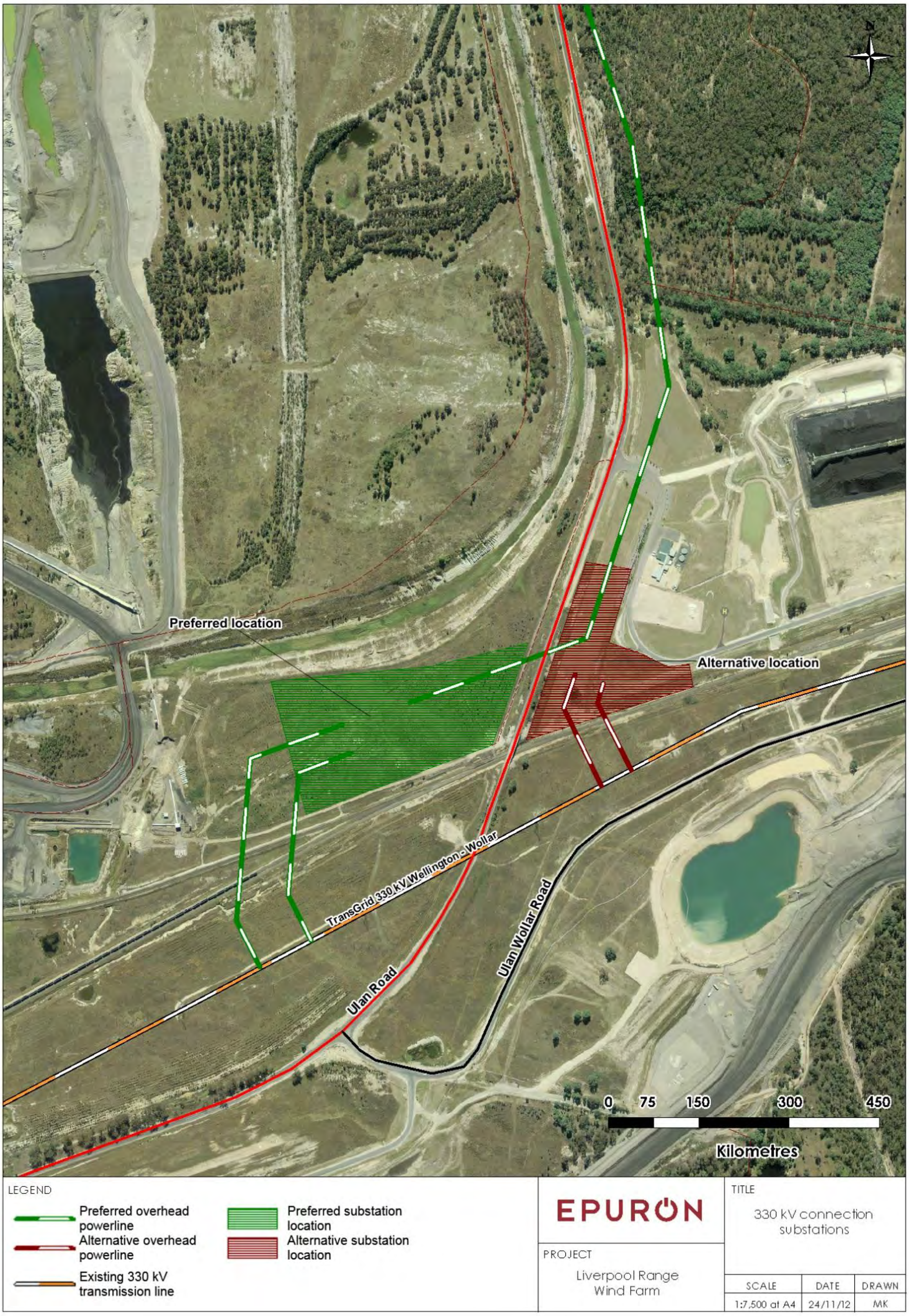


Figure 3-11 Detailed view of the proposed 330 kV connections substation options

Connection Powerline Design

The Connection Powerline is expected to be a double circuit design for most of its length, though this may reduce to a single circuit design towards the northern extremities of the site.

Powerline structures come in many designs however most are either steel or concrete pole design or a steel lattice tower design. The type of design used may vary depending on the preferred voltage, different ground conditions, carrying weights, strain angles, clearance requirements as well as local environmental conditions including local constraints (e.g. archaeological) and visual amenity.

Based on electrical design assessments for the wind farm it is proposed the new overhead powerline will be mounted on a combination of single pole, multiple pole or lattice structures, with a preference for single pole structures where visual amenity impacts are likely to be high if alternate structures are used.

Typical 132 kV and 330 kV mounting structures, together with indicative powerline heights and easement widths, are shown in Figure 3-12. Where single pole structures are used they are likely to have similar heights and easement widths to the structures shown. Where lower voltage structures are used, these are likely to be similar in appearance but lower in height to the options indicated.

The powerline will include an appropriate lightning protection system including earth mats, lightning rods, earthing conductors and earth wires as necessary.

While some clearing of the easement will be necessary for safety reasons, the amount of clearing will be minimised and lower growing species will be used to revegetate any cleared areas. In general, access tracks for construction and maintenance of the powerline will be built within this easement area.

The final confirmation of the structure type and design of the structure will be determined following further assessment by an appropriately qualified transmission line design consultant in consultation with TransGrid and nearby landowners. Final design is also dependant on selection of the construction contractor and completion of detailed design phase prior to commencement of construction.

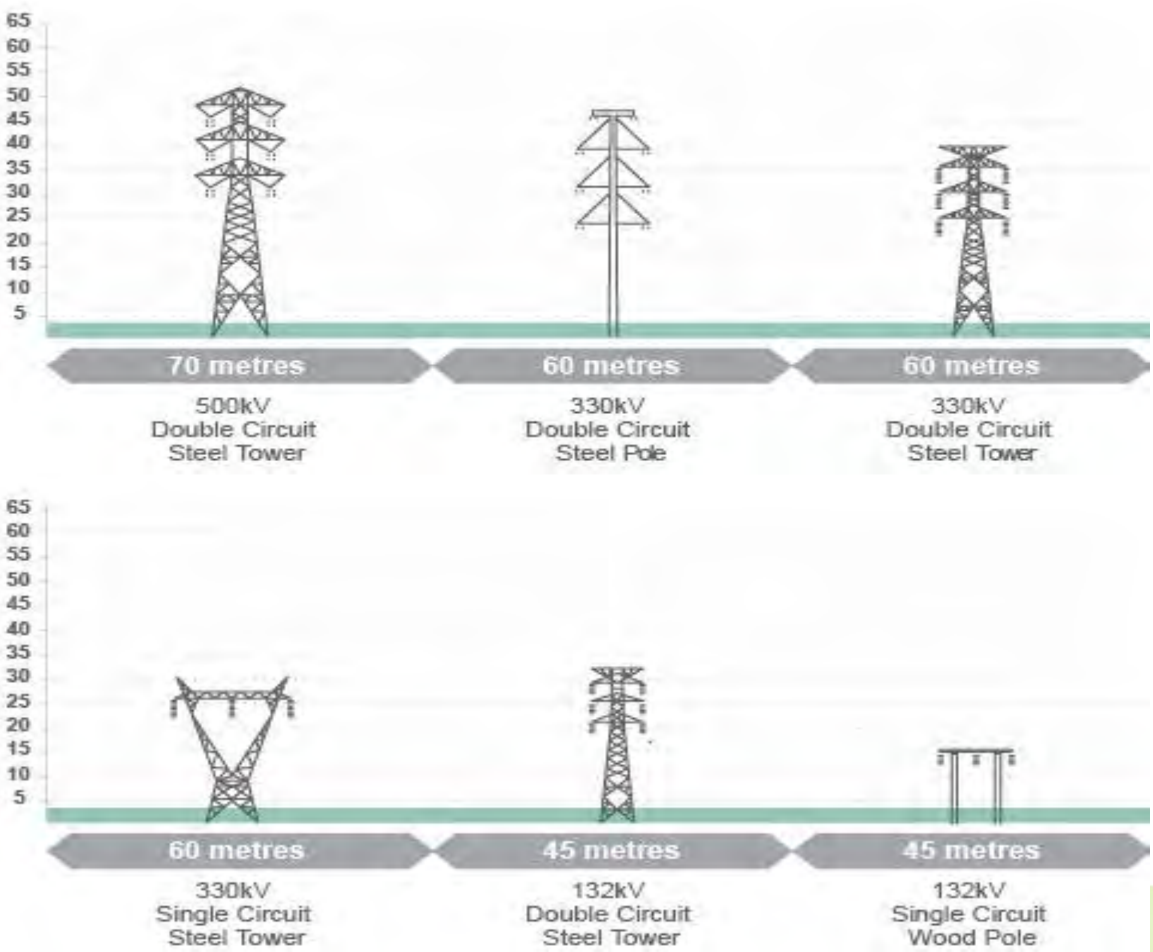


Figure 3-12 Typical 132 kV and 330 kV overhead powerline mounting structures

Collection Substations

Up to six new Collection Substations will be located on the wind farm site as indicated in Figure 3-2. The Collection Substations will collect power generated by the turbines and deliver it to the new overhead powerline. Table 3-3 indicates the preferred and alternate collection substations, with the final site selection to be based on technical and engineering requirements.

