OPTIONS EVALUATION REPORT (OER)

Western Sydney Development

OER- 000000001687 revision 4.0

Ellipse project no(s):
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Project reason: Reliability - To meet overall network reliability requirements
Project category: Prescribed - Augmentation

Approvals

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Date submitted for approval	22 December 2021	

Change history

Revision	Date	Amendment
0	8/12/2016	Initial Issue
2	2/09/2021	Update to new template and align with the latest Endeavour Energy development plan and updated NOSA
3	3/11/2021	Revision to address external review comments
4	24/12/2021	Update to wording and context

Executive summary

The Greater Western Sydney area is expected to experience significant economic growth over the coming years with the development of the Western Sydney International (Nancy Bird Walton) Airport and surrounding metropolitan, commercial, industrial precincts (collectively referred to as the "Aerotropolis"). Through direct employment at the airport and through the high-tech businesses attracted to the new city of Bradfield being developed by the NSW Government adjacent to the airport, thousands of new jobs will be created.

The resultant increase in demand due to this development will result in power flows exceeding the capacity of the Macarthur 132 kV BSP from 2026/27[1] under system normal conditions. Studies show that forecast load growth due to the development of the Western Sydney Airport and surrounding precinct will require load shedding under both system normal and contingency conditions at the Macarthur 132 kV BSP after Endeavour Energy completes its supply network upgrades in the area, which are scheduled for 2024/25.

With no augmentation of Transgrid's transmission network supply capacity in the area, the additional unserved energy forecast will result in Transgrid failing to meet its transmission reliability standards obligations at the Macarthur Group BSPs[2].

This could severely impact the development and operation of the Aerotropolis precinct, resulting in risk to billions of dollars in investment and thousands of jobs potentially affected. The timing is critical due to the pace and scale of growth from 2024/25. Augmentation of the transmission network will be required if these potential impacts are to be avoided and Transgrid is to remain compliant with the NER requirements for voltage stability.

This report is a preliminary assessment of credible options based on Endeavour Energy's current development options for its distribution network to meet the forecast demand in the area.

The assessment of the options considered to address the need/opportunity are provided in Table 1.

Table 1 - Evaluated options

Option	Description	Endeavour Energy Project Cost ($m)	Transgrid Direct capital cost ($m)	Transgrid Network and corporate overheads ($m)	Total Transgrid capital cost[3] ($m)	Weighted NPV (PV, $m)	Rank
Option A	Develop a new Bulk Supply Point (BSP) next to Kemps Creek substation	[redacted]				10,502	1
Option B	Develop a new Bulk Supply Point supplied from a cut-in to line 39 near the southern transition station of Western Sydney Airport underground cable	130	142.1	4.8	146.9	10,189	2

[1] Based on Endeavour Energy draft development plan

[2] IPART reliability standard requires the unserved minutes at Macarthur 132 and 66 kV BSP to be below 3 minutes.

[3] Total capital cost is the sum of the direct capital cost and network and corporate overheads. Total capital cost is used in this OER for all analysis.

[redacted]

The preferred option based on the options evaluation presented in this report is expected to be Option A, as this option meets the requirements of the need, is technically and commercially feasible, has the lowest capital cost and has the highest Net Present Value (NPV).

The final preferred option will be determined through the joint planning with Endeavour Energy and RIT-T process based on detailed network analysis, further cost/benefit analysis, technical and economic feasibility.

