



## **FINAL REPORT**

### **PROPOSED NEW LARGE NETWORK ASSET INVESTMENT**

# **AUGMENTATION of ELECTRICITY SUPPLY to the QUIRINDI AREA of NSW**

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# **1 PROJECT CONSULTATION & SUBMISSIONS**

## **1.1 INVITATION FOR CONSULTED PARTY SUBMISSIONS**

The publication of this final report is the third and final stage of the consultation process being undertaken by Essential Energy in respect of the requirement to correct network constraints identified in relation to electricity supply to the Quirindi area of New South Wales.

It provides information on submissions received against the initial Consultation Notice and subsequent Project Draft Report stage and presents the conclusions reached by Essential Energy in respect of these and the recommended project outcome.

Essential Energy owns the subtransmission and distribution network in the Quirindi area of NSW and is responsible for planning and developing its network to meet the requirements of customers within its region.

A constraint has been identified on the Essential Energy network supplying the Quirindi area. Essential Energy is required to address the constraint in order to comply with licence conditions and service standards as outlined in Section 2.3.1.

Essential Energy has considered the workable options available to address the identified constraint and assessed the economic cost effectiveness of these options in terms of satisfying the regulatory test. Information in respect of these options together with the economic cost assessment was presented in the project Consultation Information Report published in conjunction with the project Consultation Notice, and in the subsequent Project Draft Report.

This information is re-presented in this Project Final Report to support the understanding of the identified network constraint and the conclusions reached in respect of the recommended outcome.

The Project Final Report also provides information on the existing network, recorded and forecast load demands and the identified network limitation which are relevant to defining and assessing the workable options available to correct the limitation.

The information provided is indicated in the Contents Page (page 2 of this document).

## **1.2 PROJECT CONSULTATION SUBMISSIONS, ISSUES AND CONCLUSIONS**

Essential Energy received one response to the project Consultation Notice, primarily suggesting the use of battery storage to reduce the peak load below the nominated 15MVA N-1 security of supply limit to avoid the N-1 network supply need.

Essential Energy provided an explanation of the N-1 licence compliance, one minute security of supply requirements as indicated in Section 2.3.1 below. No written submission was subsequently received prior to the conclusion of the initial consultation period.

As such, there are no material issues in respect of submissions made to be assessed for further response by Essential Energy in addition to the comments and conclusions included in the Draft Report.

## 2 BACKGROUND

### 2.1 SUPPLY TO THE AREA

The Liverpool Plains Shire Council is south of Tamworth with an area of 5,000 sq km and a population of 8,000. The Liverpool Plains contain highly productive farming land and hence is a rich agricultural area which produces much of Australia's wheat, corn, and canola, and has considerable cattle and sheep farming. In recent years the region has become the focus for a burgeoning coal mining industry, with two new mines proposed in the areas north of Carroona. The Liverpool Plains area stretches from Currabubula just south of Tamworth to Murrindindi in the east and Colly Blue in the west.

