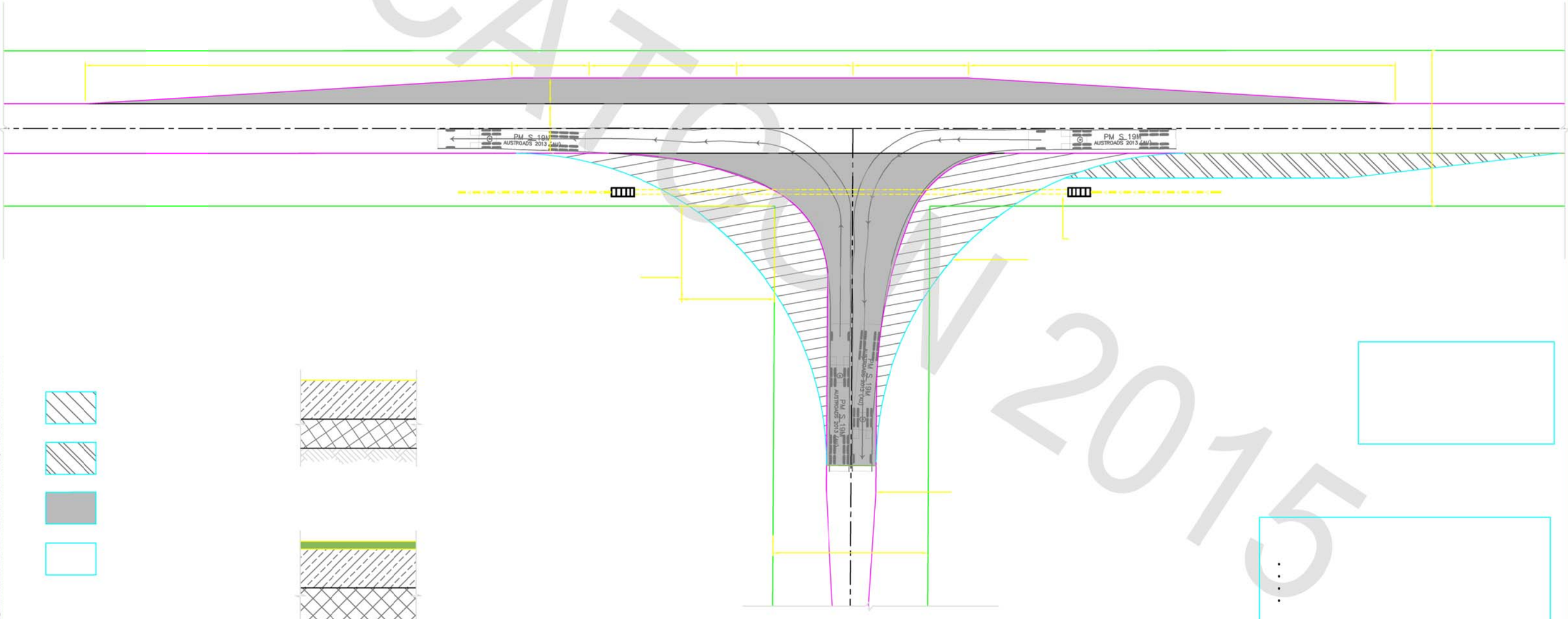

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CHECKED RB	DATE 13.11.15	TITLE	VIC ROADS TYPICAL INTERSECTION UPGRADES
APPROVED	DATE		
CONTRACTOR PROJ. No. WAD120339	SCALE AS SHOWN	A1	DRAWING No. WAD120339 S+T C117 REV C

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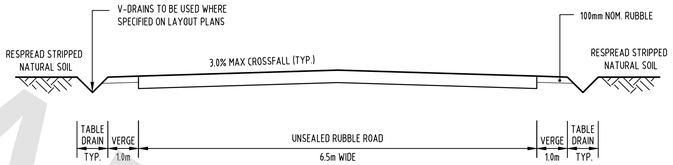
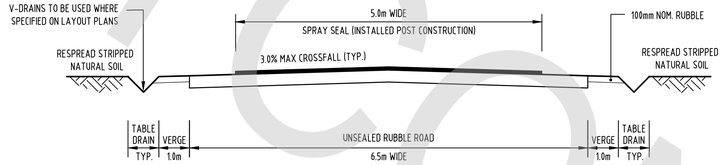