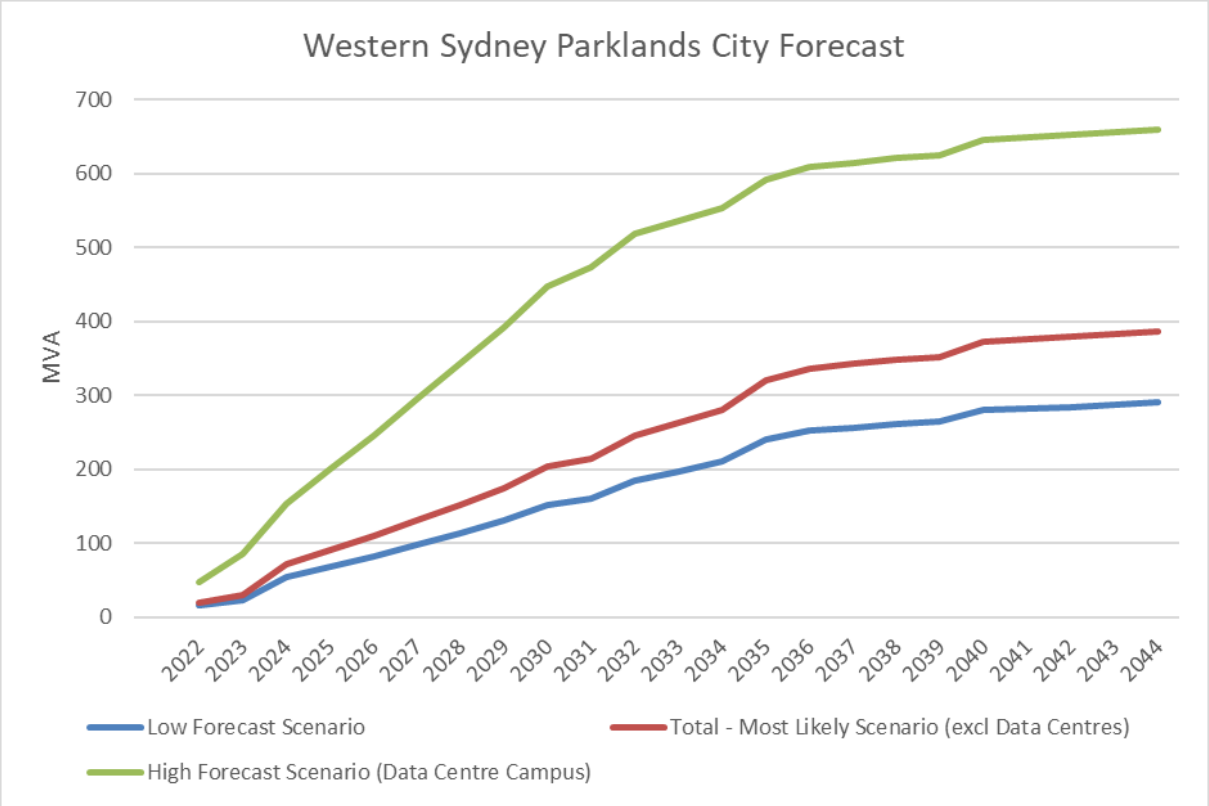
1. Need/opportunity

The Greater Western Sydney area is expected to experience significant growth over the coming years due to development of the Aerotropolis precinct comprising:

- Western Sydney International (Nancy Bird Walton) Airport
- the Sydney Metro-Western Sydney Airport line
- road infrastructure (including the M12 motorway)
- New industries including agribusiness, transport and logistics, defence, aerospace, education and advanced manufacturing.

The demand forecast for the new loads in the area is shown in Figure 1.

Figure 1 – Western Parklands City (Aerotropolis) demand forecast



Endeavour Energy's existing zone substations of Luddenham, Bringelly and Kemps Creek will initially provide sufficient capacity for small developments, but there is insufficient sub-transmission and distribution system capacity to sustain development beyond the next two to four years.

Despite the challenges brought upon the aviation industry by the current global pandemic, the Airport remains on track to open to international and domestic passenger flights and air cargo operations in late 2026. By 2031, the airport is expected to support almost 28,000 direct and indirect jobs.[5]

[5] https://www.westernsydney.com.au/sites/default/files/2021-08/2021-2022_WSA_Co_Corporate_Plan.pdf

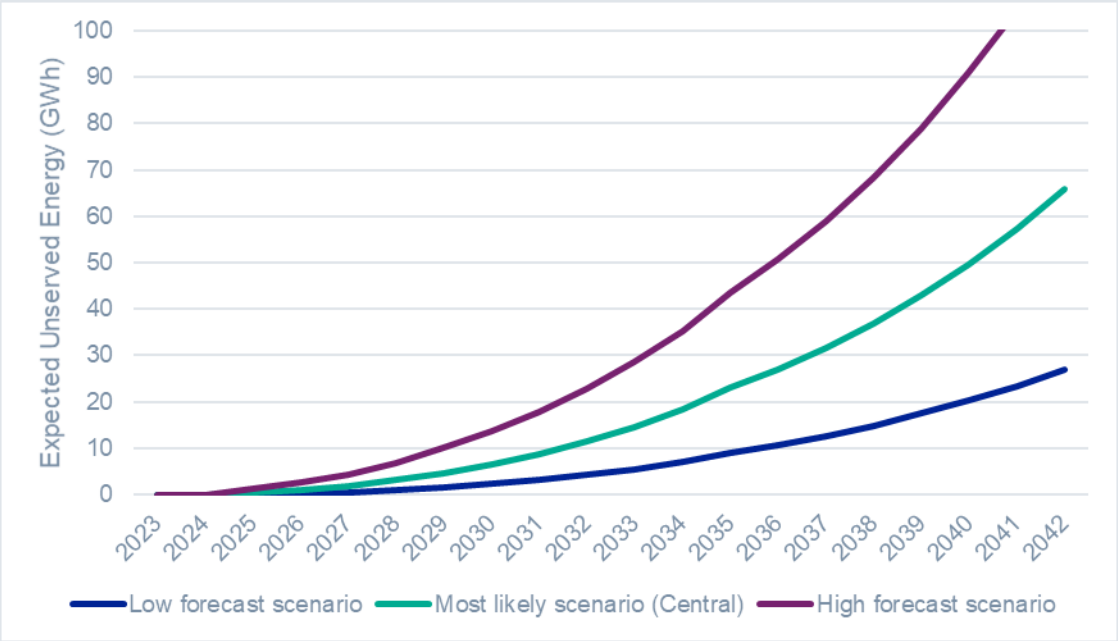
The NSW Government recently granted planning approval for the Sydney Metro – Western Sydney Airport line, with testing occurring one year prior to its commissioning in 2026/7. Sydney Metro have already started work on construction supplies, with significant load required for tunnel boring machines and other associated construction.

