Addressing the increasing risk of 33kV switchgear at Willoughby Subtransmission Substation

NOTICE ON SCREENING FOR SAPS AND NON-NETWORK OPTIONS

29 June 2026

Ausgrid

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Notice on screening for SAPS and non-network options – 29 June 2026

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1 Introduction

This Options Screening Notice has been prepared in accordance with the application of the Regulatory Investment Test for Distribution (RIT-D) process under clause 5.17.4(d) of the NER, and in line with the Draft Project Assessment Report (DPAR) publication to options for ensuring reliable electricity supply to load supplied by the Willoughby 132/33kV Subtransmission Substation (STS), as well as facilitating the connection of major new customer load, going forward.

The Willoughby 132/33kV STS is in the Lower North Shore area and was commissioned in 1968, with many of the original assets still in service. It supplies nearly 28,000 customers via Chatswood and Gore Hill zone substations (ZS), as well as several major customers such as Sydney Trains, Sydney Metro, the Lane Cove Tunnel, and three existing data centres.

The 33kV switchgear at this site is a unique design with oil circuit breakers installed within a building. Specifically, while the existing circuit breakers are outdoor bulk oil type, they have been installed in enclosed rooms – a common practice of the NSW Electricity Commission in the 1960s. Consequently, replacing them with modern equivalent circuit breakers in the existing building and enclosures while maintaining electrical clearances is complex, time-consuming and costly.

To address known issues associated with bulk oil circuit breakers, Ausgrid has developed and has been implementing a strategy to replace our entire fleet since 2009. As of the date of this report, only 59 units remain in service, with all remaining units planned for replacement within the current and next regulatory periods. Of the remaining units, 28 are installed at the Willoughby STS.

The building housing the switchgear at the Willoughby STS (the 'switchroom') is also the original building and is in poor condition. A structural and civil inspection of the building was undertaken in October 2024, which identified a broad range of condition and compliance issues.

In addition to these asset condition issues, the Lower North Shore area has emerged as a growing hub for data centres in Sydney in recent years, given its proximity to major fibre trunk connections, established electricity infrastructure, and transport links. Three data centres are already connected to the Willoughby STS, and Ausgrid has received additional supply requests for three further data centre loads – the first one targeting initial connection in 2028, the second seeking an expansion of their existing connection targeting 2029/30, and the third one requesting connection in 2030.

In total, Ausgrid expects that these new data centre loads will require more than 200 MVA of capacity. Taking into account the existing underlying peak load, it is expected that Willoughby STS will exceed its capacity of 225 MVA by 2029/30.

Ausgrid is therefore undertaking this RIT-D to assess options for addressing the risk associated with the ageing 33kV switchgear and switchroom at the Willoughby STS, as well as facilitating the additional expected data centre load.

No exemptions listed in the NER clause 5.17.3(a) apply and therefore Ausgrid is required to apply the RIT-D to this project. This notice has been prepared under cl. 5.17.4(d) of the NER and summarises Ausgrid's determination that no SAPS and non-network option forms all or a significant part of any potential credible option for this RIT-D. It sets out the reasons for Ausgrid's determination, including the methodologies and assumptions used. A full discussion of asset conditions and the identified need can be found in the Draft Project Assessment Report (DPAR) for addressing the increasing risk of increased risk of 33kV switchgear at Willoughby Subtransmission Substation

2 Description of the identified need

2.1 Overview of the relevant network area

The Willoughby STS is a 132/33kV STS that was commissioned in 1968 and is currently supplied by two 132kV feeders from Transgrid's Sydney East Bulk Supply Point via Lindfield Sub-transmission Switching Station. It is equipped with:

- three 132/33kV 120 MVA transformers (with provision to accommodate a fourth transformer); and
- four sections of 33kV switchgear, which involve a unique design with twenty-eight oil circuit breakers installed within enclosed rooms – a common practice of the NSW Electricity Commission in the 1960s.

Willoughby STS is connected to two downstream 33/11kV ZS – Chatswood and Gore Hill – which supply approximately 28,000 residential, commercial, and industrial customers in the Lower North Shore network area. It also directly supplies several major customers such as Sydney Trains, Sydney Metro, The Lane Cove Tunnel, and three data centres. Willoughby STS is located within the Artarmon industrial/business precinct. A geographical overview of this area is shown in Figure 2.1 below.

Figure 2.1 - Geographical overview of the area serviced by Willoughby STS

The 33kV switchgear at Willoughby STS, which has been in service since the site was commissioned in 1968, is approaching the end of its useful life and, as a result, has an increasing risk of failure.

To address the known issues with bulk oil circuit breakers, Ausgrid has developed and been implementing a strategy to replace its entire fleet since 2009. As of the date of this report, only 59 units remain in service, with all planned for replacement within the current and next regulatory period. Of these remaining units, 28 are installed at the Willoughby STS.

The 33kV switchgear equipment has been installed in two circuit breaker switchrooms, each containing two circuit breaker sections and each section in turn containing eight circuit breaker bays. These switchrooms are joined by a control room building creating a π shaped arrangement, as shown in Figure 2.2 below.

