# APPENDIX 3

## Crudine Ridge Wind Farm Preferred Project Report – Transport Assessment

## Samsa Consulting Pty Ltd

# Crudine Ridge Wind Farm Project

## Preferred Project Report: Transport Assessment

**November 2013**

SAMSA CONSULTING

TRANSPORT PLANNING & TRAFFIC ENGINEERING

Samsa Consulting Pty Ltd
**Transport Planning & Traffic Engineering**
ABN: 50 097 299 717
46 Riverside Drive, Sandringham, NSW 2219, AUSTRALIA
Telephone: (+61) 414 971 956 or (+612) 9583 2225
E-mail: alansamsa@telstra.com
Web: www.samsaconsulting.com

# Contents

## Appendices

# 1. Introduction

## 1.1 Project Background

Wind Prospect CWP Pty Ltd is a partnership between the Wind Prospect Group (WP) and Continental Wind Partners and is a locally based wind farm development company with an office in Newcastle, NSW. Wind Prospect CWP Pty Ltd propose to develop a wind farm on rural land near Pyramul, New South Wales, midway between Mudgee and Bathurst. The proposed development is known as the Crudine Ridge Wind Farm and would accommodate up to 106 wind turbines, with an installed capacity of approximately 135 megawatts (MW) of energy.

The Project site is located across two Local Government Areas (LGAs): Bathurst Regional Council (BRC) and Mid-Western Regional Council (MWRC). The Project site spans an approximate 16 km length across Crudine Ridge on which the wind turbines, transmission lines and ancillary structures are proposed to be located – refer to *Appendix A: Proposed Wind Farm Layout*.

This assessment investigates transportation issues associated with wind farm component and equipment haulage as part of the Preferred Project Report, which has been prepared in response to submissions received on the Project Environmental Assessment (EA).

The report identifies a preferred transportation mode and haulage routes to various site access points. Prevailing transport constraints and impacts are identified and assessed. Appropriate site access locations from the public road network are also identified. The report will serve as a supporting background paper to the Preferred Project Report (PPR).

## 1.2 Director General's & Other Authority Requirements

Planning NSW's Director General's Requirements (DGRs) require the traffic and transport assessment to assess the construction and operational traffic impacts of the project including:

- Details of traffic volumes (both light and heavy vehicles) and transport routes during construction and operation;
- Assess the potential traffic impacts of the project on road network function (including intersection level of service) and road safety;
- Assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the project (including over-dimensional vehicles) during construction and operation, including full details of any required upgrades to roads, bridges, site access provisions (for safe access to the public road network) or other road features;
- Details of measures to mitigate and/or manage potential impacts;
- Details of access roads within the site including how these would connect to the existing public road network (ie. site access) and ongoing operational maintenance requirements for on-site roads; and
- Consideration of relevant Council traffic / road policies.

In addition to the above DGRs, NSW Roads & Maritime Services (RMS) requires the traffic and transport assessment to include the following:

- Preparation of a Traffic Management Plan (TMP) to address management of additional traffic during construction (and decommissioning) and site access issues;
- Hours and days for construction and operation;
- Unloading and loading of transport and service vehicles, particularly over-size vehicles;
- On-site internal road network layout, parking facilities and infrastructure;
- Details of local climatic conditions that may affect road safety; and
- Any cumulative impacts from other proposed and approved developments in the surrounding area.

## 1.3 Assessment Scope & Methodology

The scope of the assessment included the following tasks:

- Review of project background information including a detailed transport route survey and upgrade assessment report prepared by Downer Infrastructure[1].
- Project discussions with Wind Prospect CWP project team.
- Discussions with relevant Councils and RMS.
- Site visits to the wind farm sites and surrounding road network, including preferred transportation routes.
- Spot traffic counts were undertaken at various locations to confirm counts obtained from RMS and Council sources.
- Estimation of traffic generation during construction and operational phases of the Project.
- Assessment of traffic distribution onto the surrounding local and regional road network.
- Assessment of transport impacts on the surrounding road network including site access, road safety, road capacity and road conditions.
- Discussion of mitigation measures to address potential transport impacts identified.
- Preparation of this Transport Assessment Report to be used as part of the Project's Preferred Project Report (PPR).

## 1.4 Report Structure

The remainder of this assessment report is presented as follows:

Chapter 2 provides an overall project description as well as general details of the wind farm equipment specifications and components.

Chapter 3 describes the potential transport modes as well as existing transport conditions including transport routes and site access points.

1 Downer "*Crudine Ridge Wind Farm: Route Survey and Upgrade Assessment*", 6/06/2013

Chapter 4 assesses the transportation impacts during the construction and operation phases of the Project.

Chapter 5 discusses mitigation measures to address potential transport impacts identified.

Chapter 6 provides a summary and conclusions to the assessment.

# 2. Project Details

## 2.1 Project Description

The Crudine Ridge Wind Farm (the Project) consists of up to 106 wind turbines with a rated capacity upwards of 1.5 MW each. The wind turbines would be three bladed, multi-pitch, horizontal axis machines, with a maximum height of approximately 160 m, ie. from the base of the tower to blade tip when the blade is in the vertical position.

Turbines would be chiefly located on the higher altitude ridges within the site boundary, where they would be well spaced and positioned with a high regard for landscape amenity, existing land use, ecological conservation, and cultural heritage values, and in accordance with relevant legislation – refer to site diagram in *Appendix A: Proposed Wind Farm Layout*.

The Project would also consist of ancillary structures and equipment, which would be positioned in accordance with site constraints. These would typically include:

- Access roads (internal site road network) connecting the public road network to the wind turbine locations and substations.
- Overhead and underground electrical cabling.
- Main and secondary collector substations.
- Underground electrical interconnection lines and control cables within each of the wind turbine clusters, connecting to the main and secondary collector substations.
- Internal overhead electrical interconnection lines and control cables between the main and secondary collector substations.
- Switching station.
- External overhead electrical interconnection lines (up to 132 kV single or double circuit) and associated communications cables between the main collector substation and the switching station;
- Permanent storage compounds.
- Up to six permanent wind monitoring masts.
- Concrete batching plants and rock crushing compounds.
- Cleared areas to store construction materials and wind turbine components (construction laydown areas).
- Construction site offices and site parking.
- Appropriate wind farm signage both during the construction and operational phases of the proposed development.
- Crane hardstand areas for the erection, assembly, commissioning, maintenance, recommissioning and decommissioning of the wind turbines.

The Project would connect to the TransGrid 132 kV overhead transmission line 15 km east of the Crudine ridgeline with the switching station compound to be located adjacent to the point of connection.

The Project site is currently used as rural farm land and this would continue to be the case after construction. Once the Project is operational it would be monitored remotely, with maintenance staff undertaking regular services in line with the selected wind turbine.

The life span of a wind farm is usually 20 to 25 years, after which time there would be an option to either decommission the site, restoring the area to its previous land use with regard to consent conditions and lease requirements, or to upgrade the equipment and extend the wind farm's operational life.

## 2.2 Equipment Features

The model of wind turbine that will be used for the Project has not yet been decided as final turbine selection will occur through a competitive tender process pending Development Consent. However, in terms of generation capacity, the wind turbines currently available in the market place that are under consideration for this Project vary in capacity upwards from 1.5 MW. By way of example the Suzlon S88, 2.1 MW machine (as installed at the Capital Wind Farm, east of Lake George, NSW) is typical of the type of wind turbine that could be used.

Consideration will also be given to the use of different turbine sizes and manufacturers across the site to better utilise the on-site wind resource profile. Under this circumstance, turbine dimensions would still fall within the permissible turbine sizes considered in the Environmental Assessment (EA).

The wind turbine components generally comprise a nacelle and gearbox assembly, hub, blades (three) and tower in three to five sections. Transport of blades would be typically undertaken one at a time with a maximum length of 63 m being considered. The nacelle and gearbox assembly are transported separately to limit transport weights. To facilitate transportation and ease of installation the tower support structure would be manufactured in three to five sections, depending on heights chosen.

The larger dimension wind turbine items such as the blades, nacelles and the larger diameter lower tower components may, when transported, exceed the road standard clearance restrictions and require special transportation permits. There is anticipated to be no issues for transporting the smaller sections of the smaller sized wind turbine components.

### *2.2.1 Turbine Rotor*

Potentially, the turbines to be used for the Project will be three-bladed, semi-variable speed, pitch-regulated machines with rotor diameters between 74 m and 126 m and a swept area ranging from of 4,300 $m^2$ to 12,470 $m^2$. Typically turbines of this magnitude begin to generate energy at wind speeds in the order of 3.5 m/s (12.6 km/h) and shut down (for safety reasons) in wind speeds greater than 25 m/s (90 km/h).

Wind turbine blades are typically made from glass fibre reinforced with epoxy or plastic attached to a steel hub, and include lightning rods for the entire length of the blade. The blades typically rotate at about 12 rpm at low wind speeds and up to 18 rpm at higher wind speeds.

### *2.2.2 Towers*

The supporting structures are comprised of a reducing cylindrical steel tower fitted with an internal ladder or lift. The largest tower height under consideration is 110 m with an approximate diameter at the base of 4.5 m narrowing to 2.5 m at the top. However it is important to note that the rotor diameter suitable for this wind turbine is 100 m and therefore falls within the maximum proposed blade tip height of 160 m. Similarly, the longest blade length under consideration is 63 m, however it is important to note that the tower height suitable for this wind turbine is 94 m and therefore also falls within the maximum proposed blade tip height of 160 m. Alternative tower heights of between 80 and 110 m are also under consideration, however this is not exhaustive since new models and certified designs are continually entering the market place. The tower will typically be manufactured and transported to site in three to five sections for on-site assembly.

### *2.2.3 Blade Tip*

The blade tip will comprise the highest point of the wind turbine when in a vertical position. Given the turbines under consideration, a blade tip height of 160 m is considered to be the maximum. As new turbine models are regularly appearing on the market, blade tip height may vary by up to 5 m to accommodate potential changes to tower heights and blade lengths of new machines.

### *2.2.4 Nacelle*

The nacelle is the housing constructed of steel and fibreglass that is mounted on top of the tower and can be 10 m long x 4 m high x 4 m wide. It encloses the gearbox, generator, transformers (model dependant), motors, brakes, electronic components, wiring and hydraulic and lubricating oil systems. Weather monitoring equipment located on top of the nacelle will provide data on wind speed and direction for the automatic operation of the wind turbine.

### *2.2.5 Footings*

Three types of foundation for the wind turbines will be considered pending geotechnical investigation of the ground conditions at the Project site.

Slab (gravity) foundations would involve the excavation of approximately 450 cubic metres ($m^3$) of ground material to a depth of approximately 2.5 m. Approximately 200 $m^3$ would, if suitable, be used as backfill around the turbine base. Remaining excavation material will be used for the on-site road infrastructure, where necessary. A slab foundation would involve installation of shuttering and steel reinforcement, followed by the pouring of concrete.

If slab plus rock anchor foundations are required, the construction of the foundation for each machine would involve the excavation of approximately 300 $m^3$ of ground material to a depth of approximately 2.5 m. Slab plus rock anchor foundations require shuttering and steel reinforcement, drilling of rock anchor piles up to a depth of approximately 20 m, concrete pour, after which the rock anchors are stressed and secured once the concrete has cured sufficiently.

Alternatively, if a single mono-pile foundation is required (rock anchor), approximately 50 $m^3$ of ground material would be removed by a rock drill to a depth of approximately 10 m, of which 30 $m^3$ would, if suitable, be used as back fill. If a mono-pile foundation is used, a tubular section with tower connection flange attached is inserted in the hole and concrete is then poured in-situ.

Detailed geotechnical surveys will be carried out during pre-construction work to determine the necessary foundation type per wind turbine. It is feasible that more than one type of foundation may be required for the Project, following the assessment of the individual wind turbine locations. New wind turbines are continually coming on to the market and it is possible that minor variations to these typical dimensions could occur prior to final wind turbine selection. This impact assessment assumes the use of slab foundations, which allows for the largest (worst-case) footprint and most concrete use for all turbines.

### 2.2.6 Crane Hardstand and Assembly Areas

Site access roads would have areas of hardstand (approximately 30 m by 50 m) adjacent to each wind turbine for use during component assembly and by cranes during installation. The clearing of native vegetation for the construction of access roads and hardstand areas will be avoided where possible.

The roads would be surfaced with local stone material to required load-bearing specifications. The nature and colour of surface stone would be selected to minimise visual impact prior to construction. The roads and hardstand areas would be maintained throughout the operational life of the Project and used principally for the periodic maintenance of the wind turbines.

### 2.2.7 Monitoring Masts

There are currently three temporary wind monitoring masts installed on the subject site; one 60 m mast located in the Pyramul Cluster, one 100 m mast located in the Sallys Flat Cluster, and one 100 m mast located midway between the clusters, recording wind data for Project development and planning.

Up to six permanent wind monitoring masts, up to 100 m high, are proposed to be installed on-site. Locations for these masts are yet to be determined and will be influenced by the final wind turbine selection, but may include the locations of the existing temporary monitoring masts. These permanent masts will provide information for the performance monitoring of the wind turbines. The wind monitoring masts would be of a guyed, narrow lattice or tubular steel design.

Permanent met masts will require low voltage cable connection for power and also a communications cable to be laid. The trench required for this will be much smaller than for the cables between turbines. The connection would come directly from the closest turbine.

### 2.2.8 Main Collector Substation

The main collector substation will include up to two transformers with capacities ranging between 80 megavolt ampere (MVA) or alternatively a single 180 MVA transformer to step-up the voltage to 132 kV, together with ancillary equipment.

The main collector substation will occupy an area approximately 150 m by 150 m and will be surrounded by a 3 m high security fence. It will include an array of busbars, circuit breakers, isolators, various voltage and current transformers and a static compensator-capacitor as agreed with TransGrid.

Transportation of the transformers, which are typically 90 tonnes each, would be by road and would involve the direct loading onto a platform trailer.

### 2.2.9 Secondary Collector Substation

The secondary collector substation would consist of up to three medium voltage transformers stepping up to 132 kV to minimise on site reticulation losses alongside other ancillary electrical assets such as transformer hardstands, environmental bunding, circuit breakers, busbars, voltage control and communication equipment.

The secondary collector substation will occupy an area approximately 25 m by 25 m and will be surrounded by a 3 m high security fence.

Transportation of the transformers, which are typically 90 tonnes each, would be by road and would involve the direct loading onto a platform trailer.

### *2.2.10 Switching Station*

The switching station will occupy an area approximately 75 m by 100 m and will be surrounded by a 3 m high security fence. The ground surface within the enclosure will be covered partly with a layer of crushed rock and partly by concrete slabs. The 0.75 ha area includes a provision for a 15 m buffer of land surrounding the equipment required by TransGrid.

The switching station will most likely require a communications tower, which is expected to be up to 20 m in height depending on geographic conditions.

Construction access would be via Bombandi Road which is currently unsealed, although the section of Bombandi Road between Castlereagh Highway and the proposed switching station would be upgraded with an all weather access road. Within the proposed switching station compound, an all weather access driveway incorporating provision for car parking would be constructed.

### *2.2.11 Overhead and Underground Cabling*

The electrical cables from the wind turbine sites will comprise a mix of underground and overground cabling and will connect either directly to the main collector substation or via the secondary collector substation.

The underground cable routes will generally be between the turbines and follow the route of the internal access roads. The final route will minimise vegetation clearing, avoid erosion and heritage sites, and will depend on the ease of excavation, ground stability and cost.

Control cables will interconnect the wind turbine generators and the operation facilities building. Computerised controls within each wind turbine will automatically control start-up, speed of rotation and cut-out at high wind speeds and during faults. Recording systems will monitor wind conditions and energy output at each of the turbines. Remote monitoring and control of the Project will also be employed. Control cables will consist of optic fibre, twisted pair or multi-core cable and will be located underground within the groups of turbines.

The installation of buried earthing conductors and electrodes will also be required in the vicinity of the turbines, the facilities building and the sub-stations as required.

A single or double circuit internal overhead transmission line of voltage up to 132 kV may be constructed for connection between the secondary collector substation and the main collector substation or via the secondary collector substation to minimise internal reticulation losses. The 132 kV overhead transmission line will be up to 30 m in height comprising of two cross arms with insulators with an average span length of 250 m. Above-ground control cables would also be strung from the poles of the internal overhead line located between the secondary collector substation and the main collector substation.

A single or double circuit 132 kV external transmission line will be constructed between the main collector substation and switching station for energy export into the grid. The 132 kV overhead transmission line will be up to 30 m in height comprising of two cross arms with insulators with an average span length of 250 m.

# 3. Existing Conditions

## 3.1 Transport Mode

The assessment of transportation of wind turbine components to site involves the separate consideration of the transport mode between:

- Australian ports for imports and other local manufacturing plants located in Australia to the Crudine Ridge wind farm site;
- Transportation through the towns / villages along the transport routes; and
- Site access off the public road network to the internal road network of the Crudine Ridge wind farm site.

The port of entry for imported wind turbine equipment and/or the location of manufacturing sites has not yet been resolved / confirmed. Therefore, this assessment evaluates all potential transport routes from all directions around NSW and beyond, if applicable. It is noted however, that Downer Infrastructure (2013) identified Newcastle Port as the preferred port of import.

Both rail and road transport modes have been considered for transporting the imported and locally manufactured wind turbine and substation transformer components.

*Rail Transport*

Rail as a transport option is potentially possible via the Country Rail Infrastructure Authority (CRIA) rail network that runs to Kandos. This could be accessed from the eastern seaboard via the RailCorp rail network. However, while specially designed flat bed cars and support systems are available to transport long loads of up to 40 m and the rail system can cope with heavy loads, the width of the blade container package or blade height and the size of the larger tower sections would not be able to be transported due to a lack of vertical and horizontal clearance within the electrified sections and at some en-route structures such as bridges.

Transport of components 50 m in length or less, and materials in containers, by rail was also considered. For these materials, problems of scheduling rail services and restriction on track capacity may also affect delivery and would require negotiation and confirmation with rail operators.

The problem also exists of handling and transporting wind turbine components and / or the balance of construction materials from the rail hub to site, requiring road transport in any case. The extent of transportation handling is such that it is not considered feasible to use rail transport.

Therefore, road transport is the only feasible option for transporting the larger wind turbine components and the heavy mass transformers. The use of rail is not considered to be feasible and as an option, rail transport has not been pursued any further.

*Road Transport*

The majority of road routes to Mudgee and Bathurst (being the main centres in close proximity to the Project site) are primarily by either National Routes or State Highways and, subject to statutory permit conditions, can accommodate the proposed wind turbine components generating over-mass and over-size / length vehicles.

Note, for the purposes of this report, the following definitions are used to describe over-dimensional vehicles:

Over-length vehicles: Vehicles transporting wind turbine blades. Due to the nature of the transport routes proposed, two categories of over-length vehicles have been identified. These categories are over-length vehicles approximately up to 50 m in length and over-length vehicles approximately greater than 50 m in length. Over-length vehicles may have similar dimensions to over-size vehicles, but would carry blades up to 63 m in length.

Table 3.1: Typical dimension and weight ranges of WTG blades

| **Wind Turbine Component** | **Component Only** | | **Component on Vehicle** | | |
|---|---|---|---|---|---|
| | **Weight (tonnes)** | **Dimensions (metres)** | **Weight (tonnes)** | **Dimensions (metres)** | **Axle Load (tonnes)** |
| Blade up to 50 m in length | 10 | 50 m long | 42.5 | 55 x 4 x 5 | 6.5 |
| Blade over 50 m in length | 12 | 63 m long | 49 | 68 x 4 x 5 | 8.5 |

Over-size vehicles: Over-size vehicles are those over 19 m in length, 2.5 m in width and / or 4.3 m in height. Vehicles with a gross mass up to 42.5 are also defined as over-size.

