Augmenting Supply to the Southern Macarthur Growth Area

Options Screening Report

8 April 2024

Endeavour Energy

POWER together

Contents

1.0 Introduction

The Southern Macarthur Growth Area is located in the south-west of Sydney and includes parts of the local government areas of Campbelltown, Camden and Wollondilly. The area is supplied by a 66kV overhead network supplying four zone substations at the village townships of Appin, Maldon, Tahmoor and Wilton and also supplies several major customers in diverse business activities including mining, agriculture, water supply and building materials manufacturing.

The area is planned to grow significantly during the period up to 2040 based on the NSW Government's ***Greater Macarthur 2040 Plan***. The plan outlines the release of residential housing lots, development of new town centres and the release of employment lands. Land use zoning is being changed to support the development of the widespread increase in residential housing in the area. The 66kV electricity supply network will require augmentation to support the forecast increase in electricity demand in the area.

The major development precincts within the Southern Macarthur area include:

- The Menangle Park and Mount Gilead area to include over 15,000 new residential dwellings and 24 hectares of employment land.
- The Wilton area to include over 15,000 new residential dwellings and 300 hectares of employment land.
- The West Appin area to include over 20,000 new residential dwellings and 30 hectares of employment land.

While these developments will not fully mature until 2040 and beyond, the early stages of development will require significant augmentation to the existing electricity supply in the area.

The existing 66kV supply to the area is not capable of providing the supply capacity required to support these developments. While there will be additional network investments required in the area over the next 15 years to support the connection of these new customers, it is the 66kV network that requires augmentation.

We are therefore commencing this Regulatory Investment Test for Distribution (RIT-D) to determine the most economically efficient means to provide additional secure supply to the Southern Macarthur Growth Area.

This identified need was included in our recent Distribution Annual Planning Report released in December 2023 and has been included in our regulatory submission covering the period 2025 to 2029.

This Options Screening Report (OSR) sets out the reasons for our determination that there could be a non-network option that could form a potential credible option on a standalone basis, or that could form a significant part of a credible option for the Southern Macarthur Growth Area RIT-D, in accordance with NER clause 5.17.4(c).

This report is the first formal stage of the RIT-D to address the supply requirements of the Southern Macarthur Growth Area and we are seeking options from non-network proponents.

The second formal stage of this RIT-D will be a Draft Project Assessment Report (DPAR), which will include a net present value (NPV) economic assessment of all credible options including potential options submitted in response to this OSR.

Endeavour Energy applies a probabilistic planning methodology to evaluate network constraints and the value of expected unserved energy in order to determine the optimal timing for network augmentation investments. This is for the benefit of all stakeholders and ensures that network investment is neither too early or too late but maximises the benefits for all stakeholders including existing customers and new customers planning a future network connection.

Network augmentation investment will commence only when there is a high degree of certainty that the anticipated customer connections and their corresponding network demand will proceed.

Furthermore, newly connecting customers will contribute to the costs of the network augmentation investment via their 'Distribution Use of System' tariffs.

1.1 Invitation for submissions

We invite submissions from any suppliers or proponents of non-network options. We are interested in exploring all potential non-network solutions that may meet the requirements of the Southern Macarthur Growth Area.

We recognise that some proponents may require clarification of aspects of this report and encourage contact with us as early as possible to ensure adequate time is available for their submission.

Submissions must be lodged with us on or before **15 July 2024**.

If you have any comments or enquiries regarding this report please send them to the Portfolio Management Office at consultation@endeavourenergy.com.au.

1.2 Next Steps

Following consideration of submissions made in response to this Options Screening Report, we will prepare a Draft Project Assessment Report (DPAR). The DPAR will present a detailed assessment of all credible options to address the identified need at Southern Macarthur and include a summary and commentary on submissions received to this report.

At this stage, we intend to publish the DPAR in the second half of calendar 2024.

2.0 Identified Need

This section sets out the 'identified need' for this RIT-D and provides the detailed information to enable the development of credible options. The key assumptions that underpin the identified need are outlined including a background into the relevant geographic area of our network.

These assumptions have been used in making our determination that a non-network option could form a significant part of a potential credible option for this RIT-D and are provided to assist proponents prepare credible solutions.

2.1 Relevant area of our network

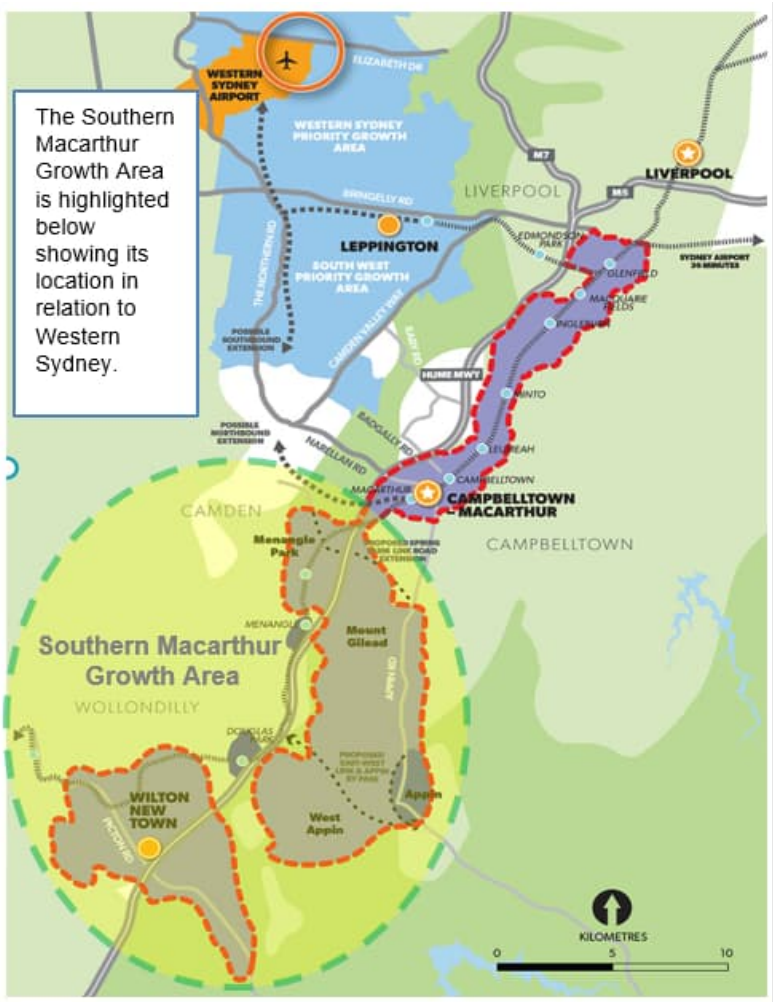
The Southern Macarthur area is located approximately 50km south-west of Parramatta. It is south of Campbelltown and the village of Douglas Park is approximately the geographic centre of this area. We have used the place name of 'Southern Macarthur' to help represent the identified need for the supply of electricity to this area.

Figure 1 below shows the geographic location.

Figure 1 – Southern Macarthur in relation to Western Sydney and Parramatta

Figure 2 below shows the Southern Macarthur Growth Area and its relation to the major precincts in NSW Planning's 2040 plan for the Greater Macarthur area. The Menangle Park, Appin and Wilton areas will see major development that will transform the existing rural residential villages into town centres with large new developments of residential dwellings.

Figure 2 – Southern Macarthur Growth Area including the precincts in the Macarthur 2040 Plan by NSW Planning



2.2 Planning Methodology

Endeavour Energy applies a probabilistic planning methodology to evaluate the customer needs and the network constraints and the value of expected unserved energy in order to determine the appropriate timing for network augmentation projects. Network constraints are analysed in terms of the load at risk, energy at risk and the expected unserved energy. The trigger for initiating network investment is based on a cost benefit analysis and compares the annualised cost of the preferred network option with the option benefits. Network augmentation is only taken further if the option benefit or the reduction in the cost of expected unserved energy outweighs the network augmentation cost required to reduce the unserved energy.

The analysis of the Southern Macarthur growth area takes into account the limited existing supply in the area and the fact that the area is mainly supplied from two 66kV overhead feeders. The Southern Macarthur area also includes embedded generation related to certain mining operations. The level of embedded generation provides supply to the area, however it is variable in nature and is not under the control of the distribution network service provider and cannot be solely relied upon to supply customers in the area.

Our planning methodology includes a thorough and conservative analysis of the demand forecast. Including the likelihood of delays in developments and the diversity of non-coincident customer maximum demand. We use three demand forecast scenarios to cover a range of outcomes to test the robustness of the planning. The optimal timing of the implementation of solution options is important to avoid being either too early or too late in meeting customer's needs and to optimise network augmentation timing for the benefit of all stakeholders.

2.3 Key assumptions underpinning the identified need

The identified need for this RIT-D is to increase the supply to the Southern Macarthur Growth Area. The area is subject to the NSW Government's "Greater Macarthur Plan 2040" which will result in the large release of land for residential dwellings and for employment lands. The existing supply capacity to the area is based on the historical customer base of rural residential villages and a small number of major customers. The key assumptions underpinning this are below:

- The demand forecast for the Southern Macarthur area is based on the government's plans to increase residential dwellings and industrial land. It also includes the moderate growth in the existing customer base and the small number of very large customers who take their supply directly from the 66kV network.

- The rate of development anticipated by the demand forecast for the Greater Macarthur 2040 Plan have been prudently moderated over the time period based on observation of major developer activity in the area and formal network connection enquiries.

