

PR741 WESTERN SYDNEY AIRPORT GROWTH AREA 132kV SUPPLY

CONTINGENT PROJECT BUSINESS CASE

Project	Description
Primary Driver	Greenfield Industrial
Project Category	Augex – Contingent Project
Publish Date	

Approvals	Name	Designation	Date
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Revision	Amendment	Date

1.0 Background

The Western Sydney Airport Priority Growth Area is approximately 10,300 hectares of rural land encompassing the proposed second Sydney airport, the Sydney Science Park and Western Sydney Employment Lands extending from Eastern Creek to Austral, Leppington and Bringelly.

This area forms the basis of the Greater Sydney Commission's vision of a 'third city' for Sydney, after Sydney CBD and Parramatta.

With this in mind the NSW Government is working with local councils and service utilities to develop employment opportunities, residential and supporting infrastructure and services around the planned Western Sydney Airport (WSA) at Badgerys Creek in Sydney's west.

Since the announcement of the construction of the airport, development interest in the surrounding lands continues to increase significantly. The airport is expected to be operational by 2026. However Western Sydney Airport Corporation has expressed a desire to establish connection to our 132kV network prior to FY24.

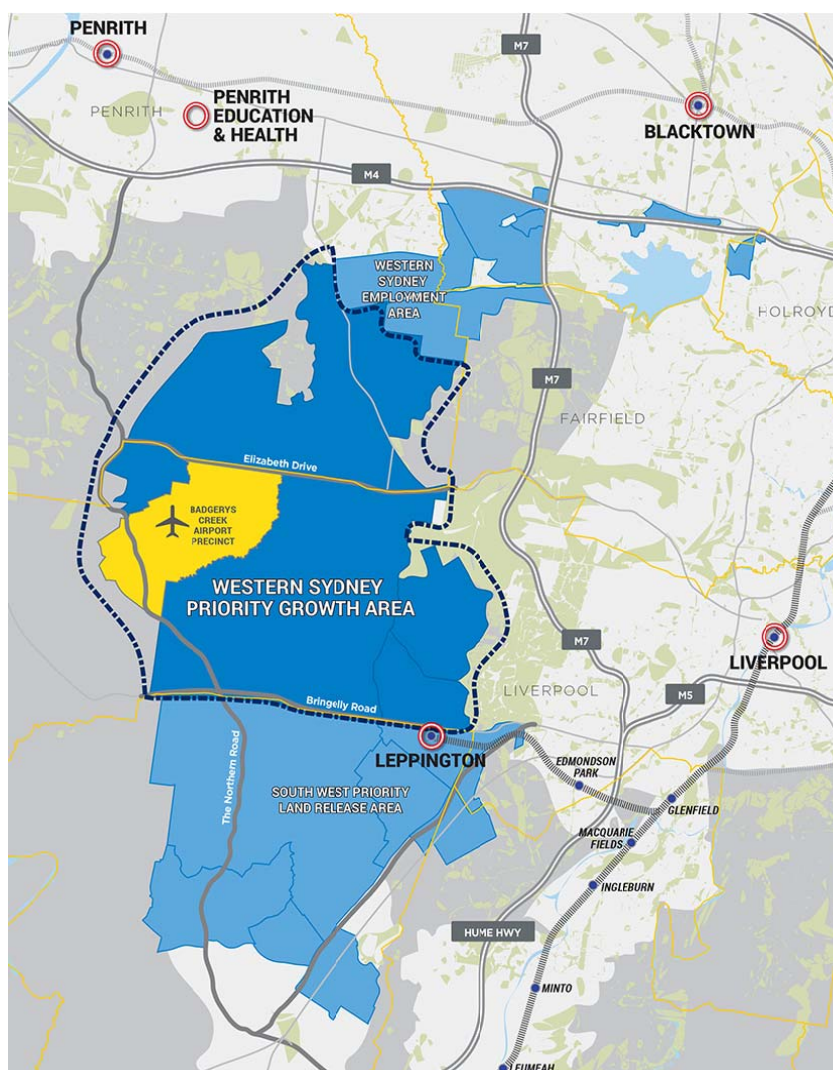


Figure 1 – Overview of the Western Sydney Priority Growth Area

Anticipated ultimate load requirements have been calculated at a total of 850MVA over a 40 year period based on current available information.