Figure 2.2 - Willoughby STS aerial view

Of the 32 available circuit breaker bays, there are currently 28 occupied with 33kV bulk oil circuit breakers.

The switchroom building at the Willoughby STS in which the switchgear is housed is also in poor condition. A structural and civil inspection of the building was undertaken by Qubist in October 2024, which identified a broad range of condition and compliance issues, including:

- Concrete cancer (i.e., exposed and corroded steel reinforcement) at multiple locations;
- Cracking in brickwork externally and on inner walls at multiple locations;
- Roof deterioration and holes in the internal ceilings of individual circuit breaker bays;
- Significant corrosion of steel supports, walkways, handrails, and platforms, with advanced pitting and flaking that compromise structural strength;
- Significant corrosion of all roller doors, with several assumed to be non-functional;
- Presence of asbestos-containing materials in various parts of the buildings and conduits, posing a safety exposure risk to personnel;
- Presence of Perfluorooctane Sulfonic Acid (PFOS) contamination; and
- Multiple Building Code of Australia (BCA) compliance issues.

On the basis of these findings, the condition assessment concluded that, although the switchroom does not present an immediate risk of structural failure, any works to replace the electrical infrastructure housed within it would necessitate significant associated civil works, including balcony repairs, fire system upgrades, and PFOS remediation. The combined cost and complexity of these works support immediate replacement of the buildings in their entirety rather than a program of repair and remediation.

Without action, the condition of the existing 33 kV switchgear and switchroom at Willoughby STS is expected to continue to deteriorate, resulting in prolonged outages to customers, increased safety risks and long repair times.

In addition, and separate to the condition issues, the Lower North Shore has experienced growing interest from data centre operators in recent years, driven by its proximity to major fibre trunk connections, established electricity infrastructure, and transport links. Three data centres are already connected to the Willoughby STS, and Ausgrid has received additional supply requests for three further data centre loads – the first one targeting initial connection in 2028, the second seeking an expansion of their existing connection targeting 2029/30, and the third one requesting connection in 2030.

Of the three new potential data centre loads:

- The first has a signed connection agreement with Ausgrid and is currently undertaking construction;
- The second is seeking expansion of an existing connection; and
- The third is in early design stage connection discussions with Ausgrid.

Each of the new data centre customers has requested N-1 supply and accommodating them all will require more than 200 MVA of capacity. In combination with the current peak load of 115 MVA at Willoughby STS, these new loads will exceed the existing transformer capacity of 225 MVA by 2029/30.

2.2 Summary of the 'identified need'

Ausgrid is obliged to comply with reliability and performance standards as part of its distribution license granted by the Minister for Industry, Resources and Energy under the *Electricity Supply Act 1995 (NSW)*. Under the license, reliability and performance standards are expressed in two measures:

- SAIDI[1] – which means the average derived from the sum of the durations of each sustained customer interruption (measured in minutes), divided by the total number of customers (averaged over the financial year); and
- SAIFI[2] – which means the average derived from the total number of sustained customer interruptions divided by the total number of customers (averaged over the financial year).

These two reliability measures capture two key aspects of supply disruptions to electricity customers, i.e., how long their electricity supply is off for as well as how often their electricity supply is off. Customers experience a better electricity service the lower each of these measures are. Reliability standards applied to distribution networks typically set maximums in relation to each of these two measures.

The primary concern this RIT-D is seeking to address focuses on the increasing customer supply risks derived from the condition of the 33kV switchgear and switchroom at Willoughby STS. If action is not taken to address the deteriorating condition of this equipment, then the analysis shows that the unserved energy modelled will put these performance standards at risk. By addressing the reliability concerns associated with the aging switchgear, the proposed investment will deliver material net market benefits for customers from a reduction in Expected Unserved Energy (EUE), as well as through avoided safety risk costs and avoided maintenance and repair costs.

[1] System Average Interruption Duration Index.

[2] System Average Interruption Frequency Index.

In addition, Ausgrid is obliged under clause 5.2.3(d) of the NER to review and process applications to connect to its network and to enter into connection agreements with applicants. As outlined in section 2.1, Ausgrid has received formal connection applications from three major data centre customers in the Lower North Shore area. The existing network cannot accommodate these loads without augmentation, and inaction would place Ausgrid in breach of these NER obligations.

Overall, Ausgrid considers the identified need for this investment to be a reliability corrective action, encompassing both the obligation to maintain reliable supply to existing customers, and the obligation to facilitate the additional expected data centre load, in the Lower North Shore area.

