



# Report

## Crookwell 3 Windfarm - Traffic Impact Assessment

1 SEPTEMBER 2010

Prepared for  
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## Introduction

URS Australia Pty Ltd (URS) has been engaged by Crookwell Development Pty Ltd to prepare a Traffic Impact Assessment (TIA) for the proposed Crookwell 3 Wind Energy Facility planned in the Upper Lachlan Shire near Goulburn, southeast New South Wales. This TIA analyses the impacts of the construction and on-going operation of the proposed development on the existing transport network and identifies mitigating measures in order to minimise any of these impacts.

The proposed development is to be co-located on two sites to the east and south of the approved Crookwell 2 Wind Energy Facility, as described in Section 2 of this report, and will consist of 30 wind turbines across the two sites.

This TIA has been prepared in response to the Director-General's Requirements for the Environmental Assessment for the proposed development and conforms to the NSW Department of Planning's requirements in assessing the traffic impacts of vehicles generated by the development.

The Director-General Requirements under a letter from the NSW Department of Planning (document reference 10/01492) specifically outlines the items to be addressed in this document. A brief summary of all requirements under these items and where the responses may be found in this TIA are as follows:

- Details of the nature of traffic generated – refer section 3.2;
- Details of transport routes – refer section 2.4;
- Details of traffic volumes – refer section 3;
- Details of potential impacts on local and regional roads, bridges and intersections (including proposed road upgrades and repairs) – refer sections 3 and 4;
- Details of measures to mitigate and/or manage the potential impacts (including measures to control soil erosion and dust generated by traffic volumes – refer section 4; and
- Details of site access roads including how these would connect to the existing road network and any operational maintenance or handover requirements – refer section 2.6.

## Development

This section describes the site and its location and access arrangements for the site. It should be noted that this is based on information provided by Crookwell Development Pty Ltd.

### 2.1 Development Site

Crookwell Development Pty Ltd (CDPL), the proponent, is seeking project approval for the construction and operation of a wind energy facility to be known as the Crookwell 3 Wind Farm (the project). The project is to be located on two separate land parcels known as Crookwell 3 East (with an area of 1100 Hectares) and Crookwell 3 South (with an area of 400 Hectares) (the Site).

The project comprises a number of elements, including:

- 30 individual wind turbines standing up to 152m at top of blade tip with a capacity of up to 3.4MW each (some of the turbines may be fitted with obstacle lighting as required);
- 30 individual kiosks for the housing of 33kV Transformers and 33kV Switchgears and associated control systems to be located in the vicinity of the wind turbine towers (in some turbine models being considered the kiosk's equipment are integrated within the tower or nacelle);
- internal unsealed tracks for turbine access;
- upgrades to local road infrastructure as necessary to provide access to the site;
- An underground electrical and communication cable network linking turbines to each other within the site boundary and then using either an underground or overhead connection between the Crookwell 3 site boundaries and the Crookwell 2 site boundary to reach the substation approved as part of the Crookwell 2 Wind Farm;
- up to 3 wind monitoring masts fitted with various instruments such as anemometers, wind vanes, temperature gauge and potentially other electrical equipment; and
- The project will also require a maximum of two temporary concrete batching plants during the construction phase only, to supply concrete for the foundations of the turbines and other associated structures;

Grid connection will be achieved via a connection to the 330kV transmission line which bypasses the site. The project will utilise and be connected to the single substation, control room and facilities for the grid connection, approved as part of the Crookwell 2 Wind Farm.

Figure 2-1 shows the proposed indicative layout of the project and is subject to further detailed design.

Crookwell 3 East and Crookwell 3 South may be developed in stages.

#### *Location Details*

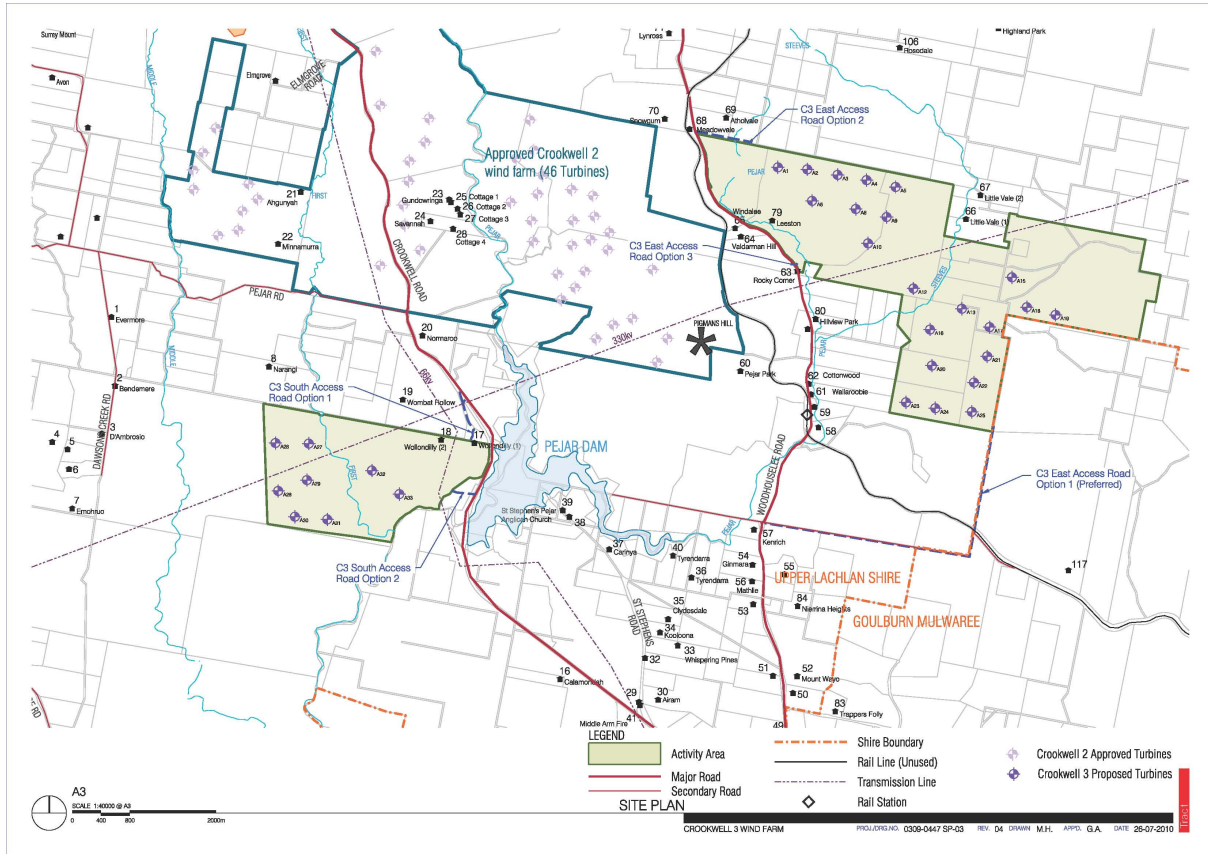
The Crookwell 3 East site is bounded by Boltons Lane to the north, Woodhouselee Road to the west and the Upper Lachlan Shire / Goulburn-Mulwaree Council border to the south east. The Crookwell 3 South site is bounded by Crookwell Road to the east and property boundaries to the north, south and west. The two sites are located approximately 4 km apart with the Crookwell 1 and 2 windfarms being located nearby. Major regional centres surrounding the site include Crookwell (15 km northwest), Goulburn (25 km south) and Canberra (90 km southwest) and Oberon (135 km to the north).

Crookwell Road and Woodhouselee Road are the two major arterial roads servicing the development and each of these roads straddle a portion of the two separate sites.