- The existing 66kV supply network is capacity constrained and consists of two long route feeders to supply the four zone substations in the area and the major customers who take their supply directly from the 66kV network. The capacity constraint is seasonal based due to the continuous rating of the overhead feeders being lower in the summer period. The loss of one of the 66kV feeders during the peak demand summer period is likely to lead to loss of supply to customers.

- There is a large level of embedded generation within the area related to certain mining operations. The embedded generation provides a significant portion of the supply to the area, however it is privately owned and operated and the generation is dispatched to the National Electricity Market based on the availability of waste coal seam methane gas which is dependent upon mining operations. This generation cannot be solely relied upon to provide supply reliability to the standard required by our customers.

- There are numerous future network investments that will be required in the period from 2025 to 2040 to support the growth plans of the area, these include zone substations located closer to major residential housing estates and town centres. These investments are continuously being assessed and they would be enabled by increasing the supply to the area and in particular by augmenting the 66kV supply.

2.3.1 Demand Forecasts

We have developed our demand forecast for the Southern Macarthur Growth Area by considering the existing customer base, the expected new customers connecting to the network in relation to the Government's growth plans and the demand of the major customers including the level of embedded generation.

The existing customer base consists of customers supplied from our zone substations at: Appin, Maldon, Tahmoor and Wilton and the major customers who take supply directly from the 66kV network. We have extensive data and information on the historical demand of these customers. For the projected customer growth related to the release of land for residential dwellings we are guided by the Government's 2040 plan.

Table 1 below shows the planned land release precincts, dwelling numbers and employment lands (expressed in Hectares) identified by the NSW Government. The values shown are the final development plans projected for 2040 and provide a basis for Endeavour Energy's demand forecast. Our demand forecast is a conservative view of these projections and take into account the rate of development based on monitoring network connection requests from major developers and the development of other infrastructure including roads and water.

Table 1 – NSW Government's "Macarthur Growth Plan 2040" – Land Release and Dwellings by 2040.

Land Release Precinct	Number of Dwellings	Employment Land (Ha)
Menangle Park & Mount Gilead	18,100	24
Wilton New Town	16,600	344
West Appin	23,590	32
Total	**58,290**	**400**

Based on our analysis of the existing customer base including the level of embedded generation and the projected growth in the area we have developed three demand forecast scenarios, they are:

- a central demand scenario, where existing customer demand and growth proceeds at a level that we consider most likely and it assumes that the level of embedded generation continues at the **average** level of recent years;
- a low demand scenario, where existing customer demand and growth proceeds at a level that we consider most likely and it assumes that the level of embedded generation is at the **higher** end of the range over the recent years ; and
- a high demand scenario, where existing customer demand and growth proceeds at a level that we consider most likely and it assumes that the level of embedded generation is at the **lowest** end of the range over the recent years.

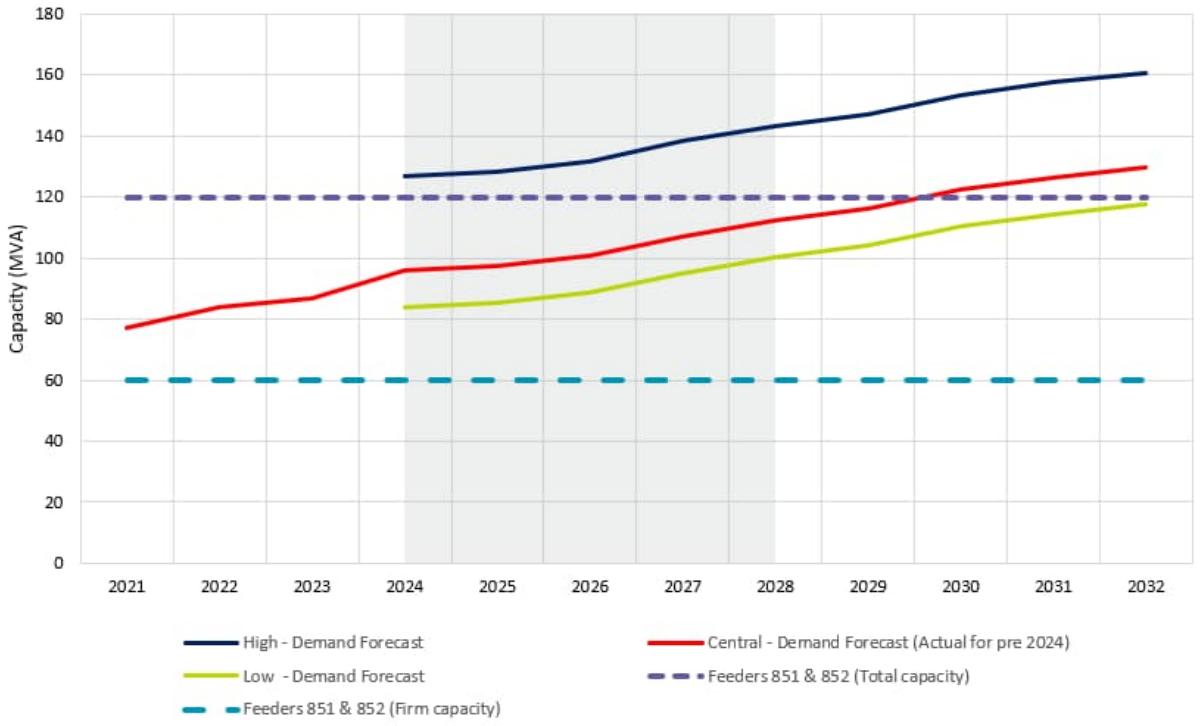
The demand forecast for the Southern Macarthur Growth Area is shown below in Table 2. It shows our three demand scenarios, the capacity of the network based on the 66kV feeders and the load at risk for each of the demand forecast scenarios. The load at risk is determined in relation to the firm capacity of the two 66kV feeders.

Table 2 – Southern Macarthur Growth Area Demand Forecast including the High, Central and Low scenarios

Summer Demand Forecast 2024-2032 (MVA)	2024	2025	2026	2027	2028	2029	2030	2031	2032
High forecast	126.9	128.2	131.5	138.2	143.1	147.2	153.4	157.5	160.4
Central forecast	95.9	97.2	100.5	107.2	112.1	116.2	122.4	126.5	129.4
Low forecast	83.9	85.2	88.5	95.2	100.1	104.2	110.4	114.5	117.4
	2024	2025	2026	2027	2028	2029	2030	2031	2032
Feeders 851 & 852 (Total capacity)	120	120	120	120	120	120	120	120	120
Feeders 851 & 852 (Firm capacity)	60	60	60	60	60	60	60	60	60
Load at risk (High)	66.9	68.2	71.5	78.2	83.1	87.2	93.4	97.5	100.4
Load at risk (Central)	35.9	37.2	40.5	47.2	52.1	56.2	62.4	66.5	69.4
Load at risk (Low)	23.9	25.2	28.5	35.2	40.1	44.2	50.4	54.5	57.4

Figure 3 below shows the central, low and high demand forecast scenarios and the 66kV supply capacity of the existing Southern Macarthur area. The actual peak demand on the 66kV supply network is provided for the years prior to 2024 on the central demand forecast graph. The actual peak demand for the area has been above the firm capacity for the 66kV supply for a number of years. This situation has been closely monitored by Endeavour Energy in the interests of balancing the supply security to the area for customers and the capital investment required.

Figure 3 – Southern Macarthur Growth Area Demand Actual and Forecast 2021-2032



2.3.2 Expected pattern of use

The Southern Macarthur area has a geographically diverse customer base including rural, residential, enterprise and major customers. While the major customers have a predictable and regular pattern of use throughout the year and during the week, the residential customer base is influenced by the air temperature and the use of air conditioning during the summer and particularly on days with a maximum temperature above 30 degrees. The demand for the area is peaky. The peak in demand and demand levels within 10% of the peak demand have a total duration of approximately 48 hours in the year (0.13% of the year has a demand level over 90% of the annual peak demand). Based on our analysis of customer demand, this area has a high peak demand relative to the average demand.

Figure 4 below presents the normalised load duration curve (LDC) for the Southern Macarthur growth area.

