Project Justification: Smithfield West Substation Upgrade

2025-2030 Revised Regulatory Proposal

Supporting document 5.4.2.4

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SA Power Networks

Empowering South Australia

Contents

Document Control

Version	Date	Author	Notes
0.0	November 2024		
0.1	December 2024		

Glossary

Acronym / term	Definition
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
BCR	Benefit Cost Ratio
BESS	Battery Energy Storage System
Capex	Capital expenditure
CER	Customer Energy Resources
DLF	Distribution Loss Factor
DSP	Demand-Side Participation
EAC	Equivalent Annual Cost
EOI	Expression of Interest
EMCa	Energy Market Consulting Associates
ESOO	Electricity Statement of Opportunities
EV	Electric Vehicle
HEMS	Home Energy Management Systems
KV	Kilo Volt
ISP	Integrated System Plan
LV	Low Voltage
MWh	Mega Watt hour
MVA	Mega Volt Ampere
NER	National Electricity Rules
NSSA	Network System Support Agreements
NPV	Net Present Value
POE	Probability of Exceedance
RCP	Regulatory Control Period
RIT-D	Regulatory Investment Test for Distribution
RIT-T	Regulatory Investment Test for Transmission
SAPS	Stand-Alone Power Systems
SCADA	Supervisory Control and Data Acquisition
URD	Urban residential development
USE	Unserved Energy
VCR	Value of Customer Reliability

1 About this document

1.1 Purpose

This project justification document addresses the need to manage the forecast risk of unserved energy for customers supplied by the Smithfield West Substation.

This document describes the need, identifies and evaluates options to address the need, and selects a preferred option for investment which is proposed to be delivered as part of SA Power Networks' capacity augmentation program for the 2025-30 Regulatory Control Period (**RCP**).

1.2 Expenditure category

- Network capex: augmentation

1.3 Related documents

Table 1: Related documents

Ref	Title
Attachment 5	Capital Expenditure Revised Proposal
5.4.2	Augex Capacity Business Case Addendum