Over-mass vehicles: Vehicles transporting wind turbine components, including tower sections, nacelle, generator and rotor hub components and ancillary components above standard road haulage weights and dimensions. Over-mass loads will be carried on trailers, or combinations of trailers, with sufficient axle groups to ensure compliance with point load and overall load limits for the road surface. As such, over-mass vehicles will generally incur less loading stress on the road surface, especially when run under escort with limited speed, than normal heavy vehicle traffic.

Table 3.2: Typical dimension and weight ranges of WTG components

| Wind Turbine Component | Component Only | | Component on Vehicle | | |
|---|---|---|---|---|---|
| | Weight (tonnes) | Dimensions (metres) | Weight (tonnes) | Dimensions (metres) | Axle Load (tonnes) |
| Tower Section | 20 – 65 | 20 – 30 m long | 105 | 39 x 4.5 x 5.5 | 12.5 |
| Nacelle | 75 | 12 x 4.5 x 4 | 120 | 28 x 4.5 x 5.5 | 15 |
| Separate Generator and Gearbox | 30 | | 60 | 25 x 4.5 x 5 | 9 |
| Nacelle with Generator and Gearbox | 100 to 140 | | 215 | 39 x 4.5 x 5 | 13.5 |
| Rotor Hub | 40 | 4.5 x 3 | 78 | 27 x 4.5 x 4.5 | 9 |

Over-dimensional vehicles: Collective term to describe all of the above classifications.

A NSW Roads & Maritime Services (RMS) permit may be obtained for road access for over-mass and over-size / length vehicles along the major road network (National Routes or State Highways) from areas of component manufacture or import to the Mudgee and Bathurst areas. The nominated transport contractor would be responsible for obtaining all necessary transport permits, arranging escort services and any other third party services as required by applicable regulations.

The road network has the flexibility to provide a single transportation mode from origin to the wind farm site without the need for additional loading and handling operations.

*Air Transport*

Due to the over-size nature of wind farm components and the potential difficulties associated with land transport, the option of air transport by helicopter has been considered. This type of transport has been used previously for wind farm projects in difficult to access locations.

Air transport is considered to be the most direct and efficient transport mode, often with a significant reduction in impacts to the community. However, air transport is costly and wind farm components may not necessarily be designed for aerial transport, loading and unloading.

In this case, while air transport has been considered as a transport option, it is unlikely to be practicable with respect to the economic feasibility of this Project.

## 3.2 Road Transport Routes

### *3.2.1 Major Road Network Route Options*

Road transport routes are required to access two site access points (described in detail in *Section 3.2.6* below):

- The Southern Site Access Point:

  Southern access off the northern side of Hill End Road approximately 4.9 km west of Turondale Road.

- The Northern Site Access Point:

  Northern access off the southern side of Aarons Pass Road approximately 2.5 km east of Pyramul Road.

In addition to the above two major site access points, there would be minor and limited construction access required to the switching station site (off Castlereagh Highway via Bombandi Road) and the external transmission line route (potentially off Crudine Road via the transmission line easement).

There are a number of potential transport routes that were identified and assessed. The assessment took into account not only the site access points but also that road transport options from all directions needed to be considered. Effectively, transport from the various directions would travel along the following major State Road or highway routes:

- East and north-east – via Golden Highway and Castlereagh Highway (or alternatively via the Ulan Road-Cassilis Road route between Golden Highway and Mudgee)
- North and north-west – via Newell Highway and/or Castlereagh Highway
- West – via Golden Highway and Castlereagh Highway
- South-west and south – via Newell Highway, Golden Highway and Castlereagh Highway. Potential alternative route is via Mid Western Highway and Great Western Highway (Bathurst)
- East and south-east – via Great Western Highway (Bathurst)

The above major road network provides transport routes to Mudgee in the north (for access to the northern site access point) and Bathurst in the south (for access to the southern site access point): refer to *Figure 3.1* below. The major road network provides a relatively high standard of road infrastructure, generally suitable for transport by heavy and over-size / length vehicles. These routes have relatively wide carriageways and road formations, pavement linemarking, and controlled access to side roads. In general, they have 100 km/h speed limits.

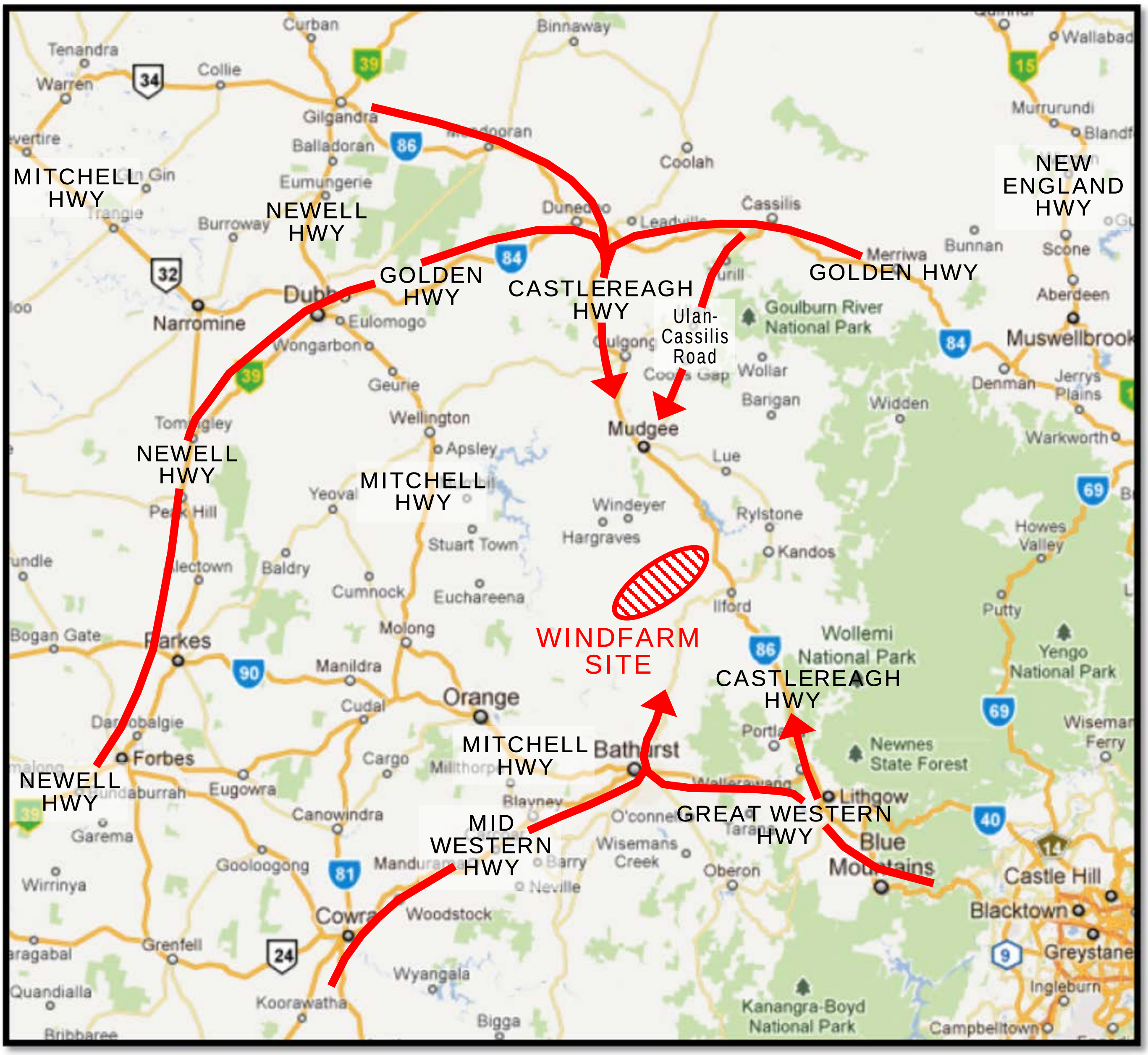



**Figure 3.1: Regional Major Road Network & Transport Routes**

Important exceptions to the above major road network suitability is the Great Western Highway route from the Sydney area through to Lithgow and Bathurst via the Blue Mountains and Ulan - Casslis Road. Discussions with RMS indicate that the Great Western Highway route from Sydney through Lithgow is not suitable for over-dimensional vehicle transport and therefore cannot be used for this transport mode. Similarly, discussions with MWRC have led to the rejection of use of Ulan Rd for over-dimensional vehicles in response to concerns about impacts to that road.

### *3.2.2 Northern Access Route Options*

There are a number of options for road transport of components to the northern site access point via the Mudgee area. These include the following:

- Golden Highway to Mudgee via Castlereagh Highway

- Castlereagh Highway to Aarons Pass Road (also relevant from the south)
- Golden Highway to Mudgee via Ulan Road-Cassilis Road (see note above)
- Castlereagh Highway to Pyramul Road and Aarons Pass Road via Queens Pinch Road and Campbells Creek Road
- Hill End Road to Pyramul Road and Aarons Pass Road via Doughertys Junction Road
- Hill End Road to Pyramul Road and Aarons Pass Road via Windeyer Road
- Diversion off Castlereagh Highway onto Putta Bucca Road through Rocky Waterhole Road, then return to Castlereagh Highway

Route 1: Due to various road network and land use constraints, Route 1 was designed to minimise potential impacts, and is the preferred route. Route 1 runs along the Golden Highway, left-turn south onto Castlereagh Highway, bypass Gulgong urban area via right-turn onto Goolma Road and proceed onto Guntawang Road, right-turn back onto Castlereagh Highway, continue south along Castlereagh Highway through to Mudgee (Market Street). At Mudgee, turn right into Duoro Street, left-turn into Horatio Street and continue south along Castlereagh Highway to turn right (west) into Aarons Pass Road (Downer Infrastructure 2013).

Whilst Route 1 would efficiently accommodate over-size / over-mass vehicles, two corners were identified as having the potential to create delays if navigated by over-length vehicles carrying blades greater than 50 m long. These corners are the right-turn from Market Street onto Douro Street and the left-turn from Douro Street onto Horatio Street.

It was determined that it would be possible for over-length vehicles to navigate the left-turn from Douro Street onto Horatio, however, those over-length vehicles carrying blades greater than 50 m long would require use of the incorrect side of the road (on Douro Street) and parking restriction zones adjacent to the intersection. It was assessed that over-length vehicles carrying blades greater than 50 m long could take up to five minutes to travel through this intersection.

To avoid use of both these turns a diversion off the RMS route (Cox Street / Short Street / Lawson Street / Mortimer Street / Burrundulla Avenue diversion) is proposed. The corners associated with this variation are all suitable for over-length vehicles, and road pavement conditions were assessed as suitable for the loads proposed (Downer Infrastructure 2013).

Route 2: Castlereagh Highway (Market Street) turn left into Cox Street, right-turn into Short Street, right-turn into Lawson Street, left-turn into Mortimer Street, veer right into Burrundulla Avenue and turn left to rejoin the Castlereagh Highway.

The original Traffic and Transport Report (Samsa, 2011) initially reviewed and assessed transport along Aarons Pass Road, and determined it was unsuitable for transport of over-dimensional loads. In light of the submissions received through the exhibition phase, and in particular MWRC's submission regarding the use of Aarons Pass Road as a transport option, the route was re-assessed. Subsequent to a detailed survey (Downer Infrastructure 2013), it is now considered that the road is suitable for the transport of over-dimensional components, with recommended upgrades.

The various constraints of the alternative routes, noted previously, are as follows:

- Castlereagh Highway to Pyramul Road and Aarons Pass Road via Queens Pinch Road and Campbells Creek Road – the Queens Pinch Road / Campbells Creek Road connection between Castlereagh Highway and Pyramul Road is not preferred due to numerous sections of tight horizontal alignment along steep grades over the central range area, which would restrict the transport of long and over-size loads without significant realignment upgrades. While the carriageway width is generally adequate, there are sections of unpaved road in relatively poor condition. The route also has several causeways and two narrow (less than 4 m), single-lane bridges requiring 'give way' from one direction.

- Hill End Road to Pyramul Road and Aarons Pass Road via Doughertys Junction Road – the Doughertys Junction Road connection between Hill End Road and Aarons Pass Road (via Sallys Flat Road) is not preferred due to a combination of sections of tight horizontal and vertical alignment, narrow carriageway width and poor pavement conditions, which would restrict the transport of long and over-size loads without significant roadworks. Roadside trees would also result in numerous obstructions for movement of large vehicles.
- Hill End Road to Pyramul Road and Aarons Pass Road via Windeyer Road – while this route (previously assessed in detail for the EA) was considered to be feasible subject to various road upgrades, issues have been raised by MWRC and others with respect to its current sub-standard condition and the requirement for significant upgrade works to make it suitable for the transport of long and over-size loads as well as the balance of heavy vehicle movements required during the construction period. Subsequent assessment confirmed that significant upgrades would be required prior to the construction phase, including full upgrades of four bridges and a piped culvert. It was also determined that Project related traffic could cause significant delays along these routes during construction if utilised. It is considered that this route would be adequate for light vehicles (cars) and smaller transport vehicles and could be used as an alternative route for these vehicles.
- Ulan-Cassilis Road – this road was previously considered as Route 1b, an optional route for over-length vehicles only. It was determined that the road was of a suitable standard for use of over-length vehicles, given their dimensions. However, during discussions between the Proponent and MWRC on 11 July and 24 September 2013 concerns were raised regarding use of Ulan Road. In response to MWRC's concerns, the Proponent removed Ulan Road as an option for over-length vehicles.
- Putta Bucca Road, right-turn onto Henry Lawson Drive, right-turn onto Ulan Road, left-turn onto Lue Road, right-turn onto Rocky Waterhole Road, left-turn to rejoin the Castlereagh Highway - this route, which bypasses Mudgee, was identified through the consultation process for the preferred project report. Assessment determined that the route and road surfaces would be technically suitable for over-dimensional vehicles, however, works would be required at three intersections (Downer Infrastructure 2013). Utilisation of each of these intersections would potentially require significant works. Further, the extent of upgrade works required for the left hand turn from Ulan onto Lue Road has the potential to impact on a footpath and the visual amenity of the Mudgee township. Given MWRC's concerns regarding impacts to Ulan Road, the Proponent considered that use of even a short section of the road would not be appropriate.

Refer to *Figures 3.2* and *3.2(a)* below showing the preferred transport route and route options assessed in detail, other alternative routes considered and the minor access route required to the switching station site and the external transmission line route.

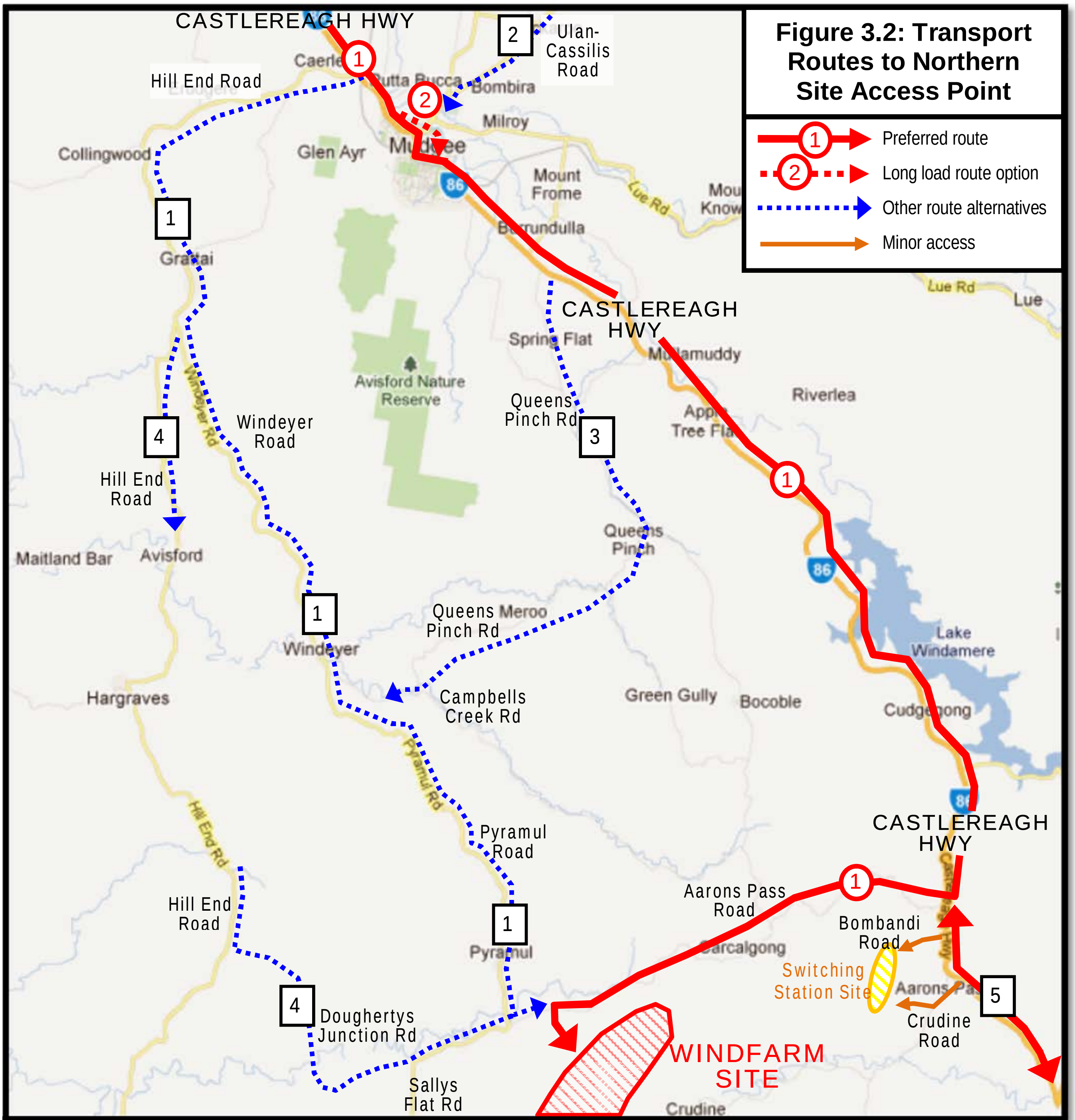



**Figure 3.2: Transport Routes to Northern Site Access Point**

| | |
|---|---|
| 1 | ▪ Hill End / Windeyer / Pyramul Road connection to Aarons Pass Road has sub-standard conditions and need for significant upgrade works – considered to be adequate as an alternative route for light vehicles (cars) and smaller transport vehicles. |
| 2 | ▪ Ulan-Cassilis Road / Castlereagh Highway route through Mudgee is not preferred due to MWRC concerns in regards to its use for heavy vehicle and over-dimension transport. |
| 3 | ▪ Queens Pinch Road / Campbells Creek Road connection between Castlereagh Highway and Pyramul Road is not preferred due to sections of tight alignment along steep grades. |
| 4 | ▪ Doughertys Junction Road connection between Hill End Road and Aarons Pass Road (via Sallys Flat Road) is not preferred due to sections of tight alignment, narrow carriageway width and poor pavement conditions. |
| 5 | ▪ Castlereagh Highway south of Aarons Pass Road connection to site access is feasible for non-over-size vehicles and is an alternative route in both directions. |