UPGRADED COUNCIL ROAD (TYPE 1)

SCALE 1:50

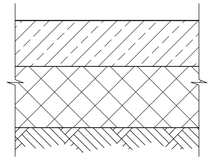
NOTE: PREDOMINATELY UNDEVELOPED ROAD CORRIDORS



UPGRADED COUNCIL ROAD (TYPE 2)

SCALE 1:50

NOTE:
1. EXISTING SEALED SECTION ALONG MOUNT EMU SETTLEMENT ROAD AND STOCKYARD HILL ROAD TO BE REMOVED. ROAD WIDENED TO SUIT TWO WAY TRAFFIC, SEAL TO BE INSTALLED POST CONSTRUCTION.
2. MOUNT EMU SETTLEMENT ROAD CONTAINS AN UPPER SAND LAYER (APPROX 200mm TO BE REMOVED AND REPLACED WITH QUARRY RUBBLE)



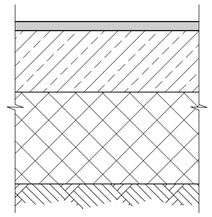
THICKNESS	TYPE	COMPACTION
200mm	WEARING BASE COURSE QUARRY RUBBLE CLASS 4 OR EQUIVALENT	95% MODIFIED
200-250mm	SUB-BASE QUARRY RUBBLE CLASS 4 OR EQUIVALENT	95% MODIFIED
	SUBGRADE	98% STANDARD

TYPE 1-UNSEALED COUNCIL ROAD PAVEMENT

SCALE 1:10

(CBR = 2.5%)

BASED ON CBR = 2.5% ROAD PAVEMENT TO ACHIEVE 250 kPa ALLOWABLE BEARING PRESSURE



THICKNESS	TYPE	COMPACTION
	SPRAY SEAL 14/7mm	
200mm	CRUSHED ROCK BASE VIC ROADS SPEC CLASS 2	98% MODIFIED
300mm	QUARRY RUBBLE SUB-BASE VIC ROADS SPEC CLASS 2-3 OR APPROVED ALTERNATIVE	98% MODIFIED
	SUBGRADE	98% STANDARD

TYPE 2-SEALED COUNCIL ROAD PAVEMENT

SCALE 1:10

(CBR = 2.5%)

GENERAL ROAD BATTER NOTES:

TYPICAL SET OF PARAMETERS FOR BATTER CONSTRUCTION AND TREATMENT

- NO RETAINING STRUCTURES, MECHANICAL STABILISATION (I.E. SOIL ANCHORING) OR CONCRETE SURFACING (I.E. SHOTCRETE)
- NO MULCHING TO BATTERS OR USE OF WEED MATS
- IN STABLE ROCK
  - -MINIMISE BATTER SLOPES (I.E. MINIMUM OF 6:1)
  - -MINIMISE BATTER TRIMS (ALLOW ROCK PROTRUSIONS)
  - -NO TOPSOIL TO BE PLACED ON BATTERS
  - -NO TREATMENT TO BATTERS
- IN UNSTABLE ROCK (I.E. FRIABLE ROCK OR CLAY/ROCK LAYERS)
  - -MINIMISE BATTER SLOPES MAKING ALLOWANCE TO ENSURE LONG TERM STABILITY (I.E. 6:1 TO 1:1)
  - -MINIMISE BATTER TRIMS
  - -NO TOPSOIL (RE-SPREAD NATURAL MATERIAL) TO BE PLACED ON BATTERS
  - -NO TREATMENT TO BATTERS
- IN STABLE SOILS
  - -MINIMISE BATTER SLOPE WITH GEOTECH ASSESSMENT (I.E. 1:1 TO 1:2) TO ENSURE LONG TERM STABILITY
  - -TOPSOIL BATTER WITH SITE WON MATERIAL (AVERAGE 100MM THICKNESS)
  - -SEED USING TRACTOR SPREADER OR HYDROMULCH (ON STEEP BATTERS ONLY, I.E. 1:1) RELYING ON SEASONAL RAINS FOR GERMINATION
- IN UNSTABLE SOILS
  - -MINIMISE BATTER SLOPE WITH GEOTECH ASSESSMENT (I.E. 1:1 TO 1:2) TO ENSURE LONG TERM STABILITY
  - -GEOTECH CONSIDERATION FOR STABILISATION OF BATTER (I.E. PLACE RIPRAP, CUT IN HORIZONTAL RIDGES TO PROVIDE A WATER PATH, PLACEMENT OF A STABLE MATERIAL LAYER TO SURFACE OF BATTER)
  - -TOPSOIL BATTER WITH SITE WON MATERIAL (AVERAGE 100MM THICKNESS)
  - -SEED (ON STEEP BATTERS ONLY, I.E. 1:1) RELYING ON SEASONAL RAINS FOR GERMINATION