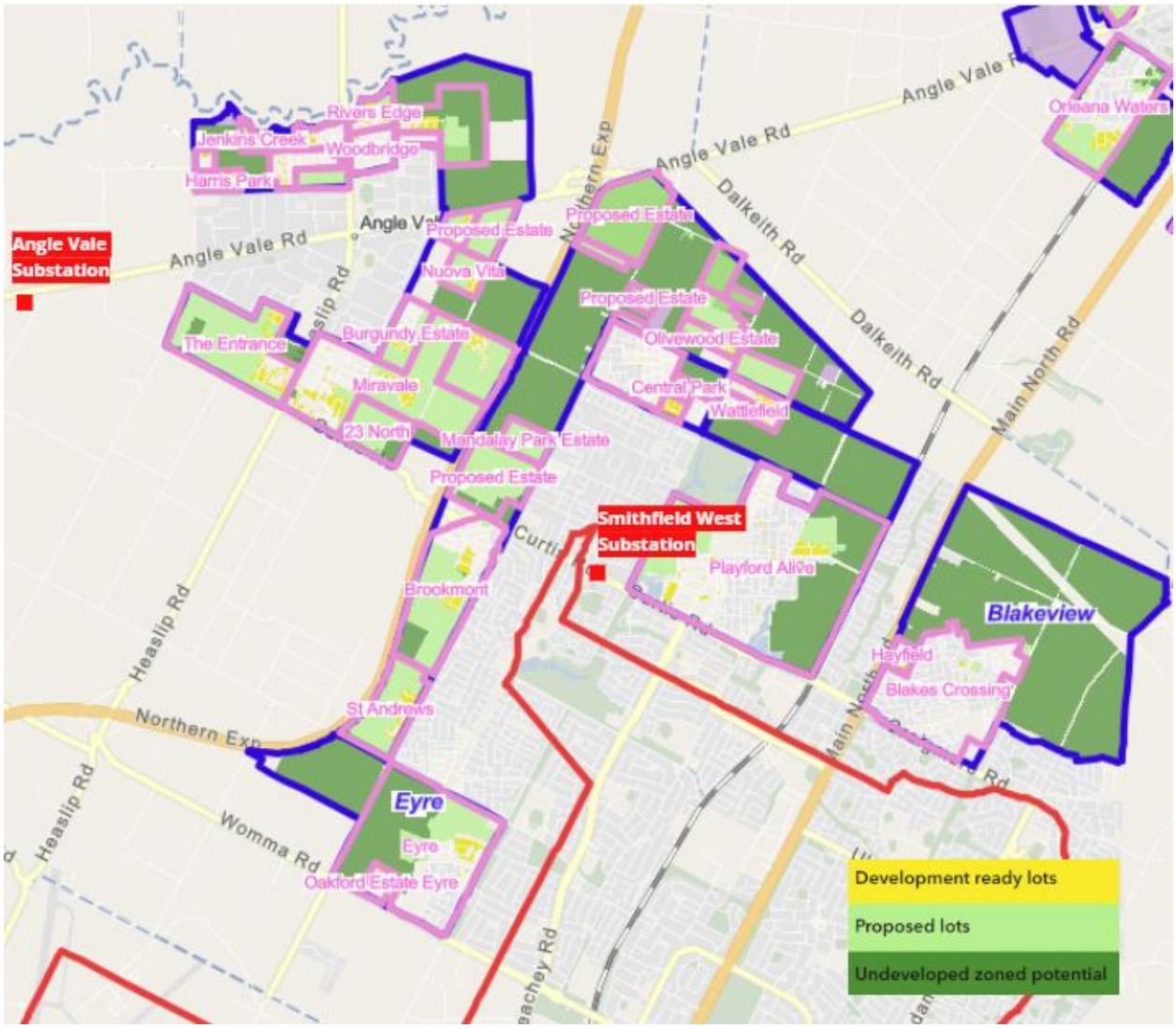
2 Background and identified need

The identified need for this project, is pursuant to the overarching identified need described in section 4 of our Revised Proposal Supporting Document 5.4.2 Augex capacity business case addendum, described in more detail below.

The Smithfield West substation is experiencing one of the fastest growth rates in SA Power Networks' distribution network. It supplies the surrounding suburbs of Smithfield Plains, Munno Para and Andrews Farm located in the outer northern suburbs of the Adelaide metropolitan area. The Smithfield West substation supplies electricity to over 10,000 customers and currently has four 11kV feeders and a single 32MVA transformer.

The South Australian Department for Infrastructure and Transport's Playford Growth Area Structure Plan[1] has led to significant re-zoning around the substation, with multiple Urban Residential Developments (**URDs**) contributing to substantial residential growth[2], within Playford Alive, Mandalay Park, Brookmont, St Andrews, Olivewood, Roberts Farm, Mandorla, Aria Park, and Wattlefield developments. This expansion is illustrated in Figure 1.

Figure 1 - Smithfield residential re-zoning[2]



[1] http://www.dit.sa.gov.au/__data/assets/pdf_file/0005/283091/Structure_Plan_combined.pdf
[2] https://plus.geodata.sa.gov.au/landsupply/index.html

A contingency (N-1) constraint has been identified, which, in the event of a single transformer or radial incoming 66kV line fails under 50 PoE conditions, would necessitate load transfers to other substations. However, these transfers would be insufficient to supply all load, leading to increasing load at risk over the RCP, outlined in Table 2.

Table 2: Forecast Load at Risk

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34
N-1 Rating (MVA)	21.3	20.5	20.2	19.9	19.4	18.9	18.5	18.0	17.5	16.2
10POE Forecast (MVA)	28.4	28.9	29.9	31.1	32.7	33.7	34.7	35.7	36.8	37.8
10POE Load At Risk (MVA)	7.1	8.4	9.7	11.3	13.2	14.7	16.2	17.7	19.2	21.5
50POE Forecast (MVA)	26.0	26.6	27.5	28.7	30.1	31.1	32.0	33.0	34.0	35.0
50POE Load At Risk (MVA)	4.8	6.1	7.3	8.8	10.7	12.1	13.6	15.0	16.5	18.8

Contingency modelling projects a total energy at risk of 27.8MWh during the 2025-30 RCP under 50 PoE conditions, escalating to 50.9MWh under 10 PoE conditions. An additional N substation constraint is forecast for Smithfield West in 2034, which has been factored into the long-term value of the proposed solution. The need for augmentation has been previously deferred by constructing a new feeder tie between Smithfield West and Angle Vale substations in 2023. The anticipated future load surpasses the capacity of any mobile substations owned by SA Power Networks.

3 Comparison of options

3.1 The options considered

SA Power Networks has evaluated options to increase capacity and ensure security of supply for our customers in the Smithfield region, including the deferral of investment, the installation of a second transformer and distribution feeder works.