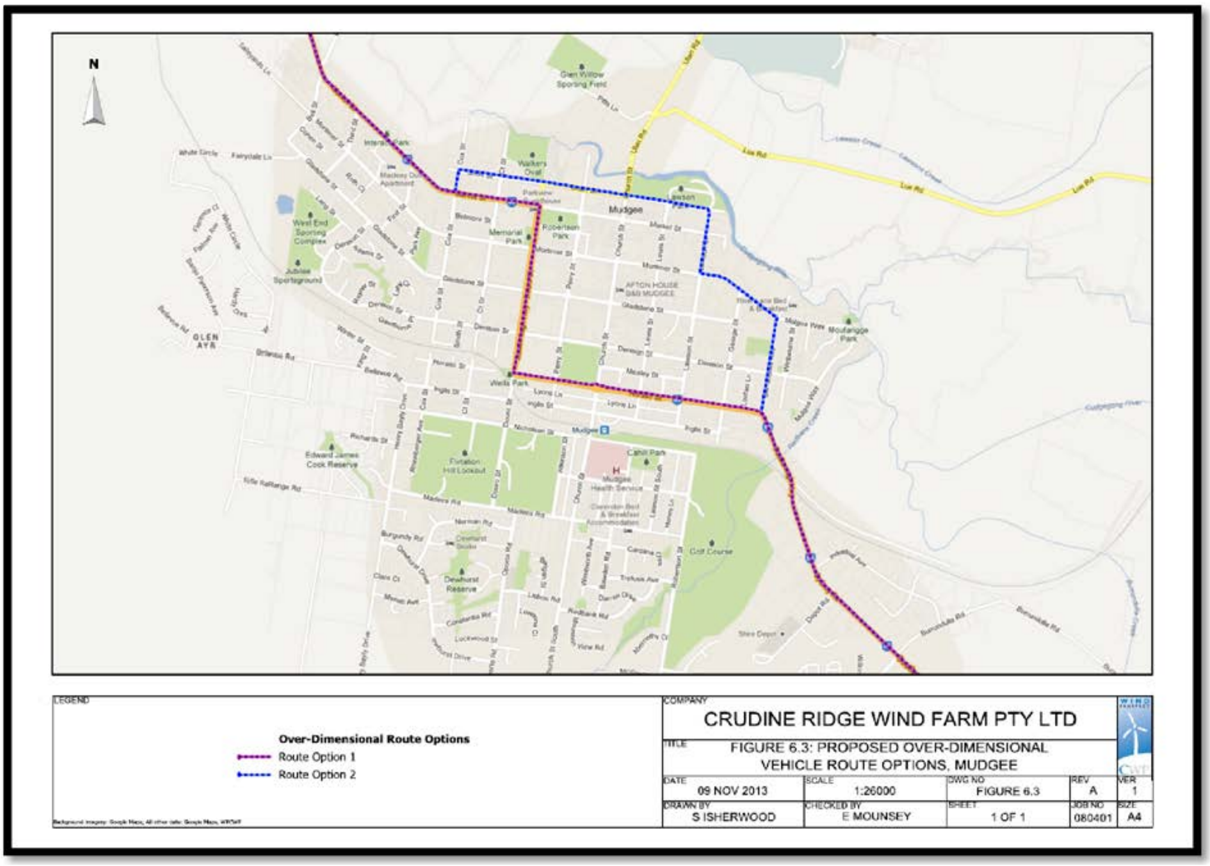



**Figure 3.2(a): Transport Routes Through Mudgee Urban Area**

### *3.2.3 Assessment of Preferred Northern Access Route*

Major Road Network

*Castlereagh Highway*

Castlereagh Highway is a State Highway (SH86), forming an arterial route from Great Western Highway (west of Lithgow) in the south to Gilgandra in the north. With respect to the Mudgee area, it provides a north-south link between the east-west Golden Highway and the Mudgee area as well as south of Mudgee to Great Western Highway near Lithgow.

Castlereagh Highway is generally a two-lane, undivided road with varying shoulder widths and formations. There are sporadic sections of additional (overtaking) lanes, eg. near Lake Windamere, at Aarons Pass Road, etc. The pavement condition is generally average to good, commensurate with its status as a State Highway and its suitability as a route for larger heavy vehicles, eg. B-doubles.

The general road environment can be described as flat to gently rolling terrain with some sharper curves requiring lower advisory speeds within the background 100 km/h speed zone. The road environment and alignment are generally conducive to over-dimensional vehicle transport. Any over-dimensional vehicle issues would be covered under the RMS permit system for over-dimensional transportation along the major road network.

Traffic volumes along Castlereagh Highway north of Mudgee in 2005 varied from approximately 3,700 vehicles per day (vpd), north of Hill End Road, to almost 5,000 vpd, approaching the Mudgee urban area[2]. South of Mudgee, traffic volumes along Castlereagh Highway vary from approximately 4,647 vpd (south of railway level crossing) to 2,115 vpd (1.2 km south of Burrundulla Road) to 1,584 vpd (north of Kandos Road) to 4,300 vpd (south of Boulder Road)[3]. From site observations and spot counts along Castlereagh Highway, it is estimated that daily traffic volumes are currently of the same order as those described above.

Mudgee Urban Area Road Network

*Route 1: Market Street, Duoro Street, Horatio Street*

This route along the Mudgee urban area, which is part of the preferred Route 1, is proposed for over-mass and over-size vehicles (not over-length vehicles). The route would travel along Market Street, Duoro Street and Horatio Street before travelling along Castlereagh Highway to the south of Mudgee. All the roads have a 50 km/h urban area speed limit.

Market Street forms the Castlereagh Highway entry to Mudgee from the north and travels east-west. It is largely residential in character with intermittent commercial land uses. Market Street is relatively wide, especially at its eastern end and has priority over side streets along its length. It intersects with Duoro Street at a roundabout with raised median splitter islands, which would be problematic for over-length loads greater than approximately 50 m in length. Hence, the preferred over-length vehicle route (Route 2) has been identified (see below and *Figure 3.2(a)* above).

Duoro Street is largely residential with some commercial land uses as well as Mudgee Public School and Mudgee High School, which are located on its eastern side between Gladstone Street and Horatio Street. Duoro Street is relatively wide and is divided by a central grassed median. It has priority over side streets along its length and it turns left into Horatio Street as part of the Castlereagh Highway route through Mudgee.

Horatio Street, also known as Castlereagh Highway, is a busy section of the route, commensurate with its status as a through route as part of the Castlereagh Highway. It has two travel lanes and marked parking lanes in either direction. It has priority over side street junctions and is mainly residential in character although there is some commercial activity at its eastern end.

The route through the urban area does not present any significant restrictions to the movement of over-size or over-mass vehicles with the use of traffic management measures. Some street signage would need to be made removable and some parking restrictions would be required at corners along the route as well as other minor traffic management to temporarily control parking along swept path areas (refer to Downer Infrastructure, 2013).

In 2008, traffic volumes in the Mudgee urban area along Route 1 described above varied from approximately 5,000 vpd (Market Street approach to town) to approximately 7,000 vpd (Duoro Street) to approximately 8,500 vpd (Horatio Street)[4].

*Route 2: Market Street, Cox Street, Short Street, Lawson Street, Horatio Street, Mortimer Street, Burrundulla Avenue*

This route for transport of over-length loads only would travel along Market Street (as per

2 Traffic volume data from 2005 provided by Mid Western Regional Council

3 RMS counting station no's 99.169, 99.922, 99.267 and Barnson "*Traffic & Rail Impact Assessment: Lidsdale Siding Upgrade Project*" May 2012

4 Gennaoui Consulting "*Mudgee Traffic Management Study*", March 2008

preferred Route 1) before turning left into Cox Street, right into Short Street, right into Lawson Street, left into Mortimer Street, right into Burrundulla Avenue and onto Horatio Street before travelling along Castlereagh Highway to the south of Mudgee. All the roads have a 50 km/h urban area speed limit.

Cox Street is relatively wide and residential in character. It is a relatively short distance to Short Street from Market Street. Both intersections with Market Street and Short Street have relatively large curved alignments. The turn at the Cox Street corner into Short Street will require some branches removed from a tree on the left-hand side as well as some temporary parking restrictions on the entry and exit of the corner. Temporary parking restrictions will also be required at the Short Street corner into Duoro Street (refer to Downer Infrastructure, 2013).

Short Street travels east-west and is largely residential in character with some recreational land use (Lawson Park and Mudgee Swimming Pool) on its northern side. Short Street is relatively wide and divided by a central grassed median for much of its eastern end. It ends and turns south into Lawson Street with a relatively large curve.

Lawson Street is mainly residential and relatively wide, especially at its northern end where the pavement width is approximately 11 m. This narrows to approximately 8 m at its southern end near Horatio Street.

Mortimer Street is wide and predominantly residential in nature. The turn onto Mortimer Street has sufficient clearance to accommodate vehicles carrying blades up to 60 metres in length.

The right turn from Mortimer Street onto Burrundulla Avenue is broad and sweeping, also having sufficient clearance to accommodate vehicles carrying blades up to 60 metres in length.

There is a slight rise on Burrundulla Avenue at the approach to the Castlereagh Highway and a sign in the median strip that may require being removable, Traffic management would consist of escorts holding through traffic on the Castlereagh Highway if traffic is heavy.

The route through the urban area does not present any significant restrictions to the movement of over-dimensional vehicles. It is acknowledged that over-length vehicles would need to utilise the full road formation width (ie, travel on the opposite side of the road) when negotiating corners. This would be strictly controlled with traffic management in place, eg. pilot vehicles holding oncoming traffic and industry standard radio protocol between pilots / escorts and over-length vehicles. Some street signage would need to be relocated or made removable along the route as well as other minor traffic management to temporarily control parking along swept path areas (refer to Downer Infrastructure, 2013).

In 2008, traffic volumes in the Mudgee urban area along the route described above varied from approximately 2,100 vpd (Short Street) to approximately 530 vpd (Lawson Street)[5]. While traffic volumes were not available for the eastern end of Mortimer Street and Burrundulla Avenue, it is estimated that these would be similar to those along Lawson Street and certainly less than 1,000 vpd.

5 Gennaoui Consulting "*Mudgee Traffic Management Study*", March 2008

## Rural Roads

*Aarons Pass Road*

Aarons Pass Road is an unclassified local road between the Pyramul Road / Sallys Flat Road junction in the west to Castlereagh Highway in the east. The length of Aarons Pass Road proposed to be used for transport is approximately 20 km from Castlereagh Highway at its eastern end to the proposed northern site access point.

Aarons Pass Road has relatively consistent conditions and standards of unsealed pavement, which is generally of average quality with some poorer quality sections. Carriageway width varies from approximately 4 m to 6 m, which includes soft shoulder areas. The general alignment is undulating with some tight horizontal and vertical alignments.

Along the route, there are numerous trees that will require foliage trimming or removal to allow for the swept paths of over-dimensional vehicles. Moreover, there are a number of causeways and/or sag alignments that may require road upgrades to accommodate over-dimensional transport.

Traffic volumes were approximately 23 vpd, east of Pyramul Road in 2004[6]. Site observations and spot counts indicate that current traffic volume levels are still very low (less than 100 vpd) at both ends of the road. This is confirmed by the arrangement of the local road network with its minimal local traffic generators.

The following road characteristics are noted along Aarons Pass Road (based on the route survey undertaken by Downer Infrastructure, 2013), which would need to be considered by the transport contractor:

- Intersection with Castlereagh Highway has adequate swept path radius for the over-dimensional wind farm components. Due to sight restrictions at the crest alignment where the junction is located, traffic control will be required to control highway movements when larger vehicles turn across northbound highway traffic to access Aarons Pass Road off the highway.
- Approximately 1.0 km west of Castlereagh Highway, there is a right curve alignment where trees will need to be removed on the inside of the curve and the curve levelled on both sides to allow for transport by over-dimensional vehicles.
- Approximately 2.5 km west of Castlereagh Highway, there is a right curve alignment where the outside of the curve requires levelling to allow for transport by over-dimensional vehicles.
- Approximately 2.8 km west of Castlereagh Highway, there is a left curve alignment where the outside of the curve requires levelling to allow for transport by over-dimensional vehicles.
- Approximately 3.0 km west of Castlereagh Highway, there is a right curve alignment where trees will need to be removed on the inside of the curve and the curve levelled on the inside to allow for transport by over-dimensional vehicles.
- Approximately 3.1 km west of Castlereagh Highway, there is a right curve alignment where trees will need to be removed on the inside of the curve and the curve levelled on the inside to allow for transport by over-dimensional vehicles.

6 Traffic volume data from May 2004 provided by Mid Western Regional Council

- Approximately 3.8 km west of Castlereagh Highway, there is a relatively sharp vertical crest alignment, which will need to be upgraded to provide suitable ground clearance for transport by over-dimensional vehicles.
- Approximately 3.9 km west of Castlereagh Highway, there is a left curve alignment where trees will need to be removed on the inside of the curve and the curve levelled on the inside to allow for transport by over-dimensional vehicles.
- Approximately 5.3 km west of Castlereagh Highway, there is a relatively sharp vertical crest alignment, which will need to be upgraded to provide suitable ground clearance for transport by over-dimensional vehicles.
- Approximately 6.6 km west of Castlereagh Highway, there is a right curve alignment where trees and fence post will need to be removed / relocated on the inside of the curve and the curve filled and levelled on the inside to allow for transport by over-dimensional vehicles.
- Approximately 6.9 km west of Castlereagh Highway, there is a relatively steep grade and sharp vertical crest alignment, which will need to be upgraded to provide a suitable maximum grade and adequate ground clearance for transport by over-dimensional vehicles.
- Approximately 7.3 km west of Castlereagh Highway, there is a left curve alignment where the outside of the curve will need filling and levelling to allow for transport by over-dimensional vehicles.
- Approximately 7.7 km west of Castlereagh Highway, there is a left curve alignment where the outside of the curve will need filling and levelling to allow for transport by over-dimensional vehicles.
- Approximately 8.1 km west of Castlereagh Highway, there is a left curve alignment where trees will need to be removed on the inside of the curve and the curve filled on the inside to allow for transport by over-dimensional vehicles.
- Approximately 9.1 km west of Castlereagh Highway, there is a left curve alignment where the outside of the curve will need filling and levelling to allow for transport by over-dimensional vehicles.
- Approximately 10.7 km west of Castlereagh Highway, there is a right curve alignment where trees will need to be removed on the inside of the curve, an existing culvert extended to the right and the curve filled and levelled on the inside to allow for transport by over-dimensional vehicles.
- Approximately 10.9 km west of Castlereagh Highway, there is a left curve alignment where the outside of the curve will need filling and levelling to allow for transport by over-dimensional vehicles.
- Approximately 11.0 km west of Castlereagh Highway, there is a right curve alignment where trees will need to be removed on the inside of the curve, an existing culvert extended to the right and the curve filled and levelled on the inside to allow for transport by over-dimensional vehicles.
- Approximately 12.0 km west of Castlereagh Highway, there is a right curve alignment where trees will need to be removed on the inside of the curve and the curve levelled on the inside to allow for transport by over-dimensional vehicles.

- Approximately 12.5 km west of Castlereagh Highway, there is a relatively sharp vertical crest alignment, which will need to be upgraded to provide suitable ground clearance for transport by larger vehicles.
- Approximately 12.9 km west of Castlereagh Highway, there is a left curve alignment where the curve will need to be levelled on both sides and filled on the left side to allow for transport by over-dimensional vehicles.
- Approximately 13.0 km west of Castlereagh Highway, there is a right curve alignment where trees and a fence post will need to be removed on the inside of the curve, an existing embankment removed / flattened on the inside of the curve and the left side (outside of curve) widened / levelled to allow for transport by over-dimensional vehicles.
- Approximately 13.2 km west of Castlereagh Highway, there is a right curve alignment where a number of trees (approximately 15 trees) will need to be removed on the inside of the curve and the curve levelled on the inside to allow for transport by over-dimensional vehicles.
- Approximately 15.3 km west of Castlereagh Highway, there is a left curve alignment where a number of trees (approximately six trees) will need to be removed on the inside of the curve and the curve levelled on the inside to allow for transport by over-dimensional vehicles.
- Approximately 15.4 km west of Castlereagh Highway, there is a right curve alignment where the curve will need to be levelled on the outside of the curve to allow for transport by over-dimensional vehicles.
- Approximately 15.7 km west of Castlereagh Highway, there is a left curve alignment where a number of trees (approximately four trees) will need to be removed on the inside of the curve and the curve levelled on the inside to allow for transport by over-dimensional vehicles.
- From approximately 16.0 km west of Castlereagh Highway to the proposed northern site access point, road width and cross-drainage (culverts) need widening to at least 6 metres. A culvert needs widening at 16.0 km west of Castlereagh Highway.
- Approximately 17.3 km west of Castlereagh Highway, there is a causeway that will need to be confirmed for structural adequacy to allow the transport of over-mass loads.
- Approximately 17.9 km west of Castlereagh Highway, there is a causeway that will likely need to be replaced due to existing failure (cracking) and poor condition of sub-grade pavement layer.
- Approximately 19.2 km west of Castlereagh Highway, there is a causeway that will likely need to be replaced due to existing failure (cracking) and poor condition of sub-grade pavement layer.
- Approximately 19.6 km west of Castlereagh Highway, there is the proposed northern site access point. Local widening will be required to allow suitable swept path for transport by over-dimensional vehicles.
- In general, Aarons Pass Road needs to be upgraded to a 6 m wide formation. An unsealed surface is considered to be adequate as per the on-site access road network and as per local routes used for other wind farm projects.

- Passing bays are proposed along the shoulder areas approximately every 1 km, where practicable without substantial tree clearing. With traffic management in place (eg. pilot vehicles holding oncoming traffic at nearest passing bays and industry standard radio protocol between pilots / escorts and over-dimensional vehicles) this route would not present any significant safety issues for the transportation of the wind farm components.
- Some general pruning of overhanging trees will be required to create a suitable vertical clearance plane.

Refer to *Section 5.4* for typical examples of upgrade works and other risk mitigation measures along over-size transport routes.

*Bombandi Road / Crudine Road (Minor Access Routes)*

Both Bombandi Road and Crudine Road are unclassified local roads running west off Castlereagh Highway. Only the eastern sections of each road are proposed to be used for minor and limited transport to the switching station site (Bombandi Road) and the external transmission line route (Crudine Road).

Crudine Road at its eastern end is sealed with average pavement conditions and a carriageway width of approximately 5 m to 6 m. For travel further west / south, Crudine Road conditions deteriorate somewhat with unsealed surfaces, narrower carriageway widths and poor horizontal and vertical alignment.

Bombandi Road is sealed for a length of only some 60 m from its junction with Castlereagh Highway after which it becomes a relatively narrow unsealed road of approximately 4 m to 5 m width.

At Castlereagh Highway, both roads form ‘Give Way’ controlled T-junctions. The Crudine Road junction has a protected right-turn bay off Castlereagh Highway. Adequate sight distance along Castlereagh Highway is available at both junctions.

Although traffic volumes were not available for either road, site observations and spot counts indicate very low traffic volume levels less than 100 vpd. This is reinforced by the ‘closed’ arrangement of the local road network with its minimal local traffic generators and the condition of both roads along other sections (narrow, unsealed, poor alignment).

It is proposed that the currently unsealed section of Bombandi Road required for minor access would be upgraded with an all weather access road. The short section of Crudine Road does not require any significant road upgrades for the type and volume of traffic proposed to use it.

### 3.2.4 Balance of Plant Route Options

There are a number of options for road transport of construction material and components to the southern and northern site access points via the Bathurst or Lithgow areas from the south and the Mudgee area from the north. These include the following:

- Castlereagh Highway to Hill End Road via Sofala-Ilford Road
- Castlereagh Highway to Hill End Road via Crudine Road
- Great Western Highway to Hill End Road via Gilmour Street (Bathurst) and Sofala Road
- Hill End Road route (from north and west) via Hill End township

- Sallys Flat Road connection to southern site access from northern site access (Pyramul Road / Aarons Pass Road)
- Great Western Highway to Hill End Road via Gilmour Street (Bathurst), Eleven Mile Drive, Wellington Street, Duramana Road and Turondale Road

Due to various road network constraints, the preferred road transport route that has been assessed in detail is Great Western Highway, left or right-turn north into Gilmour Street (Bathurst), continue north into Sofala Road and Peel Road, left-turn west into Hill End Road.

