EXTRACT OF NON-NETWORK OPTIONS REPORT FOR PR258 MENANGLE PARK MOBILE SUBSTATION

10 April 2018

The following is provided to the AER in advance of publication to interested parties in the market as part of the RIT-D process. It provides business case justification for the Menangle Park Mobile Substation which is a greenfield Augex project proposed in the next regulatory control period.

PART C: SPECIFICATION

OVERVIEW

Endeavour Energy releases the Distribution Annual Planning Report (DAPR) on an annual basis. The report details the forthcoming RIT-D projects to be investigated for non-network options. This Non-Network Options Report is listed in the Endeavour Energy 2017 DAPR.

Endeavour Energy supplies electricity network services and other regulated services to 997,631 customers, or 2.4 million people, in households and businesses across a network franchise spanning 24,980 square kilometres in Greater Western Sydney, the Blue Mountains, Southern Highlands, Illawarra and the South Coast.

We power the third largest economy in Australia, with the population of Greater Western Sydney forecast to grow approximately 46% by 2031. Our network area includes some of the fastest growing residential development areas and employment areas in the Australia in both greenfield and brownfield sites. This has seen CBD's and high-density developments grow rapidly in recent times. We also maintain 195 major substations and 32,238 distribution substations connected by almost 59,300 kilometres of underground and overhead cables.

Endeavour Energy's corporate planning framework is made up of strategic objectives that are designed to promote the long term interests of our customers by targeting three key strategic goals:

- Safety – to improve safety performance for employees, contractors and the community;
- Reliability – to maintain the reliability, security and sustainability of the network; and
- Sustainability – to ensure our business is sustainable by making it efficient, affordable and competitive so that it can meet future challenges

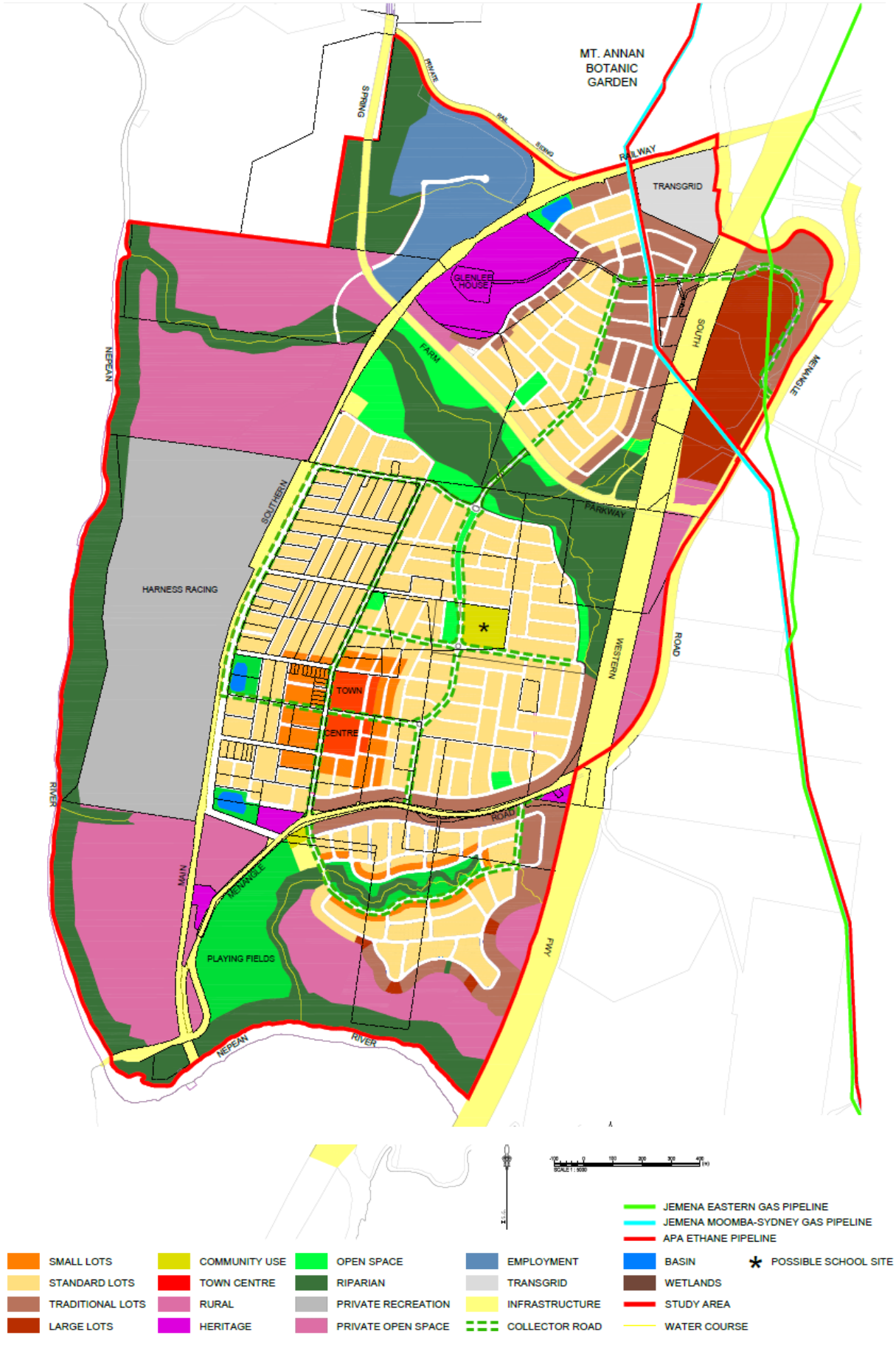
Endeavour Energy applies a lifecycle approach to managing its network and the assets that comprise it. Endeavour Energy's approach captures competing stakeholder requirements in decision making, and is supported by a spectrum of systems, processes and continual improvement.

This approach has been consolidated through embedding and integrating of functions such as network planning and asset performance with other "more operational" asset management functions that allows integration of the whole-of-life asset decision processes. Endeavour Energy has created a holistic life-cycle management approach with benefits in

capital efficiency and investment optimisation

The approach has now been integrated with the Regulatory Investment Test for Distribution (RIT-D) evaluation process which includes non-network investigation through a consultation process, such as embedded generation and demand management. The identification of these types of initiatives requires effective engagement of non-network service providers. This report provides non-network proponents and interested parties the opportunity to submit proposals that will address non-network option objectives and offer cost effective alternatives to augmenting the network to meet future demand in the Menangle Park Development Plan, refer Figure 1.

Figure 1: Menangle Park Development Plan



The demand in the development area is expected to grow by 28 MVA over the next 15 to 20 year period. This excludes the future development of the Menangle Park village. This will require additional electricity infrastructure to supply this level of demand growth. The initial development is being supplied by two 11kV feeders from Ambarvale and Nepean Zone Substations (ZS).

The purpose of this report is to identify credible non-network options that may provide a more cost effective solution to address the identified network need considering life cycle costs. This report provides the technical characteristics that a non-network option will need to meet to address the growth in peak demand. Endeavour Energy requires sufficient detail in the non-network option submission in order to properly evaluate and compare all options equally. Endeavour Energy welcomes questions from proponents in order to assist the development of a complete submission. Endeavour Energy may seek clarification from proponents where information provided is not clear or is incomplete.

To comply with the RIT-D, Endeavour Energy will issue a Draft Project Assessment Report (DPAR) and / or a Final Project Assessment Report (FPAR) detailing the preferred option. If a non-network option is preferred, or part of the preferred solution, Endeavour Energy will directly negotiate and seek to engage the successful proponent(s) to secure non-network services. Endeavour Energy will consider multiple non-network initiatives in order to achieve the overall demand reduction targets required for the 11kV network supplied from the Ambarvale and Nepean ZSs. Initiatives must be cost-effective in their own right and will be ranked in order of cost-effectiveness.

This Non-Network Options Report is an invitation to proponents to submit non-network solutions to be considered by Endeavour Energy and used as the basis for engagement if the proposal if shown to be cost-effective and is selected to be the preferred option, or part of the preferred option.

Information on providing a non-network option submission is included in section 8 of Part C and section 4.1 of Part A of this report.

1 INTRODUCTION

1.1 PURPOSE

Endeavour Energy has prepared this Non-Network Options Report (NNOR) in accordance with the requirements of section 5.17.4 of the National Electricity Rules (NER) and the RIT-D process. This process must be followed for all RIT-D projects, that is, where the most expensive potential credible option to address the identified need is more than $5 million. As part of the RIT-D process, distribution businesses must consider non-network options when assessing credible options to address the identified need.

Distribution businesses must screen all RIT-D projects to determine the feasibility of a non-network option to address the network limitation or renewal project. Where it is determined to be feasible the distribution business must publish a NNOR as part of the RIT-D consultation procedures. Endeavour Energy is seeking to obtain submissions from the market and interested parties for non-network alternatives to manage the load at risk.

1.2 OBJECTIVE

The objective of the non-network option is to obtain sufficient demand reduction on the network to address the network limitation created by the Menangle Park development area. A successful non-network option will defer or, if possible, avoid the construction of additional electricity infrastructure to supply the Menangle Park development area. Endeavour Energy will implement a non-network option that meets the program objectives and is, or is part of, the most cost-effective solution to address the network need.

This report provides Interested Parties and non-network service providers with the appropriate information and opportunity to consider how to address the identified need on the network and make a submission a for non-network options.

