



FINAL REPORT

MARRICKVILLE 11kV ZONE DEVELOPMENT

24th June 2009

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EXECUTIVE SUMMARY

This paper has been prepared to report on upgrade work that is proposed to develop the electricity supply network in the Marrickville load area in accordance with Clause 5.6.6 (h) of the National Electricity Rules. The work proposed by this report is classified as a new small distribution asset.

A Distribution Network Service Provider does not need to consult on an option which would be a new small network asset. Accordingly, EnergyAustralia has not previously consulted on this project.

To provide a safe and reliable electricity supply for existing customers and provide capacity for future loads, EnergyAustralia is faced with a primary need to provide additional supply system capacity to meet forecasted load demands. The provision of additional capacity is required to meet network performance requirements set by EnergyAustralia in accordance with Schedule 5.1 of the Rules.

This report covers the following issues:

Section 1 of the paper provides a background of the Marrickville zone substation supply area and the need for augmentation of the 11kV network.

Section 2 describes the issues associated with the increase in 11kV feeder loading and the projected load forecast. The concept of service standard, including the risk of loss of load, as implemented by EnergyAustralia is discussed.

Section 3 describes the proposed augmentation in relation to the National Electricity Rule (the Rules). Marrickville zone substation and its associated 11kV distribution network is classified as a distribution system asset by the Rules, and the proposed development is classified as a small network asset as it involves expenditure less than \$10 million.

Section 4 describes the options that were considered, including Demand Management:

- Option 1 – Upgrade limiting sections on two feeders and move an the inter-feeder connection further downstream
- Option 2 – Form a new feeder at Marrickville Zone teeing onto an existing feeder section

Section 5 presents a cost analysis of the options presented in Section 4.

Section 6 concludes the preferred option is Option 1 – Upgrade limiting sections on two feeders and move an the inter-feeder connection further downstream.

The conclusion to develop Option 1 is made on a least cost test (in accordance with the Regulatory Test) to provide increased future capacity and to meet EnergyAustralia's reliability standard. The estimated capital cost for this option is \$2 million and the completion date is anticipated to be November 2009.

1. BACKGROUND

This Final Report has been prepared to advise on the upgrade work that is proposed to be carried out on the 11kV network at Marrickville to maintain loading within reliability standards. The information provided includes:

- A discussion of emerging supply system limitations identified by EnergyAustralia that have led to the necessity for augmentation of the distribution network in the area.
- A discussion of the service standard that has been adopted for planning purposes.
- Descriptions of options for development of the electricity supply in the area.
- Details of the outcomes of cost effectiveness analysis for the options that have been considered.

Marrickville 132/11kV zone substation was originally commissioned in 1972 with four 37.5MVA 132/11kV transformers. Three of these transformers are currently in operation. It is supplied by four 132kV underground feeders: 91X/2, 91Y/2 from Chullora STSS and 91X/1 and 91Y/1 from Beaconsfield West BSP.

Marrickville zone supplies parts of the following suburbs: Dulwich Hill, Enmore, Lewisham, Marrickville, Marrickville South, Mascot, Newtown, Petersham, St Peters, Stanmore, Sydenham and Tempe. The area supplied by Marrickville zone is shown in the Figure 1.