Additionally, a viable route from the east is from Castlereagh Highway to Hill End Road via Ilford-Sofala Road. This latter route allows transport from the Mudgee area in the north and from Lithgow area in the south.

For the purposes of clarity in this report, the above routes will be identified as follows:

Route A – Bathurst (Gilmour Street) continue into Sofala Road / Peel Road and left-turn into Hill End Road.

Route B – Castlereagh Highway (from north), turn right into Ilford-Sofala Road and right-turn into Hill End Road.

Route C – Castlereagh Highway (from south), turn left into Ilford-Sofala Road and right-turn into Hill End Road.

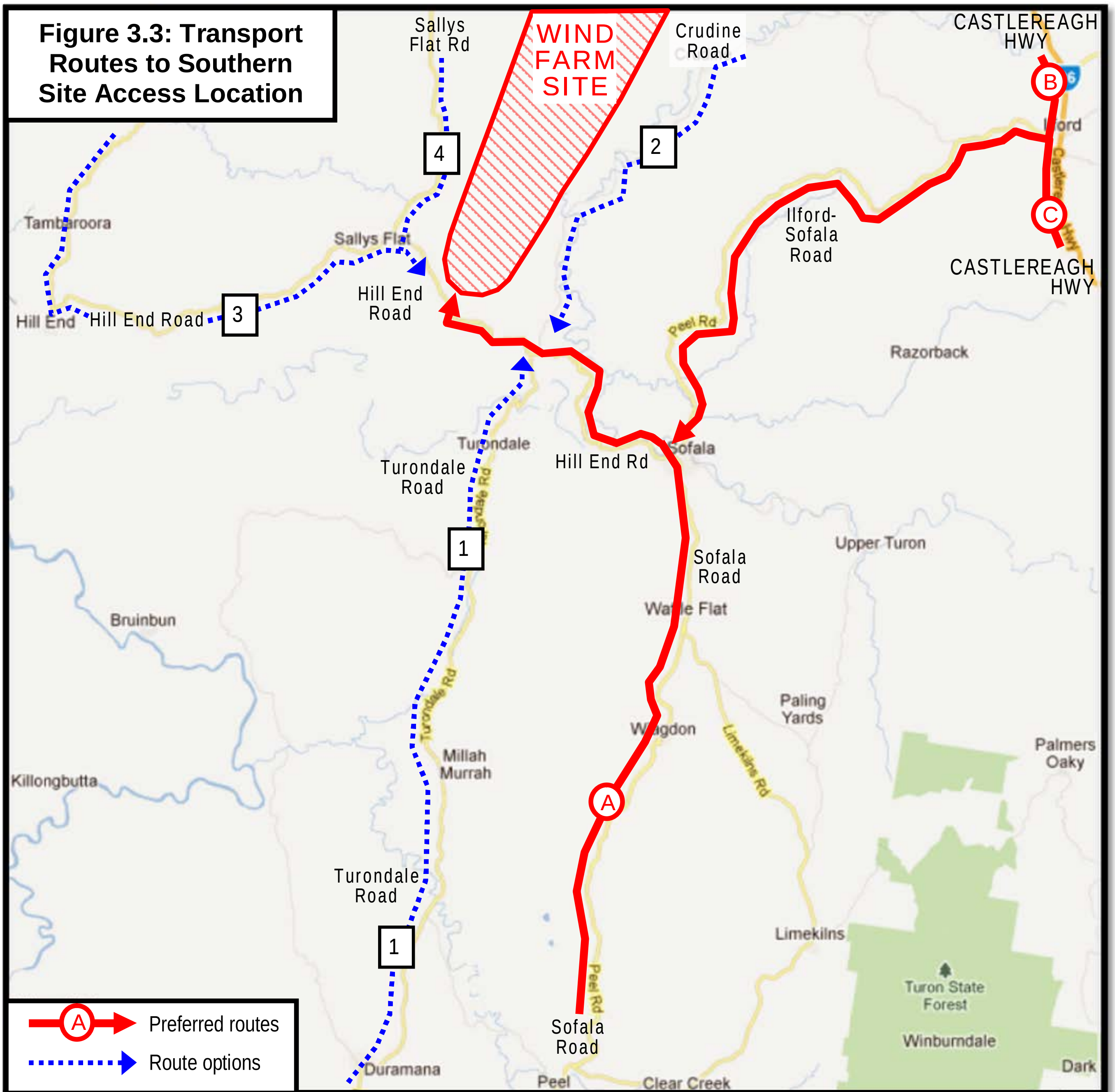
Route 1 – Castlereagh Highway to the northern site access point (see Route description above).

The road network constraints of the alternative routes are as follows:

- Bathurst urban area to Hill End Road via Duramana Road / Turondale Road is not preferred due to steep grades and very tight, hairpin curves on the approach and departure from the Coles Bridge over Turon River. BRC have indicated that this route is feasible for standard heavy vehicle transport but prefer the Sofala Road route north from Bathurst. Therefore, this could be a possible alternative or contingent transport route for standard heavy vehicle transport.
- Castlereagh Highway to Hill End Road via Crudine Road – the Crudine Road connection between Castlereagh Highway and Hill End Road is not preferred due to several sections of tight horizontal and vertical alignment, numerous causeways and poor unsealed pavement conditions.
- Hill End Road route (from north and west) via Hill End township – travel from the north (Mudgee) via the Hill End Road route requires travel through the Hill End township area. This route is not preferred due to its length from the north (almost 90 km from Castlereagh Highway turn-off north of Mudgee), and narrow carriageway widths and a very tight corner within the township area.
- Sallys Flat Road connection to southern site access from northern site access (Pyramul Road / Aarons Pass Road) – the Sallys Flat Road connection to southern site access point from Pyramul Road / Aarons Pass Road is not preferred due to sections of tight horizontal alignment, several causeways and narrow carriageway widths, and poor, unsealed pavement conditions. Downer Infrastructure (2013) indicates that subject to the type of vehicles using this route, some relatively minor upgrading (eg. widening to facilitate passing, using crushed gravel without modification to the existing formation) may be undertaken for its use if required.

Refer to *Figures 3.3* and *3.4* below showing the preferred transport route that was assessed in detail and other route options considered.

**Figure 3.3: Transport Routes to Southern Site Access Location**




| | |
|---|---|
| 1 | ▪ Duramana / Turondale Road connection between Bathurst and Hill End Road is not preferred due to very tight, hairpin curves on the approach and departure from the Coles Bridge over Turon River, although this could be a possible alternative route. |
| 2 | ▪ Crudine Road connection between Castlereagh Highway and Hill End Road is not preferred due to sections of tight horizontal and vertical alignment, numerous causeways and poor pavement conditions. |
| 3 | ▪ Hill End Road route (from north and west) via Hill End township is not preferred due to its length from the north, and narrow carriageway widths and a very tight corner within the township. |
| 4 | ▪ Sallys Flat Road connection to southern site access from northern site access (Pyramul Road / Aarons Pass Road) is not preferred due to sections of tight horizontal alignment, narrow carriageway widths and poor pavement conditions. |

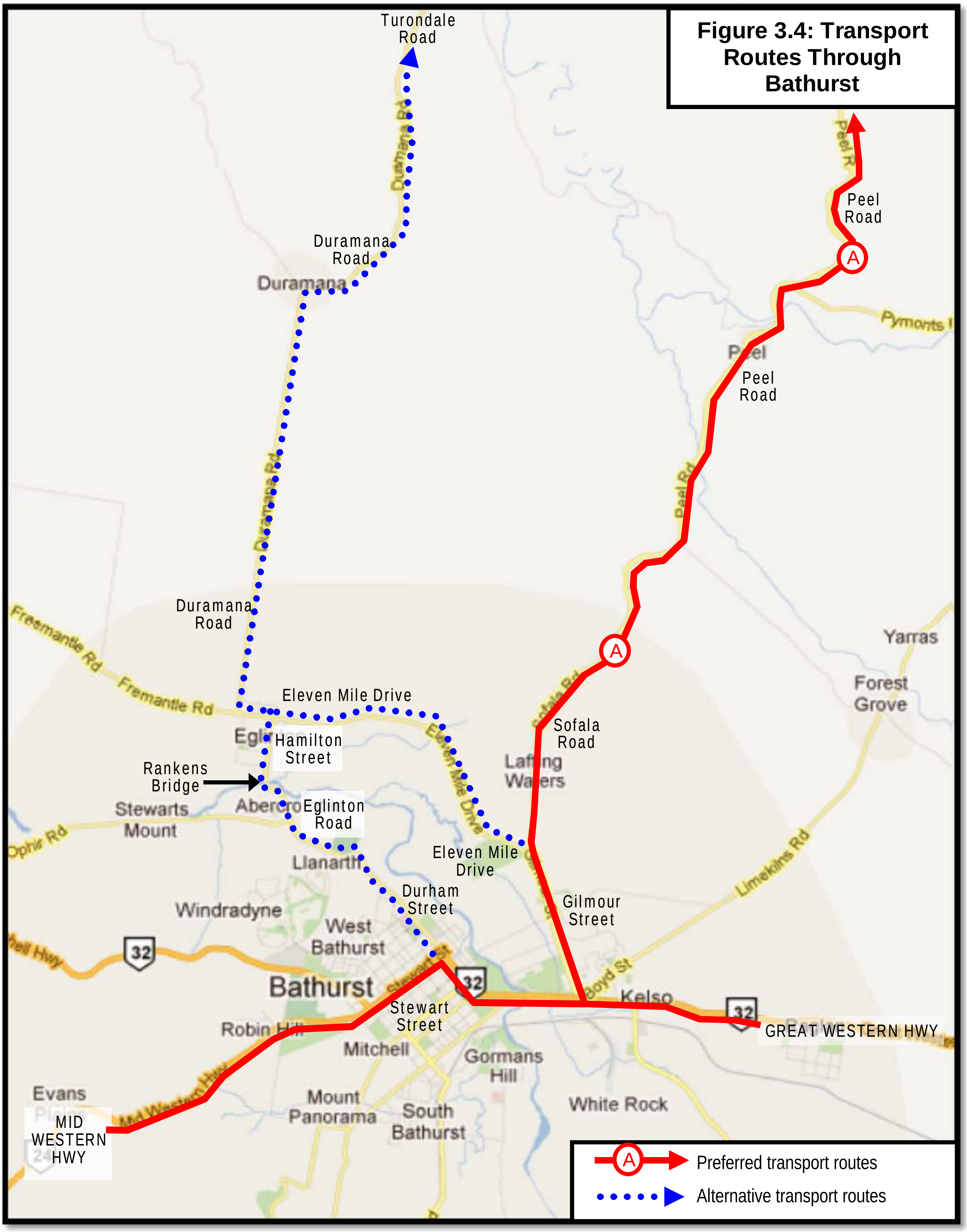



**Figure 3.4: Transport Routes Through Bathurst**

### 3.2.5 *Assessment of Preferred Southern Access Routes*

Major Road Network

*Great Western Highway*

Great Western Highway is a State Highway (SH32), forming part of National Route A32 from the Sydney metropolitan area in the east to Bathurst and beyond in the west. With respect to the Bathurst area, it provides a link east to Lithgow, Blue Mountains and beyond to Sydney, while to the west it connects to Orange, Dubbo and beyond.

Approaching Bathurst, Great Western Highway is generally a two-lane, undivided road with available overtaking lanes. The pavement condition is generally good, commensurate with its status as a State Highway and its suitability as a route for larger heavy vehicles, eg. B-doubles. Within the Bathurst urban area, the highway becomes a four-lane road incorporating two travel lanes in each direction separated by a central median.

The general road environment for the highway approach to Bathurst can be described as rolling terrain with some sharper curves requiring lower advisory speeds within the background 100 km/h speed zone. The road environment and alignment are generally conducive to standard heavy vehicle transport.

Traffic volumes along Great Western Highway in 2010 at Raglan Creek, Bathurst were almost 23,000 vpd[7].

*Castlereagh Highway*

Castlereagh Highway is a State Highway (SH86), forming an arterial route from Great Western Highway (west of Lithgow) in the south to Gilgandra in the north. With respect to its southern end, it provides a north-south link between the Lithgow area to the Mudgee area.

North of Great Western Highway (west of Lithgow), Castlereagh Highway is generally a two-lane, undivided road with varying shoulder widths and formations. There are sporadic sections of additional (overtaking) lanes along steeper grades. The pavement condition is generally average to good, commensurate with its status as a State Highway and its suitability as a route for larger heavy vehicles, eg. B-doubles.

The general road environment can be described as flat to gently rolling terrain with some sharper curves requiring lower advisory speeds within the background 100 km/h speed zone. The road environment and alignment along the southern end of Castlereagh Highway are generally conducive to over-dimensional vehicle transport, however the Project only proposes over-dimensional vehicle transport from Golden Highway and the Mudgee area to the northern site access point.

Traffic volumes along the subject section of Castlereagh Highway are approximately 1,600 vpd (north of Kandos Road) to 4,300 vpd (south of Boulder Road)[8]. From site observations and spot counts along Castlereagh Highway, it is estimated that daily traffic volumes are currently of the same order as those described above.

*Mid Western Highway*

Mid Western Highway is part of National Route A24, travelling west from Bathurst to Sturt Highway (A20) at Hay in western NSW. Relevantly, it provides a south-western connection

7 Traffic volume data from 2010 provided by Bathurst Regional Council
8 RMS counting station no. 99.267 and Barnson "*Traffic & Rail Impact Assessment: Lidsdale Siding Upgrade Project*" May 2012

into Bathurst from the Cowra area and its surrounding major road network.

Approaching Bathurst, Mid Western Highway is generally a two-lane, undivided road with varying shoulder widths and formations and available overtaking lanes. The pavement condition is generally average to good, commensurate with its National Route status and its suitability as a route for larger heavy vehicles, eg. B-doubles.

The general road environment can be described as rolling terrain with some sharper curves requiring lower advisory speeds within the background 100 km/h speed zone. The road environment and alignment are generally conducive to standard heavy vehicle transport.

Traffic volumes along Mid Western Highway on the western outskirts of Bathurst in 2005 were approximately 3,700 vpd[9]. From site observations and spot counts along Mid Western Highway, it is estimated that daily traffic volumes are currently of the same order as those recorded in 2005.

### Bathurst Urban Area

*Gilmour Street*

On approaching Bathurst, the transportation route ideally needs to be diverted around the town's central urban area due to greater vehicular and pedestrian traffic impacts. Gilmour Street most directly provides access to the Sofala Road / Peel Road route and has the least constraints and impacts as opposed to alternative routes.

Gilmour Street is an extension of the Sofala Road route south to Great Western Highway. It intersects Great Western Highway at a signalised T-junction. Great Western Highway is a divided four-lane road with right and left-turn bays into Gilmour Street. Gilmour Street is a typical two-lane urban collector road north of Great Western Highway with dual turn lanes on its approach to the T-junction.

Gilmour Street is largely residential along its length to Sofala Road / Eleven Mile Drive, a distance of almost 3 km. It has a background 60 km/h speed limit with a 40 km/h school speed zone immediately north of the highway junction.

In 2006, traffic volumes along Gilmour Street were approximately 5,200 vpd near the highway junction[10]. It is assumed that current traffic volumes have remained at similar levels to those in 2006.

### Rural Roads

*Sofala Road / Peel Road*

The Sofala Road / Peel Road route (both sides of Sofala village) between Bathurst and Castlereagh Highway is a regional route (MR 54) and tourist drive providing access north from Bathurst to the Mudgee area via Castlereagh Highway.

Sofala Road continues on from Gilmour Street at Eleven Mile Drive in the south (within the Bathurst urban area). It continues through the villages of Peel, Wattle Flat, Sofala and eventually Ilford at Castlereagh Highway. At its northern / eastern end, it is also known as Ilford-Sofala Road. The length of the route is approximately 69 km between Castlereagh Highway and Gilmour Street with approximately 40 km between Gilmour Street and Hill End Road at Sofala.

9 RMS counting station no.99.847
10 Traffic volume data from 2006 provided by Bathurst Regional Council

In general, the Sofala Road / Peel Road route has relatively consistent conditions and standards along its length with varying carriageway width from approximately 6 m to 8 m incorporating two travel lanes with periodic lengths of centreline linemarking and shoulder areas. The pavement conditions are generally good with stable, sealed carriageway edges, although there are some sections of lesser standard with infrequent patching and rutting resulting in an average pavement.

The general alignment is undulating with larger radius curves. There are some sections with shorter radius curves and steeper grades (over 10%) but these are localised. There are a number of bridge crossings although all appear to be adequate for standard heavy vehicle transport.

In 2005, traffic volumes near Sofala village were approximately 1,050 vpd while near Ilford (west of Castlereagh Highway) traffic volumes were approximately 900 vpd[11]. While traffic volumes increase on the approach to the Bathurst urban area, the remainder of the route has similar volumes to the volumes above. Site observations and spot counts indicate that these traffic volume levels are still likely to be approximately 1,000 vpd at present.

*Hill End Road*

Hill End Road (MR216) is a regional road connecting the town of Hill End to Castlereagh Highway in the north and Sofala in the east. The relevant section of Hill End Road for the southern access route is west of Sofala.

Hill End Road varies in width from 5 m to 7 m wide with mostly no linemarking. The section east of Turondale Road is more varying in nature with some upgraded sections of above average condition and some relatively poorer standard of road sections. West of Turondale Road, there are some narrower sections formed due to alignment constraints and recently installed safety barriers. Pavement conditions along this section are generally good.

The general road environment can be described as undulating to hilly terrain with some sharper curves requiring lower advisory speeds within the background 100 km/h speed zone.

Traffic volumes along Hill End Road are unknown, although less than 100 vpd were recorded in 2005 west of Sofala[12]. From site observations and spot counts, it has been estimated that current daily traffic volumes along the subject section of Hill End Road are still likely to be less than 100 vpd.

## 3.3 Wind Farm Site Access Locations

There are proposed to be two major site access points serving all the wind turbine locations and the majority of the other ancillary facilities – refer to *Figures 3.2* and *3.3* above and *Appendix A: Proposed Wind Farm Layout*. An internal site road network would allow access across the entire Project site, providing the flexibility of external transportation to either of the site access locations.

The two major site access points are proposed to be located as follows:

- Northern site access point: Off the southern side of Aarons Pass Road approximately 2.5 km east of Pyramul Road.

11 RMS survey information (2011)
12 RMS counting station 99.342 (2005)

- Southern site access point: Off the northern (eastern) side of Hill End Road approximately 4.9 km west of Turondale Road.

In addition to the above two major site access points, there would be minor and limited construction access required to the switching station site (off Castlereagh Highway via Bombandi Road) and the external transmission line route (potentially off Crudine Road via the transmission line easement).

With respect to each major site access point, the following pertinent issues have been identified.

*Northern site access point*

- Sight distance to the east along Aarons Pass Road is considered to be adequate subject to some tree / vegetation pruning required. There is a slight crest on the western approach to the proposed site access location, which partially restricts sight distance towards light vehicles (cars) to approximately 150 m. Larger (taller) vehicles would be able to be sighted over 200 m away. While this restriction in sight distance is less than what would normally be required for a paved road with a 100 km/h speed limit, it is not considered to be critical for the following reasons:
  - Construction traffic movements would be left-turn in and right-turn out, thus should have minimal affect on traffic from both directions, especially under traffic control;
  - The road at this location is unsealed and traffic speeds are likely to be well below 100 km/h due to pavement conditions and the general road environment; and
  - Traffic volumes are very low (< 100 vpd) and consist predominantly of local rural traffic familiar with the conditions and likely to be familiar with the Project construction activities.