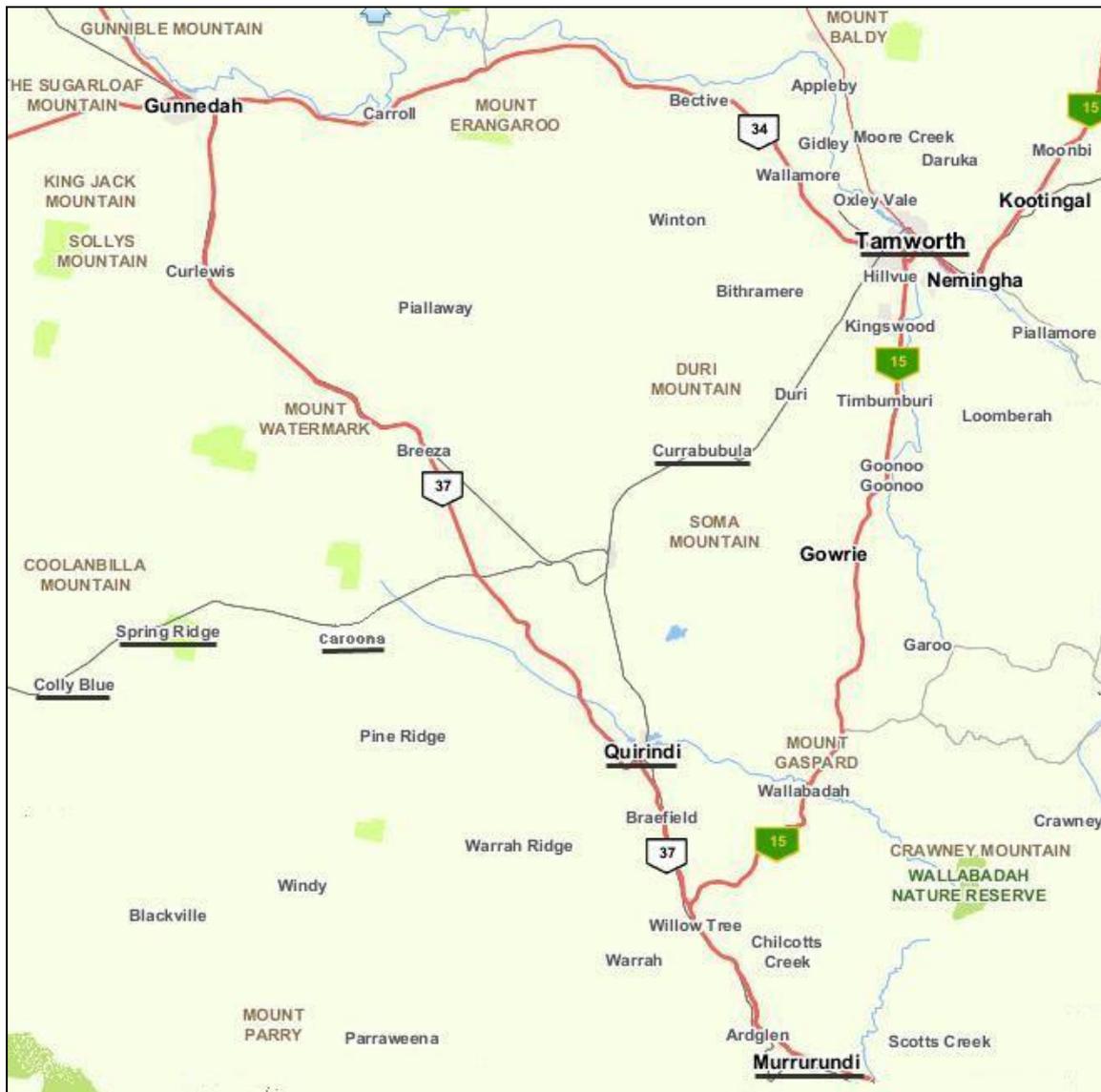


Figure 1 – Location map of the investigation area

Quirindi is the hub of the Liverpool Plains Shire Council, located a short distance off the New England Highway, 350 km north of Sydney and 60 km south of Tamworth. Werris Creek, north of Quirindi is a key railway town that links the main north rail line from Sydney to the northern rail line to Tamworth/Armidale and north western rail line to Gunnedah/Moree.

The area is supplied by a radial 66kV powerline (#813, 57km) that emanates from TransGrid's Tamworth 132/66kV bulk supply point substation and supplies three zone substations at Currabubula, Quirindi and Werris Creek as shown below in Figure 2. Two radial 33kV powerlines (#798 31km, #799 58km) from Quirindi zone substation supply a further four zone substations at Caroona, Colly Blue, Murrurundi and Spring Ridge and a private substation at Ardglen (Road and Maritime Services).

