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- GREATER MACARTHUR
- PRIORITY GROWTH AREA
- PLAN



August 2022

Version Control and Approvals

This document is updated annually, or more frequently as revised data is received. **Table 1** below is updated detailing key changes made between versions. The table is populated in descending order.

Table 1 – Version Control

Version #	Date of Issue	Description
2	July 2022	Release of revised dwellings projection, precincts load forecasts and project approvals.
1	June 2018	Original version.

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1. Executive Summary

In June 2018 the original Greater Macarthur Priority Growth Area Plan was released which defined the preferred strategy for the Sydney's Greater Macarthur Priority Growth Area (GMPGA). This 2022 revision of the original Area Plan is based on updated dwelling and employment land projections, total mature load, network project approvals and servicing strategy. The process of revising the original Area Plan has confirmed there is no material changes required to the original recommended supply strategy and actions.

This report outlines the investment needs and strategy to accommodate the development of an estimated **55,100 to 82,100** dwellings by 2056 and **7.78km²** (778Ha) of employment lands in Sydney's GMPGA. This area comprises of the Menangle Park, Mount Gilead, West Appin, and Wilton precincts. This plan does not address growth in the adjacent urban reactivation precincts of the Glenfield to Macarthur Rail Corridor.

It is expected that when fully developed beyond 2056, the Sydney's GMPGA will result in up to 405MVA of load (subject to any demand management initiatives and actual future customer demand) being added to Endeavour Energy's network. The network that is proposed to supply the ultimate load comprises of one additional bulk supply point, augmentation of three existing zone substations and the establishment of six new zone substations.

The strategy aims to maximise the use of the existing 66kV infrastructure currently in place within the development area for as long as possible and includes the establishment of a new Bulk Supply Point (BSP) at Appin at a later stage that will provide a 66kV injection point to cater for the identified shortfall in network capacity. Strengthening of the 66kV network will also assist in the effective utilisation existing embedded coal seam methane gas generation in the area.

Consideration is given to staging the implementation of the ultimate network, with short/medium term (5-10 years) network configuration proposed for supplying the land that is currently zoned or is being planned for development. Consideration is also given to the possible level of demand reduction arising from successful demand management initiatives resulting from the uptake of Distributed Energy Resources and DRED ready air conditioners.

The need to continue engagement with various stakeholders, including the NSW Department of Planning & Environment, the Greater Sydney Commission, TransGrid, developers and landowners, is highlighted as critical for the acquisition of line corridors and zone substation sites.

In summary, the following recommendations are made:

1. The proposed Ultimate Network Topology outlined within this report be carried forward as the basis for further planning within the Greater Macarthur Priority Growth Area. Individual projects based on the principles outlined in this report will be developed separately and funding sought for each of these projects at the appropriate level and time.
2. Projects be initiated and completed as required prior to FY25 include:
 - Establishment of Menangle Park Zone Substation (ZS) in mobile configuration
 - Rebuild of Feeder 308 to 66kV, including future provision to ring in Menangle Park ZS
 - Acquisition of Mount Gilead ZS site
 - Acquisition of West Appin ZS site
3. Projects be completed in the 2025-29 regulatory period include:
 - Establishment of Mt Gilead ZS
 - Establishment of Menangle Park ZS (Permanent)
 - Establishment of West Appin ZS
 - Acquisition of South Gilead ZS site
 - Acquisition of North Appin ZS site
4. Projects that are programmed outside of the 2020-2029 regulatory periods which are presently not costed but have some possibility of being brought forward depending on the rate of development of the Greater Macarthur Priority Growth Area are as follows:

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 - Acquisition of North Wilton ZS site
 - Establishment of North Wilton ZS
 - Establishment of North Appin ZS
 - Augmentation of 66kV Feeders
 - New 66kV feeders outlined as required this Area Plan.
 - Establishment of Appin BSP (by TransGrid)
 - Establishment of South Gilead ZS
5. Establish Joint Planning with TransGrid on the establishment of 330/66kV Appin BSP. Based on present projections and depending on the future of the existing embedded generation in the area, it is likely that the BSP at Appin and some associated works will not be required for the Greater Macarthur Priority Growth Area for at least 20 years.
 6. Continue in collaborative working relationships with Developers and the Department of Planning and Environment to ensure that zone substation sites and line corridors are included in the development of master plans.
 7. Continue discussions with the Department of Planning and Environment (DPE) on an ongoing basis to ensure that Endeavour Energy's staging for the establishment of major infrastructure is in line with projected development timing.
 8. Assist developers that wish to implement opportunities for micro grid developments that limit the level of demand drawn from the grid at a single connection point.

2. Purpose

The purpose of this document is to establish a supply plan for the Sydney's Greater Macarthur Priority Growth Area.

This report outlines the strategy for supplying the Greater Macarthur Priority Growth Area which spreads across the Campbelltown and Wollondilly Local Government Areas (LGA) and extends from Menangle Park in the north, Appin in the East, Wilton in the south and Maldon to the south west. The Area comprises an area of approximately 17,600 hectares and is located approximately 70km south-west of the Sydney CBD. As illustrated in **Figure 1**, the development site is made up of four major areas, these are:

- Menangle Park
- Mount Gilead
- Wilton New Town
- West Appin

This plan does not address growth in the adjacent urban reactivation precincts of the Glenfield to Macarthur Rail Corridor.

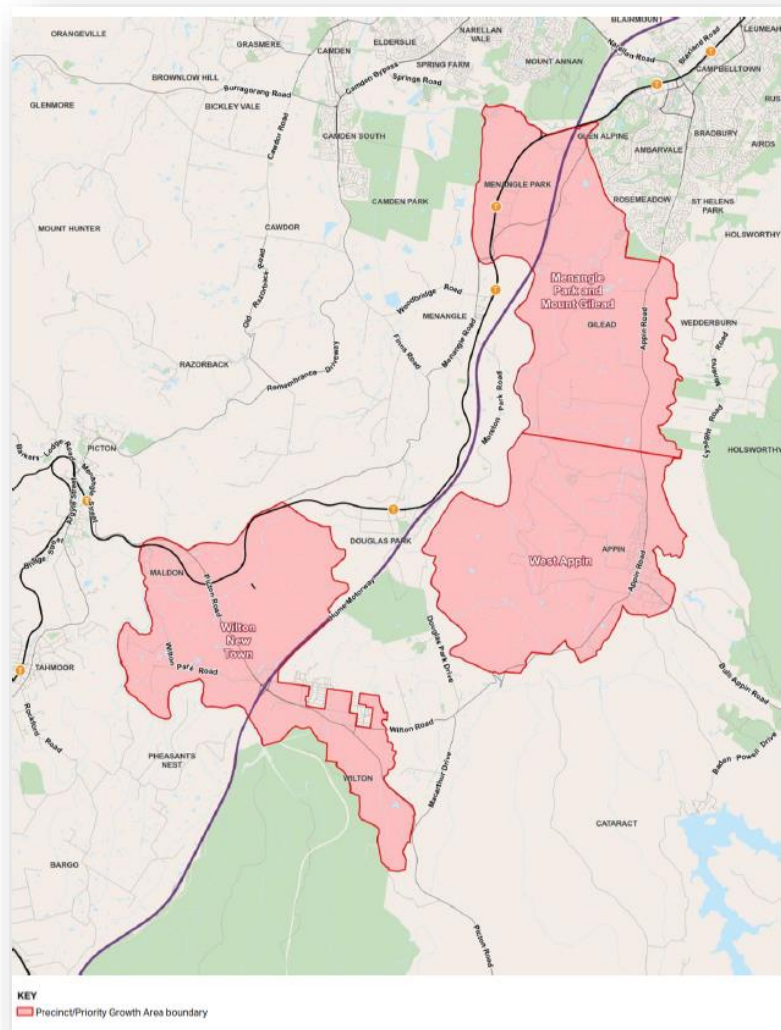


Figure 1 – Precincts within the Sydney's GMPGA Plan – Geographic View²

² Based on the NSW DPE Utilities Services Study from June 2017: [Source](#)

The NSW Government DPE has outlined that Sydney's GMPGA is expected to have an estimated 53,100 to 80,100 dwellings by 2056³ and 9.83km² (983Ha) of employment lands. An extra 2,000 lots were added to the base case scenario for a total of 55,100 to 82,100 lots to account for applications from different developers from Moreton Road and Menangle Park⁴. The dwelling projection is presented in **Figure 2**.

