APPENDIX 13

Traffic and Transport Study

Bega Duo Designs

TRAFFIC & TRANSPORT STUDY

PROPOSED SAPPHIRE WIND FARM

Glen Innes Severn & Inverell Shire Councils

West of Glen Innes N.S.W.

Prepared for Wind Prospect CWP Pty Ltd

February 2011

By Rodger Ubrihien

Bega Duo Designs

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1 INTRODUCTION

1.1 Scope of this Assessment

Bega Duo Designs was commissioned by Wind Prospect CWP PTY LTD to complete the Traffic and Transport Study for inclusion in the Environmental Assessment of the proposed Sapphire Wind Farm.

This report conforms to the *Guide to Traffic Generating Developments* as recommended by the NSW Roads and Traffic Authority and provides a technical appraisal of the traffic and safety implications arising from the proposal. The report also develops measures and makes recommendations for the minimisation of traffic impacts during the construction and operation of the wind farm. This report focuses primarily on the construction phase of the project which would generate the maximum traffic impact.

The requirements of the Director General of the Department of Planning arising from the Preliminary Environmental Assessment have also been taken into consideration. These include:

- details of the nature of the traffic generated
- transport routes
- traffic volumes
- potential impacts on local and regional roads
- potential impacts on bridges and intersections
- proposed road upgrades and repairs

The primary focus of this report is on the existing public road network and its connections with the proposed site access roads.

This report considers the general impact of the heavy and oversized vehicles on the public road network and immediate surrounds. It does not include a detailed route assessment for the transportation of the over-mass and over-dimension turbine and transformer components along the routes from the major manufacturing centres. This assessment would be required to be produced as part of the permit system by the haulage contractor and approved by the relevant roads authorities prior to the commencement of the construction phase. Included in Sec. 3.2 of this report is a summary of the most likely routes from the eastern Australian ports.

It is proposed to construct the wind farm over a two year period. Preparation of an Environmental Assessment has commenced for submission to the NSW Department of Planning in mid 2011.

This assessment examines the projected traffic impacts for the construction of up to 159 wind turbines within three clusters, referred to as Wellingrove, Swan Vale & Sapphire. Combined, the three clusters would generally be referred to as the 'Sapphire Wind Farm' in this report.

The precise number of wind turbines in the final project has not been determined and for the purposes of this report it has been assumed that the "1.5 MW layout" will be adopted which produces the maximum number of wind turbines (159).

The precise location of all internal access roads has not been determined at this stage of the planning and therefore assumptions have been made about the most likely access points on to the existing road network based on terrain and sight distance. The precise locations will be determined during the detailed design stage however any variations to access locations are not expected to be significant and should not significantly affect the conclusions of this report.

This report does not include details of the hand over requirements of onsite access roads. These details would require the involvement of the local roads authorities and land holders following the preparation of the detailed design plans. These issues are discussed in the on-site access section of this report.

1.2 Proposal Overview

The Sapphire Wind Farm is located between 26 and 39 kilometres (road distances) west of Glen Innes in the north east of N.S.W. (refer to Appendix A & B).

A section of the Wellingrove cluster in the East of the project site is located in the Glen Innes Severn Shire with the majority of the wind turbines being located in the Inverell Shire. (refer to Appendix A). Most construction would be located in open grazing land.

An indicative layout for a wind farm of up to 159 turbines is shown in Appendix A. It is anticipated the final number and positions of the wind turbines will be refined through the final design process. The currently adopted layout has been modelled using a wind turbine with a nominal capacity of 1.5 megawatts however other turbines are under consideration with nominal capacities up to 3.4 megawatts, resulting in a predicted output of 999,363 megawatt hours per annum (based on a 2.05 MW turbine and 35% capacity factor).

Typical dimensions of the wind turbines include a tower height of 80 or 100 metres and blade lengths of 44 to 54 metres, albeit the maximum blade tip height will be in the order of 155 metres.

The wind turbines would be automated to face into the wind and will generate with wind speeds from 4 metres per second. Typically a turbine will shut down at around 25 metres per second to avoid damage to the equipment.

The individual turbines would be connected by underground or overhead cables to a new substation constructed on the site. Connection via overhead transmission lines would be made to the 330kV or 132kV TransGrid distribution network which pass through the western section of the wind farm or to the south of the site.

Roads would be constructed connecting the turbine sites and level work areas would be provided surrounding turbines for the safe operation of cranes. These work areas would also provide turning areas for large vehicles. Internal roads would connect to the public road network at a minimum number of locations providing safely designed intersections.

1.3 Key Issues and Objectives

The issues outlined in Table 2.1 of the Roads and Traffic Authority's *Guide to Traffic Generating Developments* are considered in this study. Additional issues have been included because of the unique nature of the development and requirements of the Director General of Planning. These include the impact on the existing road surfaces and bridges as observed during site inspections.

Key Issues

- Existing road hierarchy and proposals for improvement

- Impact on road safety
- Impact of traffic noise
- Traffic volumes and trends
- Traffic generation
- Impact on bridges, intersections and surrounding developments
- Safety and efficiency of access routes (including capacity) between the sites and adjacent road networks

1.4 Methodology

- Base project information was obtained from Wind Prospect CWP PTY LTD.
- Further information was obtained from the Preliminary Environmental Assessment of 28th April 2009 and the Sapphire Wind Farm website.
- Existing mapping was used to identify features and place names.
- Planning documentation for other wind farm proposals was reviewed.
- All roads were inspected, inventories prepared and photographs taken. Road junctions and intersections were inspected and photographed.
- Approximate traffic count information was obtained from observations at all precincts during January 2011. Roads & Traffic Authority data was used to establish the existing traffic volumes (vehicles per day) on the main roads.
- Discussions were held with representatives from Wind Prospect CWP PTY LTD, Glen Innes Severn and Inverell Shire Councils.
- Heavy vehicle operators were consulted.
- Methods of wind turbine construction and programming of the works were investigated to estimate the proposed number of vehicle trips.

Note:

In accordance with the *Guide to Traffic Generating Developments,* a 'trip' is defined as a one-way vehicle movement from one point to another, excluding the return journey.

The general method of measuring traffic volume is 'vehicles per day'. This is the total of all trips made in either direction per day.

2 PROPOSED DEVELOPMENT

2.1 Site Description

The Sapphire Wind Farm site is shown in Appendix A and the diagram in Appendix B shows the location with road distances to major centres. The site comprises open grazing land with generally long undulating ridges ranging in height between 750 and 1050 metres above sea level.

The site is accessed from a number of local roads which connect to Waterloo Road. Waterloo Road junctions with the Gwydir Highway approximately 19 kilometres west Glen Innes.

The geology of the site is primarily basalt soil and the elevated areas appear to have soil cover to a reasonable depth.