The expected increase in demand due to these developments will result in power flows exceeding the capacity of the Macarthur 132 kV BSP from 2026/27[6] under system normal conditions. This will require load shedding under both system normal and contingency conditions at the Macarthur 132 kV BSP after Endeavour Energy completes the first phase of its supply network upgrades in the area.

In its Draft Project Assessment Report for the RIT-D associated with these works, Endeavour Energy noted that it had received formal connection applications from Western Sydney Airport, Sydney Metro and Sydney Science Park for their initial and future power requirements.[7] This underscores the confidence in the load forecasts driving this project.

With no augmentation of Transgrid's transmission network supply capacity in the area, the additional unserved energy forecast, shown in Figure 2, will result in Transgrid failing to meet its transmission reliability standards obligations at the Macarthur Group BSPs.

Figure 2 – Expected Unserved Energy (EUE)



In addition to the regulatory compliance requirement, the unserved energy that can be avoided provides an expected economic benefit that is sufficient to justify the proposed investment to augment the transmission network supply capacity in the area in accordance with the expected demand growth.

The Endeavour Energy distribution network upgrades noted above, which will trigger the need for load shedding, are expected to be completed by 2024/25. If no augmentation to Transgrid's supply capacity is made, the quantity of load required to be shed will steadily increase from then until 2030, and likely beyond. This will have a significant impact on the major commercial, industrial and broad-acre domestic customers supplied by Endeavour Energy in the area should load shedding be required to contain loads to within Transgrid's network capacity.

An outcome of this nature could result in compliance risks for Transgrid due to the billions of dollars in investment and thousands of jobs potentially affected.

[6] Based on Endeavour Energy draft development plan

[7] endeavourenergy.com.au/__data/assets/pdf_file/0014/15170/Draft-Project-Assessment-Report-PR741-Aerotropolis-Foundation-Supply.pdf

The timing for this project is now urgent due to the pace and scale of growth from 2024/25.

2. Related needs/opportunities

- Need N2371 – Supply to Sydney West BSP
  This need investigates suitable options to increase the transformer supply capability at Sydney West BSP to support fast spot load growth at the region supplied by Sydney West BSP.

3. Options

3.1 Base case

The base case for this project is that no augmentation to relieve the loading on the Macarthur 132 kV BSP transmission network be undertaken. Other projects related to supplying the Western Sydney International (Nancy Bird Walton) Airport and surrounding precinct may proceed but none of those projects will reduce the risk or extent of load curtailment required at Macarthur.

The base case will require Transgrid to load shed during system normal (up to 3.1 GWh by 2028/29, increasing exponentially as shown in Figure 2) and contingency events due to the large increase in demand expected from the development in the area.

The base case has no capital or OPEX costs but does have a risk cost (unserved energy).