This NNOR:

- provides the background information on the network capacity limitations;
- details the demand forecast for the Menangle Park development area and surrounding distribution network;
- describes the credible network options considered to address the identified need;
- provides the demand reduction target and objectives for non-network options;
- quantifies the value of a non-network option in terms of network investment deferral and the financial remuneration to implement demand reduction initiatives;
- provide instructions on how to apply to be on Endeavour's Register of Interested Parties and how to make a submission; and
- seeks submissions from Interested Parties on credible non-network options for reducing peak demand on the network.

2 BACKGROUND

The Menangle Park development area is approximately 888 hectares in size. It is bounded by the Nepean River to the south and west, the Hume Highway (M31 Hume Motorway) and Menangle Park Road to the east and the Mount Annan Botanic Gardens to the north. The existing Menangle Park Village is located adjacent to the Menangle Park train station which is on the Main Southern Railway Line, refer to Figure 1. The existing Menangle Park village is in fragmented ownership.

The Menangle Park precinct was rezoned in February 2012 under a gateway determination issued by the Minister of Planning. The Menangle Park development plan is shown in Figure 1. UrbanGrowth NSW was the major proponent of the development at the time but is divesting its interest to a major land developer. Campbelltown City Council (Council) is the other major landowner in the precinct and is also selling their property to the same developer.

The development will comprise of approximately 4,000 residential lots, 20 hectares of commercial and 28 hectares of industrial developments. Sydney Water has finalised their plans for sewerage pumping stations and associated sewerage mains to service the Menangle Park development area. The Menangle Park development represents approximately 28 MVA of load. This figure has been calculated using the reduced After Diversity Maximum Demand (ADMD) of 4 kVA per lot. This was reduced from 5 kVA per lot

as a result of new housing energy efficiency construction standards and other government policy such as solar panel incentives, energy saving certificates and minimum energy performance standards (MEPS) for appliances. The calculated ultimate load does not include the future redevelopment of the existing Menangle Park village which will include medium density housing at an ADMD of 3.2 to 3.5 kVA per lot.

The land developer is subject to foreign investment rules and will be required to commence the development within a specified time frame and maintain development activity on a continuous basis. Public Works NSW had previously submitted two applications for a total of 86 lots as part of a staged development for the initial 200 lots for this site. The Menangle Park development area has been rezoned allowing the development to proceed.

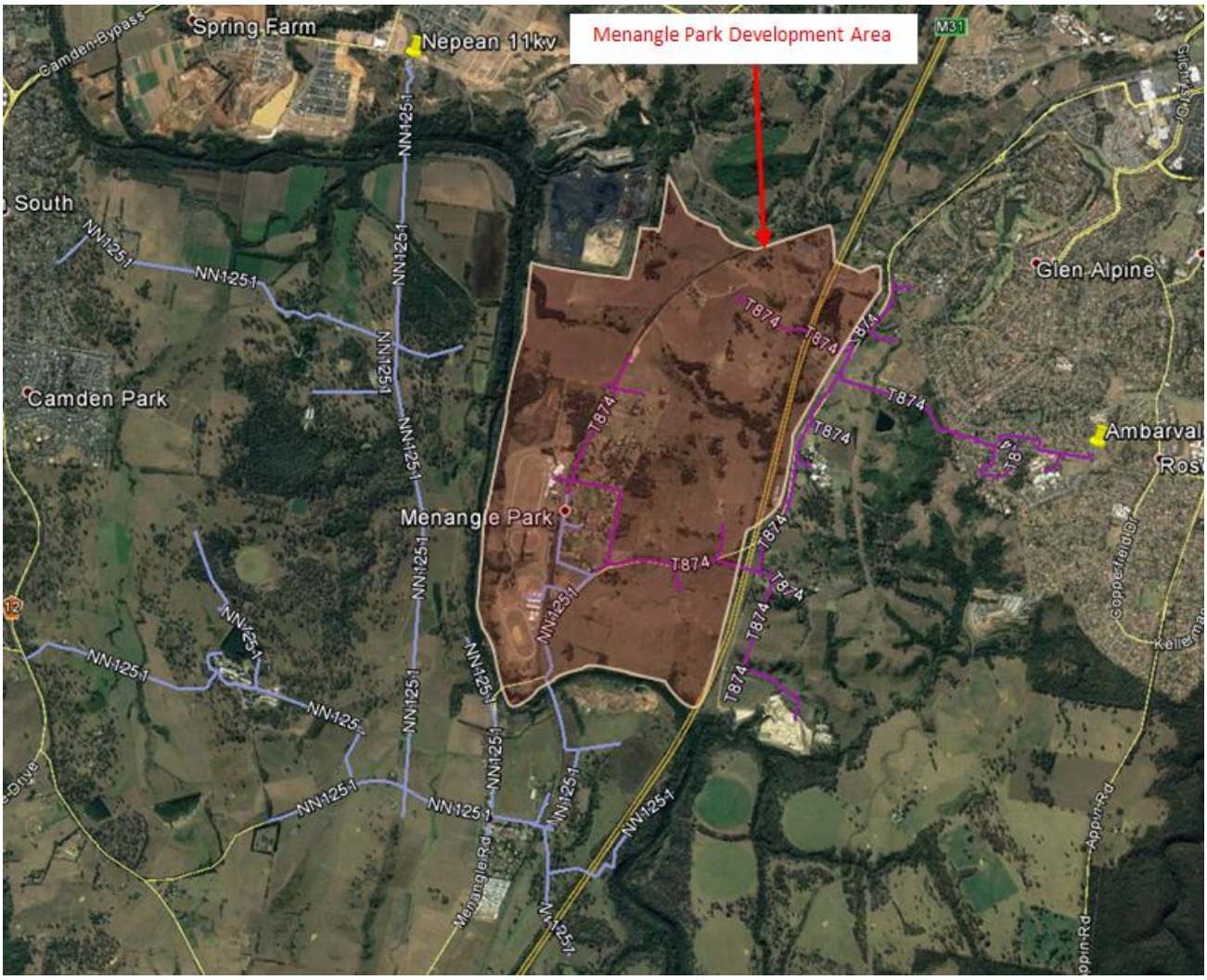
3 IDENTIFIED NEWORK NEED

3.1 EXISTING NETWORK OVERVIEW

The closest source of supply to the new Menangle Park development area is Ambarvale Zone Substation approximately 4.2 km to the east and Nepean Zone Substation which is a similar distance to the north-west. The existing Menangle Park Village is supplied from two rural 11kV feeders, T874-Demetrius Rd from Ambarvale ZS and NN1251-Cawdor Rd and Nepean ZS, refer Figure 2. The Demetrius Rd feeder is 6 km in length to the load centre and the Cawdor Rd feeder is 10 km to the load centre. These feeders may supply the initial part of the Menangle Park development area. Both substations have natural and manmade barriers between them and the development area which makes it difficult to develop additional 11kV feeders, refer Figure 3. These barriers include the:

- M31 Hume Motorway;
- Main Southern Railway Line;
- Steep terrain; and
- Nepean River.

Figure 2: 11kV Supply to Menangle Park Development Area



3.2 DESCRIPTION OF NETWORK NEED

Based on the development plan provided to Endeavour Energy, a minimum capacity of 28 MVA will be required to service this area which would require six 11kV distribution feeders. The 11kV capacity that currently is available from the existing 11kV network is 1.8 MVA. This represents the available capacity on the Demetrius Rd feeder (T874) ex Ambarvale ZS, refer Table 1. The available capacity on the Cawdor Rd 11kV feeder (NN1251), ex Nepean ZS, cannot be fully utilised as this feeder has reached its voltage regulation limits. Also, the Nepean ZS is approaching its capacity limitation and has exceeded its firm capacity by 7.8 MVA in summer 2016/17. Loading details are further discussed in Section 2.1 – Area Forecast.

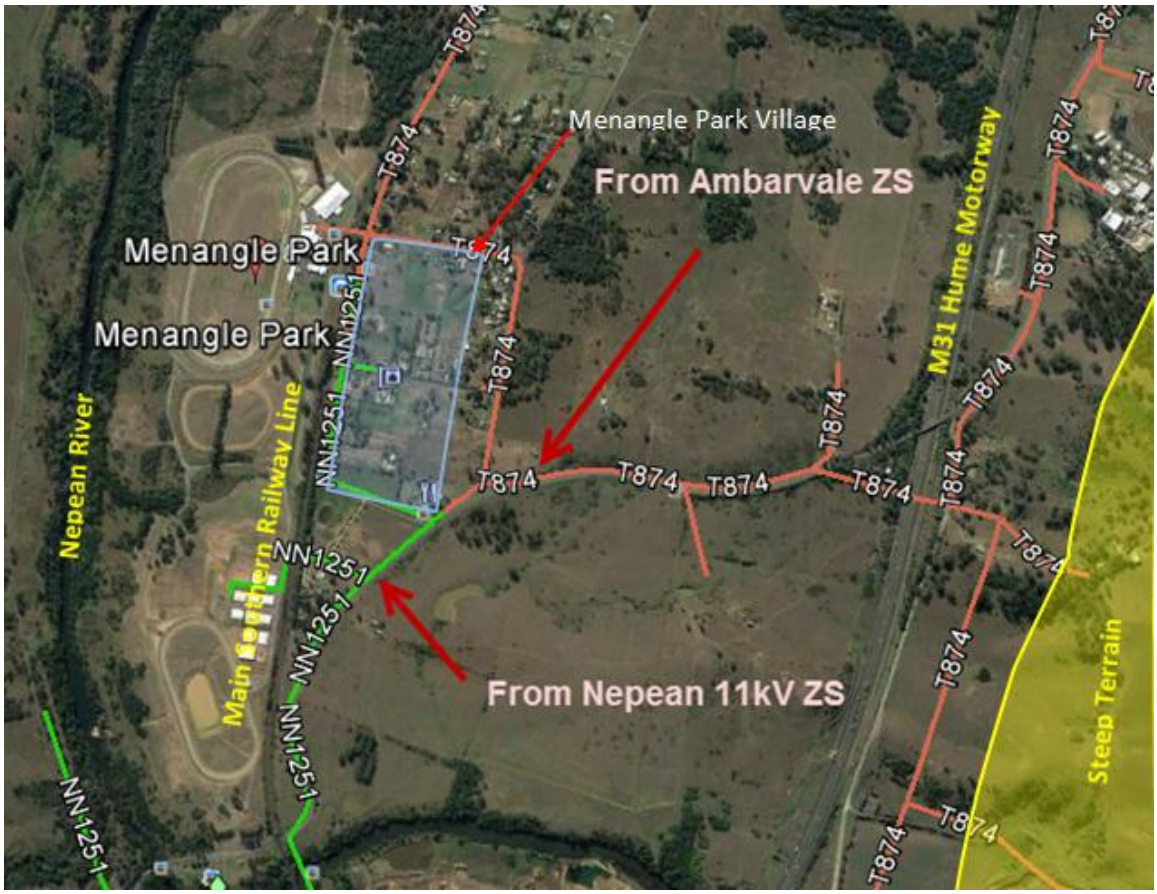
Table 1: 11kV Network Capacity to Menangle Park Development Area

