



FINAL REPORT

DEVELOPMENT OF NEW 132kV ROYAL NORTH SHORE HOSPITAL ZONE SUBSTATION

27 March 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 Royal North Shore Hospital load area in accordance with Clause 5.6.2 (h) of the National Electricity Rules. The work proposed by this report is classified as a new large distribution asset under the National Electricity Rules.

A Consultation Paper on the projected limitation and possible options was published on 30th June 2008. This Consultation Paper included a preliminary application of the Regulatory Test to options that had been identified to address the projected limitations. No submission was received in response to this paper.

To provide a safe and reliable electricity supply for existing customers and new developments in the Lower North Shore area, 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 in accordance with Schedule 5.1 of the Rules and EnergyAustralia's licence conditions.

This report covers the following issues:

Section 1 provides a background of the Lower North Shore load area and the need for augmentation of the distribution network.

Section 2 presents EnergyAustralia's service standards for the area and describes, in detail, various asset condition and forecast capacity issues in the area that resulted in the need for augmentation of supply to the area.

Section 3 describes the proposed augmentation in relation to the National Electricity Rule (the Rules). The proposed Royal North Shore Hospital zone substation is classified as a distribution network asset by the Rules, and the proposed development is classified as a new large network asset as it involves augmentation expenditure of above \$10M.

Section 4 describes the options that were considered to address the issues affecting the supply network including options for supply system development. Two options are described:

Option 1 – Development of a new 33/11kV RNSH zone substation

Option 2 – Development of a new 132/11kV RNSH zone substation

These options have been considered in the context of the long term area strategy for the Lower North Shore load area.

Section 5 presents the results of the regulatory test and ranks the options.

Section 6 concludes that the most cost effective option within the regulatory test is Option 2 – Development of new 132/11kV RNSH zone substation.

The estimated capital cost of this option is \$44.0M which includes Stage 1 works consisting of commissioning of new 132/11kV RNSH zone substation, new 132kV feeders and associated subtransmission and distribution network augmentation. The project is scheduled for completion in July 2011.

1 BACKGROUND

This Final Report has been prepared to meet the requirements of clause 5.6.2(h) of the National Electricity Rules (the Rules) and to advise on the development work that is proposed to develop the electricity supply network in the Royal North Shore Hospital(RNSH) area. The information provided includes:

- A discussion of emerging supply system limitations identified by EnergyAustralia that have led to identification of options for corrective action to address projected limitations for the supply network in the Lower North Shore area;
- A discussion of the service standard that has been adopted for planning purposes;
- A description of options for development of the electricity supply in the area required; and
- Details of the outcomes of cost effectiveness analysis for the options considered.

The Lower North Shore load area extends from Chatswood and Castle Cove in the north to North Sydney in the south and Mosman in the east . The network in the Lower North Shore:

- Is supplied from TransGrid's transmission system at Sydney East Bulk Supply Point (BSP) via four 132kV feeders via Lindfield switching station;
- Includes Castle Cove and Mosman 132/11kV zone substations and Willoughby subtransmission substation (STS), which are supplied at 132kV from Lindfield switching station;
- Includes 33/11kV zone substations at Crows Nest, Chatswood, Gore Hill and North Sydney, which are supplied radially at 33kV from Willoughby STS;
- Provides a 132kV interconnection at Willoughby STS to Lane Cove switching station to provide backup capacity to cater for double circuit tower or trench outages;
- Supplies high rise commercial load in Chatswood and North Sydney;
- Predominantly serves residential and commercial load; and
- Includes the 33kV supplies to two major customers, the Lane Cove Tunnel and State Rails Authority.

North Sydney Area Health has proposed a redevelopment of Royal North Shore Hospital (RNSH) and other associated work in the area with projected additional demand of 10-30MVA(diversified), spread over a period of ten years, commencing from 2008. The area at the vicinity of the RNSH is bounded to the north by the Gore Hill Freeway, east by major railway corridors and south by the Pacific Highway.

The existing RNSH load is supplied from Gore Hill zone substation which is not forecast to be constrained within the forecast period without considering the additional 10-30MVA load from RNSH. However, with the increased spot load from RNSH, Gore Hill will be constrained by summer 2010/11. Although there is spare capacity at Gore Hill zone substation prior to summer 2010/11 to initially supply the load increase, it will exacerbate emerging constraints at Willoughby STS and Gore Hill zone substation. Whilst none of the zone substations supplied by Willoughby STS will exceed firm capacity in the current forecast period, Willoughby STS will be constrained in summer 2009/10, even without considering future RNSH load.

Figure 1 and 2 indicates the geographic overview of the area and proposed RNSH development respectively.