3.2 Options evaluated

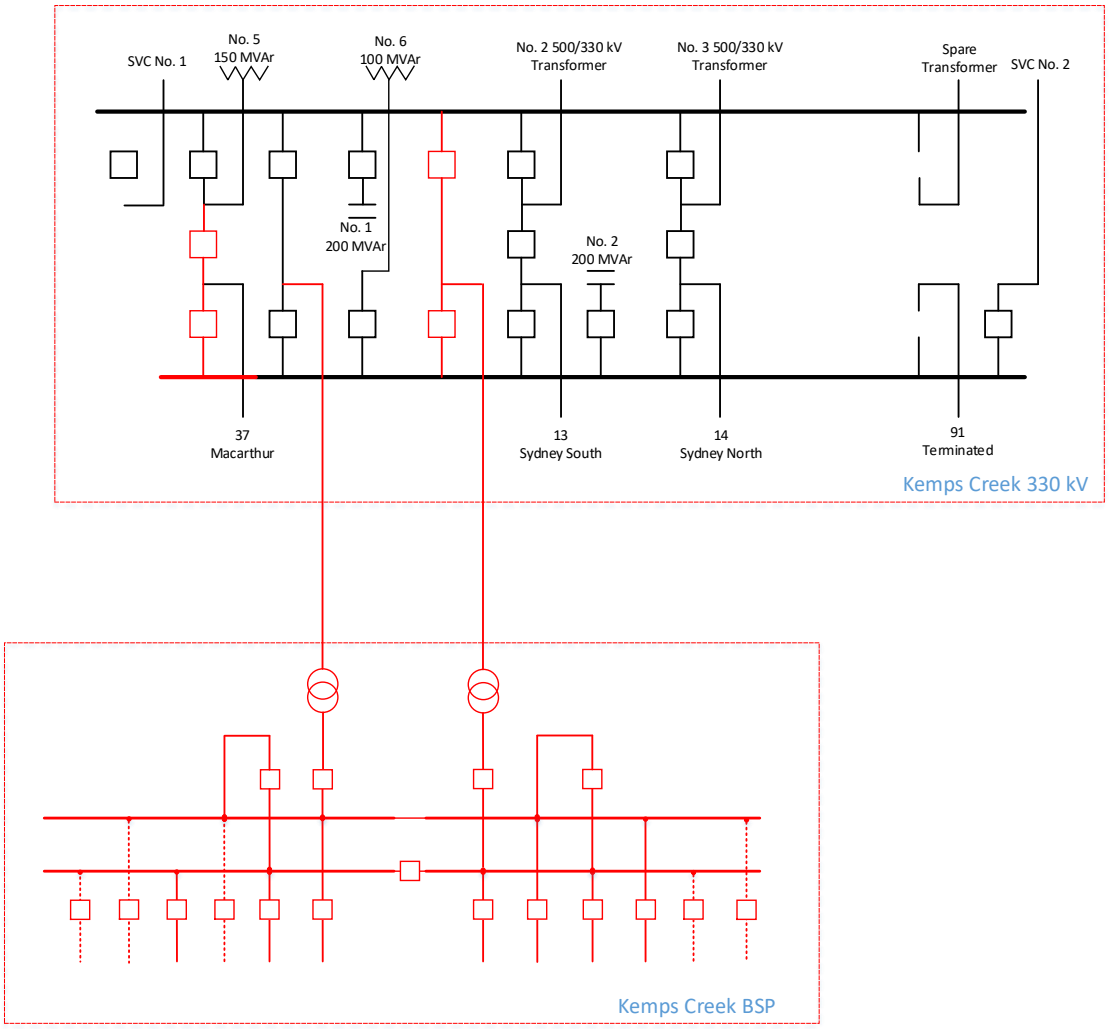
Option A — Develop a new Bulk Supply Point (BSP) next to Kemps Creek substation

The scope of works includes:

- New Kemps Creek BSP with 2 x 375 MVA 330/132 kV transformer (Transgrid work) using the property purchased under Need 2137 (refer Figure 3 below), and connect these back into Transgrid's existing Kemps Creek 500/330 kV Substation via two new 330 kV switchbays. The property costs have been included in the expected expenditure in the NPV analysis for a true comparison with the other options;
- Add a new 330/132 kV Transformer at Macarthur BSP (Transgrid work; refer Figure 4 below) and turn existing 66 kV line 85L to a 132 kV line (Endeavour Energy work[8]);
- Line 9L1 and 9L2[9] upgrade to match Transformer Rating 375 MVA (Endeavour Energy work); and
- Higher rating for new cables/lines between Kemps Creek BSP and South Erskine Park or install series reactor to manage the 132 kV line/cable loading (Endeavour Energy work)

[8] The feasibility study and cost estimate of Endeavour Energy works will be provided by Endeavour Energy.
[9] New line number when 85L turns to 132 kV.

Figure 3 – New Kemps Creek BSP Initial Layout



Once completed, the scope of works is expected to reduce load shedding to zero upon completion until 2039/40 under the Central Scenario.

The expected optimal commissioning year for this option is 2028/29.

This option has been assessed for feasibility in OFS-1687A. The estimated total un-escalated Transgrid capital cost of the option is $74.0 million ± 25% in $2020-21.

The expected expenditure profile in Table 2 for this option is obtained using Transgrid's Estimating Database (2020/21C), with the expected price of the land under Need 2137 included for the purposes of fair comparison for NPV calculations.