Figure 4 – Normalised LDC for the Southern Macarthur Growth Area based on historical data

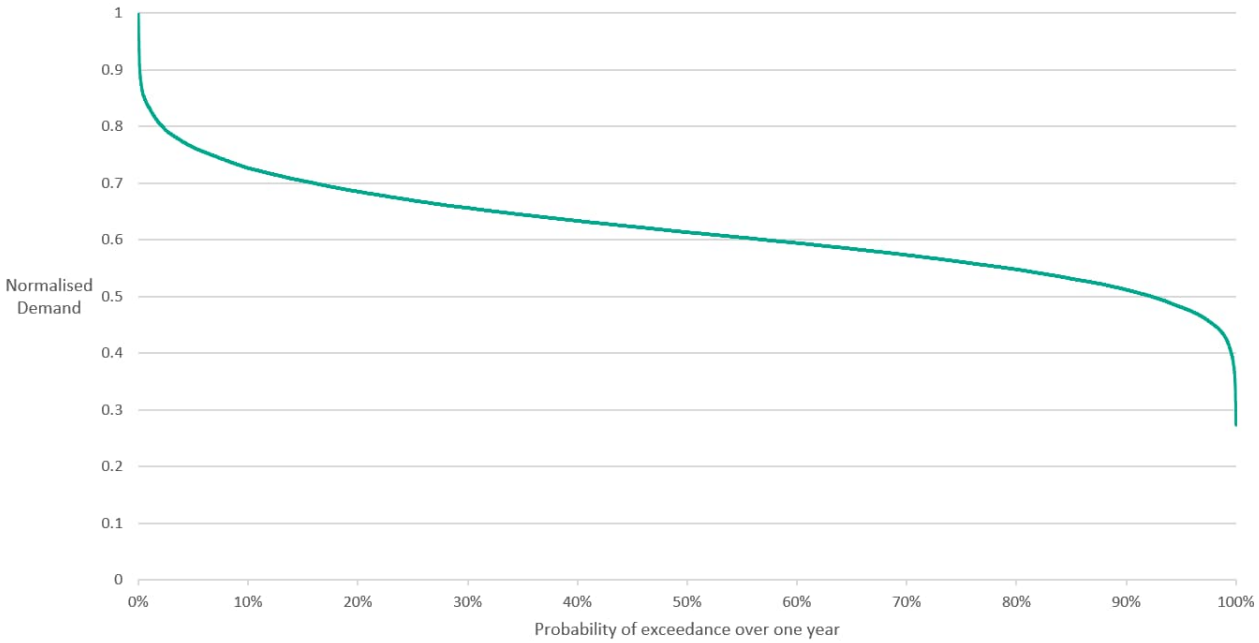
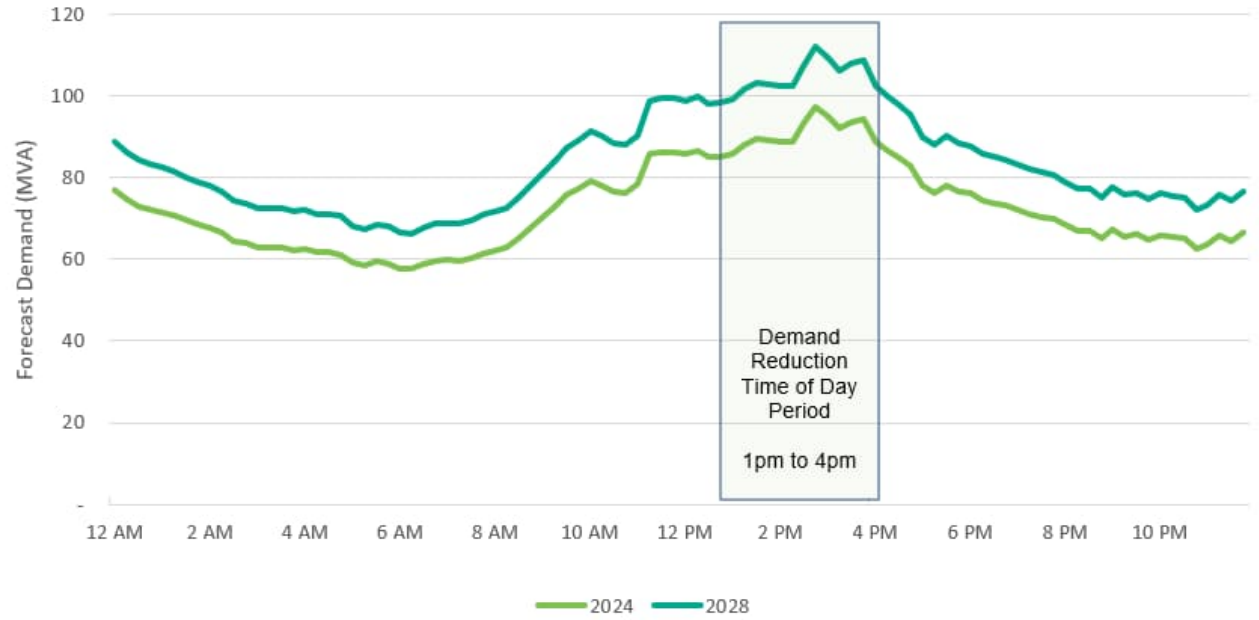


Figure 5 below shows the forecast peak day profile for the area based on historical customer demand data and our projection of demand into the future. It shows the forecast peak day profile for 2024 and 2028 for comparison. The peak time of day is shown to highlight the period from 1pm to 4pm when the customer demand reaches its highest daily level. This is the time of day that is to be targeted for demand reduction, however the demand is above the 60MVA firm capacity for almost the entire day.

Figure 5 – Peak summer day profile for the Southern Macarthur growth area

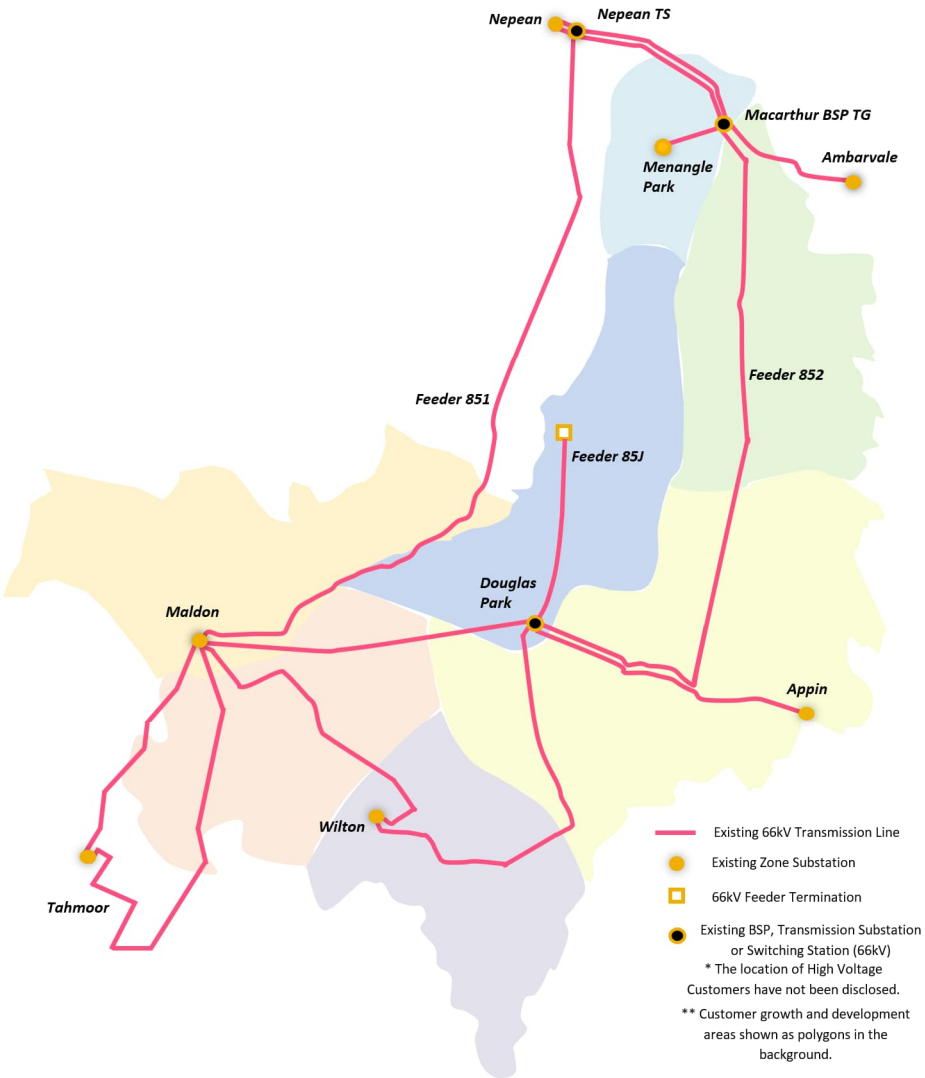


2.3.3 Existing network

The Southern Macarthur area of the Endeavour Energy network uses a 66kV subtransmission network to supply customers via zone substations at Appin, Maldon, Tahmoor and Wilton. There are also major customers in the area that take supply directly from the 66kV network. Some of the major customers in the area also have their own embedded generation and export electricity into the network. The 66kV network consists of two major overhead feeders that are constrained in their capacity to provide supply to the area. These feeders are the long route overhead feeders 851 and 852.

Figure 6 below shows a simplified line diagram of the Southern Macarthur Growth area and the 66kV network that supplies the area.

Figure 6 – Simplified line diagram of the Southern Macarthur Growth Area (66kV network)



Key aspects of the existing network in the Southern Macarthur area are:

- The area has historically been sparsely populated and that is reflected in the topology of the network. For example, feeder 851 has a route length of 18km.
- The existing zone substations have been located in their historical townships and their location has determined the 66kV network development.
- Although there will be significant future development in the area, the existing network is constrained at the 66kV network level.
- Feeder 85J is currently being augmented to provide a major customer connection and works continue on that feeder in 2024.

2.3.4 Expected unserved energy if action is not taken

The existing 66kV network supplying the Southern Macarthur is limited in its ability to meet the supply needs of the area. The summer peak demand has exceeded the firm capacity of the network for a number of years and the situation has been monitored and disclosed in our Distribution Annual Planning Reports. The constraint on the 66kV network is an N-1 constraint and the probability of an outage on one of the two feeders has been used to determine the expected unserved energy.

Figure 7 below presents the expected unserved energy if no action is taken under each of the three demand forecasts. We have included the prior years 2021,2022 and 2023 and show the respective expected unserved energy values for those years. There were no abnormal unserved energy events over those years and both feeders 851 and 852 performed with no significant unplanned outages.

