

3.8 Traffic and transport assessment

TRAFFIC IMPACT STUDY



PROPOSED GULLEN RANGE WIND FARM **Southern Tablelands, South of Crookwell**

Prepared for Epuron Pty Ltd

March 2008

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1 INTRODUCTION

1.1 Scope of this Assessment

Bega Duo Designs was commissioned by **ngh**environmental to complete the Traffic Impact Study for inclusion in the Environmental Assessment of the proposed wind farm at Gullen Range. 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.

This report considers the general impact of all 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, which would be required to be produced by the haulage contractor before the commencement of the construction phase. Detailed assessments of the possible routes from the ports and manufacturing centres to Goulburn is contained in the report prepared for the Crookwell 2 project by URS (URS 2004). This assessment also reports on the route through Goulburn and along Crookwell Road to the proposed Crookwell 2 Wind Farm (approx 30km west of Goulburn). An assessment for transportation of heavy and oversize loads from the south via Breadalbane is contained in the report prepared for the proposed Gunning wind farm by Connell Wagner PPI (Connell Wagner). These assessments have been sourced in the preparation of this report and adequately cover the assessment of transporting oversize components from the point of origin (Port Kembla or Victoria) to the immediate area of the site.

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.**

1.2 Proposal Overview

The proposed development would occupy approximately four kilometres of ridge line at four locations near Kialla, Bannister, Pomeroy and Gurrundah, totalling approximately 16km of developed ridge line. The locations are relatively close and the maximum distance between the northern and southern extremities is approximately 25 km. The location of the wind farm which is currently under consideration is shown in Appendix A. The entire proposal falls within the Upper Lachlan Local Government Area (LGA) however, the proposal would be at the eastern edge of this LGA and therefore within close proximity to the Goulburn Mulwaree LGA. The access roads to the Gullen Range directly from Goulburn are substantially within Goulburn Mulwaree LGA.

The proposed Gullen Range wind farm has up to 84 turbines, with up to 21 located at Kialla, up to 22 at Bannister, up to 23 at Pomeroy and up to 18 at Gurrundah. Connection between individual towers would be underground and connection between localities would be via overhead or underground transmission cables. The substation and control facilities would be located at the Pomeroy site near the existing 330KV transmission line.

The exact turbine locations are not critical for the purposes of this report as most of the towers are greater than 2 kilometres from any regional roads and therefore driver distraction impacts are expected to be minimal. The exception to this is the Bannister group, where the towers would be within one kilometre of Range Road where they may have a visual effect on road users. This potential impact is considered within this report.

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 included in the study. Additional issues have been included because of the unique nature of the development. These include driver distraction effects and the structural condition of the existing road surfaces as observed at the site.

Key Issues

- Existing road hierarchy and proposals for improvement
- Impact on road safety
- Impact on traffic noise
- Traffic counts
- Traffic volumes and trends
- Existing parking and demand
- Traffic generation
- Safety and efficiency of internal roads
- Impact on Intersections and surrounding developments
- Safety and efficiency of access routes (including capacity) between the site and adjacent road networks

1.4 Methodology

- Base project information was obtained from **ngh**environmental and EPURON
- Further information and feedback received from key stakeholders at the "Planning Focus Meeting" held at the site on 15/08/07
- Existing mapping was used to identify features during the site inspection
- Planning documentation for other wind farm proposals in the region was reviewed
- All roads were inspected, inventories prepared and photographs taken
- Approximate traffic count information was obtained from observations on the sites and RTA published data
- Intersections were inspected and photographed

- Discussions were held with representatives from **ngh**environmental, Epuron Pty Ltd, Upper Lachlan Shire Council and Goulburn/Mulwaree Shire Council

2 PROPOSED DEVELOPMENT

2.1 Site Description

The sites are generally open grazing land with some patches of native bushland. There are some existing fences and access tracks.

The Gullen Range runs approximately south from the Crookwell area and rises to a maximum of 1000 metres above sea level near the Kialla site down to approximately 800 metres at the Gurrundah site. The landform is generally undulating with steeper grades commencing south of the Pomeroy site extending to south of the Gurrundah site.

2.2 Site Access General

Existing access roads are shown in Appendix 1.

Access to the site is complex because of the 25km spread of the proposed four groups of wind towers.

Traditional access to most of this area has been via Goulburn to Crookwell (Regional Road 54) and thence to the sites via Regional Road 52 to Grabben Gullen or Kialla Road to Bannister.

Access to properties directly west of Goulburn would be provided by Range Road and Gurrundah Road which are under local council control. Kialla Road serves a similar function for access south from Crookwell. These roads carry relatively small traffic volumes as the area is sparsely populated. These roads vary significantly in their ability to safely cater for concentrated volumes of large vehicles but would provide adequate access for increased numbers of light vehicles.

Preferred access would be via the State Roads (Crookwell Road and Grabben Gullen Road) to Grabben Gullen because of the higher standard of construction and potential safety on the State Roads. Access to the central section of the project from Grabben Gullen would be via Range Road and Bannister Lane.

The northern access into the Kialla site would be directly off Grabben Gullen Road.

Access to the Pomeroy site off Kialla Road and Bannister Lane would be via Storriers Lane. However, Prices Lane is considered as an alternative option in this report should, for some reason, it not be possible to use Storriers Lane.