*Southern site access point*

- There is an uphill grade and crest on the western (northern) approach to the proposed site access location, which restricts sight distance to less than 120 m. For the eastern (southern) approach, sight distance is also restricted to approximately 150 m although it is not as severe due to the gentler crest alignment. These restrictions in sight distance are less than the minimum 225 m required for a paved road with a 100 km/h speed limit.

## 3.4 Existing Traffic Flows

Existing traffic volumes were obtained from RMS data or from Council (where available). Data along the northern access route was provided by MWRC, while BRC provided data along the southern access route. RMS data is generally in the form of average annual daily traffic (AADT) and has been adjusted to represent vehicle volumes.

RMS data is predominantly based on traffic volumes from 2005 counts for two-way flows. However, site traffic count surveys (one-hour counts during peak travel periods) and observations were undertaken along the most critical road sections to confirm that current traffic flows were of the same order as those recorded in previous years. Traffic volumes were further reviewed and updated as appropriate. Peak hour traffic flows have been assumed to be between 10% and 15% of daily traffic flows for the more heavily trafficked roads.

Existing traffic volumes in vehicles per day (vpd) and vehicles per (peak) hour (vph) for the relevant surrounding road network are shown in *Table 3.1* below.

**Table 3.3: Existing Traffic Volumes**

| Road | Vehicles Per Day (vpd) | Vehicles Per Hour (vph) | Traffic Volume Source |
|---|---|---|---|
| Northern Access Route (Routes 1 and 2) | | | |
| Castlereagh Highway | | | |
| – north of Hill End Road | 3,751 | 450 | Council data (2005) |
| – south of rail level crossing | 4,647 | 550 | RMS counting station 99.169 (2005) |
| – south of Burrundulla Ave | 2,115 | 250 | RMS counting station 99.922 (2005)<br>Similar numbers confirmed by on-site observations and spot counts. |
| Goolma Road | 1,300 | 160 | Traffic counts (March 2013) |
| Mudgee urban area | | | |
| – Market St | 5,000 | 600 | Consultant report (2008) |
| – Duoro St | 7,000 | 800 | |
| – Short St | 2,100 | 250 | |
| – Lawson St | 530 | 100 | |
| – Horatio St | 8,500 | 900 | |
| – Mortimer St and Burrundulla Ave | similar to Lawson St | similar to Lawson St | Estimate |
| Crudine Road | <100 | <10 | Estimates from on-site observations and spot counts. |
| Bombandi Road | <50 | <10 | |
| Aarons Pass Road – 50 m east of Pyramul Road | 23 | <10 | Council data (May 2004). Similar numbers confirmed by on-site observations and spot counts. |
| Southern Access Route (Routes A, B, C) | | | |
| Great Western Highway at Raglan Creek, Bathurst | 22,849 | 2,300 | Council data (2010) |
| Great Western Highway, 1.5 km | 6,770 | 750 | RMS counting station 99.921 (2005). Similar |

| Road | Vehicles Per Day (vpd) | Vehicles Per Hour (vph) | Traffic Volume Source |
|---|---|---|---|
| west of Glanmire | | | numbers confirmed by traffic count survey. |
| Mid Western Highway, west of Stewart Street | 3,782 | 450 | RMS counting station 99.847 (2005). Similar numbers confirmed by traffic count survey. |
| Gilmour Street, north of Great Western Highway | 5,218 | 600 | Council data (2006). Similar numbers confirmed by traffic count survey. |
| Castlereagh Highway | | | |
| – north of Kandos Rd | 1,584 | 200 | RMS counting station 99.267 (2005) |
| – south of Boulder Rd | 4,300 | 500 | Consultant report. Similar numbers confirmed by on-site observations and spot counts. |
| Sofala Road / Peel Road | | | |
| – near Sofala village | 1,050 | 150 | RMS survey information (2011) |
| – west of Castlereagh Hwy | 900 | 120 | RMS survey information (2011) Similar numbers confirmed by on-site observations and spot counts. |
| Hill End Road | | | |
| – at Evans Shire Boundary | 75 | <20 | RMS counting station 99.305 (2005) |
| – west of Sofala | 86 | <20 | RMS counting station 99.342 (2005) Similar numbers confirmed by on-site observations and spot counts. |
| Alternative Routes Considered | | | |
| Hill End Road – west of Castlereagh Highway | 1,444 | 200 | Council data (January 2007) Similar numbers confirmed by traffic |

| Road | Vehicles Per Day (vpd) | Vehicles Per Hour (vph) | Traffic Volume Source |
|---|---|---|---|
| | | | count survey |
| Hill End Road – 900 m north of Old Grattai Road | 1,195 | 150 | Council data (April 2009). |
| Hill End Road at 3800 Hill End Road | 113 | < 30 | Council data (2009). Similar numbers confirmed by on-site observations and spot counts. |
| Windeyer Road – east of Hill End Road | 229 | <50 | RMS counting station 99.461 (1992). Similar numbers confirmed by on-site observations and spot counts. |
| Pyramul Road (north)<br>(south) | 54<br>80 | <20<br><20 | Council data (August 2004 & June 2002). Similar numbers confirmed by on-site observations and spot counts. |
| Crudine Road<br>Bombandi Road | <100<br><50 | <10<br><10 | Estimates from on-site observations and spot counts. |
| Ulan-Cassilis Road<br>– southern (Mudgee) end<br>– north of Wollar Rd | <br>5,700<br>2,491 | <br>650<br>300 | Council information (2011: estimated from average weekday traffic) |
| Stewart Street, east of Vittoria Street | 13,896<br>(axle pair) | 1,500 | RMS counting station 99.722 (2005). Similar numbers confirmed by traffic count survey. |
| Eleven Mile Drive | 1,480 | 200 | Council data (2006). Similar numbers confirmed by on-site observations and spot counts. |
| Wellington Street, between Duramana Road and Alexander Street | 2,197 | 300 | Council data (2006). Similar numbers confirmed by on-site observations and |

| Road | Vehicles Per Day (vpd) | Vehicles Per Hour (vph) | Traffic Volume Source |
|---|---|---|---|
| | | | spot counts. |
| Durham Street, between Hope Street and Mitre Street | 10,445 | 1,200 | Council data (2011). |
| Eglinton Road at Rankens Bridge | 4,634 | 550 | Council data (2005). |
| Hamilton Street, north of Cox Street | 2,290 | 300 | Council data (1999). |
| Duramana Road at 1.49 km | 549 | < 100 | Council data (2001). Similar numbers confirmed by on-site observations and spot counts. |
| Turondale Road | | | |
| - At 1.82 km | 279 | < 50 | Council data (2009). |
| - At 22.0 km | 156 | < 30 | Council data (2009). Similar numbers confirmed by on-site observations and spot counts. |

# 4. Impact Assessment

In general, construction of the Project will include the following activities:

- Transport of construction machinery and labour to the Project site.
- On-site civil works for internal access roads, crane pads, lay-down areas, wind turbine footings and cable trenching.
- Road upgrade works (as required) to the public road network to allow over-size and over-mass transportation.
- Transport of wind turbine infrastructure to the Project site.
- Installation of wind turbines on site using cranes.
- Construction of electrical substations.
- Construction of site control room and operations and maintenance facilities.
- Construction of electrical transmission lines.
- Restoration and revegetation of disturbed areas.

In general, construction will be limited to the following times:

- Monday to Friday, 7:00 am to 6:00 pm;
- Saturday, 8:00 am to 1:00 pm; and
- No construction on Sundays or public holidays.

## 4.1 Construction Vehicle Types

The type of construction vehicles proposed to access the Project site depends on the equipment and/or personnel being transported and their function on the site. Access to construction site offices and facilities buildings would generally be available for conventional two-wheel drive vehicles. Access to individual wind turbine locations may be restricted to four-wheel drive or multiple wheel drive vehicles depending on the internal road network conditions.

Due to the size and weight of the wind turbine components it is expected that many of the delivery vehicles will be ‘over-size’ (width and/or length), ‘over-mass’ or both. These vehicles will be regarded as restricted access vehicles (RAVs) and will require special RMS operating permits to allow them to travel on public roads.

‘Over-mass’ loads will be carried on trailers, or combinations of trailers, with sufficient axle groups to ensure compliance with point load and overall load limits for the road surface. As a point of reference, the heaviest load based on an assessment of current turbine specifications from a variety of turbine manufacturers is 125 tonnes (comprising the entire nacelle / gearbox configuration in one unit). Such loads are typically carried on trailers with 10-plus axles, with each axle having up to 8 tyres. Allowing for the weight of the trailers themselves, typical axle weights under such configurations are in the range of 12 to 13 tonnes, or less than 2 tonnes per tyre. This is less than a typical semi-trailer with 11 tonnes per axle but only 4 tyres per axle, resulting in 2.75 tonnes per tyre. Turbine specifications are continually changing, as new models enter the market, however, with trailer and axle variations, a similar result can be achieved for heavier components also.

Over-size vehicles therefore incur less loading stress on the road surface, especially when run under escort with limited speed, than normal heavy vehicle traffic. Furthermore, 'over-size', 'over-length' and 'over-mass' vehicles feature trailers with steering on some or all rear axles. This technology ensures improved manoeuvrability, minimises stress on the equipment and the load, and reduces or eliminates tyre scrubbing and the associated stresses on the road surface when cornering.

The fleet of vehicles engaged to deliver over-size components will typically consist of:

- Extendable blade trailers of standard semi-trailer width (2.5 m) with the ability to extend to 45 m with up to 4 rear axles, some or all of which will be steerable;
- Heavy duty low loaders, with up to 10-plus rear axles and with each axle having 8 or more tyres to spread the load of the heavier WTG components. These low loaders may have the ability to carry loads up to 30 m in length, and may widen up to 5 m to reduce pressures on the road surface. Depending on the extendable length of these trailers, some of the rear axles may be self-steering;
- Dolly / jinker arrangements to carry loads over-size / length (greater than 30 m), where permitted to do so by permits and the WTG supplier. The rear axle groups on the jinker arrangements are steerable; and
- A variety of high power prime movers, typically rated 130 to 200 tonnes gross combination mass (GCM), as required depending on the total combination weight, ie. WTG load + trailer + prime mover.

Over-size vehicles are those over 19 metres in length, 2.5 metres in width and/or 4.3 metres in height and their operating permits will require one or more escort vehicles to accompany them. Over-mass vehicles are those with a gross mass greater than 42.5 tonnes.

As mentioned previously, each wind turbine generator comprises:

- Three blades comprising over-length loads;
- Three to five tower sections comprising over-size / over-mass loads;
- One nacelle and generator comprising up to two over-size / over-mass loads; and
- One rotor hub, typically comprising one over-size / over-mass load.

The components would typically be carried on specially designed trailers with axles that extend up to 4.2 metres in total width to carry the hubs and nacelles. The blades, which may be up to 63 m long are carried on specialised trailers which have steerable rear axles allowing negotiation of relatively small radius curves provided that the inside of the curve is clear of obstacles.

The standard design vehicle for swept path adequacy in the provision of intersections and the design of parking and turning areas would generally be (as a minimum) the Austroads single unit truck / bus of 12.2 m length. However, provision would be made, where possible, to allow for a 'B-double' swept path, which requires a wider area allowing for manoeuvring by semi trailers and over-size vehicles.

The design of access roads and junctions would need to allow for widths of up to 4.5 metres and weights complying with Roads and Traffic Authority maximum loading.

## 4.2 Construction Phase Traffic Generation

During the construction phase, several tasks would generate traffic. These are categorised as follows:

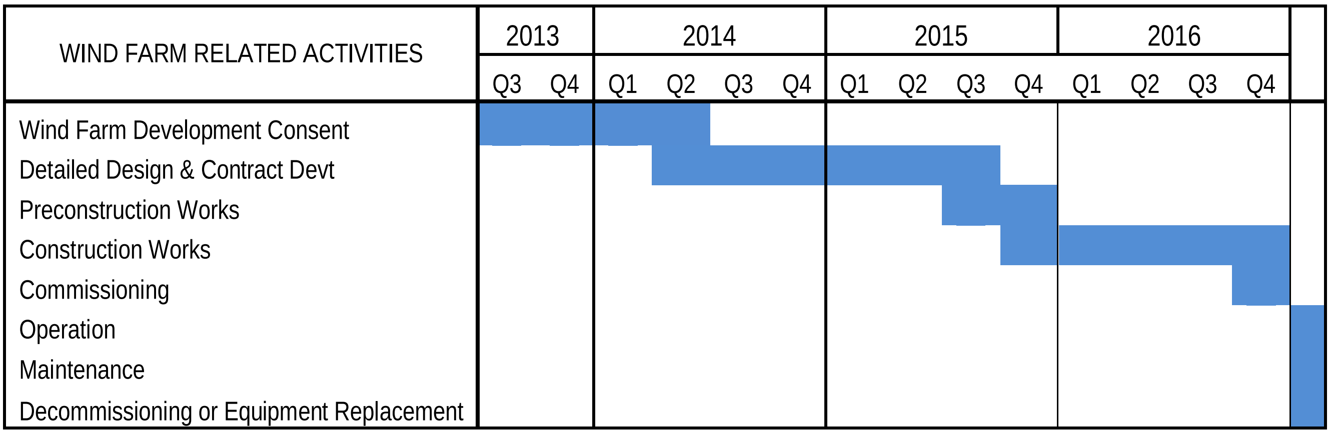
- Wind farm component delivery
- Construction material delivery
- Construction staff transport

Traffic-generating tasks include:

- initial site set-up and access construction during the pre-construction period;
- construction staff movements, wind farm component deliveries (including over-dimensional transport), concrete material deliveries and other general deliveries during construction works;
- operational staff movements during operation and maintenance; and
- decommissioning and reinstatement construction activities.

These tasks are proposed to occur over the following general Project timeline shown in *Figure 4.1* below.

**Figure 4.1: Anticipated Project Timeline**




### *4.2.1 Transport of Wind Farm Components*

The transport of the various wind farm components would generate traffic as shown in *Table 4.1* below.

**Table 4.1: Wind Farm Component Transportation**

| Wind farm Component | Characteristics | Traffic Generation |
|---|---|---|
| Nacelle | Weight is up to 140 tonnes, one per wind turbine: single load with installed drive trains. | Traffic generation for 1 wind turbine: 1 over-mass vehicle<br>Traffic generation for 106 wind turbines: 106 over-size vehicles |

| Wind farm Component | Characteristics | Traffic Generation |
|---|---|---|
| Blades | Three blades per wind turbine: up to 63 m long, single blade per vehicle. | Traffic generation for 1 wind turbine: 3 over-length vehicles<br>Traffic generation for 106 wind turbines: 318 over-size vehicles |
| Hub | Typical weight is approximately 40 tonnes, one per wind turbine in single load. Sometimes the hub 'capping', which is a lightweight fibreglass piece, is stacked into groups of 3 and sent in a single load to site. | Traffic generation for 1 wind turbine: 1 low-loader vehicle<br>Traffic generation for 106 wind turbines: 106 low-loader vehicles |
| Tower | Typically three to five sections, each weighing between 20 and 65 tonnes depending on the section and measuring between approximately 20 m to 30 m long. An additional section for insert into the foundation weighs 10 tonnes and is typically 4 m in diameter and 5 m long. | Traffic generation for 1 wind turbine: 5 low-loader (over-mass) vehicles + 1 semi-trailer truck<br>Traffic generation for 106 wind turbines: 530 low-loader (over-mass) vehicles + 106 semi-trailer trucks |
| Additional Materials | Typically for each wind turbine, additional miscellaneous equipment to be delivered to the site would require approximately one container (semi-trailer) truck. | Traffic generation for 1 wind turbine: 1 semi-trailer truck<br>Traffic generation for 106 wind turbines: 106 semi-trailer trucks |
| Substation Transformers | The main and secondary collector substation transformers would have a typical weight of up to 90 tonnes. Transportation of up to five transformers would be by road and would involve direct loading onto a platform trailer. | Traffic generation: 5 over-mass vehicles + 10 semi-trailers of support equipment. |
| Switching Station | Semi-trailer for transportation of switching station components at the point of connection. | Traffic generation: 10 semi-trailers of components and associated equipment. |
| Overhead Transmission Lines | Semi-trailer for transportation of power poles, conductors, wires and other materials. | Traffic generation: dependant on final details of pole numbers, spacing and location but typically 20 semi-trailers of poles and associated transmission line equipment. |
| Site Cranes | Assume four cranes (2 main cranes and 2 tailing cranes) moving between wind turbine sites. These would travel to the preferred site access point at the start of construction and then leave at the end. | Traffic generation: 4 over-mass vehicles + 12 semi-trailers of support equipment. |

As a worst case, based on delivery of a total of three whole wind turbines per week and working on a six-day week, up to a maximum of six over-dimensional loads per day would be generated. With the addition of a maximum of two semi-trailer loads of other equipment / components in the one day, it is assumed that the delivery of wind farm components would generate a maximum 16 trips per day, inclusive of 10 over-dimensional vehicle trips per day. This figure includes return trips (empty). Over-dimensional vehicles returning (empty) will no longer be over-length or over-mass owing to either their load having been deployed on-site and / or due to the articulated capacity of their trailer sections. As such, there will be fewer over-dimensional vehicles on the return trip.

With respect to traffic distribution of wind farm component transport, this would largely depend on the origin of component manufacture. However, the route to the northern site access point (Route 1 via Aarons Pass Road) has been identified as the preferred route for over-dimensional transport vehicles. A reasonable scenario is for WTG cargo to be imported to Newcastle Port because there is no local manufacturing capability in Australia for these components. This has also been identified by Downer Infrastructure (2013) as the most feasible and likely port of entry. Therefore, the northern route (Route 1) would be used for transport of all over-size and over-mass transport vehicles, with the variation presented in Route 2 to be used for over-length transport vehicles only (blades only).

All tower sections are likely to come from the southern route (Castlereagh Highway) if sourced from KPE (Portland) or RPG (Adelaide or Dandenong), KPE and RPG being the two recognised manufacturers of WTG towers Australia.

Switching station equipment and some overhead transmission line equipment would also arrive via Castlereagh Highway onto the minor accesses at Bombandi Road and Crudine Road.

### 4.2.2 Transport of Construction Materials

The major construction materials to be transported include gravel/road base for construction of site access roads, constituent materials for the on-site concrete batch plant, steel reinforcement deliveries for foundation construction, steel strands and cabling for the transmission lines, and other miscellaneous materials deliveries for site offices and the like.

All the construction materials are able to be transported via standard transport vehicles (up to semi-trailer).

Construction material delivery would typically generate the following traffic generation.

*Concrete*

Assuming the use of slab (gravity) foundations, each tower would require approximately 250 $m^3$ of reinforced concrete. Concrete would be delivered to the wind turbine bases via the internal site road network from on-site batching plants proposed to be located at or near the two site access locations. From there, they would travel along the internal site road network to access each wind turbine location. At 6 $m^3$ per load, some 42 truck loads or 84 truck movements per foundation site would be required during a single day pour. All these movements would be within the site and not be required to travel along the external public road network.

In general, transport of off-site material to site is assumed to be equally split between the southern and northern site access points via Routes 1 and/or Routes A, B and C.

As a contingency, if the on-site concrete batching plants are unable to provide the available concrete, pre-mixed concrete would need to be sourced from local businesses in either the Mudgee or Bathurst areas or other nearby centres. If pre-mixed concrete is to be transported from off-site, the above traffic generation would use the public road network to access the northern and southern site access points.

It is assumed that pre-mixed concrete deliveries from off-site would be split equally from the north (Routes 1 and B) and south (Routes A and C) to the northern and southern site access points. This would result in a daily peak of 42 truck movements of pre-mixed concrete to both the northern and southern access points.

Delivery of constituent materials (eg. cement, sand, aggregate, water) for the on-site batching plant is assumed to be 20 truck loads per week resulting in 40 truck movements per week. This may be reduced if suitable local material such as aggregate and sand is able to be sourced on-site. In addition, it is assumed that some ten truck loads per week (or 20 truck movements per week) would be required to deliver steel reinforcement material.

