



## 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
3.1	04 August 2022	Rev 3.0: Updates to discuss changing energy needs and new technology. Rev 3.1: Editorial changes.
2	06 June 2022	Release of revised precinct forecasts and servicing strategy
1	09 April 2018	Original version.

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## 1. Executive Summary

This report outlines the investment needs and strategy to accommodate the development of an estimated 11,200 hectares of land within the recently defined Western Sydney Aerotropolis (of which approximately 9,974ha is regarded as developable). The Western Sydney Aerotropolis, or simply Aerotropolis, is the planning region immediately surrounding the future Western Sydney International (Nancy-Bird Walton) Airport. It is bounded by the Warragamba Water NSW pipeline in the North, Bringelly Road in the South, and extends from Luddenham Village in the West across to Kemps Creek and Rossmore in the East. In November 2020 the Draft Aerotropolis Precinct plan was released that included the proposed initial precincts for the region. This 2022 revision of the original Area Plan is based on updated precinct information and details more comprehensively the electricity network investment needs required to address the planned development in this area.

It is expected that when fully developed beyond 2046, some 850MVA of load will be added to the Endeavour Energy network. This is in addition to developments in bordering areas of the South West Priority Growth Area (SWPGA) and the Western Sydney Employment Area (WSEA).

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

The energy transition and the changing needs of our customers creates an environment of opportunity for Endeavour Energy. This Area Plan discusses Endeavour Energy's adaptation to this context through a range of initiatives including the extended roll out of distribution level automation, the delivery of major substations with advanced digital substation technologies, the provision for grid scale batteries on key substation sites, the integration of new technology solutions through the Advanced Distribution management System and in developing Distributed Energy Resources Management Systems.

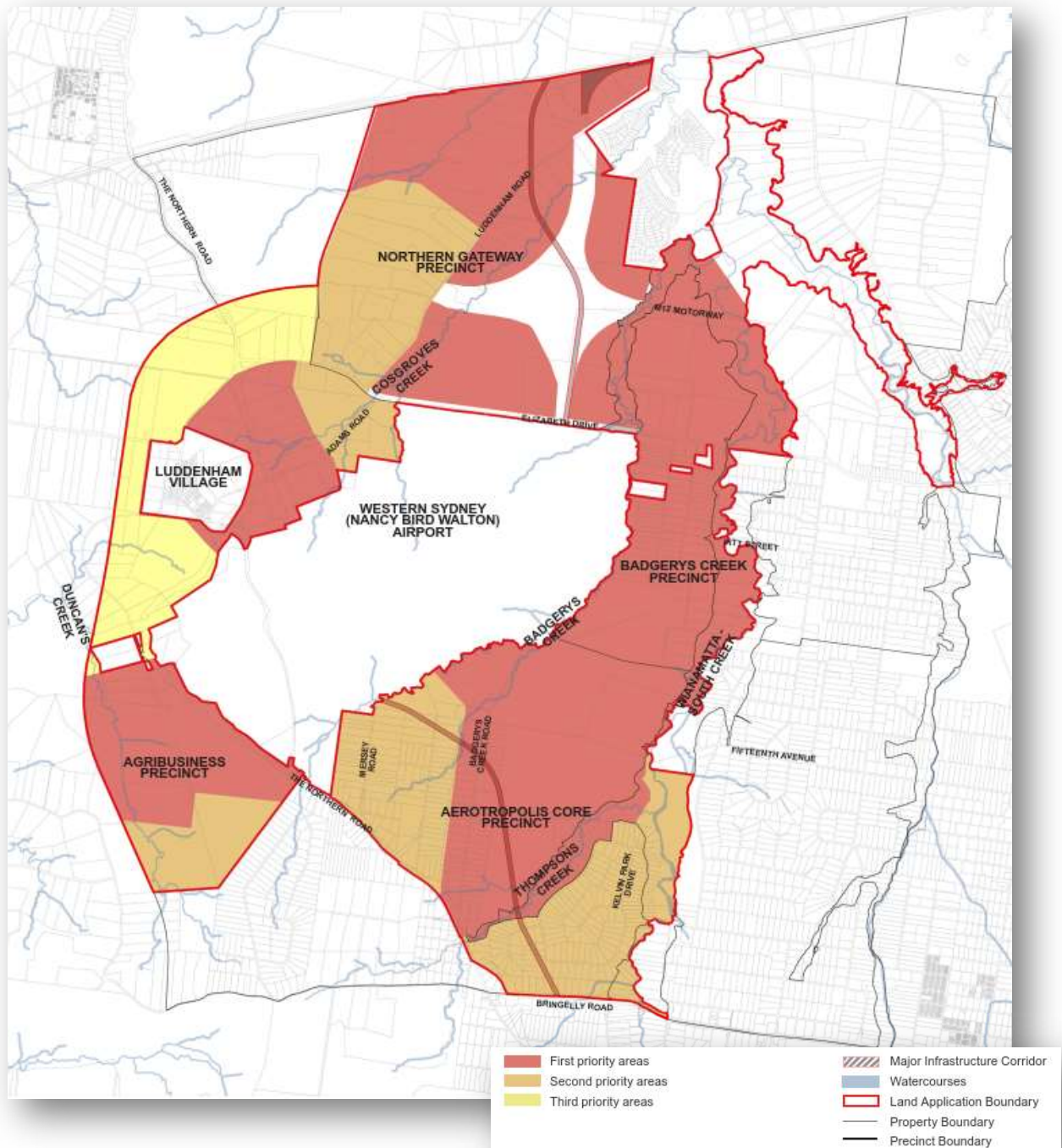
In summary, the following recommendations are made:

1. The proposed Ultimate Network Topology outlined within this report be carried forward as the basis for further planning within the Western Sydney Priority Growth Area.
2. Projects be initiated and completed as required prior to FY25 include:
  - Land acquisitions for: Badgerys Creek; Northern Gateway; Orchard Hills South SS; Western Sydney Airport TS; Bradfield City, and Agribusiness South.
  - Construction of 132kV Aerotropolis foundation supply feeder.
  - Establishment of South Erskine Park ZS.
  - Establishment of Western Sydney Airport TS.
  - Establishment of Science Park ZS.
  - Establishment of Northern Gateway ZS.
  - Establishment of Bradfield North ZS, and.
  - Establishment of Badgerys Creek ZS.
3. Projects be completed in the FY25-29 regulatory period include:
  - Land acquisitions for future zone substations in Rossmore; North Rossmore, and Oakey Creek.
  - Required connection works for the future Kemps Creek BSP to be constructed by TransGrid
  - Establishment of Agribusiness North ZS
  - Establishment of Agribusiness South ZS
4. Continue Joint Planning with TransGrid on the establishment of 330/132kV Kemps Creek BSP
5. Continue in collaborative working relationships with Developers, the Department of Planning and Environment, and Western Parkland City Authority to ensure that zone substation sites and line corridors are included in the development of master plans.
6. Continue discussions with the Department of Planning and Environment and the Western Parkland City Authority on an ongoing basis to ensure that Endeavour Energy's staging for the establishment of major infrastructure is in line with projected development timing.

## 2. Purpose

The purpose of this document is to establish a supply plan for the Western Sydney Aerotropolis.

The Western Sydney Aerotropolis, or simply Aerotropolis, is the planning region immediately surrounding the future Western Sydney International (Nancy-Bird Walton) Airport. It is bounded by the Warragamba Water NSW pipeline in the North, Bringelly Road in the South, and extends from Luddenham Village in the West across to Kemps Creek and Rossmore in the East. In March 2022 the Aerotropolis Precinct plan was released that included the proposed initial precincts for the region.



**Figure 1 – Precincts identified within the Aerotropolis Precinct Plan March 2022**

The draft Aerotropolis Precinct Plans (2020) had previously made mention or inclusion of surrounding areas such as Dwyer Road, Kemps Creek, Rossmore, North Luddenham and Mamre Road. These are not explicitly addressed with the Final Precinct Plans (2022) but are included in various parts of this report for completeness of infrastructure planning.



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## 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”.

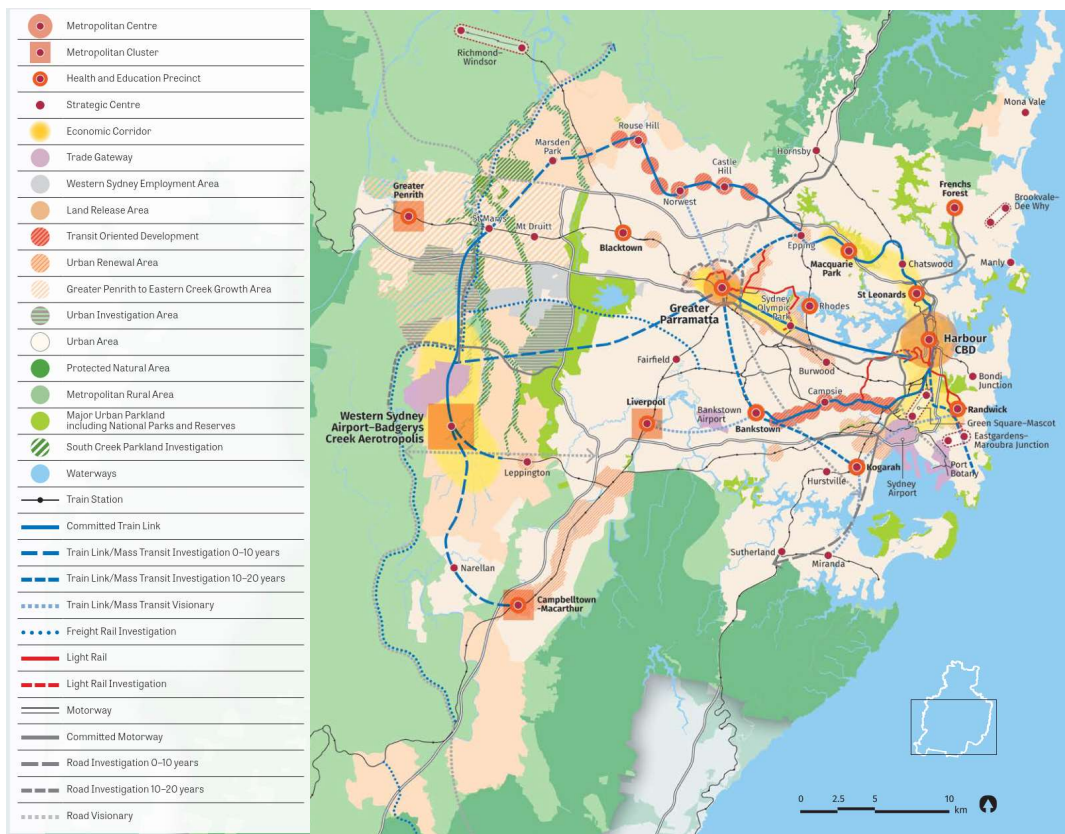
The vision describes Sydney becoming a metropolis of three cities (refer Figure 3): The Eastern Harbour City which largely exists today; the Central River City to be centred around Parramatta, and the Western Parkland City. The Western Parkland city will be centred around the Western Sydney International (Nancy-Bird Walton) Airport and its surrounding precincts that make up the Aerotropolis.