Access between the central section and the Gurrundah site would be via Bannister Lane (western section) and Gurrundah Road.

The proximity of the proposed Gurrundah site to the Hume Highway at Breadalbane introduces another alternative route (Breadalbane to Gurrundah Road) from the south to the southern extents of the current project. This link may be preferred for the transport of some heavy and oversize loads.

2.3 Future Road Proposals

Upper Lachlan Shire Council and Goulburn Mulwaree Shire Councils have ongoing maintenance and improvement programmes for their sealed and unsealed local roads as well as the regional roads and bridges.

Upper Lachlan Shire Council has no present proposals for major road improvements on the routes identified in this study. Goulburn Mulwaree Shire Council proposes to rehabilitate a 1.0km section of Range Road at approximately 19.0km from Goulburn.

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 August 2007. This work included observations of traffic volumes.

3.2 Specific Roads

Hume Highway

The Hume Highway is dual carriageway with two lanes in each direction and a design travel speed of 110 km/h. The lanes are separated by a vegetated median approximately 20 metres wide. All major intersections are grade separated and other junctions have auxiliary lanes to ensure that through traffic has minimum interruption from turning vehicles. The junction at Breadalbane is not grade separated. It has a separate right turn lane for traffic turning from the highway on the eastern approach, however vehicles from this direction are required to cross two lanes of on coming traffic. Sight distance is adequate in all directions for manoeuvres by conventional vehicles in good weather conditions. Because of the high travel speeds on the Hume Highway, the sight distance may not be adequate for slow moving, over-dimensional vehicles, particularly during poor weather conditions.

Crookwell Road

Crookwell Road is a state road (No.54) under the control of the RTA. It is a sealed high standard two lane road with marked centreline and edgelines. The Road traverses 48.0km of rolling terrain from Goulburn and has several bridge crossings (Bumana Ck Bridge, Sooley Ck Bridge, Pejar Dam Bridge). Crookwell road forms the main street in Crookwell and provides access to Grabben Gullen Road (state road No. 52) on the western edge of the town. The RTA as part of its permit system for heavy and oversize vehicles would undertake an assessment of all bridges on its roads. Because of the higher standard of road, no difficulty in obtaining approval for travel is envisaged.

The Roundabout and other junctions in Crookwell appear to be adequate for the movement of large articulated vehicles (B-Doubles) however the location of power poles and roadside furniture would need to be checked prior to the passage of extremely long vehicles (see Plate 1, Appendix B).

Grabben Gullen Road

Grabben Gullen Road in Crookwell is a bitumen sealed road greater than 6.0 metres wide with centreline marking. The road negotiates a steep section without an overtaking lane for approximately 1km after leaving Crookwell (Plate 2). The section from approximately 2.0km to

8.0km is in hilly terrain and the remainder of the road to Grabben Gullen at 12.4 km is undulating. The proposed junction site to the Kialla site at 8.5km has adequate sight distance in both directions (Plates 3 and 4). The Junction with Range Road at 12.7km (Plate 5) has good sight distance and is within the 50km/h speed restriction zone for Grabben Gullen. The bitumen surface appears to be in good condition.

The Road beyond Grabben Gullen is referred to as the Canberra Road and is in good condition through undulating terrain to Gunning (approximately 20km).

Kialla Road

The initial section of this route is in Colyer Street Crookwell. Colyer Street junctions with Crookwell Road. The Kialla Road Route is bitumen sealed approximately 6.0m wide travels past the hospital and through residential Crookwell. The Junction with Crookwell Road has good sight lines (Plate 6). The alignment and grading provide relatively safe conditions for most of the route (Plate 7) except for some isolated curves at approximately 8.5km. Travel speeds are restricted by ten concrete causeway crossings of varying length. Kialla Road is a school bus route and junctions with Range Road at 12.9km. The Junction with Range Road (Plate 8) has adequate sight distance but safety is reduced to the north by the angle of the junction. Kialla Road forms part of the Bi-Centennial Trail which can be used by horse riding groups.

Range Road

Range Road route commences from the Old Hume Highway in Goulburn and is referred to on some signposting as the Bannister Road. The timber Rossiville Bridge at 4.2km (Plate 9) has a weight restriction of 15 tonne gross and is single lane. A detour is available via Crookwell Road and Chinamans Lane which rejoins the route at 5.7km.

There are several concrete bridges on the route at Dixons Creek (Plate 10) at 15.9km and Wollondilly River at 24.5km (Plate 11) and concrete causeway crossings at 7.1km and 14.1km.

The route is bitumen sealed (generally 6.2m wide) (Plates 12 and 13) through to Walcoms Lane at 31.0km, Bannister Lane at 33.4km and Kialla Road at 35.4km. The seal continues to the top of the range at 36.7km followed by a gravel section with several concrete causeways to 38.5km. The road is sealed 6.0m wide to Grabben Gullen at 43.0km.

The proposed access roads north and south to the Bannister site are proposed to junction with this route at approximately 36.9km. The photographs (Plates 14 and 15) show the alignment and grading on Range Road at the proposed junction. An additional access to the Bannister section of the site is proposed to the north via Loughville Road. There are several homes close to the road near Loughville Road (Plate 16); marked on the topographic map as Leonardville, 39.6km from Goulburn.