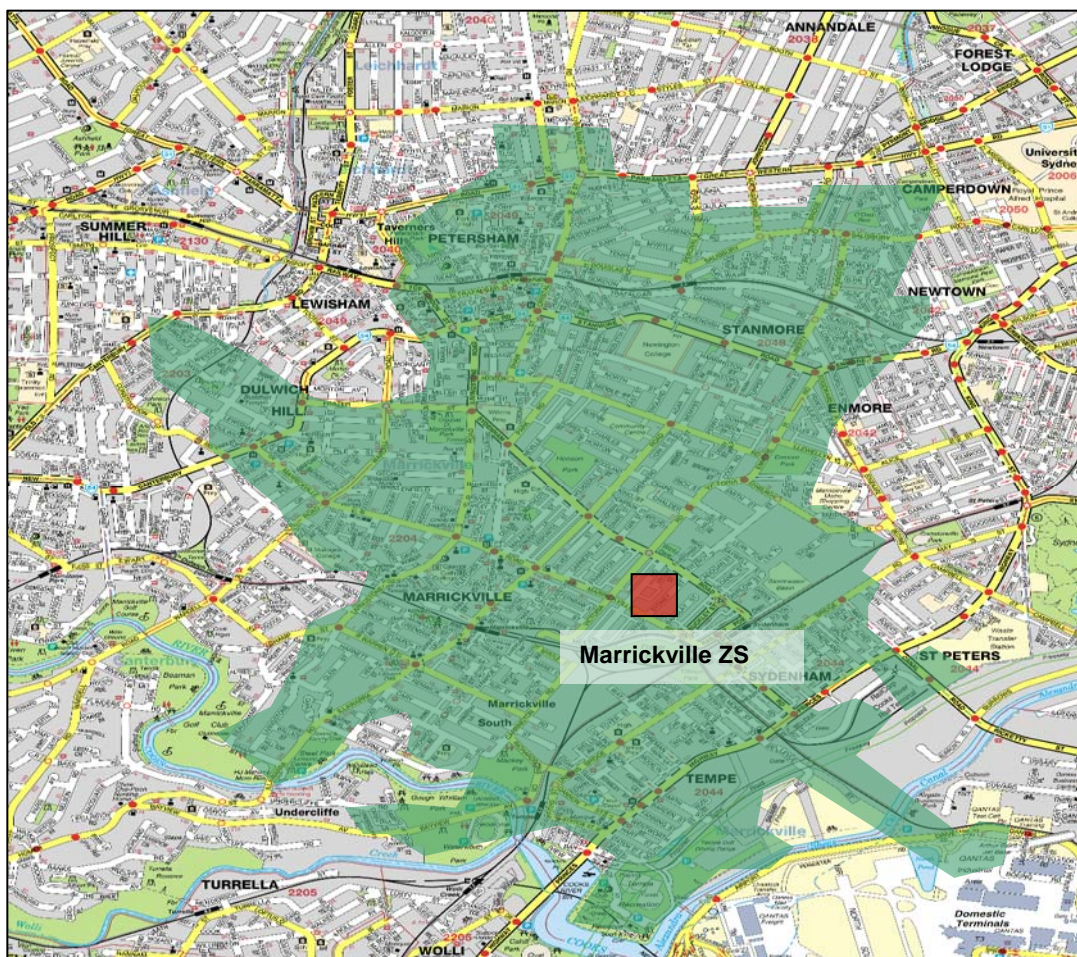


Figure 1: Area supplied by Marrickville ZS

Currently, several 11kV feeders are approaching EnergyAustralia service standard load limit in the normal state and any contingency outages on these feeders at times of high or peak loading can not be adequately restored according to the Design Planning Criteria. Action is required to ensure loading on the constrained 11kV feeders remains within the service standard.

2. ISSUES

2.1. Applied Service Standard

The service standards that are applicable to a consideration of supply constraints affecting the Marrickville supply area are summarised below:

2.1.1. Applicable to all Network Elements

The minimum requirement for any network element is that, with all elements in service, the thermal capacity is required to meet at least 115% of forecast demand. The requirements described in the following sections are additional to this requirement.

2.1.2. Zone substations and Subtransmission Network

2.1.2.1 Overhead Subtransmission Line and Zone Substations

For a failure of a single critical element (i.e. N-1 conditions) within zone substations supplying greater than 10MVA of load and for overhead subtransmission network, the forecast demand is not to exceed the thermal capacity for more than 1% of the time i.e. a total aggregate time of 88 hours per annum; up to a maximum of 20% above the thermal capacity. Recovery of load should be within one minute.

Under normal conditions (i.e N conditions), the thermal capacity is required to meet at least 115% of forecast demand.

2.1.2.2 Underground Subtransmission Cable

For an underground subtransmission cable, any overhead section should be designed as if it was a subtransmission overhead line, providing the forecast demand does not exceed the thermal capacity of the underground section at any time under N-1 conditions.