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Lower North Shore Area



Figure 1 – Geographical Overview of the Area

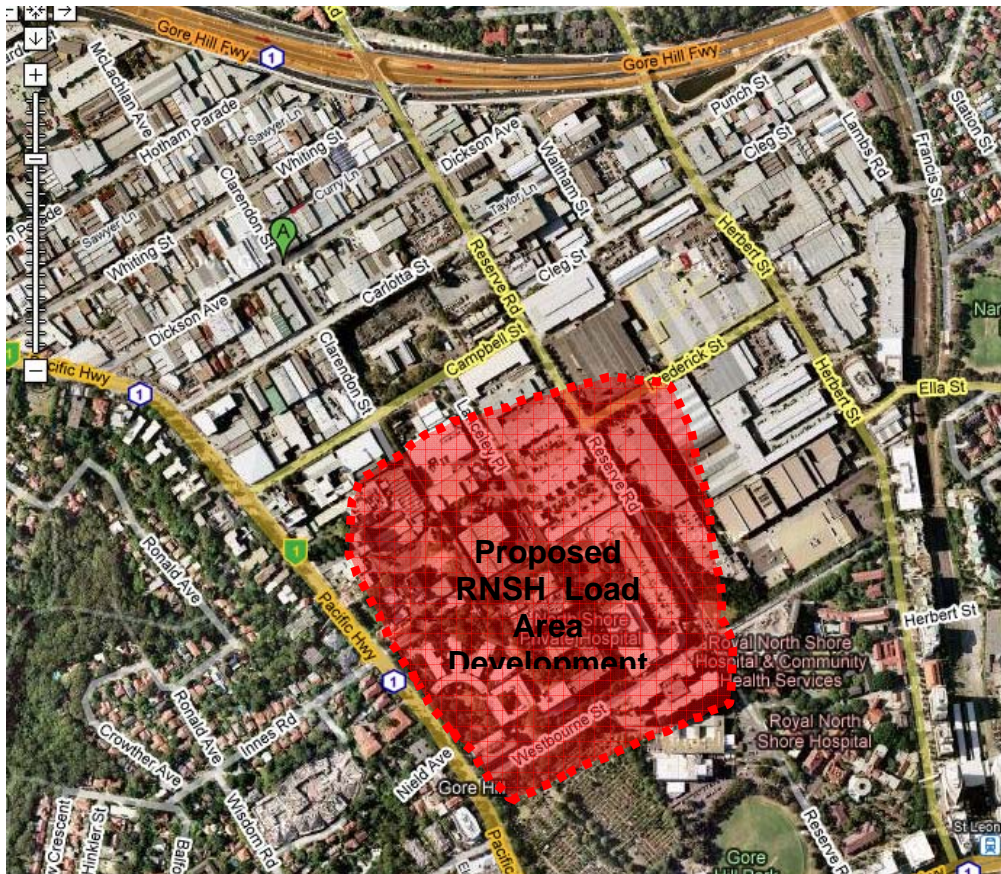


Figure 2 – Proposed RNSH Development

1.1 Supply Arrangement

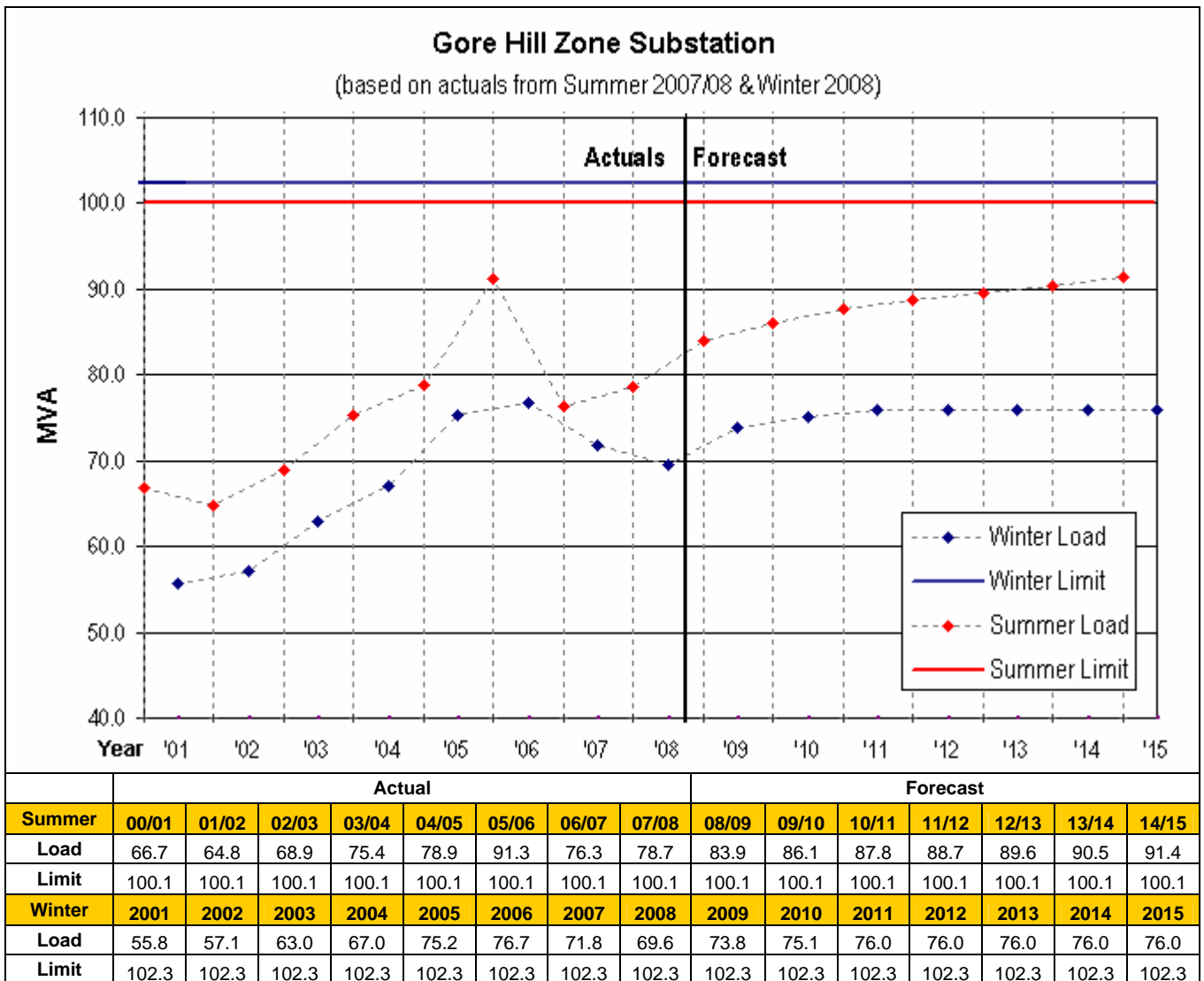
1.1.1 Zone Substations

Supply to the existing Royal North Shore Hospital and its surrounding load area is currently provided by the following zone substations:

Gore Hill Zone Substation

Gore Hill 33/11kV zone substation was commissioned in 1985 and is equipped with four 33MVA 33/11kV transformers and is developed to its ultimate design capacity. The existing RNSH load is supplied from Gore Hill zone substation.