The Vision also included overall Structure Plan for the region and for each city. Figure 4 below shows the Structure Plan for the Western Parkland City. Broadly, the coverage and development of the Western Parkland City is centred to the Aerotropolis region and therefore this area plan.

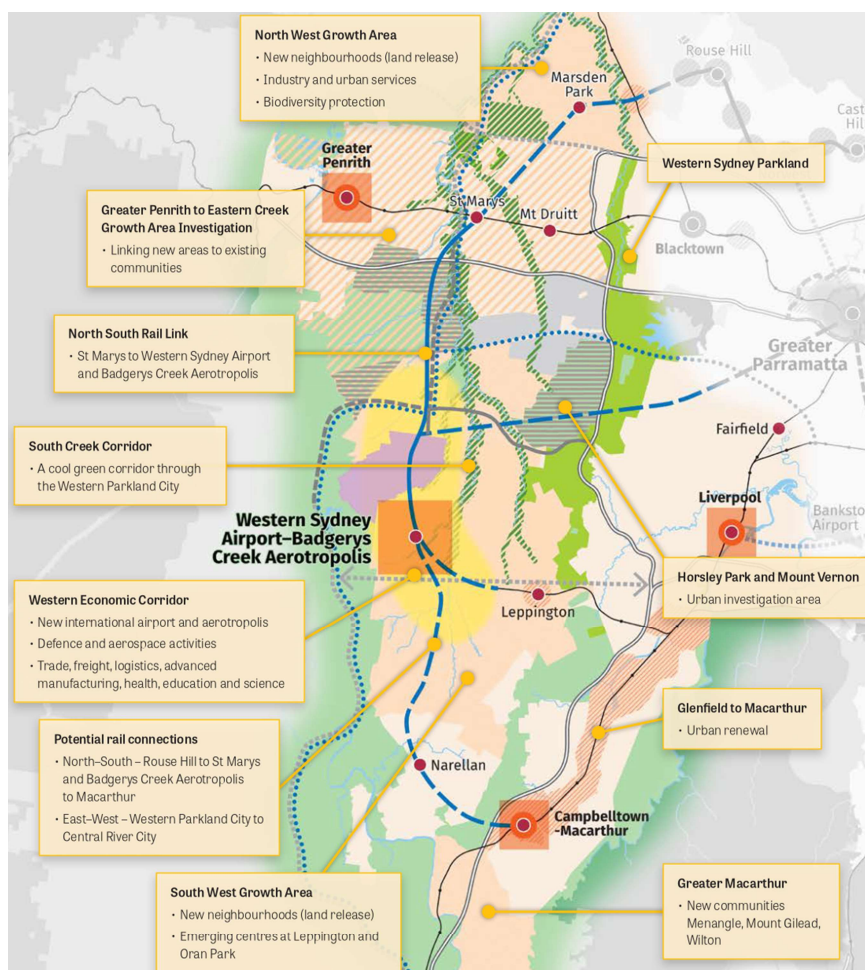


Figure 3 – Greater Sydney Commission vision for A Metropolis of Three Cities





**Figure 4 – Structure Plan for the Greater Sydney region**

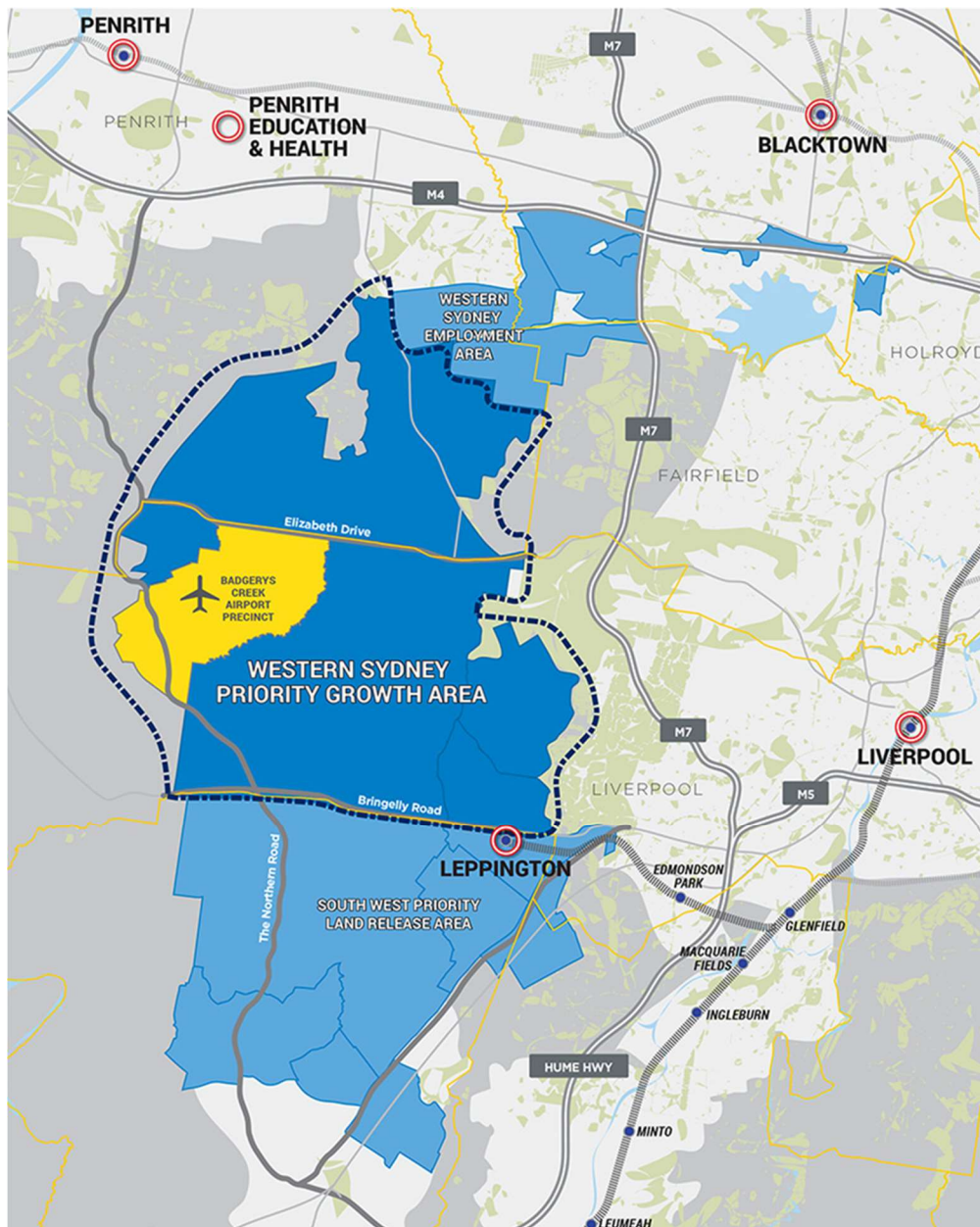


**Figure 5 –Structure Plan for the Western Parkland City**

In recent years there have been other names and boundaries for planning boundaries in this part of Western Sydney. Most recently, this land was contained within the Western Sydney Priority Growth Area (WSPGA) and bordered up against the Western Sydney Employment Area (WSEA). The previous boundaries are shown in Figure 6.

Previous Endeavour Energy Area Plans for this region have catered to the WSEA, however the focus of this area plan will be the now current Aerotropolis Precincts. While the WSEA is still active in terms of new connections, the trunk infrastructure requirements are now relatively stable. These regions are primarily serviced by Eastern Creek ZS, North Eastern Creek ZS, Mamre ZS, and South Erskine Park ZS (2022). The southern boundary of the WSEA is shared with the 'Mamre Road' Precinct of Aerotropolis and is covered by this document.

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.



**Figure 6 - Western Sydney Priority Growth Area and Western Sydney Employment Area**



## 4.2 Informing of the Area Plan

The Aerotropolis Area Plan is developed from a range of inputs. Principally the data is informed by officiated NSW Government Department of Planning and Environment (DPIE) documents such as Precinct Plans, Structure Plans and Planning Policies.

In addition to published information sources, Endeavour Energy is actively engaged further with DPIE through routine Technical Working Group (TWG) meetings as appointed through DPIE'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 7 provides an overview of the area plan detailed within this document. The key features include:

- the ultimate requirement for an additional Bulk Supply Point ("Kemps Creek BSP" to be constructed by TransGrid),
- a mesh of 132kV feeders, zone substation substations and switching stations,
- adoption and transition of the distribution reticulation voltage to 22kV. This will be discussed in detail in Section 5.3 in the document.