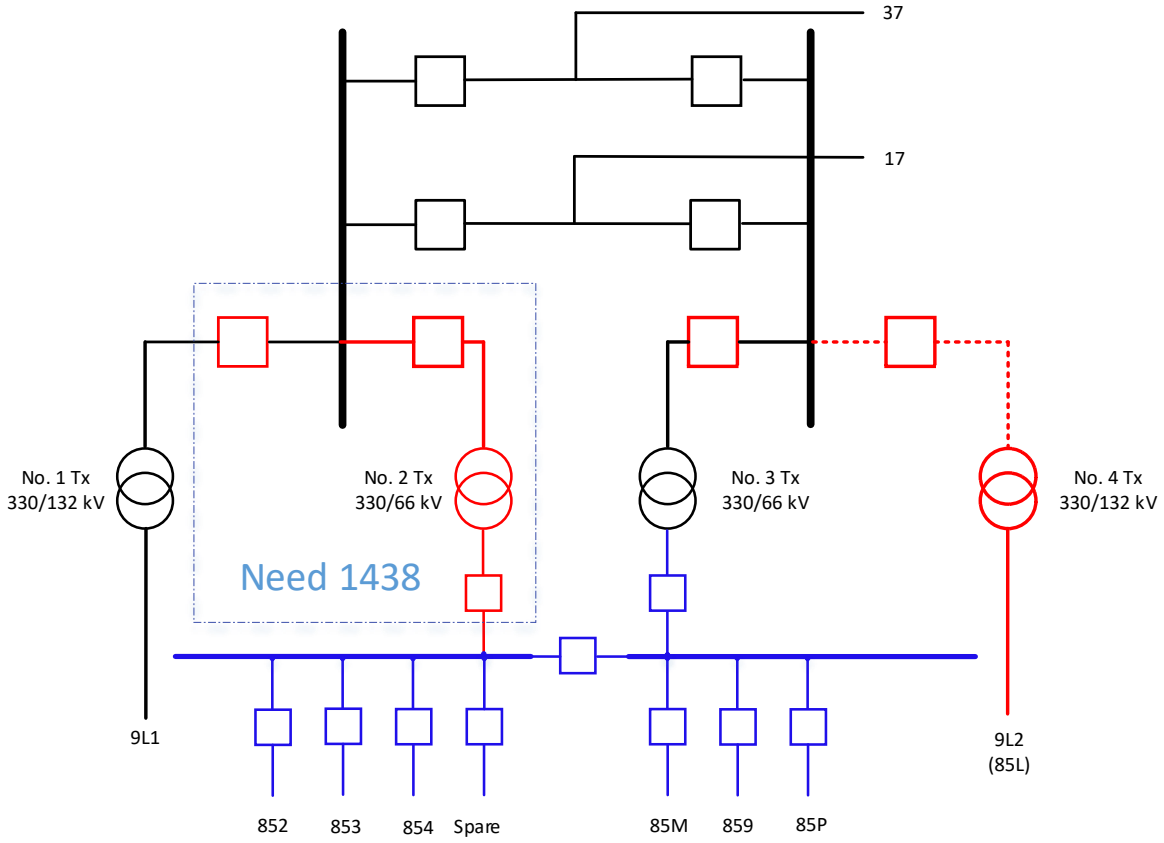
Table 2 – Option A expected Transgrid expenditure

	Total Project Cost ($M)	FY2021/ 22 ($M)	FY2022/ 23 ($M)	FY2023/ 24 ($M)	FY2024/ 25 ($M)	FY2025/ 26 ($M)	FY2026/ 27 ($M)	FY2027 /28($M)	FY2028/ 29 ($M)
Estimated P50 Cost non-escalated ($2020-21)									

It is estimated that an amount up to $2.96 million is required to progress the project from DG1 to DG2, which includes part of the costs involved in the procurement of the land within Need 2137. This is to cover activities such as site assessments, development of concept designs, the commencement of project approvals and the early procurement of long lead-time items as may be required. This cost is included in the projected expenditure.

This project is expected to be completed in an estimated 49 months following the approval of DG1.