Table 3-3 Preferred and alternative collection substation locations

Wind Farm Precinct	Preferred Collection Substation Location(s)	Alternate Collection Substation Location(s)
Cassilis	Bounty Creek	Rotherwood Rotherwood (Alternate) Bounty Creek
Turee	Bounty Creek	Turee North Starkey's Creek
Coolah Tops	Coolah Tops	Turee North
Coolah East	Coolah East	
Gundare	Gundare	Gundare (Alternate) Coolah East

Each Collection Substation will include all necessary ancillary equipment such as lengths of connecting powerlines, control room and cubicles, communication equipment and amenities. The connection substation also requires telecommunications (cable, optic fibre and/or microwave links) and backup electricity connections (415 V – 11,000 V) from local services, and an appropriate access road.

Each Collection Substation area would be surrounded by a security fence as a safety precaution to prevent trespassers and stock ingress. The ground would be covered partly by crushed rock and partly by concrete pads for equipment, walkways and cable covers. There would also be an earth grid extending outside of the boundary of the security fence.

Each Collection Substation will include up to two large power transformers to change the voltage from the reticulation voltage (expected 22 kV or 33 kV) up to the powerline voltage. Further, some Collection Substations may include step-down transformers if the voltage of the Connection Powerline is reduced (e.g. from 330 kV down to 132 kV). The transformers are likely to be of the oil-cooled variety, and therefore may contain considerable quantities of oil. In addition, lower power auxiliary transformers may be required. Provision would be made in the design of each Collection Substation for containment of any oil which may leak or spill.

Each Collection Substation will include an appropriate bushfire Asset Protection Zone (APZ) that complies with the RFS *Planning for Bushfire Protection* guidelines. This has been evaluated based on the vegetation type and slope. The site parameters (predominantly flat land) indicate that a compliant inner protection area (which can be maintained under continued grazing practices) and outer protection area could be achieved.

Typically each Collection Substation would take up an area up to 200 m x 200 m. The proposed locations for each Collection Substation have been identified and are shown in more detail in Attachment 1 – Detailed Site Maps.

Approval is sought for the preferred and alternative Collector Substations, however only up to six Collection Substations will be built.

Onsite Electrical Reticulation

From each wind turbine, the power voltage is stepped up from generation voltage to either 22 kV or 33 kV for reticulation from each group of turbines to the Collection Substations. Each turbine is then connected from its own transformer via a combination of underground cable and overhead powerline reticulation back to the Collection Substation.

Typically underground cabling is used to connect turbines along the ridgelines and overhead powerlines are used to transport power between adjacent ridges and from groups of turbines to the Collection Substations. In general, overhead powerlines offer benefits as they minimise ground disturbances and are significantly lower in cost. There are practical limitations to installing overhead cabling on ridges where turbines are located, as well as a greater visual impact. Overhead powerlines will be located along the lower lying areas and slopes of the ridgelines to minimise visual and practical impacts where possible.

An indicative reticulation layout is shown in in Figure 3-13, with more detailed maps in Attachment 1 - Detailed Site Maps.

Cable trenches would, where practical, be dug within or adjacent to the onsite access tracks to minimise any related ground disturbance. Short spur connections would diverge from the main cable route which would approximately follow the main access route at each group of turbines. Subject to ground conditions, underground cables would typically require a trench of 0.75 to 1 m deep and 0.5 to 1 m wide.

Statements of Commitment accompany this proposal to ensure that micro-siting is used to minimise environmental (particularly ecological) impacts. Micrositing would be undertaken with the assistance of an ecologist, especially where routes are located near sensitive environmental features.

Communications Equipment

A suitable communications network will be established across the wind farm site to enable appropriate operation and control including the required interaction with the TransGrid electricity grid. In addition to underground and overhead communications cabling, this network could include UHF, VHF or microwave communications equipment.

In addition to the electrical cabling, control and communications cabling is required from the maintenance facility to each wind turbine, and to the various substations. This communication cabling is typically optical fibre cable and would be installed using the same method and route as the power cabling described above, that is, strung from the same poles as overhead lines, or buried in the same cable trench as the electrical cables.

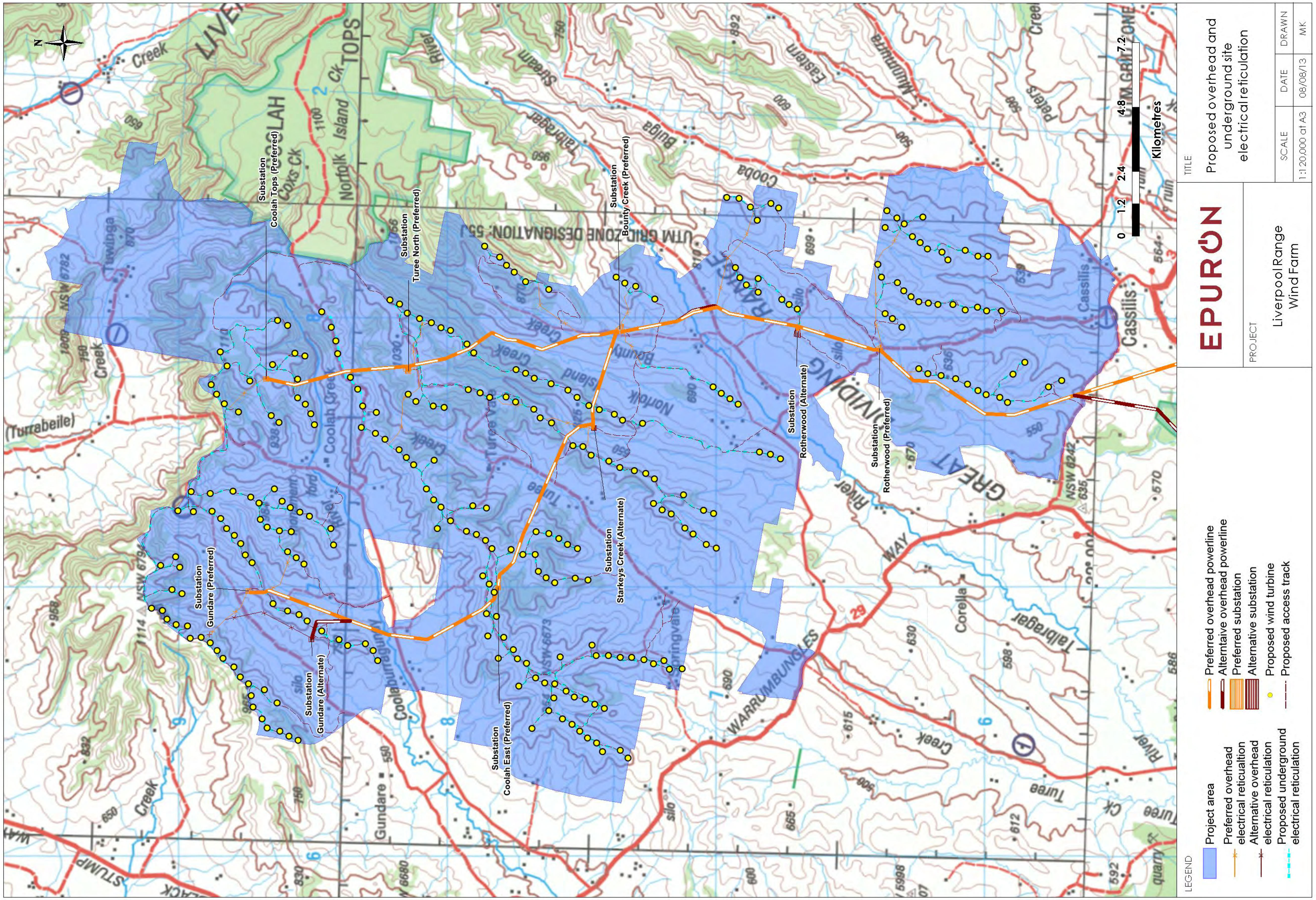


Figure 3-13 Indicative proposed overhead and underground site electrical reticulation

3.6 Access to and Around the Site

Main Site Access

The primary access to the project site will be via the Golden Highway. This is a major highway between Newcastle and Dubbo and will be able to handle the additional traffic generated during the construction of the wind farm. Minor rearrangement of street furniture and powerlines may be required at Denman to navigate through a 90 degree right hand turn at the edge of town.

From the Golden Highway, major vehicle access to the site will be via Ulan Road, Warrumbungles Way, Rotherwood Road, Turee Vale Road, Coolah Road and Coolah Creek Road, and various subsidiary public roads coming off these. These routes avoid heavy vehicles transiting the townships of Coolah and Cassilis during construction. Further, the Burragundy Bridge on the outskirts of Coolah is not suitable for oversized vehicles.

Alternate access to the site for smaller vehicles may be via the townships of Cassilis or Coolah, particularly during the operation and maintenance phase where workers are expected to travel to site from these towns.

The turn off to and from the wind farm will be signposted and designed to allow vehicles to exit and enter the roadways safely. Minor works may also be required to these public roads as outlined in the Traffic and Transport assessment summarised in Section 13.