Figure 1 indicates the location of the Western Sydney Priority Growth precinct in relation to the Western Sydney Airport and major centres within the Endeavour Energy franchise area

2.0 Contingent Project

Subject to contingent project triggers being satisfied, the project proposes the establishment of 2 x 132kV feeders and associated substation works at an estimated cost of \$61m (FY19 real \$).

Endeavour Energy has prepared an Area Plan for the Western Sydney Priority Growth area which identifies the long term electricity infrastructure requirements for greenfield industrial and residential development including the proposed airport. It is evident from this plan the 132kV works proposed in this contingent project is also required for future development in the areas adjacent to the airport.

The project will not be required in the next regulatory control period if the Western Sydney Airport project does not proceed as planned. The airport itself is a catalyst for industrial/commercial development in the surrounding area.

Investment will be required in the next regulatory control period if the airport requires their connection to be established prior to operation in 2026.

It is therefore proposed that this project contingent on the following triggers:

- 1) A formal request from the airport requiring connection within a timeframe that necessitates investment within the next RCP.
- 2) Confirmation that the proposed network solution maximises the net market benefits following completion of the RIT-D process.

The following business case is written assuming the scenario that the first trigger has been met, and therefore the load forecasts include load associated with both the construction and operation of the airport.

Figure 2 indicates the proposed infrastructure required to service the proposed growth area.