## 2 Development

Figure 2-1 Crookwell 3 Windfarm Sites



### 2.2 Access to the Site

Windfarm sites are often located in rural areas isolated from large population centres and construction requires delivery of specialised plant and equipment. This means that equipment and construction personnel travel to the site from remote locations, leading to traffic volumes on roads both local to and more distant from the actual windfarm site. Any traffic impacts arising from construction of a windfarm development therefore needs to consider the construction personnel commuting to the site and the deliveries of plant and equipment.

### 2.3 Construction Vehicles

There are three distinct categories of vehicles required during the construction phase of the development of the windfarm site:

Firstly, Over-Dimensional (OD) vehicles will be required to transport the larger and bulkier items including the tower sections, wind turbine blades and nacelles. Specialised vehicles (including possible escort arrangements) may need to be arranged in order to safely transport these larger components to the windfarm site.

Secondly, a large number of construction vehicles will be required for the general construction activities on site other than OD deliveries. Construction vehicles will transport goods such as steel, road construction materials, concreting supplies and water. The vehicle classes relating to the

## 2 Development

construction vehicles will be larger than personnel vehicles (such as cars and utes) but will have a maximum size of a B-Double.

Thirdly, the last remaining vehicle category encompasses personnel vehicles. Personnel movements incorporate construction personnel and subcontractors and will only include cars and light commercial vehicles (LCVs). Any vehicle above 4.5 tonnes (and requiring an endorsed licence) will be considered a construction vehicle and as such be included in the second class of vehicle described above.

### 2.4 Route Selection for OD Vehicles

#### 2.4.1 Port Selection

Port Kembla has been identified as the preferred port along the eastern seaboard when compared against Port Botany and Darling Harbour.

Port Kembla is the preferred port given it has good access to both rail and road transport, has adequate provision of loading and unloading facilities for oversized goods, has long-term storage available for imported goods and has competitive flexibility with unloading and storage (as this is managed directly by either a transport contractor or stevedore).

The selection of this Port for the Crookwell region was identified also in the *Crookwell Windfarm 2 DA Modification – Traffic Impact Assessment* (2009) for a site in close proximity to the proposed Crookwell 3 development.

#### 2.4.2 Transport Mode (Port Kembla to site)

Port Kembla has direct access to the rail network to Goulburn. However, the railway rolling stock and rail network can accommodate over-dimensional loads of the nature required for this development, the bridges, tunnels and electrical infrastructure would need modification to safely transport these components. Further, the Crookwell to Goulburn rail line is now decommissioned. It is therefore considered economically impractical to undertake the required modification to re-commission this section of track or to transfer modes from rail to road transport at Goulburn.

As such, it is considered that road transport is deemed to be the only feasible mode in delivering the turbine components and equipment to site.

### 2.5 Preferred Route Alignment for OD Vehicles

Port Kembla is the nominated location for the commencement of ground transportation for the larger sections of the wind turbines – namely the tower sections, blades and nacelles delivered via sea freight. Raw materials to construct the foundation works for the towers will be sourced from local suppliers. Personnel will reside in the surrounding regional centres to the site.

The proposed route from Port Kembla to the Crookwell 3 sites has been divided into three components – Port Kembla to Goulburn; Goulburn bypass; and Goulburn to site. The preferred route alignment was determined based on the following criteria:

- Road grade;
- Road width;
- Extent of works required for safe transportation of goods;

## 2 Development

- Costs; and
- Appropriateness and directness of route.

### 2.5.1 Port Kembla to Goulburn

The roads from Port Kembla to Goulburn are general national highways or state roads and able to accommodate the OD vehicles required to transport the wind turbine components. A permit for OD transport may need to be obtained from the RTA – specifically along Illawarra Highway and Mount Keira Road in accessing the Hume Highway. Mount Keira Road is considered the more appropriate option in traversing the Illawarra escarpment as it is more suitable for larger vehicles with fewer steep grades and less restrictive traffic requirements. This is therefore the preferred option for OD vehicles departing Port Kembla to access the Hume Highway.

OD vehicles will then turn south at the Mount Keira Road / Hume Highway intersection and will travel south along the highway until Goulburn.

### 2.5.2 Goulburn Bypass

The Goulburn Bypass is a designated OD route between the Hume Highway and Goulburn. It is a dual carriageway with pavement of good condition. The RTA and Greater Argyle Council prefer the use of this bypass for OD vehicles in order to reduce potential conflicts with surrounding traffic, on-street parking and street furniture. Consequently the Goulburn Bypass is the preferred option for OD vehicles in transporting the windfarm components through Goulburn; however some constraints have been identified along this route and includes:

- A school being located along the route;
- Abutting residential areas;
- Low-lying overhead cabling; and
- Unsuitable intersections for manoeuvrability of OD vehicles.

These constraints will be identified during the consultation phase in developing the Transport Management Plan for the project and will indicate mitigation and management measures.

### 2.5.3 Goulburn to Crookwell 3 Site

Once through Goulburn, OD vehicles will continue along Crookwell Road in a northerly direction for approximately 19 kilometres to the t-intersection of Crookwell Road and Woodhouselee Road.

OD vehicles accessing the Crookwell 3 South site will continue through this intersection on Crookwell Rd in a north-westerly direction for another 7 kilometres where they will turn left into the Crookwell 3 South site.

OD vehicles accessing the Crookwell 3 East site will turn right at the Crookwell Road / Woodhouselee Road t-intersection and continue in a northerly direction for another 11 kilometres where they will turn right into the Crookwell 3 East site.

### 2.5.4 OD Vehicles

OD vehicles will follow the route detailed in sections 2.5.1 to 2.5.3 and will therefore only access either sites to the Crookwell 3 development from the south (i.e. Goulburn). No OD deliveries will access the site from the north or depart the site to the north.

## 2 Development

### Crookwell 3 East

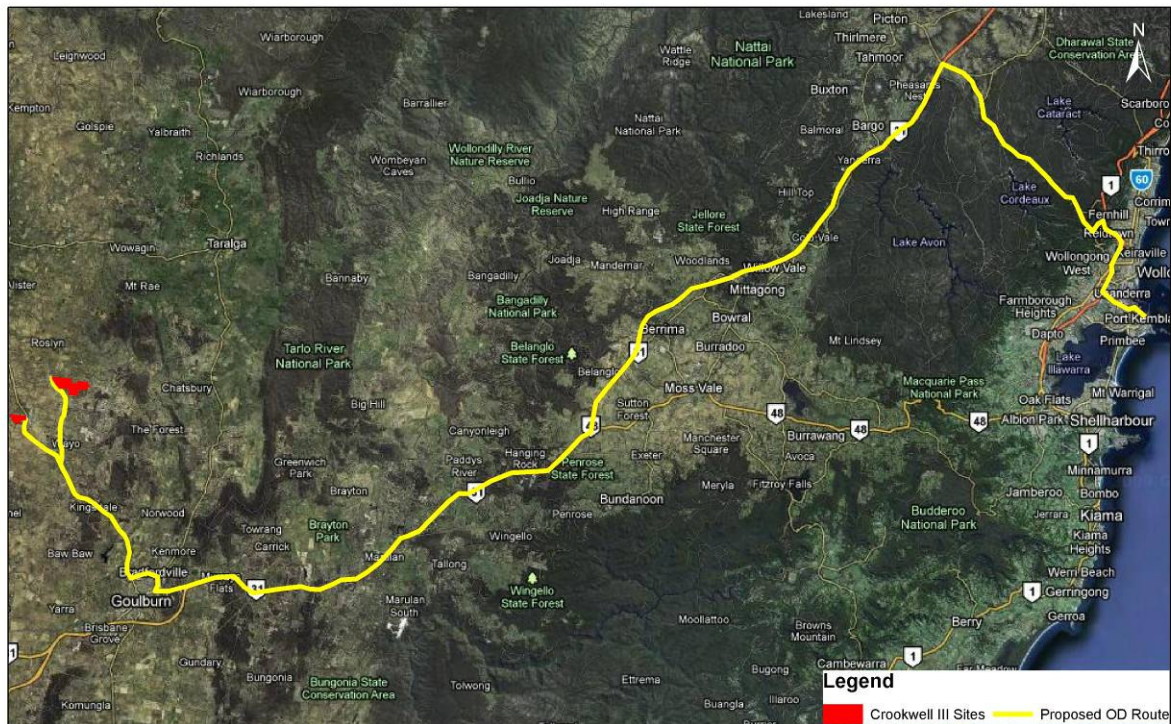
OD vehicles will originate from the south and will follow Crookwell Road in a northerly direction until the Crookwell Road / Woodhouselee Road t-intersection where they will turn right and continue in a northern direction along Woodhouselee Road. They will continue in a northern direction along Woodhouselee Road to a location approximately 11 km north of the Crookwell Road / Woodhouselee Road t-intersection where the proposed Crookwell 3 East site access intersects Woodhouselee Road. OD vehicles will turn right at this t-intersection to access the site.