Access tracks

On site access tracks required for construction and operation would be unsealed formations with a minimum width of 5 m. Access tracks are required to the base of each wind turbine location and to the location of the Connection Substation, Collection Substations, overhead powerline route, operation and maintenance facilities and other infrastructure. New gates and possibly new or realigned fences may also be required to protect stock during the construction phase and at property boundary crossings.

Once the construction phase has finished, the crane hardstands and access tracks would be maintained to allow maintenance and repairs to the wind turbines. These tracks can also be used for normal farm access.

In locating access tracks on site, every effort would be made to:

- minimise the number and length of access tracks;
- locate access tracks along the route of existing farm tracks;
- locate access tracks to minimise clearing of native vegetation;
- locate access tracks to minimise impact on sensitive ecological or heritage areas;
- construct access tracks with due regard to erosion and drainage; and
- construct access tracks with due regard to landowners ongoing farming practices.

Vehicle management

Prior to the commencement of construction a Traffic Management Plan (TMP) would be prepared to properly manage traffic impacts on public roads as detailed in Section 13. It would be developed in consultation with the roads authorities to ensure that the measures are adequate to address potential safety and asset degradation impacts.

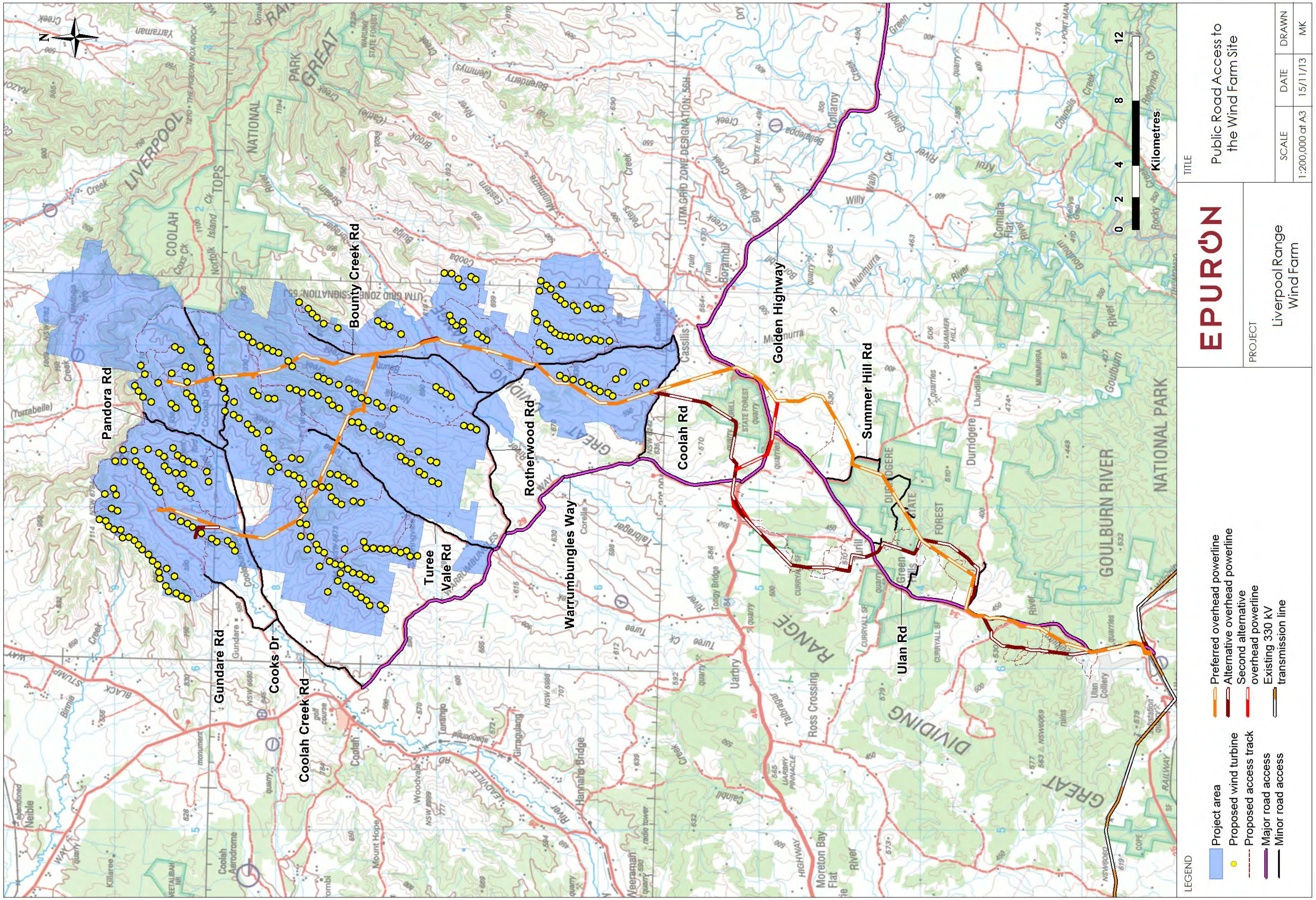


Figure 3-14 Site access to the proposed wind farm

3.7 Construction Facilities

During the construction phase up to two construction compounds will be established on the site. The compounds will include car parking, site offices, and amenities for the construction work force, and lay down areas for the temporary storage of construction materials, plant, equipment and wind turbine components. A temporary power supply will be required to be connected to the construction compounds.

Site Offices

During the construction phase up to 829 staff would be working on site at any time. Suitable locations for up to four site offices would be selected, avoiding areas that are regarded as having environmental constraints. The site offices may include several demountable buildings and amenities blocks located on site for the duration of construction. Sufficient parking would be provided for the expected usage.

Lay down areas and Construction Compounds

Temporary lay down areas to store materials and carry out pre-assembly works will be located at the construction compounds and at selected locations across the project site where require. These areas would be typically fenced off and secured but may also include the use of paddocks for a short term where required across the site.

Temporary construction compounds will be erected and maintained during the construction phase. Locations of these compounds are shown in Figure 3-15 through Figure 3-18. The temporary construction compounds will typically include amenities, offices, staff facilities, stores, car parks, communication equipment, visitor facilities and safety areas.

Concrete Batch Plants

Up to four portable concrete batching plants would be required on site and are typically located in the vicinity of the construction compounds. A typical concrete batch plant would involve a level area of approximately 100 m x 100 m to locate the loading bays, hoppers, cement and admixture silos, concrete truck loading hardstand, water tank and stockpiles for aggregate and sands. The batching plant would include an in-ground water recycling / first flush pit to prevent dirty water escaping onto the surrounding area, and would be fully remediated after the construction phase. The proposed locations are shown in Figure 3-15 through Figure 3-18.

The concrete batching plant would produce up to 400 m^3 of concrete per day when a turbine foundation is being poured. The operational period of the concrete batching plant would be for the life of the construction phase and the plant would produce a maximum of 850 tonnes per day. This is equivalent to 355,000 tonnes total during the construction phase. The batch plant operations would therefore require a license to be issued by DECCW (under the Protection of the Environment Operations Act 1997), given the amount exceeds the license threshold of 150 tonnes per day. License conditions specified by DECCW are likely to include operational protocols and monitoring.

Rock Crushing

Materials excavated during the construction of wind turbine foundations may be able to be reused for other purposes, such as road base for the road surface upgrades. For these purposes mobile rock crushers would be used during construction.

Gravel

Gravel would be sourced from suitable nearby quarry and raw material suppliers. Due to the presence of vast mining interests in the region the sourcing of gravel and other raw material is found to be widely and readily available. There are nearby gravel and quarry facilities capable of supplying all raw material needs for the project, including;

- Yarrawa Ridge Gravel Supplies - Turnerman's Road, Denham.
- CMG Sand and Gravel - Cawsey Road, Denham.
- Stoneco - Middlebrook Road, Scone.
- Boral Quarries - Mitchell Highway, Maryvale.

Water Use

During construction it is estimated 59 ML of water will be required for general construction purposes and dust suppression control. Locating concrete batching plants on site will require an additional 6-7 ML of water for concrete foundations etc.

Water for the project will be sourced primarily from Burrendong Dam near Scone and transported to onsite water storage tanks. The proponent has discussed the proposed arrangements with NSW Office of Water and has written to State Water seeking to progress the necessary arrangements to formalise the use of water during construction. As the water requirements for the project represents less than 0.006% of the capacity of the Burrendong Dam, the project is not expected to have a significant impact on ongoing dam operations. Sourcing water from Lake Windamere is an alternative to the proposed use of Burrendong Dam water.

3.8 Additional Permanent Facilities

Operations and Maintenance Facilities

An operation and maintenance facility would be located as shown in Figure 3-17. The facility will include car parking, offices and amenities for the maintenance staff, a control room and storage facilities for spares and equipment needed for the maintenance and operation of the wind turbines.