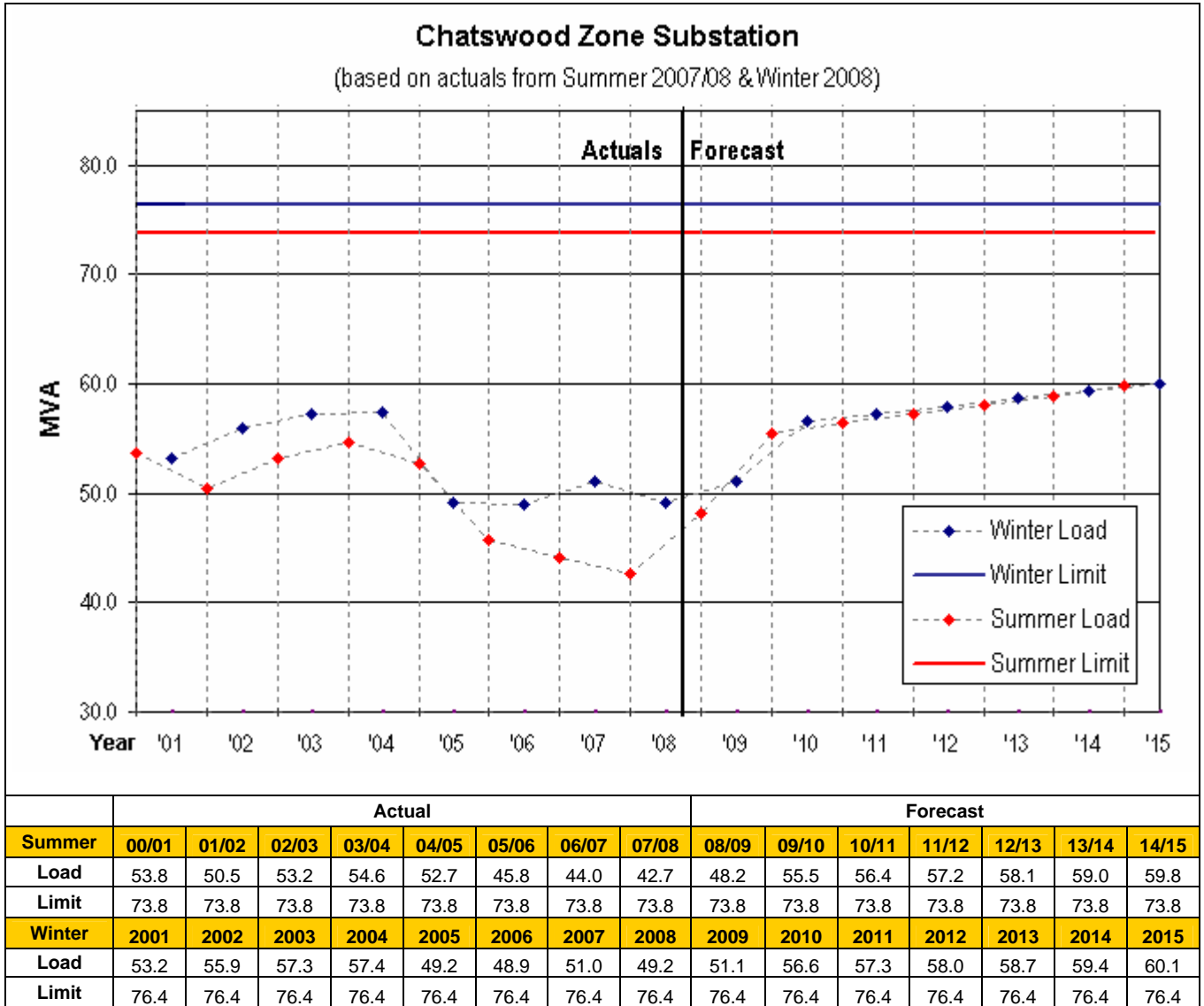
The firm capacity of Gore Hill zone substation is 100.1MVA in summer and 102.3MVA in winter and the peak load was 78.7 MVA in summer 2007/08 and 69.6MVA in winter 2008. The zone is not forecast to be constrained within the forecast period without considering the planned RNSH development works. If the proposed RNSH loads are considered, the zone would be constrained in summer 2010/11.



Chatswood Zone Substation

Chatswood 33/11kV zone substation was commissioned in 1923 and has a firm capacity of 73.8MVA in summer and 76.4MVA in winter and is developed to its ultimate design capacity.

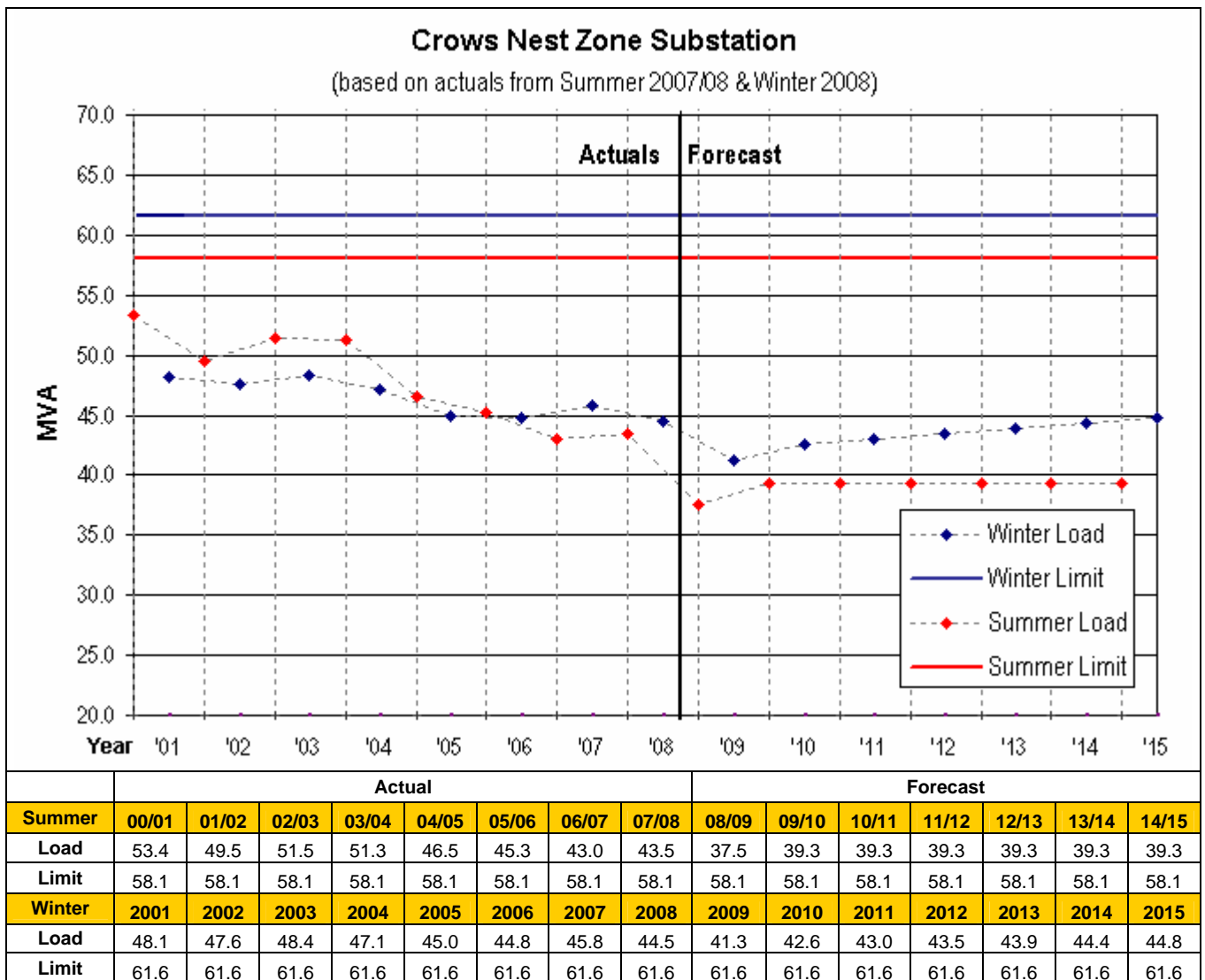
The zone peak load was 42.7MVA in summer 2007/08 and 49.2MVA in winter 2008. The zone is not forecast to be constrained within the forecast period.