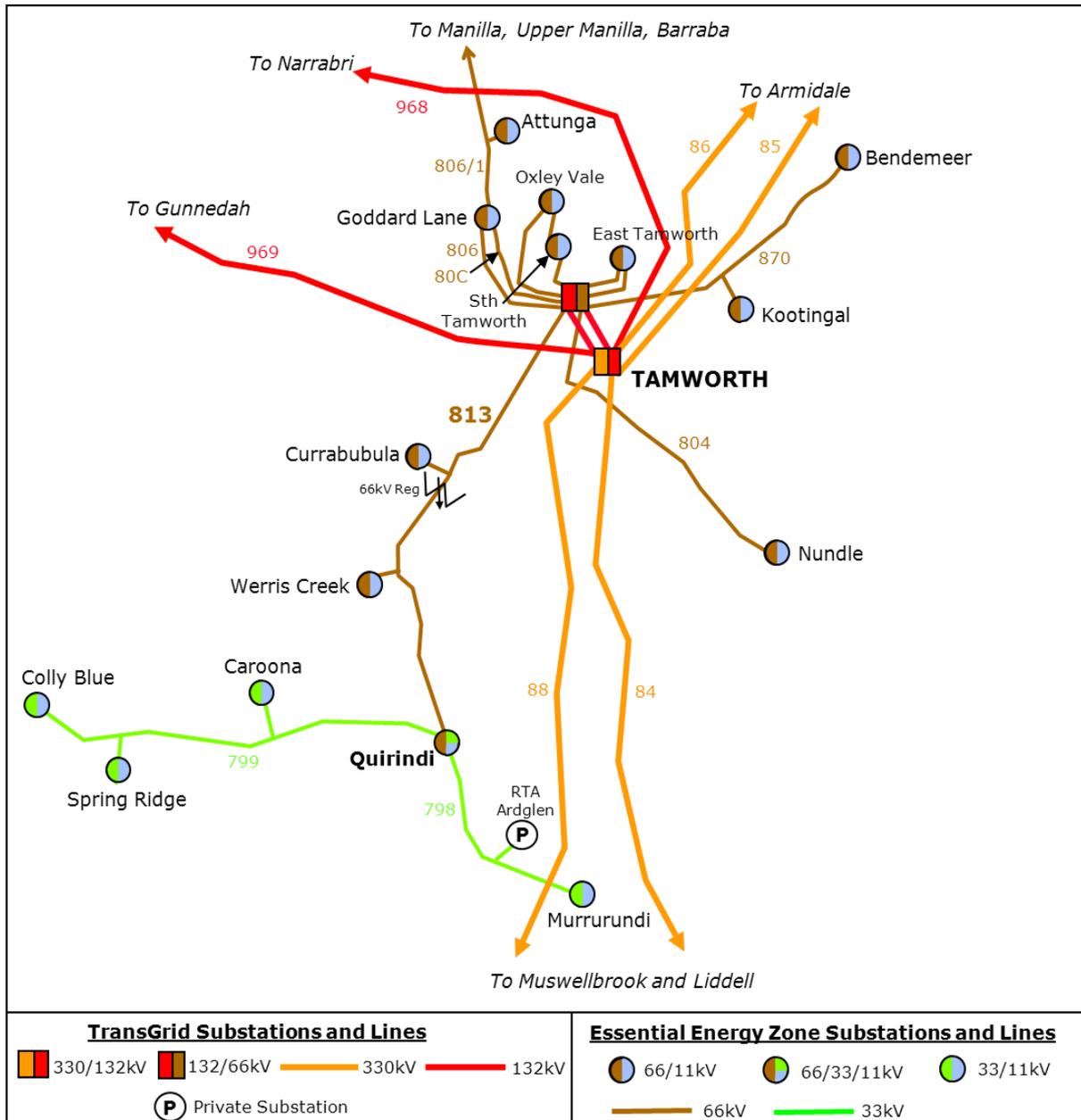


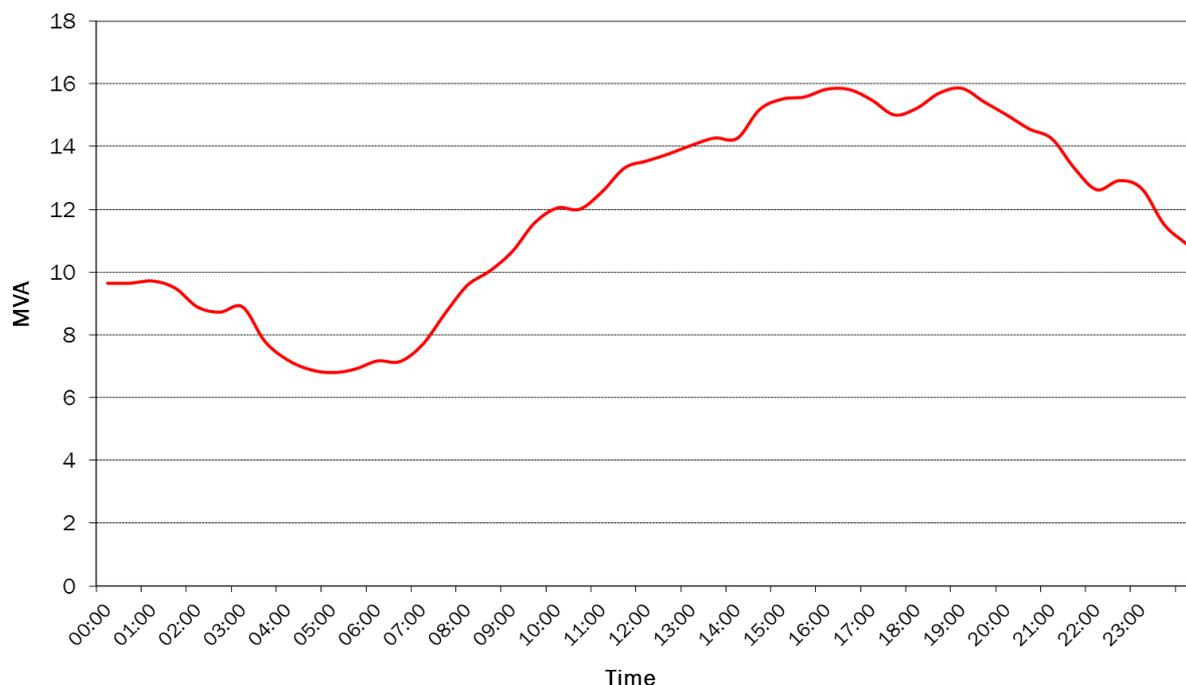
Figure 2 – Existing Quirindi area subtransmission network

## 2.2 NETWORK DEMAND

The load in the Liverpool Plains area is mainly residential and commercial/industrial in the larger townships of Quirindi and Murrurundi and rural/agricultural in the surrounding rural areas and small towns of Caroona, Colly Blue, Currabubula and Werris Creek.

Demand information for the load is available from a combination of time based statistical meters, substation scada, and zone substation reclosers. The area is summer peaking, as high daytime ambient temperatures increase the demand for air-conditioning and cooling type loads.

Summer peaks are more onerous as they occur when the thermal ratings of subtransmission equipment are at their lowest point and the peaks are longer in duration. Figure 3 below shows the profile on the #813 66kV powerline for a typical peak summer day.



**Figure 3 – #813 66kV powerline summer day MVA profile**

Forecast demand on the Tamworth to Quirindi #813 66kV powerline is based on trends of historical demands at each of the zone substations. The forecast has been revised to include load information recorded since publication of the Draft Project Report.

Summer load growth on the #813 66kV powerline is forecast to be 0.5% per annum (pa), based on trends of historical peak demands. The peak demand is influenced by a number of variables including ambient temperature, economic conditions, spot loads, price elasticity and responses to incentives such as the solar bonus scheme to install embedded generation.

Future peak demands in this region could be significantly affected by the development of coal mining in the area to the north west of Quirindi between Gunnedah and Caroonna where there are several active coal exploration licences.

In addition to the site specific spot loads, new mine developments would result in increased electricity demand from associated residential, commercial and light industrial load growth, in the surrounding towns, particularly Quirindi and Werris Creek.

Although the peak demand may reduce from one year to another it is expected over time the demand on this network will increase. The historical and forecast summer peak demand on the #813 66kV powerline is shown below in Figure 4, with the latest projections shown as solid lines and the previous forecast as dashed lines, in Figure 4 below.

In common with other similar regional areas the forecast indicates a reduction in present and projected network maximum demands with this being generally ascribed to the installation of small scale solar embedded generation (summer peaks), increases in the price of electricity and economic conditions.

As shown in Figure 4, the total summer peak demand on the #813 powerline (ex Tamworth) is forecast to remain above 15MVA with the 'start' (2013/14) level on the total forecast reduced by approximately 1MVA and the average growth rate decreased from 1.0% pa to 0.5% pa. The forecast demand on the Werris Creek to Quirindi line section (shown as blue lines in Figure 4), with the revised 'start' level being approximately 2MVA less and the average growth rate reduced from 1.0% pa to 0.3% pa.

These updated changes to the forecasts have necessitated a revision of augmentation timings in analyses of the network options, in particular, Option 1 which is a staged augmentation.