Table 3: Summary of options considered

Option	Description
Option 0 – Defer upgrade	Option 0 entails the transfer of load to adjacent substations under an N-1 contingency, and the load shedding of customers via remote switching when load cannot be fully transferred to adjacent substations within network limits. Option 0 is associated with significant unserved energy risk, in the 2025-30 RCP under 50 PoE forecast following an N-1 contingency. 2025-30 RCP Capex: $0 Total Capex: $0
Option 1 – Substation upgrade	Option 1 entails the installation of a second 32MVA transformer at Smithfield West, and a new 66kV line bay and 66kV bus section. A schematic line diagram of Option 1 is shown below in Figure 2 This Option will alleviate both the forecast N and N-1 substation constraints, removing all energy at risk, as well as de-radialise the substation transformer and incoming 66kV line. Design of this option is planned to begin in 2028, with construction completing in 2029, which is the estimated optimal year of investment, as shown in Figure 3. The primary risks associated with Option 1 are those relating to implementation and potential cost overruns. 2025-30 RCP Capex: $6,858,000 Total Capex: $6,858,000
Option 2 – Deferral feeder restring	Option 2 involves deferring the second transformer (Option 1) by restringing 4.2 km of conductor on the GA22 feeder and installing voltage regulators to increase the amount of load that can be transferred from Smithfield West to Evanston substation. Design of this option would begin in 2027, with construction completing in 2028, using optimal timing. This feeder restring only partially alleviates the load at risk. After the completion of the feeder restring, the optimal year of investment for the substation upgrade is 2031, requiring design to commence in 2030. This option does not prevent an interruption or alleviate the substation N constraint that is forecast beyond the 2025-30 RCP. Therefore, the substation upgrade is still required, but partly deferred until the 2030-35 RCP. It also does not address as much energy at risk as Option 1. 2025-30 RCP Capex: $3,282,000 Total Capex: $8,769,000
Option 3 – Deferral network support battery	Option 3 involves installation of a network support battery on the 11kV bus within the substation. The option is to defer substation upgrade works (Option 1) beyond the 2025-30 RCP. The battery would require a 2MW inverter and a total storage capacity of 2MWh. Upon investigation, the battery would not have optimal timing within the analysis period, and it has therefore been dismissed as a viable option. Smaller batteries are also infeasible, as they are insufficient to defer the substation upgrade.