Figure 3-15 Location of northern site facilities

Figure 3-16 Location of western site facilities

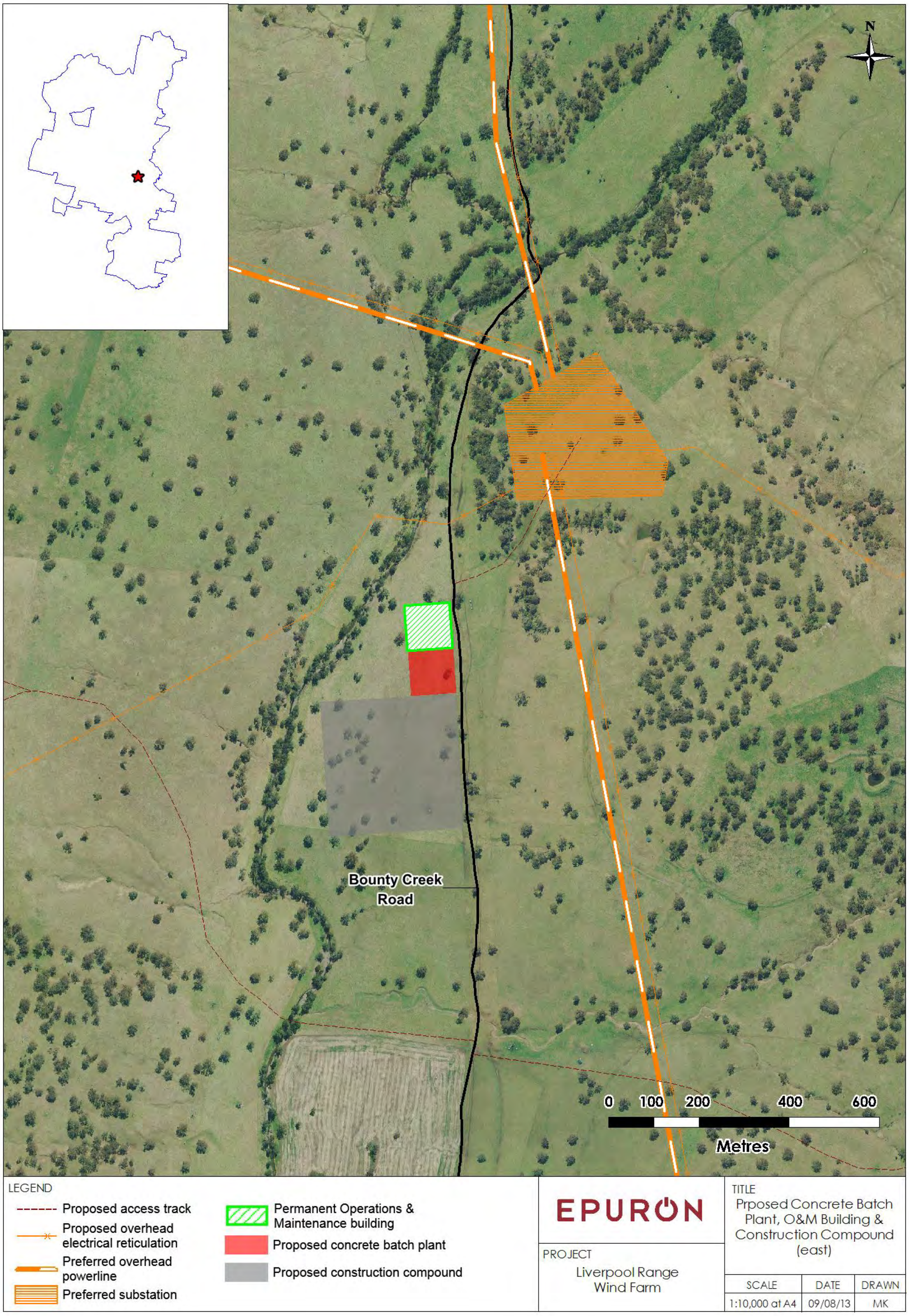


Figure 3-17 Location of eastern site facilities

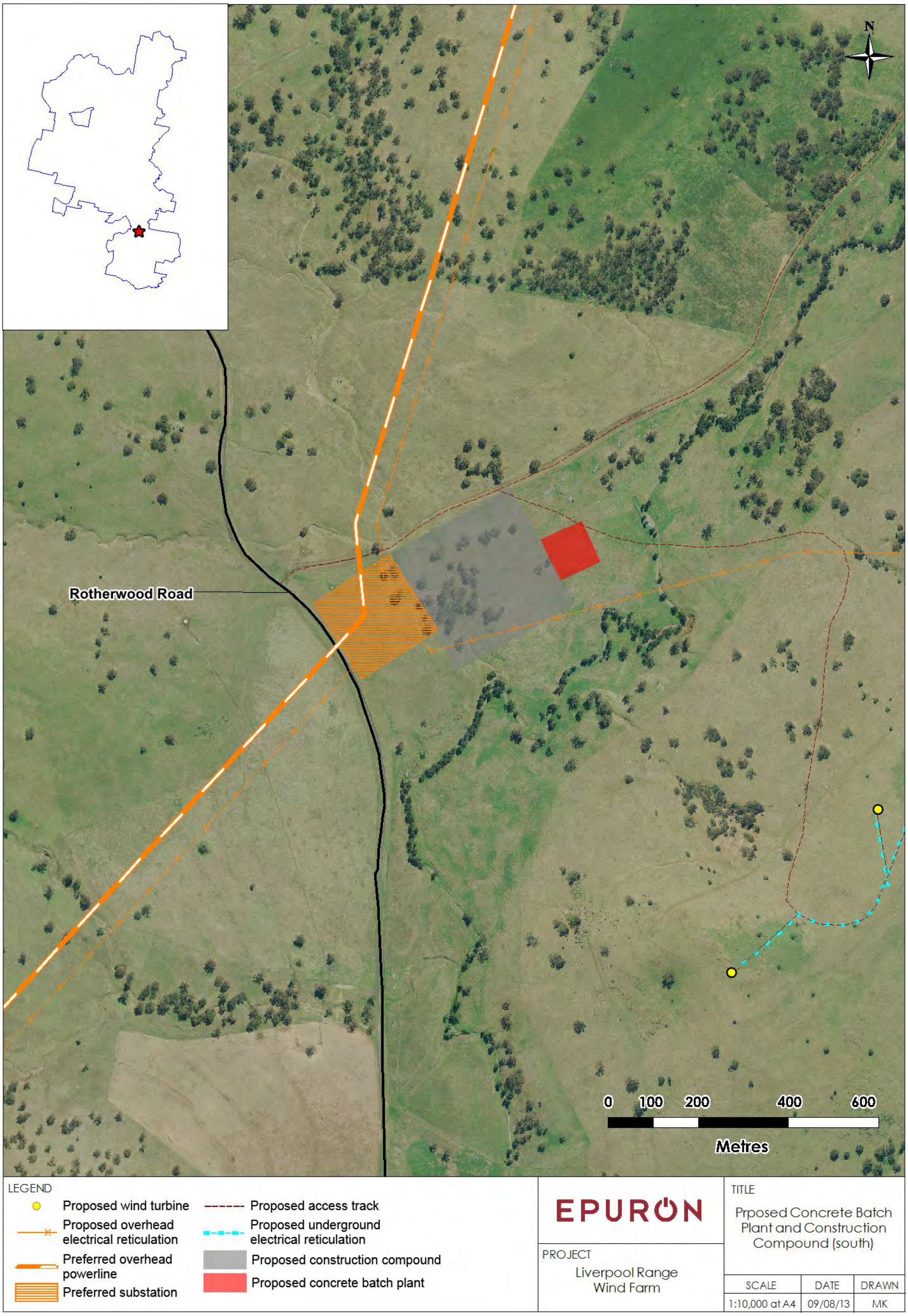


Figure 3-18 Location of southern site facilities

Wind Monitoring Equipment

Epuron is currently operating five wind monitoring masts on the site to assess wind speeds at or near proposed turbine locations. Following construction, permanent wind monitoring masts would be required to assist with the control and operation of the wind farm. These would be static guyed masts with remotely operated wind monitoring equipment installed at multiple heights on each mast. Each mast could require hub-height wind monitoring; therefore masts are expected to be at least 80 m tall.

Pending final wind turbine placements, it may be necessary to move or install additional permanent wind monitoring masts to verify wind speeds across the site.

The temporary and permanent masts would be located within the development envelope assessed in the various studies reported in this document.

Epuron will inform CASA and the Department of Defence of the location of any monitoring masts constructed.

3.9 Site Disturbance and Impact Areas

The proposed wind farm requires the construction of a number of elements including turbines, turbine foundations, underground and overhead powerlines, substations, control buildings and access roads on the site.

During the construction activities additional areas of the site would be impacted to provide construction compounds, concrete batching plants and storage areas. These areas can be rehabilitated and restored following the completion of the construction program. Table 3-4 presents the calculated area of the site impacted by the project based on the turbine layout.

Table 3-5 provides a calculated volume of vegetation that may be modified or removed based on the site footprint described in Table 3-4. Some of these impacts would be for the duration of the wind farm operation and some are temporary impacts during the construction phase. More detail can be found in Section 11 Ecology.

Table 3-4 Development footprint and site disturbance areas

Project Components	Typical Dimensions	Quantity	Total Area (ha)
Permanent Infrastructure:			
Foundation and Hardstand#	25 m x 60 m	288	44.5
Access tracks and spurs*#	10 m	10 m	359.2
Underground reticulation powerlines onsite**	1 m	210.9 km	21.09
Overhead reticulation cabling / easement^	25 m	56.2 km	140.5
Overhead Powerline^	60 m	94.8 km	568.8
Connection Substation	300 m x 300 m	1	9
Collection Substations	200 m x 200 m	6	48
Operations and Maintenance facilities and Control Building	100 m x 100 m	1	1
Temporary Infrastructure:			
Concrete batch plants	100 m x 100 m	4	4
Construction compounds, staging and storage areas	300 m x 300 m	4	36

* Access tracks around the site are anticipated to be 5 - 6 metres in width, however, a 10 metre width has been used to assess the likely impact due to cut and fill operations in order to achieve the required slope.