ENVIRONMENTAL CONSIDERATIONS DURING THE CONSTRUCTION OF BATTERS

- MINIMISE BATTER SLOPES
- TOPSOIL AS SOON AS PRACTICABLE
- DRYLAND SEED/GRASS FOR STABILISATION USING LOCAL SEED MIXES AT SEASONALLY BEST TIMES
- PLACE TREE DEBRIS TO BATTERS
- CUT IN HORIZONTAL RIDGES TO AID BATTER STABILISTION
- AVOID CONCENTRATE WATER PATHS WHERE POSSIBLE, I.E. DISSIPATE WATER FLOWS OVER LARGE AREAS

THE FOLLOWING CONSIDERATIONS MUST BE TAKEN IN TO ACCOUNT TO DETERMINE FINAL BATTER SLOPES AND TREATMENT:

- ENVIRONMENTAL
- GEOTECHNICAL
- ENGINEERING/CONSTRUCTABILITY
- AESTHETICS

ROAD CROSS SECTION NOTES:

1. CROSSFALL TO BE 3% MAXIMUM
2. ROAD PAVEMENT WIDTHS NOMINATED ON THE LAYOUT PLANS
   ROAD WIDTHS VARY BETWEEN 3.0m TO 5.5m WIDE (TYP)

ROAD VERGE/TABLE DRAIN NOTES:

1. TABLE DRAINS TO BE USED WHERE SPECIFIED ON THE LAYOUT PLANS
2. ROAD VERGES TO BE FORMED WITH 100mm NOM. RE-SPREAD NATURAL MATERIAL WHERE VEGETATION CAN BE ESTABLISHED NOT REQUIRED WHERE IN ROCK
3. 'V' - DRAINS TO BE CUT THROUGH RE-INSTATED SURFACE BY GRADER
4. BATTER SLOPES 1:2 TYP (MAX 1:1)
5. VERGE SURFACE ADJACENT PAVED AREA TO BE ROLLED WITH 4 PASSES OF A 8 TONNE ROLLER (MIN)
6. SEEDING IN ACCORDANCE WITH ENVIROMENTAL SPECIFICATION

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PROJECT: STOCKYARD HILL WIND FARM

TITLE: PUBLIC ROAD CROSS SECTIONS

SCALE		DRAWING No.	SHT	REV
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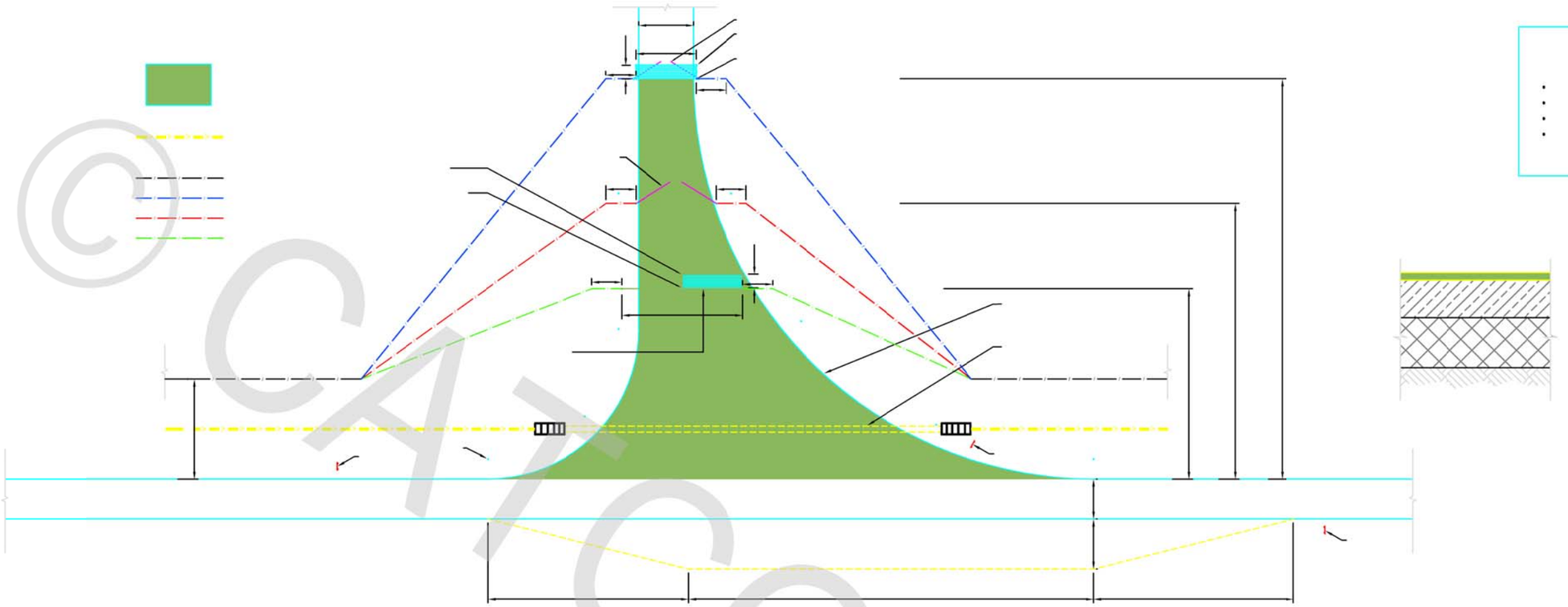