The local watercourses provide an access constraint within the site resulting in the current layout which will require a total of up to eight separate access points to the public road network for the three clusters of wind turbines. Wellingrove cluster has 37 proposed turbines, Swan Vale (66 turbines) and Sapphire (56 turbines).

2.2 Site Access General

Existing local access roads are shown on the Plan, (Appendix A) and the routes to the major ports and manufacturing centres are shown on the locality plan, (Appendix B).

The roads are generally classified as follows:

National Highways which are maintained and constructed by the State Road Authorities.

- Gwydir Highway provides access from Glen Innes and Inverell.
- New England Highway which connects Glen Innes to Newcastle in the south and the Queensland State border in the north.
- Cunningham Highway which connects Brisbane with the Queensland Border.

Local Council Roads which provide access from the Gwydir Highway to the access points for each cluster of wind turbines. These roads (proceeding west from the Gwydir Highway) are:

- Waterloo Road which is maintained by Glen Innes Severn Council up to the Shire boundary at 6.9km and Inverell Shire Council for the remainder of its length.
- Polhill Road which is maintained by Glen Innes Severn Council and departs from Waterloo Rd at 3.75km.
- Western Feeder Road which is maintained by Inverell Shire Council.
- Kings Plain Road which is maintained by Inverell Shire Council. This road may provide an alternate access to the western section of the Sapphire Cluster.

The currently favoured access points for the three clusters are shown on the Plan, (Appendix A) and described below:

Wellingrove Cluster

The major access proposed is from Polhill Road at a point 2.7km from the Waterloo Road.

Swan Vale Cluster

Four separate access points are proposed along Waterloo Road at 7.8km, 12.0km, 15.1km & 17.8km.

Sapphire Cluster

Access points proposed are at 0.2km & 2.7km along the Western Feeder Road north from Waterloo Road. An additional access point for the southern section is proposed from Waterloo Road at 19.75 kilometres.

2.3 Future Road Proposals

There are no current proposals for major road improvements for the access roads under consideration in the project area. Inverell Shire Council has a proposal to repair several of the damaged concrete causeway crossings on Waterloo Road.

3 EXISTING TRAFFIC CONDITIONS

3.1 General

Traffic safety is dependant on many variables such as driver behaviour and weather conditions. This section of the report examines the physical constraints which could have an impact on traffic safety, as observed on an inspection of the roads carried out in January 2011. This work included observations of traffic volumes. The expected routes for oversize and over mass vehicles from the major manufacturing centres to Glen Innes were not inspected and are discussed in Sec. 5.2 of this report.

Inventories for the roads comprising the major routes, as shown on the plan in Appendix A follow in Sec. 3.2. These roads are Gwydir Highway, Waterloo Road, Polhill Road, Western Feeder Road and Kings Plain Road.

3.2 Major Access Routes

Cunningham Highway & New England Highway Brisbane to Glen Innes

The Cunningham & New England Highways provide access to Brisbane in the north.

The Highways are generally high standard two lane rural roads with intersections, pavements and overtaking lanes designed for the passage of heavy vehicles.

A section of the Cunningham Highway over Cunninghams Gap 120 kilometres south of Brisbane is prone to landslips and often reduced to single lane travel.

An intersection in Warwick (150 kilometres south of Brisbane) may require an adjustment to roadside furniture and traffic control plan to allow the safe passage of the longer loads.

The New England Highway through Tenterfield has an oversize width restriction for vehicles wider than 4.0 metres which can require the adjustment of roadside furniture (refer to Plates 1 & 2).

A section of the New England Highway at Bolivia 35 kilometres south of Tenterfield has restricted shoulder widths (refer to Plate 3).

New England Highway Newcastle to Glen Innes

The New England Highway from Newcastle to Glen Innes is generally high standard two lane rural roads with intersections, pavements and overtaking lanes designed for the passage of heavy vehicles.

Sections of the alignment through Muswellbrook and Tamworth could be restrictive to long loads because of the location of obstacles on the inside of curves at intersections.

Newcastle to Sydney & Port Kembla

High standard highway and expressway conditions are available from Newcastle to Port Kembla. Restrictions to the timing of travel through the metropolitan areas for over-size and over-mass will apply.

Gwydir Highway from Glen Innes to Waterloo Road

The junction of the Gwydir Highway with the New England Highway is restricted for long trailers turning because of restrictions on the inside of the turn and signs on the medians (refer to Plates 4,5 & 6). The signs are fitted with collapsible bases (refer to Plate 7).

The Gwydir Highway has 3.5 metre wide lanes with sealed shoulders at most locations (refer to Plate 8).

The bridge over Furracabad Creek at 5.4 kilometres from Glen Innes has an available width of 6.6 metres between kerbs (refer to Plate 9).

The junction with Waterloo Road is at 18.7 kilometres from Glen Innes (refer to Plates 10, 11 & 12). This junction has sub-standard turning radii for use by heavy vehicles and the shoulder width opposite Waterloo Road on the Gwydir Highway is insufficient to allow for the passing of a turning vehicle. The sight distance from Waterloo Road looking towards Glen Innes is restricted by roadside vegetation.

Waterloo Road

Waterloo Road commences with a bitumen seal 5.0 metres wide (refer to Plate 13) and is posted as a school bus route for the first four kilometres.

Trees overhang the road at 0.2 and 1.1 kilometres (refer to Plate 14).

The bridge over Wellingrove Creek is 23.3 metres long (3 span) with timber deck and girders. The girders are supported on concrete sills. The available width between kerbs is approximately 5.0 metres (see Plates 15 & 16).

The bridge over Maids Valley Creek is at 4.7 kilometres from the Gwydir Highway (refer to Plates 17 & 18). This bridge was constructed by the Department of Main Roads in 1968 and is 3.6 metres width between Kerbs. The bridge has 3 spans and is 32 metres long. The available width between railings is 4.6 metres. The junction with Polhill Road commences at the western abutment of the bridge.

The Polhill Road junction is located at 4.75 kilometres (refer to Plates 19 & 20). The sight distances are sufficient for low speed travel and the turning radii should permit the turning of long loads. Reconstruction of the bridge over Maids Valley Creek could impact on the sight lines and turning radii.

The bitumen seal on Waterloo Road ends at 4.05 kilometres from Gwydir Highway.

The gravel section of Waterloo Road up to the Shire Boundary at 6.9 kilometres is between 4 and 5 metres wide with several low radius curves and crests (refer to Plates 21 & 22). The safe travel speed is considered to be approximately 60 kilometres per hour. There are several pipe culverts which require extension and the provision of headwalls.

A damaged concrete causeway at 7.7 kilometres is 7.0m wide with two large concrete pipes to provide for normal flows. These pipes are currently restricted by debris (refer to Plates 23 & 24).

The first access point into the Swan Vale Cluster is on the left at 7.8 kilometres. Plates 25 & 26 demonstrate the sight distance available to the east and west respectively. The sight distance to the east is restricted by a small crest.