**The impact area associated with underground cables has been incorporated into the figures for access tracks.

Habitat permanently removed

^ Habitat would be modified for transmission and power line maintenance. This would include clearing and trimming vegetation for each power pole and maintaining clearance from electrical conductors between poles.

Table 3-5 Total impacted vegetation

Vegetation Type	*Condition*							*Total (ha)*
	Good	*Mod-Good*	*Moderate*	*Poor-Mod*	*Poor*	*Exotic*	*Not Assessed*	
Wind Farm Study Area								
Brittle Gum Stringybark Woodland			1.8		1.8			3.7
Mountain Gum Silvertop Stringybark Forest					1.0			1.0
Norton's Box Woodland	11.5	9.5	20.3	26.1	37.9			105.4
Riparian Forest - Rough-barked Apple, Blakely's Red Gum and Yellow Box					45.1			45.1
River Oak Woodland					15.7			15.7
White Box / Grey Box Grassy Woodland			5.2	27.7	103.2			136.1
Yellow Box Woodland					3.6			3.6
Native Pasture			167.0	17.6	39.8			224.4
Exotic Pasture						737.7		737.7
Not Assessed							131.2	131.2
Total	**11.5**	**9.5**	**194.4**	**71.4**	**248.2**	**737.7**	**131.2**	**1404.0**
Transmission Line Study Area								
Riparian Forest - Rough-barked Apple and Blakely's Red Gum	12.1	2.0	2.9	9.5				26.5
Riparian Forest - Rough-barked Apple, Blakely's Red Gum and Yellow Box	1.3	2.6			0.4			4.3
Sandstone Forest - Black Cypress Pine dominant			2.9					2.9
Sandstone Forest - Inland Scribbly Gum dominant	7.8	23.7						31.5
Sandstone Forest - Narrow-leaved Ironbark dominant	7.5	27.7	15.3	0.5	0.2			51.1
Sandstone Forest - Red Ironbark dominant	2.8	15.0						17.8
White Box / Grey Box Grassy Woodland				1.8	8.9			10.7
Native Pasture			0.4	106.8	5.1			112.3
Exotic Pasture						14.4		14.4
Not Assessed							87.7	87.7
Total	**31.6**	**71.1**	**21.5**	**118.6**	**14.6**	**14.4**	**87.7**	**359.4**

3.10 Project Implementation

Following development, the establishment of the wind farm can be considered as occurring in four phases. These include construction, operation, refurbishment and/or decommissioning of the wind farm. A description of activities under these headings follows.

3.10.1 Phase 1: Wind Farm Construction

The construction phase of the wind farm is likely to occur over at least a 24-36 month period and would include activities such as:

- transportation of people, materials and equipment to site;
- civil works for access track construction, turbine foundations and trenching for cables;
- establishment, operation and removal at completion of any required construction equipment such as rock breaking equipment and concrete batching plants;
- potential use of blasting in foundation excavation, if required;
- installation of wind turbines using large mobile cranes;
- construction of collection substations, connection to on-site 330kV transmission line, and onsite overhead powerlines and electrical cables;
- construction of additional facilities (temporary and permanent) as required;
- construction, use and removal of temporary offices and facilities;
- temporary storage of plant and equipment; and
- restoration and revegetation of disturbed onsite areas on completion of construction works.

In general, construction would commence with site establishment, construction of access tracks and all other site civil works, including preparation of hardstand areas, and laying of cables. This would be followed by preparation of concrete and steel reinforced foundations, which must be cured prior to installation of wind turbines.

Wind turbine construction and erection can be relatively fast once the foundations are prepared, with wind turbines installed at a rate of approximately 2-3 per week, subject to weather. The towers are erected in sections, the nacelles lifted to the top of the towers, and finally blades lifted and bolted to the hub.

The necessary substation construction and grid connection works would be carried out in parallel.

The commissioning phase would include pre-commissioning checks on all high-voltage equipment prior to connection to the TransGrid transmission network. Once the wind farm electrical connections have been commissioned and energised, each wind turbine is then separately commissioned and placed into service.

On completion of construction, disturbed areas would be remediated and all waste materials removed and disposed of appropriately.

3.10.2 Phase 2: Wind Farm Operation

While the wind farm operates largely unattended, the wind turbines and other equipment would require regular maintenance. It is possible that some equipment may require major repair or replacement. In addition, during the initial operating years, operator attendance may be more regular while wind farm operation is being fine-tuned and optimised.

Once installed, the turbines would operate for an economic life of twenty to thirty years. After this time the turbines may be refurbished to improve their performance or decommissioned and removed from the site.

Routine Maintenance

To ensure the wind farm operates in a safe and reliable manner, it would require regular inspection and maintenance on an ‘as needs’ basis. This would generally be carried out using standard light vehicles.

In addition, regular scheduled maintenance is required, generally at 3, 6 and 12 monthly intervals. As a guide, each turbine requires approximately 7 days of maintenance per year. This does not require the use of major equipment, and could be carried out in a normal utility or small truck and would not require any additional works or infrastructure.

Major Repairs

It is possible that major unexpected or unscheduled equipment failures could take place during the life of the wind farm. While wind turbines and electrical components are designed for a 20 - 30 year life, failures can occur, for example due to lightning strike.

Most repairs can be carried out in a similar manner to routine maintenance, with some exceptions:

Replacement of wind turbine blades, if necessary, would require bringing new blades to the affected turbine and installation of these blades using large cranes. The requirements are similar to the construction phase, and the access tracks established for construction may need to be brought into operation again.

Replacement of wind turbine generators or gearboxes may require a crane and low loader truck to access the wind farm.

Replacement of substation transformers would require a low loader truck to access the site.

Site monitoring program

A post-construction monitoring program would be established to determine any additional impacts resulting from the operation of the wind farm. The Operational Environmental Management Plan would contain specific monitoring programs required and would assess key issues such as noise compliance.

Further details of the monitoring and adaptive management mechanisms are included in Section 17.

3.10.3 Phase 3: Wind Turbine Refurbishment / Replacement

The life of a modern wind turbine is typically 20 - 30 years, at which point individual wind turbines would be refurbished, replaced, overhauled or removed. Individual turbines may also fail at shorter intervals for various reasons as discussed above.

Replacement, refurbishment and recommissioning would involve similar road access arrangements to construction, and would require access for large cranes and transport vehicles to dismantle and remove the existing turbines and to install replacement turbines.

Existing substations and cabling would be largely reused wherever possible. It is also possible that the existing foundations and towers could also be reused, subject to the design of turbines available at the time of replacement / recommissioning. This would allow a significant cost saving for the wind farm.

Any refurbishment or turbine replacement would comply with the requirements of the project approval under this application.

3.10.4 Phase 4: Wind Turbine Decommissioning

Decommissioning the wind farm at the end of its commercial life is the Proponents obligation and at their cost. It would involve reinstating similar road access arrangements to construction, and would require access for large cranes and transport vehicles to dismantle and remove the turbines. All underground foundations and cable trenches would remain in situ and all above ground infrastructure would be removed. The decommissioning period is likely to be significantly shorter and with significantly fewer truck movements than the construction phase.

It should be noted, based on current market data, that the scrap value of turbines and other equipment is expected to be more than sufficient to cover the costs of their dismantling and site restoration.

Agreements with involved landowners ensure that the wind farm operator is responsible for decommissioning of the wind farm including the associated costs and site clean-up.

A Decommissioning and Rehabilitation Plan for the project is attached as Appendix G.

3.10.5 Staging of Works

It is possible that not all turbines, access tracks or other equipment outlined in this EA would be ultimately required for the project. Likewise, market, seasonal, or operational requirements may mean that the actual construction of the wind turbines may occur in stages or groups over a number of years.

The Precinct design concept outlined in Section 3.1 indicates how construction of the site could be broken down into different stages over time. Each construction stage would go through similar processes and a similar timeframe to that outlined above.

3.10.6 Construction hours

In general, construction activities associated with the project that would generate audible noise in excess of the requirements of the NSW Interim Construction Noise Guideline at any residence would be undertaken during the daylights hours of:

Monday – Friday: 7am – 6pm

Saturday: 8am – 1pm

Sunday and public holidays:Not currently proposed

These working hours have been proposed to allow reasonable efficiencies of effort to achieve maximum productivity and to minimise the overall construction duration but should not be restricted to daylight hours. Variations to these hours may be required subject to weather and seasonal impacts.

However, some activities (including delivery to site of major equipment, and turbine installation) may occur outside of these hours due to logistic, safety or weather related reasons.

Turbine crane lifts, for example, can only be carried out during periods of lower wind speeds because of operational limitations with the tall cranes and it is possible that out of hours work would be required for this purpose. This scenario has occurred at other wind farms (for example Cape Bridgewater, Victoria) where night crane operations have been required because of strong winds occurring during the day.

Likewise, the requirements of NSW Police or roads authorities may limit transport of major equipment to and from the site to outside of normal working hours.