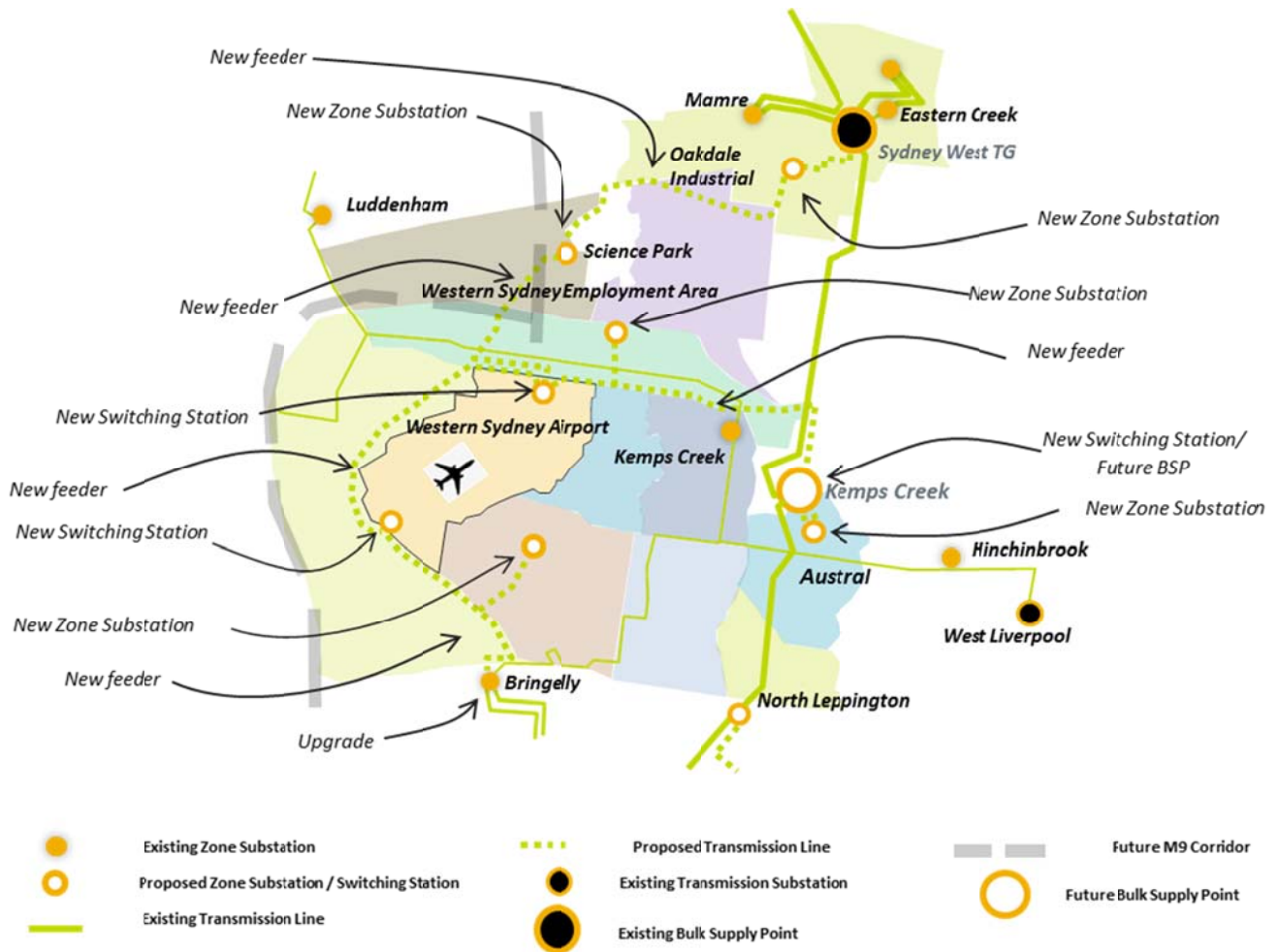


Figure 2 – Anticipated infrastructure required by 2026 to service the combined Western Sydney Airport and surrounding development areas

3.0 Need/Opportunity

The Western Sydney Priority Growth area is planned as Sydney's third city anchored by the proposed Western Sydney Airport with the potential for more than 100,000 dwellings and 100,000 jobs.

The Western Sydney Airport is planned as two staged development beginning in 2026 with a single runway airport. The commissioning of the second runway is proposed for 2050.

The NSW government is working with land holders to ensure the development of the land surrounding the airport site is commensurate with the 24/7 operations of the airport.

A number of connection enquiry applications have already been received from developers for new industrial/commercial development. These all have a bearing on the timing required to establish critical parts of the transmission network infrastructure in the area as illustrated in Figure 2.

Subject to geographical, distance and technical constraints, the extension of one or two distribution feeders from adjacent zone substations to supply new greenfield developments is often considered feasible and is explored initially if the existing network in the area is inadequate to support some initial development within a new precinct. This is already planned at Luddenham ZS and Kemps Creek, however these 11kV connections will result in upstream capacity being exhausted, and the remaining capacity is significantly inadequate of the needs of the new airport.

There is a requirement from WSA to establish their connection infrastructure at an appropriate voltage and size that meets their long term requirements. Additionally two connections points are required to deliver N-1 supply security as requested by the customer.

3.1 Forecast Demand

As the construction of airport is initiated, it is predicted major development around the site will ramp up.

A forecast demand for the area has been calculated by summing the WSA provided load forecast and an estimate of the demand for the various surrounding areas based on either known load applications or per hectare demand estimates. This is reflected in forecast demand shown in Table 1 below. It can be seen from this table a load of 176MVA is projected by 2035. Figure 3 below shows the forecast from 2018 to 2026 with reference to existing capacity.