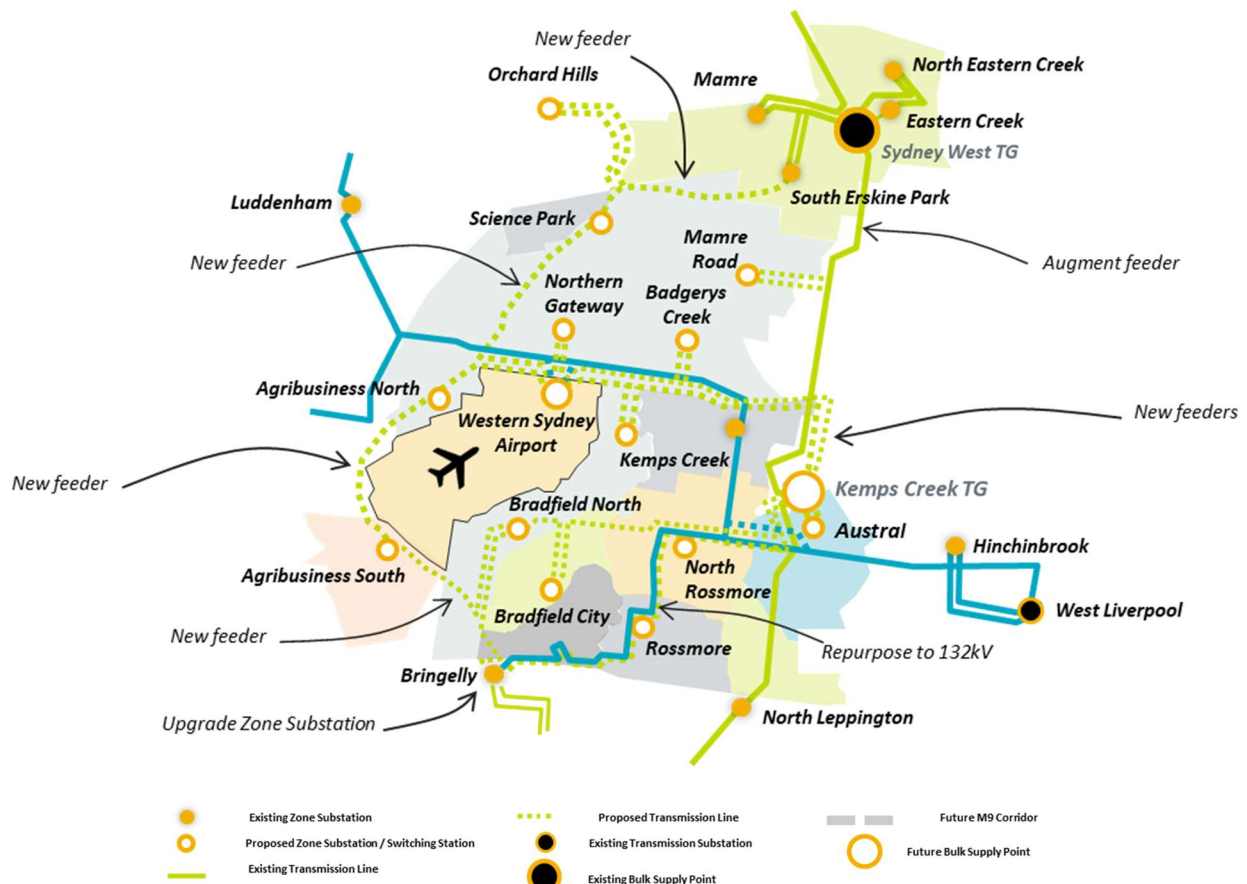


Figure 7 - Aerotropolis Area Plan

#### 4.4 Related Area Plans

This Area Plan shares common elements of the network strategy with the current South West Priority Growth Area (SWPGA) Plan that was published in March 2018. The SWPGA Area Plan identifies the need for several 132/11kV zone substations to be established in its ultimate configuration, some of these are in various stages of completion (for example: North Leppington, South Leppington, and Oran Park). The substations were supported by both existing and new 132kV feeders and, as in the case of the Aerotropolis Area Plan, will rely on two 132kV injection points, namely Macarthur BSP and the new Kemps Creek BSP. The ultimate configuration, and the relative connections to this Aerotropolis Area Plan are shown in Figure 8.

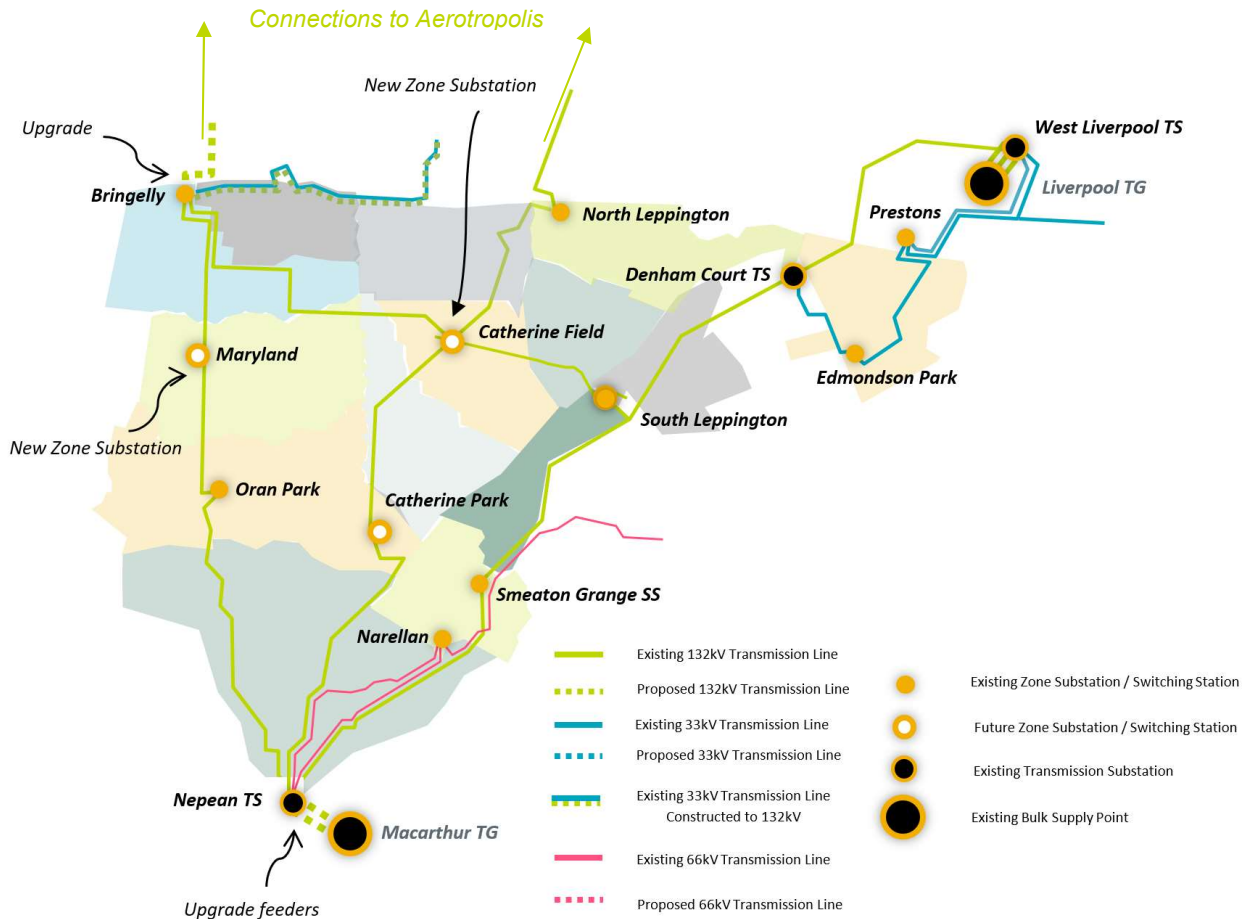


Figure 8 - South West Priority Growth Area Plan



## 5. Needs for new network and energy services

### 5.1 Developable area

For this area plan Endeavour energy have aligned to the precincts within the Aerotropolis Precinct Plan, and in early consultation with Developers, the Department of Planning and Environment, The Greater Sydney Commission, and Western Parkland City Authority have identified the developable area of each precinct.

This area calculation has made reductions for foreseeable reductions due to future motorways, riparian corridors, and the like. For internal purposes, precincts have been further broken down into sub sections to assist in planning.

Aerotropolis Precinct	Endeavour Energy Planning Area	Developable Area (ha)
Aerotropolis Core	Enterprise Southwest	737
	Aerotropolis Core	984
	Aerotropolis City	534
Agribusiness	Agribusiness North	924
	Agribusiness South	540
Badgerys Creek	Badgerys Creek	554
	Mirvac Data Centre Campus	Spot load
Kemps Creek	Oakey Creek	648
Mamre Road	Mamre Road	931
North Luddenham	Luddenham Rd to Northern Rd	837
Northern Gateway	Sydney Science Park	287
	Northern Gateway East	227
	Northern Gateway West	254
Rossmore	Rossmore	1316
Western Sydney International	Western Sydney Airport	1200
<b>TOTAL</b>		<b>9974</b>

**Table 2: Aerotropolis Precinct Plans, EE Planning Areas, and Developable Area estimates**

## 5.2 Required capacity

- Through active engagement with developers and DPIE Endeavour Energy have established an ultimate demand profile for the Aerotropolis region.
- The total forecast demand for the Aerotropolis is shown in Table 3 below.

Aero PP	Sub Area (EE use)	MVA/ha	MVA (undiversified)	MVA (diversified)
Aerotropolis Core	Enterprise Southwest	0.1	74	59
	Aerotropolis Core	0.1	98	79
	Aerotropolis City	0.2	107	85
Agribusiness	Agribusiness North	0.15	139	111
	Agribusiness South	0.136	73	59
Badgerys Creek	Badgerys Creek	0.1	55	44
	Mirvac Data Centre Campus	Spot load	273	218
Kemps Creek	Oakey Creek	0.1	65	52
Mamre Road	Mamre Rd	0.1	93	37
Out of area	Metro	42	42	27
North Luddenham	Luddenham Rd to Northern Rd	0.1	84	67
Northern Gateway	Sydney Science Park	0.13	37	30
	Northern Gateway East	0.1	23	18
	Northern Gateway West	0.1	25	20
Rossmore	Rossmore	0.07	92	74
Western Sydney International	Western Sydney Airport (central case forecast)	Spot load	143	92
<b>TOTAL</b>			<b>1423</b>	<b>854</b>

**Table 3: Ultimate demand forecast (central scenario) for Aerotropolis**

### 5.3 Distribution strategy and other 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 development in the Aerotropolis. Major infrastructure will need to be established prior to developments being completed, and it may not be possible to provide supplies to initial phases of some developments from existing infrastructure.

Through 2019 a review into optimum distribution reticulation voltages was undertaken for the Aerotropolis region. This study was undertaken in the context of having very little (or no) distribution infrastructure across much of the region, and a dramatic uplift in ultimate requirement.

The review concluded that 22kV is the preferred distribution reticulation voltage due to lower net costs, higher asset utilisation, and greater support for high load densities (as are expected in the Aerotropolis region). Endeavour Energy issued a technical bulletin in late 2019 informing the change to 22kV and the coverage region. The coverage region is shown in Figure 9.

#### 5.3.1 Relationship within Growth Servicing Strategy

The first substation with 22kV reticulation in/adjacent to the Aerotropolis is South Erskine Park ZS and is located just North-East of the Mamre Road precinct and will be online in mid-2022. Endeavour Energy has already processed more than 60MVA of diversified load applications to be supplied at 22kV from this site.

The Endeavour Energy Growth Servicing Strategy describes and adopts a “Just In Advance” approach for connection availability in high growth areas. Investments within The Aerotropolis must be carefully timed particularly given the transition to 22kV, the existing rural setting, a general lack of widespread infrastructure, and the level and frequency of load application and enquiry. In most Precincts the establishment of a Zone Substation will be required in advance of most development to avoid a lack of infrastructure resulting in a deterrent or slowing of growth.