Figure 7 – Expected unserved energy under the three demand forecast scenarios (if no action is taken)

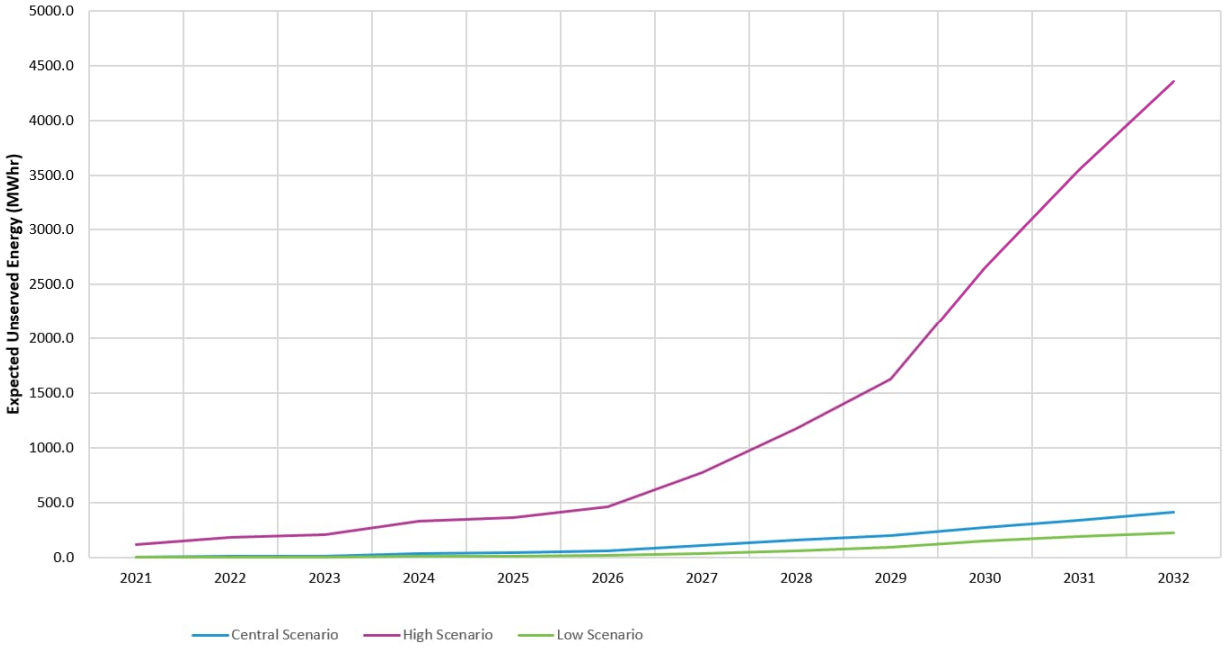


Table 3 below is a summary of the network contingency analysis conducted to determine the expected unserved energy if no action is taken.

Table 3 – Network contingency analysis for the Southern Macarthur Growth Area for determining expected unserved energy

Contingency Scenario	Identified Asset	Description
1	Loss of 66kV feeder 851 from Nepean TS to Maldon ZS	The loss of feeder 851 in either a planned or unplanned interruption to supply would result in the feeder 852 having to supply the demand of the area. During the summer period the continuous rating of feeder 852 is 60 MVA. Both feeders 851 and 852 are overhead lines and their rating is determined by the ambient air temperature. During the peak demand period over summer, the loss of feeder 851 would result in feeder 852 becoming overloaded and risk damaging the conductor and potentially causing it to lose its strength and fall to the ground or into an adjacent phase causing a risk to public safety including fire. Feeder 851 being an overhead line is exposed to lightning strikes and wind damage. The feeder is located in a well maintained easement and is protected from potential vehicle impacts to poles for example.
2	Loss of 66kV feeder 852 from Macarthur BSP to Douglas Park SS	The loss of feeder 852 in either a planned or unplanned interruption to supply would result in the feeder 851 having to supply the demand of the area. During the summer period the continuous rating of feeder 851 is 60 MVA. Both feeders 851 and 852 are overhead lines and their rating is determined by the ambient air temperature. During the peak demand period over summer, the loss of feeder 852 would result in feeder 851 becoming overloaded and risk damaging the conductor and potentially causing it to lose its strength and fall to the ground or into an adjacent phase causing a risk to public safety including fire. Feeder 852 being an overhead line is exposed to lightning strikes and wind damage. The feeder is located in a well maintained easement and is protected from potential vehicle impacts to poles for example.

2.3.5 Proposed scenarios for the forthcoming RIT-D NPV assessment.

We propose to assess three alternative future scenarios as part of the DPAR NPV assessment, namely:

- a **central scenario** – consisting of assumptions that reflect a central set of variable estimates, which, in our opinion, provides the most likely scenario.
- a **high benefit scenario** – uses the high demand forecast and the central set of variable estimates, which have been selected to investigate an upper bound on reasonably expected market benefits, this approach being consistent with AER guidance on scenario analysis; and
- a **low benefit scenario** – uses the low demand forecast and the central set of variable estimates that give rise to a lower bound NPV estimate for each credible option, in order to represent a conservative future state of the world with respect to the potential market benefits that could be realised under each credible option.

A summary of the key variables expected to be used for each scenario is provided in Table 4 below.

Table 4 – Proposed scenarios for the forthcoming RIT-D NPV assessment

Key Variable	Central scenario	High benefits	Low benefits
Capex	Central estimates	Central estimates	Central estimates
Demand	Central demand forecast	High demand forecast	Low demand forecast
VCR	Load-weighted AER VCR	Load-weighted AER VCR	Load-weighted AER VCR
Discount rate	3.26%	3.26%	3.26%

We consider that the central scenario is the most likely because it is based on the central demand forecast, however this is dependent upon the key forecast assumptions of the rate of new land development, major customer demand and the level of embedded generation. We propose to assign the central scenario a weighting of 49 per cent in the NPV assessment, with the high benefit scenario at 1 per cent and the low benefit scenario at 50 per cent. We believe that this is the most reasonable approach for undertaking the NPV assessment given the uncertainty in the demand forecast, we have given the highest weighting to the lowest benefit scenario to reflect a conservative approach.

We propose to assess all credible options across a 30-year assessment period.

3.0 Summary of potential network credible options

We have identified four credible network options for augmenting supply to the Southern Macarthur growth area. All four options involve augmenting the 66kV supply to the area. The network options are:

- Option 1 – Establishment of a new 66kV Feeder connected to Nepean TS.
- Option 2 – Establishment of a new 66kV Feeder connected to Nepean TS and include a deviation to the existing Menangle Park Zone Substation.
- Option 3 – Establishment of a new 66kV Feeder connected to Macarthur BSP.
- Option 4 - Augmentation of the existing 66kV Feeders 851 and 852.

These network options are summarised in Table 5 and detailed further in Section 3.

Table 5 – High level summary of the four network options considered for the Southern Macarthur growth area .

Network Option	Summary Description	Cost
Option 1 Establishment of a 66kV Feeder to Nepean TS.	• Establish a new 66kV feeder into the Southern Macarthur area supplied from the Nepean Transmission Substation. • Provide connection of the new feeder to Nepean TS at the northern end and to the feeder 85J approximately 5km north of Douglas Park SS at the southern end.	**$7.5M**
Option 2 Establishment of a 66kV Feeder to Nepean TS and include a deviation to the Menangle Park ZS.	• Establish a new 66kV feeder into the Southern Macarthur area supplied from the Nepean Transmission Substation. • Provide connection of the new feeder to Nepean TS at the northern end and to the feeder 85J approximately 5km north of Douglas Park SS at the southern end. • Provide a deviation to the feeder to the Menangle Park ZS location.	**$10.5M**
Option 3 Establishment of a new 66kV feeder connected to Macarthur BSP	• Establish a new 66kV feeder into the Southern Macarthur area supplied from the Macarthur bulk supply point. • Provide connection of the feeder to Macarthur BSP at the northern end and to the feeder 85J approximately 5km north of Douglas Park SS at the southern end. • Acquire required easements for the section near Macarthur BSP where Endeavour Energy does not already have suitable easements for the proposed feeder route and provide a rail crossing for the proposed feeder.	**$14.0M**
Option 4 Augment existing 66kV feeders	• Augment the existing Feeder 851 from Nepean TS to Maldon ZS by rebuilding the line to increase its capacity. • Augment the existing Feeder 852 from Macarthur BSP to Douglas Park Switching Station by rebuilding the line to increase its capacity.	**$20.0M**

The cost estimates of the network options are for the capital cost estimated for each option. The estimated on going operating cost of the network options is 0.4% per annum of the capital cost. This covers the incremental increase in operational, maintenance and inspection costs. For example, a $1,000 capital investment would result in a $4 per annum operating cost.

3.1 Option 1 – Establishment of a new 66kV Feeder connected to Nepean TS

This network option involves the establishment of a new 66kV feeder to supply the Southern Macarthur area with the feeder having a route length of 10.1km from Nepean TS and to the northern end of the feeder 85J. The feeder 85J is from the Douglas Park Switching Station.

This new feeder would utilise the easement and line route of an existing 11kV line and an out of service 33kV line. The easement is well maintained and would require no costs for acquisition.

The proposed new feeder would be connected at Nepean TS where there is an existing feeder bay available. This option would provide a closed loop feeder between the Nepean TS and Douglas Park SS and increase supply capacity to the Southern Macarthur area.

The proposed 66kV feeder connection Nepean TS to Douglas Park SS would have a summer rating of 72 MVA and provide a third 66kV feeder into the currently constrained Southern Macarthur Area.