Concrete material and foundation deliveries are assumed to be split equally along the northern and southern access routes (Routes A, B, C and/or 1). This would result in 20 truck movements of concrete materials and 10 truck movements of steel reinforcement per week to both the southern and northern site access points.

The above truck movements would reduce by approximately 90% if mono-pile foundations were able to be used and generally reduced if a combination of foundation designs (combined slab plus rock anchor design) is implemented.

*Gravel/road base*

Road upgrade works (mainly localised widening and levelling) would be required along Aarons Pass Road as a minimum. In addition, the on-site road network and hardstand areas for cranes are proposed to be constructed using a compacted road base or similar.

The construction of the on-site road network and hardstand areas would result in an estimated 50 km length of road construction. Assuming a 6.0 m wide road formation and 250 mm depth of material, approximately 75,000 $m^3$ of material would be required. It is assumed that approximately half of this material could be sourced on-site from foundation excavations or on-site borrow pits (approximately 37,500 $m^3$) while the remainder would need to be sourced from external (off-site) locations[13]. A potential on-site source is a local quarry area off Aarons Pass Road near the proposed northern site access point.

Transport of off-site material to site is assumed to be equally split between the southern and northern site access points via Routes A, B and C and/or Route 1.

Assuming the use of 'truck'n'dog' vehicles with an average 25 $m^3$ capacity, some 1,500 truck loads over the course of the project or 250 truck loads per month (over an initial 6-month construction period: say, months 2 to 7) would be required. In summary, based on the sourcing splits above, the following truck loads and two-way movements would eventuate:

- Northern site access point (Route 1) – 125 truck loads or 250 two-way truck movements per month (60 two-way truck movements per week)

13 This figure would be clarified by the construction environmental management plan (CEMP).

- Southern site access point (Routes A, B and C) – 125 truck loads or 250 two-way truck movements per month (60 two-way truck movements per week)

*Inter-turbine cabling*

It is anticipated that approximately 100 cable drums of 700 m capacity for inter-turbine cabling would be required for the Project. These would be transported by semi-trailer with two drums per load. The resulting traffic generation would be some 50 truck loads over the course of the project. It is anticipated that during peak periods when cabling is required, some 20 truck loads per month (five truck loads or 10 two-way truck movements per week) would deliver these materials to site.

Cable deliveries are assumed to be split equally to the northern and southern site access points via the northern and southern access routes. This would result in 5 truck movements of cable per week to each of the site access points (along Routes A, B and C, and Route 1).

*Water*

Water delivery for use in the on-site concrete batching plants, dust suppression and other miscellaneous activities is assumed to be sourced from a combination of on-site bores and other water sources, commercial water sources and/or nearby dam storages. An estimated 20 mega-litres (ML) of water for construction activities is anticipated to be required should slab foundations be required.

Transport of off-site water to site is estimated be an average of some 50 truck loads per week (or 100 two-way truck movements per week) throughout the construction period.

Water deliveries are assumed to be split equally to the southern and northern site access points via the northern and southern access routes. This would result in 50 truck movements of water per week to each of the site access points (along Routes A, B and C, and Route 1).

The above water transport would be approximately halved if mono-pile foundations are able to be used, and generally reduced if a combination of foundation designs (combined slab plus rock anchor design) is implemented.

*Other miscellaneous deliveries*

Other miscellaneous deliveries include general construction materials and equipment as well as site office operations equipment. It is estimated that some 20 delivery loads per week (or 40 two-way vehicle movements per week) would be required throughout the construction period.

These miscellaneous deliveries are all assumed to be sourced from nearby centres such as Mudgee and Bathurst and would be transported equally to the southern and northern site access points via the northern (Routes 1 and/or B) and southern (Routes A and/or C) access routes. This would result in 20 vehicle movements of miscellaneous deliveries per week from the north and south.

Given the scale of the Project, it is anticipated that there will be no need for waste material to be exported from the site during construction. Top soil cleared from surfaces during the construction phase will be used for remediation, and rock excavated for turbine footing preparations will be used for road base, back fill for foundations and/or erosion control purposes, as far as practicable.

#### 4.2.3 Construction Staff Traffic

For the majority (10 months) of the 18 month construction period, it is anticipated that construction staff numbers would be up to approximately 50 staff. During peak construction periods, it is anticipated that construction staff numbers would increase up to 100 staff for an approximate eight month period coinciding with the turbine installation phase.

Assuming there will be some shared journey-to-work trips by construction staff (resulting from car pooling and similar initiatives), an average of 1.25 persons/car has been adopted for traffic generation purposes. During general staffing periods, traffic generation would be some 40 light vehicles (cars) or 80 light vehicle trips/day. During peak staffing periods, traffic generation would be some 80 light vehicles (cars) or 160 light vehicle trips/day along the surrounding road network.

It is assumed that construction staff trip distribution would be split equally between the north (Mudgee area) and south (Bathurst area), resulting in 40 (80) construction staff vehicle movements per day split between Routes 1 and Routes A, B and C into both the southern and northern site access points.

#### 4.2.4 Total Traffic Generation

The above sections provide the basis for estimating the average total traffic generation over the construction period. Traffic generation used in this transport assessment ranges from a moderate (average) scenario, that would apply for the great majority of the 18 month construction period, to a conservative (high) scenario, which assumes that peak construction staff numbers would coincide with other peak traffic generating activities such as concrete pours and access road construction, as well as delivery of wind turbine components.

While the conservative (high) scenario could potentially occur, it is more likely that peak access road construction activities would be undertaken during the earlier stages of the construction program and not necessarily coincide with peak construction staff numbers and other peak construction activities such as concrete foundation pours. Nonetheless, this conservative overlap of activities has been adopted to consider a ‘worst-case’ scenario as well as the more applicable and relevant moderate (average) scenario.

Typically, the conservative (high) traffic generation scenario would apply for only some four months out of the total 18 month construction period. This four months would coincide with construction of WTG foundations and delivery of WTG components. It should be noted that it would not necessarily be a continuous four months.

For the remaining 14 months, a moderate (average) traffic generation scenario has been assumed, although realistically there would be at least one month at either end of the construction period where a low traffic generation period would apply, eg. during pre-construction tasks and pre-commissioning.

Traffic generation for both moderate and conservative (in brackets) scenarios is shown in *Table 4.2* below and has been classified into daily movement trips (ie. two-way trips), shown as vehicles per day (vpd) and peak hour trips (where applicable), shown as vehicles per hour (vph).

## Table 4.2: Project Traffic Generation

| Traffic Generating Activity | | Northern Site Access (Via Route 1) | Southern Site Access (Via Routes A and/or C from the south and Route B from the north) |
|---|---|---|---|
| Wind farm component delivery (heavy and over-size vehicles) | vpd | 0 (16) | 0 (0) |
| | vph | 0 (2) | 0 (0) |
| Pre-mix concrete deliveries[1] (heavy vehicles) | vpd | 0 (42) | 0 (42) |
| | vph | 0 (8) | 0 (8) |
| Steel reinforcement deliveries (heavy vehicles) | vpd | 0 (0) | 6 (10) |
| | vph | 0 (0) | 1 (2) |
| Gravel / road base deliveries (heavy vehicles) | vpd | 6 (12) | 6 (12) |
| | vph | 1 (2) | 1 (2) |
| Inter-turbine cabling delivery (heavy vehicles) | vpd | 0 (0) | 2 (2) |
| | vph | 0 (0) | 1 (1) |
| Water deliveries (heavy vehicles) | vpd | 6 (10) | 6 (10) |
| | vph | 1 (2) | 1 (2) |
| Other miscellaneous construction deliveries (heavy vehicles) | vpd | 0 (0) | 4 (4) |
| | vph | 0 (0) | 1 (1) |
| Construction staff (light vehicles only) | vpd | 40 (80) | 40 (80) |
| | vph | 20 (40) | 20 (40) |
| TOTAL[3] Light vehicles | vpd | 40 (80) | 40 (80) |
| | vph | 20 (40) | 20 (40) |
| Standard heavy vehicles | vpd | 12 (70) | 24 (80) |
| | vph | 2 (14) | 5 (16) |
| Over-dimension vehicles[2] | vpd | 0 (10) | 0 (0) |
| | vph | Na | Na |

1. Pre-mix concrete deliveries for WTG foundations is a worst case scenario, assuming that concrete will not be batched on site. It is more likely that concrete will be batched on site, and only concrete batching materials will be sourced off site. In this scenario, 20 trips per day, and 4 trips per peak hour are conservatively estimated.
2. Split between Route 1 (for over-size / over-mass loads) and Route 2 (for over-length loads)
3. Totals along different routes and different vehicle types do not necessarily coincide but are worst case during any point of the overall Project construction period.

## 4.3 Effect of Construction Phase Traffic Generation

### 4.3.1 *Road Capacity*

In order to assess the potential impacts on road capacity, the traffic generation of heavy vehicles and the staff traffic generation (refer to *Table 4.2* above) have been added to existing daily and peak hour traffic flows to obtain future traffic flows (for both moderate and conservative traffic generation scenarios) along the affected road network.

Future traffic volumes in vehicles per day and vehicles per hour for roads accessing the northern and southern site access points are shown in *Table 4.3* and *Table 4.4* following. The traffic volumes are broken up into light vehicles (LV) and heavy vehicles (HV) with the heavy vehicle proportion assumed to be between 10% and 15% of the total traffic volume. The figures in brackets are for the conservative (high) traffic generation scenario.

**Table 4.3: Future Traffic Volumes – Northern Site Access (Route 1)**

| Traffic Scenario | | Mudgee Urban Area[2] | Castlereagh Highway | Goolma Road | Aarons Pass Road |
|---|---|---|---|---|---|
| *Daily Traffic – vehicles per day* | | | | | |
| Existing traffic[1] | LV | 7,500 | 4,200 | 1,100 | 20 |
| | HV | 1,000 | 450 | 200 | 5 |
| Wind farm traffic generation | LV | 40 (80) | 40 (80) | 40 (80) | 40 (80) |
| | HV | 12 (80) | 12 (80) | 12 (80) | 12 (80) |
| Combined future traffic | LV | 7,540 (7,580) | 4,240 (4,280) | 1,140 (1,180) | 60 (100) |
| | HV | 1,012 (1,080) | 462 (530) | 212 (280) | 17 (85) |
| *Hourly (Peak) Traffic – vehicles per hour* | | | | | |
| Existing traffic[1] | LV | 800 | 490 | 140 | 5 |
| | HV | 100 | 60 | 20 | 1 |
| Wind farm traffic generation | LV | 20 (40) | 20 (40) | 20 (40) | 20 (40) |
| | HV | 2 (14) | 2 (14) | 2 (14) | 2 (14) |
| Combined future traffic | LV | 820 (840) | 510 (530) | 160 (180) | 25 (45) |
| | HV | 102 (114) | 62 (74) | 22 (34) | 3 (15) |

1. Existing traffic derived from *Table 3.1* with the highest volumes along each road section used as a worst case scenario. HV % assumed to be between 10% and 15% of total traffic volume.
2. Wind farm traffic generation via the nominated route through the Mudgee Urban Area would only be for over-size vehicle transport. All other wind farm traffic generation would be spread throughout the urban area.

**Table 4.4: Future Traffic Volumes – Southern Site Access (Routes A, B and C)**

| Traffic Scenario | | Great Western Highway | Gilmour Street | Sofala / Peel Road | Castlereagh Highway | Ilford-Sofala Road | Hill End Road |
|---|---|---|---|---|---|---|---|
| *Daily Traffic – vehicles per day* | | | | | | | |
| Existing traffic[1] | LV | 6,100 | 4,700 | 950 | 3,800 | 800 | 80 |
| | HV | 670 | 520 | 100 | 500 | 100 | 10 |
| Wind farm traffic generation | LV | 40 (80) | 40 (80) | 40 (80) | 40 (80) | 40 (80) | 40 (80) |
| | HV | 24 (80) | 24 (80) | 24 (80) | 24 (80) | 24 (80) | 24 (80) |
| Combined future traffic | LV | 6,140 (6,180) | 4,740 (4,780) | 990 (1,030) | 3,840 (3,880) | 840 (880) | 120 (160) |
| | HV | 694 (750) | 544 (600) | 124 (180) | 524 (580) | 124 (180) | 34 (90) |
| *Hourly (Peak) Traffic – vehicles per hour* | | | | | | | |
| Existing traffic[1] | LV | 670 | 540 | 120 | 440 | 100 | 15 |
| | HV | 80 | 60 | 30 | 60 | 20 | 2 |
| Wind farm traffic generation | LV | 20 (40) | 20 (40) | 20 (40) | 20 (40) | 20 (40) | 20 (40) |
| | HV | 5 (16) | 5 (16) | 5 (16) | 5 (16) | 5 (16) | 5 (16) |
| Combined future traffic | LV | 690 (710) | 560 (580) | 140 (160) | 460 (480) | 120 (140) | 35 (55) |
| | HV | 85 (96) | 65 (76) | 35 (46) | 65 (76) | 25 (36) | 7 (18) |

1. Existing traffic derived from *Table 3.1* with the highest volumes along each road section used as a worst case scenario. HV % assumed to be between 10% and 15% of total traffic volume.

Road capacity can be expressed and qualified along a section of the rural road network as its ‘level of service’ (LoS). Typically, the LoS is based on road capacity analysis as described in Austroads’ “*Guide to Traffic Engineering Practice, Part 2 – Roadway Capacity*”. Road capacity can be expressed in total vehicles per day and/or vehicles per hour.

The level of service descriptions are as follows:

LOS A: Free flow conditions, high degree of freedom for drivers to select desired speed and manoeuvre within traffic stream. Individual drivers are virtually unaffected by the presence of others in the traffic stream.

LOS B: Zone of stable flow, reasonable freedom for drivers to select desired speed and manoeuvre within traffic stream.

LOS C: Zone of stable flow, but restricted freedom for drivers to select desired speed and manoeuvre within traffic stream.

LOS D: Approaching unstable flow, severely restricted freedom for drivers to select desired speed and manoeuvre within traffic stream. Small increases in flow generally cause operational problems.

LOS E: Traffic volumes close to capacity, virtually no freedom to select desired speed or manoeuvre within traffic stream. Unstable flow and minor disturbances and/or small increases in flow would cause operational break-downs.

LOS F: Forced flow conditions where the amount of traffic approaching a point exceeds that which can pass it. Flow break-down occurs resulting in queuing and delays.

Road capacity for two-lane, two-way sections of a rural road network is largely based on a combination of design speed, travel lane and shoulder width, sight distance restrictions, traffic composition, directional traffic splits and terrain[14]. This provides a basic level of service and associated service flow rate under prevailing road and traffic conditions. Based on their road and traffic characteristics, the levels of service and flow rates for the affected sections of the rural road network along the routes to the northern and southern site access locations are shown in *Table 4.5* following.

**Table 4.5: Rural Road Network Service Flow Rates**

| | Level of Service (LoS) | | | | |
|---|---|---|---|---|---|
| Road Section | A | B | C | D | E |
| *Northern Site Access* | | | | | |
| Castlereagh Highway | 200 vph<br>2,000 vpd | 390 vph<br>4,000 vpd | 640 vph<br>6,600 vpd | 1,050 vph<br>11,200 vpd | 1,850 vph<br>19,000 vpd |
| Goolma Road | 105 vph<br>1,050 vpd | 260 vph<br>2,850 vpd | 480 vph<br>5,250 vpd | 730 vph<br>7,800 vpd | 1,440 vph<br>13,800 vpd |
| Aarons Pass Road | not applicable | not applicable | not applicable | not applicable | not applicable |
| *Southern Site Access* | | | | | |
| Great Western Highway | 220 vph<br>2,200 vpd | 430 vph<br>4,400 vpd | 700 vph<br>7,200 vpd | 1,150 vph<br>12,200 vpd | 2,050 vph<br>20,800 vpd |
| Sofala / Peel Road | 160 vph<br>1,600 vpd | 290 vph<br>3,100 vpd | 510 vph<br>5,600 vpd | 820 vph<br>8,500 vpd | 1,520 vph<br>15,600 vpd |
| Castlereagh Highway | 200 vph<br>2,000 vpd | 390 vph<br>4,000 vpd | 640 vph<br>6,600 vpd | 1,050 vph<br>11,200 vpd | 1,850 vph<br>19,000 vpd |
| Ilford-Sofala Road | 140 vph<br>1,500 vpd | 260 vph<br>2,750 vpd | 450 vph<br>4,800 vpd | 740 vph<br>7,750 vpd | 1,360 vph<br>14,000 vpd |
| Hill End Road | 40 vph<br>400 vpd | 100 vph<br>1,100vpd | 180 vph<br>2,000 vpd | 290 vph<br>3,100 vpd | 650 vph<br>6,700 vpd |

Based on the above service flow rates and the existing and additional wind farm generated construction traffic volumes (conservative scenario peak volumes used as a worst case scenario) of the rural roads along transport routes to both site access locations, ‘before and after’ levels of service can be expected as shown in *Table 4.6* following.

14 Austroads “*Guide to Traffic Engineering Practice: Part 2 – Roadway Capacity*”, Section 3

**Table 4.6: Rural Road Network – Existing and Future Levels of Service**

| Road Section | Existing LoS | Future LoS |
|---|---|---|
| *Northern Site Access (Route 1)* | | |
| Castlereagh Highway | C | C |
| Goolma Road | B | B |
| *Southern Site Access (Routes A, B, C)* | | |
| Great Western Highway | C / D | C / D |
| Sofala / Peel Road | A | A / B |
| Castlereagh Highway | C | C |
| Ilford-Sofala Road | A | A / B |
| Hill End Road | A | B / C |

From the above table, it is clearly evident that operating conditions (levels of service) along the majority of the rural road network would only change marginally from existing conditions, even after the addition of the conservative scenario (maximum peak) Project generated construction traffic.

The minor roads of the rural road network under consideration have significant spare capacity and are operating at high levels of service (LOS A). While the major roads have lower levels of service (LOS C / D), their levels of service are still considered to be acceptable as they are on the approaches to or within major urban centres.

In the case of the major road network, the addition of construction-related traffic to existing traffic volumes is a small percentage – mostly less than 1% and a maximum of approximately 3% during peak construction activities. This increase would be well within any daily or seasonal variations of average daily traffic flows along the road network.

The most noticeable change would be for Hill End Road, which provides the travel route to the southern site access location. Currently it has minimal traffic and LOS A. With the addition of construction traffic, the level of service would reduce to B (or B to C during peak construction traffic generation). While this change is noticeable and significant, the LOS B / C is still considered to be acceptable, particularly for the temporary nature of traffic impacts during the construction period.

For Aarons Pass Road, which is a minor unsealed road, service flow rates are not applicable as it does not have formed lanes and carriageways. However, it would be operating at a high level of service with significant spare capacity, due to its very low existing traffic volumes. The addition of limited construction-related traffic generation is able to be readily absorbed by Aarons Pass Road. It is noted that the Bocoble Road route is an alternative / contingent route to / from Mudgee that may be used by local traffic from the area surrounding Aarons Pass Road.

With respect to the urban road network that is affected by the transport access routes proposed, Market Street, Duoro Street, Cox Street, Short Street, Lawson Street, Mortimer Street, Burrundulla Avenue and Horatio Street in Mudgee and Gilmour Street in Bathurst are pertinent.

For urban roads, the level of service is largely defined in terms of average travel speed rather than actual road capacity (traffic volumes). This is because the urban road network generally has interrupted flow caused by intersection controls, side-street and parking manoeuvres, and turn movements. Intersection operations largely control traffic flow in the urban road network and delay at intersections affects the travel speed along a route.