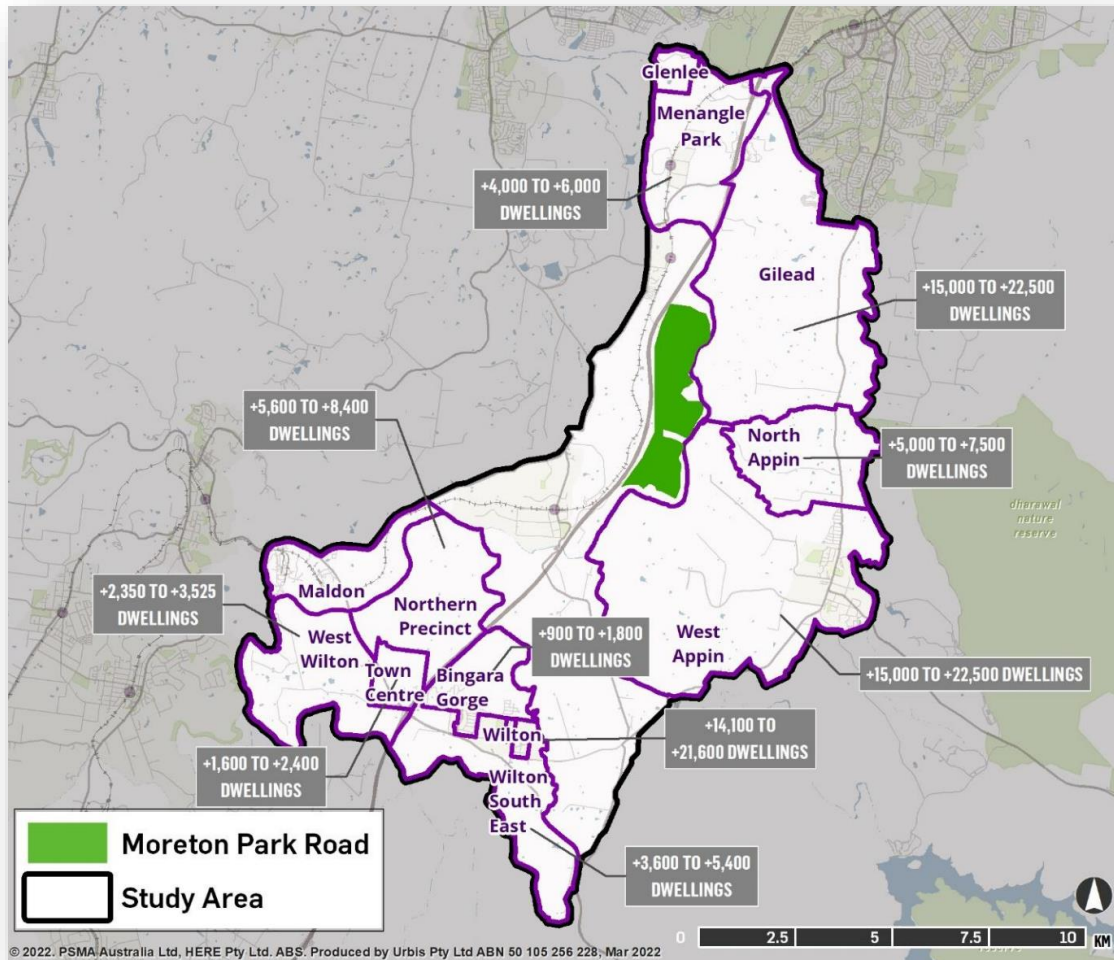


Figure 2 - Dwelling Projections³ – Geographic View

Bingara Gorge in Wilton Growth Area has commenced development. There are assumed to be 900 dwellings completed in 2021. Dwelling delivery in the rest of the Area is expected to commence in 2022. Menangle Park and Gilead dwellings are expected to be completed by 2040 while Wilton by 2050. West Appin and North Appin dwellings will be delivered through multiple stages with anticipated completion by 2056. Moreton Park Road, shown on the map, has been identified as future employment potential land in the GMGA 2040 interim plan⁵.

³ Based on the NSW DPE data from June 2022: [Source](#)

⁴ Based on the Wollondilly Council's online community engagement platform: [Source](#)

⁵ Based on the Greater Macarthur 2040 interim plan: [Source](#)

3. Scope

The scope of this document includes:

- A **description of the area** and linkages to related area plans.
- The **network need** based on triggers for growth in the service area over a rolling 10-year period.
- An **overview of proposed network topology** and available capacity to inform the potential augmentation projects to service the growth.
- A **recommended supply strategy** and list of augmentation projects over a rolling 10-year period.

The following is not within the scope or intent of this document:

- Precinct specific load forecast. These are included in demand forecasts.
- Options for investments. Options for specific precincts and network needs are included in the individual Case for Investment documents. document does not include optioneering for investments as they are included in the individual CFIs.

3.1 Asset Management System

A critical input to the Regulated Asset Base (RAB) Strategies is a series of detailed area plans developed for areas that are expected to require significant investment in the future. The purpose of these area plans is to outline an overarching view of the network infrastructure that will be required to service the identified growth area.

The Area Plans aim to assess the state of the network, identify the critical external influences to determine the likely future network requirements, and identify the high-level needs and opportunities to be refined and options (external to the Area Plan process) through the investment governance process.

The relationship between this Area Plan and the other artefacts within Endeavour Energy's asset management system is illustrated in Figure 3.