Crows Nest Zone Substation

Crows Nest 33/11kV zone substation was commissioned in 1930, is equipped with four 19MVA, 33/11kV transformers and is already constructed to its ultimate design capacity. The firm capacity of Crows Nest zone substation is 58.1MVA in summer and 61.6MVA in winter and the peak load was 43.5MVA in summer 2007/08 and 44.5MVA in winter 2008. The zone is not forecast to be constrained within forecast period.

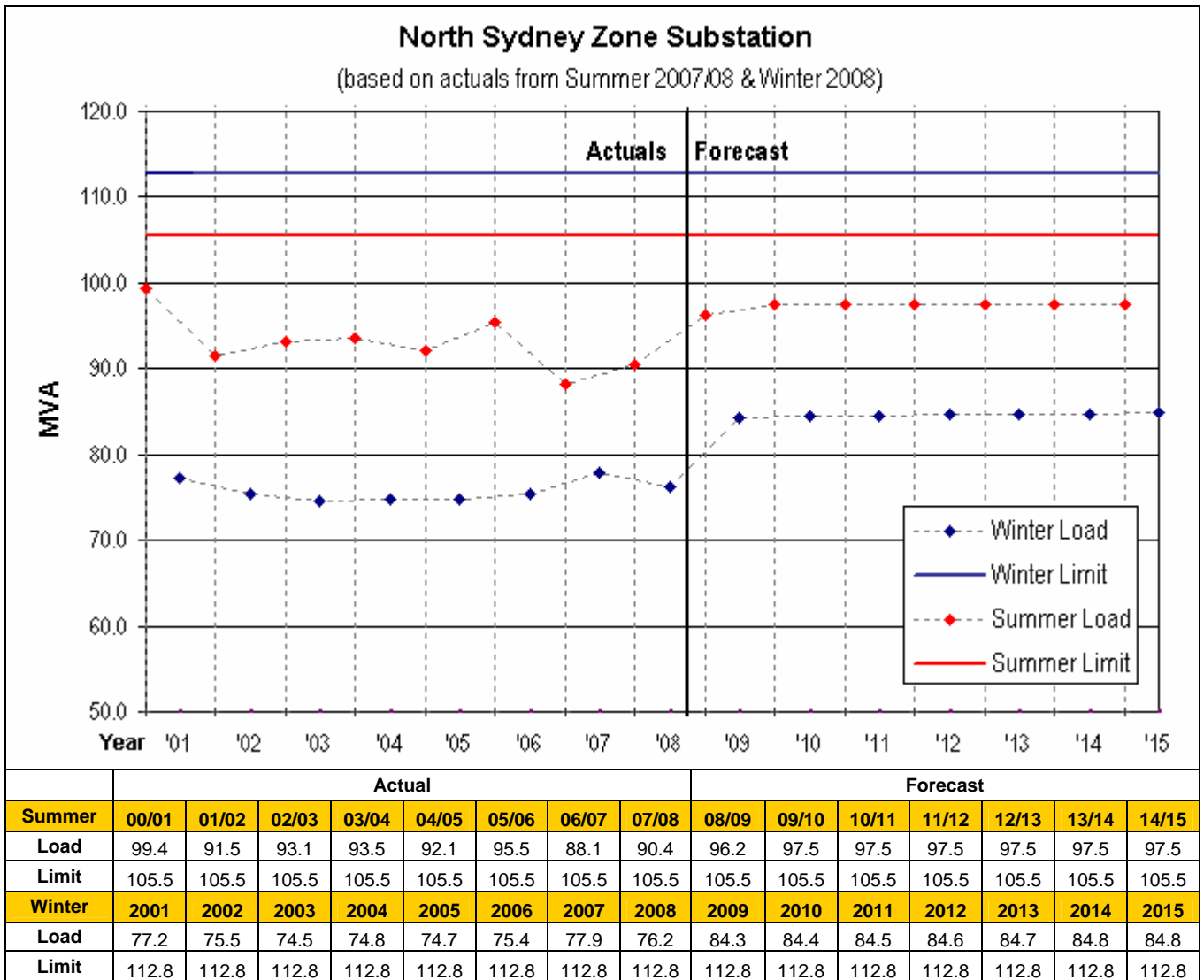
Crows Nest zone substation is supplied from Willoughby STS via four 33kV gas pressure cables which are approaching the end of their useful life and require replacement by 2012. Replacement and refurbishment of 11kV switchgear and the substation control system is currently in progress at Crows Nest zone substation and is scheduled for completion in 2008/09.



North Sydney Zone Substation

North Sydney 33/11kV zone substation was commissioned in 1968. It is equipped with four 33MVA and one 26MVA 33/11kV tail ended transformers and is already constructed to its ultimate design capacity. The firm capacity of North Sydney zone substation is 106.0MVA in summer and 114.8MVA in winter. The substation loading was 88.1MVA in summer 2006/07 and 77.9MVA in winter 2007 and is below the current firm capacity of the zone. The zone is not forecast to be constrained until around 2020.

North Sydney zone substation is supplied from Willoughby STS via five 33kV gas pressure cables which are approaching the end of their useful life. Four out of the five 33kV feeders supplying North Sydney are over 40 years old and are required to be replaced within the next 5-10 years. The 11kV switchgear, together with transformer No.1 are approaching the end of their useful life within the next 5-10 years. The 11kV switchgear replacement will be carried out after the completion of switchgear replacement at Crows Nest zone substation.