Table 1 - Forecast Demand (MVA) for the Western Sydney Priority Growth Area

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2035
Medium	0	1	6	11	15	20	27	35	88	176
Low		1	5	9	14	18	24	32	79	159
High	0	1	6	12	17	22	30	39	96	194

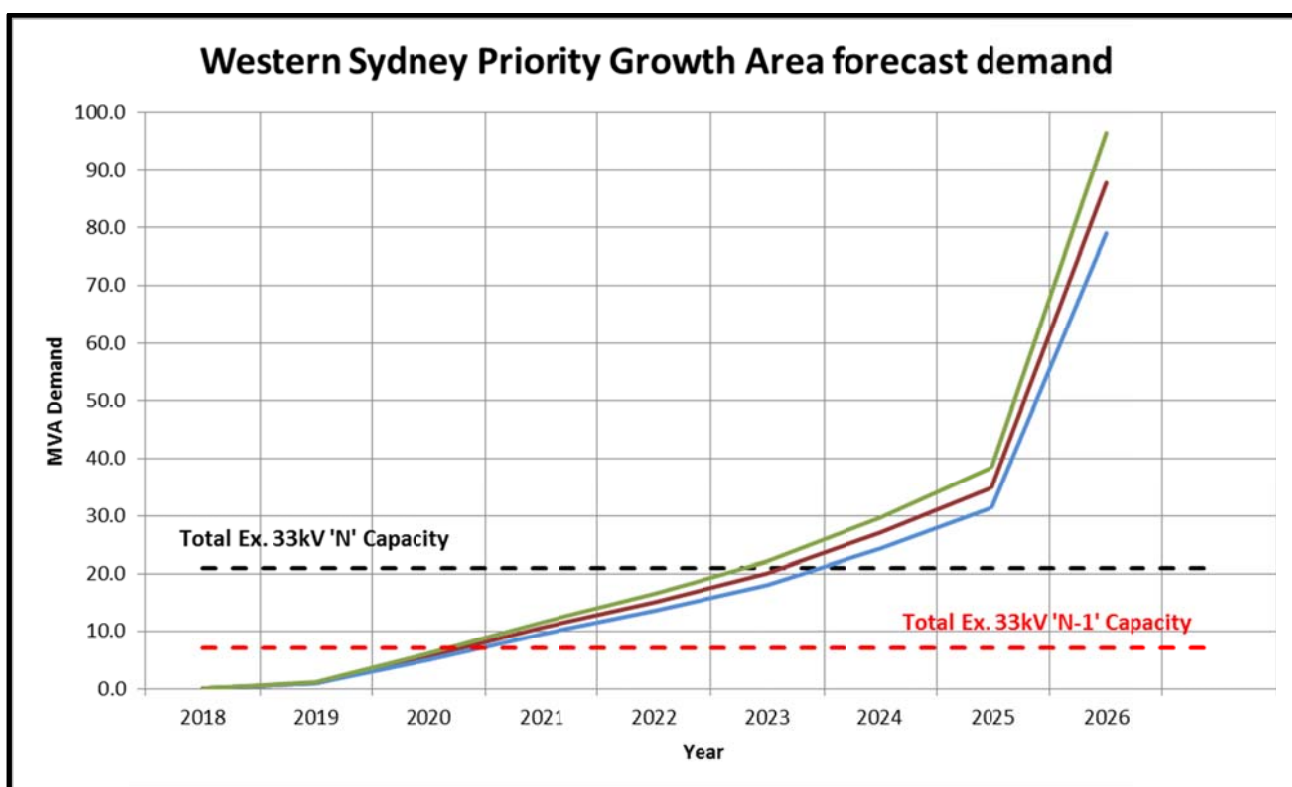


Figure 3 – Western Sydney Growth Area forecast demand

3.2 Existing Infrastructure

The proposed Western Sydney Priority growth area is located across Blacktown, Fairfield, Liverpool and Penrith local government areas with Liverpool and Penrith sharing the majority of the area.

Previously, the land was mainly used for rural primary agriculture production with the existing electricity infrastructure within the area commensurate with low density electrical load associated with this type of activity.

There are three zone substations located on the peripheries of the growth area, namely Luddenham, Kemps Creek and Bringelly zone substations, as illustrated in Figure 4. The firm capacities and 2016 actual loads for these zone substations are shown in Table 2 below.