### Crookwell 3 South

OD vehicles will originate from the south and follow Crookwell Road in a northerly direction and continue northwest through the Crookwell Road / Woodhouselee Road t-intersection. They will continue northwest along Crookwell Road to a location approximately 7 km northwest of the Crookwell Road / Woodhouselee Road t-intersection where the proposed Crookwell 3 South site access intersects Crookwell Road. OD vehicles will turn left at this t-intersection to access the site.

Figure 2-2 outlines the proposed OD route between Port Kembla and the Crookwell 3 site.

**Figure 2-2 Proposed OD Route**



Source: Google Earth, 2010

### 2.5.5 Construction and Personnel Vehicles

Construction and personnel vehicles will be originating from different locations to both sites (Crookwell 3 East and Crookwell 3 South) and are able to access the site either from the north (i.e. Crookwell, Oberon) and the south (i.e. Goulburn, Canberra).

## 2 Development

### *Crookwell 3 East*

Vehicles originating from the south will follow Crookwell Road in a northerly direction until the Crookwell Road / Woodhouselee Road t-intersection where they will turn right and continue in a northern direction along Woodhouselee Road. They will continue in a northern direction along Woodhouselee Road to a location approximately 11 km north of the Crookwell Road / Woodhouselee Road t-intersection where the proposed Crookwell 3 East site access intersects Woodhouselee Road. Vehicles will turn right at this t-intersection to access the site.

Vehicles originating from the north will follow Woodhouselee Road in a southerly direction to a location approximately 4 km south of the Crookwell Road / Middle Arm Road intersection where the proposed Crookwell 3 East site access intersects Woodhouselee Road. They will then turn left at this t-intersection to access the site.

### *Crookwell 3 South*

Vehicles originating from the south will follow Crookwell Road in a northerly direction and continue northwest through the Crookwell Road / Woodhouselee Road t-intersection. They will continue northwest along Crookwell Road to a location approximately 7 km northwest of the Crookwell Road / Woodhouselee Road t-intersection where the proposed Crookwell 3 South site access intersects Crookwell Road. Vehicles will turn left at this t-intersection to access the site.

Vehicles originating from the north will follow Crookwell Road in a south-easterly direction to a location approximately 4 km south of the Crookwell Road / Elmgrove Road intersection where the proposed Crookwell 3 South site access intersects Crookwell Road. They will then turn right at this t-intersection to access the site.

## 2.6 Details of Over-Dimensional Vehicles

OD vehicles will be required during the transportation of certain components of the wind farm turbines – particularly in the delivery of the tower sections, nacelles and rotor blades. A short listed selection of wind turbine suppliers has been established and is as follow:

1. Vestas V90 1.8/2.0MW;
2. REpower MM92 2.0MW;
3. Vestas V100 1.8MW;
4. Nordex N100 2.5MW;
5. GE 2.5xl 2.5MW;
6. Siemens SWT-2.3-101 2.3MW;
7. Enercon E101 3.0MW; and
8. REpower 3.4M104 3.4MW.

The delivery of the tower sections, nacelles and rotor blades are the critical OD transport movements as these determine the necessary height clearances, road widths and swept paths required for safe manoeuvrability of the OD vehicles. As a final manufacturer has not been selected for the wind turbines at this site, a 'worst-case scenario' will be adopted whereby the greatest width, height and turning circle requirements are taken into account based on the transport requirements of each manufacturer. The specific transport requirement of a selection of these wind turbine suppliers is outlined in Table 2-1 below (note the turbine of the REpower 3.4M104 3.4MW model is the largest of the short listed selection and will be used for the purposes of this TIA).

## 2 Development

**Table 2-1 Turbine Manufacturers**

	<b>Vestas<sup>1</sup></b>	<b>REpower<sup>2</sup></b>	<b>Nordex<sup>3</sup></b>	<b>Siemens<sup>4</sup></b>	<b>REpower<sup>5</sup></b>
Model / Turbine	V90 2.0MW	MM92 2.0MW	N100 2.5MW	SWT-2.3-101 2.3MW	3.4M104 3.4MW
Rotor Diameter	90.0 m	92.5 m	100.0 m	101.0 m	104.4 m
Blade Length	44.0 m	45.2 m	48.7 m	49.0 m	50.8 m
Transportation Requirements					
OD Vehicle Length	56 m	55 m	57.6 m	54.5 m	<b>60.6 m</b>
Minimum Height Clearance Required	Not specified	<b>5 m</b>	<b>5 m</b>	Not specified	Not specified
Minimum Road Width Required	<b>5 m</b>	4.5 m	<b>5 m</b>	<b>5 m</b>	<b>5 m</b>
Maximum Slope Gradient Permitted	8%	<b>6%</b>	<b>6% (gravel), 9% (asphalt)</b>	11%	<b>6%</b>
Maximum Side Inclination Permitted	<b>2%</b>	<b>2%</b>	<b>2%</b>	<b>2%</b>	<b>2%</b>

**Notes:**

Values in bold indicate the critical measurement for the particular transportation requirements and are therefore associated with the 'worst-case' scenario.

The transport requirement for the nominated 'worst-case' scenario for OD vehicular movements, encompassing the requirements of all wind turbine manufacturers, is therefore defined as follows:

- Maximum OD Vehicle Length: 60.6 metres
- Minimum Height Clearance Required: 5 metres
- Minimum Road Width Required: 5 metres
- Maximum Slope Gradient Permitted: 6%
- Maximum Side Inclination Permitted: 2%

## 2.7 Site Access

### 2.7.1 Crookwell 3 East

The site inspection identified three site access points to the Crookwell 3 East site as being the most suitable locations given their site distance and the speed limit along Woodhouselee Road. The three site access points, along with their opportunities and constraints, are:

- Option 1: Site access via Greywood Siding road (Crown Road Reserve – not gazetted) and along existing corridor and then left and travel in a northerly direction towards the southeast corner of the proposed site;
  - Suitable sight distance of Woodhouselee Road in both directions

<sup>1</sup> Transport Manual V90 1.8/2.0MW, Vestas Wind Systems, 12 February 2004

<sup>2</sup> Access Roads and Crane Area – REpower MD/MM, REpower, 28 November 2006

<sup>3</sup> Nordex N100/2500 – Transport, Access Roads, Crane Requirements, Nordex, 20 December 2007

<sup>4</sup> Siemens Wind Power A/S, General Site Requirements GR-SWT-2.3-101-80m HH/Asia Pacific, Siemens, 2007

<sup>5</sup> REpower MM82/MM92/3.XM Transport Access Route and Assembly Area Manual EN-DE, REpower, 10 November 2008