A power line crosses the road at 8.2 kilometres. The clearance over the road surface may not be adequate for high loads.

Plate 27 shows the rough surface at approximately 8.2 kilometres from Gwydir Highway.

The concrete causeway at 9.0 kilometres is 4.0m wide and requires repair and widening (refer to Plate 28).

The concrete causeway at 9.15 kilometres is 4.0 metres wide. The culverts for low flow appear to be of sufficient width (refer to Plates 29 & 30).

Plate 31 shows overhanging trees at 9.20 kilometres.

Eastern Feeder Road is on the right at 9.47 kilometres from Gwydir Highway (refer to Plate 32).

Trees overhang the road at 9.95 kilometres.

The concrete causeway at 10.3 kilometres is 4.0 metres wide (refer to Plate 33).

The concrete causeway at 11.4 kilometres is 4.0 metres wide with 2 large pipes for low flows. The concrete surface requires widening and extension to the east (refer to Plates 34 & 35).

The second proposed access point to the Swan Vale Cluster is on the left at 12.0 kilometres. Sight distance is more than adequate (refer to Plates 36 & 37).

Plate 38 shows overhanging trees ahead at 12.8 kilometres from Gwydir Highway.

Concrete causeways 4.0 metres wide are located at 13.30, 14.75 & 14.80 kilometres (refer to Plates (39, 40 & 41).

The third access to the Swan Vale Cluster is proposed on the left at 15.1 kilometres. The sight distance is adequate (refer to Plates 42 & 43).

Concrete causeways are located at 15.8 and 16.8 kilometres (refer to Plates 44 & 45).

The Western Feeder Road junction is on the right at 17.64 kilometres from Gwydir Highway. The sight distances and turning radii appear to be adequate for large traffic at relatively low speeds (refer to Plates 46 & 47).

Gradients increase on Waterloo Road beyond its junction with Western Feeder Road. The third proposed access into the Swan Vale Cluster is on the left near the top of the crest at 18.5 kilometres. The sight distance appears to be adequate (refer to Plates 48 & 49).

A “steep descent” warning is located at 19.6 kilometres from Gwydir Highway (refer to Plate 50).

The proposed access on the right at 19.75 kilometres will provide access to the southern end of the Sapphire Cluster. Plates 51 & 52 demonstrate the available sight distance which is restricted by the low standard alignment and steep gradients.

Polhill Road

The distances shown along Polhill Road commence from the junction with Waterloo Road. The start of Polhill Road at its junction with Waterloo Road is 3.75 kilometres from Gwydir Highway. Plate 53 shows the start of Pollhill Road.

Polhill Road is a gravel road approximately 4.0 metres wide in undulating to flat terrain (refer to Plate 54 showing Polhill Road at 0.85 kilometres from Waterloo Road.

A large concrete box culvert 8.0 metres in width is located at 2.60 kilometres. The depth of cover over the deck of the culvert may be insufficient to protect the structure under heavy loads.

The proposed access on the left to the Wellingrove Cluster is at 2.65 kilometres from Waterloo Road. The sight distance is good in both directions (as shown on Plates 56 & 57).

Western Feeder Road

The distances shown on Western Feeder Road commence at its junction with Waterloo Road at 17.64 kilometres from Gwydir Highway. Plate 58 shows the commencement of Western Feeder Road which is a gravel road approximately 4.0 metres wide in undulating terrain.

The location of the access point into Sapphire Cluster is on the left at 0.2 kilometres. Plates 59 & 60 show the sight distances in both directions which should be adequate for the travel speeds expected.

A concrete causeway 4.0 metres wide is located at 1.7 kilometres (refer to Plate 61).

The second proposed access off Western Feeder Road into the Sapphire Cluster is on the left at 2.7 kilometres. Plates 62 & 63 show the sight distances in both directions which should be adequate for the travel speeds expected.

The Western Feeder Road is generally up to 3.0 metres wide in this locality. The terrain is undulating to flat with 8 causeways between 3.0 kilometres and Kings Plain Road junction at 8.4 kilometres from Waterloo Road.

Kings Plain Road

Kings Plain Road is generally of a higher standard than Western Feeder Road and is the main route from this locality and Wellingrove into Inverell. For planning purposes this route was inspected in order to provide a possible alternate access into the Sapphire Cluster from the West. Kings Plain Road towards Sapphire has a gravel surface in good condition. The junction with Western Feeder Road has been adopted as the starting point for the distances quoted along Kings Plain Road in this section of the study.

The junction with Western Feeder Road has good sight distance however the turning radii are restricted by a drainage line and culvert (refer to Plate 64).

Causeways are located at 1.2, 2.3, 4.1 & 4.8 kilometres. These are in good condition and are between 4.5 and 5.0 metres wide.

The proposed access point into the Sapphire Cluster is at 5.5 kilometres from Western Feeder Road. The distance to Inverell from this access point is approximately 32 kilometres (refer to Plates 65 & 66).

3.3 Existing Traffic Volumes

Traffic observations were made during the morning and afternoon on 14th of January 2011. The counts obtained were compared with hourly totals obtained from Roads & Traffic Authority "Vehicle Classification Counts" which were collected in 2008 on the Gwydir Highway. The comparison confirmed that the volumes obtained were typical for average volumes.

Volumes obtained from RTA counts (Roads and Traffic Authority) are average, annual, daily traffic counts and have been adjusted to represent numbers of vehicles per day. The volumes were based on counts collected in 2007. The figures include vehicle numbers in both directions and can be adjusted if required assuming that the peak hour represents 15% of the daily traffic volumes.

Observations on the western section of Waterloo Road, Western Feeder Road and Polhill Road revealed hourly counts of approximately 2 vehicles per hour. The traffic on these roads is generated primarily by the occupied properties. The volumes adopted below are estimates only based partly on the number of properties gaining access.

The accuracy of the adopted traffic counts on the minor roads is not significant in the assessment of traffic impacts whilst the volumes remain low. Impacts of increased traffic on these roads are primarily based on observed defects in each road.

Table 3-1 Traffic Volumes (AADTs) for Roads in the Study Area.

Road	**Vehicles per day**	**Information source**
Gwydir Highway at Swan Vale	1361	Obtained from RTA 2007 records
Waterloo Road	60	Adjusted from counts taken
Pollhil Road	Less than 50	Estimated from observations
Western Feeder Road	Less than 50	Estimated from observations
Kings Plain Road	Less than 200	Estimated from observations

** Volumes represent the total traffic volume in both directions.(they also equate to the number of trips)*

3.4 Accident Records

Accident records from the Roads and Traffic "Crash" database for the five years prior to June 2010 indicate the following:

- There were 36 recorded casualty accidents on Gwydir Highway between Glen Innes and Inverell (67 kilometres). Four of these accidents resulted in a fatal injury. Sixty five percent of the accidents were attributed to speeding and fatigue.
- There were two non-casualty accidents on Kings Plain Road.
- There were no recorded accidents on Waterloo Road.