Table 2 - Surrounding zone substation capacities and loads¹

Zone Substation	Voltage (kV)	Transformer arrangement	Firm transformer capacity (MVA) ¹	2017 Actual Load (MVA)	Available Capacity 11kV (MVA) ¹
Bringelly ZS	132/11, 33/11	1 x 25MVA, 1 x 19MVA	19	14.6	4.4
Kemps Creek ZS	33/11	2 x 25MVA	25	14.2	10.8
Luddenham ZS	33/11	2 x 15MVA	15	10.9	4.1

¹ Existing loads and capacities only – these substations have their own pockets of growth which will reduce the available capacity in future years.

There are no 132kV assets currently within the area. High voltage 11kV distribution and 33kV sub-transmission assets do exist in the area, the majority of which will be subject to relocation as the airport project begins.

The existing 33kV network (Feeder 465) in the area under normal supply conditions has approximately 21MVA capacity available, however this is at 'N' supply security only. Applications for up to 6MVA of new 11kV load (ex Luddenham ZS) have been received for an area within the Science Park precinct. These will reduce the available 33kV capacity.

Modelling indicates under an outage scenario of the 33kV network in the area, ie 'N-1', the backup capacity available is approximately 7 MVA (less the above Science Park applications). This in addition to the connection of any other WPSGA load would exceed the existing feeder ratings under system normal and place the existing network load at risk of outage.

Therefore it is not credible option to supply continuing load growth and the required connection of the airport from the existing 33kV network.

As shown in Figure 3, the initial stages of development outside of the airport will, at this stage, be able to be supplied from new 11kV distribution assets constructed from both Luddenham (6MVA) and Kemps Creek (8MVA) zone substations. At this stage it is not envisaged the available capacity at Bringelly ZS will be able to be utilised in the WPSGA, as the enquiries received to date in this area are concentrated on the land north of the airport site. Additionally it is anticipated Bringelly ZS will be utilised to supply the initial stages of Lowes Creek residential, located to the south of Bringelly.

As shown in Figure 2 network augmentation will be required prior to FY24 as capacity will otherwise be exceeded on the existing network.

4.0 Options

4.1 General

Historically, Endeavour Energy has had two transformation steps in its sub-transmission network. This was typically 132kV down to 33kV or 66kV at a sub-transmission substation and then zone substations with 33kV or 66kV primary voltage stepping down to 11kV.

Experience has shown that in major greenfield areas with little or no infrastructure, it has been more efficient to avoid a double transformation and establish 132/11kV zone substations, therefore eliminating the need to establish sub-transmission substations.

Area studies undertaken have indicated the establishment of a 132kV network will be more efficient compared to the development of a 33kV network with respect to;

- Availability of suitable feeder routes
- Capacity of 132kV versus 33kV feeders, and hence number of circuits required
- Required transformation steps and
- Respective associated costs.

The airport precinct is located in an area that currently has limited electricity infrastructure with little to no capacity to support the proposed development. The area will have significant residential and industrial/commercial development in addition to the western Sydney airport. To supply development of this magnitude, major electricity infrastructure will be required.

4.2 33kV Option

A 33kV option to supply the Western Sydney Airport growth area has been explored in detail. The 33kV supply option was costed at \$92m for Stage 1 airport load and involved the establishment of two 33kV feeders, the first from Hinchinbrook ZS and the second from West Liverpool TS.

This would facilitate the Stage 1 loads up to 2042, however

- Limited capacity would be available to supply the development in the surrounding area. Additional Sub-transmission infrastructure would need to be developed for it
- no allowance has been made for the installation of transmission ducts along one of the proposed routes, currently being upgraded by RMS,
- a third 33kV feeder would be required to facilitate the connection of the Stage 2 airport load, together with the installation of the fourth 120MVA power transformer at West Liverpool TS (not included in the above estimate).
- no backup from the proposed surrounding 132kV network could be afforded under an 'N-2' contingency,

As Endeavour Energy proposed to supply the surrounding area at 132kV, efficient use of the available road corridor space is of concern. A 33kV option requires a larger number of circuits and there are limited feeder routes.