## 2 Development

- Owner permission not required as located through existing road easement
- Preliminary ecological assessments have determined that there are no major constraints along this corridor (a future heritage assessment is to be undertaken to determine if Aboriginal artefacts or any other deposit is present and of significance)
- See Figure 2-3
- Option 2: Site access via Boltons Lane 'existing privately used road' (Crown Road Reserve – not gazetted); and
  - Suitable sight distance of Woodhouselee Road in both directions
  - Owner permission is required for the use of Boltons Lane for construction traffic
  - Vegetation removal is minimal
  - See Figure 2-4
- Option 3: Site access via new access road through Leeston and Hillview Park properties on the opposite side of the road to Rocky Corner property.
  - Suitable sight distance of Woodhouselee Road to the south, however these are slightly constrained to the north
  - Owner permission required for constructing new road through properties
  - Vegetation removal will be required as part of constructing this new road
  - See Figure 2-5

**Figure 2-3 Crookwell 3 East Site Access - Option 1**



## 2 Development

**Figure 2-4 Crookwell 3 East Site Access - Option 2**



**Figure 2-5 Crookwell 3 East Site Access - Option 3**





## 2 Development

Given the constraints identified for each of the options it is considered, from a traffic-perspective, that Option 1 is the preferred site access to the Crookwell 3 East site for the following reasons:

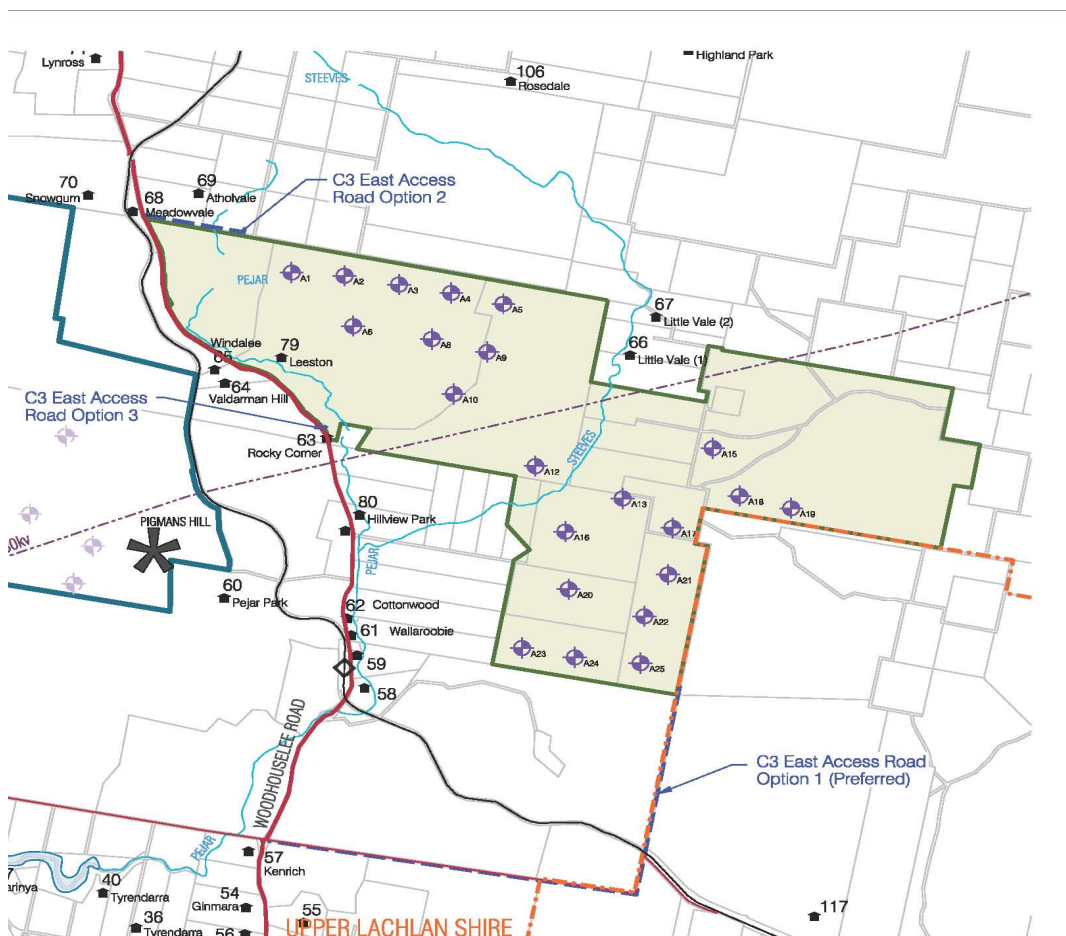
- An existing road reserve is located along Greywood Siding (although upgrades will be required to cater for the OD movements);
- Vegetation removal is minimal (however this is subject to further flora and fauna assessments); and
- Sight distances in both directions at Woodhouselee Road are suitable.

The preferred route alignment outlined in section 2.4 concludes that the Crookwell 3 East site access must be designed (during the construction phase) to cater for the OD, construction and personnel vehicles as follows:

- Right-in and left-out movements must be designed to the swept path of all vehicles up to and including OD vehicles; and
- Left-in and right-out movements must be designed to the swept path of all vehicles up to and including the B-Double.

Figures 2-6 illustrates these site accesses on a plan view for the Crookwell 3 East site.

**Figure 2-6 Preferred Site Accesses to Crookwell 3 Development – Crookwell 3 East**



## 2 Development

### 2.7.2 Crookwell 3 South

The site inspection indicated that the eastern boundary and northeast corner of the Crookwell 3 South site abuts Crookwell Road along a horizontal curve as well as a small escarpment that may result in significant excavation to conform to the vertical geometry required by OD vehicle movements. Site distances are somewhat restricted as any site located in this vicinity is located within the horizontal curve and therefore has limited views. Furthermore, double solid-white centre lines are installed at this location indicating the limited sight distances and prohibits overtaking or, more importantly, turning movements. As such, a direct site access from Crookwell Road at the eastern site boundary and northeast corner is not recommended unless significant roadworks are undertaken on Crookwell Road and at the site access, including:

- Significant excavation of the escarpment to ensure suitable vertical geometry for OD vehicles (to be confirmed by future access designs);
- Constructing appropriate left-in and right-in slip lanes to separate turning and through movements;
- Potential realignment of Crookwell Road to improve sight distances; and
- Consideration of designing a larger site access footprint as vehicles entering and exiting may be travelling at a higher speed (i.e. left-out merge lane).

Figure 2-7 illustrates the sight distance and linemarking limitations at the location of the northeast corner of the Crookwell 3 South site.

**Figure 2-7 Limitations of Crookwell 3 South Site Access at Northeast Corner**



As a result, two options have been identified for site access to Crookwell 3 South from Crookwell Road. The two site access points, along with their opportunities and constraints, are:

- Option 1: Site access located on the northern site boundary via Old Crookwell Road along existing road reserve and accessing the site from the north
  - Suitable sight distance of Crookwell Road in both directions
  - Owner permission not required as located through existing road easement
  - Vegetation removal is minimal
  - See Figure 2-8
- Option 2: Site access located on the western side of Crookwell Road approximately 400 to 500 metres north of where Crookwell Road crosses Wollondilly Creek and traverse over Council land in accessing the southeast corner of the Crookwell 3 South site

## 2 Development

- Suitable sight distance of Crookwell Road in both directions
- Alignment will traverse over Council land between Crookwell Road and the Crookwell 3 South site
- Vegetation removal will be required as no existing road reserve is located along this alignment (however this is subject to further flora and fauna assessment)
- See Figure 2-9

**Figure 2-8 Crookwell 3 South Site Access – Option 1**



## 2 Development

Figure 2-9 Crookwell 3 South Site Access – Option 2



Given the constraints identified for each of the options it is considered, from a traffic-perspective, that Option 1 is the preferred site access to the Crookwell 3 South site for the following reasons:

- An existing road reserve is located along Old Crookwell Road (although upgrades will be required to cater for the OD movements);
- Vegetation removal is minimal (however this is subject to further flora and fauna assessments); and
- Sight distances in both directions at Crookwell Road are suitable.