Feeder Name	Zone Substation	Rating (kVA)	Load (kVA)	Spare Capacity (kVA)	Comments
T874 – Demetrius Rd	Ambarvale	4,500	2, 700	1,800	Load applications = 3.7 MVA[1]
NN1251 – Cawdor Rd	Nepean	4,500	2,100	0	Spare capacity cannot be utilised
Total	-	-	4,300	1,800[2]	-

Note 1: Includes the 200 lots in Menangle Park development area and other load applications along the Demetrius Rd feeder.
Note 2: Cawdor Rd Feeder capacity cannot be utilised due to the limitation on Nepean ZS.

The developer has been informed that 200 residential lots can be supplied initially from this available capacity. However this capacity will progressively decrease over time as there will be additional developments outside the Menangle Park development area which will need to be supplied from the Demetrius Rd 11kV feeder ex Ambarvale ZS. This is further discussed below.

Figure 3: Existing Supply to Menangle Park Village



3.3 LOAD FORECAST

The demand forecast for the Menangle Park development area is shown in Table 2 and includes the 4,320 planned lots, 28 Ha of industrial development and 20 Ha of commercial development. It does not include the future redevelopment of the existing Menangle Park village. The speed and the consistency of development can be observed by the increasing yearly load requirements in the forecast. The forecast table below shows there is load at risk from FY2020/21 and incorporates the 1.8 MVA capacity supplied from the Demetrius Rd feeder from Ambarvale ZS, refer Table 1.

Table 2: Menangle Park Development Area Demand Forecast

Item	Actual (MVA)			Forecast (MVA)									
Summer	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Forecast	0	0	0	0	0.3	1	2.3	4	6.3	9.1	13.5	18.3	22.7
N – Capacity[1]	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
LAR[2]	0	0	0	0	0	0	0.5	2.2	4.5	7.3	11.7	16.5	20.9

Note 1: Limited to 1.8 MVA due to available feeder capacities on Demetrius Rd 11kV Feeder.
Note 2: LAR - Load at Risk

3.4 NETWORK LIMITATION

Nepean ZS has exceeded its firm capacity in recent years. Early indication of the 2017/18 summer peak demand for Nepean ZS is 37 MVA. Consequently, there is little spare capacity at Nepean ZS available for 11kV load transfer and 11kV feeder development. The 2016/17 summer was extreme but does show the level of peak demand that can be expected on this substation. The Nepean ZS forecast is shown in Table 3.

Table 3: Nepean ZS Summer Demand Forecast

Item	Actual (MVA)			Forecast (MVA)									
Summer	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Forecast 50% POE	24.5	35.8	42.8	34.1	35.1	35.8	36.3	36.6	36.7	36.6	36.5	36.5	36.5
Forecast 10% POE				39.7	40.7	41.4	41.9	42.2	42.3	42.2	42.1	42.1	42.1
N – Capacity	35	35	35	35	35	35	35	35	35	35	35	35	35
LAR[1]	0	1.8	7.8	0	0.1	0.8	1.3	1.6	1.7	1.6	1.5	1.5	1.5

Note 1: LAR - Load at Risk based on 50% POE forecast

The Ambarvale ZS is able to provide about 10 MVA of capacity to the Menangle Park development area, refer Table 4. There is the possibility of developing two 11kV feeders from this substation into the Menangle Park development area. This is further discussed in section 4.1.

Table 4: Ambarvale ZS Summer Demand Forecast

Item	Actual (MVA)			Forecast (MVA)									
Summer	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**
Forecast 50% POE	26.6	25.1	26.4	22.1	22.3	23.6	24.9	24.8	25.8	25.7	25.8	26.0	26.0
Forecast 10% POE	26.6	25.1	26.4	26.0	26.2	27.4	28.7	28.6	29.6	29.5	29.6	29.8	29.8
N – Capacity	35	35	35	35	35	35	35	35	35	35	35	35	35
LAR[1]	0	0	0	0	0	0	0	0	0	0	0	0	0

Note 1: LAR - Load at Risk based on 50% POE forecast

The available capacity to supply the Menangle Park development area is 1.8 MVA via Demetrius Rd 11kV feeder from Ambarvale ZS, refer Table 1. When this capacity is exhausted it will not be possible to connect further dwellings.

Endeavour Energy has received two enquiries for supply outside the Menangle Park development area. If they proceed, the two applications will be connected to the Demetrius Rd feeder which will completely exhaust the available 1.8 MVA capacity to the Menangle Park development area. Both connections could be expected around 2020 moving the load at risk constraint to that year.

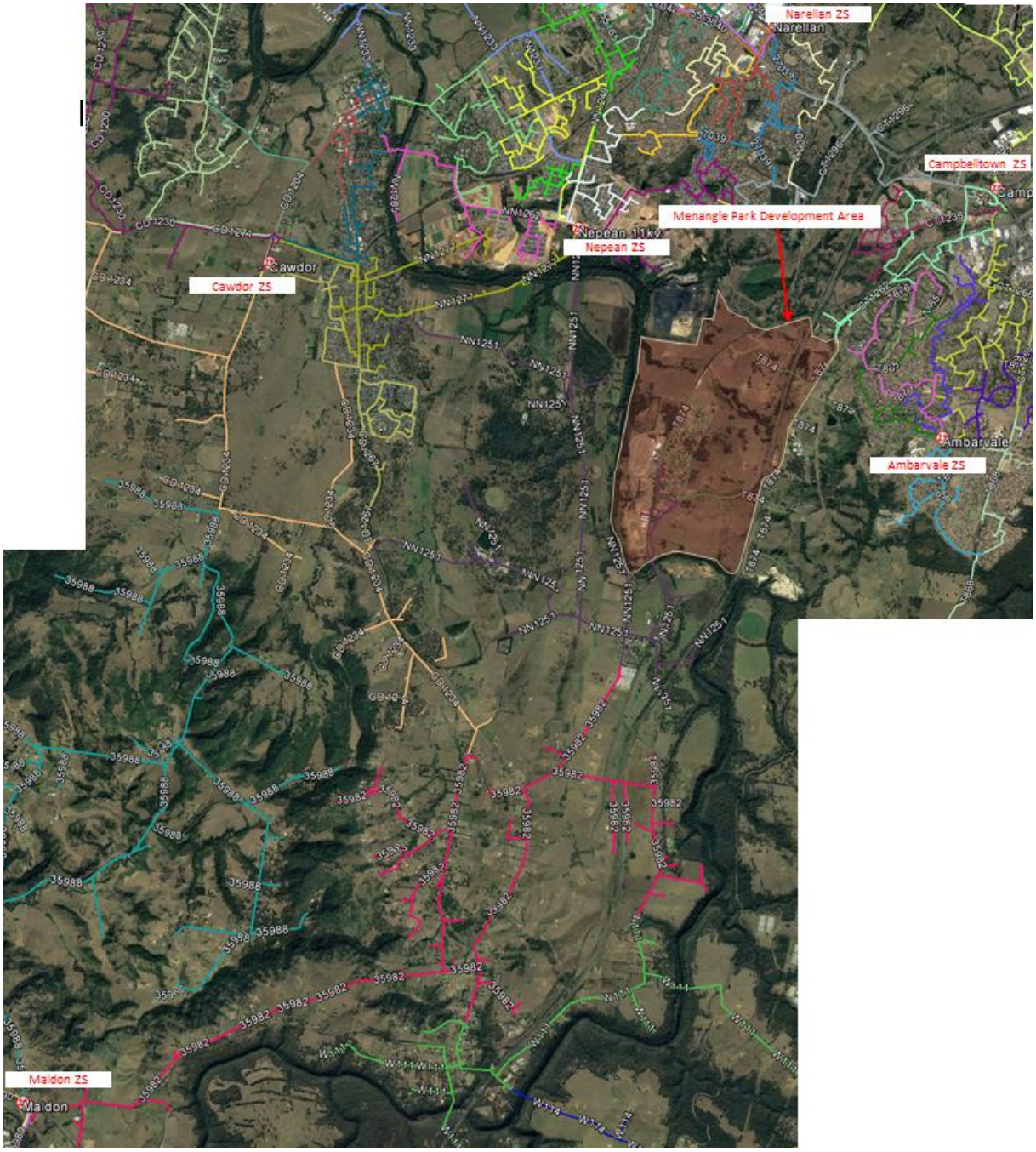
3.4.1 LOAD TRANSFER AND BACKUP CAPACITY

Load transfer capability was investigated for the two 11kV feeders that supply the Menangle Park development area being, Demetrius Rd feeder and Cawdor Rd feeder. The Cawdor Rd feeder has ties with 11kV feeders CD1234 and CD1267 from the Cawdor ZS as well as 11kV feeder 35982 from Maldon ZS. The adjacent substations to the Nepean ZS include; Campbelltown, Narellan, Cawdor and Maldon zone substations. These are shown in Figure 4. There is no load transfer capacity to these substations due to either; substation capacity limitation, 11kV feeder thermal limitation or 11kV feeder voltage regulation limitation. These are summarised in Table 5.