Figure 2 - Option 1 Smithfield West substation line Diagram

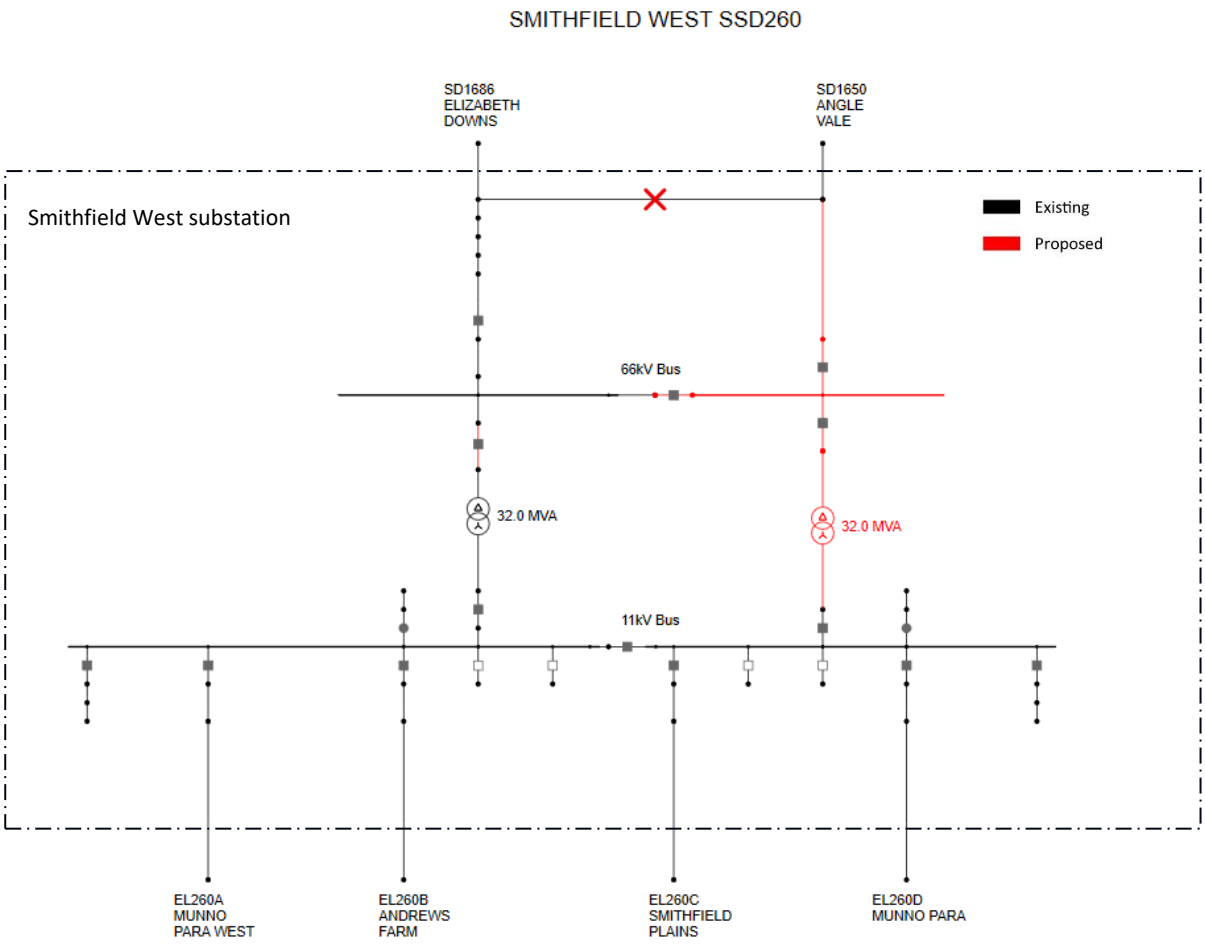
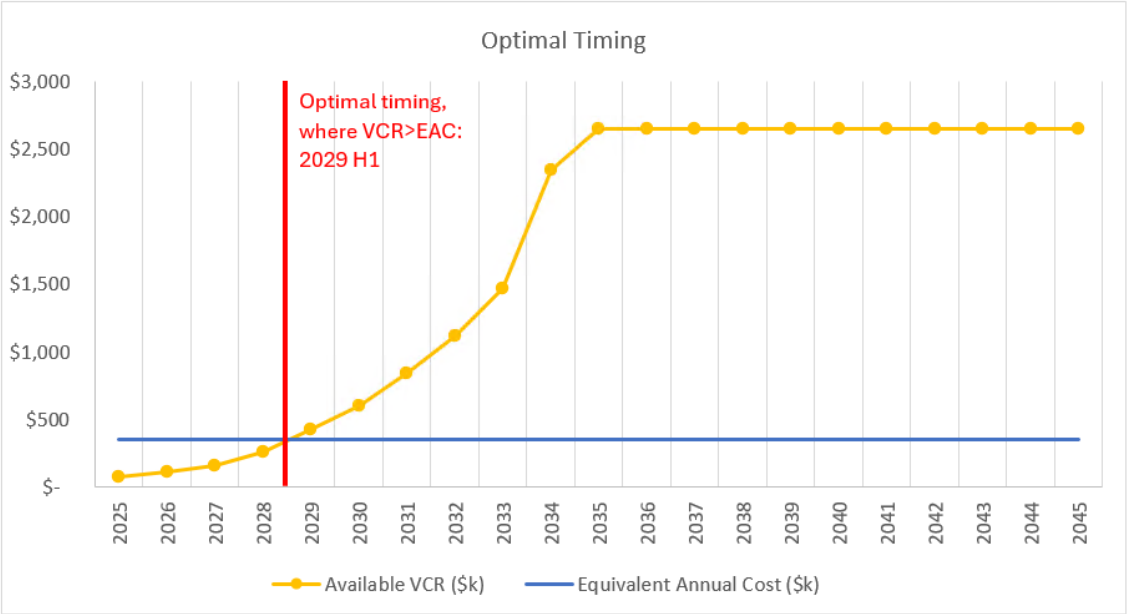


Figure 3 - Option 1 Optimal Timing



3.2 Options investigated but deemed non-credible

SA Power Networks assessed a network support battery to defer the network constraint. The proposed network support battery would provide opportunities to promote integration of renewable energy and reduce peak demand, which further contribute to the decarbonisation of SA's electricity supply. There are significant challenges that hinder battery storage long term feasibility, particularly the high cost, storage degradation and relatively short life span of the battery equipment. Although battery technology is rapidly developing and costs are decreasing, the option was not economically viable to pursue due to the short-term network benefits and projected high demand growth.