Figure 4 – Macarthur BSP Layout for connecting one new 330/132 kV Transformer (for both Options A & B)

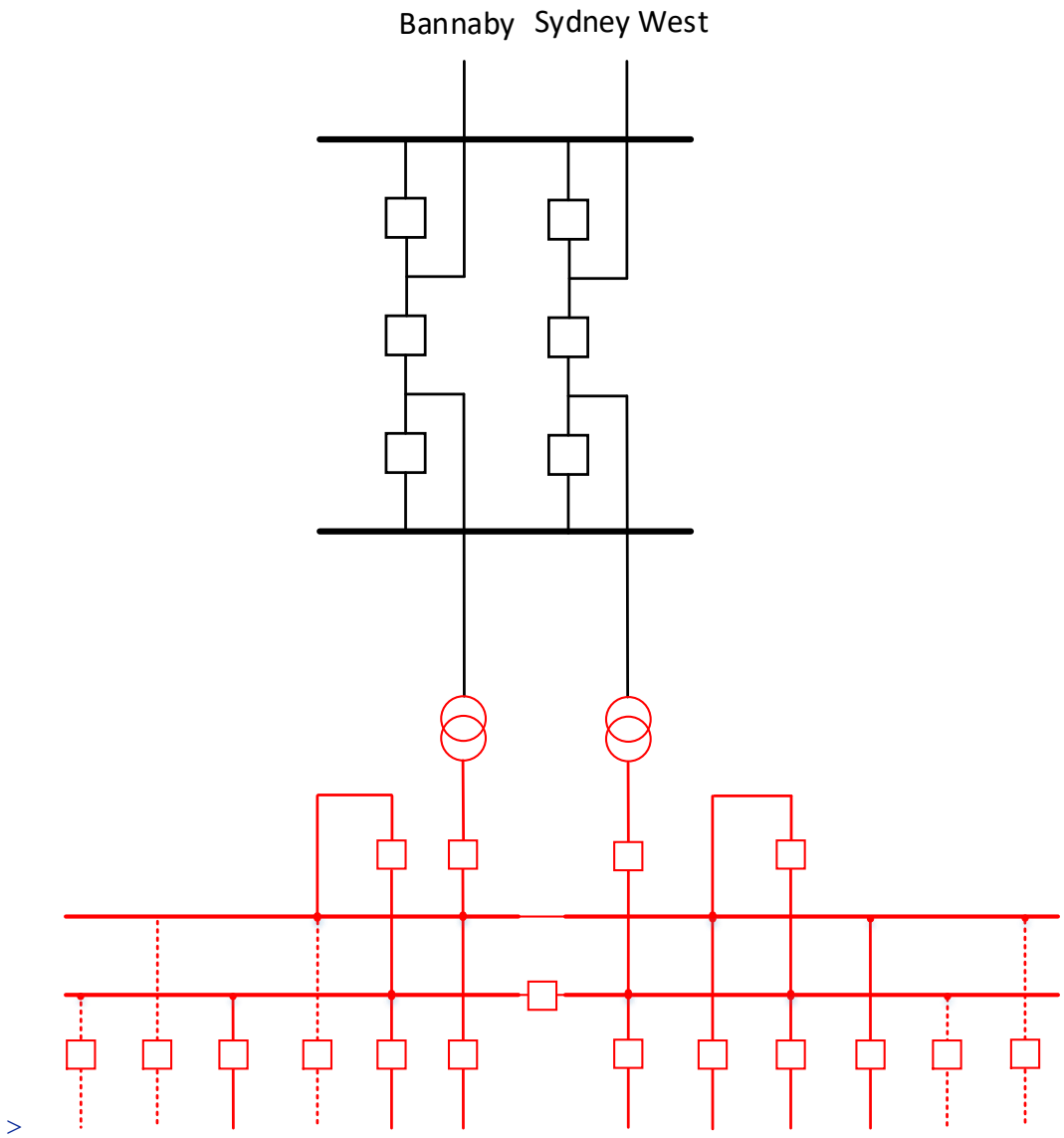


Option B — Develop a new BSP near the southern transition station of Western Sydney Airport underground cable and cut-in to line 39

The scope of works includes:

- Establish a new Transgrid Airport South BSP with 2 x 375 MVA 330/132 kV transformers, and loop-in 330 kV line 39, with property to be purchased for this new BSP (refer Figure 5 below);
- Install an additional 375 MVA 330/132 kV transformer at Macarthur BSP (refer Figure 4 above) and turn existing 66 kV line 85L to a 132 kV line (Endeavour Energy work);
- Endeavour Energy to upgrade its 132kV lines 9L1 and 9L2 to match the 375 MVA transformer ratings at Macarthur BSP; and
- Use higher-rated cables/lines between Airport South BSP and South Erskine Park, or install series reactor to manage the 132 kV line/cable loading (Endeavour Energy work).

Figure 5 – New Airport South BSP Initial Layout



Once completed, the scope of works is expected to reduce load shedding to zero upon completion until 2036/37 under the Central Scenario.

The expected commissioning date for this option is 2028/29.

This option has been assessed for feasibility in OFS-1687B. The estimated total un-escalated Transgrid capital cost of the option is $146.9 million ± 25% in $2020-21.