Any construction activities outside of the standard construction hours will only be undertaken in the following circumstances;

- Construction activities that generate noise that is:
  - no more than 5dB(A) above rating background level at any residence in accordance with the ICNG (Table 2 of the ICNG); and
  - no more than the noise management levels specified in Table 3 of the ICNG at other sensitive receivers; or
- for the delivery of material required outside those hours by the NSW police Force or other authorities for safety reasons (section 10.11.2); or
- where it is required in an emergency to avoid the loss of life, property and/or to prevent environmental harm;
- works as approved through the out-of-hours work protocol outlined in the Construction Noise and Vibration Management Plan as part of the Construction Environmental Management Plan.

3.11 Crown land

The proposed Liverpool Range Wind Farm has no turbines and associated blades that impact on any Crown Land which includes Crown Parcels, Crown Roads and Crown Waterways. Permanent and temporary facilities including O&M building, construction compound, substation and concrete batching plant also do not impact on any Crown Land. Each individual infrastructure item is documented relative to its potential impact on the type of Crown Land, shown in Table 3-6 to Table 3-8.

A survey of all infrastructures relative to the cadastre will be carried out prior to construction to accurately confirm there are no turbines and associated blades encroaching on Crown Waterways, Parcels and Roads.

In some instances access tracks, underground cabling cross or overhead powerline crosses Crown Parcel. Table 3-6 represents the number of instances where infrastructures cross a Crown Parcel.

In some instances access tracks, underground cabling cross or overhead powerline crosses Crown Parcel. Table 3-7 represents the number of instances where infrastructures cross a Crown Parcel.

In some instances access tracks, underground cabling and overhead powerline's cross Crown Waterways. Only two Crown Waterways are crossed, however there are multiple instances of this as summarised in Table 3-8.

Consultation has occurred with the NSW Trade and Investment, Crown Land division and it has been advised that during detailed design prior to construction all impacts on Crown land will be further investigated and the appropriate approvals sought. At that time the proposal will be fully investigated and if unobjectionable, the most appropriate form of tenure negotiated. Any use or occupation of Crown land will be authorised by NSW Trade and Investment before any use or occupation occurs.

Table 3-6 Infrastructure relative to Crown Parcel

Infrastructure	Parcels crossed
Turbines and blade	0
Facilities - O&M building, construction compound, substation, concrete batching plant	0
Access tracks	15
Underground cabling	1
Overhead powerline	21[1]

Table 3-7 Infrastructure relative to Crown Road

Infrastructure	Roads crossed
Turbines and blade	0
Facilities - O&M building, construction compound, substation, concrete batching plant	0
Access tracks	103
Underground cabling	62
Overhead powerline	45[2]

Table 3-8 Infrastructure relative to Crown Waterways

Infrastructure	Waterways crossed
Turbines and blade	0
Facilities - O&M building, construction compound, substation, concrete batching plant	0
Access tracks	6
Underground cabling	0
Overhead powerline	11[3]

[1] Overhead powerline has 3 route options: Preferred, Alternate and Second Alternate. Where an alternate is built the preferred route that it replaces will not be. The number of Crown Parcels crossed by the preferred line is 9 instances, Alternate is 9 instances and the Second Alternate is 4 instances.

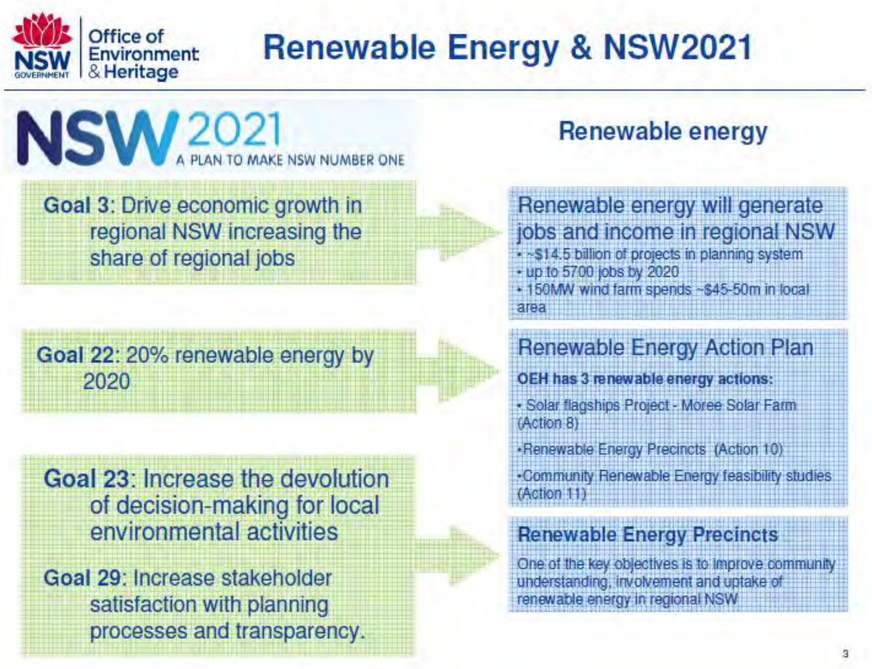
[2] Overhead powerline has 3 route options: Preferred, Alternate and Second Alternate. Where an alternate is built the preferred route that it replaces will not be. The number of Crown Roads crossed by the preferred line is 25 instances, Alternate is 13 instances and the Second Alternate is 7 instances.

[3] Overhead powerline has 3 route options: Preferred, Alternate and Second Alternate. Where an alternate is built the preferred route that it replaces will not be. The number of Crown Waterways crossed by the preferred line is 8 instances and Alternate is 3 instances.

4 Strategic Justification

This section provides a justification for the project in the context of its local and regional setting. It provides a summary of the energy context and in particular the need for additional electricity supply in NSW. It also outlines the benefits of the project including reducing Australia's greenhouse gas emissions, supporting Federal and State renewable energy targets as well as other local and wider community benefits.

The NSW State Plan has created specific goals underlining the States commitment to achieving 20% renewable energy by 2020 and driving economic growth in regional NSW. The Minister for Energy recently released the draft NSW Renewable Energy Action Plan which states that NSW is open for business in renewable energy and is keen to capture the jobs and investment that comes with it. Below is an outline of the NSW government's plans to assist the development of renewable energy in NSW.



The justification for the Liverpool Range Wind Farm development is based on the following forecasts:

- In full operation, it would generate more than 2,725 GWh of electricity per year - sufficient for the average consumption of around 340,600 homes.
- It would improve the security of electricity supply through diversification of generation locations.
- It would reduce greenhouse gas emissions by approximately 2,634,800 tonnes of carbon dioxide equivalent (CO_2e) per annum[4] or the equivalent of 717,000 cars removed from the roads
- It would contribute to the State and Federal Governments' target of providing 20% of consumed energy from renewable sources by 2020.
- It would contribute to the NSW Government's target of reducing greenhouse gas emissions by 60% by the year 2050.
- It would create local employment opportunities and inject funds of up to $1,272 million into the Australian economy.
- In addition to these primary benefits there are also secondary benefits and opportunities for improvements in infrastructure, tourism and ecology.

[4] Calculated using the NSW Wind Farm Greenhouse Gas Savings Tool developed by DECCW

4.1 Meeting Our Growing Electricity Demand

Electricity consumption continues to grow, and the additional demand must be met by either increased fossil fuel generation or an increase in generation from renewable sources such as wind power.

TransGrid's Annual Planning Report (2012) and AEMO's Annual Electricity Statement of Opportunities (2012) confirms that future electricity demand, although not as high as previously predicted, continues to rise. AEMO's latest annual energy projection for the National Electricity Market (NEM) predicts average annual growth of 1.7%, while NSW is expected to increase annually at an average of 1.2%.

Meeting this demand will require our existing electricity generators to increase their annual output, however at some point additional power generators will be also be required. AEMO has estimated that additional power generating capacity will be required to manage peak periods in NSW by summer 2021/22. Options need to be developed to meet this expected demand growth to ensure reliability of supply and evade power outages and blackouts (TransGrid, 2012). This is detailed in AEMO's Annual Electricity Statement of Opportunities report, as illustrated in Figure 4-1.

Figure 4-1 AEMO NSW Summer Generation Capacity Outlook (AEMO, 2010)

4.1.1 Quantifying the Electricity Generation from this Project

Electricity production from wind farms is variable. At any point in time a wind farm could be generating anywhere in the range of 0 to 100% of its power output, depending on the local wind speeds.

However, in the same way that the weather can be predicted hours to weeks in advance, the likely wind farm power output at any point in time can also be predicted with reasonable accuracy. In its role as electricity market operator, AEMO has established a Wind Energy Forecasting System to help it understand the likely wind farm production from minutes to days in advance. This system enables AEMO to reliably operate the electricity market taking into consideration the variability of all components including the constantly changing load, availability of and loading on transmission lines, plant outages at major power stations, and the changing output of wind farms.

In that context, while the output of wind farms is variable, it is also predictable and dependable.

The Liverpool Range Wind Farm represents a large sized wind farm with an installed capacity likely to be approximately 864 MW (based on 288 wind turbines with a capacity of 3.0 MW).

Epuron has carried out significant wind monitoring on the site to confirm the expected long term wind regime. Based on Epuron's analysis of wind speeds at the site, the project is expected to produce in the order of 2,725 GWh of electricity per year over its operating life.