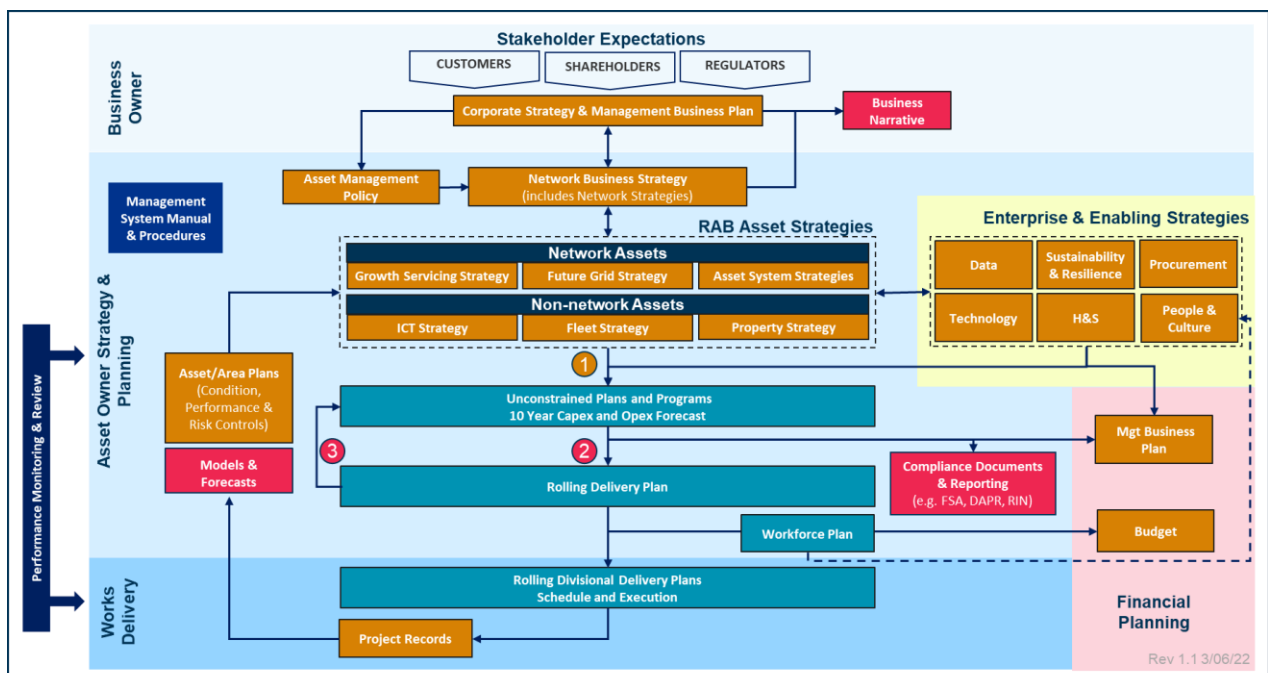


Figure 3 – Endeavour Energy Asset Management System artefact hierarchy

A detailed description of Endeavour Energy's asset management system and its constituent parts is available in the Asset Management System Manual and the Asset Management System Guidelines.

4. Description of the area

4.1 Context within broader Sydney region plans

The NSW Government, through the Greater Sydney Commission, has developed a vision for the Broader Sydney region through the Greater Sydney Region Plan “A metropolis of three cities – connecting people” released in March 2018. This plan follows on from previous reports including the December 2014 “A Plan for Growing Sydney”.

The vision describes Sydney becoming a metropolis of three cities (Figure 4): The Eastern Harbour City which largely exists today; the Central River City to be centred around Parramatta, and the Western Parkland City.

The Vision also included overall Structure Plan for the region and for each city. **Figure 5** below shows the Structure Plan for the Western Parkland City. Broadly, the Greater Macarthur Priority Growth Area Plan supports the Greater Sydney Commission’s strategic vision for a Metropolis of Three Cities and the Western Parkland City.



Figure 4 – Greater Sydney Commission vision for A Metropolis of Three Cities

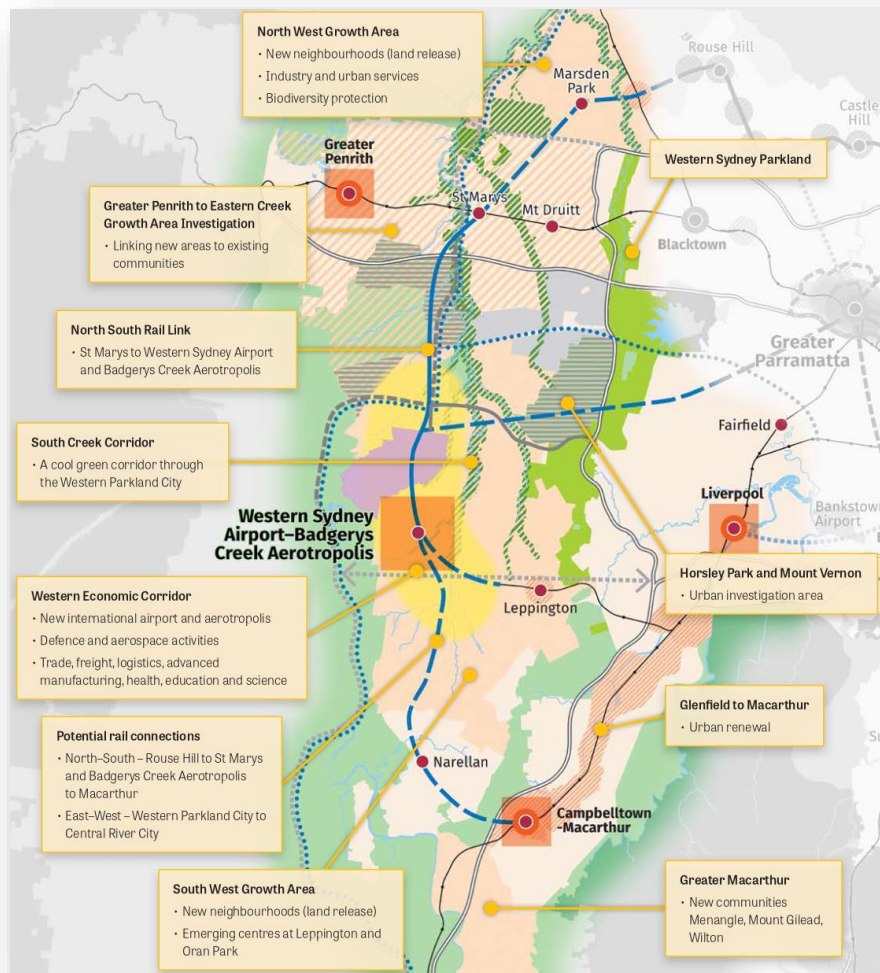


Figure 5 –Structure Plan for the Western Parkland City

Throughout this report there are occasions where Endeavour Energy may use the term “transmission” to describe some sub-transmission assets due to internal naming convention, however it does not own and operate “transmission” network assets as per the definition in the National Electricity Rules.

4.2 Informing of the Area Plan

The Sydney's GMPGA is developed from a range of inputs. Principally the data is informed by officiated NSW Government Department of Planning and Environment (DPE) documents such as Precinct Plans, Structure Plans and Planning Policies.

In addition to published information sources, Endeavour Energy is actively engaged further with DPE through routine Technical Working Group (TWG) meetings as appointed through DPE's Chief Engineer Office and the Utilities Collaboration Group (UCG).

Endeavour Energy also holds direct engagement meetings and routine written correspondence with all major developers and land holders in the region. This collaboration informs ultimate long-term needs of the precincts as well as near term servicing arrangements and investment timing.

4.3 Overview of the Area Plan

Figure 6 provides an overview of the Area Plan (medium-term) detailed within this document. The key features include:

- the ultimate requirement for an additional BSP ("Appin BSP" to be constructed by TransGrid),
- the augmentation of three existing zone substations,
- the establishment of six new zone substations in total (long-term),
- the combined use of spare capacity in existing 66kV feeders.