The road is mostly in good condition and presents a viable alternative to the Crookwell Road for light vehicle access to the Bannister and Pomeroy sites.

The section from 36.7km to Grabben Gullen should be capable of being upgraded to cater for heavy vehicles as the only structures are concrete causeways.

Bannister Lane

Bannister Lane would give access to Storriers Lane and Prices Lane which are the access alternatives being investigated for the access to the Pomeroy site. Bannister Lane also provides a link between Range Road and Gurrundah Road, thereby connecting the two southern sites by public road.

Bannister Lane is primarily an old local access route following crown road reserves and is mostly unsealed. It is a school bus route. Bannister Lane forms part of the Bicentennial Trail which can be used by horse riding groups.

Commencing from Range Road the initial 1.0 km length to Storriers Lane has several concrete causeways (Plate 17).

The route turns right at Storriers Lane with the section to 2.3km having large mature eucalypts close to the road mostly on the southern side (Plate 18) and several dwellings on both sides. The route turns left on a crest at 2.4km (Plates 19 and 20) and turns right at 2.7km. (This corner has a bitumen seal see Plate 21). The route turns left again at 2.0km and there is a residence close on western side. Prices Lane is on the left at 3.5km.

The route continues west to a sharp bend at 5.0km (Plate 22 shows Bannister Lane looking west at 4.5km). There is a residence close on the right at 5.2km.

Isolated curves with poor sight distances occur at 7.5km and 8.2km, Plates 23, 24 and 25.

Right angle bends are located at 8.5km and 8.9km (Plate 26) and large trees overhang the road at approximately 6.2km (Plate 27).

The bitumen seal commences at 10.6km and continues to Gurrundah Road at 13.3 km. The junction (at 33.2km from Goulburn) has adequate sight distance (Plate 28). The distance to the proposed entry to the Gurrundah site from this junction is approximately 10.0km.

Gurrundah Road

Gurrundah Road route commences from the Old Hume Highway in Goulburn and gives access to the Pomeroy Road at 11.5km (Plate 29).

The Baw Baw low level concrete bridge over the Wollondilly River is at 5.3km (Plate 30). The second low level bridge over the Wollondilly River at 11.7km is an older concrete and timber structure (Plate 31). There is a concrete causeway at 14.1km and a large damaged concrete causeway structure at 15.7 (Plate 32).

The route from Goulburn to 19.5km has good alignment and grading through undulating terrain with a bitumen surface at least 6.0m wide (Plate 33). The start of Upper Lachlan Shire is at 19.3km.

The rising gradient and poor alignment commence at 19.5km and the lower standard continues generally through to the end of this survey at Bannister Lane (33.2km). The bitumen surface is approximately 5.0m wide which has caused excessive wear on the shoulders when vehicles pass (Plate 34).

The existing access road into the Gurrundah site at 22.5km (Plate 35) has poor sight distance to the east (Plate 36). An alternative access which would have improved sight distance is being investigated at a crown road reserve approximately 0.7km to the west (Plate 37).

Trees overhang the road at several locations (Plate 38) on this route.

The junction with the Breadalbane Road (Mullins Creek Road) at 26.5km has restricted sight distance toward the east when turning from Breadalbane (Plates 39 and 40).

The alignment and grading of the route improves between Breadalbane Road and Bannister Lane (Plate 41).

Breadalbane Route

This route commences at the Hume Highway (see Section 3.2) and travels along Cullerin Road (Old Hume Highway) for 3.3km before turning right and crossing the Main Southern Railway Line at 3.5km.

The railway crossing is not controlled by gates or warning lights. Visibility along the tracks in both directions is not obstructed for a considerable distance in clear daytime weather conditions. The road pavement over the tracks has been strengthened with precast concrete slabs (Plate 42 and 43).

The route is through undulating terrain with generally good alignment and grading. The route takes two right angle turns at 3.3km and 5.8km. The bitumen pavement is in good condition and is at least 6.0m wide (Plate 44).

Trees overhang the route at 12.5km.

The Junction with Gurrundah Road at 14.0km is discussed in Section 3.8.

Storriers Lane

Storriers Lane off Bannister Lane at 1.0km is a gravel road which is the currently proposed access into the Pomeroy site. The junction with Bannister Lane has restricted sight distance and turning movements for long vehicles may require some junction improvements.

The alignment and grading is good to the gate and grid at 1.2 km (Plate 45). There is a steep gradient and several small radius curves for approximately 0.8km. The alignment and grading improve to the grid and gate at the entrance of "Cloverlee" at 2.5km.

There are several trees close to the road at 2.4km (Plate 46). There are residences close to the road at 0.05km and 1.7km.

Prices Lane

Prices lane off Bannister Lane at 3.5km is a gravel road which could provide an alternative access into the Pomeroy site. The junction with Bannister Lane (Plate 47) has adequate sight distance however, turning movements for long vehicles may require junction improvements.

The alignment and grading is good (Plate 48) up to the entry into "Hillview" at 3.1km.

There is a residence close to the road at 1.7km. Prices Lane is a school bus route.

Walcoms Lane

Walcoms lane connects with Range Road at 31.0km (Plate 49). This gravel lane 2.5km long leads onto Bannister lane at Storriers lane providing a shortcut to Bannister Lane for traffic travelling from Goulburn (see access roads, Appendix 1).