These relatively low accident rates result from the low volumes of traffic.

4 FACTORS RELATING TO TRAFFIC GENERATION AND TRAFFIC IMPACT

4.1 Traffic Generation

Vehicle Types

The type of vehicles accessing the site depends on the equipment or personnel being transported and their function on the site. Access is expected to be available to depot sites and facilities buildings for conventional two wheel drive vehicles. Access to the wind turbines may be restricted to four wheel drive or multiple wheel drive vehicles.

Due to the size and weight of the wind turbine equipment it is expected that many of the delivery vehicles will be “oversize”, “over mass” or both. These vehicles will be regarded as Restricted Access Vehicles (RAVs) and will require operating permits to allow them to travel on public roads.

“Oversize” 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 in excess of 42.5 tonnes. Each wind turbine generator comprises a nacelle (approx. 75 tonnes), hub (approx. 25 tonnes), three blades (approx. 7 tonnes each), four tower sections (approx. 50 tonnes each).

The components are carried on specially designed trailers with axles which extend up to 4.2 metres total width to carry the hubs and nacelles on N.S.W. roads. The blades which are up to 54 metres long are carried on “jinker” trailers which have steerable rear axles. These trailers can negotiate relatively small radius curves (similar to the turning path of a “B-double”) provided that the inside of the curve is clear of obstacles.

Construction phase of the project

The maximum traffic volume is expected to occur during the civil construction phase of the wind farm which includes the pouring of concrete for the foundations. Each footing may contain up to 310 cubic metres of concrete to be poured over an eight hour period. This results in a rate of up to 12 mixer truck trips per hour. Mobile batch plants may be provided on-site as an alternative to transport from suppliers in Glen Innes or Inverell. Location of the batch plants on-site may reduce the maximum traffic generation rate on the major roads. For the purpose of predicting maximum possible traffic generation, the concrete trucks will be included in the number of vehicles generated on all of the major routes.

The location of the three clusters in the current development (see Plan of Access Roads in Appendix A) would result in major access links being along the Gwydir Highway, Waterloo Road, Polhill Road and Western Feeder Road.

Operation phase of the project

Once operational, the wind farm would be managed and operated by several crews of locally based technicians. The clusters would be accessed regularly for operational and maintenance activities. It is estimated that the operational phase would generate up to 12 trips per day on the local road network.

4.2 Construction Program

The project would be constructed over an 18 month to 2 year period. The following major activities are expected to take place at all three clusters.

- Civil works for upgrading of access roads and establishment of cluster depots and site offices
- Civil works for construction of internal tracks, excavation for footings and trenching for cables
- Pouring of concrete in turbine footings
- Transportation to precinct, erection and commissioning of wind turbines
- Construction of substation and associated power lines.

4.3 Working Hours

Normal construction industry working hours are assumed for the purposes of this report, as specified in the EPA Environmental Noise Control Manual (7am-6pm Mon-Fri, 7am or 8am – 1pm Sat). EPA Guidelines would apply for noise emissions from construction works.

4.4 Assumed Design Traffic Volumes

The traffic volumes contained within this section would be used to design traffic management devices, such as junctions, required for the proposal. They are also used to quantify the traffic impact, for example, on residents living adjacent to the haulage routes, and possible damage to the road pavements.

The daily rate of traffic movements, rather than total number of movements, is the critical factor in determining the level of impact. The daily rate is derived from Table 4.1, which estimates the predicted maximum number of one way traffic movements (trips) per day for the various construction activities.

Table 4-1 Predicted Daily Rates of Traffic (trips).

For the purposes of predicting traffic on a major route the following table is based on a continuous construction program with specialised crews. As discussed previously the maximum traffic volumes are initially driven by the need to continuously pour a concrete footing in one day. During the erection stage large mobile cranes are required to lift the towers, nacelles and blades into position. The maximum traffic volumes assume that the erection phase is carried out by one specialised crew. Given the requirement to carry out the construction in less than two years these major operations will overlap and will be spread between clusters. The maximum traffic volumes therefore may only apply at one location in the road network during any single time period.

Information in the table is based around continuous concrete pouring one footing in a day and installation of approximately 2.5 towers per week.

Activities	Approximate Timing	Maximum number of trips per day	Comments
Construction and Management Staff	Full Duration Q2 2012 to Q4 3013	**50**	Assuming approx. 3 employees per vehicle.
Precinct Set-up & Road Construction	Q3 2012	40	
Foundation Construction	Q3 2012 to Q3 2013	**100**	Includes reinforcing steel delivery
Dust Suppression	Full Duration	**5**	
Substation & Powerline Construction	Q1 2013 to Q4 2013	**30**	Includes over-mass vehicle deliveries of transformers.
Turbines Erection & Internal Cabling	Q3 2012 to Q4 2013	**65**	Includes oversize and over-mass vehicle deliveries.

The trips shown in **bold** could be concurrent, resulting in a maximum 250 trips per day.

This table indicates that the maximum daily rate of traffic at any point on the major access route may increase by up to 250 vehicles per day during the peak construction period.

The estimated hourly rate during the peak hour (based on 15% of the daily volume) is approximately 40 vehicles per hour. This figure would be used in the design of new junctions and is applicable when estimating the impacts on residents adjacent to the proposed routes.

4.5 Design for Heavy Vehicles

The standard design vehicle for the design of parking and turning areas (as a minimum) would be the ‘Austroads’ “B-Double” . However, provision would be made wherever possible to allow for a miinum ‘B-Double’ temPlate on all intersections in the public road network. This wider path would allow for the turning of semi trailers and oversize vehicles.

There is a requirement to transport turbine blades to the precinct, which could be up to 54 metres long. These would be transported on purpose designed steerable trailers making approximately 240 deliveries in total. These vehicles would be capable of negotiating relatively small radius curves (similar to “B-Double”) provided that areas free of obstructions are available on the inside of curves. The transport of tower sections up to 25 metres long and weighing up to 50 tonnes would

require a total of 650 oversize vehicle deliveries. The nacelles would require 159 over-mass (up to 75 tonnes) vehicle deliveries.

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.

4.6 Traffic Circulation

Hardstand areas are required around each turbine for the safe operation of large cranes. These areas would also provide turning opportunities for delivery vehicles. Turning bays have also been proposed on internal access tracks to enable large vehicles to turn without reversing over long distances.

No vehicles would reverse onto the public road network.

4.7 Road Capacity (Level of Service)

Road capacity is normally described as 'Level of Service' and based on Austroads '*Guide to Traffic Engineering Practice, Part 2 Roadway Capacity*'. Capacity is expressed in total vehicles per day. The level of service descriptions are as follows:

Table 4-2 Level of Service (LOS) Descriptions.