The estimated cost of this network option is $7.5M and would result in an increase of the firm capacity rating of the 66kV network from 60 MVA to 120 MVA. This network option would be commissioned by 30 November 2025.

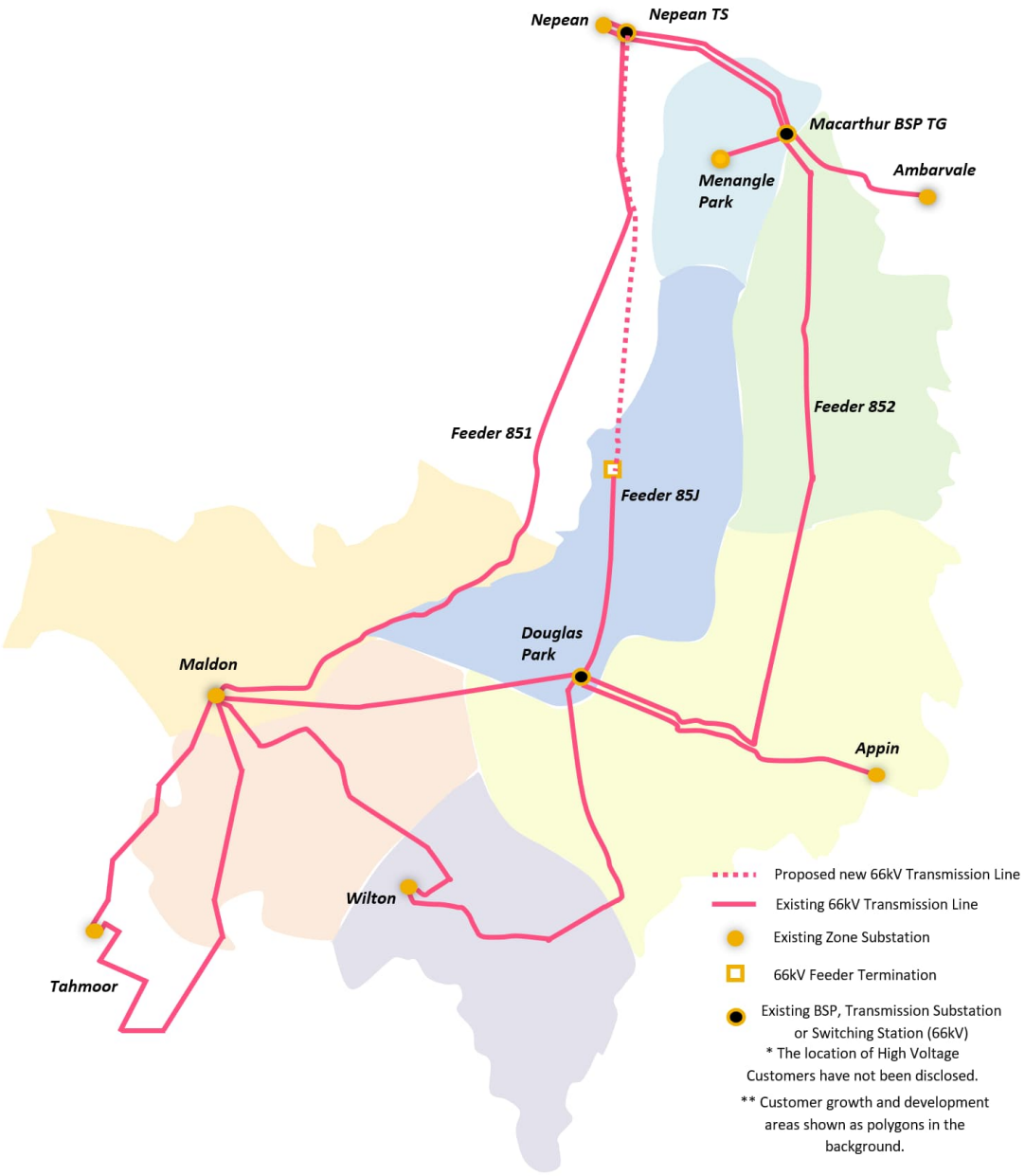
Table 6 below shows the feeder route length for the Network Option 1.

Table 6 – Network Option 1 – Augmentation Feeder Route Length

Feeder Connection Termination points for this option	Proposed Route Length (km)
Nepean Transmission Substation to the northern end of feeder 85J approximately 5km north of the Douglas Park Switching Station.	10.1

Figure 8 below shows a simplified line diagram for the proposed Network Option 1.

Figure 8 – Network Option 1 – Establishment of new 66kV feeder from Nepean TS to Douglas Park SS by connecting new mains to the northern end of feeder 85J and connect to Nepean TS



3.2 Option 2 – Establishment of a new 66kV Feeder connected to Nepean TS and including a deviation to the existing Menangle Park Zone Substation

This network option involves the establishment of a new 66kV feeder to supply the Southern Macarthur area with the feeder having a route length of 14.1km from Nepean TS and to the northern end of the feeder 85J. The proposed option would include a 4.0km route length diversion to the location of the existing Menangle Park Zone Substation. Option 2 has the scope of works of Option 1 with the addition of the diversion to the Menangle Park area.

This new feeder would utilise the easement and line route of an existing 11kV line and an out of service 33kV line. The easement is well maintained and would require no costs for acquisition.

The proposed new feeder would be connected at Nepean TS where there is an existing feeder bay available. This option would provide a closed loop feeder between the Nepean TS and Douglas Park SS and increase supply capacity to the Southern Macarthur area. The option also includes the benefit of providing supply capacity to the Menangle Park area and provides a higher level of supply security by increasing the possible supply paths to the Southern Macarthur area.

The proposed 66kV feeder from Nepean TS to Douglas Park SS would have a summer rating of 72 MVA and provide a third 66kV feeder into the currently constrained Southern Macarthur Area.

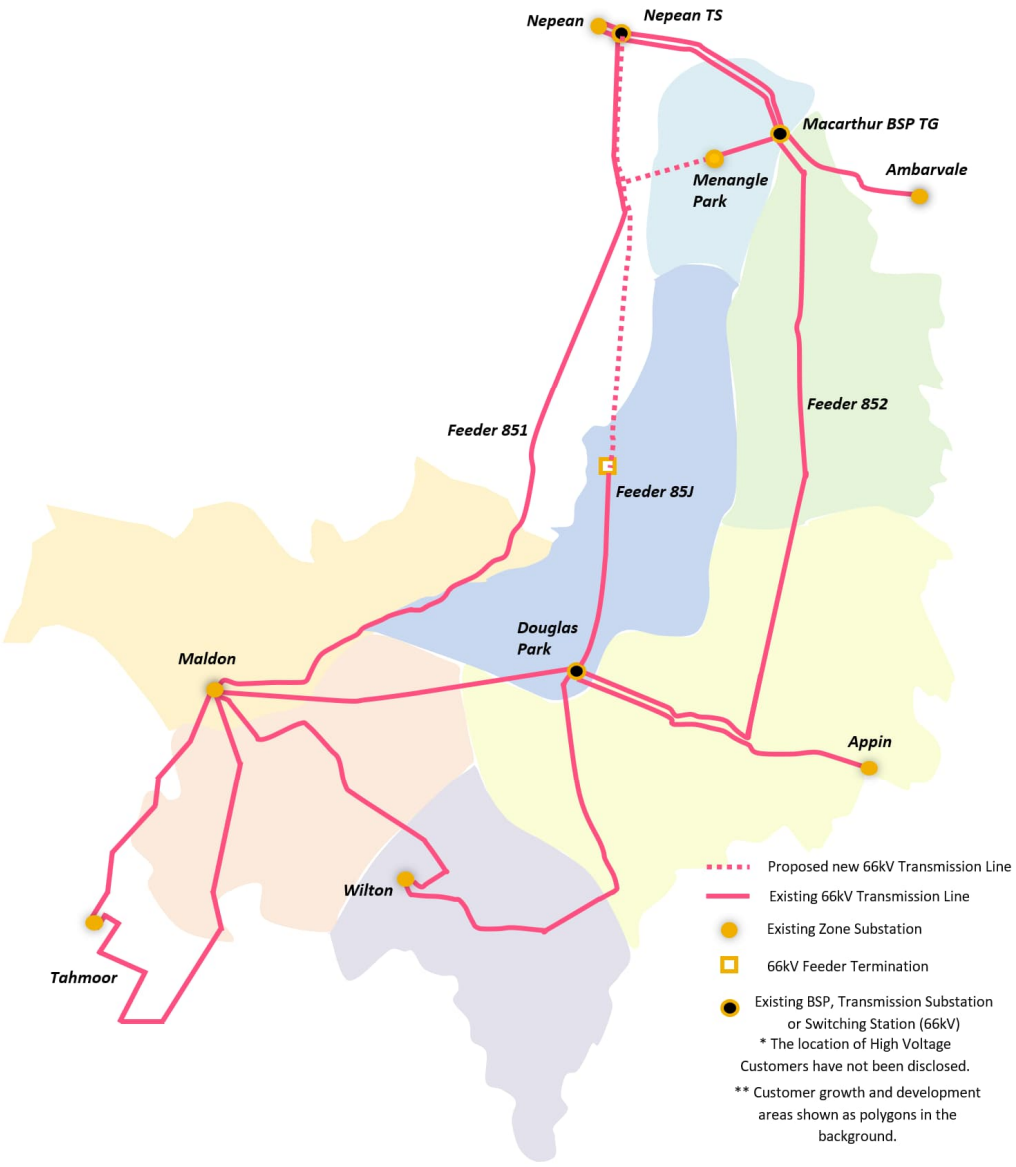
The estimated cost of this network option is $10.5M and would result in an increase of the firm capacity rating of the 66kV network from 60 MVA to 120 MVA. This network option would be commissioned by 30 November 2025.