Mining development is expected to result in further load growth in the local area with the existing coal mine increasing production and a mine accommodation camp about to be established at Werris Creek (both to be supplied from the Werris Creek zone substation) and enquires received for the provision of supply to other projects. Essential Energy is also currently progressing an enquiry received since the publication of the Draft Project Report for the connection of a large spot load in the Caroona area.

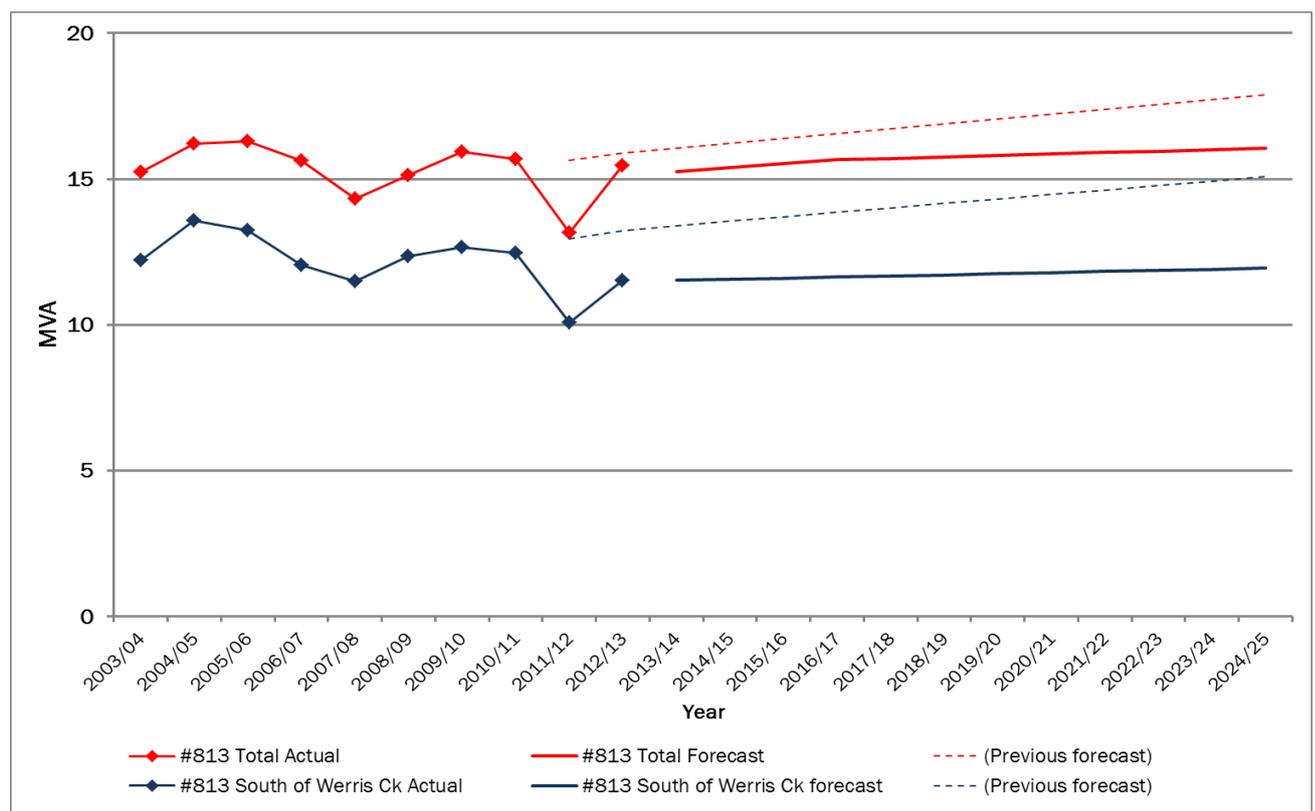


Figure 4 – Historical and forecast summer peak demand (MVA) on #813 powerline

## **2.3 NETWORK LIMITATIONS**

### **2.3.1 Service Standards**

Essential Energy's Network Planning Standards are underpinned by mandatory licence conditions for Distribution Network Service Providers (DNSP's) which, inter alia, set out reliability standards for subtransmission and distribution networks. The licence conditions for Essential Energy specify N-1, one minute reliability levels for subtransmission supply to loads equal to or greater than 15 MVA.

This condition in effect requires duplicate primary supply capability to enable supply to be either maintained or restored to the full load within one minute following the occurrence of any single credible contingency event at any time. The licence condition recognises that loads which have reached a maximum demand of 15MVA are sufficiently large to warrant full alternate supply. Reducing the load to below the nominated 15MVA limit is not an acceptable action.

Where a limited capacity alternate supply exists and subject to meeting various network operation and power quality requirements, it is acceptable to top up the shortfall in secure supply capacity for the risk period.

### **2.3.2 System Limitations**

The Essential Energy network supplying the Quirindi area of NSW is subject to an N-1 security of supply constraint which requires consideration as outlined below.

The existing Tamworth to Quirindi supply is provided by a single (radial) 66kV line with a present load in excess of 15MVA which is expected to increase further over time. Essential Energy is required to provide a full capacity alternate supply to comply with its distribution licence conditions.

## **3 OPTIONS ANALYSIS**

### **3.1 NETWORK OPTIONS**

Essential Energy has sought to identify a range of technically feasible network and non-network options that could satisfy the network requirements. When developing options to overcome actual or potential network constraints, Essential Energy initially assesses possible options against the requirements and then applies the regulatory test to those which satisfy them.

The network solution to provide the needed N-1 security of supply to the Quirindi area loads presently serviced by the #813 66kV feeder requires the construction of a second supply circuit. Options to achieve this are described in more detail below.