Table 3 – Option B expected Transgrid expenditure

	Total Project Cost ($M)	FY2024/25 ($M)	FY2025/26 ($M)	FY2026/27 ($M)	FY2027/28 ($M)	FY2028/29 ($M)
Estimated P50 Cost non-escalated ($2020-21)	146.9	1.13	4.65	10.56	61.03	69.52

The higher cost for Option B compared to Option A is largely due to the increased cost of land at the BSP location compared to the cost of purchasing the land adjacent to Transgrid's Kemps Creek 500/330 kV Substation.

It is estimated that an amount up to $5 million is required to progress the project from DG1 to DG2. This is to cover activities such as site visits, development of concept design, and commencement of project approvals and early procurement of long lead-time items.

This project is expected to be completed in an estimate 59 months following the approval of DG1.

3.3 Options considered and not progressed

We considered three other options that were not progressed as they were considered not technically feasible or commercially feasible. These options are outlined in the table below.

Option	Reason for not progressing
Option C – Upgrade existing Sydney West and Macarthur BSP	This option is technically feasible but is expected to be commercially infeasible due to the expected materially higher cost than options A and B. A high level cost estimate for this option is approximately $183 million (excluding biodiversity and property costs, which could take this number up to $257 million) required for the Transgrid portion of works, and approximately $127 million (excluding fault level upgrades in the Endeavour Energy network) for the Endeavour Energy portion of works, bringing the total cost of this option well above options A and B.
Option D – Upgrade existing Sydney West and Macarthur BSP with open point within Endeavour Energy distribution network	This option would reduce the loading on Macarthur BSP transformers, which will reduce the scope of works at Macarthur BSP. This option may be commercially viable but is technically non-feasible, as the reliability level of Metro and Western Sydney airport load will be reduced to N due to the short disruption of the supply during the switch over from one BSP to another BSP. This short disruption would not be acceptable to the Western Sydney airport as an international airport and does not meet the transmission reliability standards for redundancy at Macarthur Group BSP.
Option E – Non-network solutions	Non-network solutions have not been considered at this stage but will be canvassed as part of the RIT-T process.

4. Evaluation

4.1 Commercial evaluation methodology

The economic assessment undertaken for this project includes three scenarios that reflect a central set of assumptions based on current information that is most likely to eventuate (central scenario), a set of assumptions that give rise to a lower bound for net benefits (lower bound scenario), and a set of assumptions that give rise to an upper bound on benefits (higher bound scenario).

Assumptions for each scenario are set out in the table 4 below.

Table 4 – Evaluation Scenarios

Parameter	Central scenario	Lower bound scenario	Higher bound scenario
Discount rate	4.8%	7.37%	2.23%
Demand Growth	Medium (POE50)	Low (POE90)	High (POE10)
Capital cost	100%	125%	75%
Operating expenditure	100%	125%	75%

Value of Customer Reliability (VCR) [10]	100%	70%	130%
Scenario weighting	**50%**	**25%**	**25%**

Parameters used in this commercial evaluation are given in Table 5 below.

Table 5 – Commercial Evaluation Parameters

Parameter	Parameter Description	Value used for this evaluation
Discount year	Year that dollar values are discounted to	2020/21
Base year	The year that dollar value outputs are expressed in real terms	2020/21 dollars
Period of analysis	Number of years included in economic analysis with remaining capital value included as terminal value at the end of the analysis period.	25 Years
VCR	Value of Customer Reliability	$43.96 /KWh

The capex figures in this OER do not include any real cost escalation.

4.2 Commercial evaluation results

The commercial evaluation of the technically and commercially feasible options is set out in Table 6. Details appear in Appendix A.

Table 6 – Commercial evaluation (PV, $ million)

Option	Capital Cost PV[11]	OPEX Cost PV[12]	Central scenario NPV	Lower bound scenario NPV	Higher bound scenario NPV	Weighted NPV	Ranking
Option A	143.3	16.6	8,019	2,325	23,645	10,502	1
Option B	212.4	24.2	7,779	2,211	22,985	10,189	2

4.3 Preferred option

The NPV assessment shows that both credible options can be expected to deliver significant net market benefits to the NEM, when compared to the do nothing base case option. This is due to the fact that both options have been designed to manage the risk of substantial unserved energy to the loads in Western Sydney region.