Table 5: Nepean ZS Load Transfer Capability

Asset Name	Limiting Factor
Narellan ZS	ZS Capacity is 70 MVA with a peak demand of 75.8 MVA. The majority of 11kV feeders have also reach capacity limits
Cawdor ZS	ZS Capacity is 25 MVA with a peak demand of 27.7 MVA.
Campbelltown ZS	There is one 11kV feeder connection to Nepean ZS, CT1296 which is exceeding its capacity limit of 4.5MVA
Maldon ZS	There is one 11kV feeder connection to Nepean ZS, 35982 which has reached its voltage regulation (VR) limit of 6% for a rural feeder. The VR limit for an urban area is 4.5%.

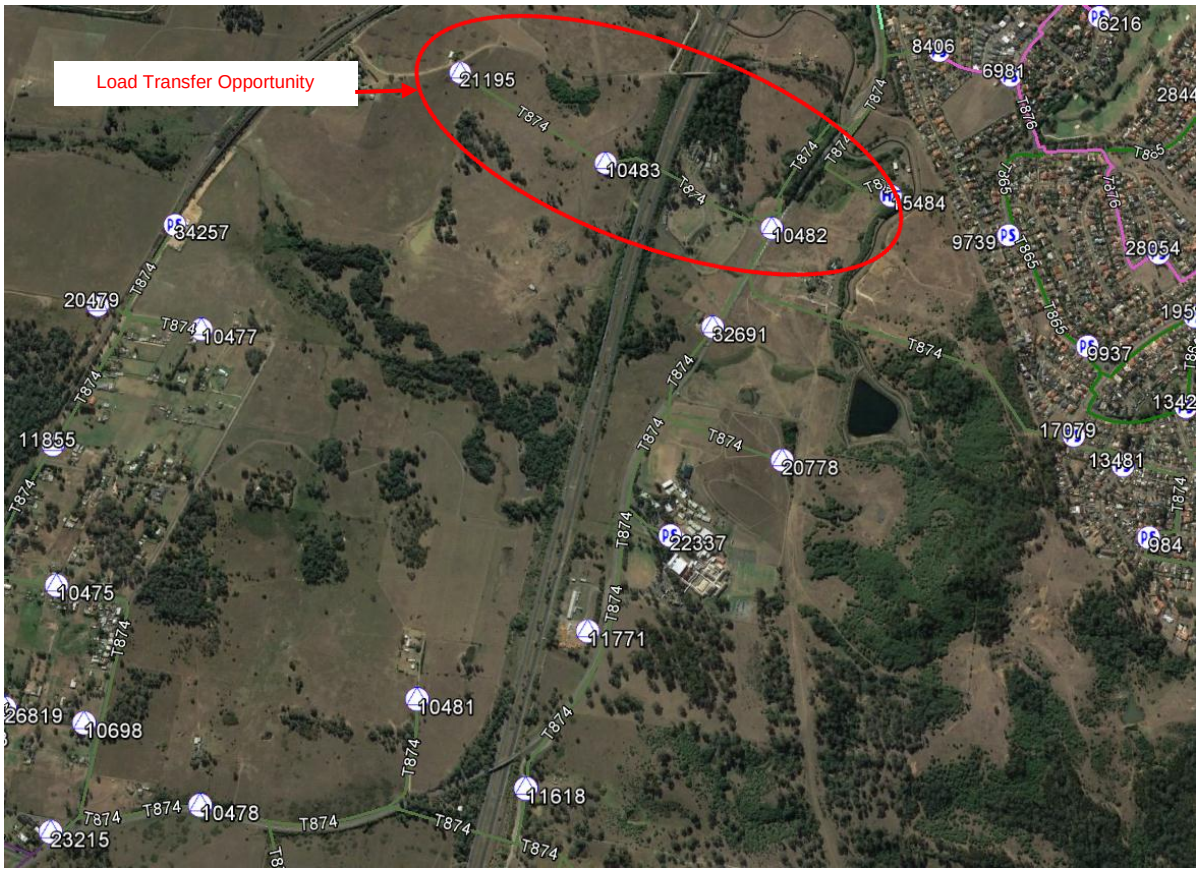
Figure 4: Nepean Zone Substation Load Transfer Opportunities



Demetrius Rd feeder, Ambarvale ZS, has an opportunity to transfer four rural distribution substations to feeder CT1262 ex Campbelltown ZS, refer Figure 5. This represents 0.1 MVA of load. However, to enable this transfer 11kV switching facilities need to be installed at a cost of between $30,000 and $40,000. As the amount of load transfer is small and would not result in any beneficial reduction this option has been discounted.

While Campbelltown ZS has the capacity to offload the Demetrius Rd feeder it is not capable of supplying the development area through additional 11kv feeder development due to the distances involved and voltage drops levels. There are no other 11kV feeders in the area that could supply the development area or provide back-up capacity under fault conditions.

Figure 5: Load Transfer Opportunity



3.4.2 LOAD AT RISK (N-1)

The load at risk that a non-network option needs to address is shown in Table 2. This load at risk is used in section 5.2 to determine the non-network option objectives.

4 SUMMARY OF CREDIBLE NETWORK OPTIONS

Three network options have been considered to supply the Menangle Park development area being:

Option 1: New feeders from adjacent zone substations;
Option 2: New Menangle Park zone substation; and
Option 3: Mobile Menangle Park zone substation.

These are further discussed below.

4.1 OPTION 1: NEW FEEDERS FROM ADJACENT ZONE SUBSTATIONS

As mentioned above, a minimum capacity of 28 MVA is required to service this area which would require six 11kV distribution feeders. With Nepean Zone Substation reaching its firm capacity the development of any new feeders is not possible. Campbelltown ZS is located about 8km from the centre of the development area. Supplying electrical power over this distance is not possible to due voltage constraints. Therefore, any new 11kV feeders will need to be from Ambarvale ZS.

Ambarvale ZS has a firm capacity of 35 MVA and is able to provide about 10 MVA of capacity to the Menangle Park development, refer Table 4. To utilise the available capacity it is proposed to construct two 11kV feeders. The development of 11kV feeders is challenging and costly due to the steep terrain and motorway and would be complex.

The development of new feeders to the Menangle Park development area will maximise on any spare capacity available in adjacent zone substation however, it may result in Ambarvale requiring augmentation within the 10 year forecast period. Due to the distance and the terrain the feeders will need to traverse, the cost of developing the two new feeders is estimated at $6 million and will be required by 2021 (prior to summer 2021/22).

This option will defer the construction of Menangle Park ZS by three years, to 2024 (prior to summer 2024/25), refer Table 2. However, if the additional load application are realised (3 MVA of demand) the deferral period reduces to two years.

4.2 OPTION 2: NEW ZONE SUBSTATION

This option involves the establishment of a permanent zone substation to supply the forecast 28 MVA from the Menangle Park development area. This substation will initially be supplied by one 66kV feeder and two 35 MVA transformers and contain ten 11kV circuit breakers. The timing of this substation is 2021 (prior to summer 2021/22) constructed over three years (2018/19 to 2020/21). This substation will also supply the future redevelopment of the Menangle Park village. Shown in Figure 6 is the location of the proposed Menangle Park ZS and shown in Figure 7 is the single line diagram. The cost of this substation is estimated to be $20.54 million.