Table 7 below shows the feeder route length for the Network Option 2. Figure 9 shows a simplified single line diagram for Network Option 2.

Table 7 – Network Option 2 – Augmentation Feeder Route Length

Feeder Connection Termination points for this option	Proposed Route Length (km)
Nepean Transmission Substation to the northern end of feeder 85J approximately 5km north of the Douglas Park Switching Station.	10.1
Deviation to Menangle Park ZS.	4.0
Total.	**14.1**

Figure 9 – Network Option 2 – Establishment of a new 66kV feeder from Nepean TS to Douglas Park SS including a deviation to the Menangle Park ZS and connecting to the northern end of feeder 85J



3.3 Option 3 – Establishment of a new 66kV Feeder connected to Macarthur BSP

This network option involves the establishment of a 66kV feeder to supply the Southern Macarthur area with the feeder having a route length of 10.2km from Transgrid's Macarthur BSP to the northern end of the feeder 85J.

The proposed feeder would be connected at Transgrid's Macarthur BSP and have a line route that would pass near the Menangle Park ZS location and then use the existing line route of the out of service 33kV line to connect to feeder 85J.

This network option would include provision of a new 66kV feeder bay and switchgear at Macarthur BSP as Transgrid have advised that there is no existing feeder bay for this proposed connection. The estimated cost of this connection is included in the cost of this network option. The line route from Macarthur BSP to Menangle Park ZS would require land acquisition for easement purposes and include a rail crossing in the route from the Transgrid substation at Macarthur and the existing Menangle Park Zone Substation. These costs have been included in the cost estimate for this option.

The network option would have a summer rating of 72 MVA and provide a third 66kV feeder into the currently constrained Southern Macarthur Area.

The estimated cost of this network option is $14.0M and would result in an increase of the firm capacity rating of the 66kV network from 60 MVA to 120 MVA. This network option would be commissioned by 30 November 2025.

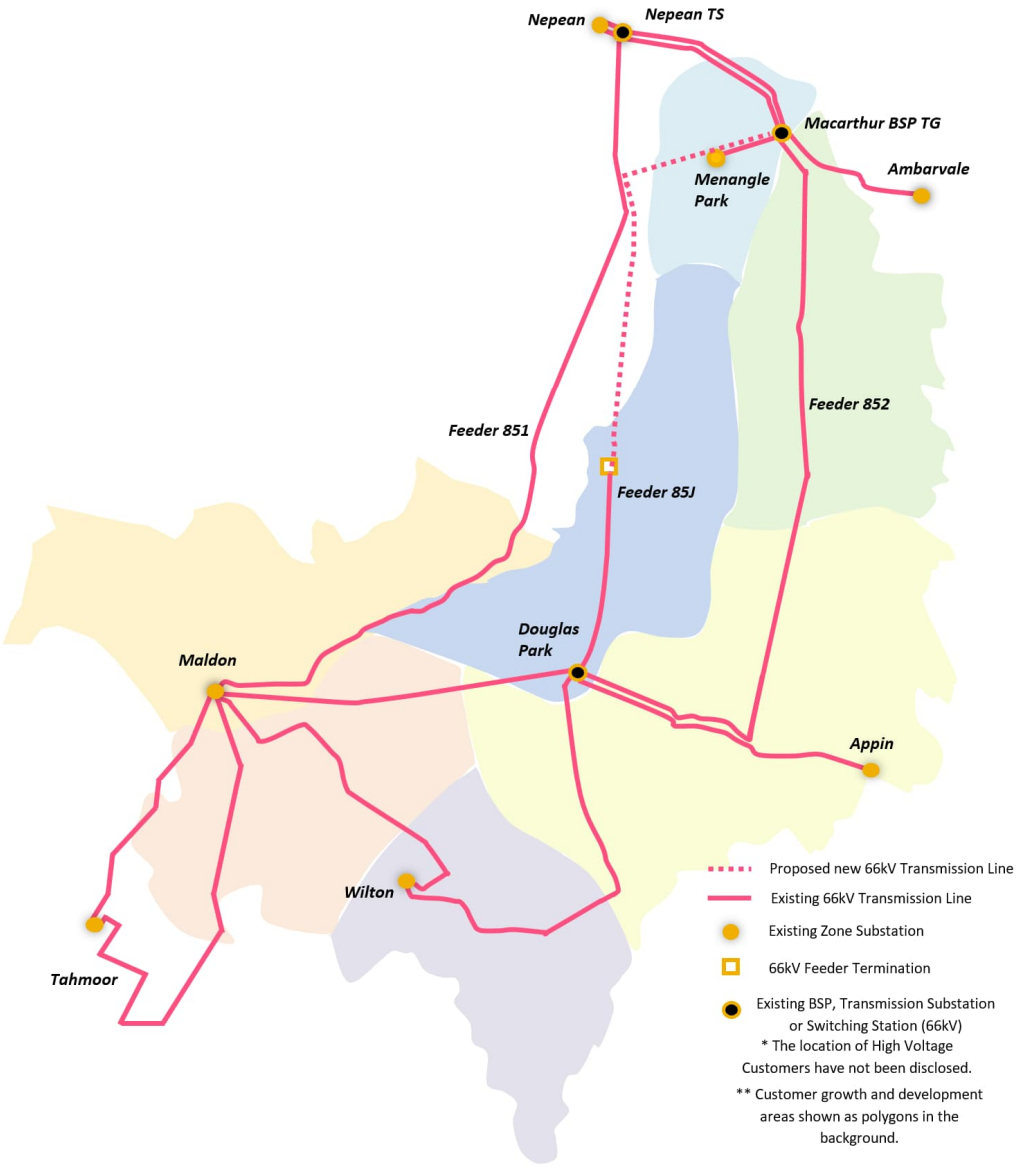
Table 8 below shows the feeder route length for Network Option 3.

Table 8 – Network Option 3 – Augmentation Feeder Route Length.

Feeder Connection Termination points for this option	Proposed Route Length (km)
Macarthur BSP to the northern end of feeder 85J approximately 5km north of the Douglas Park Switching Station.	10.2

Figure 10 below shows a simplified single line diagram for Network Option 3.

Figure 10 – Network Option 3 – New feeder from Macarthur BSP to Douglas Park SS by installing new mains to connect to the existing northern end of feeder 85J.



3.4 Option 4 – Augmentation of the existing 66kV Feeders 851 and 852

This network option would involve the augmentation of both feeders 851 and 852 to increase their supply capacity. Both of these feeders would be augmented to a higher summer rating of 72 MVA from their existing 60MVA summer rating.

This option would involve replacing the existing conductor with a higher rated conductor and rebuild the existing wood pole support structures to a contemporary concrete pole design. This would use the existing line routes of both of the feeders and would therefore require no additional easements. There would also be minimal connection works because the existing feeder bays and switchgear would be used.

The scheduling of construction works for this network option would be more complex than for the other network options due to outage constraints on both of the feeders. The construction works would require scheduling to complete rebuilding each of the feeders separately and the outage on each line being limited to off peak periods of the year most likely the periods (April/May and September/October) due to both of them being required to be in service during the peak summer and winter periods. This would require the augmentation works to mobilise and demobilise for each construction period.

The construction works under this network option would also elevate network reliability and security risk during the construction period because any unplanned outage of the in-service feeder would result in loss of supply to the area.

The route length of feeder augmentation is given in the following Table 9.