2.1.3. 11kV Distribution Network

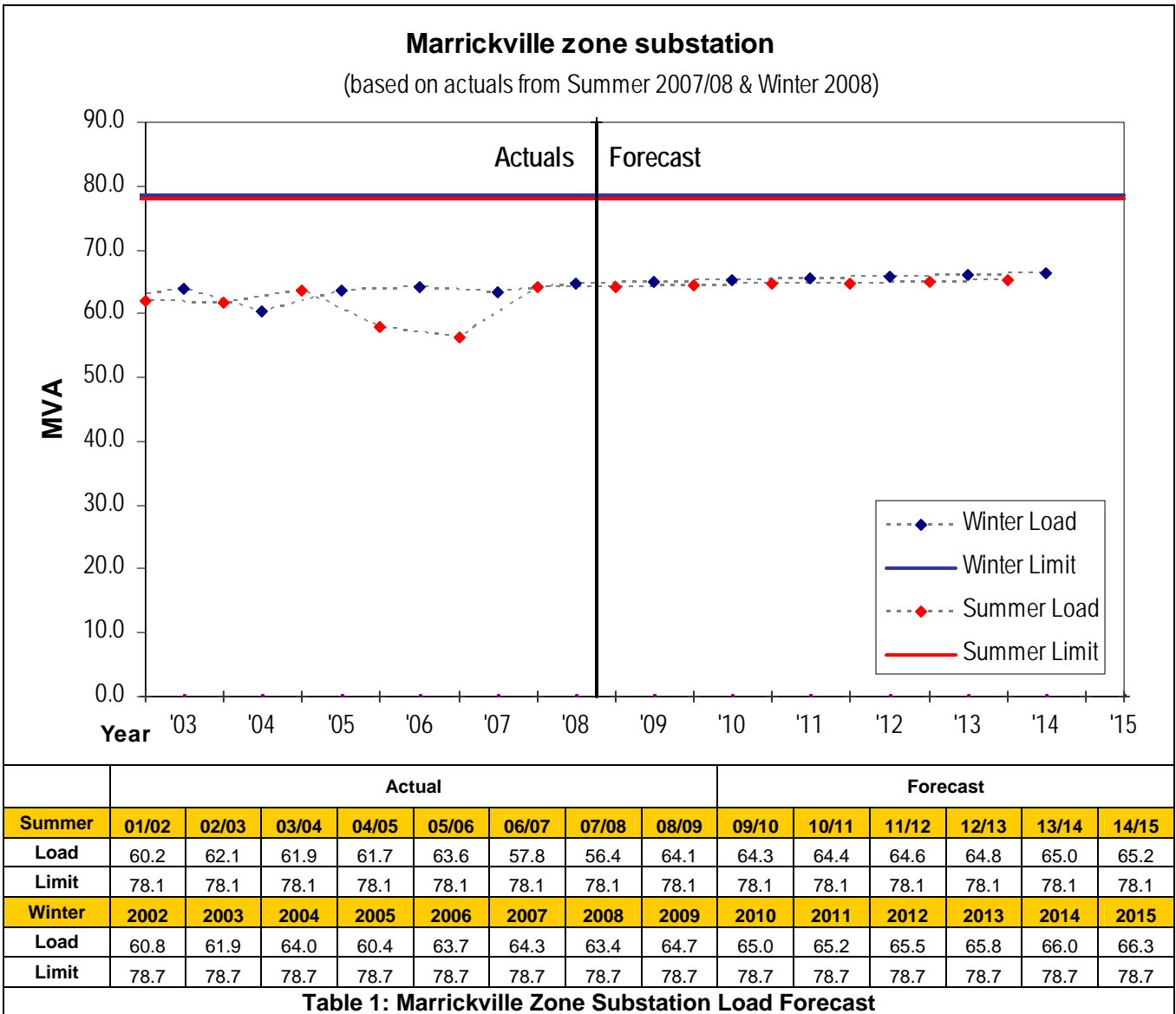
For urban feeders (i.e. feeders with an actual maximum demand greater than 0.3MVA/km), the expected demand is to be no more than 80% of feeder thermal capacity (under system normal operating conditions), with switchable interconnection to adjacent feeders to enable restoration following an unplanned failure of a single network element (i.e. N-1 conditions). The 11kV network where in a number of feeders forms an interrelated system, the limits apply to the average loading of the feeders within the one system.

For 11kV networks, voltage drops of up to 5% are regarded as satisfactory. Higher voltage drops are permissible provided that the network connection provided to low voltage customers is within the limits specified in Australian Standard AS2926.