Figure 6: Menangle Park ZS Proposed Site Location

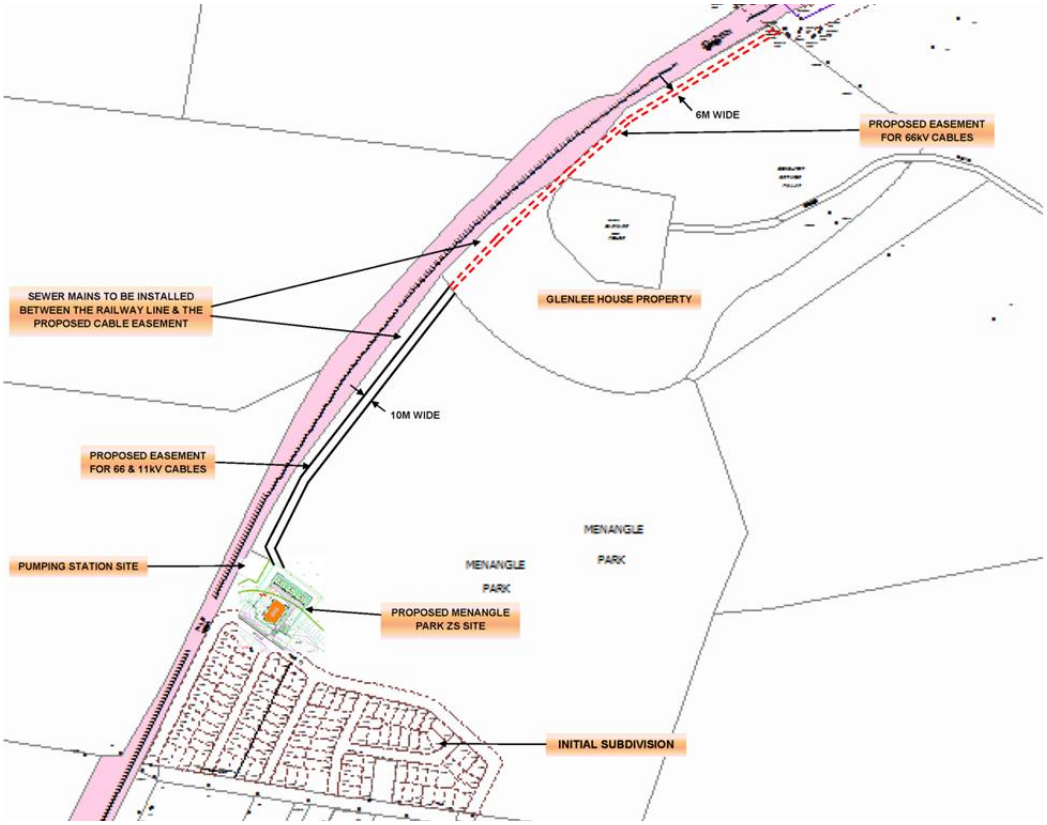
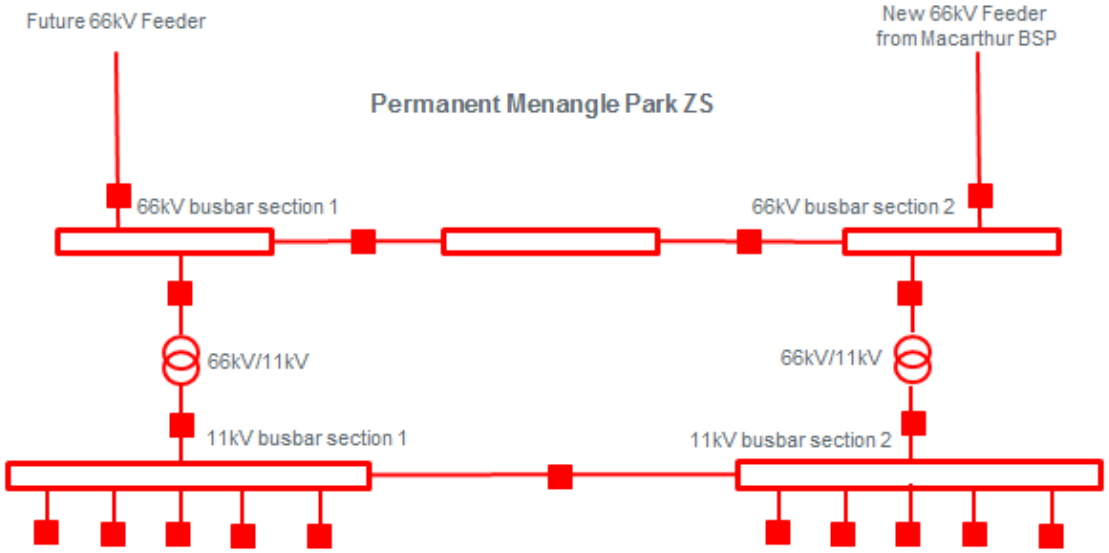


Figure 7: Menangle Park ZS Single Line Diagram

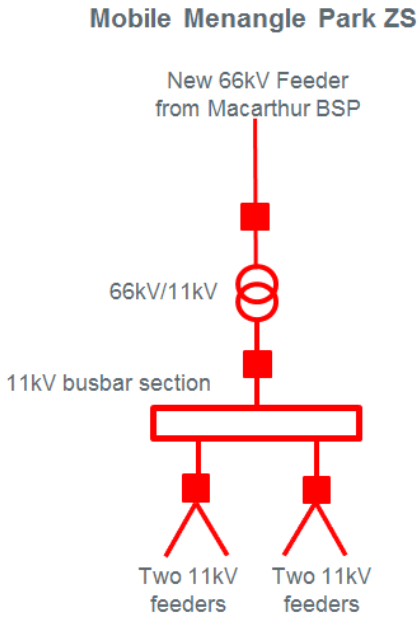


4.3 OPTION 3: NEW MOBILE ZONE SUBSTATION

This option involves the establishment of a mobile zone substation to supply the initial stages of the Menangle Park development area. This substation will initially be supplied by one 66kV feeder and one 15 MVA transformer and initially contain two 11kV circuit breakers supplying four 11kV feeders. The timing of this substation is 2021 (prior to summer 2021/22)

constructed over three years. The location of the proposed Mobile Menangle Park ZS is the same as the permanent substation as shown in Figure 6. The single line diagram is shown in Figure 8. The cost of this substation is estimated to be $4.6 million. This option will provide sufficient capacity to supply the development area until 2024 (prior to summer 2024/25).

Figure 8: Mobile Menangle Park ZS Single Line Diagram



4.4 PREFERRED NETWORK OPTION

The economic analysis for the three network options is shown in Table 6. The present value (PV) of all options includes future expenditure to address future capacity limitations.

Table 6: Network Options Summary

Option	Description	Cost ($m)	PV of costs ($m)	Capacity (MVA)	Year of Future Constraint
1	2 x 11kV feeders followed by a permanent ZS in 2024	6.0	-$21.5	9	2024
2	New Permanent ZS	22.5	-$17.2	35	-
3	Mobile ZS followed by permanent ZS in 2024	4.6	-$16.1	10	2024

Analysis shows that Option 3 has the superior PV of costs. This option involves the establishment of a mobile ZS to be commissioned in 2021 (prior to summer 2021/22). The construction of the permanent substation will be planned to be commissioned prior to summer 2024/25.

5 NON-NETWORK OPTION DEVELOPMENT

Endeavour Energy wishes to seek alternative proposals from the market for non-network options that may achieve the network demand reduction, timing objectives and targets. This

section describes those objectives and targets that a non-network proposal would need to meet in order to defer or avoid the network limitation and be considered a credible option.

As can be seen from Table 2, there is a small load at risk from summer 2020/21 on the 11kV feeders supplying the Menangle Park development area. However, the planned commissioned date for the network option is proposed to be 2021/22. This is due to the timeframe for the acquisition of easements and the establishment of subtransmission feeders connected to TransGrid Macarthur Bulk Supply Point.

The target area for load reduction is shown in Figure 9. This includes the new development area and the existing customer base supplied by the two 11kV feeders that will supply the initial stages of the Menangle Park development area. If the existing demand can be reduced and the demand growth can be managed then the network development could potentially also be managed in a more sustainable fashion and when absolutely necessary.

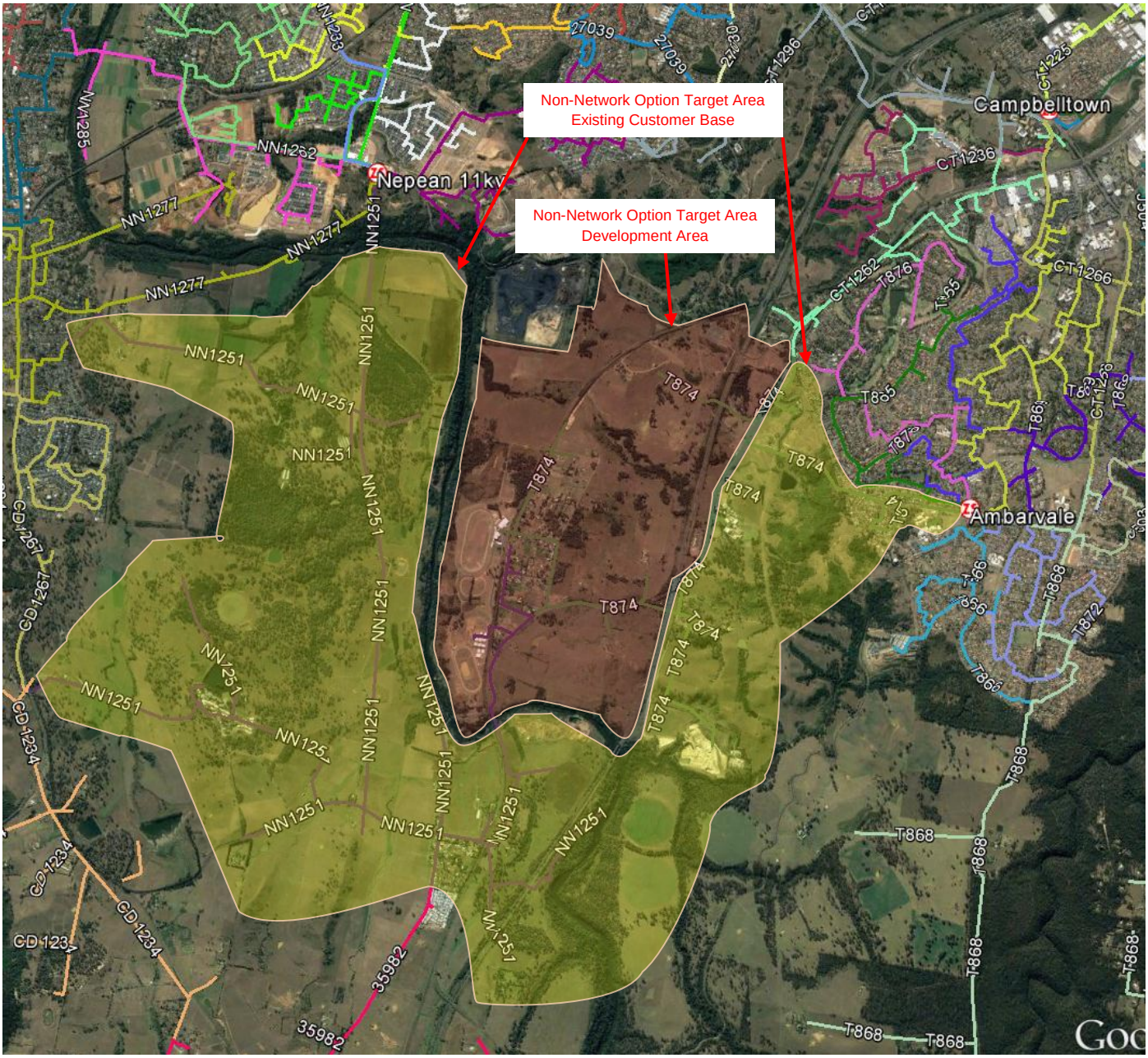
5.1 NON-NETWORK OPTION OBJECTIVE

The objective of the non-network option is to obtain sufficient net peak demand reduction on the 11kV network supplying the Menangle development area to manage the load at risk shown in Table 2 to permanently avoid or defer the construction of the mobile Menangle Park ZS for a minimum of one-year to 2022, commissioned prior to summer 2022/23.