1.1.2 Subtransmission Substations

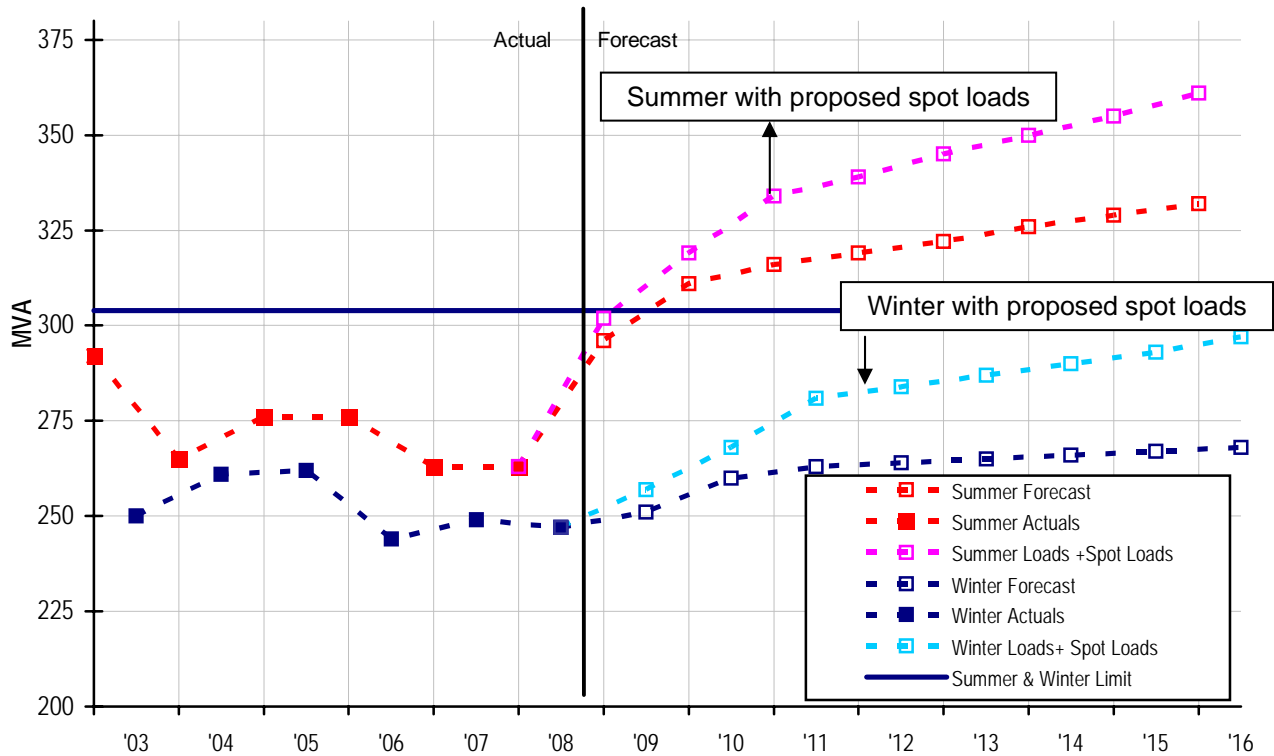
Supply to Lower North shore area which includes Royal North Shore Hospital loads is normally provided from Willoughby STS.

Willoughby Subtransmission Substation (STS)

Willoughby STS has a firm capacity of 304MVA in both summer and winter limited by transformer capacity. Willoughby STS is forecast to reach its firm capacity by summer 2009/10 even without considering the RNSH load growth. Willoughby STS does not have sufficient capacity to supply the additional RNSH load.

The load forecast of Willoughby STS is detailed as below:

Willoughby Subtransmission Substation
(based on summer 07/08 and winter 2008 actuals)



	Actual						Forecast							
	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
SUMMER														
Load	292.8	264.8	276.6	276.6	263.7	262.6	296.0	311.0	316.0	319.1	322.3	325.6	328.8	332.1
Load+Spot Loads	292.8	264.8	276.6	276.6	263.7	262.6	302.1	319.2	334.2	339.3	344.5	349.8	355.0	360.8
Limit	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0
WINTER														
Load	250.8	261.1	262.2	243.5	248.7	246.6	251.0	260.1	262.9	264.0	265.0	266.1	267.2	268.2
Load+Spot Loads	250.8	261.1	262.2	243.5	248.7	246.6	257.1	268.3	281.1	284.2	287.2	290.3	293.4	296.9
Limit	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0

2 ISSUES

2.1 Applied Service Standard

EnergyAustralia is required to comply with service standards that are specified in the 'Design, Reliability and Performance Licence Conditions' (Licence Conditions), which were imposed on NSW distributors by the Minister for Energy on 1 October 2007. The design planning criteria are specified in Schedule 1 of the Licence Conditions and reliability standards are specified in Schedules 2 and 3. For existing network, a distributor must be as compliant as practicable with these requirements by 1 July 2014 and fully compliant by 1 July 2019. All new network elements must comply with these requirements.

The service standards that are applicable to a consideration of supply constraints affecting the Lower North Shore area are summarised below. For further details refer to the Licence Conditions or to EnergyAustralia's Network Management Plan.

Subtransmission substations (urban/non-urban)

With all elements in service, the thermal capacity is required to meet at least 115% of forecast demand.

For a failure of a single critical element (i.e. N-1 conditions) within a subtransmission substation, the forecast demand is not to exceed the thermal capacity. Recovery of load should be within one minute.

Zone substations and subtransmission network (urban/non-urban)

With all elements in service, the thermal capacity is required to meet at least 115% of forecast demand.

Following a failure of a single critical element (i.e. N-1 conditions), the network must be designed to recover supply within one minute for systems supplying >10MVA, and otherwise, within best practice repair times. For systems that supply >10MVA, the forecast demand of a zone substation or overhead feeder network may exceed the N-1 capacity for up to 1% of the year i.e. a total aggregate time of 88 hours per annum, up to a maximum of 20% above the N-1 capacity; and the forecast demand of an underground feeder network may not exceed the N-1 capacity.

2.2 Description of Network Issues

2.2.1 Capacity limitation

Willoughby Subtransmission Substation

Willoughby 132/33kV STS was commissioned in 1968 and is equipped with four 120MVA 132/33kV transformers. It has a firm capacity of 304MVA in both summer and winter limited by transformer capacity. The Willoughby STS is developed to its ultimate capacity and is forecast to be constrained in summer 2009/10 even without considering the future development load of 10-30MVA at Royal North Shore Hospital.

There are three relatively large future spot loads in this area which require supply (not included in the current load forecast) and are as below:

- Development of Royal North Shore Hospital and other associated development in the area in the order of 10-30MVA over a period of 10 years, starting in 2008.
- The projected increase in load associated with the Epping to Chatswood rail link of approximately 20MVA (new and existing loads)
- Gore Hill technology Park of around 7.0MVA by 2010.

Considering the above spot loads, Willoughby STS will not have sufficient capacity to supply these extra loads and is forecast to be constrained by summer 2009/10.