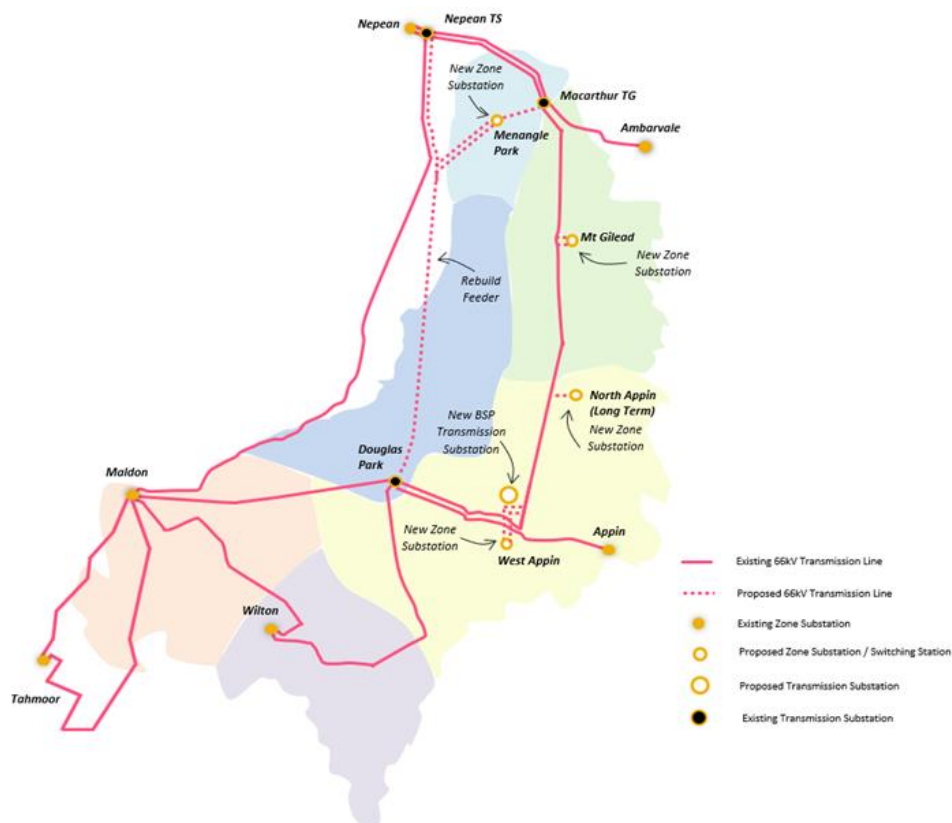


Figure 6 – Greater Macarthur Priority Growth Area Plan

4.4 Related Area Plans

The Macarthur BSP will supply the Sydney's Greater Macarthur Priority Growth Area and part of the South West Priority Growth Area via Nepean TS. The South West Priority Growth Area (SWPGA) contains several new precincts undergoing rezoning. The load requirements of the greenfield zone substations

supplying these areas together with an increase in demand driven by brownfield growth will increase overall demand the Nepean-Macarthur sub-transmission network. The Greater Macarthur Priority Growth Area plan has taken these factors into account when determining the viability of proposed supply strategy.

The ultimate configuration of SWPGA Plan and the connection to this Area Plan are shown in

Figure 7.

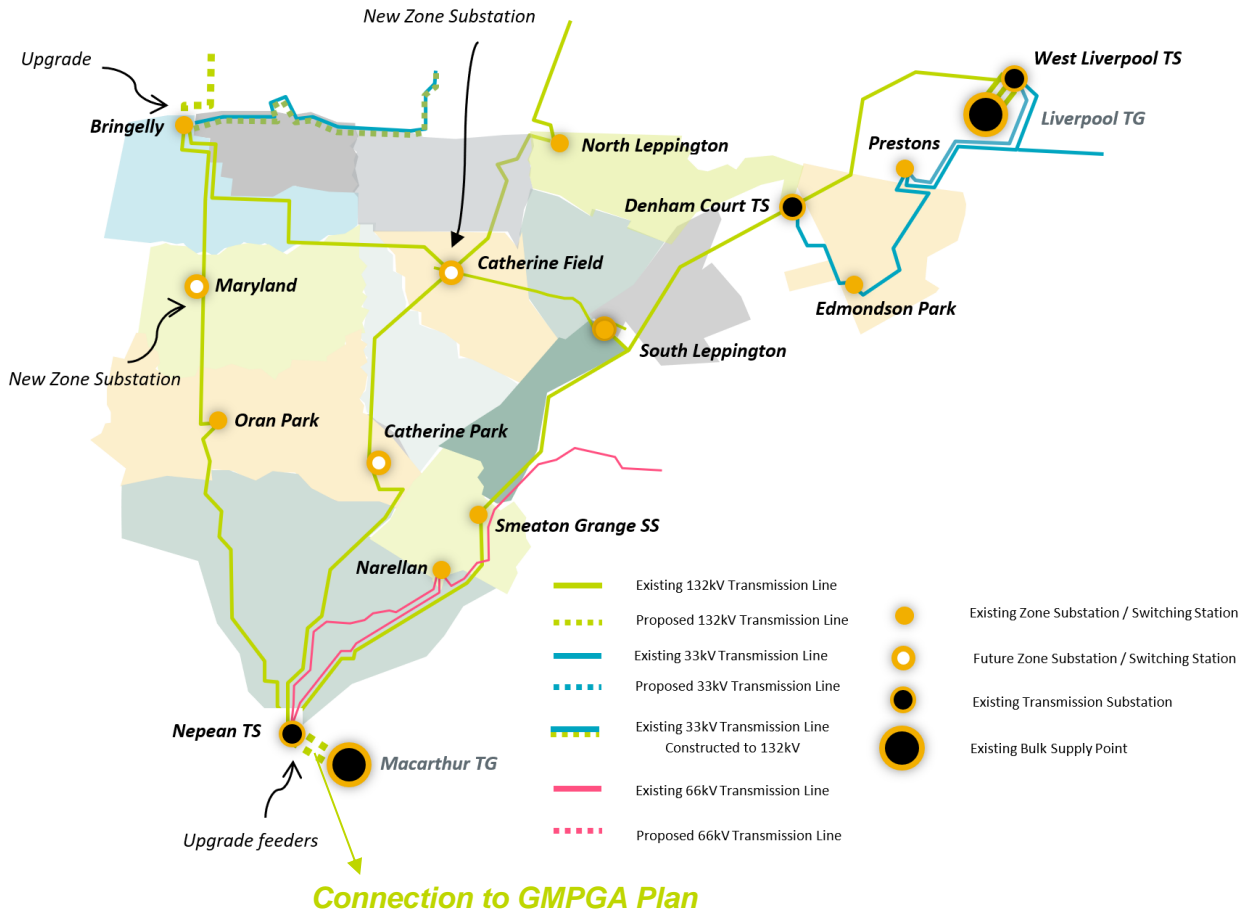


Figure 7 - South West Priority Growth Area Plan

5. Network Need

5.1 Dwelling projections

The location of the precincts within the subject of the Sydney's GMPGA is shown in **Figure 2** and their expected dwelling numbers are shown in the Table 2 and Table 3 below. In preparing these projections, two scenarios have been considered:

- The base case scenario adopting the dwelling potential identified in the Greater Macarthur 2040 and Wilton 2040 reports published by NSW DPE. Additionally, it adopts applications which Endeavour Energy have recently received from different developers from Moreton Road and Menangle Park.
- The high case scenario presenting a stronger view on dwelling capacity and allows for 50% more dwellings than the base case.