4.3 132kV Option

A 132kV option to supply the Western Sydney Airport growth area has been explored in detail. This option was costed at \$61.2m and involved the incorporation of the airport supply into the overall supply strategy for the Western Sydney Priority growth area. The initial phase of this is to be the installation of three 132kV feeders, one from a newly created 132kV switching station within the existing TG Kemps Creek BSP. The second is to be established from Bringelly ZS. These feeders are to be connected to 132kV switching stations located within the WSA site, one to the north of the site and the other to the south. The third feeder is to be established between the two 132kV switching stations to provide the required 'N-1' contingency.

This option would provide capacity for both stage 1 & 2 of the airport and development of the surrounding area, and integrate into the long term requirements set out in the Area Plan.

4.4 Preferred Option

The 33kV supply options have been considered unsatisfactory and the 132kV supply option is considered the preferred option.

The 132kV option was preferred based on;

- Overall cost
- Available feeder routes
- Provision of capacity for the surrounding area, and
- Integration of the airport supply into the overall area supply strategy

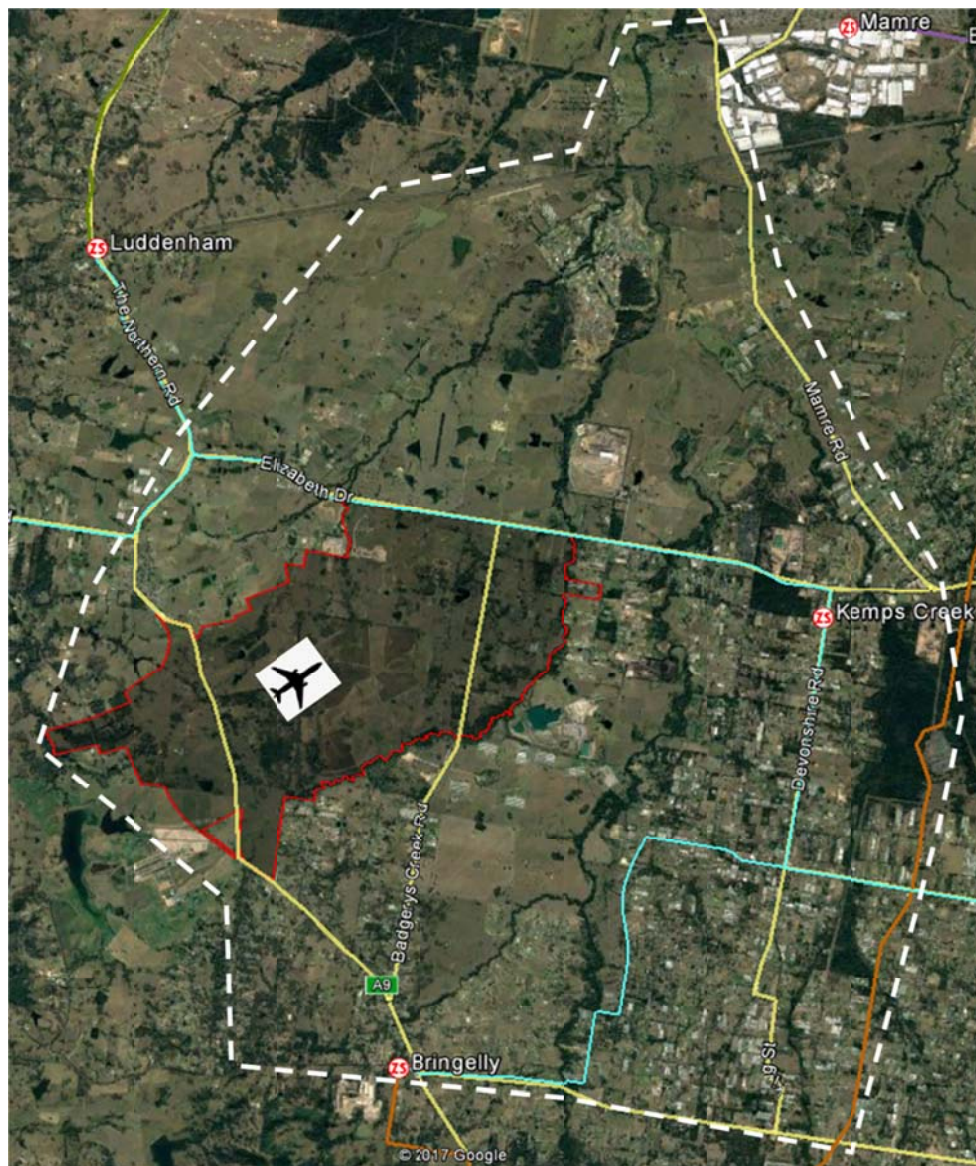


Figure 4 - Location of existing zone substations and 33kV feeders in relation to WSPGA

4.5 Development of Future Network

Taking into account future plans set out by NSW Department of Planning and the Greater Sydney Commission and WSA, Endeavour Energy has developed a 132kV long term supply strategy set out in the Western Sydney Priority Growth Area Plan.

This strategy involves the development of a number of new 132kV to 11kV zone substations and the augmentation of three existing substations. The strategy also involves the development of a meshed 132kV sub-transmission feeder network from existing Bulk Supply Points in the area and incorporates the WSA supply. The development of a 132kV network allows for higher capacity feeders within the limited existing feeder routes and less intermediate infrastructure to reach the extremities of the supply area.