Under the National Electricity Rules, Essential Energy is required to undertake joint planning with Transmission Service Network Providers (TransGrid) and interested parties (large load/generator proponents, etc.) to ensure that Essential Energy's subtransmission network is planned and augmented in a manner that is beneficial to all concerned parties.

Under this obligation, and as a result of joint discussions with the large spot load proponent and following preliminary route investigations, Essential Energy has identified that a possible connection scenario for the proposed large spot load maybe via a new powerline from Tamworth to Caroon via Werris Creek. This new powerline would need to be constructed and operated at 132kV to provide the necessary supply capacity.

Consequently in each option, the section of powerline from Tamworth to Werris Creek, has a cost allowance for possible construction with 132kV insulation. It is noted however, that this allowance has no material impact on the Present Value of Cost ranking and sensitivity analysis of the options, as it is common to both options.

The project components and costs included in Appendix A and the Regulatory Test comparisons in Section 4 have also been updated from those in the previous consultation reports.

### **3.2 OPTION 1 – STAGED 66KV DUPLICATION (CONSTRUCT A SECOND TAMWORTH TO WERRIS CREEK THEN WERRIS CREEK TO QUIRINDI 66KV POWERLINE)**

This option involves the initial construction of a second 66kV powerline (43km) between the TransGrid Tamworth 132/66kV bulk supply point substation and the Essential Energy Werris Creek 66/11kV zone substation. A new easement would be acquired which would be in proximity to the existing powerline. The new 66kV powerline would be built on the new easement (possibly with 132kV insulation). See Figure 5 below (Stage 1).

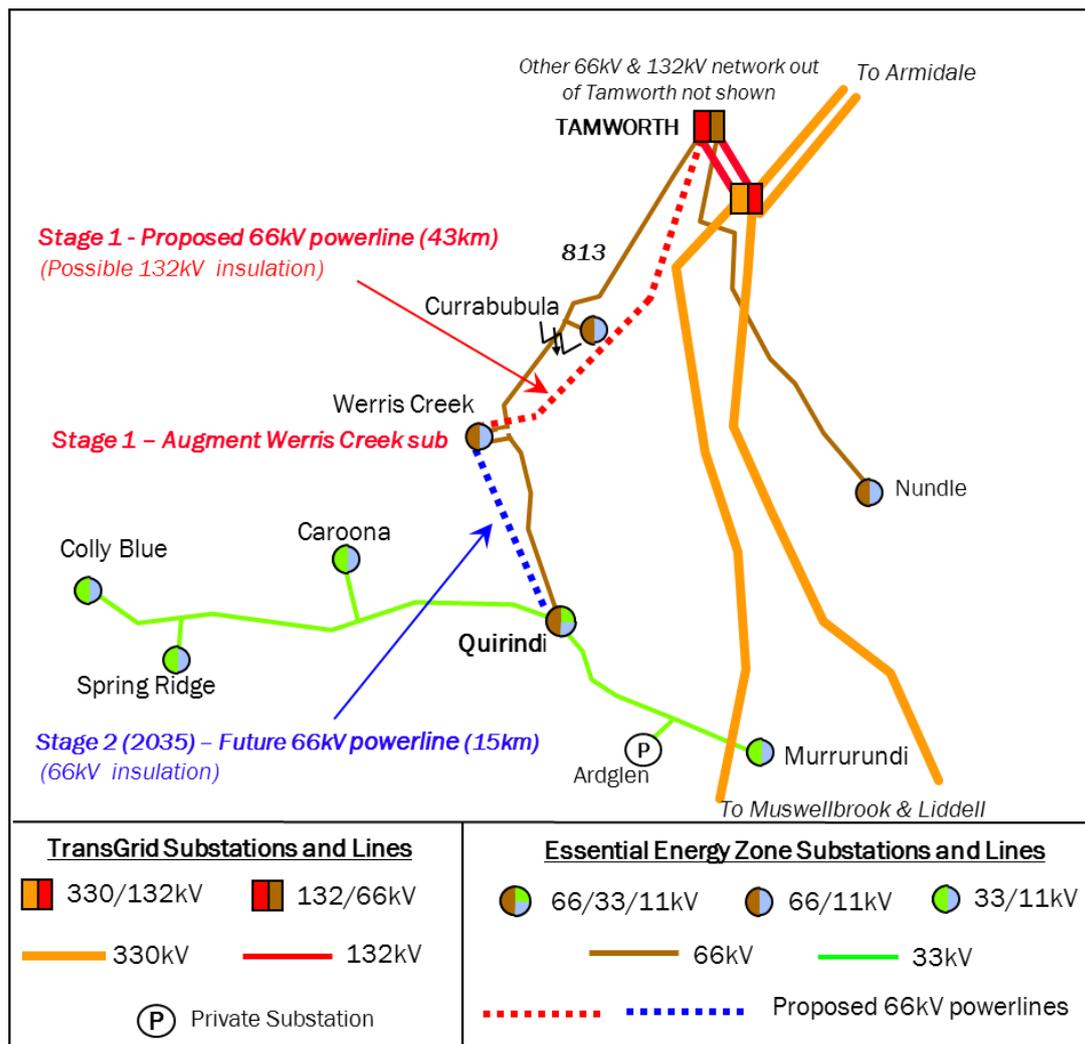
The existing Werris Creek 66/11kV zone substation has a tee connection to the #813 66kV powerline with only one 66kV circuit breaker and two 66/11kV transformers. To cater for a new 66kV powerline from Tamworth, the substation would be augmented with installation of a 66kV busbar and circuit breakers to allow a ring feed supply with the connection of the new powerline and restoration of supply within one minute on loss of either it or the existing 66kV powerline from Tamworth.