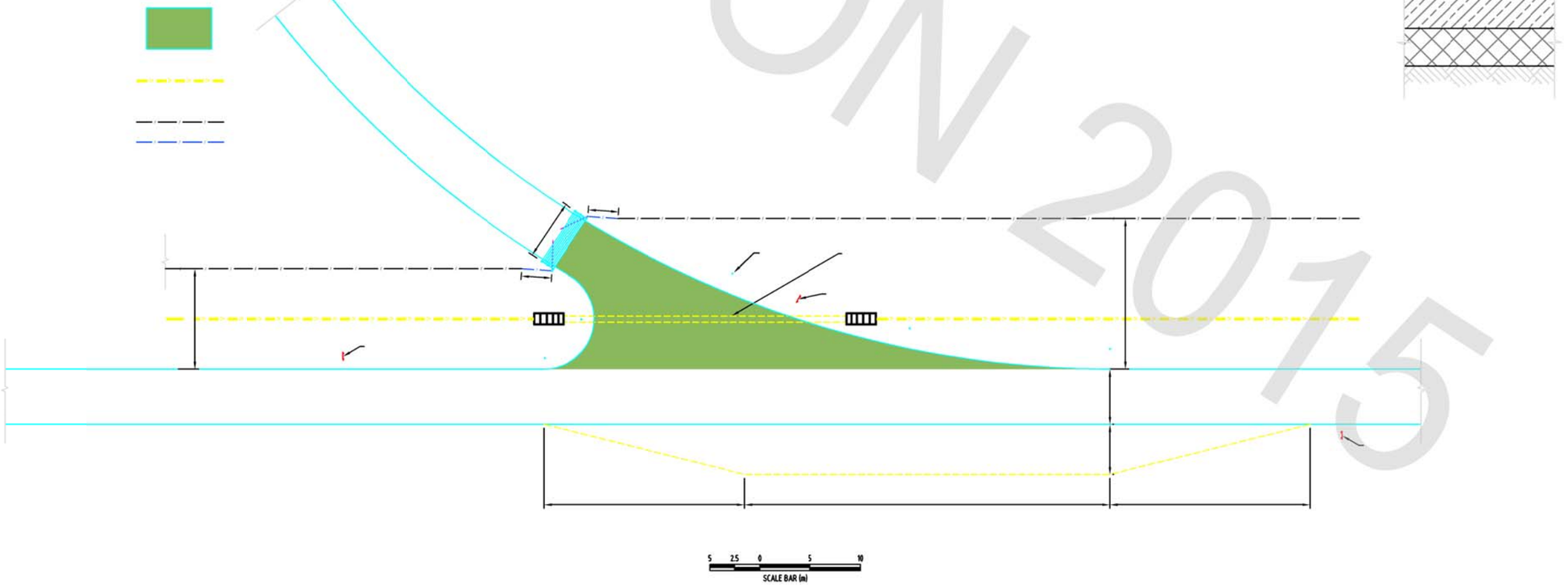

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DRAWN JJF	DATE 13.11.15	PROJECT	STOCKYARD HILL WIND FARM
CHECKED RB	DATE 13.11.15	TITLE	TYPICAL SITE ENTRANCE SHEET 2 OF 2
APPROVED	DATE		
CONTRACTOR PROJ. No. WAD120339	SCALE AS SHOWN	A1	DRAWING No. WAD120339 SHT C108 REV B