With reference to Figure 2, to service the anticipated load within this precinct including the first stage of the WSA up to 2026 it will be necessary to establish the following infrastructure;

- 132kV Switching Station in Kemps Creek BSP,
- New 132kV feeder from Kemps Creek BSP to WSA North,
- 132kV WSA north switching station,
- Augmentation of Bringelly ZS to incorporate 132kV bus section and associated feeder bays,
- New 132kV feeder from Bringelly ZS to WSA South Site,
- 132kV WSA south switching station,
- New 132kV feeder from WSA north to WSA south site,
- 132kV /11kV Science Park zone substation,
- New 132kV feeder from WSA north to Science Park ZS,
- New 132kV feeder from Science Park ZS to Oakdale Industrial ZS,
- 132kV/11kV zone substation to service the Industrial land north of WSA, and
- New 132kV feeder teed off Kemps Creek to WSA North 132kV feeder

4.6 Load at Risk

Available 33kV 'N-1' sub-transmission capacity in the area is limited to 7MVA. Connection of new loads associated with the Science Park will reduce this by 2020. Further load applications will lead to load at risk on the sub-transmission network, leading to an inability to supply developments within the growth area.

Table 3 - Load at risk (MVA)

Network	2018	2019	2020	2021	2022	2023	2024	2025	2026
Sub-Transmission 'N-1' Capacity LAR	0	0	0	3.5	8.0	13	20	28	80.7

4.7 Energy at Risk

On the basis of supply to the airport only, energy at risk over the forecast period is estimated as follows:

Table 4 - Energy at Risk - Airport Supply (MWh)

Network	2019	2020	2021	2022	2023	2024	2025	2026
Energy at Risk	0.0	4.7	9,284	31,146	60,529	98,686	116,760	122,377
Energy unable to be supplied (no capacity)	0.0	0.0	0.0	0.0	72	6,954	38,715	354,027
Sum	0.0	4.7	9,284	31,146	60,601	105,640	155,475	476,405

Table 4 - Energy at Risk – Airport Supply (MWh)

5.0 Project Value

As NSW Planning have designated this area as a priority growth area, the load requirement, outside of the WSA forecast load, is expected to initiate and exceed the available sub-transmission capacity within the 2019-2024 regulatory period. To meet this anticipated load growth and minimise the load at risk, it is considered appropriate to allocate funding to allow the commencement of the detailed designs and construction of the initial phases of the required 132kV network.