Construction of the new 66kV powerline from Tamworth to Werris Creek zone substation would be Stage 1 of a two stage project to provide the needed N-1 security of supply. It would relieve the existing N-1 security of constraint on the #813 66kV powerline for the section between Tamworth and Werris Creek.

Stage 2 would be the construction of a second 66kV powerline (66kV insulation, 15km) between Essential Energy's Werris Creek and Quirindi zone substations together with a new 66kV powerline circuit breaker at the Quirindi zone substation. This would be required once the peak demand on this section of the #813 powerline reaches 15MVA. See Figure 5 (Stage 2).

In the previous Consultation Reports, the Stage 2 works were required around 2020/21 based on forecast of peak demand in the section between Werris Creek and Quirindi.

Under the latest revised load forecasts of peak demand, 15MVA in the Werris Creek to Quirindi section is not expected until beyond 2035. Forecast of peak demand this far out into the future is difficult, particularly in areas subject to spot load developments such as new mining projects, which have a significant impact on peak demand. For the calculation of Present Value of Costs of this option, the year 2035 has been used for timing of Stage 2 augmentation.



**Figure 5 – Option 1: Staged 66kV duplication**

The Present Value of Cost of this option has been assessed to be \$20.85M with the capital investment requirements for Stage 1 being \$17.75M and the later Stage 2 being \$4.27M, with a total capital investment of \$22.02M.

### 3.3 OPTION 2 - TAMWORTH/QUIRINDI 66KV RING (CONSTRUCT A SECOND TAMWORTH TO QUIRINDI POWERLINE)

This option involves the construction of a second 66kV powerline (58km) between the TransGrid Tamworth 132/66kV bulk supply point substation and the Essential Energy Quirindi 66/33/11kV zone substation to form a 66kV ring supply with the existing #813 powerline.

Similar to Option 1, a new easement would be acquired which most likely would be in proximity to the existing powerline. A new 66kV powerline would be built on the new easement (possibly with 132kV insulation) in the first section from Tamworth to Werris Creek and 66kV insulation in the second section from Werris Creek to Quirindi. See Figure 6 below.

A new 66kV powerline circuit breaker would be installed at Quirindi zone substation to give full redundancy at Quirindi with no interruption of supply for the loss of either of the existing or proposed 66kV powerlines.

This option has a distinct advantage when compared to Option 1 in that it immediately secures the supply to the entire network load, including that south of Werris Creek at Quirindi (being more than 10MVA of the total of more than 15MVA). Whereas, Option 1 provides secure supply to the Werris Creek and Currabubula zone substations loads only (this being approximately 5MVA of the total), with the load south of Werris Creek still exposed to outages on the section from Werris Creek to Quirindi until stage 2 is constructed in 2035.