Similarly, non-network solutions, such as procuring services from VPPs, were deemed as likely not viable due to the high load at risk and forecast high demand growth. SA Power Networks plans to issue an expression of interest to seek potential non-network solutions from the market participants for addressing the constraint. Assessment of the submissions received will occur as part of the Regulatory Investment Test – Distribution (**RIT-D**) process.

In addition, SA Power Networks is working with Australian Renewable Energy Agency (**ARENA**) to deliver network support batteries at regional locations to defer costly network augmentation. The network support function provided by the batteries will assist in managing network constraints. The proposed network support batteries are currently in progress and will provide insights to improve internal structures and develop industry knowledge that will improve efficiency and streamline implementation of future utility scale battery storage. SA Power Networks is working to continuously innovate and identify opportunities for the technology.

3.3 Evaluation of options

3.3.1 Quantified benefits and risks

The costs and net present value (**NPV**) of alternative options relative to the base case over a 20-year period are shown in Table 4, based on the Australian Energy Market Operator's (**AEMOs**) "Central" scenario parameters (i.e., demand and discount rate). Information on the planning and evaluation methodology is provided in '*SAPN 2025-30 Reset Business Case – Augex Capacity*' submitted with our Original Proposal and '*SAPN 5.4.2 Augex capacity - Business case addendum'* submitted with our Revised Proposal.

Table 4: Costs and NPV over the 20-year forecasting period[3]

Options	Cost (25-30 RCP $k)	Cost (Total $k)	NPV ($k)	BCR	Ranking
Option 0 - Defer Augmentation	$0	$0	$0	-	3
Option 1 - Smithfield West sub upgrade	$6,858	$6,858	$16,350	3.71	1
Option 2 – Deferral feeder restring	$3,282	$8,769	$15,327	3.10	2
Option 3 – Deferral battery	-	-	-	-	-

3.3.2 Project selection

As the benefit cost ratio (**BCR**) of Option 1 exceeds 1.2, a deferral test has not been undertaken, and we consider this a no-regrets investment.

[3] All costs expressed in Jun $ 2022 without overheads.

3.3.3 Scenario and sensitivity analysis

The sensitivities of the NPV with respect to cost and discount rate are reflected in three scenarios as shown in Table 5.

Table 5: Sensitivity Analysis

% Cost	NPV ($k)			Discount Rate	NPV ($k)		
	Option 0	Option 1	Option 2		Option 0	Option 1	Option 2
70%	$0	$17,658	$16,888	**3.50%**	$0	$17,883	$16,894
100% (Central)	$0	$16,350	$15,327	**4.05% (Central)**	$0	$16,350	$15,327
130%	$0	$15,091	$13,909	**4.50%**	$0	$15,191	$14,184

Option 1 demonstrates the highest NPV for all sensitivities considered.

3.3.4 Unquantified benefits

The Smithfield West substation currently presents operational complexity as the whole substation must be offloaded for most planned maintenance, and there are limited windows during the year to do this, which are expected to reduce over time. Option 1 will result in only partial offloads being required for planned maintenance, reducing this complexity.

The installation of a second transformer (as in Option 1 and Option 2) is in line with the long-term strategic plan for the network, providing capacity headroom which has not been valued, which will reduce the need for investment in the future.

The 66kV bus works, delivered as part of the substation upgrade, will de-radialise Smithfield West Substation in the Metro North 66kV system, improving overall reliability and operability of the system. The meshing of Smithfield West is aligned with the long-term plans for the Metro North 66kV system, which is impacted by rapid growth in the outer Metro North region.

4 Recommendation

The recommended option based on the options evaluation presented in this report is Option 1, as this meets the requirements of the need, is technically and economically feasible, and has the greatest BCR and NPV, for all sensitivities. Option 1 mitigates significant unserved energy risk by preventing the breaching of a substation N-1 constraint and N constraint under both the 10 PoE and 50 PoE forecasts.

Option 2 has a lower BCR and NPV than Option 1 in all scenarios, as well as a higher total cost and results in greater energy at risk. Option 3 was not considered feasible as the optimal timing does not fall within the 2025-30 RCP.

Option 0 has the lowest cost of all options but ranked last in NPV due to significant unserved energy risks and additionally would fail to meet SA Power Networks customer's expectations in terms of reliability, and is therefore least preferred.