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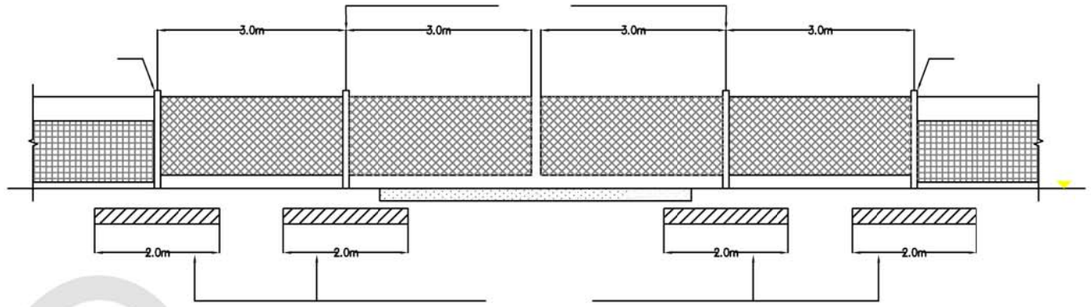
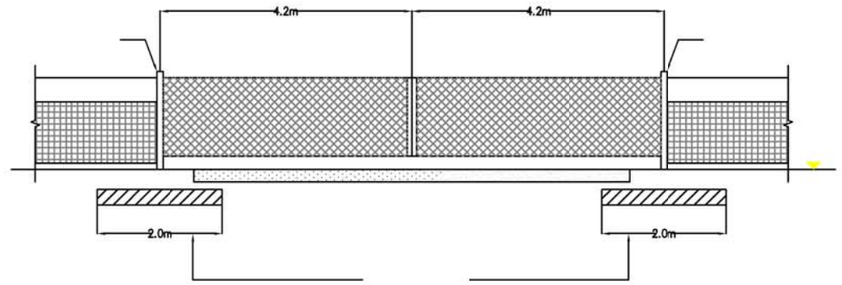
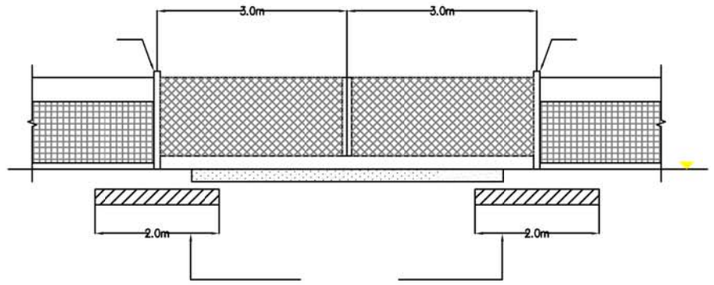