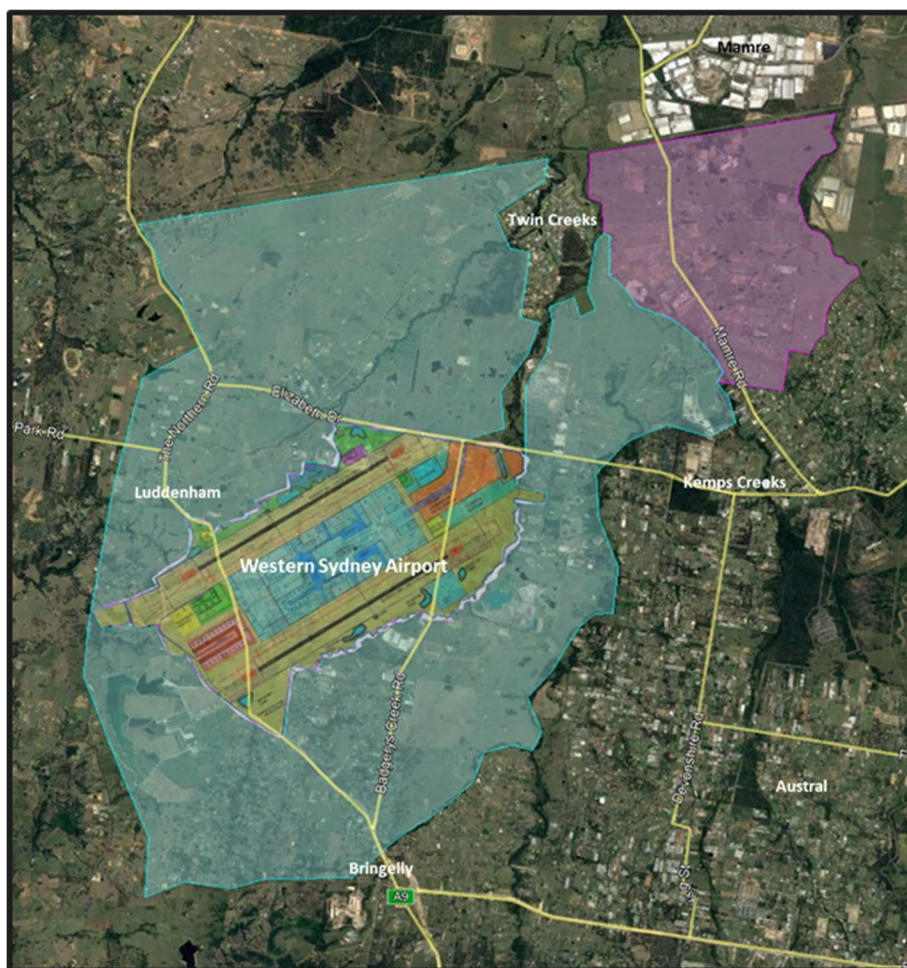


Figure 9 - Indicative 22kV supply area.  
(Purple area is indicative of initial servicing from South Erskine Park Zone Substation)

## 5.4 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 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 (digital substations), the provision for grid scale storage on all main zone substation sites within Aerotropolis, 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.

Multiple major developer within the Aerotropolis are engaged with Endeavour Energy to explore microgrids, and how best to incorporate new technologies (such as batteries, STATCOM's, and automation).

The integration of new technology and non-network solutions within the foundational Aerotropolis infrastructure is discussed further in Section 8.



## 6. Existing Supply Arrangements

### 6.1 Overview

Endeavour Energy is supplied in this region at 132kV from the TransGrid owned Bulk Supply Points at Sydney West and Macarthur. The 132kV feeder 93X that runs between Sydney West BSP and Nepean TS in the Macarthur system runs along the eastern fringe of the Aerotropolis Area. In addition to this, 33kV Feeder 512 runs through the area from West Liverpool TS to Bringelly ZS, with a tee to Kemps Creek ZS. Feeder 465 is another 33kV feeder in the area that runs between Luddenham ZS and Kemps Creek ZS, with a tee to North Warragamba ZS. Both 33kV feeders are already constrained.

The original WSEA, where development is already underway, is serviced by Eastern Creek ZS, Mamre ZS, North Eastern Creek ZS, and South Erskine Park (from 2022).

Figure 10 below shows the existing transmission and sub transmission network surrounding the Aerotropolis and the location of existing zone substations. Also shown are the TransGrid feeders traversing the WSPGA and the surrounding TransGrid Bulk Supply Points. The WSPGA region is currently serviced by a very sparse 33kV network which feeds a weak rural 11kV distribution network.

The existing network cannot service the significant step change in loads that will materialise because of the rezoning and developments surrounding the Western Sydney Airport.

The network in the area has the following characteristics:

- The network presently serves a mixture of mainly rural residential and some industrial areas.
- Three 33/11kV zone substations around the perimeter of the area (Luddenham, Horsley Park and Kemps Creek ZSs) supplying existing non-Aerotropolis loads.
- One hybrid 132/11 33/11kV zone substation (Bringelly ZS) also at the perimeter of the Aerotropolis supplying existing non-Aerotropolis loads.
- Three 132/11kV zone substations (Mamre, Eastern Creek, North Eastern Creek ZSs) all of which are concentrated around WSEA.
- The network is comprised mainly of overhead lines operating at 132kV (with some underground cables) close to precinct A and 33kV mainly overhead but with some underground cables.

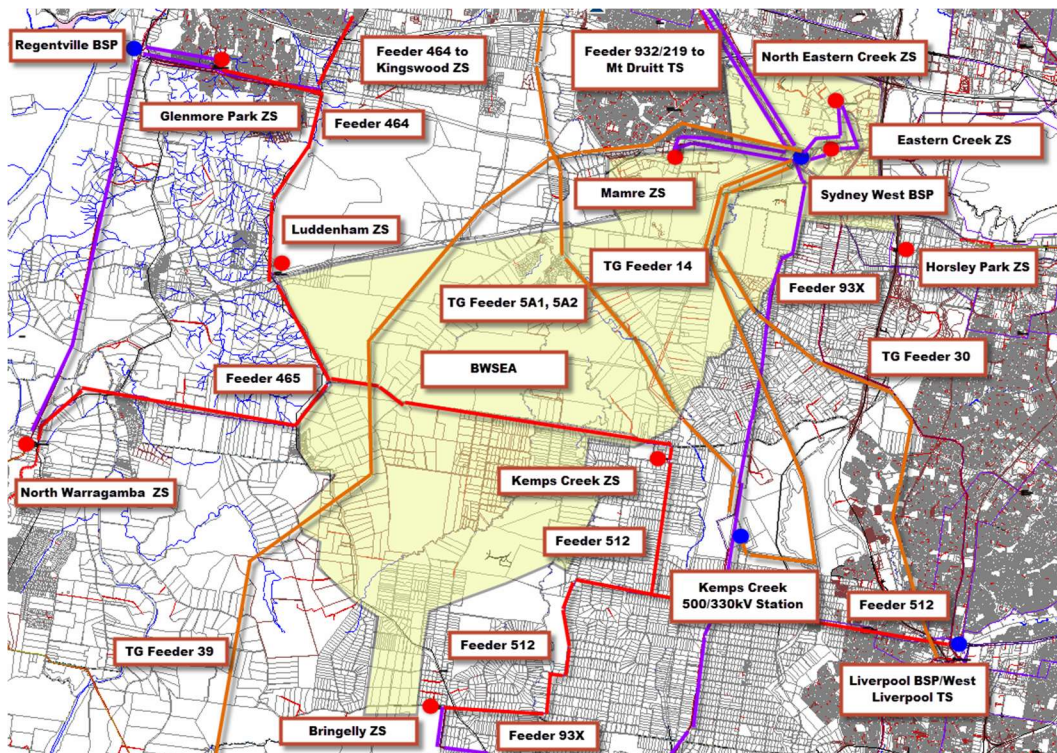


Figure 10 - Transmission/Sub Transmission Network Surrounding WSPGA

## 6.2 Capacity of existing sub-transmission feeders

Table 4 shows each sub-transmission line in the area along with the contingency demand and the associated rating.

Feeder	Voltage (kV)	Rating (MVA)	Contingency Load (MVA)
93X	132	122	125
465 Luddenham ZS to Tee	33	21	26
465 Tee to Kemps Creek ZS	33	21	26
512 Tee Kemps Creek ZS	33	37	47

**Table 4: Existing sub-transmission feeder assets**

## 6.3 Capacity of existing substations

Table 5 below shows the zone substations that supply the WSPGA, their transformer arrangements and their firm nameplate capacities.

Zone Substation	Voltage (kV)	Transformer arrangement	Firm transformer capacity (MVA)
Bringelly ZS	132/11, 33/11	1 x 25MVA, 1 x 19MVA	19
Eastern Creek ZS	132/11	2 x 45MVA	45
Horsley Park ZS	33/11	2 x 25MVA	25
Kemps Creek ZS	33/11	2 x 25MVA	25
Luddenham ZS	33/11	2 x 15MVA	15
Mamre ZS	132/11	3 x 45MVA	90
North Eastern Creek	132/11	2 x 45MVA	45

**Table 5: Zone Substation Capacities**

Table 6 below shows the TransGrid owned bulk supply points that supply the surrounding network, their current transformer arrangements and their current firm capacities.

Bulk Supply Point	Voltage (kV)	Transformer arrangement	Firm transformer capacity* (MVA)
Liverpool BSP	330/132kV	3 x 375MVA	800
Regentville BSP	330/132kV	2 x 375MVA	400
Sydney West BSP	330/132kV	5 x 375MVA	1600
Macarthur BSP	330/132kV, 330/66kV	1 x 330/132kV 375MVA 1 x 330/66kV 250MVA	250

**Table 6: Bulk Supply Point Configuration and Capacities**

Note: \* TransGrid have advised that the 375MVA transformers are capable of supplying 400MVA under contingency conditions.

## 6.4 Renewal needs

The existing zone substations that provide supply in the area and their age and renewal needs of is summarised below in Table 7. The table shows that there are limited renewal needs in the area and these needs have minimal impact on determining the ultimate supply strategy for increased capacity.

Zone Substation	Current age of the asset (years)	Condition comments
Bringelly ZS	31	Currently no renewal needs
Eastern Creek ZS	14	Currently no renewal needs
Horsley Park ZS	52	Auxiliary switchgear being replaced. No other short-term renewal needs.
Kemps Creek ZS	50	Recently refurbished. Currently no renewal needs
Luddenham ZS	56	Currently no renewal needs. 11kV switchgear recently extended and double cabled to allow additional connections.
Mamre ZS	17	Currently no renewal needs.
North Eastern Creek	12	Currently no renewal needs
North Leppington	3	Currently no renewal needs

**Table 7: Renewal Needs**

## 7. Recommended Supply Strategy

Various supply arrangements were considered in the early iterations of this area study. Options included both 132kV and 33kV sub-transmission arrangements to supply the expected ultimate demand. As there is very little existing transmission infrastructure servicing this area, careful consideration has been given to the timelines associated with the Western Sydney Airport and the practical orderly and progressive development of the transmission network to service the surrounding regions. This section will outline the aspects of the option in progression.

### 7.1 Initial supplies

Initial supply to the airport for the purposes of commencement of construction works is available from Kemps Creek and Luddenham Zone Substations at 11kV. Minor development is being serviced from distribution supplies, and in the North 22kV supplies from South Erskine Park ZS are reaching into the Northern Sections of the Aerotropolis Precincts. The existing 11kV supplies in Aerotropolis are now already facing constraints and will need to be relieved by the construction of the first 132/22kV substations central to the region. Use of 22/11kV auto-transformers at the fringes of the expanding 22kV network are also necessary to provide backup capacity in the case of failures on the limited initial 22kV trunk infrastructure.

Figure 11 below shows the current proximity of Aerotropolis between the Sydney West and Macarthur bulk systems and the existing 132kV transmission infrastructure.