Along the Mudgee and Bathurst urban road networks affected by the access routes, the addition of traffic generated by the wind farm project would constitute the following increases in current traffic volumes along the roads affected and their intersections:

- Short Street: less than 1.0% of daily traffic flows (additional 10 vpd during peak construction activities against current 2,100 vpd) and less than 1.0% of hourly traffic (additional 2 vph against current 250 vph)[15]
- Lawson Street: approximately 1.9% of daily traffic flows (additional 10 vpd against current 530 vpd) and approximately 2.0% of hourly traffic (additional 2 vph against current 100 vph)
- Traffic volumes were not available for Mortimer Street or Burrundulla Avenue, however, it was estimated they would be of the same order as Lawson Street and certainly no more than 1,000 vpd. This would result in increases of between approximately 1% and 2% of daily and hourly traffic flows.
- Market Street: less than 1.0% of daily traffic flows (additional 10 vpd against current 5,000 vpd) and less than 1.0% of hourly traffic (additional 2 vph against current 600 vph)
- Duoro Street: less than 1.0% of daily traffic flows (additional 10 vpd against current 7,000 vpd) and less than 1.0% of hourly traffic (additional 2 vph against current 800 vph)
- Horatio Street: less than 1.0% of daily traffic flows (additional 10 vpd against current 8,500 vpd) and less than 1.0% of hourly traffic (additional 2 vph against current 900 vph)
- Great Western Highway: less than 1% of daily traffic flows (additional 62 vpd or 180 vpd (peak) generated by wind farm project against current 22,849 vpd) and approximately 2.6% of hourly traffic (additional 22 vph or 60 vph (peak) against current 2,300 vph)
- Gilmour Street: approximately 3.4% of daily traffic flows (additional 62 vpd or 180 vpd (peak) against current 5,218 vpd) and approximately 10.0% of hourly traffic (additional 22 vph or 60 vph (peak) against current 600 vph)

From the above, Project generated traffic constitutes a negligible increase on current Great Western Highway traffic flows as well as the nominated over-size/over-mass and over-length vehicle routes through the Mudgee Urban Area. The increases are well within daily or seasonal traffic variations and thus, the Project traffic generation would have an insignificant impact on the traffic flow operations.

Similarly for Gilmour Street, while the proportional increases due to project generated traffic are greater, they are still relatively minor and likely to be within any daily or seasonal traffic variation. It is considered that the Project traffic generation would have a minimal impact on

15 Project traffic generation via the nominated route through the Mudgee Urban Area would only be for over-size vehicle transport. All other wind farm traffic generation from the north would be spread throughout the Mudgee urban area.

traffic flow operations along Gilmour Street and its intersections. It should also be noted that the traffic generation predicted along Gilmour Street is a worst case scenario. Some traffic may also access the southern site access point from the south (Route C) via Castlereagh Highway from Lithgow, for example.

In summary, the addition of heavy vehicles and construction staff traffic during peak construction periods is able to be absorbed by the rural and urban road networks with appropriate road infrastructure upgrades and construction traffic management.

### 4.3.2 Site Access and Road Safety

Construction traffic is proposed to access the various wind turbine sites via an internal site road network off two site access points (described previously in *Section 3.2.6*). Both site access locations have some sight distance issues onto the public road network and thus, suitable temporary traffic control (conforming to RMS' "*Traffic Control at Worksites Manual*" and relevant Australian Standards) will be required to warn road users of turning truck traffic and the like. Additional traffic management (eg. 'stop-go' traffic control) may also be required at both site access points during peak activities such as concrete pours for example.

Suitable on-site manoeuvring areas would be available so that larger vehicles are able to safely manoeuvre into the site off the public road network, around the site and out of the site onto the public road network. The location and layout of the two site access junctions with Aarons Pass Road and Hill End Road would be confirmed with the relevant road authorities taking into account set back of property boundaries and, for Aarons Pass Road, swept path turn radii for over-size and over-length loads.

It is envisaged that for the over-dimensional vehicles to be used for wind turbine component delivery, escort vehicles, transport restrictions and appropriate traffic management would be adopted to ensure safe passage from the public road network onto the site. These issues would be resolved in detail by the by the selected transport contractor when seeking approvals from relevant road authorities.

All vehicles would enter and exit the site to/from the public road network in a forward direction only. All vehicles generated by construction staff would be accommodated within on-site parking areas.

To ensure adequate road safety is maintained, a comprehensive Construction Traffic Management Plan (CTMP) would be prepared in conjunction with the chosen transport contractor and relevant road authorities. The CTMP would detail appropriate construction traffic controls and management measures and all aspects would be implemented in co-ordination with the Councils and RMS. It is acknowledged that on occasions local traffic will be inconvenienced. However, the management measures within the CTMP would endeavour to mitigate any impacts. The CTMP would include, but not be limited to, provisions for:

- Scheduling of transport deliveries, particularly outside of school bus route hours, ie. 7:00 to 9:00 am and 3:00 to 4:30 pm;
- Undertaking community consultation before and during all transport and haulage activities, including contact details to ensure community concerns are logged and addressed;
- Clear communication of road closures (if required);

- Letterbox drop along affected routes;
- Minimising disruption to local vehicles by ensuring average and maximum wait times due to project traffic along local roads are minimised and stipulated by the chosen transport contractor;
- Upgrading road infrastructure including designing and implementing temporary modifications to intersections and roadside furniture as appropriate;
- Managing transport operations including provision of warning and guidance signage, traffic control devices, temporary construction speed zones and other temporary traffic control measures;
- Preparation of a 'Transport Code of Conduct' for all staff and contractors detailing designated transport routes, road behavioural requirements, speed limits and local climatic conditions that may affect road safety, eg. snow / ice, fog, etc.;
- Procedure to monitor traffic impacts and respond to impacts rapidly; and
- Reinstatement of pre-existing road conditions after construction phase is complete.

### 4.3.3 Internal Access Roads

The construction and maintenance of the Project will require the construction of an internal site road network to access all the wind turbine locations and the substations. This internal site road network will allow access across the entire Project site, thus providing the flexibility of external transportation to either of the site access points and subsequent access to the entire Project site.

In some cases the site road network works will involve upgrading existing access tracks and in others constructing new ones. Route selection for the access roads has been determined taking into consideration topography, drainage and potential erosion impacts – refer to *Appendix A: Proposed Wind Farm Layout*.

The internal site road network will consist of private roads and will not be accessible to the public. Access will be controlled by locked gates. The internal site access roads will generally be 6.0 m wide with regular passing bays and turning heads to accommodate construction vehicles and the crane required to assemble the wind turbines. Hardstand areas would be required around each turbine site for the safe operation of large cranes. These areas would also provide turning opportunities for delivery vehicles.

The roads will be an all-weather graded surface. Ongoing operational maintenance of on-site roads would be undertaken by the wind farm operator.

### 4.3.4 Road Condition Maintenance

There are a number of public road works that would be required to enable transport of components and materials to the wind farm sites. These have been identified in general previously in this assessment but would be confirmed and resolved in detail by the selected transport contractor when seeking approvals from relevant road authorities.

The permit system requires transport contractors to state the registration details of the trucks / trailers used for each load, so the link between permissions and equipment is very tight.

Trucks being used for all escorted loads are inspected by the escort at the start of every trip, while other trucks are required to meet regulated maintenance requirements and these procedures are regularly audited to ensure compliance. Under these operating procedures, there would be no further actions required by local Councils to ensure that trucks are fit for purpose. Notwithstanding, the transport contractor would be expected to comply with any additional requirements from any party (ie. Councils, RMS, etc.), if requested to do so.

A thorough dilapidation survey would be undertaken on all public access roads prior to construction starting. This would provide the basis for identifying any road damage and subsequent restoration works after the construction period is complete. Regular inspection regimes undertaken in consultation between local Councils and the proponent would be developed. Any damage resulting from construction traffic, except that resulting from normal wear and tear, would be repaired to pre-existing conditions.

## 4.4 Operational Phase Traffic Generation

Traffic generation during operations would be relatively minor. There is proposed to be 15 operational / maintenance staff in the first year of operations reducing to approximately five (5) operational / maintenance staff per day for the remainder of the wind farm's operations.

All staff are likely to be sourced / based in the local area, servicing the Project. Aspects of the Project operation to be dealt with by on-site staff would include safety management, environmental condition monitoring, landowner management, routine servicing, malfunction rectification and site visits. Other remote monitoring functions would typically include turbine performance assessment, wind farm reporting, remote re-setting and maintenance co-ordination.

It is understood operational traffic would consist of 4WD-type service vehicles travelling between individual wind turbine sites along the internal road network after gaining access off the public road network from either of the two site access points. It is envisaged that with journey-to-work and home trips, this would amount to a maximum of approximately 30 trips per day in the first year of operations reducing to approximately 10 trips per day for the remainder of the wind farm's operations. These levels of trip generation would readily be absorbed into the spare capacity of the existing road network.

There is the possibility that the operational Project may attract tourist traffic along the roads surrounding the sites. However, it is considered that this would not significantly increase traffic volumes or cause any unfavourable impacts.

## 4.5 Effect of Operation Phase Traffic Generation

Based on the relatively minor traffic generation during operations described above, traffic and road network impacts would be negligible. The current road network has significant spare capacity and is used by 4WD-type vehicles, which are proposed to be used for servicing the various sites.

All vehicles generated by operations staff would be accommodated within on-site parking areas.

## 4.6 Cumulative Impacts

At present, there are a number of known nearby major developments or projects that may result in cumulative impacts in conjunction with the subject Crudine Ridge Wind Farm Project. These include the following projects:

- Bodangora Wind Farm
- Uungula Wind Farm
- Liverpool Range Wind Farm
- Ulan Coal projects
- Caerleon Planning Proposal (2,000 residential allotments)
- Kelso Great Western Highway upgrade in Bathurst
- Cobbora Coal Project

The timing for construction and operation of all the above projects is uncertain as they are at different stages of the design and development process. Therefore, cumulative impact assessment, at this stage, is an educated guess and worst case scenario.

If and when any of the above projects or other future major projects are confirmed in the general surrounding area, the cumulative impact of multiple projects would need to be considered with respect to transport and traffic operations.

Any of the above projects would use the major and minor road network in the surrounding area, some of which may be similar to the transport routes proposed for the Crudine Ridge Wind Farm Project, eg. Castlereagh Highway. This has the potential to exacerbate any traffic and transport impacts.

Once progression of the subject projects is confirmed and other possible major developments in the surrounding area are determined, and also when the construction dates / timetables are finalised for the Crudine Ridge Wind Farm Project, the cumulative impact of these would need to be considered with respect to transport and traffic operations.

Generally, any impacts would initially need to be considered as part of construction traffic management plans to minimise cumulative construction impacts. This is particularly relevant for wind farm projects such as Crudine Ridge, which generate the great majority of their transport impacts during the construction phase.

Typical mitigation measures may include:

- Independent scheduling of construction activities and deliveries for each project so that they do not overlap in order to minimise road transport movements;
- Region-wide traffic management;
- Shared road infrastructure upgrade works;
- Targeted dilapidation and reinstatement programs; and
- Collective community consultation programs.

# 5. Mitigation Measures

## 5.1 General Management of Potential Impacts

The management of potential impacts caused by the Project would cover the construction, operation and decommissioning phases of the Project. With respect to the potential traffic impacts during the decommissioning phase, these essentially mirror the construction phase impacts, although would occur over a shorter time period.

For management of potential impacts during the construction phase, the following general measures would need to be undertaken:

- Engage a licensed and experienced transport contractor with experience in transporting similar wind farm component loads. The contractor would be responsible for obtaining all required approvals and permits from the RMS and local Councils and for complying with conditions specified in the approvals. Transport contractors would also conduct any dilapidation surveys and arrange for detailed pavement and infrastructure inspections (eg. bridge loading adequacy) to ensure all access routes are suitable prior to carrying out the transport tasks.
- Develop a Construction Traffic Management Plan (CTMP) in conjunction with the transport contractor and relevant road authorities and implement all aspects of the CTMP in co-ordination with the local Councils and RMS. Refer to previous *Section 4.3.2* for typical details to be included in the CTMP. The CTMP would typically address:
  - Scheduling of transport deliveries, particularly outside of school bus route hours;
  - Community consultation and issue logging;
  - Clear communication of road closures (if required);
  - Letterbox drop along affected routes;
  - Minimising disruption to local vehicles by ensuring average and maximum wait times due to project traffic along local roads;
  - Road infrastructure upgrade requirements;
  - Traffic management of transport operations;
  - Preparation of a 'Transport Code of Conduct' for all staff and contractors;
  - Procedure to monitor traffic impacts and respond to impacts rapidly; and
  - Reinstatement of pre-existing road conditions after construction is complete.

- Undertake road infrastructure upgrade works to allow over-dimensional transport along the proposed transport routes to access the site. Details of specific upgrade works follow in *Section 5.3* below and are also detailed in Downer Infrastructure (2013).
- There are numerous locations along the over-dimensional transport route (particularly Aarons Pass Road) where relatively sharp curve alignments and/or narrow carriageway widths would require over-dimensional vehicles to use the full carriageway width. This would require traffic management in the form of temporary, short-term full road closures ('rolling' road closures as vehicles pass critical locations) aided by escort vehicles.
- Prepare road dilapidation reports covering pavement, drainage and bridge structures in consultation with RMS and the local Councils for all of the proposed transport routes before and after construction. Regular inspection regimes undertaken in consultation

between local Councils and the proponent would be developed. Any damage resulting from construction traffic, except that resulting from normal wear and tear, would be repaired to pre-existing conditions.

- Consider establishing a 'car pool' initiative for construction staff from nearby centres to minimise construction staff trips.
- For decommissioning, similar general measures would be necessary as those detailed for construction. However, the CTMP for decommissioning would need to be revised to address traffic operation and volume changes in the future years during the decommissioning phase.

For management of potential impacts during the operations phase, the following general measures would need to be undertaken:

- Establish a procedure to ensure the ongoing maintenance of the internal on-site access roads during the operation phase. This maintenance would include sedimentation and erosion control structures, where necessary.

## 5.2 Road Authority Approvals

The use of licensed and experienced contractors for transporting wind farm equipment is essential to ensure the minimisation of any impacts on the road network and traffic operations. There are a number of transport contractors who are experienced in the specialised transport of over-dimensional loads. These contractors operate closely with road authorities and are able to arrange all required permits for undertaking the transport tasks. They would also carry out detailed transport route assessments and confirm the requirement for any road infrastructure upgrades and/or bridge strengthening works.

In obtaining approval and permits for over-dimensional transport, the following documents are pertinent:

- NSW RTA "*Operating Conditions: Specific permits for over-size and over-mass vehicles and loads*" Version 2, August 2008
- NSW RTA "*Road Transport (General) Act 2005: General Class 1 Over-size (Load-Carrying Vehicle) Notice 2007 under Division 3 of Part 2 of the Road Transport (Mass, Loading and Access) Regulation 2005*" August 2007
- NSW RTA "*Road Transport (General) Act 2005: General Class 1 Over-size (Special Purpose Vehicle) Notice 2007 under Division 3 of Part 2 of the Road Transport (Mass, Loading and Access) Regulation 2005*" August 2007

Consultation with the NSW RMS regarding their requirements for transporting over-size / length and/or over-mass loads resulted in the following pertinent issues:

- The Great Western Highway route from the Sydney area west to Lithgow and Bathurst is unsuitable for over-dimensional vehicle transport.
- Generally, over-size / length / mass transport will require two pilot vehicles and contact with NSW Police for further guidance (pilot vehicles).
- Over-size permits are required to be 'specific' permits for each vehicle if they will be travelling along designated roads or locations. Additional and specific over-size permits may be required for loads with greater dimensions than covered by a General Class 1 Over-size Notice.

- A specific permit:
  - prescribes the travel conditions that apply to a particular vehicle;
  - identifies the vehicle to which the permit applies; and
  - identifies the registered operator of the vehicle.
- The permit may also specify conditions to secure payment for:
  - damage caused to roads, bridges or other property by the over-size vehicle;
  - road work that must be conducted before the vehicle can travel on a particular route; or
  - costs incurred by the RMS to evaluate the proposed route or provide any special escort services.
- An over-mass permit will be required for each nacelle component.
- An over-size (length) permit will be required for each blade component. The requirement for over-mass permits for blade components will depend on the type of vehicle used to transport them. However, preliminary assessment indicates that over-mass permits may not be required for blade components.
- Transport of blade components will most likely utilise a rear-end steering system on a trailer or low loader.
- An over-mass permit will be required for each tower component.
- An over-mass permit will be required for the sub-station transformer unit.
- An over-mass permit will be required for each crane.
- Night transport is generally available along the major road network (between 1 am and sunrise or 6 am, whichever is earlier).
- Transport through urban areas must generally occur during daylight periods. It is recommended that if the transport routes pass through any school zones or adjacent to any schools (eg. Mudgee Public School, Mudgee High School along Duoro Street in Mudgee), transport also be restricted to outside school drop-off and pick-up times (8:00 am to 9:30 am and 2:30 pm to 4:00 pm) to prevent conflicts with these activities.
- As part of the transport permit process, the RMS and local Councils require a detailed sufficiency assessment of all bridges and other structures along the transport route to identify and specify strengthening requirements, if any. This may apply to several bridge crossings along Castlereagh Highway, etc.

## 5.3 Potential Road Infrastructure Upgrades

As well as the construction of an internal on-site road network that links up the various wind turbine sites and associated wind farm infrastructure, road upgrade works will be required at a number of locations along the transport route to accommodate the increased heavy vehicle volumes and over-dimensional transport vehicles. The latter issue would be confirmed by a licensed transport contractor as part of their transport route assessment based on specific vehicles to be used.

The potential road infrastructure upgrades that may be required and/or would need to be considered by the chosen transport contractor include the following (refer to *Section 5.4* below for typical examples of upgrade works and other risk mitigation measures along over-size transport routes).

*Castlereagh Highway / Goolma corner, Gulgong*

- The inside of the corner has a disused power pole that may need to be removed and the shoulder may require widening with all weather material.

*Mudgee Urban Area*

- Route 1 – preferred route for all over-size and over-mass vehicle transport:
  - The Market Street / Duoro Street roundabout has two sets of signs that would need to be made removable.
  - The Duoro Street / Horatio Street corner would require parking restrictions on the exit of the corner into Horatio Street.
- Route 2 – route option for over-length loads:
  - The Cox Street / Short Street corner requires some branches removed from a tree on the left hand side and parking restrictions on the entry and exit of the corner.
  - Some street signage would need to be made removable within the central median area of Short Street at its junction with Lawson Street. Also, parking restrictions would also be required on the entry and exit of the corner.
  - A sign in the median strip at the Burrundulla Avenue / Horatio Street intersection may require being made removable.