Gore Hill Zone Substation

Gore Hill 33/11kV zone substation supplies the existing RNSH load. The zone is not forecast to reach its firm capacity without considering the extra load from future RNSH. However, the zone would be constrained by summer 2010/11 considering the future RNSH loads.

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 Rules (Clauses 5.6.2(e) and (f)) requires 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 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. The proposed options for the RNSH load area (to address the projected limitations of the system) include new distribution network asset options that involve expenditure in excess of \$10 million. These options are classed as new large network assets and consequently EnergyAustralia published a Consultation Paper on 30th June 2008. This Consultation Paper included a preliminary application of the Regulatory test to options that had been identified to address the projected limitations. No

submission was received in response to the Consultation Paper. In addition, EnergyAustralia has previously provided notification of emerging constraints at Willoughby STS in the AESDR of 2006/07 and AESDR of 2007/08.

Clause 5.6.2(g) of the Rules requires DNSPs to include the economic analysis of possible options in their consultation on options. This paper has been prepared to consult on identified options which satisfy the regulatory test and meet the network performance standards set out in Schedule 5.1 of the Rules and limb (a) of the regulatory test must be applied to determine the option that satisfies the regulatory test. Under limb (a) of the regulatory test, the option that meets the test is the one that minimises the present value of costs compared with a number of alternative options in the majority of reasonable scenarios.

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

Two feasible options were considered for providing additional capacity to support the extra demand from RNSH redevelopment:

- Option 1: Development of a new 33/11kV RNSH Zone Substation
- Option 2: Development of a new 132/11kV RNSH Zone Substation

These options are discussed in detail in the following sections. The options have been considered in the context of the long term area strategy.

4.1 Demand Side Management

EnergyAustralia undertook an investigation of demand management options in early 2008 and found that there was a feasible DM strategy that would enable the need for this project to be deferred for one year (from summer 2009/10 to summer 2010/11). The strategy consists of network support agreements with several providers using embedded generation options and a small customer power factor correction program. These projects are currently under final development for implementation prior to summer 2009/10.

Subsequent to this decision, the forecast has changed and demand is now expected to be above the firm capacity at Willoughby in 2009/10 even with the DM initiatives in place. Since the substation is now expected to be delivered in 2011, the DM options will assist in reducing the level of load at risk during summer 2009/10 and 2010/11. No DM options were identified that could enable the proposed investment to be deferred further.

4.2 Option 1: Develop a new 33/11kV RNSH zone substation

Option 1 is to develop a new 33/11kV Zone Substation and associated 33kV feeders to meet the increased load requirement from the new RNSH development. As per the forecast, even without considering the proposed development of RNSH, Willoughby STS would be constrained in summer 2009/10. The additional load from the proposed RNSH development would exacerbate the constraint at Willoughby STS and require Crows Nest zone substation to be converted to 132/11kV operation before summer 2009/10 to relieve the constraint. Additionally, Willoughby STS would be constrained again in summer 2012/13 after the Crows Nest zone substation conversion, which requires North Sydney zone substation to be converted to 132/11kV operation before summer 2012/13 to relieve the constraint on the 33kV network supplied by Willoughby STS.

Due to the short time frame and resource availability, it is not physically practicable to convert the Crows Nest zone to 132/11kV operation by summer 2009/10 and convert the North Sydney zone to 132/11kV operation by summer 2012/13.

Hence, Option 1 is not considered as a feasible strategy. However for the comparison purpose this option is further analysed to reiterate that development of 132/11kV RNSH zone substation (option 2) still represents the least cost option.

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The proposed new RNSH zone substation will be initially equipped with two and provision for ultimately a three 33MVA 33/11kV transformer substation arrangement with three incoming 33kV feeders from Willoughby STS.

Option 1 consists of the following stages:

- **Stage 1** – Upgrade Crows Nest zone substation from 33/11kV to 132/11kV operation by 2009.
- **Stage 2** – Development of new 33/11kV RNSH zone substation by 2010.
- **Stage 3** – Upgrade North Sydney zone substation from 33/11kV to 132/11kV operation by 2012.
- **Stage 4** – Development of new 132/11kV Cremorne Junction zone substation by 2014.

Table 1: Area strategy with approximate timing and costs associated with Option 1			
Proposed Project	Net Present Cost (\$M)	Estimated Capital Cost (\$M)	Required Completion Date
Stage 1 – Upgrade Crows Nest zone substation from 33/11kV to 132/11kV operation	50.0	50.4	2009
Stage 2 – Development of new 33/11kV RNSH zone substation	26.4	29.3	2010
Stage 3 – Upgrade North Sydney zone substation from 33/11kV to 132/11kV operation	58.6	74.5	2012
Stage 4 – Development of new 132/11kV Cremorne Junction zone substation	59.5	95.3	2014
TOTAL	194.5	249.4	

This Final Report covers the Stage 2 part of the work only and Stage 1, 3 & 4 works will be covered under separate Final Report.

The estimated capital cost for Stage 2 – Development of 33/11kV RNSH zone substation is \$29.3M which includes easement, 11kV and 33kV feeder works. The total estimated capital cost including Stage 1, 2, 3 & 4 is \$249.4M.

4.3 Option 2: Develop a new 132/11kV RNSH zone substation

Option 2 is to develop a new 132/11kV Zone Substation with two 37.5MVA 132/11kV transformers. . The firm capacity of the 132/11kV RNSH zone substation will be 56MVA limited by the emergency rating of the transformers. The supply to the zone substation will require two 132kV feeders from Willoughby STS to new RNSH zone substation. This option will also facilitate the conversion of Crows Nest zone substation to 132/11kV operation and provide load relief for 33kV network supplied by Willoughby STS.

With this option, Willoughby STS will no longer be constrained till beyond 2025.

Stage 1 – Development of new 132/11kV RNSH zone substation by 2010.

Stage 2 – Upgrade Crows Nest zone substation from 33/11kV to 132/11kV operation by 2011

Stage 3 – Development of new 132/11kV Cremorne Junction zone substation by 2014.

Stage 4 – Upgrade North Sydney zone substation from 33/11kV to 132/11kV operation by 2016.