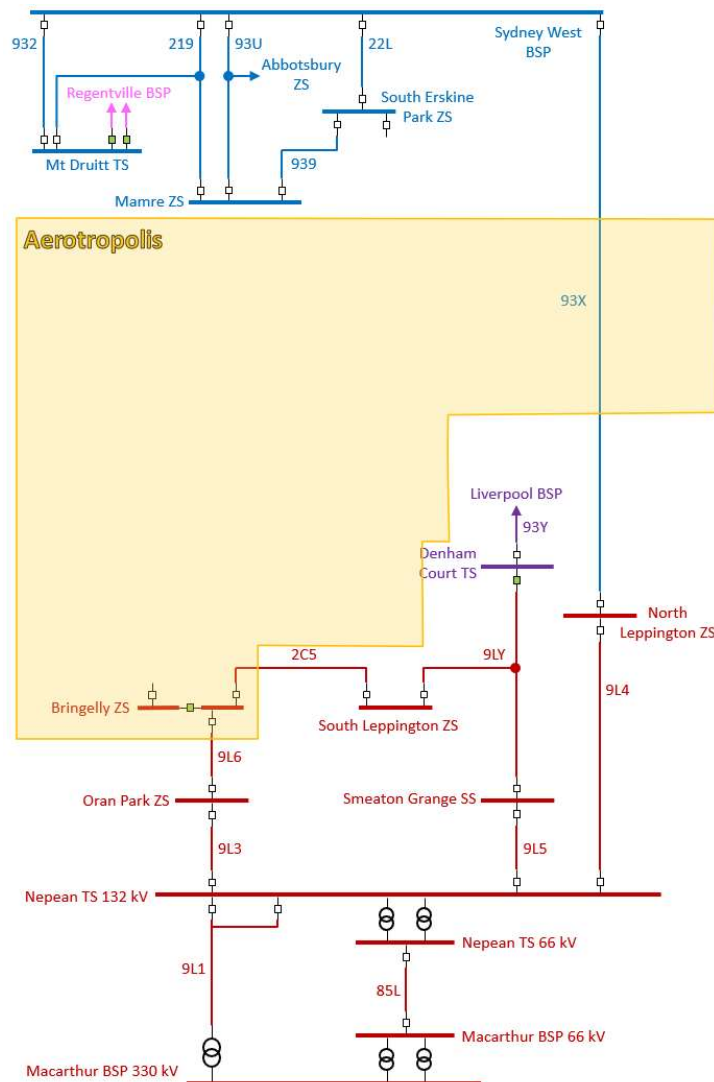


Figure 11 – Initial Supplies – Single Line Diagram



## 7.2 Near term configuration

In the near term (circa 2024-25) a significant piece of enabling infrastructure will be completed providing a 132kV feeder from Sydney West BSP system to Bringelly ZS in the south. The feeder originates from South Erskine Park and will provide the initial supply security to Sydney Metro via Orchard Hills SS, WSIA from Airport TS, as well as initial connection capacity for developments at Science Park, Badgerys Creek and Bradfield. This is enabling work to provide connection capability and available 22kV reticulation to enable the region.

It is specifically acknowledged that the initial 132kV supply security is effectively a radial supply between two bulk supply points and will need to be operated in a change-over arrangement. There will be nominated mid-point open points, and outages on any one side will see widespread loss of load while automated feeder chargeback schemes re-energise sequentially. The supply to the various new substations and the need to cut and joint the existing cable at multiple points is a further acknowledged risk.

To mitigate the aforementioned risk, investments shall consider the long term benefits of establishing East-West links toward future Kemps Creek BSP at the earliest appropriate stage. It is expected that this will occur with the establishment of Badgerys Creek Zone Substation.

By way of further staging of the initial substations, it is Endeavour Energy's experience that staging of zone substations in industrial areas does not work as well as it does for zone substations in residential areas due to the large blocks of connecting load in industrial areas. This was particularly significant at South Erskine Park ZS where an increase in the installed capacity from 90MVA to 135MVA needed to be triggered even before initial stage commissioning was complete. This contrasts with growth in residential areas that is usually incremental and allows Endeavour Energy sufficient time to react to demand growth signals in a 'just in time' approach. The lack of timely capacity being available in industrial lands often leads to stifling of economic growth. Connection availability "Just In Advance" (Section 5.3.1) is further supported by the NSW Government designation of significant land area being classified as "First Priority" (Figure 1, Section 2). Similar connection acceleration of connection availability has been experienced at both Western Sydney Airport and Metro West Line connection points.

Figure 12 and Figure 13 provide both geographical and single line representations of this near-term network configuration.

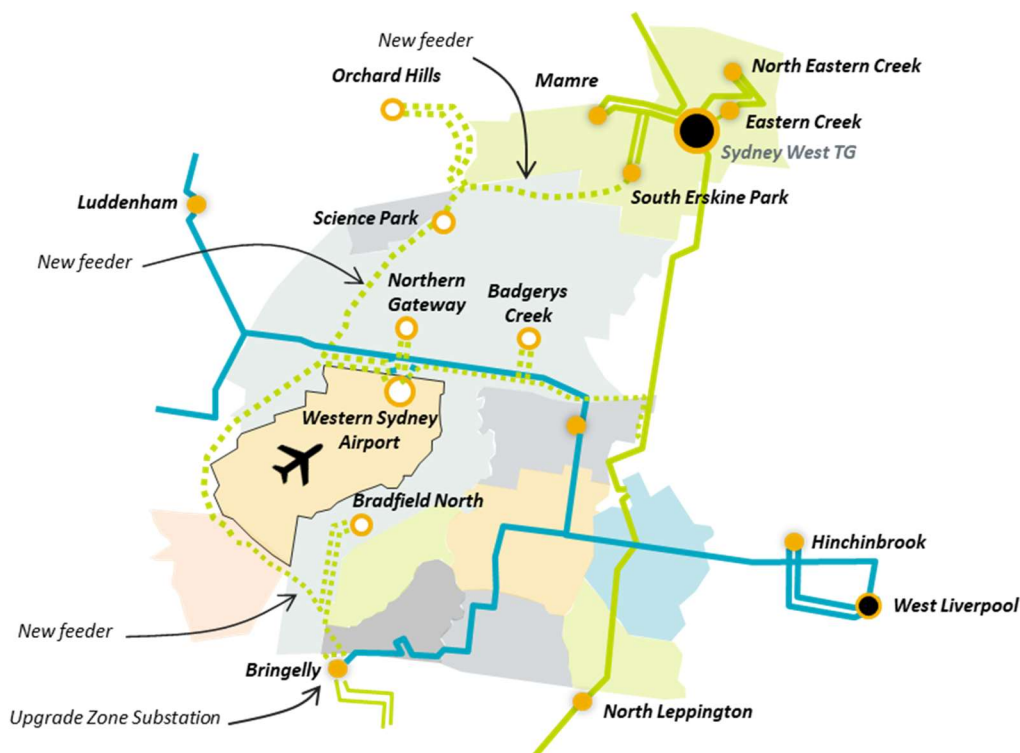


Figure 12 - Near term network configuration and enabling substations - Geographic

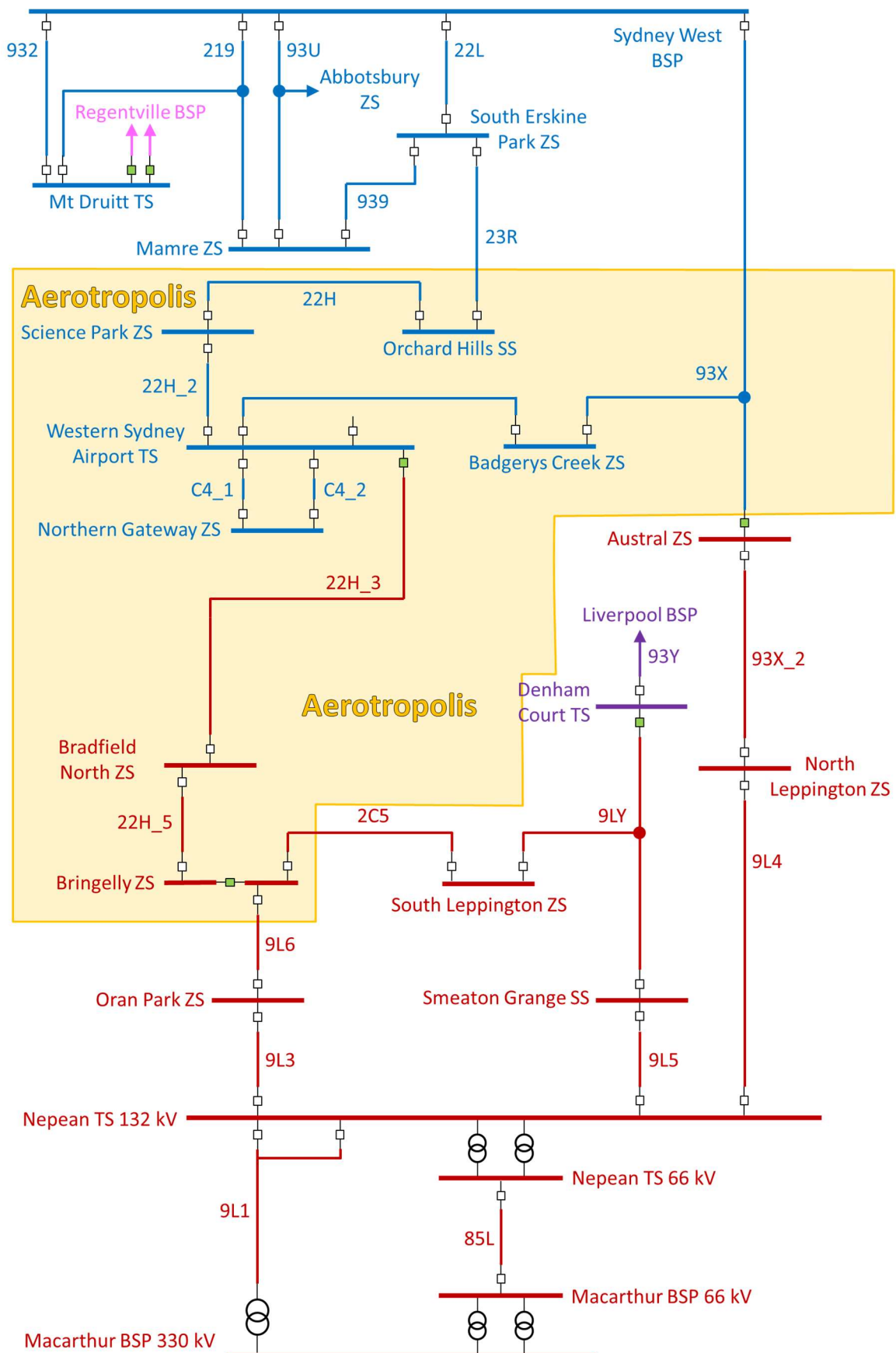


Figure 13 - Near term network configuration and enabling substations – Single Line Diagram

### 7.3 Proposed long term network topology

Given the anticipated load of the Western Sydney and South West Priority Growth Area, and the geographical spread of this load across the various precincts, a network topology has been developed to service the development by best utilising the existing assets. The recommended strategy needs to link with the South West Priority Growth Area strategy as there are elements common to both.