2.2. Description of Network Constraints

2.2.1. Marrickville Zone Substation

Marrickville Zone Substation has a firm capacity of 78.1MVA in summer and 78.7MVA in winter. The licence rating, limited by the RD ratings of the transformers, is equal to the firm rating. The load is not forecast to exceed licence capacity in the present forecast period. The load forecast for Marrickville Zone Substation is shown in the graph below.



2.2.2. Marrickville Zone 11kV Network

Under current loading conditions, the 11kV feeder supplied from panel 32 at Marrickville zone does not comply with design planning criteria. It has an average summer utilisation (under normal operating conditions) of 106%, in excess of 80% of feeder thermal capacity stipulated in the network service standard. Additionally, assuming no augmentation works are carried out over the next 6 years, average summer utilisation increases to 110%.

Moreover, 11kV feeders from panels 32 and 40 are experiencing N-1 feeder pickup constraints. If a first contingency 11kV outage occurs during times of peak load, these feeders cannot be picked up and any emergency switching at panels 32 and 40 will be restricted. This would result in load not being able to meet the 11kV network service standard under the N-1 condition.

These issues with the 11kV network result in the necessity to carry out the augmentation for the Marrickville 11kV distribution network described in this report.

3. TYPE OF AUGMENTATION

The requirements of the National Electricity Rules (the Rules) for new asset proposals are outlined in Section 5.6 and depend on the cost, purpose and function of the new asset.

The 11kV Marrickville zone substation 11kV network is classified as distribution system assets by the Rules. The Rules (clauses 5.6.6(e) and (f)) require that, where analysis indicates that any relevant technical limits of a distribution system will be exceeded, that the Distribution Network Service Provider (DNSP) must notify any affected Registered Participants of these limitations and of the expected time for corrective action and consult with affected Participants and interested parties on the possible options to address the projected limitations of the relevant distribution system. A Network Service Provider does not need to consult on a network option that would be a small network asset, or for options that do not augment the system.

Each of the options considered under Section 4 are considered new small distribution network assets as they involve a network augmentation with expenditure less than \$10 million. A DNSP is not required to consult on new small distribution assets and hence no consultation paper was issued for this project.

The new capacity provided by the proposed augmentation has been necessitated by the need to meet the service standards described in Section 2 and has therefore been treated as a reliability driven augmentation for the purposes of the Regulatory Test. Consequently, EnergyAustralia has used a least cost test to examine the options identified to address projected system limitations.

4. OPTIONS CONSIDERED

4.1. Demand Management

A Demand Management Screening Test for the 11kV feeders supplied from panels 32 and 40 at Marrickville zone substation was undertaken in May 2009. A one-year deferral would require a 1.2MVA demand reduction by summer 2009/10, representing a high 32% reduction in the total forecast demand of the two feeders and resulting in a moderate saving of \$180,000.

Given the size of the demand management requirement, the moderate savings potential, and the relatively short timeframe to make the investment decision, it is not considered reasonable to expect that it would be cost-effective to postpone the proposed supply-side solution by implementing demand management strategies.

4.2. Option 1 – Upgrade limiting sections of 11kV cable and move an inter-feeder connection further downstream

This option involves upgrading limiting sections of 11kV cable on panel 32 (on Unwins Bridge Rd and Union St onto the Princess Highway) and panel 40 (Smith St onto Wood St and along the Princess Highway) using newly installed 11kV XLPE cable. The inter-feeder connection between the panel 32 and panel 28 feeders will be moved further downstream.

The forecast utilisation summary for the Panel 32 feeder at Marrickville zone, before and after the proposed work, is shown in the table below. However, it should be noted that the average Normal State utilisation does not reflect the ability of feeders to carry emergency loads, nor the reality that pick up scenarios can often be worse than the percentages indicate.

Average Normal State Utilisation	Do Nothing	After Option 1
Current Utilisation	106%	67%
Forecast Utilisation – 6 Years	110%	69%

Table 2: Utilisation Summary After Option 1

This option provides enough network capacity, and the required security standard as per the Licence Compliance Design Planning Criteria for the panel 32 and panel 40 11kV feeders at Marrickville zone to meet the predicted maximum demand with N-1 security for the current forecast period.