[10] AER 2019 December VCR value escalated by CPI to 2020/21 dollars.
[11] Include both Transgrid and Endeavour Energy project costs.
[12] Only Transgrid Opex cost is considered in assessment

Of the network options assessed, Option A has the highest NPV and lowest capital expenditure. Option B has less supply capability to the Endeavour Energy distribution network and it will also add extra loading on already heavily loaded line 39 (between cut-in point and Bannaby) which may lead to the network constraint. Therefore, Option A is considered to be the preferred option. The final preferred option will be determined through the RIT-T process. Under this option, the following investments will be undertaken:

- New Kemps Creek BSP with 2 x 375 MVA 330/132 kV transformer (Transgrid work) using the property purchased under Need 2137
- Add a new 330/132 kV Transformer at Macarthur BSP (Transgrid work) and connect new 132 kV line 9L2 (85L upgrade to 132 kV)

Capital and operating expenditure

The preferred option requires capital expenditure of $74.0 million under this Need 1687. Additional operating expenditure of $1.8M per year has been identified for this option.

Regulatory Investment Test

As the estimated cost of the project is above the Regulatory Investment Test (RIT-T) threshold of $6 million, a RIT-T will be required.

The Project Specification Consultation Report (PSCR) is expected to be published by the end of 2021.

5. Optimal Timing

The test for optimal timing of the preferred option has been undertaken. The approach taken is to identify the optimal commissioning year for the preferred option where net benefits of the preferred option exceeds the annualised costs of the option.

The annual benefit significantly exceeds the annualised cost. However, the earliest practical commissioning year based on the project program in OFS-1687A and the estimated duration of approval process through the RIT-T is 2028/29. The final commissioning year will be determined through joint planning with Endeavour Energy and will subject to the implementation of Endeavour Energy's supply network development plan.

The results of optimal timing based on the project program in OFS-1687A is:

- Optimal commissioning year: 2028/29
- Commissioning year annual benefit: $130 million
- Annualised cost: $5.3 million

Based on the optimal timing, the project is expected to commence in the 2023-2028 Regulatory Period.

6. Recommendation

The final preferred option will be determined through the RIT-T process based on detailed network analysis, market modelling, technical and commercial feasibility. While both options will deliver significant net market benefits due to a substantial reduction in unserved energy, the preferred network option is Option A – Develop a new Bulk Supply Point (BSP) next to Kemps Creek substation. This is because Option A provides the highest weighted NPV, greater supply capability to the Endeavour Energy distribution network and a reduced probability of network constraints.

It is therefore recommended that the project be approved to proceed to a RIT-T assessment, with a view to the preferred option being implemented as soon as practicable from 2028/29.

Based on the options listed in Section 3.2, it is expected that this Project would incur a capital cost of approximately $74.0 million in non-escalated 2020/21 dollars, excluding the land cost of Need 2137.

The recommendation is to progress with Option A. This option requires $2.96 million of capex to progress the project to DG2. This cost is included in the expected expenditure.

Appendix A – Option Summaries (repeat for each option)

Project Description	*Western Sydney Development*		
Option Description	Option A - Develop a new Bulk Supply Point (BSP) next to Kemps Creek substation		
Project Summary			
Option Rank	1	Investment Assessment Period	25 Years
Asset Life	40	NPV Year	2021/22
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	8,019	Annualised CAPEX ($m)	5.3
NPV @ Lower Bound Scenario (PV, $m)	2,325	Network Safety Risk Reduction ($m)	N/A
NPV @ Higher Bound Scenario (PV, $m)	23,646	ALARP	N/A
NPV Weighted (PV, $m)	10,502	Optimal Timing	2028/29
Transgrid Cost			
Direct Capex ($m)	[redacted]	Network and Corporate Overheads ($m)	4.8
Total Capex ($m)	[redacted]	Cost Capex (PV,$m)	73.7
Terminal Value ($m)	50.9	Terminal Value (PV,$m)	16.5

Project Description	*Western Sydney Development*		
Option Description	Option B - Develop a new BSP near the southern transition station of Western Sydney Airport underground cable and cut-in to line 39		
Project Summary			
Option Rank	1	Investment Assessment Period	25 Years
Asset Life	40	NPV Year	2021/22
Economic Evaluation			
NPV @ Central Benefit Scenario (PV, $m)	7,780	Annualised CAPEX ($m)	8.3
NPV @ Lower Bound Scenario (PV, $m)	2,212	Network Safety Risk Reduction ($m)	N/A
NPV @ Higher Bound Scenario (PV, $m)	22,985	ALARP	N/A
NPV Weighted (PV, $m)	10,189	Optimal Timing	2028/29
Transgrid Cost			
Direct Capex ($m)	142.1	Network and Corporate Overheads ($m)	4.8
Total Capex ($m)	146.9	Cost Capex (PV,$m)	109.3
Terminal Value ($m)	84.5	Terminal Value (PV,$m)	27.4