LOS A :	Free flow condition, high degree of freedom for drivers to select desired speed and manoeuvre within 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, restricted freedom for drivers to select desired speed and manoeuvre within traffic stream.
LOS D :	Approaching unstable flow condition, severely restricted freedom for drivers to select desired speed and manoeuvre within traffic stream.
LOS E :	Condition close to capacity, virtually no freedom for drivers to select desired speed and manoeuvre within traffic stream. Small increases in flow would generally cause operational problems.

Tables contained in Austroads '*Guide to Traffic Engineering Practice*', Sec. 3.4 & Sec 4 Roadway Capacity, have been used for the following determinations based on the traffic volumes shown in Section 3.1:

- The Gwydir Highway at approximately 1,400 vehicles per day (vpd) operates at LOS A and would not reach LOS B until the volume reaches approximately 2,400 vpd. The estimated maximum design volume (see Section 4.4 of this report) is 1,650 vpd.
- The sealed two lane section of Waterloo Road with approximately 200 vpd is operating at LOS A and the level of service would no drop to LOS B until volumes reach 1,100 vehicles per day.

The determinations above show that the increase in traffic volumes of 250 vehicles per day would have a negligible effect on the capacity of the sealed two lane roads shown above.

The single lane gravel roads which comprise the remainder of the roads under consideration perform their function as property access roads however **would not** perform satisfactorily with an increase in traffic of 250 vehicles per day. Delays would occur regularly as vehicles are required to give way to opposing traffic.

The Roads & Traffic Authority design guidelines suggest that roads with volumes between 150 and 500 vehicles per day should be provided with two lanes of 3.0 metres minimum width each (6.0m pavement). This is generally the minimum standard adopted by councils for smaller rural subdivisions.

5 POTENTIAL IMPACTS

5.1 Traffic Impacts General

Traffic generation calculations indicate that the maximum hourly increase in traffic at any location would be approximately 40 vehicles per hour (equivalent to 250 vpd) during the construction phase of the project.

The following impacts have been considered:

- Vehicle collisions
- Vehicles losing control
- Dust from unsealed roads
- Obstruction by long loads
- Wet weather
- Road surface deterioration
- Structural failure of road structures
- Conflicts with School Busses.

5.2 Impacts of Over-mass and Over-dimensional Haulage on Major Routes

Detailed discussion of the impacts relating to over-mass and over-dimension routes from the major manufacturing centres and ports to Glen Innes is not included in this report as this aspect will be the subject of Traffic Management plans to be prepared in conjunction with a Heavy Haulage and the Roads Authorities.

The Locality Plan in Appendix B shows the possible routes from the east coast ports.

Most of these routes carry volumes in excess of 2,000 vehicles per day with a large percentage of heavy vehicles. The proposed addition of up to 1,000 heavy vehicles over an eighteen month period is considered to present an insignificant impact.

The impacts would mostly include minor delays such as:

- Stopping for traffic control whilst Traffic Management Plans are being implemented at restricted sites.

These sites may include Cunninghams Gap and Warwick in Queensland. Sites in NSW may include Tenterfield, Glen Innes, Tamworth and Muswellbrook.

- Moving on to the road shoulder to allow the passage of oncoming escorted wide loads.

These impacts would be temporary, as the equipment haulage is not a continuous program. Most of the heavy haulage would be in the form of convoys and would be managed through the mitigation measures contained in this report.

5.3 Impacts of Increased Volumes of Traffic from Glen Innes to the Sites

Gwydir Highway

The Gwydir Highway may be subject to an increase of up to 250 vehicles per day if ready mixed concrete is obtained from the suppliers in Glen Innes and or Inverell in lieu of being mixed on the sites. The Gwydir Highway is provided with overtaking lanes and therefore delays should be minimised. The most significant impacts will occur because of additional turning movements at junctions along this route.

Waterloo Road (sealed section from Gwydir Highway for 4.0 kilometres)

Movement toward the side of the road to avoid oncoming heavy vehicles could result in excessive wear of the road shoulders. This edge wear can result in vehicles losing some steering control. Conflicts with pedestrians could result on the school bus route.

Unsealed Roads

The potentially large relative increase in the number of vehicles using the minor roads will generate many impacts. The larger vehicles would occupy most of the width of the roadway at many locations increasing the chance of 'head on' collisions. For nearby property owners, there would be an increase in traffic noise and dust nuisance. Dust would be generated on the unsealed roads affecting visibility and resulting in the loss of pavement materials. The gravel road surfaces would deteriorate and potholes would form under the increased traffic loads, particularly during wet weather when water ponds or floods across the road. Structural damage may occur to some of the culverts and concrete causeway crossings. The location of trees and other roadside objects have the potential of obstructing the passage of long wide loads and high loads. Lack of roadside delineation in some locations may impact traffic safety during periods of poor visibility.

Some existing intersections have inadequate pavement width to safely accommodate the turning manoeuvres of the over-size vehicles.

Additional junctions at access points will introduce potential collisions.

Increased usage of gravel roads by drivers unfamiliar with the route could result in excessive speed in the curved sections.

5.4 Additional Potential Impacts at Specific Locations

Gwydir Highway & Waterloo Road Junction

An Increased number turning manoeuvres at the junction could result in vehicle conflicts between turning vehicles and high speed through traffic.

Wellingrove Creek Bridge at 0.5 kilometres on Waterloo Rd

This timber bridge may fail structurally under increased loads.

Maids Valley Creek Bridge at 3.7 kilometres on Waterloo Road

This concrete bridge has insufficient width (3.6 metres) for the passage of wide loads and may fail structurally under increased loads. The bridge railing could restrict the turning movements at the adjacent junction with Polhill Road.

5.5 Management of Potential Impacts

The mitigation measures listed in this section of the report cover four phases of the project operation. These phases being pre-planning, detailed design, construction, operation and decommissioning.

The potential traffic impacts in the decommissioning phase are expected to be similar to the construction phase over a shorter time period.