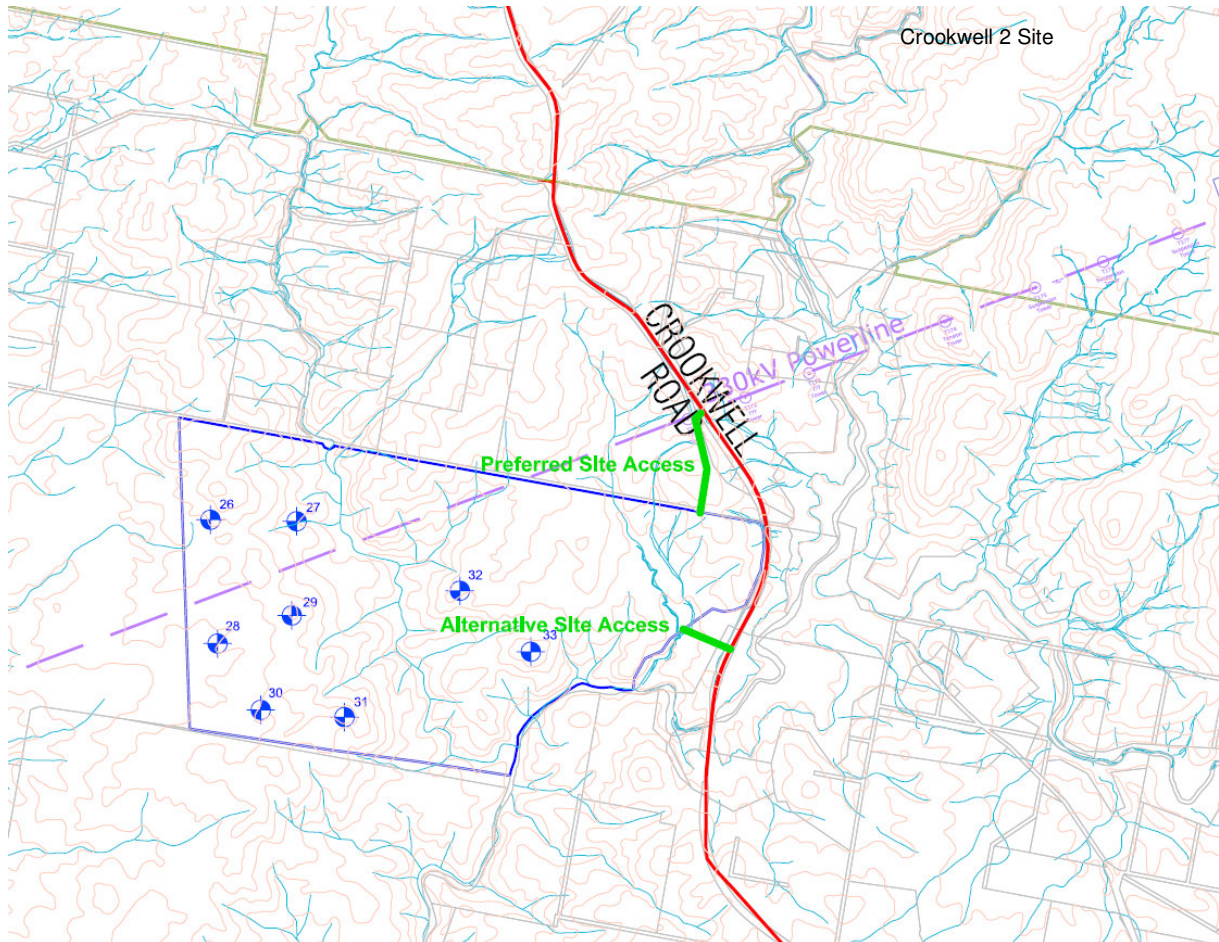
The preferred route alignment outlined in section 2.4 concludes that the Crookwell 3 South site access must be designed (during the construction phase) to cater for the OD, construction and personnel vehicles as follows:

- Left-in and right-out movements must be designed to the swept path of all vehicles up to and including OD vehicles; and
- Right-in and left-out movements must be designed to the swept path of all vehicles up to and including the B-Double.

Figures 2-10 illustrates these site accesses on a plan view for the Crookwell 3 South site.

## 2 Development

**Figure 2-10 Preferred Site Accesses to Crookwell 3 Development – Crookwell 3 South**



### 2.8 Crookwell 2 Windfarm Road and Intersection Upgrades

It should be noted that the Crookwell 2 windfarm development is likely to be well into its construction phase prior to the approval of the Crookwell 3 windfarm development. As such, road and intersection upgrades between Port Kembla and the Crookwell 2 site accesses will already be upgraded to permit the safe passage of vehicle sizes up to that of the OD vehicle specified following Table 2-1.

Consequently road and intersection upgrades along the proposed route will not be required as part of the Crookwell 3 development as these would have already been constructed, and are summarised as follows:

- Port Kembla and Crookwell Road / Woodhouselee Road intersection
  - All road and intersection upgrades will have been completed as part of the Crookwell 2 development
- Crookwell Road (between Woodhouselee Road and Crookwell 3 South site access)
  - All road and intersection upgrades will have been completed as part of the Crookwell 2 development as its Crookwell Road site access is located north of the Crookwell 3 South site access

## 2 Development

- Woodhouselee Road (between Crookwell Road and Crookwell 3 East site access)
  - All road and intersection upgrades between Crookwell Road and the Crookwell 2 Woodhouselee Road site access will have been completed as part of the Crookwell 2 development
  - All road and intersection upgrades between the Crookwell 2 Woodhouselee Road site access and the Crookwell 3 East site access must be constructed as part of the Crookwell 3 windfarm development (to be determined following the confirmation of the preferred site access to Crookwell 3 East)

## Vehicle Generation and Impact

### 3.1 Existing Traffic Volumes

Traffic volume data has been collected in 2005 to indicate the existing conditions at two locations – at Crookwell Road and Woodhouselee Road adjacent to the Crookwell 2 windfarm site. An annual population increase of 0.7% per annum (based on ABS Census data for Crookwell in 2001 and 2006) has been applied to the 2005 data in order to estimate 2010 traffic volumes given that increases in traffic volumes is often negligible in rural environments. The 2005 data suggests that the directional breakdown of this data is approximately two-thirds of vehicles travel southbound during the AM peak and one-third northbound – with the vice-versa occurring during the PM peak.

Table 3-1 outlines the maximum 2005 traffic data collected with the inclusion of the estimated 2010 traffic volumes based on the annual traffic increase of 0.7% per annum.

**Table 3-1 Existing Traffic Volume Data (2005) and 2010 Estimates**

Period	Crookwell Road			Woodhouselee Road		
	<b>2005 Data*</b>	<b>2010 Estimate**</b>	<b>Commercial Vehicles*</b>	<b>2005 Data*</b>	<b>2010 Estimate**</b>	<b>Commercial Vehicles*</b>
AM Peak (vehicles per hour)	146	151	7.7%	24	25	14.8%
PM Peak (vehicles per hour)	174	180		27	28	
Daily Traffic (vehicles per day)	1,669	1,725		211	219	
Total weekly traffic (vehicles)	10,454	10,801		1,204	1,244	

Notes:

\* Refer section 2 of Crookwell Windfarm 2 DA Modification Traffic Impact Assessment (2009).

\*\* Rounded up to next whole vehicle.