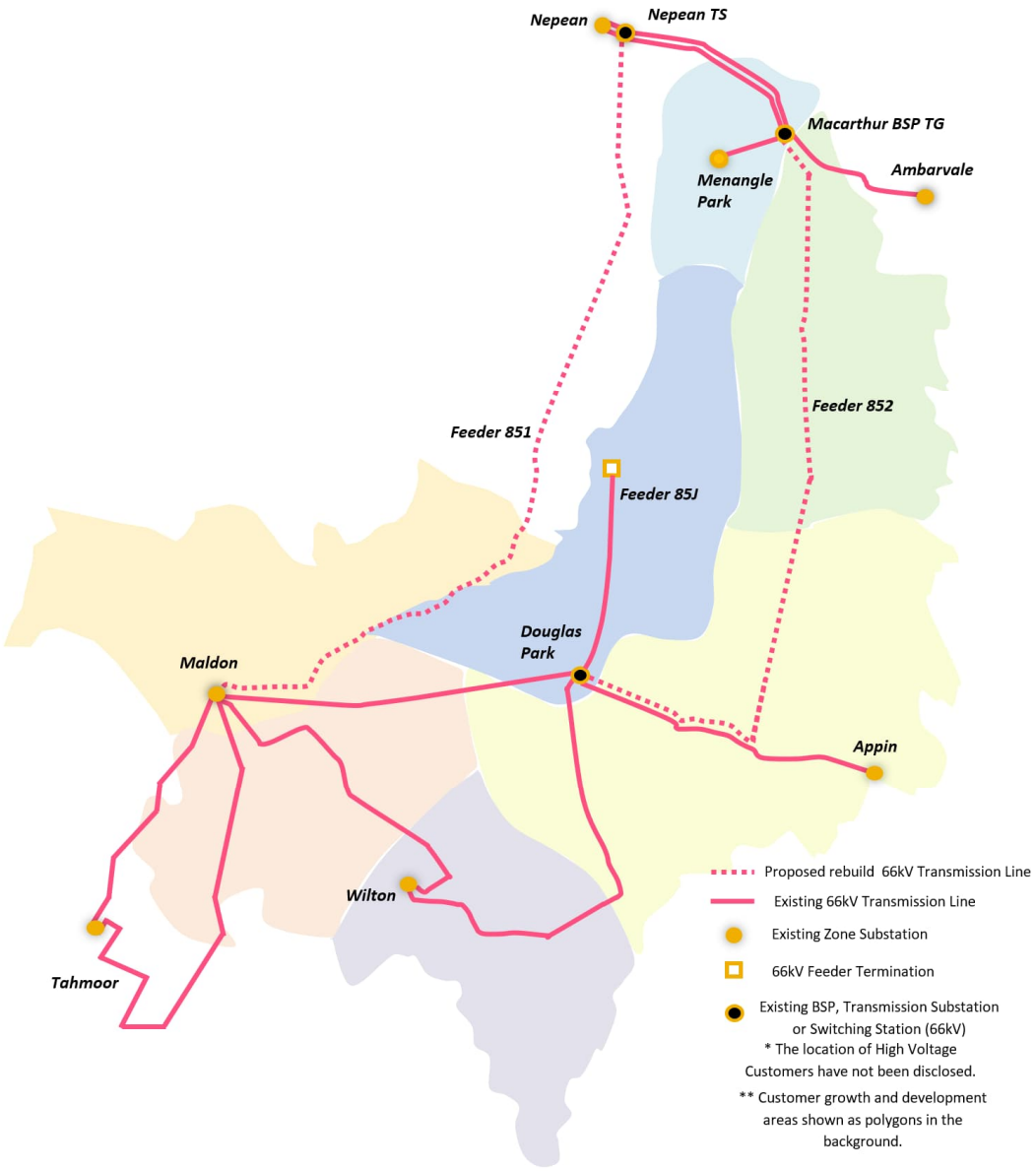
Table 9 – Network Option 4 – Augmentation Feeder Route Length

Feeder	Route Length Augmentation (km)
851 Nepean TS to Maldon ZS	18.3
852 Macarthur BSP to Douglas Park SS	17.4
Total	**35.7**

The estimated cost of this network option is $20.0M and would result in an increase of the firm capacity rating of the 66kV network from 60 MVA to 72 MVA and be commissioned by 30 November 2025.

Figure 11 below shows the simplified line diagram for Network Option 4.

Figure 11 – Network Option 4 – Rebuild feeders 851 and 852 to augment supply capacity to the Southern Macarthur growth area



3.5 Options considered but not progressed

Endeavour Energy considered a number of options that we have not progressed further. These options and our reasoning for not progressing them further are summarised in Table 10.

Table 10 – Options considered but not progressed

Option	Reason not progressed
Potential Staging of Option 2 to construct the deviation to Menangle Park at a later time	Option 2 could be staged to construct the deviation to Menangle Park ZS at a later time to align to the customer demand in the Menangle Park area. However, there are potentially more beneficial 66kV supply options to the Menangle Park area that may utilise a lower cost supply option from Transgrid's Macarthur BSP where two 66kV feeders could be utilised. We consider it beneficial to assess 66kV supply options to Menangle Park at a later time and in close alignment to the customer need in this area which is currently in an early development stage. We expect to explore this option further in our assessment of the future needs for the high growth area at Menangle Park over the next few years. This may result in a separate RIT-D assessment for the Menangle Park Development Area.
Wait for a possible new Bulk Supply Point in the Appin area	Any new Bulk Supply Point (BSP) for the Appin area would be at least several years in the future and be dependent upon Transgrid's decision and timing, however the identified need for Southern Macarthur is urgent and cannot wait for a new BSP to provide an additional 66kV supply to the area. Our network options identified here would complement any new BSP in the Appin area by providing high capacity connection to the large and growing customer base in the area.

3.6 Preliminary preferred network option annual deferred augmentation value

At this stage, based on our early internal economic assessment, the preliminary preferred network option is **Option 1 - Establishment of a new 66kV Feeder connected to Nepean TS**.

The estimated **annual deferred augmentation value** associated with this network option to meet the identified need is **$0.25M**.

This value assumes a one year deferral and uses the central discount rate and the central capital cost estimate.

4.0 Required technical characteristics of non-network options

This section sets out the technical characteristics that a non-network option would be required to provide to assist with meeting the identified need.[1] This information is provided to enable proponents of non-network options to understand the identified need and to tailor their proposals accordingly. It also sets out the reasons that we consider a SAPS option could not form a potential credible option on a standalone basis, or could form a significant part of a potential credible option.

Endeavour Energy intends to explore all possible non-network options with proponents to ensure that the most efficient option is selected to satisfy the identified need.

Based on our screening of non-network options for the Southern Macarthur Growth Area we consider the following options may be both technically and commercially feasible:

- Embedded generation of electricity within the Southern Macarthur area.
- Virtual Power Plant with the aggregation of many customers.

Additionally, based on our screening of non-network options and our evaluation of possible technology types we consider the following options to be possibly technically feasible. However, based on our assessment of the costs of the non-network options and the magnitude of demand reduction and energy storage requirements, we believe that they may not be commercially feasible for a non-network options proponent based on the deferral value available from the preferred network option.

- Grid Connected Battery Energy Storage Systems with energy storage capability to provide supply in the event of the loss of one of the two major 66kV feeders.
- Direct Load Control at existing enterprise customer premises.
- Use of existing back-up generation that may already be installed at customer premises.
- Behavioural demand response for enterprise, residential and rural customers using aggregation services.

We note that these non-network options may require critical input factors for their technical feasibility including but not limited to: land for locating any new embedded generation including battery and related approvals from authorities, establishing new network connections for any new embedded generation or energy storage solutions, agreements with customers including obtaining contact details and network technical details including customer demand profiles.

We have determined that a stand alone power system (SAPS) would not be feasible due to the requirement of major customers in the area to have an N-1 fully redundant back up supply and any SAPS would be required to provide this level of supply security and we do not believe that this is commercially feasible based on any current technology.

Endeavour Energy welcomes submissions from proponents able to offer a credible non-network option solution that is both commercially and technically feasible under the RIT-D.

[1] In accordance with clause 5.17.4(e)(4) of the NER.

4.1 The level of demand reduction required from a non-network option

It is the loss of either 66kV feeder 851 or 852 at peak demand levels during summer that creates the load at risk and the corresponding demand reduction requirement that we are seeking to resolve.

Endeavour Energy has closely monitored the Southern Macarthur area load at risk over the years. In 2023, based on the actual peak demand, we estimate that the load at risk was 26.6MVA, however there was no loss of either feeder at this time and supply was maintained.

Table 11 below presents the annual load at risk for the Southern Macarthur Growth Area using the central demand forecast based on the loss of either of the 66kV feeders. The 2023 values are based on actual recorded demand.

We are seeking non-network options that will eliminate the load at risk for the Southern Macarthur Growth area.

Table 11 – Southern Macarthur Growth Area Load at Risk

Load at Risk (MVA)	2023	2024	2025	2026	2027	2028	2029	2030	2031
Loss of Feeder 851	26.6	35.9	37.2	40.5	47.2	52.1	56.2	62.4	66.5
Loss of Feeder 852	26.6	35.9	37.2	40.5	47.2	52.1	56.2	62.4	66.5
Load at Risk	**26.6**	**35.9**	**37.2**	**40.5**	**47.2**	**52.1**	**56.2**	**62.4**	**66.5**
Our Risk based Assessment	*Monitor this level of load at risk.*			*Endeavour Energy deems this load at risk level to be such that network augmentation or non-network options are cost & risk justified.*					

Table 12 below shows the level of demand reduction required to produce certain deferrals of our preliminary preferred network option. This table is intended to provide clarity on the investment deferral and demand reduction required for the area.

Table 12 – Deferral periods of our Southern Macarthur Growth Area Network Option achieved in combination with a Non Network Option

Years of Deferral	Deferred Commissioning of network option	Demand Reduction Required
1 year	FY2027	47.2
2 years	FY2028	52.1
3 years	FY2029	56.2

We expect, at this early stage, that non-network options may be able to credibly defer the commissioning of a network option by one to three years. This is based on our current central demand forecast.