Mitigation Measures

- Contract a licensed haulage contractor with experience in transporting similar loads, to be responsible for obtaining all required approvals and permits from the RTA and Councils and for complying with conditions specified in the approvals.
- Develop a Traffic Management Plan in conjunction with the haulage contractor and road authorities to include but not be limited to the following:
    - Scheduling of deliveries
    - Managing timing of transport
    - Limiting the number of trips per day
    - Undertaking community consultation before and during all haulage activities
    - Designing and implementing temporary modifications to intersections and roadside furniture
    - Managing the haulage process, including the erection of warning signs and/or advisory speed posting prior to isolated curves, crests, narrow bridges and changes of road conditions
    - Placing of speed limits on all of the roads that would be used primarily by construction traffic to reduce the severity of any accidents and reduce maintenance costs
    - Producing a Transport Code of Conduct which would be made available to all contractors and staff detailing traffic routes, behavioural requirements and speed limits
    - Establishing procedures to monitor the traffic impacts during construction, such as noise, dust nuisance and travel times and work methods modified to reduce the impacts. This procedure would include site access roads
    - Providing a dedicated telephone contacts list to enable any issues or concerns to be rapidly identified and addressed
    - Reinstating pre-existing conditions after temporary modifications to the roads and pavement along the route.
- Implement all aspects of the Traffic Management Plan in coordination with the Councils, RTA and property managers
- Upgrade the Intersection at Gwydir Highway with Waterloo Road to Roads & Traffic Specifications and clear vegetation from sight lines
- Repair the road shoulders on the sealed section of Waterloo Road to provide frequent locations for road users to allow for the passage of oncoming loads up to 4.5 metres wide

- Determine available width and required load limits for the timber bridge over Wellingrove Creek and assess the options for reconstruction and or provision of a temporary crossing for heavy vehicles. Discuss the available options with Glen Innes Severn Council
- Determine available width and required load limits for the concrete bridge over Maids Valley Creek and assess the options for reconstruction and or provision of a temporary crossing for heavy vehicles. Discuss the available options with Glen Innes Severn Council
- Consider the reconstruction of gravel pavements to a minimum of 6.0 metre width with trafficable shoulders at least 0.5 metres on each side of all gravel roads which will be subject to increased traffic volumes. The extents of construction and standards to be discussed with Glen Innes Severn and Inverell Shire Councils. It may be economical to provide a bitumen surface on some steeper sections. The decision to provide a bitumen seal needs to be balanced against the cost of maintenance on the gravel surface. Sealing would help address dust suppression and sediment control as well as road deterioration. The environmental impacts of this work should also be considered in the decision
- Upgrade the drainage structures including the concrete causeways to provide a minimum trafficable pavement width of 6.0 metres. The design of these structures should be discussed with Glen Innes Severn and Inverell Shire Councils
- Upgrade the layouts and improve warning signposting of junctions at Polhill Road, Eastern Feeder Road and Wester Feeder Road
- Design in conjunction with council new junctions with internal access roads and the public road network
- Apply the procedure established in the Traffic Management Plan to monitor traffic volumes and road conditions during construction to the sections of road adjacent to the identified access routes
- Consider establishing a transport pool for employees to minimise traffic volumes in peak periods
- Prepare road dilapidation reports covering pavement and drainage structures in consultation with the Councils for all of the routes prior to the commencement of construction and after construction is complete. Any damage resulting from the construction traffic, except that resulting from normal wear and tear, would be repaired at the Proponent's cost. Alternatively, the proponent may negotiate an alternative for road damage with the relevant roads authority
- Establish a procedure to ensure the ongoing maintenance of the site access roads during the operation phase. This maintenance would include sedimentation and erosion control structures
- Prepare a revised traffic management plan for the decommissioning phase reflecting changes in traffic volumes work procedures.

The management procedures listed in this report have not been discussed in detail with road authorities or property owners and are presented for further discussion and assessment. The decision on the extent and standard of road improvements to be provided would be subjective and related to the economies of construction for short term use.

6 ON-SITE ACCESS

On-site access for all sites would generally be across open grazing land and along the ridges on which the turbines are located.

The location of the access routes through the properties would be undertaken in consultation with the individual property owners to ensure minimal impact on their management and to avoid areas of identified environmental sensitivity. Tracks would be sited to minimise the impact on existing drainage lines.

The precise location and layout of junctions with the public roads would be negotiated with the relevant roads authorities taking into account gradients, safe intersection sight distance, set back of boundaries and turning radii to allow for long loads.

The width of turning paths for the vehicles likely to negotiate the individual access tracks would be taken into consideration in the determination of pavement width particularly on the curved sections. Road pavement widths would generally be up to 6 metres wide to allow for the transport of turbine components and cranes used in the erection. Wider track widths of up to 12 metres may be required between turbine locations depending on the width required for the movement of the mobile cranes. Longitudinal grades of less than 8% would generally be required for ease of access however grades up to 14% can be negotiated.

The earthworks required along most of the ridges would be minimal including clearing, filling, grading and drainage improvements. Earthworks would be balanced where possible with material from the higher areas being used as filling in embankments.

Soil and water management plans would be prepared as part of the Environmental Management Plan showing locations of proposed sediment and erosion control measures to be placed and maintained during the construction and rehabilitation of the road drains and exposed earth batters.

The Environmental Management Plan for the site would stipulate which tracks may be used for access around the site in order to prevent unrestricted access of undisturbed sites and minimise erosion.

The Environmental Management Plan should also identify the access tracks which can be rehabilitated, closed or downgraded in width following each specific construction phase

It is expected that some access tracks would be downgraded following the completion of construction as access by the oversize and over mass vehicles may not be required during the operational phase of the project. The rehabilitation of these tracks would be carried out in consultation with the property owner and addressed in the Environmental Management Plan.

The condition of the onsite access roads should be monitored and maintained in accordance with the procedures outlined in the Traffic Management and Environmental Management plans.

The responsibility for the ongoing maintenance of the site access roads during the operational phase should be discussed with the property managers and procedures established which will ensure future access for maintenance and maintain adequate erosion and sedimentation control.

7 CONCLUSION

The area proposed for the Sapphire Wind Farm is sparsely populated and the introduction of an additional 250 vehicles per day during the construction period could have a significant impact on the existing road users on the minor and unsealed roads for approximately 2 years. The impacts during the operational phase are considered to be minimal provided that the increased road widths are maintained.

Management strategies required to address the traffic impacts of the proposal are outlined in this report. These strategies should be implemented in consultation with the Glen Innes Severn and Inverell Shire Councils. Strategies on the Gwydir Highway should be discussed with the Roads and Traffic Authority.

Adoption of all the strategies for minimising traffic impacts outlined in this study should reduce community disruption and the risk of traffic accidents.

A summary of key issues follows:

Road Improvements

The road and bridge improvements required would allow for the passage of vehicles up to 4.5 metres wide carrying loads of up to 90 tonnes. All of the oversize and over mass vehicles would be provided with escort vehicles on the public road network. Sufficient width of road pavement and trafficable shoulder would remain at most locations to permit an opposing vehicle to park on the road shoulder. The intersections would be required to permit the turning of a steerable trailer carrying blades up to 54 metres long.

Road surfaces would be improved to permit safe passage in all weather conditions.

Road signposting and guideposts would be upgraded to provide increased guidance for all road users.

Traffic Management

Accidents rates on the roads in the Project Area are low due to the low volumes and local knowledge of the road conditions by the majority of users.

The introduction of a large number of road users unfamiliar with the conditions on the local roads would require the implementation of a Traffic Management Plan which can be sufficiently flexible to adapt to the changing conditions.