The energy produced from the wind farm would be 100% renewable energy and would be fed directly into the electricity grid and sold on the National Electricity Market (NEM).

4.2 Reducing Greenhouse Gas Emissions

4.2.1 Context

There is scientific evidence that the earth's climate is changing. Observations have shown global increases in air and ocean temperatures, the widespread melting of snow and ice and rising sea levels (IPCC, 2008). It has further been observed that many of the world's natural systems are already being affected by the change of regional climates, in particular temperature increases (IPCC, 2008). Other indicators include altered rainfall patterns and more frequent or intense weather patterns such as heatwaves, drought, and storms. In Australia, this change in the climate is anticipated to have an impact on water supply and quality, ecosystems and conservation, agriculture and forestry, fisheries, settlements and industry and human health.

The drivers for climate change have been identified as being from both natural and anthropogenic forces, however a main contributor is the release of greenhouse gases GHG into the atmosphere (IPCC, 2008).

The Intergovernmental Panel for Climate Change (IPCC) has acknowledged that it is very likely that human greenhouse gas emissions have directly influenced global temperatures to increase, as well as lead to other climate impacts. As greenhouse gas emissions stay in the atmosphere for decades, a predicted warming of 0.2°C or higher per decade is already expected regardless of future emission levels. However, if greenhouse gas emissions continue to be emitted at their current rate then further and more extreme changes to the global climate system will be experienced. Therefore, a reduction in greenhouse gas emissions could assist in reducing the rate and magnitude of climate change. The IPCC recognises that mitigation efforts over the next 20-30 years will be crucial to stabilising the amount of change (IPCC, 2008).

Referring to the Australian context, Department of Climate Change and Department of Sustainability, Environment, Water, Population and Communities reports show that greenhouse gas emissions from the stationary energy sector, is the largest and fastest growing area in terms of greenhouse gas emissions in Australia. The stationary energy sector accounted for 52% of total emissions in 2009 and within this sector, emissions from electricity generation contributed over 70%. Furthermore, stationary energy emissions between 1990 and 2009 energy have increased by 51% (DSEWPC, 2011).

In regards to NSW, the vast majority of Greenhouse Gas Emissions in 2007 were from the stationary energy sector, emitting 61 Mt CO_2-e. During this year, the generation of electricity accounted for over 37% of all emissions in NSW. Between 1990 and 2007 emissions from stationary energy grew by 33% to a total amount of 79 Mt CO_2-e (OEH, 2009).

4.2.2 Options to Reduce our Emissions

The IPCC has identified key technologies and practices for the energy sector that are currently commercially available which could be used to mitigate the effects of Greenhouse Gas emissions. They include:

- improved supply and distribution efficiency (transmission and distribution of electricity);
- fuel switching from coal to gas;
- utilisation of nuclear power;
- utilisation of renewable heat and power (hydropower, solar, wind, geothermal and bioenergy);
- utilisation of combined heat and power technologies; and,
- early applications of carbon dioxide capture and storage (e.g. storage of removed CO_2 from natural gas).

In addition the IPCC has also identified policies, measures and instruments shown to be environmentally effective. These include:

- reduction of fossil fuel subsidies;
- an increase of taxes or carbon charges on fossil fuels;

- feed-in tariffs for renewable energy technologies;
- renewable energy obligations; and
- renewable energy producer subsidies.

In 2006 the NSW Government committed to reduce greenhouse gas emissions by 60% by 2050 (DECCW, 2009). In considering this level of reduction to the power generation sector in NSW, we should note:

- By 2050 electricity consumption is expected to more than double compared to 2006 (DPMC, 2006).
- Achieving a 60% reduction in emissions, whilst doubling our electricity use, requires an >70% reduction in greenhouse gas emissions per unit of electricity generated.
- Even if our entire fossil fuel power generation fleet was converted to natural gas, this would not even halve our existing level of emissions, and do nothing to address growth.
- Accordingly, to achieve this target, as a minimum all of our electricity growth over the next 40 years must be met with zero emission power sources.
- Wind energy is currently the most economic zero emission power source.

4.2.3 Contributions to reducing greenhouse gas emissions

During its operational phase, the Liverpool Range Wind Farm would generate electricity without producing greenhouse gas emissions. In addition the wind farm would be displacing electricity produced by fossil fuel sources (coal and gas), and hence, would reduce the overall amount of GHG emissions produced by the stationary energy sector (electricity generation).

To estimate the potential GHG emissions savings that large scale wind farm developments would have in NSW, DECCW commissioned McLennan Magasanik Associates (MMA) to conduct a study and subsequently developed a tool to calculate the expected savings from the wind farm based on its size and location. This tool can be accessed via the DECCW website at http://www.environment.nsw.gov.au/climatechange/greenhousegassavingstool.htm.

The results of the study as they relate to this project showed the following:

- In NSW wind farms would initially almost exclusively displace fossil fuel generation from coal and, to a lesser extent, gas.
- The savings from a wind farm the size of Liverpool Range in the South Western Slopes would initially reduce GHG emissions by 2,634,800 t CO_2e per annum.
- If CPRS was introduced in 2015 the overall emissions in the NSW energy sector would be reduced as a result of gas generation replacing coal, therefore reducing the GHG emissions savings directly related to wind generation.
- The impact on the management of the network due to the variability of wind would be negligible and the emissions savings would greatly outweigh any such impact.

Figure 4-2 presents the results from the study, showing the estimated GHG emissions savings for three different scenarios; a single wind farm of 150 MW, 500 MW representing future developments in each region, and 3,000 MW representing the total capacity estimated for wind development in NSW (DECCW, 2010d).

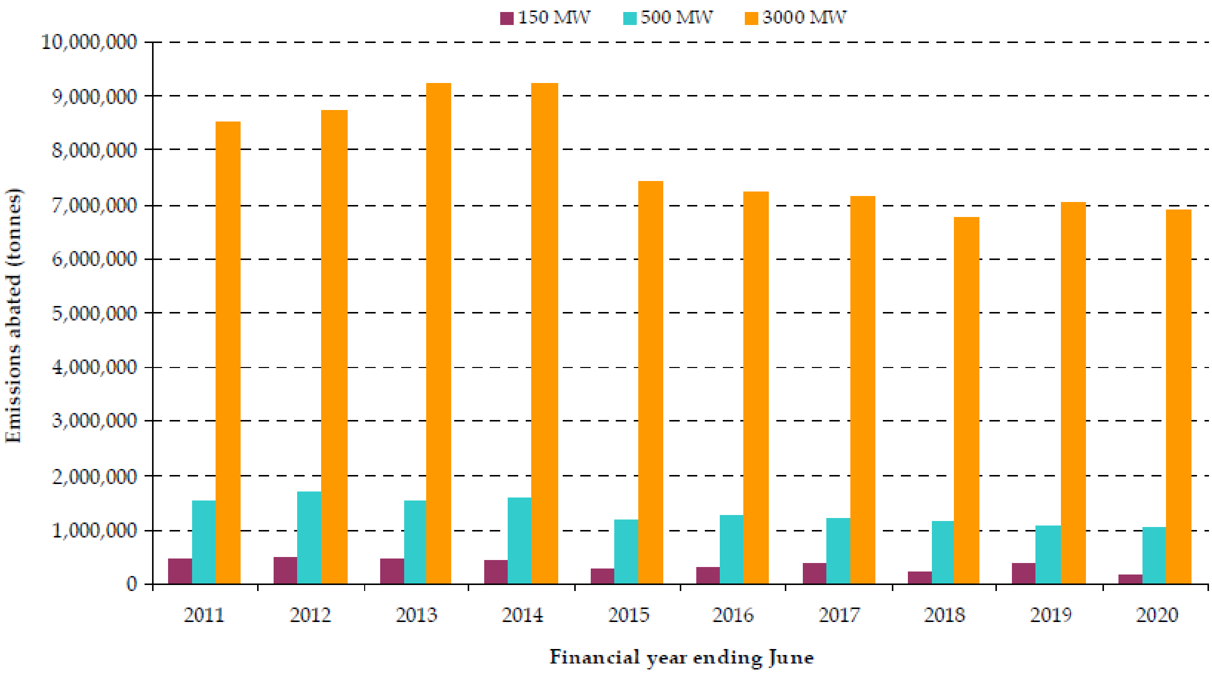


Figure 4-2 Estimated GHG emissions savings for three different scenarios

Since the MMA study the Carbon Tax has been introduced by the Federal Government and the 2015 CPRS scenario is no longer foreshadowed but an Emissions Trading Scheme (ETS) is scheduled to commence instead.

The greenhouse gas contributing the most to climate change is CO_2. Between 1970 and 2004 the amount of CO_2 being emitted from human-based activities increased by 80% and the current level of CO_2 in the atmosphere is now higher than ever measured (IPCC, 2008). This large increase is predominantly due to the burning of fossil fuels, such as coal, gas and oil. Between 1990 and 2007 emissions from stationary energy grew by 33% to a total amount of 79 $MtCO_2$-e (OEH, 2009).

An indicator used to determine the amount of greenhouse gases emitted per MWh of electricity supplied to the NSW grid in a particular year is the NSW Annual Pool Value (GGAS, 2011). Table 4-1 shows that the Annual Pool Value is calculated by dividing the total energy supplied to the NSW grid by the total NSW emissions in that year.