Figure 14 below provides the overview of the long-term network topology foreseeable for the Aerotropolis.

A notable progression from the short-term configuration is the highly meshed configuration of the 132kV transmission network. Where the short-term configuration may be exposed to momentary widespread outages, the ultimate mesh configuration will secure substation primary supplies. Investment into transmission elements providing for an ultimate mesh configuration shall be incorporated as part of individual project investments where appropriate for the benefit of all future substations in the region.

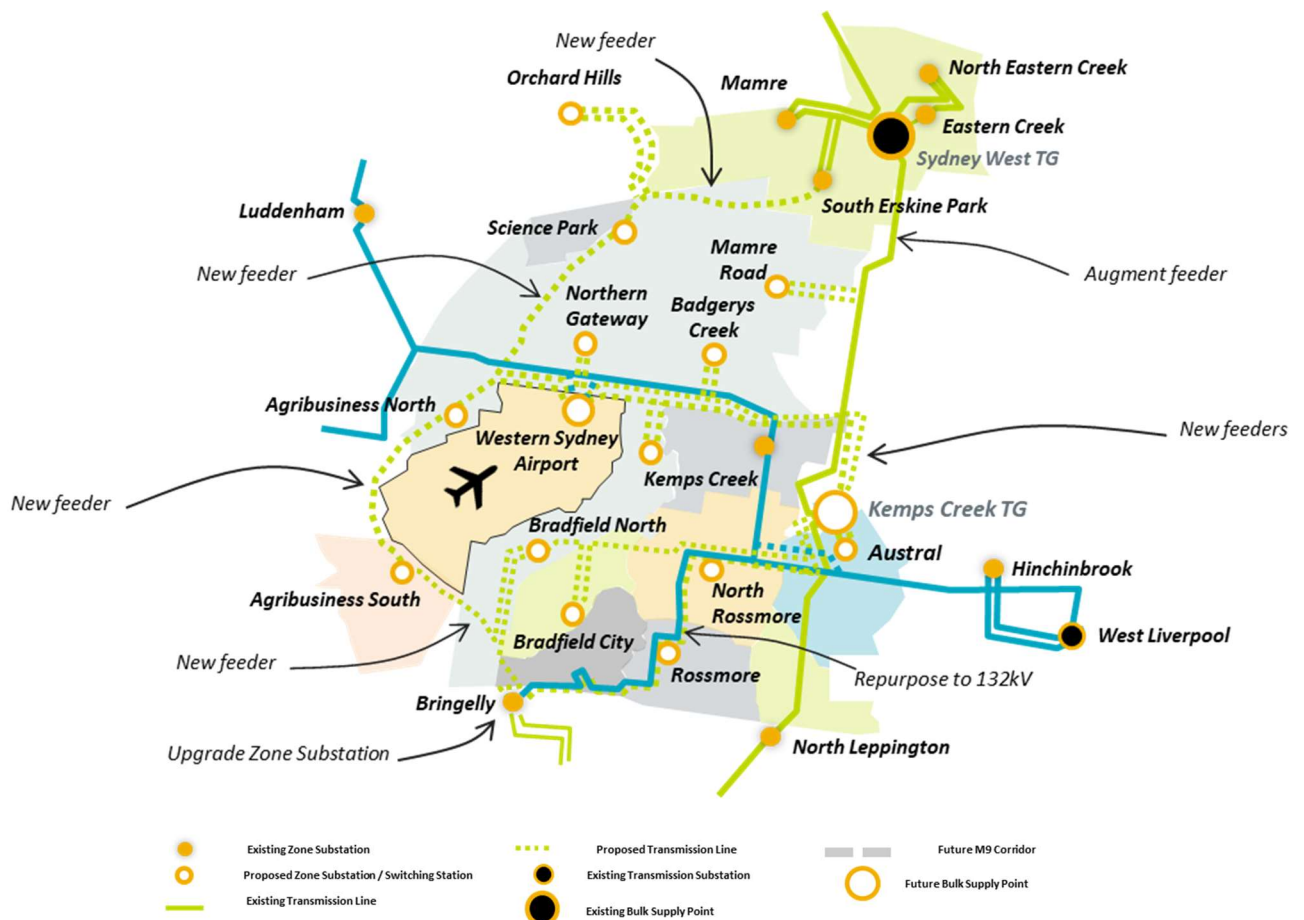


Figure 14 - Aerotropolis Area Plan - geographic

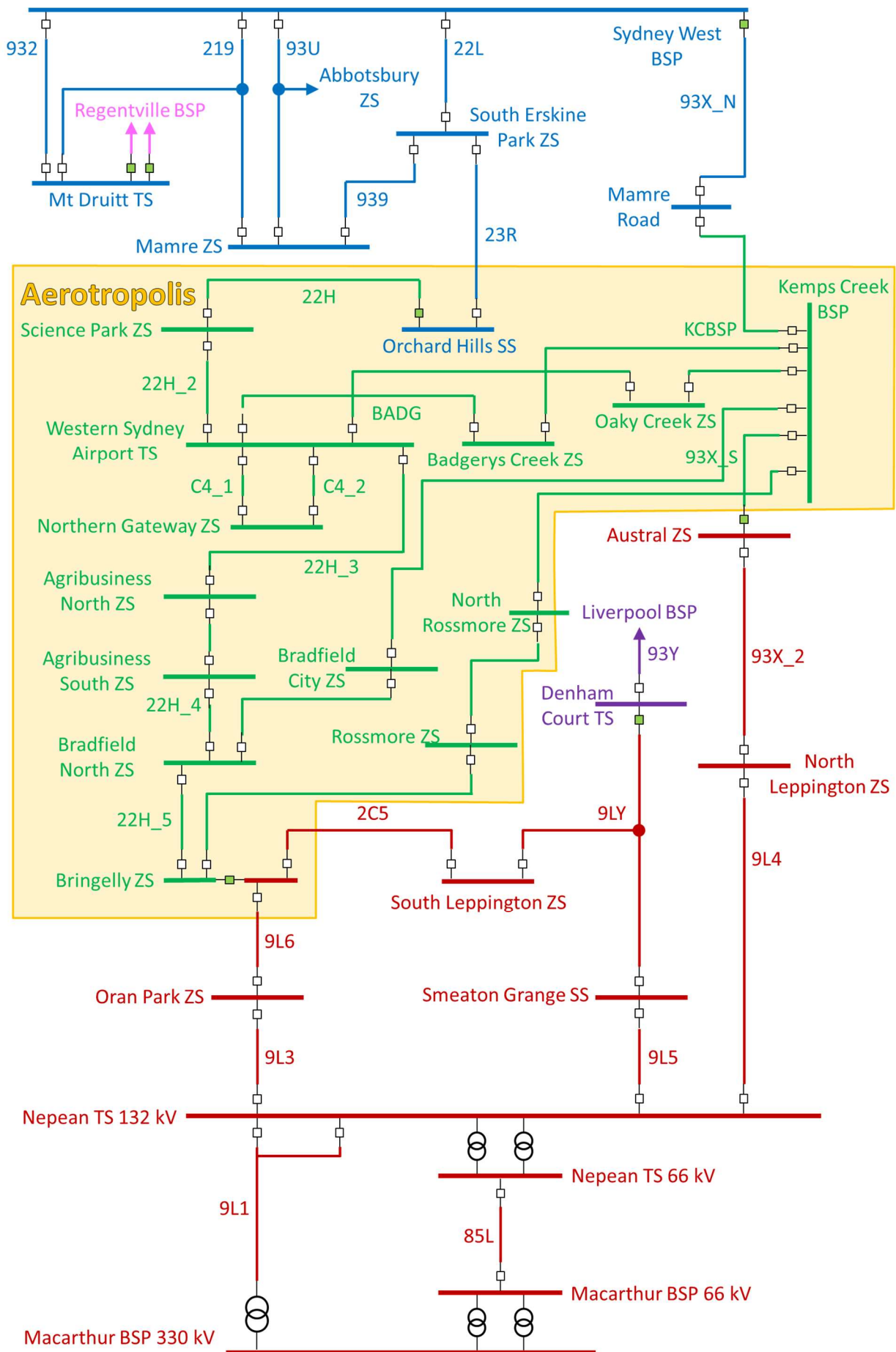


Figure 15 - Aerotropolis Area Plan – single line diagram



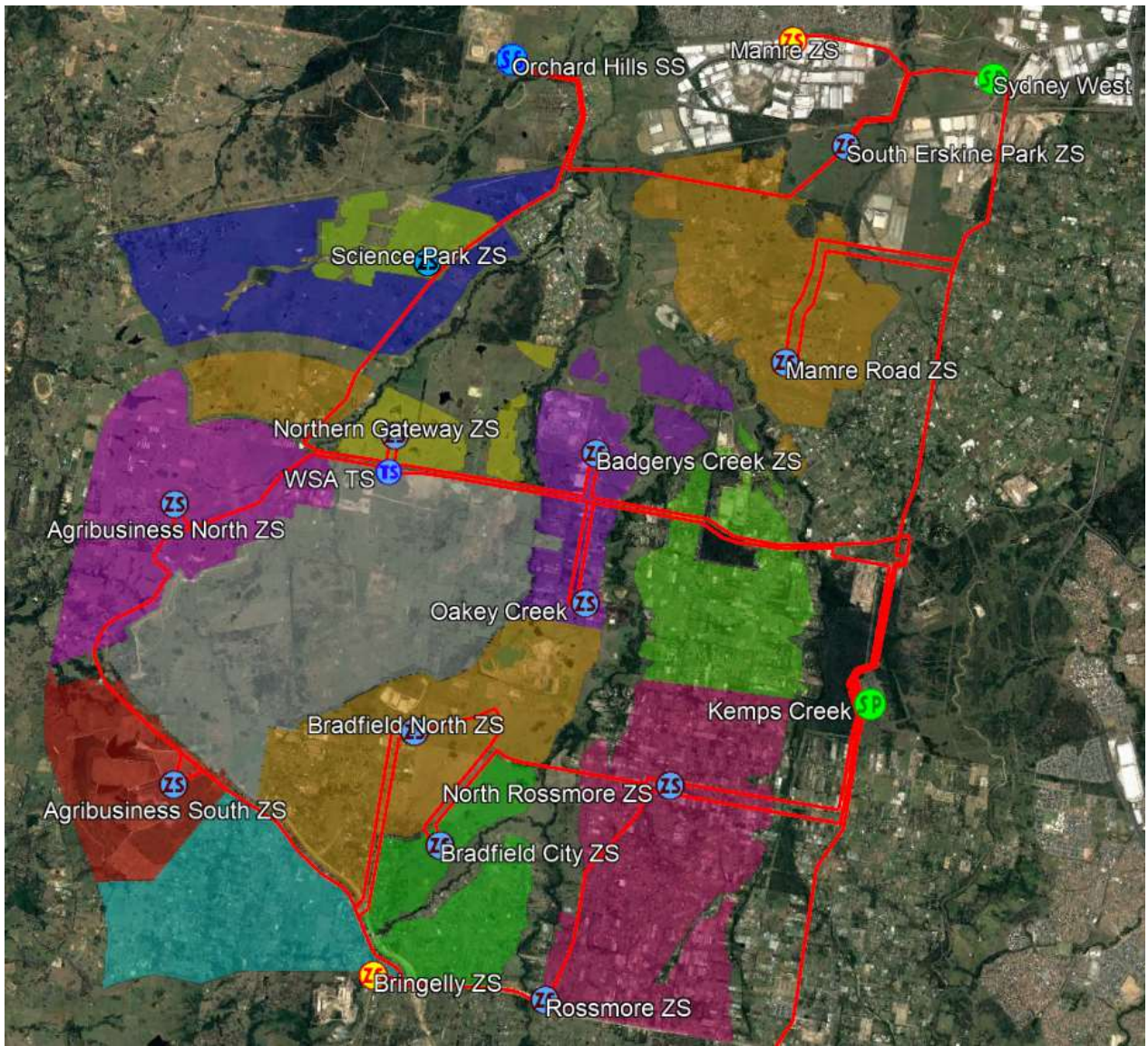


Figure 16 - Aerotropolis Area Plan – geographic, overlaid

## 7.4 Indicative timing of investment

The following tables provide details on the anticipated network requirements. Section 5.3 discusses the significant transition of this region from the historically rural setting, and accordingly this table identifies a large number of early investments in order to facilitate the Aerotropolis region.