The Junction with Range road is recently constructed and provides adequate sight lines.

There is a residence close to the road near the junction with Range Road.

3.3 Existing Traffic Volumes

Traffic observations were made during morning and afternoon on 23rd and 24th of August 2007 at the junctions of Range Road, Kialla Road, and Grabben Gullen Road. These volumes can be adjusted assuming that the peak hour represents 10% of the annual average daily traffic volumes (AADT). As well, AADTs were available for the regional routes from the RTA website and from previous studies, as indicated below.

Table 3-1 AADTs for Roads in the Study Area.

Road	AADT	Information source
Hume Highway at Breadalbane	13,000	AADT obtained from RTA records
Crookwell Road at Sooley Bridge	1,800	AADT obtained from RTA records
Grabben Gullen Road	300	AADT obtained from RTA records and traffic observation
Range Road (western end)	80	Traffic observation
Kialla Road	40	Traffic observation

** AADTs represent the total traffic volume in both directions.*

Range Road and Kialla Road are important local through roads, receiving greater traffic volumes than minor roads in the area. Based on traffic observations on these roads, for the purposes of this study it would be assumed that all minor roads have volumes of less than 100 vehicles per day.

4 FACTORS RELATING TO TRAFFIC GENERATION AND TRAFFIC IMPACT

4.1 Traffic Generation

Operation

Once operational, the wind farm will be managed and operated by a small team of technicians, based at Pomeroy, during normal business hours. The sites would be accessed regularly for operational and maintenance activities. Two crews can provide maintenance for all turbines. This equates to having a permanent maintenance crew working in the area which may generate up to 8 trips per day (includes travel in both directions) on the main access roads.

Construction

The maximum traffic volume is expected to occur during the civil construction phase which includes the pouring of concrete for the foundations. Each footing may contain up to 340 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. It is probable that a concrete batching plant would be located on or near the construction site however, for the purposes of determining a maximum traffic volume it will be assumed that concrete trucks would be travelling on the major access routes being:

- a/ Crookwell to all sites via Grabben Gullen Road.
- b/ Section of Range Road between Grabben Gullen and Bannister Lane
- c/ Full length of Bannister Lane
- d/ Kialla Road, Prices or Storriers Lane
- e/ Gurrundah Road between Bannister Lane and the Gurrundah site.

It is proposed to construct a concrete batching plant at Gurrundah therefore the actual volumes during construction on Bannister Lane could be considerably less than the maximum predicted.

4.2 Construction Program

The project would be constructed over a 12 to 24 period expected to commence in 2010. The following major activities are expected to take place in sequence during the construction period at each of the four sites:

Civil works for upgrading of access roads and establishment of site office.

- Civil works for construction of internal tracks, excavation for footings and trenching for cables.
- Establishment and operation of concrete batching plants (at Pomeroy and Gurrundah) and pouring of footings.
- Transportation to site, erection and commissioning of wind turbines.
- Construction of substation, overhead and underground power lines, cables and facilities building.
- Restoration of site and completion of on site buildings.

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 pavement.

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

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

Calculations are based on the maximum traffic generation at one site during concrete pouring. Considering the location and capacity of the concrete batch plants (assumed to be Crookwell, Pomeroy and Gurrundah) and the road network, vehicle traffic should not exceed the numbers stated in Table 4-1. The approximate duration of activities was derived considering similar scale projects. The maximum number of trips per day is highest for the foundation construction, calculated using the turbine footing dimensions (assuming a construction rate of one footing per day). Assuming the worst case scenario, where all these activities overlap, the total number of maximum trips is the sum of these activities, 296.

Activities	Approximate duration (months)*	Maximum number of trips per day	Comments
(Many activities would occur concurrently).			
Construction and management staff	19	60	Assuming approx. 3 employees per vehicle
Site set up	1	10	
Road construction	8	22	
Foundation construction	11	102	Based on 12 concrete truck trips per hour
Dust suppression	12	12	
Substation construction	3	26	Includes up to 4 overmass vehicles
Cabling	7	6	
Turbines erection	9	58	Includes up to 50 oversize and overmass vehicles
Total maximum trips per day		296	

This table indicates that the maximum daily rate of traffic at any point in the project's road network is approximately 300 vehicles per day. Note that this is the maximum possible traffic load at any one point in the project and works scheduling will result in lower traffic rates across most of the road network. It is likely for example that the road construction work would be completed prior to the commencement of the concrete pouring.

The maximum vehicles per day figure (300) is added to the existing traffic volumes for the estimation of road capacity (see Section 4.7).

The estimated hourly rate during the peak hour (based on 15% of the daily volume) is approximately 45 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 Vehicles

The design vehicle for the construction of intersections and design of parking and turning areas generally would be the “Austroads” Single Unit Truck/Bus 12.2m long. Provision would be made on site at an area for the turning of semi trailers and oversize vehicles.

There is a requirement to transport turbine blades to the site, which could be up to 52 metres long. These would be transported on purpose designed steerable trailers making approximately 80 deliveries (all sites). These vehicles would be capable of negotiating relatively small radius curves provided that areas free of obstructions are available on the inside of curves.