Endeavour Energy will implement cost effective demand reduction initiatives from 2019/20 to manage the expected energy and load at risk commencing from 2020/21 and into 2021/22 to secure a minimum one-year deferral, refer Table 2. The reason for the early implementation of demand reduction is to provide sufficient time to implement the marketing strategies to obtain customer participation.

The challenge for this project is that the load growth is from ‘greenfield’ development areas. A successful non-network option will need to target the new development to ensure the impact on peak demand is minimised. The existing customer base must also be targeted to identify all cost effective demand reduction. Customer participation is also a challenge and service providers would need to assist customers to implement initiatives. Endeavour Energy will work with service providers and customers and provide assistance.

Figure 9: Location of Demand Reduction



5.2 TECHNICAL CHARACTERISTICS OF A NON-NETWORK OPTION

This section sets out the technical characteristic for a non-network option to successfully meet the objective. The trigger for network investment is not necessarily the load and energy at risk only. However, when identifying options to address the load and energy at risk they would need to successfully eliminate this risk in order to compare options equally.

The technical characteristics include the following:

- Meet the demand reduction levels as detailed in Table 8 focusing on 2020/21 and 2021/22 to achieve a minimum one-year deferral;
- Provide demand reduction conditions as specified in Table 7;
- Provide the level of reliability required by Endeavour Energy, refer section 5.4;

- Meet the timeframes expected to address the Load at Risk, refer Table 9.

5.2.1 CONDITIONS AND TIMING OF DEMAND REDUCTION

The 'time of day' demand reduction requirement is based on the load profiles shown in Figures 12 and 13 which is the load profile for the 11kV feeders supplying the development area and representative of the load profile of the target area. The Demetrius Rd feeder load profile peaks in the evening indicating predominantly residential load peaking between 2pm to 8pm. The Cawdor Rd Feeder is slightly different as it has a higher early afternoon demand indicating a component of business customers from the town centre and outer rural businesses peaking between 12pm and 6pm. It is expected that as development occurs the 2pm to 8pm residential evening peak will dominate.

Table 7: Non-network Option Technical Characteristics

Objective	Target
Time of year	1 November to 31 March (growing to all year round by 2022/23)
Time of day	2pm to 8pm (Demetrius Rd feeder) and 12pm to 6pm (Cawdor Rd feeder) (refer Figures 12 and 13)
Season condition	Summer (growing to all year round by 2022/23)
Day type	Days above 30 degrees[1] (growing to all peak days all year round by 2022/23)
Demand reduction required	Refer Table 9

Note 1: Refer Figure 11.

The seasonal demand reduction variation shows the existing winter peak demand is about 40% lower than summer and the existing mid-season is about 55% lower than summer, refer Figure 10. The seasonal demand reduction levels are shown in Table 9.

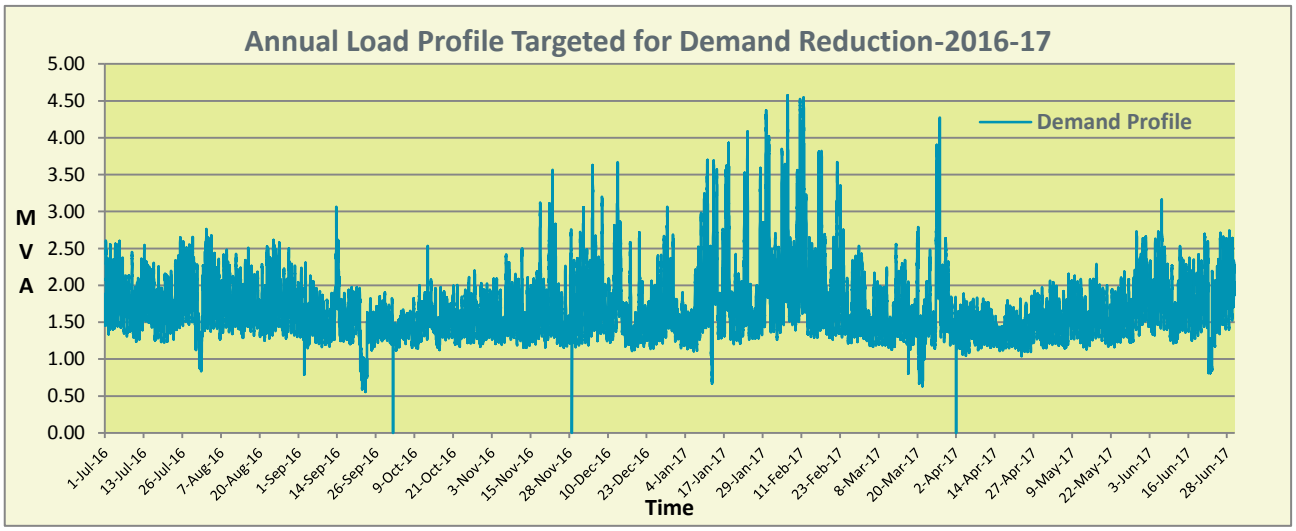
Table 8: Menangle Park Development Area - 11kV Feeders Load at Risk

Item	Actual (MVA)			Forecast (MVA)								
Summer	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**
Forecast	0	0	0	0	0.3	1.0	2.3	4.0	6.3	9.1	13.5	18.3	22.7
N – Capacity[1]	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
LAR[2]	**0**	**0**	**0**	**0**	**0**	**0**	**0.5**	**2.2**	**4.5**	**7.3**	**11.7**	**16.5**	**20.9**

Table 9: Menangle Park Development Area - 11kV Feeders Seasonal Load at Risk

11kV Feeder Load (MVA)	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
T874 – Demetrius Rd	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
NN1251 – Cawdor Rd	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Development Area	0	0.3	1	2.3	4	6.3	9.1	13.5	18.3	22.7
Total Load	4.8	5.1	5.8	7.1	8.8	11.1	13.9	18.3	23.1	27.5
11kV Capacity1	**6.6**	**6.6**	**6.6**	**6.6**	**6.6**	**6.6**	**6.6**	**6.6**	**6.6**	**6.6**
Load At Risk-Summer	**0**	**0**	**0**	**0.5**	**2.2**	**4.5**	**7.3**	**11.7**	**16.5**	**20.9**
Load At Risk-Winter	**0**	**0**	**0**	**0**	**0.3**	**2.6**	**5.4**	**9.8**	**14.6**	**19.0**
Load At Risk-Mid-season	**0**	**0**	**0**	**0**	**0**	**1.9**	**4.7**	**9.1**	**13.9**	**18.3**

Figure 10: Menangle Park Development Area 11kV Supply Annual Load Profile – 2016/17

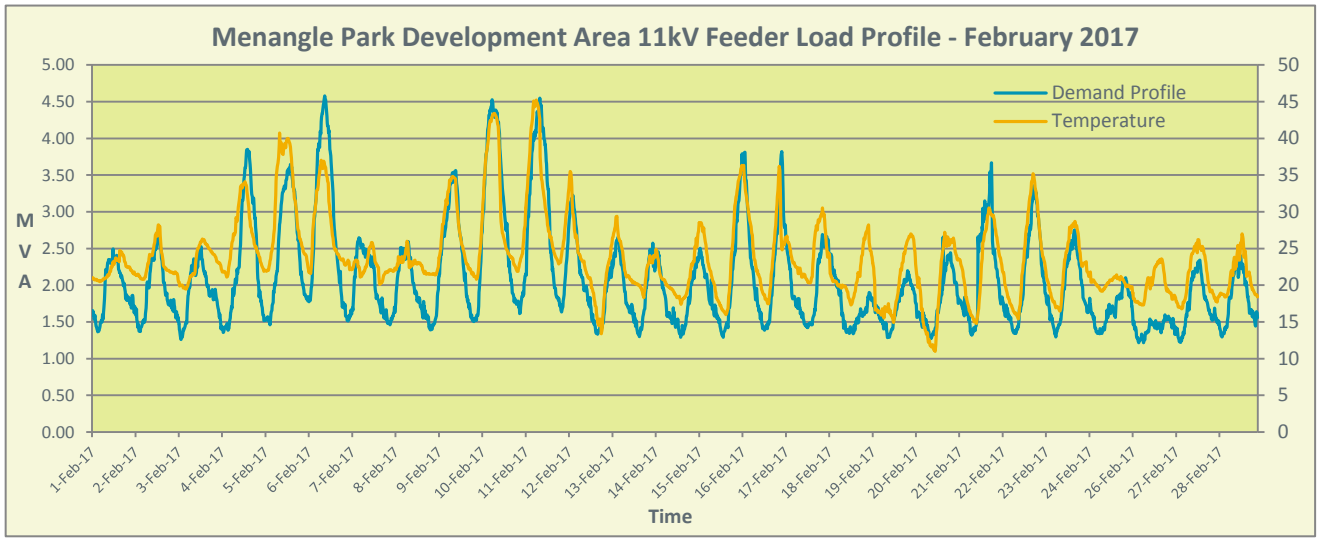


The demand reduction will need to target the 2pm to 8pm and 12pm to 6pm (refer Table 7) peak demands on days above 30 degrees Celsius on the 11kV network. This demand reduction will need to be initiated up to 9 times on a pre-emptive basis for the 2020/21 summer. The number of demand response (DR) events will quickly increase to about 120 events in 2021/22 and will be required all year round.