The total estimated capital cost of this option is \$2.0M.

4.3. Option 2 – Form a new feeder at Marrickville Zone teeing onto a panel 32 feeder section

This option involves the formation of a new 11kV feeder from the spare panel at Marrickville Zone, teeing onto the existing panel 32 feeder section linking the distribution kiosks close to the Smith St – Princes Highway

intersection and at Wood St, Tempe. This option would incur the increased difficulty and additional cost of boring under a section of rail line in close proximity to Sydenham Station.

The total estimated capital cost of this option is \$2.6M.

5. ANALYSIS OF OPTIONS

5.1. Base Case Analysis

The results of the base case economic analysis are summarised in table 3 below using the base discount rate of 8.5%.

Options	NPC (\$M) *	Capital Cost (\$M)	Ranking
Option 1 – Upgrade limiting sections 11kV cable and move an inter-feeder connection further downstream	1.94	2.00	1
Option 2 – Form a new feeder at Marrickville Zone teeing onto a panel 32 feeder portion	2.52	2.60	2

* The net present cost includes operation and maintenance cost

Table 3: Base case economic analysis

Refer to Appendix A for further details of the base case economic analysis.

Under the base case condition, Option 1 is the least cost option.

5.2. Sensitivity Analysis

The NPC results for variations in discount factor and capital cost are shown in table 4 below:

Sensitivity Scenario		NPC (\$M)	
		Option 1	Option 2
Discount rate	7.0%	1.96	2.56
	8.5% (base case)	1.94	2.52
	10.0%	1.91	2.49
Capital cost	25% increase	2.42	3.15
	25% decrease	1.45	1.89

Table 4: NPC results for variations in discount rate and capital cost

Option 1 is the least cost option under all analysed sensitivity scenarios.

5.2.1 Variations in Load Growth Rates

Variation in load growth rates will not affect the cost of the supply options as the 11kV network is presently constrained. Variations in load growth have no effect on the timing of the projects presented in section 4.

6. CONCLUSION

Option 1 is the least cost option for all analysed scenarios and is thus the recommended course of action to be taken by EnergyAustralia.

EnergyAustralia intends to augment limiting sections of 11kV cable on the feeders supplied from panels 32 and 40 at Marrickville zone substation and move the inter-feeder connection between the panel 32 and panel 28 feeders further downstream to ensure the service standard is met for 11kV distribution network in south Marrickville load area. All works are anticipated to be completed by November 2009.

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This service date availability date may change if the project is affected by circumstances beyond EnergyAustralia's control, such as changes in the timing of customer load increases or other issues such as: delays in the approval process, equipment supply difficulties, unforeseen technical constraints, acts of God and industrial action.

7. APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE

Discount rate: 8.5%

All amounts in 2008/09 dollars

Option 1 - Upgrade limiting sections of 11kV cable and move an inter-feeder connection further downstream

Actions	NPC (\$M)	CAPEX (\$M)	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17
Bulk Cable Laying	0.77	0.82	0.17	0.65							
Materials	0.36	0.38	0.08	0.31							
Permanent Reinstatement	0.38	0.42		0.42							
Project Management and Labour	0.14	0.15		0.15							
Field Service materials and commissioning works	0.21	0.22		0.22							
Operations & Maintenance	0.08				0.00	0.02	0.02	0.02	0.02	0.02	0.02
Total	1.94	2.00	0.25	1.75	0.00	0.02	0.02	0.02	0.02	0.02	0.02

Options 2 - Form a new feeder at Marrickville Zone teeing onto a panel 32 feeder section

Actions	NPC (\$M)	CAPEX (\$M)	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17
Bulk Cable Laying	1.00	1.07	0.22	0.85							
Materials	0.47	0.50	0.10	0.40							
Permanent Reinstatement	0.50	0.54		0.54							
Project Management and Labour	0.18	0.19		0.19							
Field Service materials and commissioning works	0.27	0.29		0.29							
Operations & Maintenance	0.10				0.01	0.02	0.02	0.02	0.02	0.02	0.02
Total	2.52	2.60	0.32	2.28	0.01	0.02	0.02	0.02	0.02	0.02	0.02