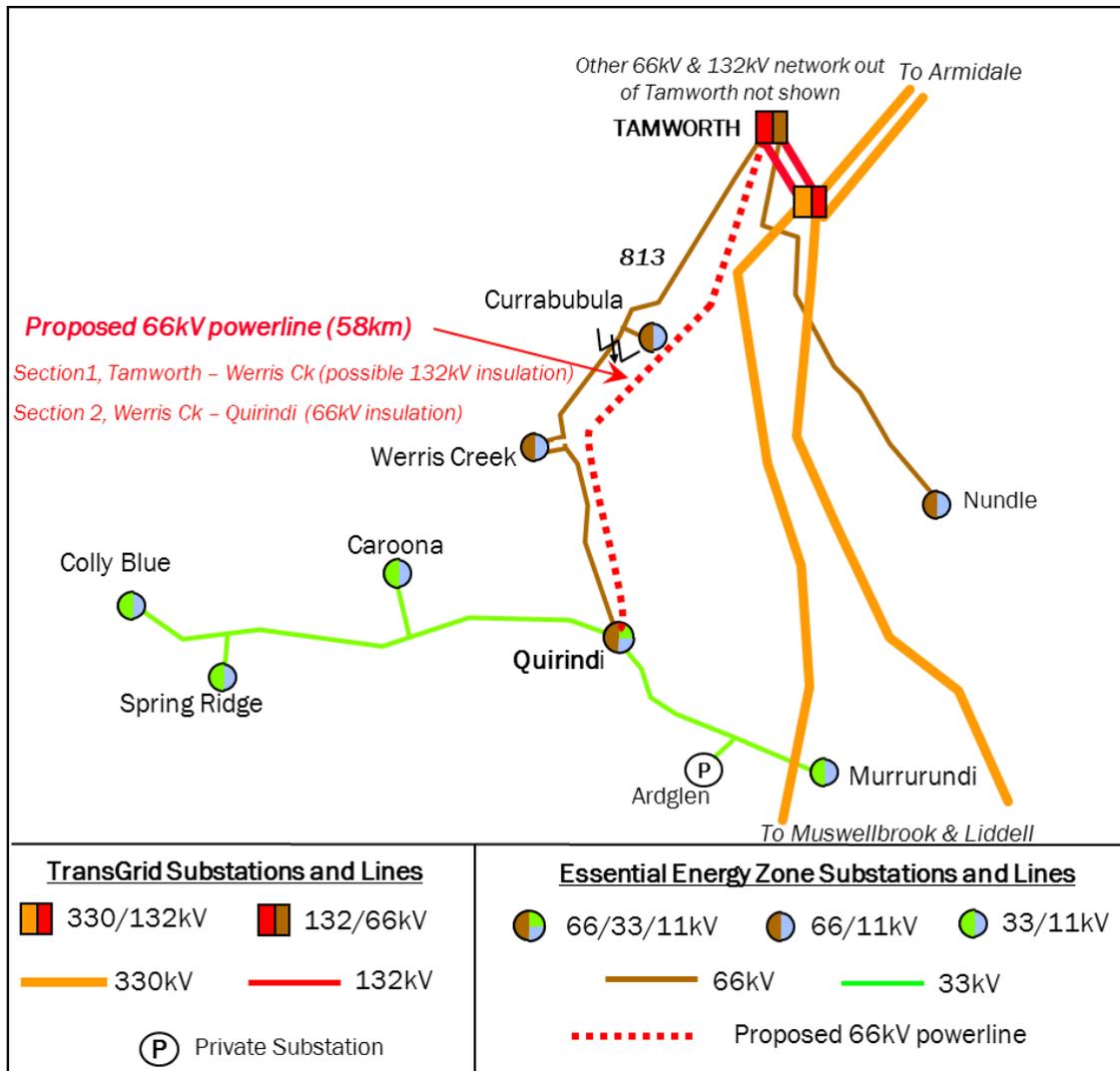


Figure 6 – Option 2 : Quirindi 66kV Ring

The Present Value of Cost of this option has been assessed to be \$21.18M with a total capital investment of \$18.71M.

### 3.4 OTHER NETWORK OPTIONS CONSIDERED

Other supply side options were considered but not included in the final assessments as summarised below. These were rejected mainly on the basis of substantially higher costs with some also subject to network load supply and project delivery constraints.

#### **a) Provision of a 66kV supply from Gunnedah**

This option would require acquisition of a new easement and construction of a new 66kV powerline from the TransGrid Gunnedah 132/66kV substation with connection either directly to the Essential Energy Quirindi 66/33/11kV zone substation or via a reconstructed Carroona 33/11kV zone substation, utilising the Quirindi/Carroona line section which is constructed at 66kV but currently operating at 33kV and requiring conductor replacement to provide the needed load supply capacity.

Joint planning discussions with TransGrid have indicated that this option would be technically feasible in terms of the supply capacity available at Gunnedah to meet the potential (contingent) demand increase of 15+MVA and the “closed” operation of a Gunnedah/Quirindi/Tamworth 66kV tie. However, in comparison to the supply options ex Tamworth, this network arrangement would result in:

- an extra line construction cost of at least \$4 - 5 Million (approximately 25%) because of the additional 15km of route length (73km versus 58km to Quirindi) or substation and line reconstruction costs (Carroona/Quirindi)
- more complex network protection and operating requirements
- earlier future constraints on the Tamworth to Gunnedah 132kV transmission supply

#### **b) Construction of a dual circuit Tamworth to Quirindi 66kV powerline (58km)**

This option would involve the widening of the existing #813 66kV powerline easement and the construction of a dual circuit 66kV powerline adjacent to the existing line which would be dismantled on its completion. The dual circuit construction would add some \$5 - 6Million (30%) to the single circuit construction costs. Further increases would result from the existing line dismantling requirements. A full length dual circuit construction would also result in some increased security of supply risk compared to supply from two single circuits.

#### **c) Establish a 330/66kV substation at Murrurundi**

This option would require the establishment of a 330/66kV substation at Murrurundi on the TransGrid Liddell – Tamworth 330kV powerline. The existing 33kV powerline from Quirindi to Murrurundi would be rebuilt at 66kV and the Murrurundi 33/11kV zone substation would be reconstructed to a 66/11kV substation. The supply capacity provided by this option would far exceed the present load supply needs whilst the cost would be some 50% greater than the 66kV upgrades from the existing Tamworth supply point.

### **3.5 NON-NETWORK OPTIONS**

Assessment under the Demand Management Code of Practice (2004) and the National Electricity Rules have been undertaken. This assessment included a ‘Reasonableness’ test to determine whether it would be considered ‘reasonable’ to expect that a non-network measure could be cost effectively employed to defer or avoid the network investment.

Essential Energy notes that no formal submissions were received in relation to the traditional non-network alternatives of load reduction or deployment of generation embedded within the local distribution network. This supports the results of the ‘Reasonableness’ test included in the Draft Report which concluded that it was not ‘reasonable’ to expect that a non-network measure could be cost effectively employed to avoid or defer the network investment.

As such, Essential Energy considers that the consultation process has confirmed the conclusion that there are no non-network options readily available which could address the identified network constraints.

## 4 APPLICATION OF THE REGULATORY TEST

The regulatory test has been applied to the nominated network option with the result summarised in the following sections.

### 4.1 FORM OF THE REGULATORY TEST

The option covered by this Application Notice is a reliability augmentation and the regulatory test is to be applied in accordance with clause 1(a) of the test:

- (a) in the event the option is necessitated solely by the inability to meet the minimum network performance requirements set out in schedule 5.1 of the Rules or in relevant legislation, regulations or any statutory instrument of a participating jurisdiction - the option minimises the present value of costs, compared with a number of alternative options in a majority of reasonable scenarios;

The values used as the basis for the evaluation are shown below in Table 1.

Parameter	Base Case Value	Sensitivity Checks at
Real Discount Rate	9%	6% and 12%
Marginal Annual O&M Cost	2% of Capital Cost	1% and 3% of Capital Cost
Capital Costs	Nominal Value	±25% variation

**Table 1 – Values Used in Financial Analysis**

### 4.2 BASE CASE ANALYSIS

The Base Case Present Value of Costs for Options 1 and 2 are shown below in Table 2.