Table 2 - Dwellings estimates in GMPGA from June 2022 – Base Case Scenario

GMPGA's precinct	2026	2031	2036	2041	2046	2051	2056
Menangle Park & Mount Gilead	7,000	12,000	17,000	21,000	21,000	21,000	21,000
West Appin	1,200	4,900	8,600	12,500	15,000	17,500	20,000
Wilton New Town	2,431	4,862	7,293	9,724	12,155	14,100	14,100
Total	10,631	21,762	32,893	43,224	48,155	52,600	55,100

Table 3 - Dwellings estimates in GMPGA from June 2022 – High Case Scenario

GMPGA's precinct	2026	2031	2036	2041	2046	2051	2056
Menangle Park & Mount Gilead	9,500	17,000	24,500	30,500	30,500	30,500	30,500
West Appin	1,800	7,350	12,900	18,750	22,500	26,250	30,000
Wilton New Town	3,724	7,448	11,172	14,897	18,621	21,600	21,600
Total	15,024	31,798	48,572	64,147	71,621	78,350	82,100

5.2 Employment Land projections

The Greater Macarthur Employment Lands Study 2022⁶ identifies around 948 hectares of industrial and 35 hectares of commercial land currently zoned in the study area. Existing industrial land is located at Maldon (641 hectares)⁷, Menangle Park (28 hectares), adjacent to Hume Motorway in Wilton (13 hectares), Appin (11 hectares) and Moreton Park (255 hectares).

At this moment, Endeavour Energy only has visibility of 50 hectares at Moreton Park. Since this development is still in the rezoning stage, we will keep 50 hectares until concrete information is provided. As a result, Endeavour Energy identifies around 778 hectares (7.78 km²) of employment lands in the GMPGA.

⁶ Based on the NSW DPE data from June 2022: [Source](#)

⁷ Based on the following report: [Source](#)

5.3 Required capacity

Based on the total number of dwellings and employment land area provided in Sections 5.1 and 5.2, Endeavour Energy have established an ultimate demand profile for the GMPGA.

After Diversity Maximum Demand (ADMD) of 5.4kVA per dwelling has been used to estimate residential demand. With the introduction of Distributed Energy Resource (DER) technologies and the introduction of a time-of-use tariff may result in an increase penetration of this technology. It is feasible that the ADMD may be reduced to 3.5 kVA per dwelling.

The load of the employment lands was based on the provisions from the Network Capability Planning Standards document (NCP 1104 section 5.9 Load Density Figures) where 12MVA per km² was adopted for employment lands load.

The total forecast demand for the GMPGA for Base Case Scenario is shown in Table 4 below for ADMD of 5.4kVA and Table 5 for ADMD of 3.5kVA. The total forecast demand for the GMPGA for High Case Scenario is shown in Table 6 below for ADMD of 5.4kVA and Table 7 for ADMD of 3.5kVA.

Table 4 - Ultimate demand forecast for the GMPGA – Base Case Scenario with 5.4kVA per dwelling

Load type	Number of dwellings/ Employment land (km ²)	Load per dwelling/employment land (MVA/dwelling or MVA/km ²)	Total Load (MVA) - Undiversified
Dwelling's development	55,100 dwellings	0.0054 MVA/dwelling	297.54 MVA
Employment land ⁸	7.78 km ²	12 MVA/km ²	93.36 MVA
Total			390.9 MVA

Table 5 - Ultimate demand forecast for the GMPGA – Base Case Scenario with 3.5kVA per dwelling

Load type	Number of dwellings/ Employment land (km ²)	Load per dwelling/employment land (MVA/dwelling or MVA/km ²)	Total Load (MVA) - Undiversified
Dwelling's development	55,100 dwellings	0.0035 MVA/dwelling	192.85 MVA
Employment land ⁸	7.78 km ²	12 MVA/km ²	93.36 MVA
Total			286.21 MVA

Table 6 - Ultimate demand forecast for the GMPGA – High Case Scenario with 5.4kVA per dwelling

Load type	Number of dwellings/ Employment land (km ²)	Load per dwelling/employment land (MVA/dwelling or MVA/km ²)	Total Load (MVA) - Undiversified
Dwelling's development	82,100 dwellings	0.0054 MVA/dwelling	443.34 MVA
Employment land ⁸	7.78 km ²	12 MVA/km ²	93.36 MVA
Total			536.7 MVA

⁸ Does not contain town centre loads.

Table 7 - Ultimate demand forecast for the GMPGA – High Case Scenario with 3.5kVA per dwelling

Load type	Number of dwellings/ Employment land (km ²)	Load per dwelling/employment land (MVA/dwelling or MVA/km ²)	Total Load (MVA) - Undiversified
Dwelling's development	82,100 dwellings	0.0035 MVA/dwelling	287.35 MVA
Employment land ⁸	7.78 km ²	12 MVA/km ²	93.36 MVA
Total			380.71 MVA

5.4 Study considerations

The existing electricity infrastructure in the study area is of a light, rural nature and is limited in its ability to supply any load arising from wholesale redevelopment of the greater Macarthur region. Infrastructure will need to be established as seed investments to enable development to commence. However, due to ongoing (potentially competing) developments in the South West Sector, the risk of slower paced developments occurring in this region needs to be considered. For this reason, this plan focusses on initial investments in pockets of development in Menangle Park, Mount Gilead, South Gilead, with investments for Wilton New Town and West Appin occurring later in the program.

Due to the difficulties in establishing overhead electricity infrastructure, the following basic design considerations have been used in the determination of a suitable network topology:

- Lines should be to the current Endeavour Energy standards, namely single pole lines with line post insulators using a single conductor wherever possible.
- Meshed 66kV is preferred, but changeover schemes are acceptable.
- The use of standard capacity overhead lines will allow standard underground installations where required.
- Existing lines and easements should be used wherever practicable.
- The use of 11kV as the distribution voltage.

5.5 Relationship within Growth Servicing Strategy

A key component of our investment approach for augmentation expenditure is servicing growth in “stages” to defer significant network investment until it is self-evidently necessary. Broadly, these stages entail utilisation of the existing network and/or minor network extensions, non-network solutions and network augmentation. Endeavour Energy is committed to selecting the most efficient option and staging approach that best addresses the strategic objectives outlined in our Growth Strategy.

5.6 Electrification and our customers changing energy needs

Customer energy needs continue to evolve within the wider context of the energy transition. There is a growing bias from both customer groups and developers to transition or move away from gas, increase energy efficiency (e.g., building standards and heat pump heating systems), adopt low emission transportation options, and increase the penetration and capability of distributed energy resources (DERs) such as solar generation and storage.

Endeavour Energy continues to adapt to changing needs. The extended roll out of distributed automation, latest technology substation control systems, the provision for grid scale storage on many zone substation sites, amongst other initiatives provides enabling options in this transition. The deployment of the Advanced Distribution Management System (ADMS), continued developments in Distributed Energy Resource Management System (DERMS), TimeScale Databases, and Next Generation Planning Systems (NGPS) will provide data platforms to underpin an ability to inspect, understand and forecast changing customer behaviours and continue to adapt.

Continuously investigating alternative, new-technology and non-network options and integrating these into the network planning process represent important enablers of energy transition. Endeavour Energy applies innovative method to provide capacity for initial stages of new release areas. The Greater Macarthur area is expected to be suitable to mobile and staged substation developments. In addition, the use of larger scale Battery Energy Storage System (BESS) is also in consideration for these areas and may allow modular and rapid deployment of additional network capacity which can reduce or defer the need for networks to invest in new capacity.