### 3.2 Vehicle Volumes Generated by Development (Construction Vehicles only)

An estimate for the vehicle generation for the total development of 30 wind turbines at the site has been summarised in Table 3-2 of which the values are based on a windfarm development of similar size to the being proposed for Crookwell 3 (Hawkesdale windfarm in southwest Victoria is a proposed wind energy facility of 31 wind turbines).

### 3 Vehicle Generation and Impact

**Table 3-2 Vehicle Volumes Generated by Development (Construction Vehicles only)**

Vehicle Class	Peak One-Way Vehicle Movements Generated*****			Activity
	Per month	Per day*	Peak Hour**	
Over-Dimensional	35	2	1	Delivery of Tower Sections
	23	1	1	Delivery of Blades/Nacelles etc.
Heavy Vehicles	111	5	1	Gravel for Foundations
	24	1	1	Water for Concreting
	16	1	1	Cement for Foundations
	7	1	1	Steel for Foundations
	96	4	1	Water for Foundations
	10	1	1	Fuel for Foundation Works
	149	7	1	Gravel for Road Construction
	1	1	1	Substation Works
	2	1	1	Sand for Cabling Works
	2	1	1	Cables for Cabling Works
	3	1	1	Conduit for Cabling Works
	3	1	1	Switchgear Works
	2	1	1	Steel for Substation Electricals
	3	1	1	Switchgear for Substation Electricals
Light Vehicles (cars, utes etc.)****	1,000	41	41	Construction Personnel
	116	6***	4***	Escort Vehicles for OD Deliveries
<b>Total</b>	<b>2,5,03</b>	<b>77</b>	<b>61</b>	<b>Vehicle Proportion during Peak Hour</b>
<i>Over-Dimensional</i>	<i>58</i>	<i>3</i>	<i>2</i>	<i>OD Proportion: 3.3%</i>
<i>Heavy Vehicles</i>	<i>429</i>	<i>27</i>	<i>14</i>	<i>HV Proportion: 23.0%</i>
<i>Light Vehicles</i>	<i>1,116</i>	<i>47</i>	<i>45</i>	<i>LV Proportion: 73.8%</i>

**Notes:**

\* Rounded up to next whole vehicle.

\*\* During AM or PM peak hour it is assumed that all personnel vehicles will arrive or depart in that hour, with construction vehicle activities being spread evenly over the 11-hour working weekday. NB: all values are rounded up to the next whole vehicle.

\*\*\* Due to total number of OD vehicles – based on two escort vehicles per OD vehicle (one pilot and one escort at rear).

\*\*\*\* It is assumed that no car pooling is taking place.

\*\*\*\*\* As many factors have not been determined at this preliminary stage of the project, these figures have been used to provide an estimate of movements during the peak construction month based on the estimated movements relating to a windfarm of similar size (Hawkesdale Windfarm).



### 3 Vehicle Generation and Impact

#### 3.2.1 Construction Vehicle Movements

As this proposed development is still in its preliminary stages a number of assumptions have been applied when undertaking the SIDRA modelling for the two intersections specified:

- Two-thirds of construction and personnel vehicles are assumed to originate north of the Crookwell 3 sites, with the remaining one-third generated south of the site (given the location of nearby major centres);
- All OD vehicles will following the specified OD route outlined in section 1.4;
- OD and construction vehicle movements will occur at a constant rate over the weekday;
- All personnel movements to site will occur in the AM peak and all personnel movements from the site will occur in the PM peak;
- An 11-hour working day will be applied (7am – 6pm); and
- 45 personnel (construction staff and escort vehicle personnel) will be on-site during the peak construction month.

Table 3-3 therefore provides an estimated turning movement distribution of the construction vehicles generated by the site based on these assumptions and the number of vehicles identified during peak periods under section 3.2. In order to determine the 'worst-case' scenario for both intersections, it is assumed that there will be no construction works occurring on the Crookwell 3 South and Crookwell 3 East site simultaneously – rather all OD, construction and personnel vehicles will only be utilising one site at any given time. The 'worst-case' scenario will therefore be produced as all vehicles generated by the development will only be accessing the site at one access point therefore increasing the number of turning movements and potential delays at the access point entry.

**Table 3-3 Summary of Construction Vehicle Turning Movements (Peak Hour)**

Vehicle Class	Crookwell 3 South Site Access		Crookwell 3 East Site Access		Total
	Crookwell Rd Site	Site Crookwell Rd	Site Woodhouselee Rd	Woodhouselee Rd Site	
OD Vehicles*		2	2		2 (per site)
Construction Vehicles*	10	5	5	10	15 (per site)
Cars and LCVs*	30	15	15	30	45 (per site)
<b>Total</b>	<b>40</b>	<b>22</b>	<b>22</b>	<b>40</b>	<b>62 (per site)</b>

Notes:

\* Rounded up to next whole vehicle.

\*\* It is assumed that all AM peak hour movements will be inbound to site with all PM peak hour movements being outbound from site.

## 3 Vehicle Generation and Impact

### 3.3 Total Vehicle Volumes during Construction Phase (Construction Vehicles and Background Traffic)

The vehicle generations outlined in section 3.2 are applied to those estimated for 2010 in section 3.1 to determine whether the road network performance is still acceptable during peak construction activities under the current layout of the intersections. Two intersections have been nominated to be modelled:

- Crookwell Road / Crookwell 3 South site access; and
- Woodhouselee Road / Crookwell 3 East site access.

As this proposed development is still in its preliminary stages the following assumptions have been applied when undertaking the SIDRA modelling for the two intersections specified:

- Two-thirds of construction and personnel vehicles are assumed to originate north of the Crookwell 3 sites, with the remaining one-third generated south of the site;
- All OD vehicles will following the specified OD route outlined in section 1.4;
- OD and construction vehicle movements will occur at a constant rate over the weekday;
- All personnel movements to site will occur in the AM peak and all personnel movements from site will occur in the PM peak; and
- An 11-hour workday will be applied (7am – 6pm).

#### 3.3.1 SIDRA Modelling

The SIDRA modelling package was used to analyse the performance of the existing road network to identify the current traffic characteristics (in 2010 estimates) to the two key intersections at the access points to both sites of the development during the peak construction phase of the project. The two intersections are:

- Crookwell 3 South site access / Crookwell Road intersection; and
- Crookwell 3 West site access / Woodhouselee Road intersection.

The 'degree of saturation' and '95% queue length' are used to compare the affect that construction vehicles will have on the operation of the intersections.

The Degree of Saturation refers to the ratio of an intersection between the traffic demands at the intersection compared to its total capacity. An intersection with a Degree of Saturation approaching 0.90 to 0.95 is considered to be at capacity.

The 95% queue length value is used as an indication of the length whereby the probability of exceeding it is only 5% - often referred to as the design queue length.

The results of the SIDRA modelling are provided in Tables 3-4 and 3-5.

### 3 Vehicle Generation and Impact

**Table 3-4 SIDRA Results – AM Peak Hour (Existing and Crookwell 3 Development)**

<b>Intersection</b>		<b>2010 Existing Conditions (pre-construction)</b>	<b>2010 Conditions – During Peak Construction</b>	<b>Critical Turning Movement – During Peak Construction</b>
Crookwell 3 East site access / Woodhouselee Road intersection	Degree of Saturation	0.01	0.04	Southbound Woodhouselee Road left turn and through movements into Crookwell 3 East site access
	95% Queue Length	Less than one vehicle	Less than one vehicle	Westbound Crookwell 3 East site access left and right turn movements into Woodhouselee Road
Crookwell 3 South site access / Crookwell Road intersection	Degree of Saturation	0.07	0.15	Eastbound Crookwell 3 South site access left and right turn movements onto Crookwell Rd
	95% Queue Length	Less than one vehicle	7m	Southbound Crookwell Rd through and right turn movements into Crookwell 3 South site access

### 3 Vehicle Generation and Impact

**Table 3-5 SIDRA Results – PM Peak Hour (Existing vs Crookwell 3 Development)**

Intersection		2010 Existing Conditions (pre-construction)	2010 Conditions – During Peak Construction	Critical Turning Movement – During Peak Construction
Crookwell 3 East site access / Woodhouselee Road intersection	Degree of Saturation	0.01	0.08	Westbound Crookwell 3 East site access left and right turn movements into Woodhouselee Road
	95% Queue Length	Less than one vehicle	Less than one vehicle	Westbound Crookwell 3 East site access left and right turn movements into Woodhouselee Road
Crookwell 3 South site access / Crookwell Road intersection	Degree of Saturation	0.07	0.09	Eastbound Crookwell 3 South site access left and right turn movements onto Crookwell Rd
	95% Queue Length	Less than one vehicle	Less than one vehicle	Eastbound Crookwell 3 South site access left and right turn movements onto Crookwell Rd

Note: A queue length of 'less than one vehicle' represents a distance of less than 6 metres.