The significant spend on foundational infrastructure is necessitated to provide initial 22kV connection point infrastructure and as a reliability corrective action due to the absence of adequately rated infrastructure. It is acknowledged that the expansion of the initial precincts will be subject to a range of externalities (e.g. economic conditions and stimulus) and the expansion of the foundational assets to service later parts of the Aerotropolis is subject to market benefit assessments. It is also expected that the foundational assets will facilitate future new technology and non-network solutions

	Configuration	FY Year Required	Driver
Badgerys Creek Land	Site purchase	<2024	
Northern Gateway Land	Site purchase	<2024	
Orchard Hills South Land	Site purchase	<2024	
Western Sydney Airport Land	Site purchase	<2024	
Bradfield City Land	Site purchase	<2024	
Agribusiness South Land	Site purchase	<2024	
South Erskine Park ZS	2x 45 MVA 132/22kV Trf	<2024	Distribution capacity constraint in WSEA
South Erskine Park ZS (Trf 3)	+1x 45 MVA 132/22kV Trf	<2024	Distribution capacity constraint in WSEA
132kV Aerotropolis Supply	132kV feeder initially South Erskine Park to Bringelly	<2024	Supply for future substations
Western Sydney Airport TS	2x 120 MVA 132/33kV Trf	<2024	33kV capacity constraints
Science Park ZS	2x 45 MVA 132/22kV Trf	2025	Distribution capacity constraint in Sydney Science Park lands
Northern Gateway ZS	2x 45 MVA 132/22kV Trf	2025	Distribution capacity constraint in Airport North region
Bradfield North ZS	2x 45 MVA 132/22kV Trf	2025	Distribution capacity constraint in future Bradfield CBD
Badgerys Creek ZS	2x 45 MVA 132/22kV Trf	2026	Distribution capacity constraint in Airport North East region

Table 8: Indicative investment before FY24

	Configuration	Year Required	Driver
Science Park ZS	Carry over	2025	
Northern Gateway ZS	Carry over	2025	
Bradfield North ZS	Carry over	2025	
Badgerys Creek ZS	Carry over	2025	
North Rossmore Land	Site purchase	2025	
Rossmore Land	Site purchase	2026	
Oakey Creek Land	Site purchase	2029	
Kemps Creek BSP	2x 375 MVA 330/132kV Trf	2028	By TransGrid
Kemps Creek BSP	Connection works	2028	Transmission capacity constraints across Aerotropolis
Agribusiness North ZS	2x 45 MVA 132/22kV Trf	2029	Distribution capacity constraint in Airport West region. [1]
Agribusiness South ZS	2x 45 MVA 132/22kV Trf	2031	Distribution capacity constraint in Airport South West region

**Table 9: Indicative investment for FY24-29 Regulatory Period**

Notes:

[1] Timing of Agribusiness North may move to FY29 regulatory period due to supplementary servicing from Agribusiness South and/or Northern Gateway.

	Configuration	Year Required	Driver
Agribusiness South ZS	Carry over	2031	
Mamre Road ZS	Site purchase	2030	
Bradfield City ZS	2x 45 MVA 132/22kV Trf	TBD	Capacity constraint due to Bradfield city densification. [2]
North Rossmore ZS	2x 45 MVA 132/11kV Trf	TBD	Capacity constraint in residential East of WSA
Bringelly ZS (augment)	2x 45 MVA 132/22kV Trf	TBD	Distribution constraint South of Airport
Kemps Creek ZS (augment)	2x 45 MVA 132/22kV Trf	TBD	Distribution constraint South of Airport
Oakey Creek ZS	2x 45 MVA 132/22kV Trf	TBD	Distribution constraint East of Airport
Rossmore ZS	2x 45 MVA 132/11kV Trf	TBD	Capacity constraint in residential East of WSA

**Table 10: Indicative investment for beyond FY30**

Notes:

[2] Bradfield City may be accelerated into FY24-29 period.



## 7.5 Summary of network requirements

### 7.5.1 Bulk Supply Points

TransGrid have existing supply points at Macarthur BSP in the South, and Sydney West BSP in the north. Macarthur BSP was established for the purposes of supplying growth in the South West Priority Growth Area (south of this Area Plan's coverage), however this will have insufficient capacity to service the development within Aerotropolis. Initial supply will be from both Sydney West BSP and Macarthur BSP via South Erskine Park ZS and Bringelly ZS respectively, however a BSP capacity shortfall is projected due to the connections within Aerotropolis.

It has been established through joint planning with TransGrid that a 132kV bulk supply point will be required for Endeavour Energy at TransGrid's existing Kemps Creek 500/330kV substation.

The following bulk supply point works are required as part of this strategy:

- TransGrid to establish 132kV bulk supply point at Kemps Creek Substation

### 7.5.2 Transmission Substations

The following transmission substation works are required:

- Western Sydney Airport TS

### 7.5.3 Zone substations

The following zone substation works are potentially required:

- Agribusiness North ZS
- Agribusiness South ZS
- Augment Bringelly ZS
- Augment Kemps Creek ZS
- Badgerys Creek ZS
- Bradfield City ZS (and a potential second Bradfield city ZS depending on load density and new technology solutions)
- Bradfield North ZS
- Mamre Road ZS
- North Rossmore ZS
- Northern Gateway ZS
- Oakey Creek ZS
- Rossmore ZS
- Science Park ZS

The following zone substation works are shared by other priority growth areas and area plans:

- Upgrade Bringelly (shared with South West Priority Growth Area)
- Establish Rossmore (shared with South West Priority Growth Area)
- Establish South Erskine Park ZS and Mamre Road ZS (shared with the WSEA growth area)

The ultimate loads on each zone substation have been estimated in Table 11 below.

Substation	Precinct	Percentage	MVA	Ultimate load	Planned configuration
Orchard Hills SS	Metro	100%	34	34	Switching Station
Western Sydney Airport TS	Western Sydney Airport	100%	114	114	2 x 120MVA
Badgerys Creek ZS	Badgerys Creek	100%	55	55	2 x 45MVA
Bradfield North ZS	Enterprise Southwest	25%	18	92	2 x 45MVA
	Aerotropolis Core	75%	74		
Northern Gateway ZS	Northern Gateway East	100%	23	108	3 x 45MVA
	Northern Gateway West	80%	20		
	Agribusiness North	35%	49		
	Luddenham Rd to Northern Rd	20%	17		
Science Park ZS	Sydney Science Park	100%	37	104	3 x 45MVA
	Luddenham Rd to Northern Rd	80%	67		
Agribusiness South ZS	Agribusiness South	100%	73	110	3 x 45MVA
	Enterprise Southwest	50%	37		
Agribusiness North ZS	Agribusiness North	65%	90	95	3 x 45MVA
	Northern Gateway West	20%	5		
Bradfield City ZS	Aerotropolis City	80%	85	104	3 x 45MVA
	Enterprise Southwest	25%	18		
Rossmore ZS	Rossmore	50%	46	67	2 x 45MVA
	Aerotropolis City	20%	21		
North Rossmore ZS	Rossmore	50%	46	46	2 x 45MVA
Oakey Creek ZS	Aerotropolis Core	25%	25	89	2 x 45MVA
	Oakey Creek	100%	65		
Mamre Road ZS	Mamre Rd *	50%	47	47	2 x 45MVA
South Erskine Park ZS	Existing WSEA	50%	105	105	3 x 45MVA

**Table 11: Ultimate Substation loads**

\* Note that ~50% of Mamre Precinct is planned to remain on South Erskine Park due to the ultimate three transformer configuration.

Table 12 lists the load and source of supply for Aerotropolis substation.

Supply Source	Substation	Load (MVA)
Kemps Creek BSP	Agribusiness North ZS	95
	Agribusiness South ZS	110
	Badgerys Creek ZS	55
	Bradfield City ZS	104
	Bradfield North ZS	92
	Mamre Road ZS	47
	North Rossmore ZS	46
	Northern Gateway ZS	108
	Oakey Creek ZS	89
	Rossmore ZS	67
	Science Park ZS	104
	Western Sydney Airport TS	114
Sydney West BSP	Orchard Hills SS	34
	South Erskine Park ZS	105

**Table 12: Ultimate diversified load and source of supply**

#### 7.5.4 Sub-transmission Network

The sources of supply for the Aerotropolis are primarily Kemps Creek BSP and Sydney West BSP.

This strategy requires the establishment of up to four transmission feeders heading north from Kemps Creek BSP and may require the existing easement for 93X from Kemps Creek Substation to Elizabeth Dr to be widened from the present 30m.

In addition, substations on the southern side of the Aerotropolis as well as substations in the north of the South West Sector also rely on supplies also from existing feeder 93X: Sydney West BSP to Nepean TS. Ultimate transmission supply to the Aerotropolis and the South West Sector will require up to four transmission feeders heading south from Kemps Creek BSP, inclusive of feeder 93X.

The existing substations of Bringelly, Kemps Creek, and Luddenham are supplied, or backed up at 33kV. Luddenham ZS and Kemps Creek ZS are supplied by radial 33kV from alternate TransGrid supply points and operate on a change-over basis. These circuits are already constrained, and the establishment of Airport TS will secure the 33kV network supplies and capacity. Augmentations or conversion of existing substations to 132kV may occur at an appropriate time.

## 8. Extended view of the network and integration of new technology solutions

The identified long term network topology is broadly to a timeline out to 2030-2035 and foresees the connection to the future TransGrid supply point at Kemps Creek via a number of strategic rings of 132kV feeders.