In support of the role our network will play in shaping the future electricity landscape, Endeavour Energy is continuing engagements with a number of proactive developers expressing sustainability targets for their developments. The use of community batteries is likely to be trialled at various sites, with a view to maximising DER integration and network utilisation. These technologies are also likely to offer a range of broader system level services and additional benefits to participating customers, in the form of avoided capital expenditure (CAPEX). Early implementations are also expected to better inform development choices where these technologies are deployed (for example, the impact on the After Diversity Maximum Demand (ADMD)).

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6.2 Capacity of existing transmission and sub-transmission network

Table 8 below shows the BSPs and transmission substations that supply the area in subject, their voltage levels, firm nameplate capacities, existing demand, and spare capacity.

Table 8 - Existing Substations' Capacities

Substation	Voltage (kV)	Firm transformer capacity (MVA)	Existing Load (MVA)	SPARE Capacity (MVA)
Macarthur BSP	132	264 ⁹	189 ¹⁰	75
Macarthur BSP	66	250 ¹¹	161	89
Nepean TS	66	127	131 ¹²	0
Nepean TS	33	60	37	23

Table 8 suggests that limited 66kV capacity is available from Macarthur BSP 66kV. The preliminary estimate for the spare capacity available is approximately 89MVA. Nepean TS 66kV does not have any spare capacity.

The proposed load increase of between 286MVA and 391MVA (base case scenario) in the Greater Macarthur area suggests that there will be a shortfall of 66kV capacity at some time in the medium to long term future. In concept, this could be addressed either through the establishment of an additional bulk supply point or through the augmentation of Nepean 132/66kV TS and the addition of 66kV feeders. Non-network investigations will be conducted for every RIT-D project to identify cost-effective demand reducing initiatives.

Nepean 132/66kV TS is presently in 2 x 120MVA configuration with the possibility for a third 120MVA transformer in the future. Even when augmented, there will still be a capacity shortfall. Any additional load placed on Nepean 132/66kV TS will impose additional constraints on the 132kV supplies into Nepean TS.

6.3 Capacity of existing sub-transmission feeders

Table 9 shows each sub-transmission line in the area along with the contingency demand and the associated rating.

Table 9 - Existing Feeders' Capacities

Feeder	Voltage (kV)	Rating (MVA)	Contingency Load (MVA)
9L1	66	233	358
85L	66	116	179
851	66	60	60
852	66	60	60

⁹ Macarthur BSP 132kV has a single 330/132kV transformer. Firm supply is provided by Sydney West BSP and Liverpool BSP via 132 kV feeders.

¹⁰ Includes South West Priority Growth Area load.

¹¹ Macarthur BSP 66kV has a single 330/66kV transformer. TransGrid is installing a second transformer to bring the firm to 250MVA.

¹² 131MVA of existing load includes loads normally supplied by large, embedded generators in the system.

850	66	51	51
85C	66	72	84
845	66	42	42
848	66	60	60
868	66	60	60
869	66	40	40

6.4 Capacity of existing zone substations

Table 10 below shows the zone substations that supply Sydney's GMPGA, their transformer arrangements, firm nameplate capacities, existing demand, and spare capacity.

Table 10 - Zone Substations' Capacities

Zone Substation	Voltage (kV)	Firm transformer capacity (MVA)	Existing Load (MVA)	SPARE Capacity (MVA)
Appin	66/11	0	5.4	0
Ambarvale	66/11	35	26.2	8.8
Wilton	66/11	20	3.9	16.1
Maldon	66/11	35	20.6	14.4
Tahmoor	66/11	25	16.3	8.7

6.5 Renewal needs

The existing zone substations that provide supply in the area and their age and renewal needs of is summarised below in Table 11. The table shows that there are no significant renewal needs in the area and the needs have no impact on determining the ultimate supply strategy for increased capacity.

Table 11 - Summary of Renewal Needs

Zone Substation	Current age of the asset (years)	Condition comments
Nepean 66kV TS	48	No other major renewal needs currently forecast.
Ambarvale ZS	34	Substation in good condition. Replacement of the 11kV oil circuit breaker trucks with vacuum trucks planned for FY26. No other renewal needs.
Appin ZS	36	To be decommissioned and load transferred to West Appin ZS once constructed.
Maldon ZS	28	No renewal needs in the foreseeable future.
Wilton ZS	6	Substation in new condition apart from the 66/11kV power transformers. Power transformer No. 2 planned to be assessed for replacement. No other renewal needs in the foreseeable future.

7. Recommended Supply Strategy

Various supply arrangements were considered in this study. Given the existing 66kV network in the area, all options include strengthening the 66kV network by augmenting existing feeders where prudent and the establishment of additional 66kV feeders. The question of bulk supply point adequacy becomes an issue in the longer term. Given the magnitude of the additional load forecast for the region, the preferred network strategy is to add to and augment the existing 66kV system up until a new bulk supply point is required in the region.

7.1 Medium term configuration

This section describes network configurations that will allow for the staged implementation of the proposed ultimate network and cater for the expected short and medium-term network needs as illustrated on **Figure 9**. In relation to establishing individual zone substations, a strategy has been developed to minimise the present cost of servicing green field development by taking a staged approach to 66kV zone substation construction.

This strategy involves establishing Menangle Park ZS in mobile configuration as the first stage of ZS establishment, which will defer the cost of constructing a traditional zone substation, minimising the net present value, and provide flexibility in managing areas with uncertain growth rates. It has been also planned to rebuild Feeder 308 from Nepean TS to Douglas Park SS to 66kV, including future provision to ring in Menangle Park ZS. In the medium term, this tee will provide security of supply to Menangle Park ZS once a full permanent zone substation is established.

The second stage involves establishing **Menangle Park ZS** in permanent configuration along with establishing **Mount Gilead ZS** and **West Appin ZS**.

The network augmentation required will be subject to individual business case approval and the timing of projects will depend on the actual pace of development. Staging is also subject to demand growth which is influenced by the success of demand management initiatives in the form of time-of-use tariffs and the uptake of DER's.