The transport of turbine components up to 25 metres long and weighing up to 50 tonnes will require a total of 670 oversize vehicle deliveries. It is expected that the tower sections will be delivered between months five and 11 at a rate of four deliveries per day.

The nacelles will require 84 over-mass (up to 75 tonnes) vehicle deliveries.

The blades, nacelles and tower hubs are expected to be delivered in convoys of up to 15 trucks at a rate of 3 convoys per month. This results in a total of 17 convoys between months 6 and 11.

The design of access roads and junctions would need to allow for widths of up to 4.2 metres and weights complying with Roads and Traffic Authority maximum loading.

4.6 Traffic Circulation

Level areas would be required around each turbine for the safe operation of large cranes. These areas would also provide turning opportunities for delivery vehicles.

No vehicles would reverse on to 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.
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Tables contained in Austroads “Guide to Traffic Engineering Practice, Sec. 3.4 Roadway Capacity” have been used for the following determinations based on the traffic volumes shown in Section 3.13:

- Crookwell Road at 1800 vehicles per day (vpd) operates at LOS B and would not reach LOS C until the volume reaches 2800 vpd. The estimated maximum design volume (see Section 4.4) is 2100 vpd.
- Grabben Gullen Road at 300 vehicles per day operates at LOS A and would not reach LOS B until the volume reaches 1100 vpd. The estimated maximum design volume (see Section 4.4) is 600 vpd.
- The impact of an additional 300 vehicles per day on the Hume Highway is considered to have a negligible effect on capacity.
- All other roads with lower traffic volumes (less than 100vpd) would operate at LOS A and would not reach a lower level of service until the volume reaches approximately 700 vpd. The estimated maximum design volume (see Section 4.4) is 400 vpd.

The above assumptions are based on two lane, two-way rural roads in rolling terrain and the whole of the predicated maximum design volume which has been applied to each road separately to model the ‘worst case’ scenario.

4.8 Safety Considerations

Traffic generation calculations indicate that the maximum hourly increase in traffic at any location would be approximately 45 vehicles per hour (equivalent to 300 vpd) during the construction phase of the project. This increase would remain at the maximum for approximately 20 weeks during the construction period for the four sites. It would be assumed for the purposes of this study that this increase in volume could occur at any location on the roads surrounding the sites and appropriate safeguards adopted.

The following safety issues have been considered:

- Risk of collisions
- Traffic noise
- Dust from unsealed roads
- Shadow flicker from turbines
- Risk of collision due to fog
- Driver distraction
- Obstruction by long loads
- Wet and icy weather
- Road surface deterioration
- Structural failure of bridges and culverts

The impacts of these issues are discussed for key locations, below.

5 IMPACT ASSESSMENT AND ASSOCIATED SAFEGUARDS

5.1 Traffic Impacts on Over-mass and Over-dimensional Haulage Routes

These routes include:

Hume Highway, Crookwell Road, Grabben Gullen Road, Bannister Lane, Kialla Road, Storriers Lane, Prices Lane, Part of Gurrundah Road and Breadalbane Route.

There are a number of constraints common to all of these routes and some that need special consideration including:

- Schools and residential areas along the route
- School bus routes
- Some overhead cables and trees at low-level
- Intersections inadequate for manoeuvring of the haulage vehicles along the route
- Railway crossing
- Narrow and structurally deficient structures

The potential impacts associated with these constraints include

- Risks/delays to local traffic and pedestrians
- Noise, and
- Works required to modify the route so that it is suitable for the haulage vehicles.

These impacts would only be temporary, as the equipment haulage is not a continuous program. It is scheduled to take place over a number of months and would be managed through a number of specific mitigation measures developed and implemented in conjunction with both RTA and local Councils. These measures are outlined below:

Safeguards

- Use of 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.
- Development of a traffic management plan to include scheduling of deliveries, managing timing of transport through Goulburn and Crookwell to avoid peak hours (beginning/end of the school day), limiting the number of trips per day, undertaking community consultation before and during all haulage activities, designing and implementing temporary modifications to intersections and street furniture, restoring all changes to their original condition and managing the haulage process.
- Implementation of all aspects of the Traffic Management Plan in coordination with the Councils and RTA.
- Providing a dedicated telephone contacts list to enable any issues or concerns to be rapidly identified and addressed.
- Installing required signage to direct traffic flows appropriately during haulage through Goulburn and Crookwell.

- Reinstating pre-existing conditions after temporary modifications to the roads and pavement along the route.
- Undertaking forward planning to ensure equipment transportation complies with requirements of the management plan, RTA and Council.

5.2 Traffic Impacts on Council Roads which would experience a significant increase in traffic.

These routes include:

Kialla Road, Range Road, Bannister Lane, Storriers Lane, Prices Lane, Gurrundah Road and Breadalbane Route.

The potential impacts along these routes include delays to local traffic, noise, dust and works required to modify the route so that it is suitable for the haulage vehicles.

Because of the potentially large increase in the number of vehicles using these routes there are many impacts to be considered. The volumes are likely to increase from several vehicles to over 200 per day during concrete pouring operations. The low standard of horizontal and vertical alignment would assist in controlling speed on many sections however, isolated curves between higher speed sections would increase the risk of vehicles losing control.