Option	Description	PVC (\$M)	Rank
1	Staged 66kV duplication (Construct Tamworth to Werris Creek and Werris Creek to Quirindi 66kV powerline)	20.85	1
2	Tamworth/Quirindi 66kV ring (Construct Tamworth to Quirindi 66kV powerline)	21.18	2

**Table 2 – Comparison of Options for the Base Case**

### 4.3 SENSITIVITY ANALYSIS

The results of the sensitivity analysis performed over a range of cases are shown below in Table 3. The sensitivity analyses cover the parameters shown in Table 1.

	Base Case	High Disc.	Low Disc.	High O&M	Low O&M	High Capital	Low Capital
Disc. Rate	9.00%	12.00%	6.00%	9.0%			
O&M	2.0%			3.0%	1.0%	2.0%	
Capital \$	100%					125%	75%
Option 1	20.85	19.26	23.43	23.10	19.16	25.43	16.83
Option 2	21.18	19.86	23.17	23.47	19.45	25.82	17.10

**Table 3 – Results of Sensitivity Analysis**

Whilst the results of the Regulatory Test indicate that Option 1 has the lowest cost in all but one scenario (the low discount rate) the differences are small for all cases, being in the order of \$0.3M in a Present Value of Cost Assessment of approximately \$20M, or around 1.5% of the estimate only costs.

It is also noted that the now marginally lower Present Value of Cost for Option 1 (Staged construction), is a result of the revised load forecasts deferring the Stage 2 required date to a nominal 20 years from the 10 years allowed in the initial consultation reports. In effect the present value of the Stage 2 works (allowed \$4.27M) is approximately equal to the additional initial capital expenditure (approximately \$1M) required to complete Option 2 (the full ring) as the preferred project.

## 5 CONCLUSION

The consultation process did not result in any valid written submissions relating to the indicated network options or other alternatives to address the identified constraints in respect of the electricity supply to the Quirindi area of NSW. Hence, there are no material issues or alternatives to be assessed by Essential Energy for further comment and conclusion in addition to those included in the Draft Project Report which was published as the second stage of the consultation process.

Given that the Present Value of Cost analyses of the network options show they that are virtually equal, Essential Energy has determined that Option 2 provides a substantially greater benefit to customers by securing supply to the entire load rather than the lesser part only (being the Currabubula and Werris Creek zone substation components) and hence is the preferred network project option.

As such, Essential Energy proposes to proceed with the original conclusion of the Draft Project Report which is Option 2, construction of a second 66kV powerline from the TransGrid Tamworth 132/66kV bulk supply point substation to Essential Energy's Quirindi 66/11kV zone substation, with the Tamworth to Werris Creek section possibly being with 132kV insulation.

## 6 NOTICE OF DISPUTES

Under Chapter 5 of the NER, Registered Participants may dispute the recommendation made in section 5 above within 40 business days of the publication of this Final Report. Any such dispute should be submitted in writing by no later than Friday 18th October 2013, and should be directed by email to:

[nerconsultation@essentialenergy.com.au](mailto:nerconsultation@essentialenergy.com.au)

## 7 APPENDIX A

### BASE CASE PRESENT VALUE OF COSTS:

#### 7.1 OPTION 1 – STAGED 66KV DUPLICATION (CONSTRUCT A SECOND TAMWORTH TO WERRIS CREEK THEN WERRIS CREEK TO QUIRINDI 66KV POWERLINE)

Option 1 - Construct Tamworth to Werris Creek 66kV powerline (43km) and future Werris Creek to Quirindi 66kV powerline (15km)	2013	2014	2015	2016	2017	2018	2019	2020	2035	2053
Acquire Tamworth-Werris Ck easement (43km)	2.41									
Construct Tamworth-Werris Ck 66kV powerline (132kV insulation, 43km)		11.20								
OH construction mobilisation		0.30								
Augment Werris Substation to full in/out 66kV busbar		3.00								
Acquire Tamworth-Werris Ck easement (15km)	0.84									
Construct Werris Ck-Quirindi 66kV powerline (66kV insulation, 15km)									3.47	
OH construction mobilisation									0.30	
Add 66kV feeder Bay at Quirindi									0.50	
<b>Avoided O&amp;M (Enter Negative Value)</b>										
<b>Increase in O&amp;M (2% of Capital - Avoided O&amp;M)</b>		0.06	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.44
<b>Capital Expenditure</b>	3.25	14.50							4.27	
<b>Option 1 Expenditure - PVoC = \$20.85M</b>	<b>3.25</b>	<b>14.56</b>	<b>0.35</b>	<b>0.35</b>	<b>0.35</b>	<b>0.35</b>	<b>0.35</b>	<b>0.35</b>	<b>4.62</b>	<b>0.44</b>

#### 7.2 OPTION 2 - TAMWORTH/QUIRINDI 66KV RING (CONSTRUCT A SECOND TAMWORTH TO QUIRINDI POWERLINE)

Option 2 - Construct Tamworth to Quirindi 66kV powerline (58km)	2013	2014	2015	2016	2017	2018	2019	2020	2035	2053
Acquire Tamworth-Quirindi Easement (58km)	3.25									
Construct Tamworth-Quirindi 66kV powerline (section 1, Tamworth-Werris Ck 132kV insulation, 43km)		11.20								
Construct Tamworth-Quirindi 66kV powerline (section 2, Werris Ck-Quirindi 66kV insulation, 15km)		3.47								
OH Construction mobilisation		0.30								
Add 66kV feeder Bay at Quirindi		0.50								
<b>Avoided O&amp;M (Enter Negative Value)</b>										
<b>Increase in O&amp;M (2% of Capital - Avoided O&amp;M)</b>		0.06	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
<b>Capital Expenditure</b>	3.25	15.46								
<b>Option 2 Expenditure - PVoC = \$21.18M</b>	<b>3.25</b>	<b>15.53</b>	<b>0.37</b>							