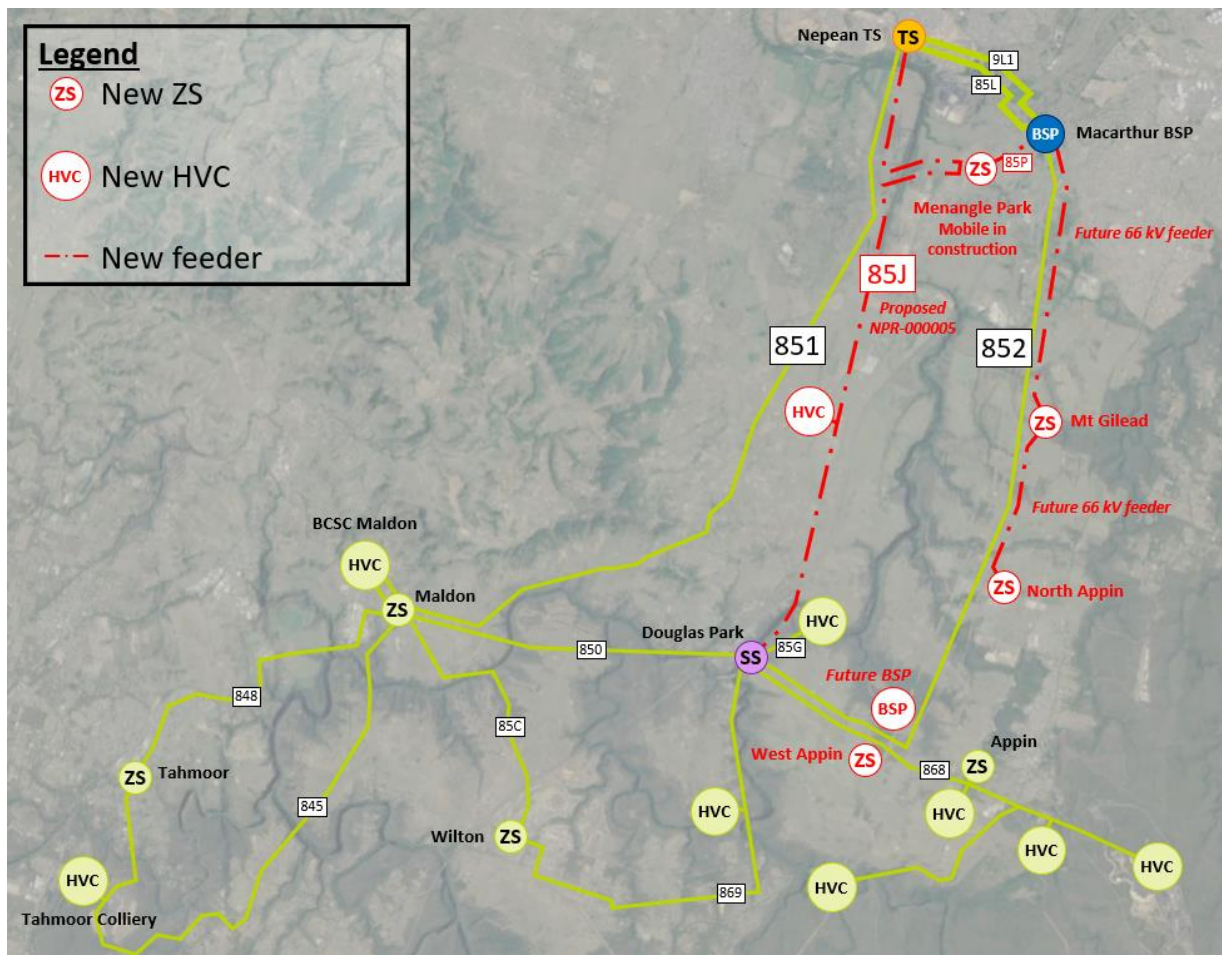


Figure 9 - Medium term network configuration and enabling substations - Geographic

7.2 Proposed long term network topology

Combined with medium term strategy outlined in Section 7.1, the network that is proposed to supply the ultimate load comprises of one additional bulk supply point, augmentation of three existing zone substations and the establishment six new zone substations.

Projects that are programmed outside of the 2020-2029 regulatory periods which are presently not costed but have some possibility of being brought forward depending on the rate of development of the GMPGA.

- Acquisition of North Wilton ZS site
- Establishment of North Wilton ZS
- Establishment of North Appin ZS
- Augmentation of 66kV Feeders
- New 66kV feeders outlined as required this Area Plan
- Establishment of Appin BSP (by TransGrid)
- Establishment of South Gilead ZS

7.2.1 Bulk Supply Points

To cater for the shortfall in supply capacity outlined in Section 6.2, it is proposed that a new 330/66kV BSP be established (Appin BSP), with two 250VA transformers, at the intersection of Feeder 852 and Feeder 868. The proposed network topology, with this new BSP established, is shown in **Figure 6** above.

Two new zone substations, Menangle Park ZS and Mount Gilead ZS, which are planned to be constructed first, will be supplied by Macarthur BSP. Appin BSP will provide backup to Mount Gilead via a changeover scheme. Appin ZS, Maldon ZS, North Wilton ZS and Wilton ZS will be transferred over to Appin BSP and backup will be provided by existing Feeder 851 through Nepean TS 66kV.

Based on the proposed long-term network topology, Appin BSP will supply following ZS from Greater Macarthur Priority Growth Area:

- Tahmoor ZS (existing)
- Maldon ZS (existing)
- Wilton ZS (existing)
- High voltage customer (HVC) substation (existing)
- Wilton North ZS (new)
- West Appin ZS (new)
- North Appin ZS (new)
- South Gilead ZS (new)

This arrangement will allow Macarthur BSP to be offloaded, providing capacity for the South West Priority Growth Area.

Table 12 provides the values of the long-term, ultimate loads which will be supplied by the BSPs in the Area Plan.

Table 12 - BSPs' Ultimate Loads

Substation	Voltage (kV)	Firm Capacity (MVA)	Greater Macarthur Load (MVA)	Ultimate Load (MVA) - undiversified	Ultimate Load (MVA) - 80% diversified
Macarthur BSP	132	375	0	660	528
Macarthur BSP	66	250	234	293	234
Appin BSP	66	250	240	405	324
Total		875	474	1,358	1,107

7.2.2 Zone Substations

It has been determined that the capacity to supply the new development described in Section 5 can be provided by building six new substations (long-term plan) and augmenting three existing substations. All new and existing substations will be supplied at 66kV.

A combination of 35 and 70MVA zone substations are planned to be used to service the ultimate requirements of the Greater Macarthur Priority Growth Area. The new substations will be as follows:

- Menangle Park ZS (FY25-29)
- Mount Gilead ZS (FY25-29)
- West Appin ZS (FY25-29)
- North Wilton ZS (>FY29)
- North Appin ZS (>FY29)
- South Gilead ZS (>FY29)

The existing substations which will be augmented are as follows:

- Appin ZS
- Wilton ZS
- Maldon ZS

Given the temporary nature of Appin ZS and its non-firm capacity status, it is likely that this zone substation will be decommissioned, and its load will be transferred to West Appin ZS. Wilton ZS is presently a 2x20MVA zone substation. This will need to be upgraded to 2x35MVA in the future. Maldon ZS is planned to be upgraded to 3x35MVA.

The ultimate loads on each zone substation have been estimated and presented in the following Table 13:

Table 13 - Ultimate loads on each ZS

Zone Substation	Ultimate Configuration	Supplying Precinct	Residential Load (MVA)	Employment Load (MVA) ¹³	ZS Load (MVA)	Forecast load in Existing Catchment
Existing Appin	To be decommissioned and load transferred to West Appin	Appin North Appin	7.5	< 1.0	12.9	5.4
Existing Ambarvale	35 MVA firm	Mt Gilead	9.2	1.0	36.0	26.2
Existing Wilton	35 MVA firm	Wilton	29.0	8.4	36.5	1.1
Existing Maldon	35 MVA firm	-	-	22.0	31.8	18.8
Existing Tahmoor	25 MVA firm	-	-	-	25.0	16.3
New Menangle Park	35 MVA firm	Menangle Park	10.8	30.6	36.2	0.7
New Mt Gilead	35 MVA firm	Mt Gilead	32.4	3.0	34.7	-
New Wilton North	70 MVA firm	Wilton	44.0	13.7	54.4	-
New North Appin	70 MVA firm	Appin North Appin	54.9	13.2	64.9	-
New West Appin	70 MVA firm	Appin North Appin	53.2	4.8	62.2	5.4 from Appin ZS
New South Gilead	35 MVA firm	South Gilead	39.4	3.0	41.7	-

The ultimate loads for these zone substations have been estimated by apportioning the precinct ultimate loads (outlined in Section 5). Where precincts were close to existing zone substations the loads were apportioned to the adjacent substations to maximise utilisation at the nearby 66kV substation capacities. For the precincts without an existing nearby substation, the precinct load was split into separate substations to minimise distribution feeder length and ensure maximum utilisation of a standard 66kV 35MVA or 70MVA zone substation.