The larger vehicles would occupy most of the width of the roadway at many locations increasing the chance of “head on” collisions. There would be an increase in traffic noise and dust nuisance for property owners and a need to control stock from straying on the roads.

The failing pavement sections on the sealed lengths would rapidly deteriorate under heavy loads. On the narrow bitumen sections the gravel shoulders would wear causing the edge of bitumen to break away.

The gravel road surfaces would deteriorate and potholes would form under the increased traffic loads particularly during wet weather when water ponds in drains and potholes. 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.

School buses use many of the routes.

The Bicentennial Trail utilises Bannister Lane and Kialla Road and the interaction between horses and their riders and construction traffic along these roads needs to be managed.

Safeguards

- As stated in Section 5.1.
- Realignment of some of the low speed sections of Bannister Lane could be considered (described in Section 3.2). These sections are on the western section of Bannister Lane which may not be used by concrete trucks if a concrete batch plant is established at Gurrundah.
- The erection of warning signs and/or advisory speed posting could provide a more economic solution to reconstruction.
- The pavement and drainage structures require inspection and possible upgrading after consultation with Council.

- The Proponent would prepare road dilapidation reports covering pavement and drainage structures in consultation with Council, for the construction (and decommissioning) route prior to the commencement of construction (and decommissioning) and after construction (and decommissioning) is complete. Any damage resulting from the construction (or decommissioning) 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.
- The decision to provide a seal needs to be balanced against the cost of maintenance on the gravel surface. Sealing would also help address dust suppression, and sediment control. The environmental impacts of this work should also be considered.
- A speed limit should be placed on some of the roads near dwellings or sub standard junctions. The speed restriction would be included in the traffic management plan to be submitted to Council.
- A procedure should be established to monitor the traffic impacts during construction, such as noise, dust nuisance and travel times and work methods modified to reduce the impacts.
- A procedure could also be established to inform vehicle operators on the precise timing of school buses.
- Regular monitoring and scheduled maintenance of gravel pavements such as grading, dust suppression and drainage control should take place during the construction period.
- Signposting to warn horse riders of construction traffic and clearing (slashing) of vegetation from verges on the Bi-Centennial Route to allow horses to move off the road when vehicles approach.

5.3 Traffic Impacts at Key Locations

Hume Highway Junction at Breadalbane

The junction with Cullerin Road at Breadalbane is constructed to a standard which is considered to be sufficient for an increase of traffic of up to 45 vehicles per day.

The manoeuvring of long wide loads would introduce the need for additional high-speed manoeuvres by motorists on the Hume Highway.

Safeguards

An increase in the number of potential vehicle conflicts would have an impact on the safety of a junction generally. The conflict would be minimised by providing safe intersection sight distance compatible with travel speed. In fog conditions on the Hume Highway safe travel speeds are often exceeded and the potential impacts of additional vehicle movements are multiplied. To address this issue, the following safeguard is recommended:

- Speed controls. The Roads and Traffic Authority are generally not in favour of speed restrictions on the Hume Highway because of the loss in efficiency of the route. However, the use of speed controls for specific short-term activities could be included in a traffic control plan or other temporary traffic control measures.

Crookwell Road

The potential impacts along this route would be delays and general inconvenience experienced by local traffic and pedestrians in the main street of Crookwell.

Safeguards

- As stated in Section 5.1 and 5.2.

- The business owners, retailers etc in the main street of Crookwell should be made aware of the timing for heavy, over-mass and over-dimensional vehicles.

Grabben Gullen Road

The main access to the Kialla site would be constructed at 8.5km from Crookwell.

Safeguards

- As stated in Section 5.1 and 5.2.
- The junction is to be designed and constructed in consultation with Upper Lachlan Shire Council and the Roads and Traffic Authority.

Range Road

The western section of Range Road would contain the junctions for access to the Bannister site on both sides and would need to be utilised as a heavy transport route.

Shadow flicker may have an impact on traffic safety. Information from the Danish Wind Industry Association suggests that this effect diminishes beyond 500 metres from the wind tower site and is not noticed beyond 1000 metres. The effect is only present when the sun is directly behind the wind turbines. Turbines are located approximately 140m and 260m either side of Range Road and these effects may be experienced for brief periods by westbound vehicles during the late afternoon in winter at approximately 36km from Goulburn (immediately prior to the crest). The roadside vegetation has not been taken into account or other obstructions which would reduce the “flicker” effects by masking the view of the towers. It is considered that a small amount of road side planting may be required at this one location.

Safeguards

- As per safe guards identified above in sections 5.1 and 5.2.
- The new junction required to be constructed on Range Road would be designed and constructed in consultation with Upper Lachlan Shire Council.
- Consideration should be given to the reconstruction and sealing of the 1.8km length of unsealed pavement which would include the proposed junctions.
- The shadow flicker effects should be monitored following commission and any remedial measures to address concerns would be developed in consultation with the Council and the Department of Planning.

Bannister Lane, Storriers Lane, Prices Lane

Residents and road users in the Bannister Lane area would experience very large relative increases in traffic during the construction phase. The impacts would require residents and regular users to be exposed to increased noise and dust. There would be a need for increased observation when entering from their properties onto the local road network and greater control of straying stock.

Safeguards

- As per safe guards identified above in sections 5.1 and 5.2.