The results of the SIDRA modelling indicate that very little impact will occur under the conditions of the 'worst-case' scenario provided by the assumptions indicated in this section. The existing 95% queue lengths of 'less than one vehicle' is to be expected as the proposed site accesses currently do not exist and so do not yet carry any traffic volumes. However, very little impact if any is experienced at these intersections once the construction vehicles during the AM and PM peak hours is applied to the SIDRA modelling. This illustrates that Woodhouselee Road and Crookwell Road have sufficient spare capacity to allow the turning movements in and out of both site accesses without interfering with the existing road network performance. The largest 95% queue length (7 metres) will be experienced during the AM peak hour at the Crookwell 3 South site access however this is insignificant for the purposes of this traffic impact assessment.

The degree of saturation outputs from the SIDRA analysis are at a maximum of 0.08 and 0.15 for the Crookwell 3 East and Crookwell 3 South site accesses respectively – also both occurring during the PM peak hour. However these maximum values are well below the 0.90-0.95 threshold and as such indicate that both site access t-intersections will perform appropriately during the construction phase of the project and have additional capacity available.

### 3 Vehicle Generation and Impact

#### **Cumulative Effect of Crookwell Windfarm 2 Development**

The approved Crookwell 2 windfarm development is located immediately north of the Crookwell 3 South site and to the west of the Crookwell 3 East site. The Crookwell 2 development has three proposed site accesses – one on either side of Crookwell Road (located north of the preferred Crookwell 3 South site access) and one on Woodhouselee Road (located south of the Boltons Lane site access road option). Therefore its traffic generation needs to be taken into account in order to determine the cumulative traffic impacts on Crookwell Road and Woodhouselee Road under the scenario that both developments (Crookwell 2 and Crookwell 3) are constructed simultaneously.

It is noted, however, that it is likely that Crookwell 2 will be constructed first, with the construction team then moving to Crookwell 3.

The *Crookwell Windfarm 2 DA Modification – Traffic Impact Assessment* (2009) outlines the following values for traffic generation for the Crookwell 2 development:

- 80 staff will be employed during the peak of the construction phase – 60 construction staff will reside south of the development and 20 staff to the north;
- 203 heavy vehicles will access the site per day – 14 from the north and 189 from the south; and
- A total of 377 OD vehicle deliveries will access the site throughout the project construction period and will all be delivered from the south (i.e. via Goulburn) – this equates to approximately 2 OD vehicles per day (given an 8-month construction period of 24 working days).

These values have been assumed to apply individually to Crookwell Road and Woodhouselee Road as this reflects a ‘worst-case’ scenario whereby only one site access is available to all vehicles and is outlined in Table 3-6. It is assumed that all personnel movements and 10% of the OD / heavy vehicle deliveries will take place during the peak periods. As such, the traffic volumes will be generated during the construction phase of Crookwell 2 and will be further analysed in SIDRA to determine these cumulative traffic impacts on the Crookwell 3 East and South site accesses.

**Table 3-6 Crookwell Windfarm 2 Traffic Generation**

	<b>AM Peak</b>		<b>PM Peak</b>	
	Northbound through movement	Southbound through movement	Northbound through movement	Southbound through movement
Crookwell 3 East site access / Woodhouselee Road intersection	<ul style="list-style-type: none"> <li>• 2 heavy vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• 60 cars</li> <li>• 2 heavy vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• 60 cars</li> <li>• 2 heavy vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• 2 heavy vehicles</li> </ul>
Crookwell 3 South site access / Crookwell Road intersection	<ul style="list-style-type: none"> <li>• 20 cars</li> <li>• 20 OD/heavy vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• 20 OD/heavy vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• 20 OD/heavy vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• 20 cars</li> <li>• 20 OD/heavy vehicles</li> </ul>

*Note: Vehicles accessing Crookwell 2 from the north and departing to the north will not impact on the Crookwell 3 South site access / Crookwell Road intersection.*

These additional traffic volumes generated by the Crookwell 2 development have been applied to the SIDRA analysis of the Crookwell 3 development against the existing conditions (see Tables 3-4 and 3-5) and these cumulative impacts are provided in Tables 3-7 and 3-8.

### 3 Vehicle Generation and Impact

**Table 3-7 SIDRA Results – AM Peak Hour (Crookwell 2 Development Cumulative Impact on Crookwell 3 Development)**

<b>Intersection</b>		<b>Crookwell 3 Development Only Impact</b>	<b>Crookwell 2 and Crookwell 3 Cumulative Impact</b>	<b>Critical Turning Movement – During Peak Construction</b>
Crookwell 3 East site access / Woodhouselee Road intersection	Degree of Saturation	0.04	0.08	Southbound Woodhouselee Road left turn and through movements into Crookwell 3 East site access
	95% Queue Length	Less than one vehicle	Less than one vehicle	Westbound Crookwell 3 East site access left and right turn movements into Woodhouselee Road
Crookwell 3 South site access / Crookwell Road intersection	Degree of Saturation	0.15	0.17	Eastbound Crookwell 3 South site access left and right turn movements onto Crookwell Rd
	95% Queue Length	7m	8m	Southbound Crookwell Rd through and right turn movements into Crookwell 3 South site access

### 3 Vehicle Generation and Impact

**Table 3-8 SIDRA Results – PM Peak Hour (Crookwell 2 Development Cumulative Impact on Crookwell 3 Development)**

Intersection		Crookwell 3 Development Only Impact	Crookwell 2 and Crookwell 3 Cumulative Impact	Critical Turning Movement – During Peak Construction
Crookwell 3 East site access / Woodhouselee Road intersection	Degree of Saturation	0.08	0.10	Westbound Crookwell 3 East site access left and right turn movements into Woodhouselee Road
	95% Queue Length	Less than one vehicle	Less than one vehicle	Westbound Crookwell 3 East site access left and right turn movements into Woodhouselee Road
Crookwell 3 South site access / Crookwell Road intersection	Degree of Saturation	0.09	0.10	Eastbound Crookwell 3 South site access left and right turn movements onto Crookwell Rd
	95% Queue Length	Less than one vehicle	10m	Southbound Crookwell Road through and right turn movements into Crookwell 3 site access

Note: A queue length of 'less than one vehicle' represents a distance of less than 6 metres.

As identified in Tables 3-7 and 3-8, the Degree of Saturation only increases marginally when considering the cumulative impacts of construction activities occurring simultaneously at the Crookwell 2 and Crookwell 3 sites. The largest Degree of Saturation occurs during the AM Peak Hour and is estimated at 0.17, well below the 0.90 to 0.95 threshold, and indicates that the intersections at both site accesses will perform appropriately without requiring modification to the proposed t-intersections or existing road network. Queue lengths are also minimal with the maximum calculated at 10 metres and considered insignificantly for the purposes of this traffic study.