Regular monitoring of the traffic volumes, travel speeds and accidents is considered to be essential. A commitment to carry out road repair works at short notice is critical to the continued safety of the access routes during the construction phase.

8 REFERENCES

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The assistance of the following in obtaining information for this study is recognised:

Glen Innes Severn Shire Council Engineer*, Malcolm Donelly.*

Inverell Shire Council Manager Works, *Alan Kerr.*

Roads and Traffic Authority , *James Synott*

Rex Andrews Pty Ltd Manager, *Warwick Andrews*

9 AUTHOR

Rodger John Ubrihien

Road Design Consultant

Cert. Engineering Surveyor

Rodger has been involved in the survey, planning and design of road projects since commencing work with the Department of Main Roads NSW in 1966. Rodger gained knowledge in Traffic Engineering with the Roads and Traffic Authority Traffic Section in Sydney. Since opening his own business 'Bega Duo Designs' in 1993, Rodger has completed the planning of a wide variety of civil engineering and related projects throughout NSW and ACT including wind farms at Goulburn, Crookwell, Yass, Silverton & Nimmitabel.

Contact: Bega Duo Designs

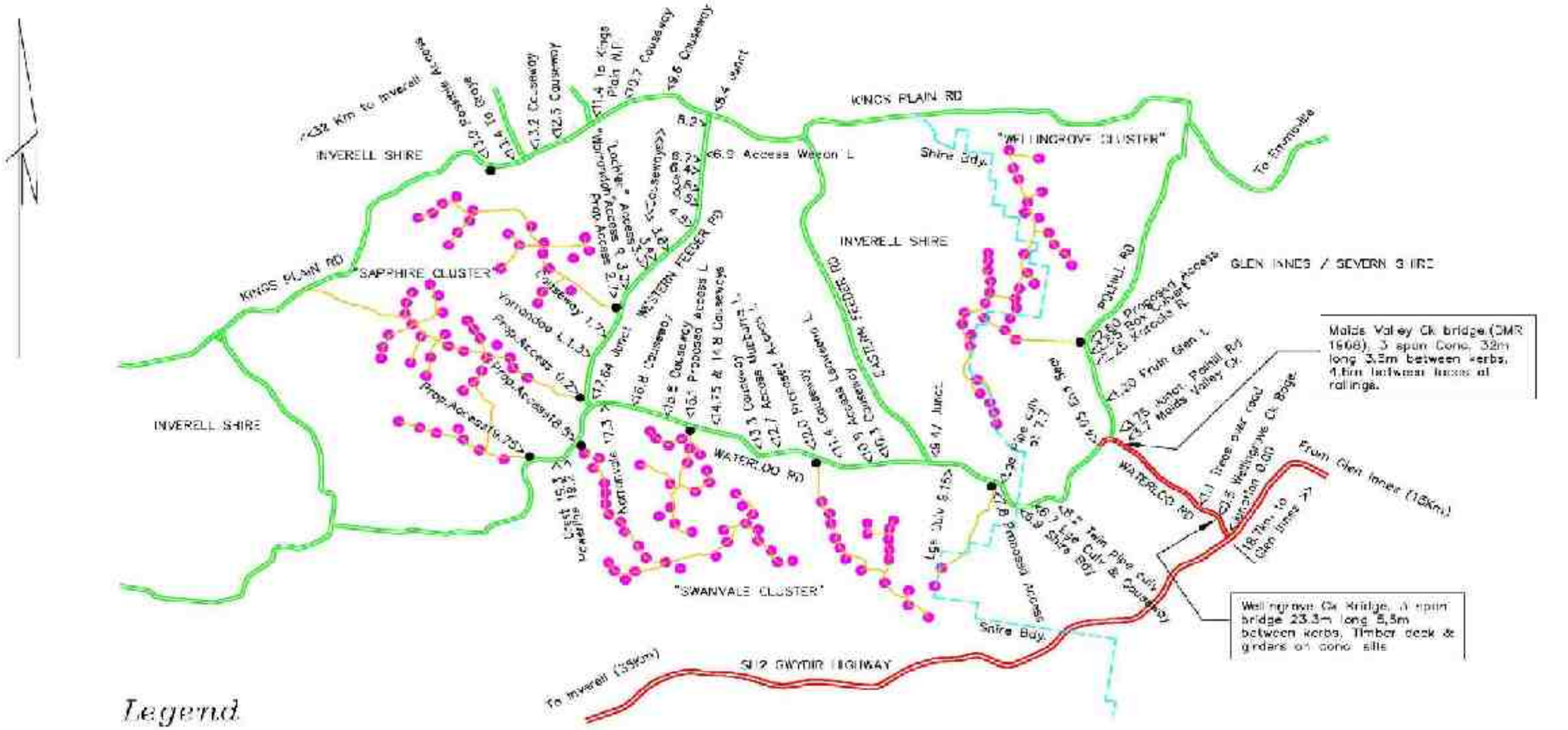
Office 1 Main Street

Merimbula NSW 2548

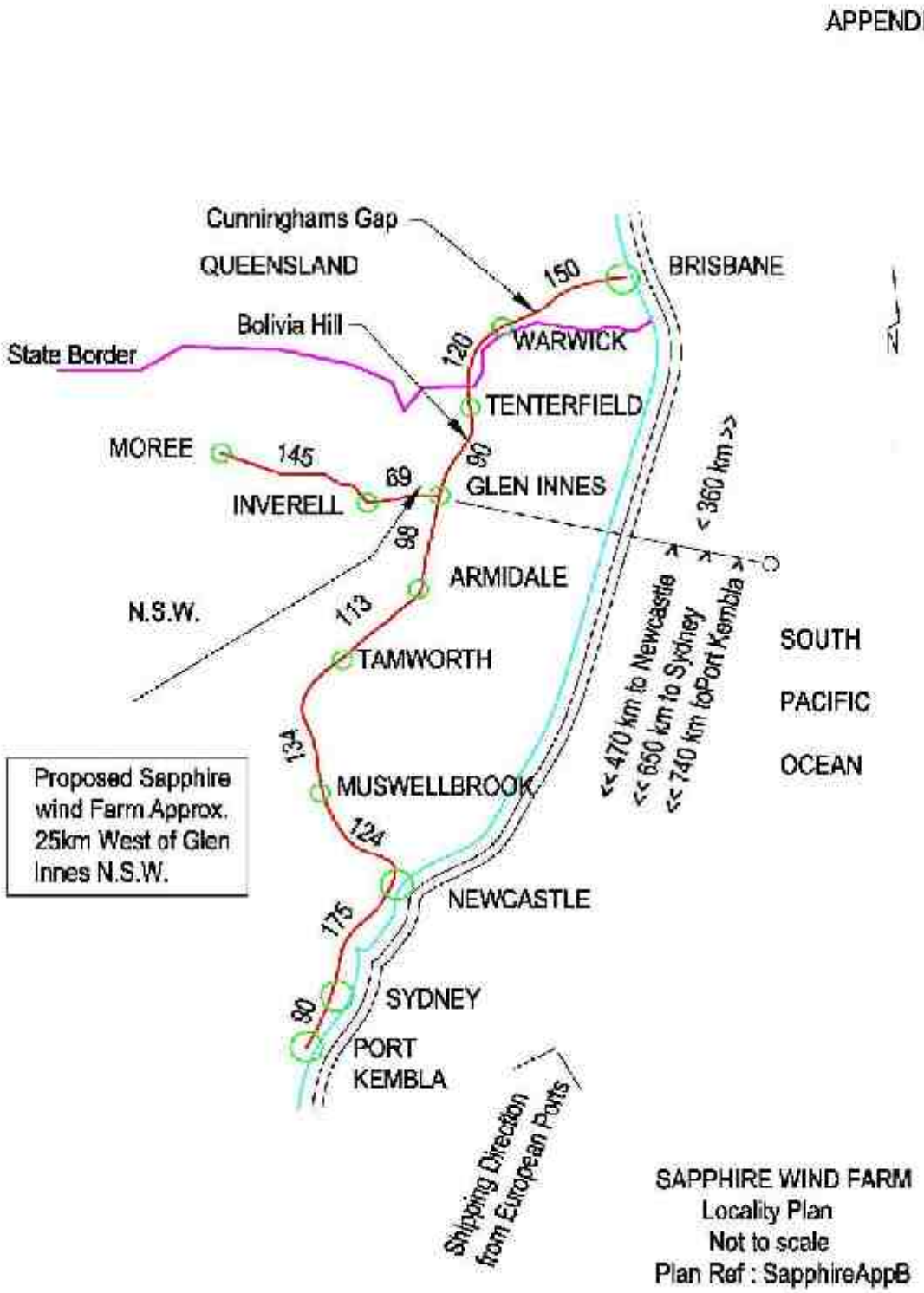
Ph: 02 64945456

Mobile: 0417292170

Appendix A: Plan Showing Relevant Access Roads



Appendix B: Plan showing details of access roads



Appendix C: Photographic Plates

PLATE 1

Sign near Queensland Border.

PLATE 2

Main Street of Tenterfield.

PLATE 3

New England Highway at Bolivia Hill.

PLATE 4

Junction Gwydir & New England Highways.

PLATE 5

Junction Gwydir & New England Highways looking North.

PLATE 6

Junction Gwydir & New England Highways looking West.

PLATE 7

Junction Gwydir & New England Highways showing sign bases.

PLATE 8

Gwydir Highway west of Glen Innes.

PLATE 9

Bridge over Furacabad Creek.

PLATE 10

Gwydir Hwy & Waterloo Rd Junction looking East.

PLATE 11

Gwydir Hwy & Waterloo Rd Junction looking West

PLATE 12

Gwydir Hwy & Waterloo Rd Junction looking South.

PLATE 13

Waterloo Road near Gwydir Hwy.

PLATE 14

Waterloo Road showing trees over road.

PLATE 15

Wellingrove Creek Bridge.

PLATE 16

Wellingrove Creek Bridge.

PLATE 17

Maids Valley Creek Bridge.

PLATE 18

Maids Valley Creek Bridge.

PLATE 19

Waterloo Rd/Polhill Road Junction.

PLATE 20

Polhill Road Junction looking along Polhill Rd.