A program would need to be established to consult with all of the road users and residents in the area particularly those living in the residences close to the roads. The road improvements may be supplemented by noise barriers, double glazing on residences, road sealing or other compensation to allow for relocation during the peak traffic periods.

Gurrundah Road

The main access to the Gurrundah site would be constructed at 23.2km from Goulburn.

Safeguards

- As per safe guards identified above in sections 5.1 and 5.2.
- The junction is to be designed and constructed in consultation with Upper Lachlan Shire Council.

Breadalbane to Gurrundah Road

The railway crossing at 3.3km has potential to impact on road safety. There are two tracks and the route is used by high speed inter city train. Fog and poor light conditions can reduce visibility, increasing the risk of collision.

Safeguards

- As per safe guards identified above in sections 5.1 and 5.2.
- A procedure should be established for all vehicles associated with the Gullen Range wind farm project to make contact with a railway service to establish approximate timing of trains so that crossings could be made during the safer periods. The need to always visually check for the approach of trains would be stressed to vehicle operators.

5.4 General Safeguards

Additional to the specific safeguards outlined above, it is recommended that a transport carpool be organised for construction workers. This would minimise the number of vehicles travelling to and from the site, with resultant safety and environmental benefits.

The aforementioned safeguards have not been discussed in any 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 CONCLUSION

The area proposed for the Gullen Range Wind Farm is sparsely populated and well served with access roads from all directions.

The local roads were not constructed for high volumes of heavy traffic, however adoption of all the safeguards for minimising traffic impacts outlined in this report should reduce the risk of traffic accidents to an acceptable level and minimise structural and environmental damage.

The key to minimising the impacts to the residents of the area is to seek their cooperation in implementing safety and protection measures as early as possible during the planning process.

Safeguards considered necessary to address the traffic impacts of the proposal are outlined in this report. These safeguards should be implemented in consultation with the Upper Lachlan Shire Council, Goulburn Mulwaree Shire Council and the Roads and Traffic Authority.

7 REFERENCES

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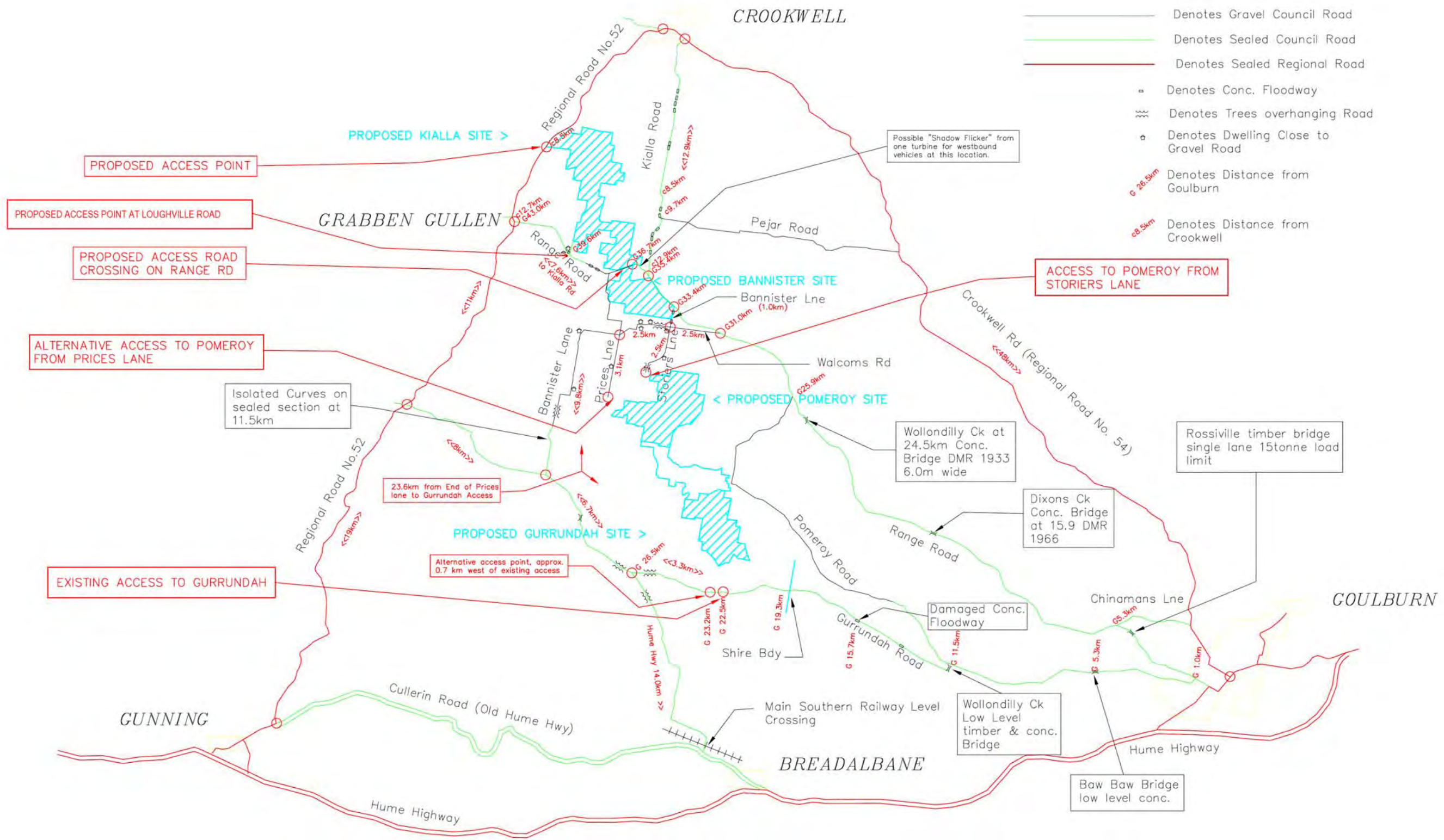
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APPENDIX A:

LOCATION OF THE PROPOSAL AND RELEVANT ACCESS ROADS



GULLEN RANGE WIND FARM
Plan Showing Details of Proposed Access Roads

Plan by Bega Duo Designs 19/11/07
Plan Ref : Gullen Roads2.dwg

APPENDIX B: PHOTOGRAPHIC PLATES



PLATE 1

Junction with Grabben Gullen Road in Crookwell.



PLATE 2

Steep Climb south of Crookwell.



PLATE 3

Access to the Kialla site looking south.



PLATE 4

Access to the Kialla site looking north.



PLATE 5

Junction with Range Road looking north.



PLATE 6

Kialla Road junction with Crookwell Road in Crookwell.



PLATE 7

Kialla Road 2.8 km south of Crookwell looking south.



PLATE 8

Kialla Road Junction with Range Road looking from Crookwell.



PLATE 9

Range Road, Rossville Bridge.

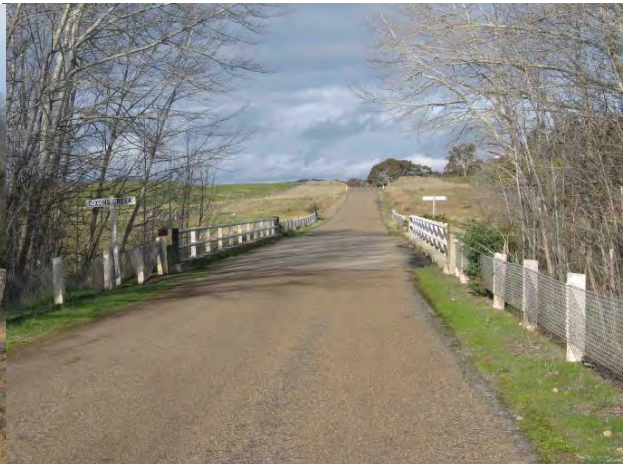


PLATE 10

Range Road, Dixon's Creek Bridge.



PLATE 11

Range Road, Bridge over Wollondilly River at 24.5km.



PLATE 12

Range Road at 19.0km.



PLATE 13
Range Road at 30km.



PLATE 14
Range Road at 36.9km looking east.



PLATE 15
Range Road at 36.9km looking west.



PLATE 16
Range Road looking west at Loughville Road.



PLATE 17
Bannister Lane at 0.3km looking south.



PLATE 18
Bannister Lane showing trees on the left at 1.1km.



PLATE 19

Bannister Lane, corner at 2.4km looking west.



PLATE 20

Bannister Lane, corner at 2.4km looking north.



PLATE 21

Bannister Lane, corner at 2.7km looking east.



PLATE 22

Bannister Lane looking west at 4.5km.



PLATE 23

Bannister Lane curve at 7.5km looking north.



PLATE 24

Bannister Lane poor alignment at 8.2km.



PLATE 25

Bannister Lane poor alignment at 8.2 looking north.



PLATE 26

Bannister Lane bend at 8.9km.



PLATE 27

Bannister Lane trees overhang road.



PLATE 28

Bannister Lane Gurrundah Road Junction.



PLATE 29

Gurrundah Road Junction with Pomeroy Road looking east.



PLATE 30

Gurrundah Road, Baw Baw Bridge.



PLATE 31
Gurrundah Road, Wollondilly Low level Bridge at 11.7km.



PLATE 32
Gurrundah Road, Concrete Causeway at 15.7km.



PLATE 33
Gurrundah Road at approx 19km.



PLATE 34
Gurrundah Road at approx 20km.



PLATE 35
Gurrundah Road, existing access to the Gurrundah site.



PLATE 36
Gurrundah Road existing access sight distance to east.



PLATE 37
Gurrundah Road, approx location of alternative access looking west.



PLATE 38
Gurrundah Road, trees overhanging road.



PLATE 39
Gurrundah Road junction with Breadalbane Route showing sight distance to east from Breadalbane approach.



PLATE 40
Gurrundah Road junction with Breadalbane Route looking from Breadalbane.



PLATE 41
Gurrundah Road at 28.4km.



PLATE 42
Breadalbane Route, railway level crossing.



PLATE 43
Breadalbane Route, railway level crossing looking north.



PLATE 44
Breadalbane Route showing width of bitumen.



PLATE 45
Storriers Lane at 1.2km.



PLATE 46
Storriers Lane at 2.4km.



PLATE 47
Prices Lane Junction with Bannister Lane looking south.



PLATE 48
Prices Lane at 1.4km (house on right at 1.7km)



PLATE 49

Walcoms Lane junction with Range Road, looking east.