Therefore there is no significant cumulative impact when incorporating the construction phase of the Crookwell 2 development with the proposed vehicle activities of the construction phase of the Crookwell 3 development. Note that the construction is unlikely to occur simultaneously in any case.

### 3.4 Operational Phase Volumes

The number of vehicles generated by the Crookwell 3 windfarm site during its operational phase will be insignificant relative to that experienced during the construction phase. The impact that construction traffic had on the existing Degree of Saturation and Queue Lengths of all intersections modelled were minimal if non-existent. As such, the impact produced by operational traffic associated with the windfarm will be insignificant.

## Management

### 4.1 Equipment Transportation

This TIA identifies the impact of the traffic generated by this development at a preliminary level. A more detailed Transport Management Plan is to be developed as part of obtaining approvals from the RTA and Local Councils and will incorporate the input from the haulage contractor. Mitigation measures to be incorporated in further assessments prior to construction activities include:

- Commissioning a suitably-qualified haulage contractor to transport the OD loads. The haulage contractor must be familiar with the approvals process and have an established relationship with the appropriate road authorities;
- Develop a detailed Traffic Management Plan which will include the following matters:
  - Confirm OD vehicle type and total traffic generation for the development;
  - Ensure impacts are minimised during the delivery of construction materials (particular OD);
  - Detail the hours of operation for construction and/or operational vehicles and the proposed construction timetable;
  - Define the safety principles to be maintained throughout the construction and operational phases of the project;
  - The undertaking of an existing conditions report;
  - Outline any temporary works required during the construction phase (i.e. signage, linemarking, modified street furniture); and
  - Require liaison with all relevant road authorities and for their feedback to be considered in finalising the TMP.
- Provide the design of access points to the site to comply with RTA and local Council requirements – ensuring safe manoeuvrability of all vehicles proposed to access and egress the site;
- Finalise the design and construction of the internal site tracks network to be suitable for OD vehicles; and
- Undertake a roadside vegetation and/or ecological assessment (if required) of the roadside environment to determine any impacts associated with any roadworks.

### 4.2 OD Deliveries and Haulage Contractor Requirements

The use of OD vehicles will require their swept path to be taken into consideration when developing the Transport Management Plan outlined in section 4.1. In particular, analysing the swept path of OD vehicles at key intersections and at access points will determine the extent of 'free zone' is required to safely manoeuvre the vehicles without striking objects such as trees, poles, fences and bridges. Determining the swept path of these vehicles (particularly at site access points) is also important as it will highlight the extent of vegetation removal required and compared to the area permitted under Consent approvals vegetation removal limitations apply to the project.

The commissioned haulage contractor (detailed in section 4.1) is responsible for several aspects in finalising the transport arrangements prior to the construction of the development including:

- Being responsible for applying and obtaining the necessary approvals for the haulage of the OD components;
- Confirming the appropriateness of the finalised route selection and providing a detailed Haulage Transport Plan to be incorporated into the Traffic Management Plan;
- Complying with all permit approvals and conditions imposed by the RTA and local councils;
- Meet the delivery schedule and requirements as agreed for the project;



## 4 Management

- Conducting a detailed road survey and conditions assessment before and after haulage activities; and
- Adhering to the Traffic Management Plan (to be developed).

### 4.3 Existing Conditions Assessment

The Traffic Management Plan is to include a detailed existing conditions report. This assessment will include a pavement assessment and road safety audit of which will contribute to the outcomes developed in the finalised Transport Management Plan. The haulage contractor is to also conduct an existing conditions assessment of the proposed OD haulage routes to ensure the suitability of horizontal and vertical alignment for over-dimensional and over-mass loads. The ability structures to permit OD loading will be confirmed upon further consultation with the relevant road authorities and be incorporated into the finalised Transport Management Plan.

### 4.4 Other Mitigation Measures

A Transport Management Plan will be prepared after consultation with the relevant road authorities. The Transport Management Plan will include any further mitigation measures required by the relevant road authorities.

## Conclusion

This Traffic Impact Assessment has analysed the vehicle generation of the proposed Crookwell 3 windfarm development, along with the cumulative impact of the adjacent Crookwell 2 windfarm development, and has determined that no significant impact to the existing road network will result from the proposed Crookwell 3 windfarm development. As such, road network improvements are not required to be undertaken given the low vehicle volumes estimated to be generated from the Crookwell 3 windfarm development. However, the swept path of OD vehicles may require some intersection or road upgrades and this will be determined during the more detailed Transport Management Plan as indicated in section 4.1 of this document.

Preferred t-intersection access points to each site have been determined based on sight distances, existing conditions and any other restrictions (such as topography or linemarking). The preferred site access to Crookwell 3 East is to be located along the Greywood Siding road reserve based on existing conditions, minimal vegetation removal and sight distances. The selection of the site access to Crookwell 3 South is more restricted with a preferred site access located approximately 400 to 500 metres north of where Crookwell Road crosses the Wollondilly Creek due to location of an escarpment and poor sight lines where the site abuts Crookwell Road.

A detailed Transport Management Plan will be developed and will outline the finalised transport details and include management and mitigation measures for the project. This document is to be prepared before the construction phase of the project and will apply to all traffic-related activities for the Crookwell 3 windfarm development.

A summary of all traffic-related activities to be conducted following the approval of the project is outlined in Table 5-1.

## 5 Conclusion

**Table 5-1 Summary of Required Tasks**

<b>Task</b>	<b>Already Undertaken for Crookwell 2</b>	<b>Required Under Crookwell 3</b>	<b>Notes</b>
Prepare detailed Transport Management Plan for Crookwell 3 windfarm development	X	✓	To be completed prior to construction phase of project
Finalise traffic generation numbers and proposed route for Crookwell 3 windfarm development	X	✓	To be included in Transport Management Report
Confirm Haulage Contractor and prepare Haulage Transport Plan for Crookwell 3 windfarm development	X	✓	To be completed prior to finalisation of Transport Management Plan
Liaise with appropriate road authorities for Crookwell 3 windfarm development	X	✓	To be undertaken during Transport Management Plan tasks
Finalise design of access points to Crookwell 3 windfarm site	X	✓	To be included in Transport Management Plan following finalisation of preferred site accesses
Finalise design of internal site tracks network for Crookwell 3 windfarm site	X	✓	To be completed prior to construction phase of project
Undertake existing conditions assessment and roadside vegetation assessment	✓	✓	Any additional assessments required specific to the Crookwell 3 windfarm sites to be included in Transport Management Plan
Intersection and road upgrades between Port Kembla and Crookwell Rd / Woodhouselee Rd intersection to allow safe passage of OD vehicles	✓	X	Already completed prior to construction phase of Crookwell 2 windfarm
Intersection and road upgrades on Crookwell Rd between Woodhouselee Rd and Crookwell 3 South site access to allow safe passage of OD vehicles	✓	X	Already completed prior to construction phase of Crookwell 2 windfarm
Intersection and road upgrades on Woodhouselee Rd between Crookwell Rd and Crookwell 3 East site access to allow safe passage of OD vehicles	✓ (completed to Crookwell 2 site access on Woodhouselee Rd)	Remainder  (only required if Crookwell 3 East site access is located north of Crookwell 2 site access on Woodhouselee Rd)	Upgrades between Crookwell Rd and Crookwell 2 site access on Woodhouselee Rd already completed prior to construction of Crookwell 2 windfarm. Any upgrades further north of the Crookwell 2 site access on Woodhouselee Road will only be required should the site access to Crookwell 3 East be north of this location. The preferred site access along the Greywood Siding road reserve is located south of the Crookwell 2 site access on Woodhouselee Road and as such no intersection or road upgrades to Woodhouselee Road would be required.

## Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Union Fenosa Wind Australia Pty Ltd and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 12 February 2010.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between April and August 2010 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.



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