Commitment to the establishment of these assets will also allow the plans/proposals to be forwarded to the relevant government planning bodies for incorporation into the global area plans. By doing this, benefits may be achieved through the coordination of the needs of all relevant utilities and infrastructure bodies. From a high level planning perspective, the needs of all infrastructure groups become known and any common requirements are identified as possible joint use routes/sites.

Any delay in establishing appropriate servicing for this area may result in;

- the inability to supply valuable supporting infrastructure to the \$5.3bn airport and third city proposal
- the unavailability of appropriate infrastructure routes and sites, and
- reputational damage for Endeavour Energy

5.1 Modelled Project Benefits (VCR Risk Costs + Risk of Non-Supply)

Table 5 - VCR Risk Costs

Network	PV of VCR Risk + Non supply Risk Costs
Supply from Existing 33kV network	\$779.6m

The VCR benefits are high for this project as connection capacity will be exceeded in 2024 and if no action is taken development will not be able to proceed.

5.2 Project Costs

The estimated costs associated with the establishment of the 132kV network required to service the Western Sydney Airport and the surrounding development expected during the 2019-2024 regulatory period, have been derived from two sources.

The first is the Endeavour Energy Western Sydney Airport Electricity Infrastructure – Project brief & Scope of Works issued October 2016. This report contained preliminary estimates carried out by Endeavour Energy’s transmission mains design group for the establishment of the required 132kV infrastructure to service the airport.

The second is the application of unit rates for the construction of 132kV feeders and zone substations. These have been used as a guide to estimate the 132kV assets not allowed for in the airport estimates and have been assigned to the relevant major projects for the establishment of the assets required in the 2019-2024 regulatory period.

The tables below detail the works required and the estimated costs involved with each item to establish supply to the Western Sydney Airport Growth Area PR741.

PR741 - Western Sydney Airport 132kV Supply	Estimated Cost
132kV Feeder Works Required	
Relocate and Terminate 132kV Fdr 93X Kemps Creek BSP to Elizabeth Dr	\$1,078,000
Reconfigure & Terminate 132kV 93X South	\$92,500
Establish 132kV feeder – Kemps Creek BSP to Airport North Switching Station (SS)	\$9,465,000
Establish 132kV link feeder – Airport North SS to Airport South SS	\$16,994,000
Establish 132kV feeder –Airport South SS to Bringelly ZS	\$10,429,000
132kV feeder works Kemps Creek BSP to Airport North SS – Environmental works	\$171,200
132kV feeder works Airport North SS to Airport South SS - Environmental works	\$171,600
132kV feeder works Airport South SS to Bringelly ZS - Environmental works	\$171,600
Sub Total	\$38,572,900
Substation Construction Works Required	
Construct indoor 132kV Airport North Switching Station	\$8,400,000
Construct indoor 132kV Airport South switching Station	\$8,400,000
Airport North SS - Environmental works	\$63,400
Airport South SS - Environmental works	\$63,400
Extend Bringelly ZS outdoor switchyard	\$4,500,000
Purchase additional land required to allow expansion of Bringelly ZS	\$1,170,000
Expansion of Bringelly ZS - Environmental works	\$63,800
Sub Total	\$22,660,600
PR741 Western Sydney Airport 132kV Supply TOTAL	\$61,233,500

Table 6 – Estimated costs associated with the establishment of the Western Sydney Airport 132kV supply

6.0 Conclusion

Subject to satisfying the Contingent Project Triggers set out in this document, it is recommended that the 132kV supply to the Western Sydney Airport Growth area at a cost of \$61.2m be delivered within the 2020-2024 regulatory control period.

7.0 Appendix

Probabilistic VCR Template v3 Aiport Supply.xlsm			
	PV investmen ts (\$m)	PV Market Benefits (\$m)	NPV (\$m)
Deterministic Assessment	\$ 44.2	\$ 3,517.7	\$ 3,473.5
Proabablistic Assessment	\$ 47.2	\$ 3,508.0	\$ 3,471.2
PV of Risk Costs (Potential Market Benefits)		\$ 3,557.0	
		% Risk	
Risk of Negative Market Benefits		0%	