Proposed Project	Net Present Cost (\$M)	Estimated Capital Cost (\$M)	Required Completion Date
Stage 1 – Development of new 132/11kV RNSH zone substation	38.3	44.0	2010
Stage 2 – Upgrade Crows Nest zone substation from 33/11kV to 132/11kV operation	34.4	41.4	2011
Stage 3 – Development of new 132/11kV Cremorne Junction zone substation	45.4	78.2	2014
Stage 4 – Upgrade North Sydney zone substation from 33/11kV to 132/11kV operation	54.6	87.5	2016
TOTAL	172.6	251.1	

This Final Report covers the Stage 1 part of the work only and Stage 2, 3 & 4 works will be covered under separate Final Report. In order to facilitate the 132kV feeder connections to RNSH zone substation, 132kV Crows Nest zone substation, new Cremorne Junction zone substation and 132kV North Sydney zone substation, 132kV switchgear at Willoughby STS requires redevelopment by 2012. This redevelopment work is included in Stage 1 – Development of new 132/11kV RNSH zone substation.

The estimated capital cost for Stage 1 – Development of new 132/11kV RNSH zone substation is \$44.0M which includes easement, 11kV feeder works, 132kV feeder works, RNSH zone substation construction and reconfiguration of Willoughby STS. The total estimated capital cost including Stage 1, 2, 3 & 4 is \$251.1M.

5 ANALYSIS OF OPTIONS

Economic analysis has been carried out for the period 2007/08 to 2019/20. This analysis involves the comparison of options on an economic basis by carrying out NPC analysis for each of the two options.

EnergyAustralia has included a range of parameters in comparison of options such as change in discount rates and variations in zone, transmission and feeder costs. In summary, the two options as presented are technically and economically comparable, given due consideration to all capital costs and operating costs that are able to be defined and quantified.

5.1 Base Case Analysis

The options considered are ranked by cost considering 8.5% discount rate as the base case in the following table. The options are considered in the context of the broader area strategy.

Description	NPC (\$M)	Cost (\$M)
Option 2: Develop a new 132/11kV RNSH zone substation	172.6	251.1
Option 1: Develop a new 33/11kV RNSH zone substation	194.5	249.4

As per the above table Option 2 is the least cost strategy.

The analysis above indicates that under base case conditions, the NPC of Option 2 is the least cost solution irrespective of Option 1 not being a feasible strategy.

Refer to APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE for the detailed analysis.

5.2 Sensitivity Analysis

Sensitivity Analysis was carried out to consider the impact of different discount factors and price variations. The base case and the range over which sensitivity checks were conducted are shown in Table 4.

Parameter	Base Case Value	Cases Considered
<i>Discount Rate</i>		
Real Discount Rate	8.5%	7% and 10%
<i>Cost Variations</i>		
Zone Costs	100%	75% and 125%
Transmission Costs	100%	75% and 125%
132kV or 33kV Feeder Costs	100%	75% and 125%
<i>Load Growth</i>		
Load Growth	100%	50% and 150%

5.2.1 Results of Sensitivity Analysis

The results of the sensitivity analysis are provided in Table 5.

Parameter		Option 1		Option 2	
		NPC (\$M)	Cost (\$M)	NPC (\$M)	Cost (\$M)
Real Discount Rate 8.5% (Base Case)		194.5	249.4	172.6	251.1
Real Discount Rate 7%		204.8	249.4	185.3	251.1
Real Discount Rate 10%		185.0	249.4	161.1	251.1
Zone Costs	25% Increase	218.2	279.0	192.3	280.1
	25% Decrease	170.8	219.8	152.9	222.2
Transmission Costs	25% Increase	201.3	257.5	180.8	261.3
	25% Decrease	187.7	241.3	164.4	241.0
132kV or 33kV feeder Costs	25% Increase	212.7	274.9	187.9	275.6
	25% Decrease	176.3	223.9	157.3	226.6
Load Growth	50% Increase	194.5	249.4	172.6	251.1
	50% Decrease	194.5	249.4	172.6	251.1

The results of the sensitivity analysis reiterates that Option 2 – Development of new 132/11kV RNSH zone substation is the least cost option under all sensitivity scenarios.

6 CONCLUSION AND RECOMMENDED ACTION

Option 2 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 develop a new 132/11kV RNSH zone substation, install associated 132kV feeders, and reconfigure Willoughby STS 132kV switchgear. When considered in the context of the long term area strategy, Option 2 is the least cost option and is the preferred strategy should the development of Royal North Shore Hospital take place.

The estimated capital cost of this option is \$44.0M which includes Stage 1 works consisting of commissioning of new 132/11kV RNSH zone substation, associated 132kV feeders cost and reconfiguration of Willoughby STS. The project is scheduled for completion in 2010/11 (Willoughby STS reconfiguration will be completed by 2011/12).

This service 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 CONTACT DETAILS FOR ENQUIRIES

This report recommends the construction of a new large distribution network asset. Registered Participants may dispute the recommendations of the report under Clause 5.6.2(i) of the Rules. Registered Participants who intend to dispute the recommendations of this report must do so within 40 business days of the report being published and made available on EnergyAustralia's website.

Any enquiries regarding this report should be directed to the contact listed below:

John Hele

A/Manager – Network Investment

GPO BOX 4009

Sydney 2001

Email: jhele@energy.com.au

Phone: 02 9269 2862

8 APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE

Discount Rate = 8.5%

All figures are in 2007/08 real dollars.

Discount Factor **8.5%**

Option 1 - Development of new 33/11kV RNSH North zone substation

Description	NPC (\$M)	Capex (\$M)	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Conversion of Crows Nest zone to 132/11kV															
Disconnect feeder 919 & 929 from Willoughby STS	0.92	1.07	-	0.07	1.00	-	-	-	-	-	-	-	-	-	-
Willoughby STS feeder 9E3 & 9E5 132kV RMI and feeder works	15.28	15.71	10.21	5.50	-	-	-	-	-	-	-	-	-	-	-
New 132kV feeders from Willoughby to Crows Nest zone	15.27	16.42	3.30	11.48	1.64	-	-	-	-	-	-	-	-	-	-
Conversion of Crows Nest zone from 33/11kV to 132/11kV	15.57	17.16	-	13.75	3.41	-	-	-	-	-	-	-	-	-	-
O & M Cost	2.94		-	-	0.11	0.42	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Total (Stage 1)	49.98	50.36	13.51	30.91	6.48	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
New 33/11kV RNSH zone															
Construct new RNSH zone at 33/11kV	16.90	19.70	0.95	2.84	13.23	2.69	-	-	-	-	-	-	-	-	-
Three 33kV Feeder Works & Connections from Willoughby STS to RNSH zone	6.67	8.00	-	1.00	4.00	3.00	-	-	-	-	-	-	-	-	-
11kV works + load transfer from Gore Hill zone	1.31	1.56	0.05	0.23	0.74	0.54	-	-	-	-	-	-	-	-	-
Easement	0.00	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-
O & M Cost	1.49		-	-	-	-	0.25	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Total (Stage 2)	26.37	29.26	0.99	4.06	17.97	6.49	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Conversion of North Sydney zone to 132/11kV															
Replacement of North Sydney zone 11kV switchgear	7.04	8.99	-	-	0.45	8.09	0.45	-	-	-	-	-	-	-	-
New 132kV feeders from Willoughby to North Sydney zone	20.52	29.63	-	-	-	0.00	14.44	15.18	-	-	-	-	-	-	-
Conversion of North Sydney zone from 33/11kV to 132/11kV	30.43	41.06	-	-	0.71	13.50	24.88	1.97	-	-	-	-	-	-	-
Selling of existing North Sydney zone land	-2.12	-5.21	-	-	-	-	-	-	-	-	-	-	-	-5.21	-
O & M Cost	2.75		-	-	-	-	-	0.11	0.63	0.82	0.82	0.82	0.82	0.82	0.82
Total (Stage 3)	58.62	74.46	-	-	1.16	21.59	39.88	17.79	0.82	0.82	0.82	0.82	0.82	-4.39	0.82