As the demand reduction requirement increases and moves down the load duration curve the hours of load above capacity dramatically increase. By 2021/22 the demand reduction requirement is 2.2 MVA with a peak demand of 4.0 MVA in the development area, refer Table 8. This indicates that temporary demand reduction initiatives may not be capable of providing the number of events and duration required. Endeavour believes that only permanent demand reduction initiatives are capable of meeting this demand reduction characteristic and the demand management program objectives particularly from 2021/22 onwards.

The demand follows the temperature very closely peaking on days above 30 degrees regardless of the day being working or non-working, as shown in Figure 11; Friday 10th and Saturday 11th February 2017.

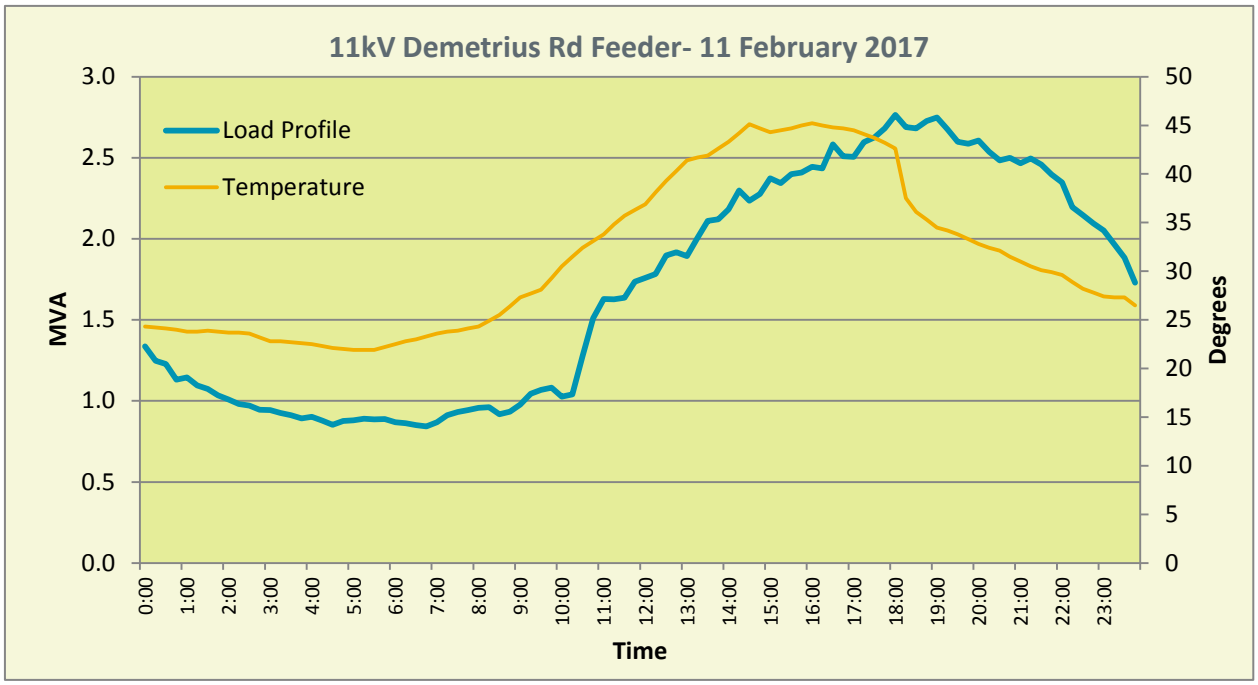
Figure 11: Menangle Park Development Area 11kV Supply Load Profile – February 2017



5.3 LOAD PROFILE CHARACTERISTICS

The load profiles of 11kV Demetrius Rd 11kV feeder (T874) off Ambarvale ZS and Cawdor Rd 11kV feeder (NN1251) off Nepean ZS are shown in Figures 12 and 13. The load type currently connected to these feeders is predominantly rural / residential in nature peaking in the evening. The Cawdor Rd Feeder is slightly different as it has a higher early afternoon demand indicating a component of business customers from the Menangle village and various rural businesses. It is expected that as development occurs the residential peak will dominate with the 2pm to 8pm peak increasing in magnitude.

Figure 12: 11kV Demetrius Rd Feeder Load Profile – Saturday 11 February 2017



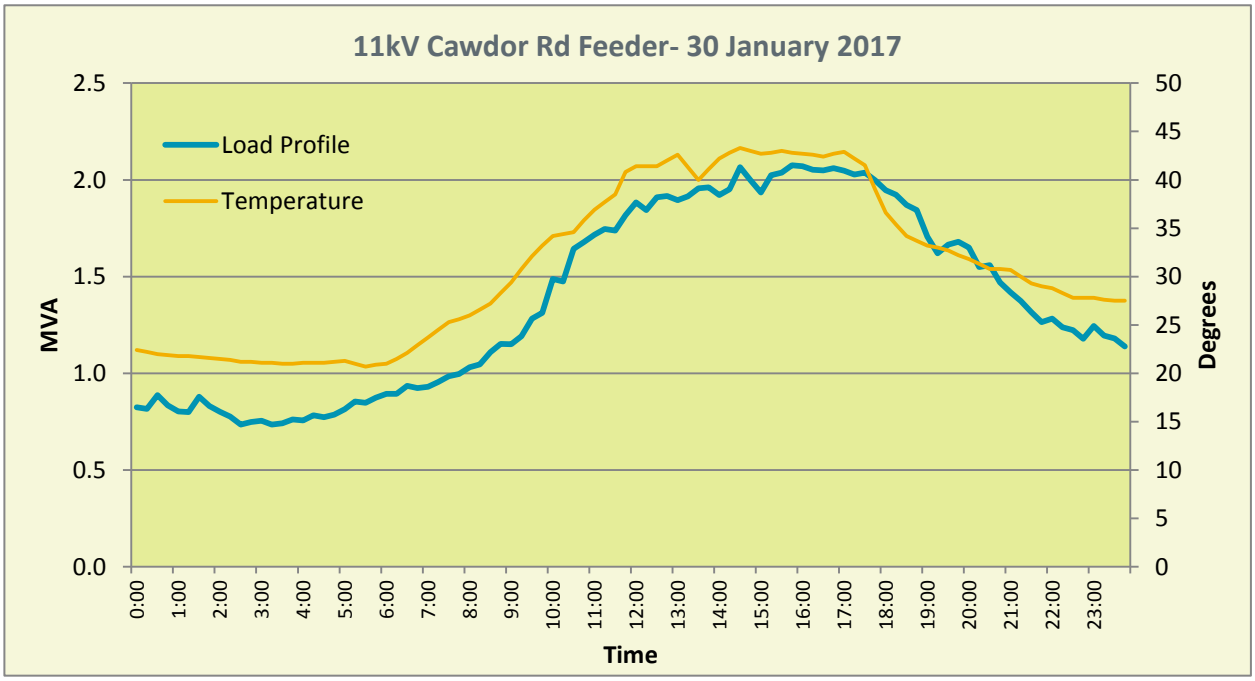


Figure 13: 11kV Cawdor Rd Feeder Load Profile – Monday 30 January 2017

5.3.1 LOAD TYPE SPLIT

The load type split based on existing connected loads on the Demetrius Rd and Cawdor Rd 11kV feeders is shown in Table 10 and is based on the recorded 2016/17 summer demand. As can be seen the connected load is predominantly residential / rural. There are 694 customer in total of which 557 are residential / rural and 79 business customers with 58 unknown. This represents 88% of the load base. There are no industrial loads in the area. It is estimated that the 12% of small business customers contribute only 3% of demand to the evening peak.

Table 10: Load Type Split

Load Type	Demand	Percentage
Industrial	0 MVA	0%
Commercial	0.2 MVA	3%
Residential	4.1 MVA	97%

5.4 RELIABILITY

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. These are detailed below in Table 11.

Table 11: Applicable reliability standards

Feeder/network type	Average reliability duration standards (minutes per customer)	Average reliability interruption standards (number per customer)	Equivalent average service availability (% of Time)
Urban network (overall)	80	1.2	99.98%
Individual urban feeder	350	4	99.93%
Rural network (overall)	300	2.8	99.94%
Individual rural feeder	1,000	8	99.81%

The option selected to address the network limitation should have adequate availability levels to contribute to maintaining reliability performance within these licence condition requirements.