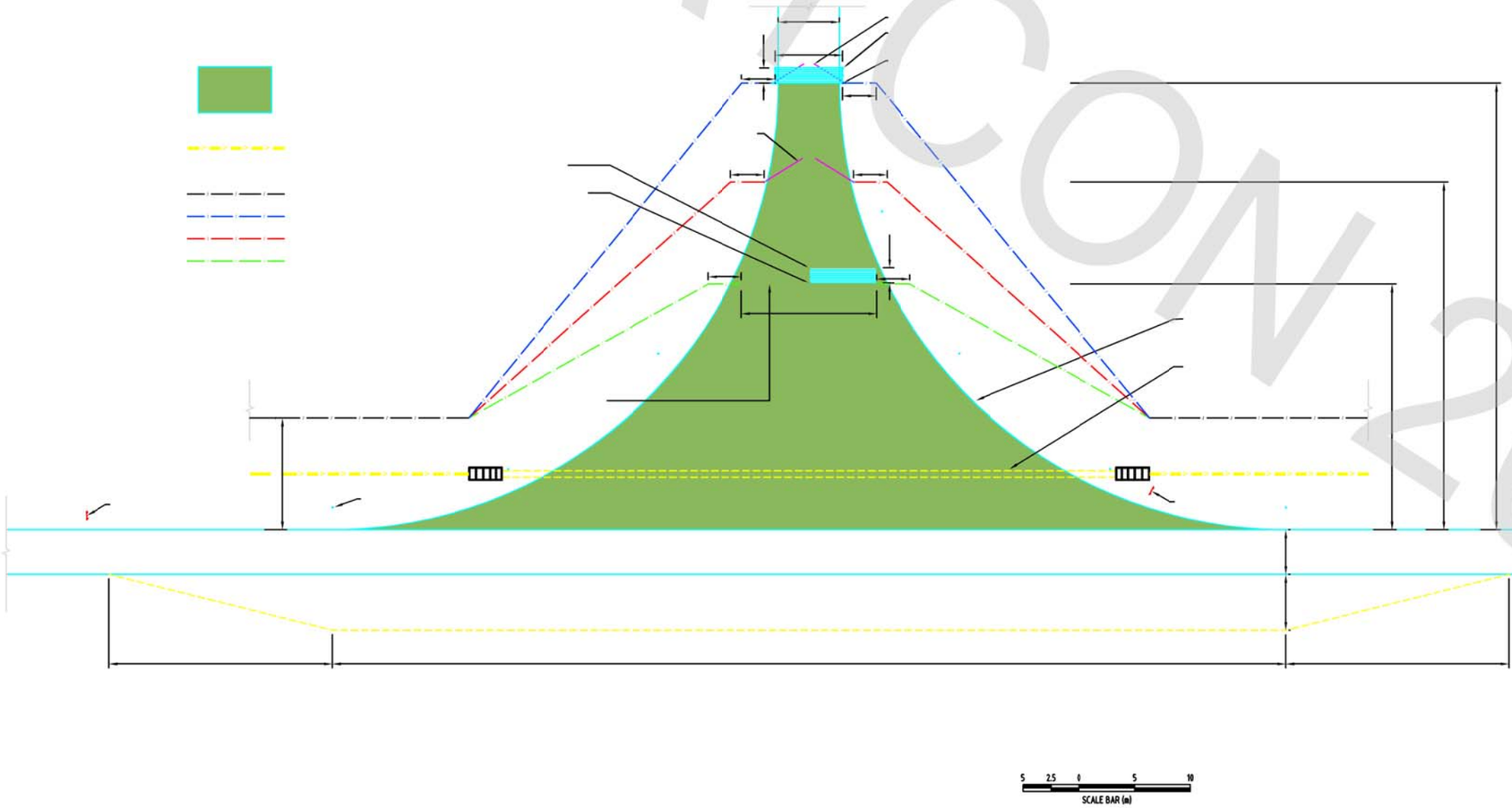
TYPICAL 12m GATE ENTRY DETAIL



TYPICAL 8m GATE ENTRY DETAIL



TYPICAL 6m GATE ENTRY DETAIL



INFORMATION ISSUE
NOT FOR CONSTRUCTION

REV	DETAIL OF REVISION	RVD	CHKD	APP'D	CLIENT	DATE
B	ISSUED FOR REVIEW	JJF	RB		SM	27.11.15
A	ISSUED FOR INFORMATION	JJF	RB		SM	13.11.15

REFERENCE DRAWING

DRAWING No.

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DRAWN JJF	DATE 13.11.15	PROJECT	STOCKYARD HILL WIND FARM
CHECKED RB	DATE 13.11.15	TITLE	TYPICAL SITE ENTRANCE SHEET 1 OF 2
APPROVED	DATE		
CONTRACTOR PROJ. No. WAD120339	SCALE AS SHOWN	A1	DRAWING No. WAD120339 SHT C107 REV B

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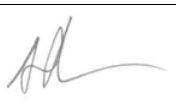
Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	H. Klein	C. Hall		T. Frodsham		14/01/16
B	H. Klein	C. Hall		T. Frodsham		18/01/16
C	H. Klein	C. Hall		T. Frodsham		21/01/16
D	H. Klein	C. Hall		T. Frodsham		22/02/16
E	H. Klein	C. Hall		T. Frodsham		25/02/16
F	H. Klein	C. Hall		T Frodsham		22/04/16

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