¹³ Includes town centre loads.

The load forecast for the proposed zone substations was estimated by utilising the precinct, industrial and commercial area development rates documented in Section 5.

7.2.3 Augmentation of 66kV network

The existing 66kV network in the area will need to be augmented to provide supply to the seven-zone substation proposed under this strategy. This strategy relies on the following 66kV feeder works prior to considering the establishment of a bulk supply point at Appin:

- A new 66 kV Feeder 85P from Macarthur BSP 66kV to Menangle Park
- A new 66 kV Feeder from Macarthur BSP 66kV to Menangle Park
- Feeder 308 to be rebuilt to 66 kV Feeder 85J from Nepean TS to Douglas Park SS
- Feeder 85J to be rung into proposed Menangle Park ZS
- Feeder 85J to be rung into proposed Menangle ZS
- Feeder 852 to be rung into proposed West Appin ZS, North Appin ZS, Mt Gilead ZS & Gilead ZS
- Augment existing Feeder 852 from Macarthur BSP 66kV to Mt Gilead ZS
- A new 66 kV Feeder from Macarthur BSP 66kV to Mt Gilead ZS
- Feeders 852 and 868 to be rung into future Appin BSP
- Two new 66kV feeders from Appin BSP to West Appin ZS
- Augment existing Feeder 852 from Appin BSP to North Appin ZS
- A new 66kV feeder from Appin BSP to North Appin ZS
- Augment existing Feeders 852 and 868 from future Appin BSP to Douglas Park SS
- A new 66 kV feeder from future Appin BSP to North Wilton ZS
- Augment existing Feeder 850 from Douglas Park SS to North Wilton ZS
- Augment existing feeder 850 from North Wilton ZS to Maldon ZS
- Augment existing feeder 869 from Douglas Park SS to Wilton ZS

7.3 Indicative timing of investment

The following table provide details on the anticipated timing of network requirements.

Table 14 - Indicative timing of investment

	Configuration FY Year Required	
Mt Gilead ZS	Site purchase	2019
West Appin ZS	Site purchase	2024
South Gilead ZS	Site purchase	2028
North Appin ZS	Site purchase	2029
North Wilton ZS	Site purchase	2031
Menangle Park ZS	Mobile	2022
Mt Gilead ZS	Permanent	2025-2027

Menangle Park ZS	Permanent	2025-2027
West Appin ZS	Permanent	2028-2030
North Appin ZS	Permanent	2032-2035
North Wilton ZS	Permanent	>2035
Appin BSP (by TransGrid)	Permanent	>2035

Most of the works on the augmentation of 66kV network listed down in Section 7.2.3 will not be done until 2035-2040.

8. Stakeholder engagement and challenges

8.1 TransGrid joint planning

TransGrid are the Transmission Network Provider in NSW. They provide the main grid injection points in the form of Bulk Supply Points that supply Endeavour Energy's network, and, as such, the two organisations conduct joint planning in relation to these connection points. Macarthur BSP was established by TransGrid in 2009 to service growth in the SWPGA and has a firm transformer capacity of 250MVA. Joint planning with TransGrid has identified the need for installation of a 330/132kV supply point at Kemps Creek by 2028. This will continue to be pursued in future joint planning meetings between the two organisations.

8.2 Roads and Maritime Services (RMS) and Local Road Authorities

Roads and Maritime Services and Local Councils will be packaging works to widen existing roads and construct new roads as precincts in the area develop. Opportunities to provide for future development of the network through installation of ducts and relocation of existing assets will arise and provisions have been made to utilise these opportunities to minimise costs of expanding the network.

8.3 Developers

To obtain the appropriate land to build each zone substation and the corridors for the connecting feeders, it is important that Endeavour Energy is involved in the subdivision planning stage of developments. The way developments take place is important from a land acquisition and corridor development perspective. It is critical that the following issues be considered and addressed where appropriate based on learnings from experience:

- Endeavour Energy must actively support NSW Planning and Environment in their efforts to coordinate development in areas of fragmented land ownership.
- Early discussions must be held to determine options for incorporating existing and future infrastructure into precinct master plans (involving the NSW Department of Planning and Infrastructure and the Greater Sydney Commission). This should incorporate the need for relocation and the identification of feasible options where required. Zone substation sites and line corridors should be identified on precinct master plans from the outset where appropriate.
- Early strategic acquisition of zone substation sites and sub-transmission line corridors can be advantageous due to lower land prices (pre-rezoning) and fewer environmental constraints (not surrounded by existing residential dwellings). However, the Foreign Investment Review Board (FIRB) mandates a maximum holding period between acquisition and development of land by Endeavour Energy. This limitation must be carefully considered during the planning process.

It is also necessary to compare the cost of easement acquisition for overhead sub-transmission lines versus undergrounding or use of the road reserve.

- Sub-transmission line design and construction has a longer lead time than zone substations due to the ability to secure appropriate line routes. Consideration should be given to lead times and final commissioning dates when issuing projects with significant sub-transmission line design and easement acquisition.
- Assistance will be provided to developers that which is implement opportunities for micro grid developments that limit the level of demand drawn from the grid at a single connection point.

There is a need to have a consistent process by which the necessary properties and line easements can be acquired. The preferred option would be suitable substation locations and line corridors are identified at an early stage and these included on precinct master plans. As design work on the development proceeds, final details of sites and corridors can be determined in discussions between developers and Endeavour Energy.

8.4 Environmental impacts

The construction and upgrading of zone substations and the connecting lines will be assessed under the Environmental Planning and Assessment Act (1979) (the Act). Reviews of Environmental Factors (REFs) will be prepared for all activities and depending on the impacts of the proposals, Environmental Assessments may be required for some of the works and therefore extensive community involvement and community consultation would be required. Depending on the complexity of a project, the Environmental Assessment process can take between 12 – 24 months before environmental approval is obtained and construction of a project can commence. Allowance of sufficient forward planning time is therefore essential. The planning process needs to ensure that electrical infrastructure can be installed in strategic locations and be located adjacent to suitable compatible land uses to minimise the impacts to the environment and the community.

9. Recommendations

The following recommendations are made:

1. The proposed Ultimate Network Topology – (Appin BSP) outlined within this report be carried forward as the basis for further planning within the Greater Macarthur Priority Growth Area. Individual projects based on the principles outlined in this report will be developed separately and funding sought for each of these projects at the appropriate level and time.
2. Continue Joint Planning with TransGrid on the establishment of 330/66kV Appin BSP (note that this is not expected to be required for the Greater Macarthur Priority Growth Area for at least 20 years).
3. Engage in discussions with the Department of Planning and Environment and development proponents to ensure that zone substation sites and line corridors are included in the development of master plans for Greater Macarthur Priority Growth Area precincts.
4. Continue discussions with the Department of Planning and Environment on an ongoing basis to ensure that Endeavour Energy's staging for the establishment of major infrastructure is in line with projected development timing.
5. Investigate non-network options for every RIT-D project and implement demand management initiatives where cost effective to reduce the level of distribution network development ultimately required.

It is noted that demand management initiatives and changes in electricity demand may modify the ultimate load of the Macarthur Priority Growth Area as well as the timing of the required infrastructure. It has, however, been shown that the proposed solution is flexible enough to supply both the high and low residential load scenarios presented within this report with minimal variation in the proposed network topology.

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