FINAL REPORT - DEVELOPMENT OF NEW 132KV ROYAL NORTH SHORE HOSPITAL ZONE SUBSTATION

Description	NPC (\$M)	Capex (\$M)	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
New Cremorne Junction 132/11kV zone															
Willoughby STS feeder 925/1 132kV RMI and feeder works	4.61	7.70	-	-	-	-	-	-	5.50	2.20	-	-	-	-	-
Willoughby STS feeder 9E4 132kV RMI and feeder works	4.70	7.85	-	-	-	-	-	-	5.60	2.25	-	-	-	-	-
New 132kv feeders from Willoughby STS to Cremorne Junction zone	28.94	47.96	-	-	-	-	-	1.09	36.13	10.74	-	-	-	-	-
New Cremorne Junction 132/11kV zone	19.50	31.82	-	-	-	-	-	4.71	20.40	6.28	-	-	-	-	-
O & M Cost	1.77		-	-	-	-	-	-	-	-	0.51	0.88	0.88	0.88	0.88
Total (Stage 4)	59.52	95.33	-	-	-	-	0.44	5.80	67.63	21.98	0.88	0.88	0.88	0.88	0.88
TOTAL	194.49	249.42	14.50	34.98	25.61	28.60	41.17	24.43	69.29	23.65	2.55	2.55	2.55	-2.66	2.55

FINAL REPORT - DEVELOPMENT OF NEW 132KV ROYAL NORTH SHORE HOSPITAL ZONE SUBSTATION

Discount Rate = 8.5%

All figures are in 2007/08 real dollars.

Option 2 - Development of new 132/11kV RNSH zone substation

Description	NPC (\$M)	Capex (\$M)	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Disconnect feeder 919 & 929 from Willoughby STS	0.92	1.07	-	0.07	1.00	-	-	-	-	-	-	-	-	-	-
Willoughby STS feeder 9E4 & 9E5 132kV RMI and feeder works	19.02	23.85	-	1.40	6.74	10.89	4.82	-	-	-	-	-	-	-	-
New 132/11kV RNSH zone															
Construct new RNSH zone at 132/11kV	12.54	14.93	0.27	2.26	7.14	5.26	-	-	-	-	-	-	-	-	-
Two 132kV Feeder Works & Connections to RNSH zone	2.16	2.53	-	0.16	2.37	-	-	-	-	-	-	-	-	-	-
11kV works + load transfer from Gore Hill zone	1.35	1.60	0.03	0.24	0.77	0.56	-	-	-	-	-	-	-	-	-
Easement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
O & M Cost	2.28		-	-	-	0.00	0.21	0.40	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Total (Stage 1)	38.26	43.99	0.30	4.14	18.02	16.71	5.03	0.40	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Conversion of Crows Nest zone to 132/11kV															
Willoughby STS feeder 9E3 132kV RMI and feeder works	6.49	7.85	-	-	5.10	2.75	-	-	-	-	-	-	-	-	-
New 132kV feeders from Willoughby to Crows Nest zone	12.97	16.42	-	-	3.30	11.48	1.64	-	-	-	-	-	-	-	-
Conversion of Crows Nest zone from 33/11kV to 132/11kV	13.23	17.16	-	-	-	13.75	3.41	-	-	-	-	-	-	-	-
O & M Cost	1.67		-	-	-	-	0.06	0.32	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Total (Stage 2)	34.36	41.43	-	-	8.40	28.03	5.37	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Conversion of North Sydney zone to 132/11kV															
Replacement of North Sydney zone 11kV switchgear	7.04	8.99	-	-	0.45	8.09	0.45	-	-	-	-	-	-	-	-
New 132kV feeders from Willoughby to North Sydney zone	16.31	31.05	-	-	-	-	-	-	-	6.21	21.74	3.11	-	-	-
Conversion of North Sydney zone from 33/11kV to 132/11kV	22.83	43.41	-	-	-	-	-	-	-	7.87	32.55	2.99	-	-	-
Selling of existing North Sydney zone land	-2.12	-5.21	-	-	-	-	-	-	-	-	-	-	-	-5.21	-
O & M Cost	1.30		-	-	-	-	-	0.11	0.12	0.12	0.12	0.12	0.66	0.86	0.86
Total (Stage 3)	45.35	78.24	-	-	0.45	8.09	0.56	0.12	0.12	14.20	54.40	6.76	0.86	-4.35	0.86

FINAL REPORT - DEVELOPMENT OF NEW 132KV ROYAL NORTH SHORE HOSPITAL ZONE SUBSTATION

Description	NPC (\$M)	Capex (\$M)	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
New Cremorne Junction 132/11kV zone															
Willoughby STS feeder 925/1 132kV RMI and feeder works	4.61	7.70	-	-	-	-	-	-	5.50	2.20	-	-	-	-	-
New 132kV feeders from Willoughby STS to Cremorne Junction zone	28.94	47.96	-	-	-	-	-	1.09	36.13	10.74	-	-	-	-	-
New Cremorne Junction 132/11kV zone	19.50	31.82	-	-	-	-	-	4.71	20.40	6.28	-	-	-	-	-
O & M Cost	1.57		-	-	-	-	-	-	-	-	0.46	0.78	0.78	0.78	0.78
Total (Stage 4)	54.62	87.48	-	-	-	-	0.44	5.80	62.03	19.67	0.78	0.78	0.78	0.78	0.78
TOTAL	172.59	251.14	0.30	4.14	26.87	52.78	11.03	6.63	63.11	34.38	55.82	7.95	2.40	-2.61	2.60