PLATE 21

Waterloo Road at 5.6 km.

PLATE 22

Waterloo Road at 6.7 km.

PLATE 23

Waterloo Rd, damaged causeway at 7.7 km.

PLATE 24

Waterloo Rd, outlet of causeway at 7.7 km.

PLATE 25

Waterloo Road, Access at 7.8 km looking East.

PLATE 26

Waterloo Road, Access at 7.8 km looking West.

PLATE 27

Waterloo Road, surface at 8.2 km.

PLATE 28

Waterloo Rd, Damaged causeway at 9.0 km.

PLATE 29

Waterloo Rd, causeway at 9.5 km.

PLATE 30

Waterloo Rd, causeway at 9.5 km.

PLATE 31

Waterloo Road, Trees overhanging road at 9.20 km.

PLATE 32

Waterloo Road, Eastern feeder road on right.

PLATE 33

Waterloo Road, causeway at 10.3 km.

PLATE 34

Waterloo Rd, causeway at 11.4 km.

PLATE 35

Waterloo Rd, causeway at 11.4 km.

PLATE 36

Waterloo Rd proposed access at 12.0 km looking West.

PLATE 37

Waterloo Road, Access at 12.0 km looking East.

PLATE 38

Waterloo Road, trees over road at 12.8 km.

PLATE 39

Waterloo Road, causeway at 13.3 km.

PLATE 40

Waterloo Rd, causeway at 14.75 km.

PLATE 41

Waterloo Rd, causeway at 14.80 km.

PLATE 42

Waterloo Rd, access at 15.1 km looking East.

PLATE 43

Waterloo Road, Access at 15.1 km looking West.

PLATE 44

Waterloo Road, causeway at 15.8 km.

PLATE 45

Waterloo Road, causeway at 16.8 km.

PLATE 46

Waterloo Rd, Western Feeder Rd Junct. looking West.

PLATE 47

Waterloo Rd, Western Feeder Rd Junct looking East.

PLATE 48

Waterloo Rd, access at 18.5 km looking West.

PLATE 49

Waterloo Road, Access at 18.5 km looking East.

PLATE 50

Waterloo Road, warning sign at 19.6 km.

PLATE 51

Waterloo Road, proposed access at 19.75 km looking East.

PLATE 52

Waterloo Rd, access at 19.75 km looking West.

PLATE 53

Polhill Rd, at Waterloo Road.

PLATE 54

Polhill Rd at 0.85 km from Waterloo Rd.

PLATE 55

Polhill Rd Culvert at 2.60 km.

PLATE 56

Proposed access at 2.65 km looking North.

PLATE 57

Proposed access at 2.65 km looking South.

PLATE 58

Western Feeder Rd at Waterloo Rd.

PLATE 59

Western Feeder Rd access at 0.2 km looking South.

PLATE 60

Western Feeder Rd access at 0.2 km looking North.

PLATE 61

Western Feeder Road causeway at 1.7 km.

PLATE 62

Western Feeder Rd, prop. access at 2.7 km. looking South

PLATE 63

Western Feeder Rd, proposed access at 2.7 km. looking North

PLATE 64

Western Feeder Rd, junct with Kings Plain Rd looking West along Kings Plain Road.

PLATE 65

Kings Plain Rd, possible access at 5.5 km looking North.

PLATE 66

Kings Plain Rd, possible access at 5.5 km looking South.