*Aarons Pass Road*

- Intersection with Castlereagh Highway will require traffic control to control highway movements when larger vehicles turn across northbound highway traffic to access Aarons Pass Road off the highway. RMS have recommended use of trailer mounted Variable Message Signs (VMS) on the Castlereagh Highway during the construction period.
- Curve alignments will require widening, filling, levelling, culvert extension and/or removal of trees or fence posts at the following locations:
  - Approximately 1.0 km west of Castlereagh Highway
  - Approximately 2.5 km west of Castlereagh Highway
  - Approximately 2.8 km west of Castlereagh Highway
  - Approximately 3.0 km west of Castlereagh Highway
  - Approximately 3.1 km west of Castlereagh Highway
  - Approximately 3.9 km west of Castlereagh Highway
  - Approximately 6.6 km west of Castlereagh Highway
  - Approximately 7.3 km west of Castlereagh Highway
  - Approximately 7.7 km west of Castlereagh Highway
  - Approximately 8.1 km west of Castlereagh Highway
  - Approximately 9.1 km west of Castlereagh Highway
  - Approximately 10.7 km west of Castlereagh Highway
  - Approximately 10.9 km west of Castlereagh Highway
  - Approximately 11.0 km west of Castlereagh Highway
  - Approximately 12.0 km west of Castlereagh Highway
  - Approximately 12.9 km west of Castlereagh Highway
  - Approximately 13.0 km west of Castlereagh Highway
  - Approximately 13.2 km west of Castlereagh Highway
  - Approximately 15.3 km west of Castlereagh Highway

  - Approximately 15.4 km west of Castlereagh Highway
  - Approximately 15.7 km west of Castlereagh Highway

- Crest alignments will require upgrading to provide suitable ground clearance for transport by over-dimensional vehicles at the following locations:
  - Approximately 3.8 km west of Castlereagh Highway
  - Approximately 5.3 km west of Castlereagh Highway
  - Approximately 6.9 km west of Castlereagh Highway
  - Approximately 12.5 km west of Castlereagh Highway

- Causeways will need to be confirmed for structural adequacy to allow the transport of over-mass loads at the following locations, and other locations as required from 16km west of Castlereagh Highway onwards to the northern site access point:
  - Approximately 17.3 km west of Castlereagh Highway
  - Approximately 17.9 km west of Castlereagh Highway
  - Approximately 19.2 km west of Castlereagh Highway

- Culverts may require widening (as required) between 16.0 km west of Castlereagh Highway and the northern site access point.
- At the proposed site access point, local widening will be required to allow suitable swept path for transport by over-dimensional vehicles.
- In general, Aarons Pass Road needs to be upgraded to an unsealed 6 m wide formation.
- Passing bays are proposed along the shoulder areas approximately every 1 km, where practicable without substantial tree clearing.
- Some general pruning of overhanging trees will be required to create a suitable vertical clearance plane.

*Bombandi Road*

- Provide an all-weather surface for the currently unsealed section of Bombandi Road required for minor access to the switching station.

## 5.4 Typical Transport Route Upgrade & Risk Mitigation Measures

Full structural road upgrades are not normally required for wind farm construction traffic, including over-dimensional vehicles. Exceptions include where access is via an under-rated bridge or where there are obstructions that overhang the road or limit the width of the vehicle / load that can pass. Mitigation strategies that are typically utilised instead of full structural road upgrades comprise the following:

*Road Surface*

As a general rule, ground clearances as low as 300 mm should be considered for over-mass trailers. Depending on the details of the transport equipment to be used, road camber, rise, fall and undulations may require review. Placing limits on vehicle speed ensures that even with heavy loads, the stresses on the road surface can be minimised. Whilst a sealed road surface is ideal, the vehicles are designed to and capable of travelling on unsealed surfaces such as those found on wind farm sites during construction – see *Figure 5.1* below. Therefore, temporary surfaces of crushed rock or similar material are normally adequate, on the basis that any such surface is properly drained to prevent loaded vehicles becoming bogged. There is not anticipated to be any significant impacts to road safety and/or traffic operations as a result of this type of road surfacing measure.

**Figure 5.1: Typical unsealed access road within a wind farm site**

*Road width*

Larger WTG loads require a road width of up to 5 m, which is sometimes more than the width of minor roads that service remote wind farm sites. Consideration needs to be given to ensure adequate road width for over-size / over-mass transport, although it is not normal to increase the width of a sealed surface if it already exists at less than 5 m. Where the road width is restricted (be it sealed or unsealed), the common approach is to clear sufficient vegetation from the sides of the road to allow shoulders of crushed rock to be laid. The level of the surface of any such preparation needs to match the edge of the existing road, to prevent tyre damage (and in the case of sealed roads, the break-up of the edge of the sealed section) when the vehicle is required to run wide for corners or to move over for on-coming traffic – see *Figure 5.2* below for increased unsealed road width.

Swept path analysis is generally undertaken once the WTG has been determined for the project, to ensure that any obstacles such as ditches or traffic furniture can be identified and remedied ahead of time where required. Where further road modifications are required to allow for 'cutting in' of vehicle rear wheels, crushed rock in-fill is normally sufficient on the basis that the vehicles are travelling slowly enough on the curves / turns to ensure minimum road stresses. Where temporary or crushed rock road surfaces are used, a regime of regular maintenance should be employed when over-dimensional vehicles are travelling to / from the wind farm site.

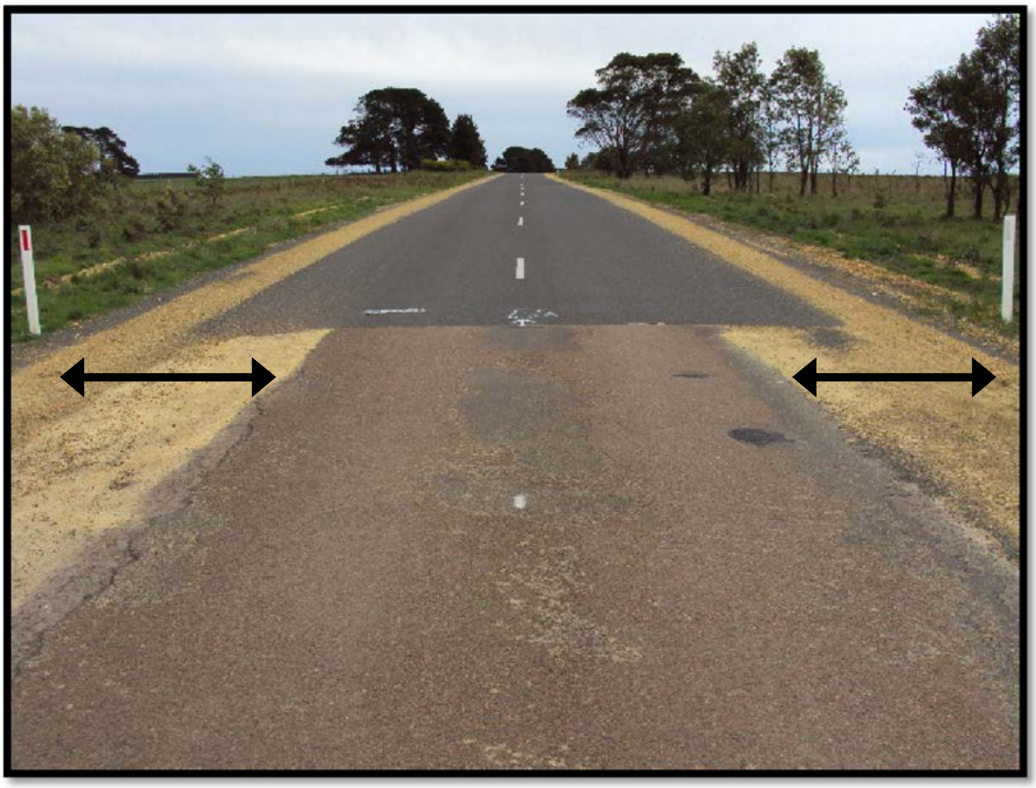


**Figure 5.2: Typical unsealed increase in width of (public) road**

*Overhead obstacles*

Over-dimensional vehicles can travel with a combined total height of 5.2 m without the need for an overhead pilot. Any obstructions or height risks such as low bridges (see *Figure 5.3* below), overhead power lines, hanging wires or tree branches would be identified. Where there is a bridge risk, detailed calculations would be done to ensure the loads as specified by the selected WTG manufacturer do not present any risk of a bridge strike. If this is possible, alternative route(s) should be sought. Overhanging wires can be provided with additional temporary support if required, whereas any overhanging tree branches would be cut back or restrained away from the path of the vehicle.

*Bridges and culverts*

In the event that there are bridges and/ or culverts which are deemed not strong or wide enough (typically less than 5 m travel path width) to support WTG transport equipment, the options are as follows:

- Build a temporary diversion with a structure to provide the necessary support, whilst leaving the original structure in place.
- Reinforce the existing structure by means of steel plates / girders as required to provide the necessary support. Reinforcement can be provided either below the structure, or as additional support on top of the existing road surface.
- As a last resort, if other options are not feasible or practicable, consideration may be given to the replacement of the bridge / culvert with a structurally suitable permanent upgrade to support the projected wind farm component loads.

The selection of any of the above options is dependent on a full technical assessment by a qualified structural engineer which typically occurs during the detailed design phase of the project, once the component and vehicle dimensions and loads are known.

**Figure 5.3: Identification of bridge underpass height risk**

# 6. Summary & Conclusions

The following pertinent issues summarise the transport impact assessment for the proposed Crudine Ridge Wind Farm Project (Preferred Project Report):

- The wind farm would consist of up to 106 wind turbines to be located on rural land near Pyramul, New South Wales, midway between Mudgee and Bathurst.
- Road transport is the preferred method of transport. Rail is not feasible due to larger wind farm components not being able to be accommodated by the rail system, lack of vertical and horizontal clearance in some sections, double handling, problems of scheduling rail services and potential restriction on track capacity.
- The preferred transport routes for over-dimensional vehicle transport are as follows:
  - Route 1: for all over-size and over-mass vehicles – Golden Highway, Castlereagh Highway, Goolma Road, Guntawang Road, Castlereagh Highway, Mudgee Urban Area (Market Street, Duoro Street, Horatio Street), Castlereagh Highway and Aarons Pass Road to the northern site access point.
  - Route 2: route option for all over-length vehicles – Golden Highway, Castlereagh Highway , Goolma Road, Guntawang Road, Castlereagh Highway, Mudgee Urban Area (Market Street, Cox Street, Short Street, Lawson Street, Mortimer Street, Burrundulla Avenue), Castlereagh Highway and Aarons Pass Road to the northern site access point.
  - The southern site access point is not proposed to be used for delivery by over-dimensional vehicles.
- The balance of heavy vehicle movements would access the site via the southern and northern site access points off Hill End Road. The preferred transport routes are as follows:
  - Route A (from Bathurst area): via Gilmour Street, Sofala / Peel Road and Hill End Road.
  - Route B (from Mudgee area): via Castlereagh Highway (north), Ilford-Sofala Road and Hill End Road.
  - Route C (from Lithgow area): via Castlereagh Highway (south), Ilford-Sofala Road and Hill End Road.
  - Route 1 (from the north): as above.
- The major road network provides transport routes to Mudgee (connecting to Castlereagh Highway and Ulan-Cassilis Road) and Bathurst (connecting to Great Western Highway, Castlereagh Highway and/or Mid Western Highway).
- The minor road network of Aarons Pass Road (northern site access) and Sofala / Peel Road, Ilford-Sofala Road and Hill End Road (southern site access) all have significant spare capacity along the road network.
- Site access is proposed via two major access points. These would be located off Aarons Pass Road (northern access) and Hill End Road (southern access).
- The whole Project site would be able to be accessed from either access point via the internal road network.

- In addition to the two major site access points, there would be minor and limited construction access required to the switching station site (via Bombandi Road) and the external transmission line route (via Crudine Road).
- During the construction phase, several tasks would generate traffic including wind farm component delivery, construction material delivery, concrete pours and construction staff transport. For the majority of the construction period, maximum daily traffic generation would be 80 light vehicle trips and 36 heavy vehicle trips per day.
- General traffic generation (excluding over-dimension vehicles) is conservatively anticipated to be split between the northern and southern site access points (via Route 1 and/or Routes A / C and B). All over-dimension vehicles would travel to the northern site access point off Aarons Pass Road via Routes 1 and 2. Some minor traffic generation would also use the Bombandi Road / Crudine Road access routes.
- During peak construction activities, all affected roads on the road network would maintain their levels of service and adequately absorb construction-generated traffic.
- It is proposed that during peak traffic generation activities such as concrete pours and wind farm component delivery, escort vehicles and appropriate traffic management would be adopted to ensure safe passage from the public road network onto the site.
- Traffic generation during project operations would be minimal, resulting in an average of approximately 10 trips per day with a maximum of approximately 30 trips per day in the first year of operations. Consequently, traffic and road network impacts would be negligible during the operational phase.
- For the over-dimensional transport routes, road infrastructure upgrades would be required at a number of locations along Aarons Pass Road and some minor adjustment works within the Mudgee Urban Area to accommodate the over-dimensional vehicles.
- Along the over-dimensional transport routes, where vehicles would require the use of the full carriageway width, traffic management would be required in the form of temporary, short-term full road closures (‘rolling’ road closures as vehicles pass critical locations) aided by escort vehicles. This will be aided by the provision of passing bays along the Aarons Pass Road section of the over-dimensional transport route.
- A Construction Traffic Management Plan (CTMP) would be prepared in conjunction with the transport contractor and relevant road authorities and all aspects would be implemented in co-ordination with the local Councils and RMS. The CTMP would typically address:
  - Scheduling of transport deliveries, particularly outside of school bus route hours;
  - Community consultation and issue logging;
  - Clear communication of road closures (if required);
  - Letterbox drop along affected routes;
  - Minimising disruption to local vehicles by ensuring average and maximum wait times due to project traffic along local roads;
  - Road infrastructure upgrade requirements;
  - Traffic management of transport operations;
  - Preparation of a ‘Transport Code of Conduct’ for all staff and contractors;
  - Procedure to monitor traffic impacts and respond to impacts rapidly; and
  - Reinstatement of pre-existing road conditions after construction is complete.

- The use of licensed and experienced contractors for transporting wind farm components would ensure a minimisation of transport impacts. They would arrange required over-size vehicle permits, carry out a detailed transport route assessment and confirm the requirement for any road / bridge infrastructure upgrades.

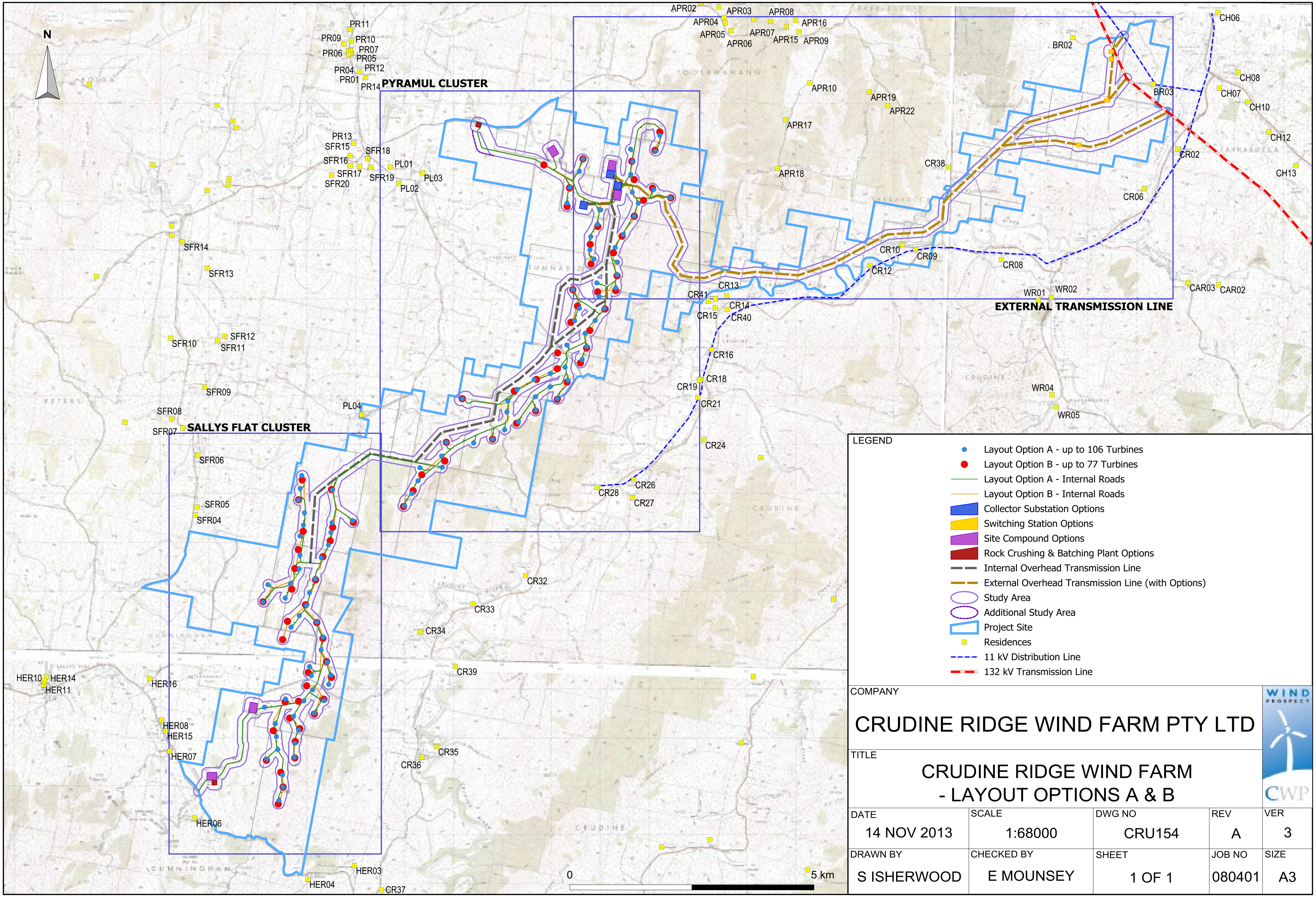
This Transport Assessment has addressed Planning NSW's Director General's Requirements (DGRs), as well as some additional issues raised by NSW RMS and MWRC, for the construction and operational impacts of the project as follows:

- Details of light and heavy vehicle traffic volumes during construction and operation – refer to *Section 4.2* (specifically *Tables 4.2* and *4.3*) and *Section 4.4*.
- Details of transport routes during construction and operation – refer to *Section 3.2*.
- Assess potential impacts on road network operations and road safety – refer to *Section 4.3.1* and *Section 4.3.2*.
- Assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the project (including over-dimensional vehicles) during construction (refer to *Section 4.3.1*) and operation (refer to *Section 4.5*), including full details of any required upgrades to roads, bridges, site access provisions (for safe access to the public road network) or other road features (refer to *Section 5.3*).
- Details of measures to mitigate and/or manage potential impacts – refer to *Section 5*, particularly *Section 5.3*.
- Details of internal site access roads and connections to the existing public road network, including ongoing operational maintenance for on-site roads – refer to *Section 3.3*, *Section 4.3.2* and *Section 4.3.3*.
- On-site internal road network layout, parking facilities and infrastructure – refer to *Section 4.3.3* and *Appendix A: Proposed Wind Farm Layout*.
- Preparation of a Traffic Management Plan (TMP) to address management of additional traffic during construction (and decommissioning) and site access issues – refer to *Section 4.3.2*.
- Unloading and loading of transport and service vehicles, particularly over-dimensional vehicles – refer to *Section 4.3.2* and *Section 4.3.3*.
- Hours and days for construction and operation – refer to *Section 4*.
- Details of local climatic conditions that may affect road safety – refer to *Section 4.3.2*.
- Any cumulative impacts from other proposed and approved developments in the surrounding area – refer to *Section 4.6*.

In conclusion, it is considered the proposed Crudine Ridge Wind Farm Project would not create any significant adverse impacts with respect to transport issues such as traffic operations, road capacity on the surrounding road network, site access and road safety. The management of heavy vehicle movements during construction would be appropriately covered by a CTMP to be prepared prior to construction starts, while the use of a specialised and licensed transport contractor would ensure that the transport of over-dimensional wind turbine components would be carried out in an appropriate manner.

## Appendix A

# Proposed Wind Farm Layout




| | | | | |
|---|---|---|---|---|
| COMPANY | CRUDINE RIDGE WIND FARM PTY LTD | | | |
| TITLE | CRUDINE RIDGE WIND FARM - LAYOUT OPTIONS A & B | | | |
| DATE 14 NOV 2013 | SCALE 1:68000 | DWG NO CRU154 | REV A | VER 3 |
| DRAWN BY S ISHERWOOD | CHECKED BY E MOUNSEY | SHEET 1 OF 1 | JOB NO 080401 | SIZE A3 |