4.2 Location

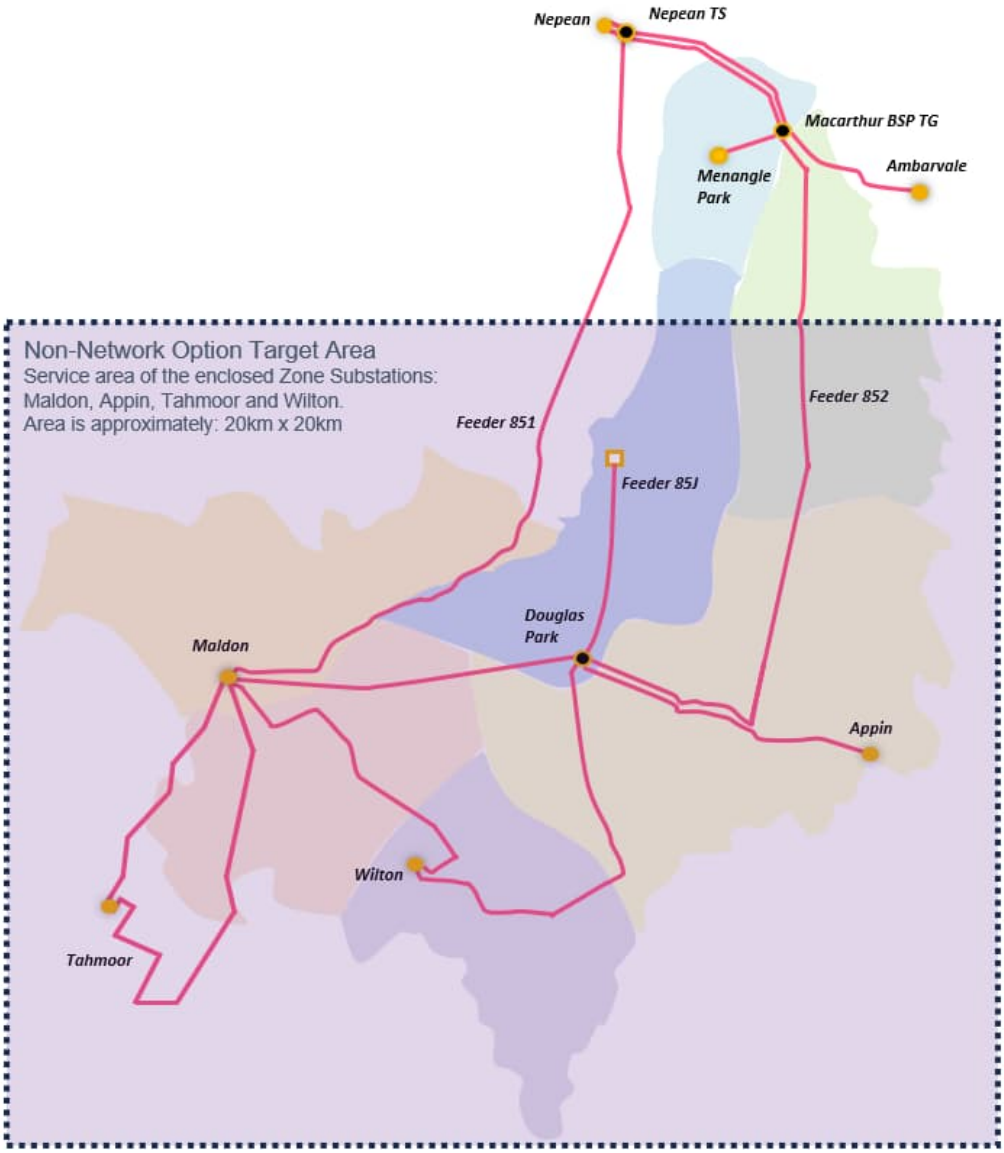
We are seeking non-network options for the Southern Macarthur Growth Area located in the geographic area shown below in the box in Figure 12.

The geographic area is defined by the service area of the 66kV feeders 851 and 852. These are the constrained network assets that cause the load at risk and the expected unserved energy for the Southern Macarthur Growth Area. The existing zone substations at Appin, Maldon, Tahmoor and Wilton are within the target area.

For any clarification on the applicable location, please contact us at:

consultation@endeavourenergy.com.au

Figure 12 – Southern Macarthur Growth Area Non Network Option Target Area



For non-network options proponents who target demand management and demand response to produce the required demand reduction to meet these requirements, Endeavour Energy will assist in providing further details to support their proposal.

The Zone Substations in the Southern Macarthur area have a high penetration of solar installations.

Table 13 below shows the customer numbers, solar customers and related demand and installed capacity details to assist demand or VPP aggregation service providers.

Table 13 – Southern Macarthur Customer Numbers and Solar Connections.

Zone Substations	Total Customers	Solar Customers	Zone Substation Peak Demand (MVA)	Solar Capacity Installed (MVA)	Percentage (Solar/Zone Peak)
Appin ZS	1,718	548	5.5	3.1	56%
Maldon ZS	5,031	1,475	22.5	9.4	42%
Tahmoor ZS	6,651	1,577	17.6	7.8	44%
Wilton ZS	1,397	476	4.7	2.7	57%

4.3 Operating profile

To support the Southern Macarthur growth area with reliable and secure supply a non-network option would be required to provide network support over the period FY26 to FY28 and during the peak demand days over the summer period. Based on our analysis of the area and the customer connections, we have determined that it is days with a maximum temperature exceeding 30 degrees Celsius that define a key technical requirement. The nearest Bureau of Meteorology automatic weather station is situated at Mt Annan and could be used as a reference point for any network support agreement in relation to this requirement.

Table 14 sets out the key expected technical characteristics that a network support solution would need to exhibit.

Table 14 – Non-network option technical characteristics

Objective	Target
Time of year	1 November 2025 to 31 March 2026 1 November 2026 to 31 March 2027 1 November 2027 to 31 March 2028
Time of Day	1pm to 4pm (Summer period) is the typical peak demand period. Demand reduction is required to reduce the demand to below 60MVA on the feeders 851 and 852.
Estimated Energy Value for an energy storage solution	3 hrs at 50MW = 150 MWhrs This is a guide for the elimination of 3 hrs of peak demand load at risk. We consider this to be a minimum energy storage capability to be able to reduce peak demand during the peak period of the day to enable a possible deferral of our preferred network option.
Season	Summer 2025/26, 2026/27 and 2027/28.
Day type	Any day of the week with maximum air temperature forecast to be above 30^{o}C. Weekdays and weekends excluding public holidays.
Demand reduction required	Refer to Table 11 – Southern Macarthur Growth Area Load at Risk

4.4 Contribution to power system reliability

Proposed services must be capable of reliably meeting electricity demand under a range of conditions and must meet all relevant NER requirements related to grid connection (if this is required as part of the solution).

Endeavour Energy has obligations under the NER, its distributor's licence and connection agreements to ensure supply reliability is maintained to customers. Failure to meet these obligations may give rise to liability. Proponents of non-network solutions must also be willing to accept any liability that may arise from its contribution to a reliability of supply failure.

Endeavour Energy operates under the NSW Electricity Licence Conditions and is required to maintain standards for reliability. The licence conditions stipulate the average reliability performance levels that are acceptable for different network supply categories. The relevant performance levels are detailed below in Table 15.

Table 15 – Applicable reliability standards

Feeder/network type	Average reliability duration standards (minutes per customer)	Average reliability interruption duration standards (numbers per customer)	Equivalent average service availability (% of time)
Urban Network (overall)	80	1.2	99.98
Individual Urban Feeder	350	4	99.93

Non-network options should have adequate availability levels to contribute to maintaining reliability performance within these licence condition requirements.

4.5 Contribution to power system fault levels

Non-network solutions are not required to address any existing issues in relation to fault levels as part of this RIT-D.

4.6 Consideration of SAPS options

Recent changes to the NER, RIT-D and RIT-D application guidelines require Endeavour Energy to consider whether a SAPS option can fully or partly address an identified need. In practice, this relates to consideration of whether an identified need could be fully or partly addressed by converting part of our distribution network forming part of the interconnected national electricity system to a regulated SAPS.[2] Regulated SAPS are set out in section 6B of the National Electricity Law (NEL), which defines a SAPS as a system that:[3]

- generates and distributes electricity; and
- does not form part of the interconnected national electricity system.

We consider that there is not a SAPS option that could form a potential credible option on a standalone basis, or that could form a significant part of the credible option, in this RIT-D. In particular, the demand requirements (including back-up as required by the customers) of the area are significant and therefore could not be supported by a network that is not part of the interconnected national electricity system with the ability to draw on grid-connected generation sources. In forming this conclusion, we have considered both the potential to convert part of our distribution network to a regulated SAPS as well as the potential to build a new SAPS.

We note that this conclusion does not preclude the development of embedded generation and storage by specific customers or other proponents to meet part of their supply needs and/or as back-up to their grid connections. Such developments fall outside of the definition of a SAPS and are coupled with those customer connections continuing to also require their full demand to be able to be met from the grid.

[2] See definition of 'SAPS option' in the NER.

[3] Section 6B(6) of the NEL.

Appendix A – Checklist of compliance clauses

This section sets out a compliance checklist that demonstrates the compliance of this OSR with the requirements of clause 5.17.4(e) of the National Electricity Rules version 205.

Clause 5.17.4(e) requirements	Section of this OSR
(1) Description of the identified need.	2.0
(2) Assumptions used in identifying the identified need.	2.0
(3) Relevant annual deferred augmentation charge associated with the identified need.	3.6
(4) The technical characteristics of the identified need that a non-network option would be required to deliver, such as: (i) the size of load reduction or additional supply; (ii) location; (iii) contribution to power system security or reliability; (iv) contribution to power system fault levels as determined under clause 4.6.1; and (v) the operating profile.	4.1 4.2 4.4 4.5
(5) Summary of potential credible options to address the identified need, as identified by the RIT-D proponent, including network options and non-network options.	3.0
(6) For each potential credible option, the RIT-D proponent must provide information, to the extent practicable, on: (i) a technical definition or characteristics of the option; (ii) the estimated construction timetable and commissioning date (where relevant); and (iii) the total indicative cost (including capital and operating costs).	3.0
(7) Information to assist non-network providers wishing to present alternative potential credible options including details of how to submit a non-network proposal for consideration by the RIT-D proponent.	1.0

CONTACT

If you have any comments or enquiries regarding this report, please send them to the **Portfolio Management Office** at: consultation@endeavourenergy.com.au

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Endeavour Energy

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