6 PLANNING METHODOLOGY AND ASSUMPTIONS

A core justification for this project is based on load at risk and energy not supplied to customers waiting to connect. This is different to a situation where already connected customers risk losing supply. Arguably, the value that connected customers place on continuity of supply is different to the value customers waiting to connect will place on having access to supply. However, neither the RIT-D application guidelines nor the AEMO VCR guidelines provide any guidance on procedures to follow in such greenfield development situations. Hence, the same VCR value has been applied as a default position to the energy at risk values established from the above proposition. For a greenfield situation such as this, where the forecast demand rapidly exceeds the available capacity in the network, the VCR benefits to be captured from formulating a project to address network shortfalls can quickly rise to extremely large sums. In order to derive meaningful results when comparing options against each other and consistent with industry practice elsewhere, the annual VCR benefits that can be captured in a project has been capped corresponding to an annual expected unserved energy value of 360 MWh. This is reflected in Table 12.

6.1 LOAD AND ENERGY AT RISK (N-1)

The above demand forecast shows a demand reduction of 2.2 MVA is required by 2021/22 to remove the capacity constraint on the 11kV network and defer the proposed Menangle Park mobile ZS for one year. Endeavour Energy will consider implementing the lower level demand reduction of 0.5 MVA in 2020/21 if 2.2 MVA of demand reduction is unattainable, refer Table 8.

An analysis of the energy at risk and expected unserved energy was conducted to determine the value of expected unserved energy. This analysis involves an assessment of the probability of failure and the consequence in the event of failure including the expected outage duration and expected unserved energy (refer section 6.4). These factors form the basis of probabilistic planning and the timing for network limitation investigations.

The base case (do nothing option) results in unserved energy, as shown in Table 12 for the 11kV feeder constraint, subject to the 360 MWh cap. The figures represent a weighted average of 30% and 70% of the expected unserved energy figures for the 10% POE and 50% POE maximum demand forecasts respectively. The development and use of these figures is discussed below.

Table 12: Base case risk exposure – Menangle Park ZS Development - 11kV Feeders

Year	Energy at risk (MWh) annual	Hours at risk pa	Expected unserved energy (MWh)	Value of expected unserved energy ($'000)
2019/20	0	0	0	0
2020/21	13	70	13	215
2021/22	360	1,420	360	6,200
2022/23	360	7,700	360	6,200
2023/24	360	8,680	360	6,200

6.2 PROBABILISTIC PLANNING

Endeavour Energy applies a probabilistic planning methodology to evaluate the network constraints 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 over the 10-year planning forecast period. The trigger for network investment is based on a cost benefit analysis. Network augmentation is only considered if the benefit or the reduction in the cost of expected unserved energy outweighs the network augmentation cost required to reduce the unserved energy.

The main requirements driving the construction of the Menangle Park Zone Substation are:

- Zone substation capacity;
- Security and quality of supply at the zone substation and feeder level; and
- Exceeding 11kV feeder design capacity due to progressive customer connections.

The value of expected unserved energy is not used to determine the financial incentive payment for non-network options. This value is determined by the deferral or avoidance value of the capital expenditure.

6.3 ENERGY AT RISK

The magnitude of energy at risk annually has been estimated from the annual peak demand forecasts and load duration curves. The energy at risk is considered to be the energy above firm capacity (or above “N-1” capacity). Two components of energy at risk are calculated:

a) Energy at risk above “N-1” capacity but below “N” capacity
b) Energy at risk above “N” capacity.

In the former case, the energy at risk is subject to the probability of an outage occurring. In the latter case, if new connections to the existing network continued to be made, the energy at risk above N capacity simply refers to the energy that cannot be supplied at all during peak periods due to insufficient capacity in the network. Hence in this situation, the expected unserved energy is the total energy at risk.

6.4 EXPECTED UNSERVED ENERGY

The calculation of the expected unserved energy for the RIT-D analysis is determined by taking a 30% weighting of the unserved energy at the 10% POE maximum demand forecast and a 70% weighting of the unserved energy at the 50% POE maximum demand forecast. This is to account for the uncertainty in the demand forecast and is consistent with practices adopted by AEMO and other distribution network businesses in Australia.

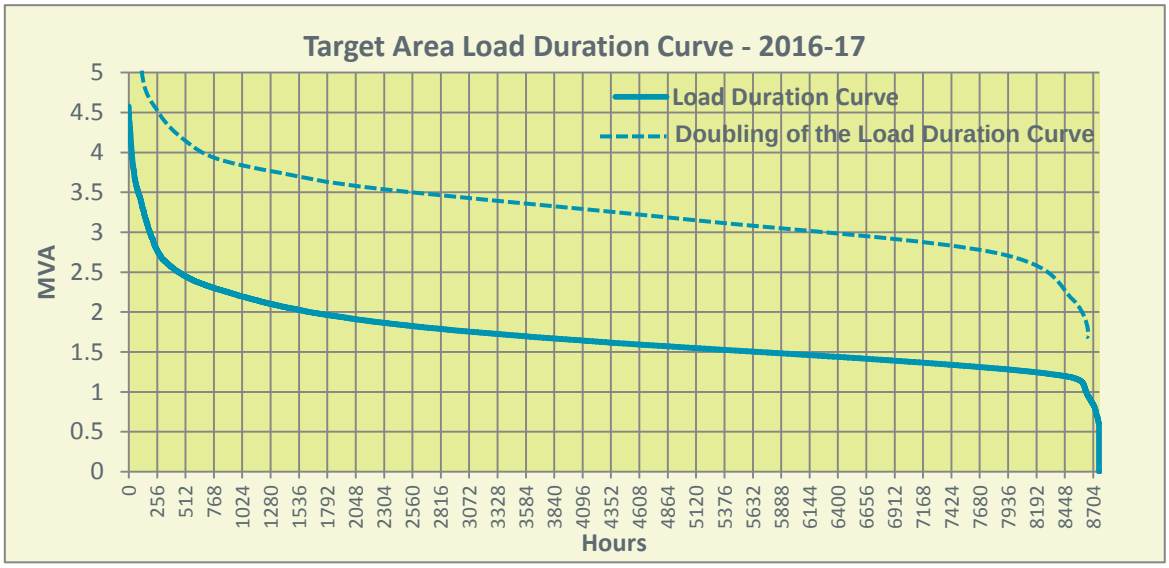
As stated above, all of the energy at risk above “N” capacity is taken to be expected unserved energy. However, where loads are between “N-1” capacity and “N” capacity, the energy at risk is subject to a probability of an outage occurring to determine the expected unserved energy. The calculation of the expected unserved energy for the base case is shown in Table 12 above.

6.5 LOAD DURATION CURVE

The load duration curve (LDC) for Menangle Park development area 11kV feeders for the 2016-2017 year is shown in Figure 14. This curve is principally influenced by the residential / rural component of demand. The determination of the expected unserved energy is based on this load duration curve.

Due to the initial low level of load and capacity compared with the forecast load increase (the base load will double within three years of development commencement) the energy at risk value under the LDC can increase quickly. Similarly, the hours when capacity is exceeded also increases quickly, as demonstrated by the dotted line in Figure 14.

Figure 14: Menangle Park Development Area - Load Duration Curve



6.6 VALUE OF CUSTOMER RELIABILITY

The value of unserved energy is calculated using the value of customer reliability (VCR). This represents an estimate of the value electricity consumers place on a reliable electricity supply. Endeavour Energy uses the VCR estimates provided by AEMO, weighted in accordance with the composition of the commercial, industrial and residential load within the Menangle Park development area. The VCR values are shown in Table 13 below.

Table 13: Value of customer reliability

Load type	11kV Supply to Menangle Park Development Area	VCR ($ per kWh)
Residential	97%	$26.53
Commercial	3%	$44.72
Industrial	0%	$44.06
Agriculture	0%	$47.67

7 FINANCIAL MODELLING

Endeavour Energy is required to ensure investments in the distribution network are prudent with the preferred option being the one that represents the best net economic value that achieves the desired outcome. Endeavour Energy's financial incentive payments for the implementation of demand management initiatives are based on the cost saving from deferring capital expenditure (Avoided Distribution Cost) and addressing the expected load and energy at risk.

A financial evaluation of the deferring the construction of the Menangle Park mobile ZS ($4.6 million) for one-year results in an Avoided Distribution Cost (ADC) of $0.29 million. The expenditure to implement a non-network option will occur over three years from 2019/20 to 2021/22 to achieve a one-year deferral. The maximum financial incentive payment to achieve a one-year deferral equates to $127 per kVA for permanent demand reduction as a one-off incentive payment based on targeting 2.2 MVA of demand reduction. This represents the maximum amount that would be available as an incentive payment and is dependent on the reliability of demand reduction and other administration costs. This is summarised in Table 14.

Table 14: Financial Evaluation Summary – Expenditure/Incentive Profile

Item	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	Comments
Load At Risk			**0.5**	**2.2**	**4.5**	**7.3**	**11.7**	-
Network Expenditure ($'000)	1,300	2,100	1,200					**Total = $4.6m**
One year deferral		1,300	2,100	1,200				**ADC = $0.29m**
Two year deferral			1,300	2,100	1,200			**ADC = $0.57m**
Permanent demand reduction $/kVA[1]		**127**	**127**	**127**				One-off payments

Note 1: Payments are based on a 2.2 MVA reduction to achieve a one-year deferral.

Payments for load curtailment and load shifting program will be structured differently and based on a kVAh basis. Payments are also based on the reliability level as demand reduction and customer participation to the demand response request. Endeavour Energy will need to be satisfied that customer participation is reliable. As the number of days that exceeds the capacity will be about 120 in 2021/22 Endeavour Energy believes that temporary load reduction in the way of load curtailment is not likely to be feasible. Permanent demand reduction or alternative energy sources are more likely to meet the demand reduction requirements.

Other costs borne by Endeavour Energy in implementing proposals will be factored into the financial evaluation and will impact on the ultimate level of payment offered for demand reduction.