To account for one-off highs or lows that may be experienced in a particular year the Pool Coefficient is determined. This value is calculated by averaging the five Annual Pool Values from previous years, with a lag of two years (GGAS, 2010). So the NSW Pool Coefficient for 2011 is the average of the Annual Pool Values from 2003 to 2009.

Table 4-1 NSW Annual Pool Values and Pool Coefficients (2003-2009)

Year	Total NSW emissions (tCO_2-e)	Total NSW sent out generation (MWh)	Annual pool value tCO_2-e /MWh	Pool coefficient tCO_2-e /MWh
2003	63,431,793	66,800,866	0.950	0.897
2004	65,979,036	67,276,401	0.981	0.906
2005	65,896,606	69,341,455	0.950	0.913
2006	70,010,515	72,222,646	0.969	0.929
2007	69,810,669	71,015,242	0.983	0.941
2008	71,394,801	72,646,917	0.983	0.954
2009	68,585,696	69,450,575	0.988	0.967
2010	66,242,294	69,051,955	0.959	0.973
2011	TBA	TBA	TBA	0.975

Source: GGAS, 2011

Source: GGAS, 2012

Figure 4-3 Historical NSW Pool Value and Pool Coefficient (2000-2010)

The 2012 Pool Coefficient value indicates that presently for every MWh of electricity supplied to the NSW electricity pool, 975 kg of greenhouse gases are emitted. At this point in time, approximately 90% of electricity in NSW is generated by fossil fuel power stations, primarily coal fired. Therefore it can be assumed that for every megawatt-hour of electricity generated at a coal power station 975 kg of greenhouse gases are emitted.

The Annual Pool Value is calculated using the total sent out electricity from all technologies, including that from renewable energy. It is expected that the more electricity supplied to the pool from renewable sources, reducing the amount required from coal power stations, the lower the Annual Pool Value and the lower the Pool Coefficient.

The Liverpool Range Wind Farm will generate 2,725 GWh per annum and on this basis, would result in a reduction in greenhouse gas emissions of approximately 2,634,800 tonnes of $C0_2$.

4.3 The Role of Renewable Energy

4.3.1 Federal Renewable Energy Target

The Australian Government’s Mandatory Renewable Energy Target (MRET) scheme was established in 2001 to expand the renewable energy market and increase the amount being utilised in Australia's electricity supply. The MRET advocated that an additional 2%, or 9,500 GWh, of renewable energy was to be sourced by 2010 (DCC, 2009).

In 2007, the NSW State Government introduced new legislation called the Renewable Energy (NSW) Bill as part of their Greenhouse Policy to encourage additional generation of renewable energy. The NSW Renewable Energy Target (NRET) required 10% of electricity to be sourced from renewable energy by 2010 and 15% by 2020 (DEUS, 2006). This Bill was overtaken by the introduction of legislation at the Federal level and therefore not legislated.

In August 2009 the Federal Government introduced a revised renewable energy scheme. The Renewable Energy Target (RET) is an expansion of the MRET and required an additional 45,000 GWh of electricity (approximately 20% of Australia’s total electricity supply) to be sourced from renewable projects by 2020 (DCC, 2009). This requires an additional 8,000 - 10,000 MW of new renewable energy generators to be built across Australia in the next decade.

In February 2010 the Federal Government amended the RET scheme by dividing the renewable sources into two categories, the small-scale renewable energy generators (SRET) and large scale renewable energy generators (LRET). The purpose of this move was to ensure continued ongoing investment in large scale renewable energy projects (i.e. those projects greater than 30 MW).

In 2012 the current RET was reviewed by the Climate Change Authority. The outcome of the RET Review Discussion Paper was that existing LRET target should not be changed, and that the benefits of any change at this time (either an increase or decrease) would be outweighed by the costs of increased regulatory uncertainty. The final report is expected in December 2012 (GGAS, 2011).

The LRET provides large-scale renewable energy generators with an ongoing source of revenue in addition to electricity sales through the NEM, through the creation and sale of Large-scale Generation Certificates (LGCs). Prior to 2011, these certificates were called Renewable Energy Certificates (RECs) and could be created by large-scale and small-scale renewable energy generators. Figure 4-4 below shows the REC and LGC contributions to the LRET.

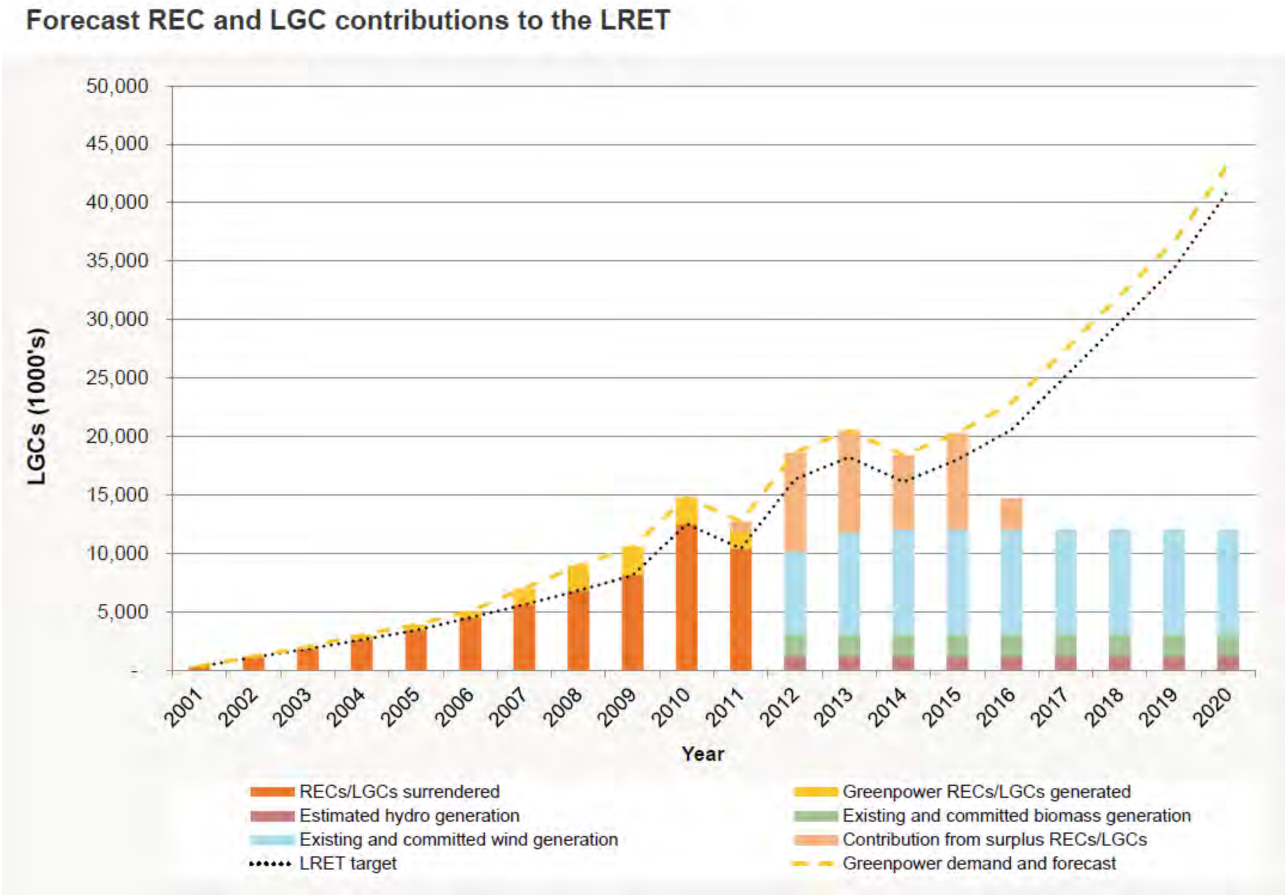


Figure 4-4 Forecast REC and LGC contributions to the LRET (AEMO, 2012)

AEMO estimates that enough RECs and LGCs have been created, or are likely to be created from existing generators, to satisfy the LRET until 2015. Given the scale of the deficit from 2016 onwards, however, this analysis suggests there is still a strong driver for additional investment in large-scale renewable energy technologies under the LRET.

Figure 4-5 shown below is a table sourced from the AEMO 2012 Electricity Statement of Opportunities which states the deficit of LGCs towards the LRET from 2016 onwards. For example, in 2019 24,600 GWh worth of extra LGCs will be required, which is approximately 8500 MW of wind generation capacity.

Forecast LGC deficit

Year	2016	2017	2018	2019	2020 to 2030
Forecast LGC deficit (GWh, non-cumulative)	8,200	15,400	20,000	24,600	31,200
Equivalent wind generation capacity required to supply LGC deficit (cumulative, based on South Australian output) (MW)	2,800	5,300	6,900	8,500	10,800

Figure 4-5 Forecast LGC deficit (AEMO, 2012)

Epuron estimates that around one third of the renewable energy generation required to meet the Mandatory Renewable Energy Target will need to be built in NSW, and predominantly be supplied by wind generation.

The Liverpool Range Wind Farm would have a generation capacity of 864 MW and would contribute directly to the LRET.