The identified lack of existing network infrastructure requires the investment in foundational assets as a Reliability Corrective Action and facilitates the initial connections, however the expansion to full installed capacity will come at later dates and as required by the maturity of precincts and the load.

The investment timing of these later stages is subject to market benefit assessments and in particular it is expected that the integration of New Technology and Non-Network solutions will become apparent (refer Section 5.4). Early design choices, including distribution level automation and the provision of grid scale storage within all zone substation sites (refer Figure 19), will act as enablers for these future options. The development of microgrids, and integration with the substation, is expected within these developments with multiple large developers engaging with Endeavour Energy on early enablers to establish microgrids that will maximise the integration of and use of Distributed Energy Resources such as solar.

The proliferation of new technology solutions and non-network solutions is not well represented in the included geographics and single line diagrams of this document, predominantly as these solutions are fundamentally evolutions within the foundational asset base (both substation and automated equipment).

Further beyond the planning horizon of the primary Aerotropolis investment, additional network growth is expected into the suburbs of Mulgoa, South Glenmore Park, Luddenham, Orchard Hills and Claremont Meadows. A strategy from NSW DPIE exists for the 'Greater Penrith to Eastern Creek Corridor' and broadly extends across the North of Aerotropolis. However, until dedicated Precinct Plans are released there is an inability to size and plan the required network expansion. These regions and an indication of investment timings are presented in the following figures.

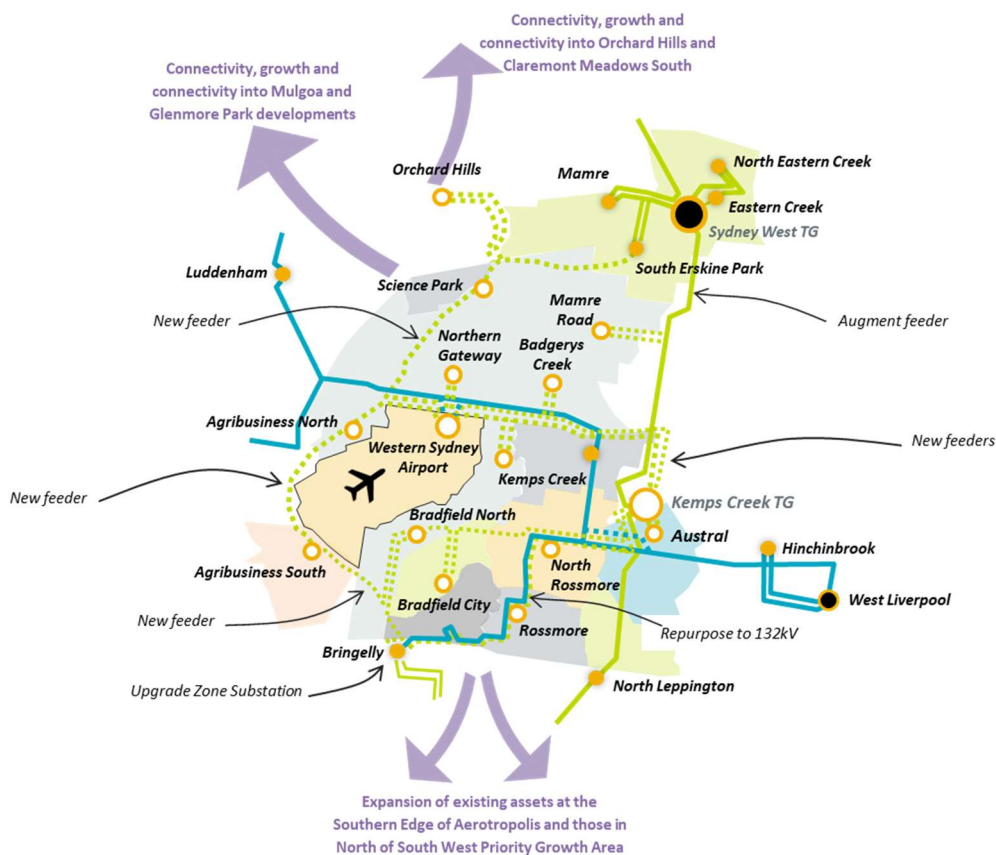


Figure 17 – An extended timeframe view of network



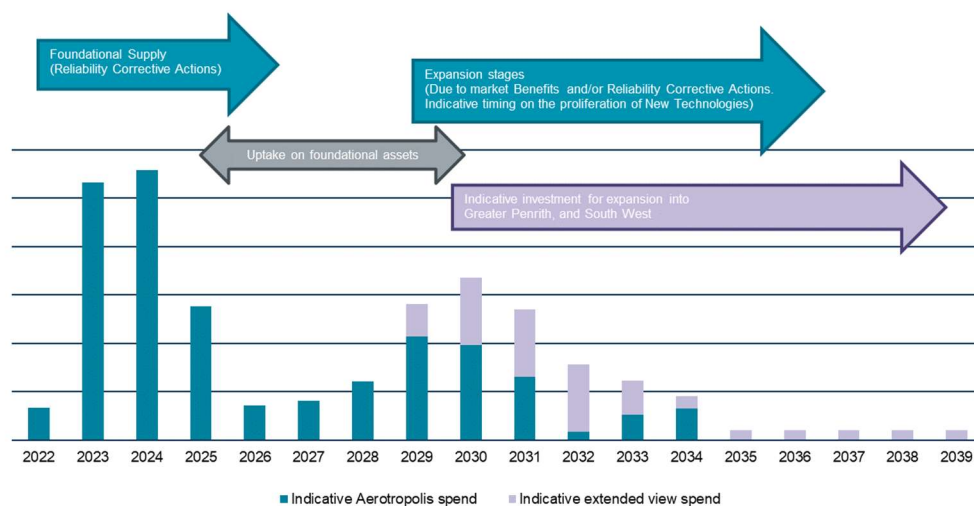


Figure 18 – Indicative timing of later stages

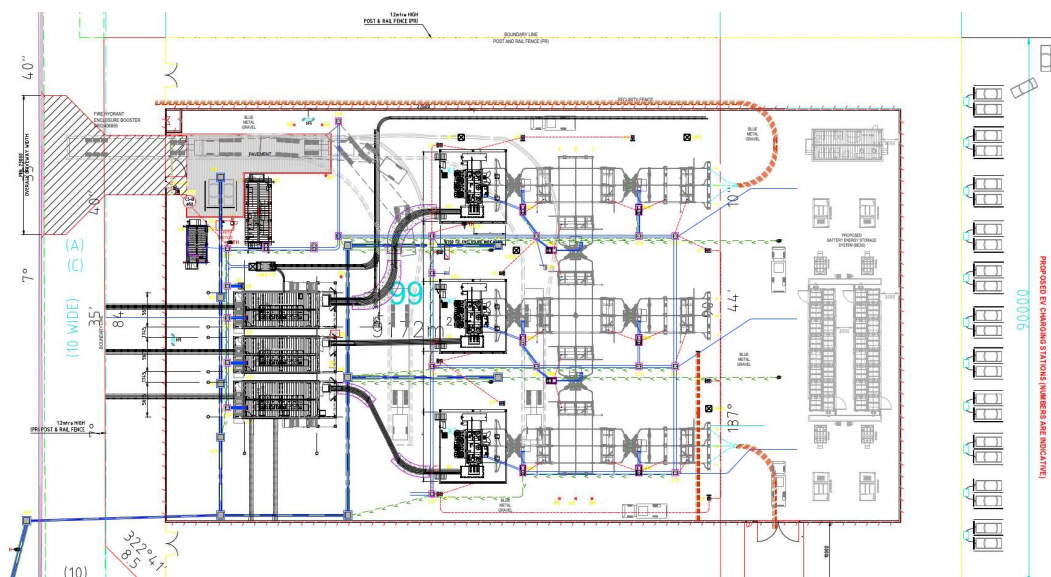


Figure 19 – Concept General Arrangement of 132/22kV Zone Substation with provision for Grid Battery Storage and roadside accessed EV charging.

## 9. Stakeholder engagement and challenges

### 9.1 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.

### 9.2 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. The widening of the Northern Road has been used as an opportunity to provide for ducts for the 132kV cables to the region. Endeavour Energy will continue to contribute and collaborate with other authorities through Technical Working Groups and the like.

### 9.3 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 past 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, The Greater Sydney Commission and Western Parkland City Authority). 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.
- 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.

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.

### 9.4 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.

A significant sensitive area within the Aerotropolis is the Western Sydney Parkland. This has the potential to create constraints on development and maintenance of the electricity network.

The 132kV feeder easement from Kemps Creek Substation to Elizabeth Dr will need to be increased from 30m to 60m. This may cause issues as the easement would further encroach into Kemps Creek Nature Reserve.

## 9.5 Transmission corridor

This area plan will see the establishment of a significant number of sub-transmission feeders. The orderly construction of these assets will be best achieved through early engagement with other authorities and alignment with other major pieces of infrastructure work.

## 9.6 Distribution connection availability

As described in earlier sections, the lack of distribution assets in the region and a strategic change to 22kV presents some challenges for initial connections within the Aerotropolis. Consideration should be made to the timing of assets such that adequate count and capacity of 22kV connections and backups are available as customers begin to invest in the region. This may occur through the accelerated delivery of zone substations to provide for 22kV connection, or the advanced construction of 'flying feeders' designed and/or operating at 22kV through auto-transformers.

## 10. Recommendations

The following recommendations are made:

1. The proposed Ultimate Network Topology – (Kemps Creek BSP) outlined within this report be carried forward as the basis for further planning within the Western Sydney 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 330/132kV Kemps Creek BSP
3. Continue in collaborative working relationships with Developers, the Department of Planning and Environment and Western Parkland City Authority to ensure that zone substation sites and line corridors are included in the development of master plans.
4. Continue discussions with the Department of Planning and Environment and Western Parkland City Authority 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. Projects be initiated and completed as required prior to FY24 include:
  - Land acquisitions for: Badgerys Creek; Northern Gateway; Orchard Hills South SS; Western Sydney Airport TS; Bradfield City, and Agribusiness South.
  - Construction of 132kV Aerotropolis foundation supply feeder.
  - Establishment of South Erskine Park ZS.
  - Establishment of Western Sydney Airport TS.
  - Establishment of Science Park ZS.
  - Establishment of Northern Gateway ZS.
  - Establishment of Bradfield North ZS, and.
  - Establishment of Badgerys Creek ZS.
6. Projects be completed in the FY24-29 regulatory period include:
  - Land acquisitions for: Rossmore; North Rossmore, and Oakey Creek.
  - Establishment and required connection works for TransGrid Kemps Creek BSP
  - Establishment of Agribusiness North ZS
  - Establishment of Agribusiness South ZS
7. Projects be completed in regulatory periods beyond FY29, or as the need requires, include:
  - Establishment of Bradfield City ZS
  - Establishment of North Rossmore ZS
  - Establishment of Rossmore ZS
  - Establishment of Oakey Creek ZS
  - Augment of Bringelly ZS
  - Augment of Kemps Creek ZS



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