2.3 Key assumptions underpinning the identified need

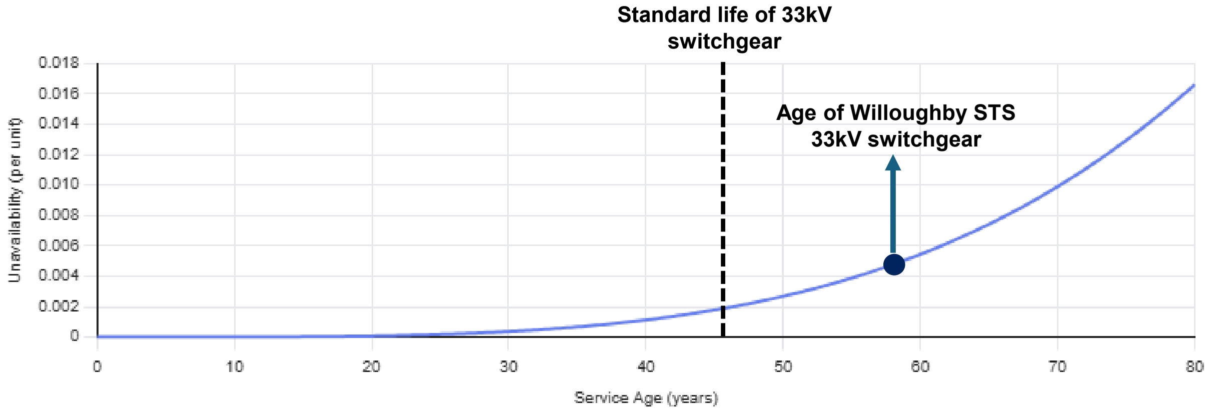
This section summarises the key assumptions underpinning the identified need for this RIT-D. Appendix D provides additional detail on the assumptions used, and methodologies applied, to estimate the costs and market benefits as part of this RIT-D.

2.3.1 Probability of assets failing increase with age

Ausgrid has adopted well-accepted models for each major class of network asset to estimate the probability of failure. In general, the probability of failure increases with asset age.

Figure 2.3 shows unavailability plotted for 33kV bulk oil circuit breakers, considering failure rates parameters that represent strong wear-out behaviour (aging-driven failures). It shows robust performance in the early years (very low unavailability), with an accelerated failure region after 40 years of service. Considering that Willoughby STS was commissioned in 1968 and the 33kV switchgear remains original, the equipment is nearing the end of their service life.

Figure 2.3 - Unavailability of 33kV bulk oil circuit breakers



A Weibull analysis is used to derive a probability distribution function for the asset's age at time of failure. This probability distribution considers a behaviour of the failure rate that assumes failures become more frequent as degradation mechanisms become noticeable (i.e., oil degradation, mechanical fatigue or insulation wear-out) and the characteristic life of the asset matches the field experience with 33kV circuit breakers nearing retirement.

This methodology is considered a standard industry practice. A detailed discussion of the probability of failure and asset availability for switchgear is provided in Appendix D of DPAR report.

2.3.2 Supply restoration takes time and has been considered to determine EUE

While the majority of the EUE for this RIT-D relates to new load that would exceed the current capacity of the Willoughby STS (outlined in the section below), the level of expected cost associated with any involuntary load shedding for currently connected load is dependent on underlying assumptions relating to supply restoration times.

Ausgrid considers that the time required for restoration after a switchgear failure of the type in the Willoughby STS can vary between 40 and 408 hours (i.e. 17 days) depending on the type of failure, with some complex failure cases requiring up to 600 hours (i.e. 25 days). Detailed restoration assumptions are set out in Appendix D of DPAR.

It should be noted that the 33kV isolators and earth switches require manual operations through a series of mechanical drives and linkages. This requires the operator to be in close proximity to the equipment while it is operated. Switching time is two hours for isolators within Willoughby STS.

All 33/11kV zone substations (ZS) and major customers connected to Willoughby have at least N-1 supply arrangements. Some of the customers have no attributable EUE if there was an outage at Willoughby STS. This is the case of Sydney Trains and Sydney Metro, as they can automatically connect to a remote supply from another substation under loss of supply from Willoughby STS.

In the event of a total loss of supply to Willoughby STS, a portion of the residential and small commercial loads can be recovered by switching supply between ZS via the 11kV network after a time delay (i.e., by closing and opening normally open point on the network), as there are 11kV interconnections between Chatswood and Gore Hill ZS, and well as with neighbouring Crows Nest, Royal North Shore and North Sydney ZS.

Ausgrid has factored the ability to transfer load into our assessment of forecast unserved energy.

Whilst load to many customers can be restored through switching operations in the 11kV network combined with the use of mobile generation sets, the full incident recovery process (i.e., cable and/or substation equipment repairs) can take several weeks (which may result in unserved energy over this period).

In other cases, such as data centre connections, the customers have embedded generation to support loads for up to 48 hours in the event of total loss of supply.

As the loads served from Willoughby STS become predominantly large customer loads, comprising data centre connections and infrastructure services, it is anticipated that the combined load will become more stable over time.

For the case of the potential third new data centre connection (i.e., the one in early design stage connection discussions with Ausgrid), we have included it equally in all three demand forecasts but capped the level of EUE in the NPV assessment. This is because there are no available feeder bays to connect the new load under the 'do nothing' case, and the current network arrangement at Willoughby STS will have all available connection bays in use with no means to accommodate the connection of the third data centre (i.e., in this case, every MW of load will be unserved if corrective action is not taken and, if uncapped, the EUE will increase exponentially, dwarfing the contribution to the avoided EUE from the currently connected and the other connecting loads in the existing arrangement).

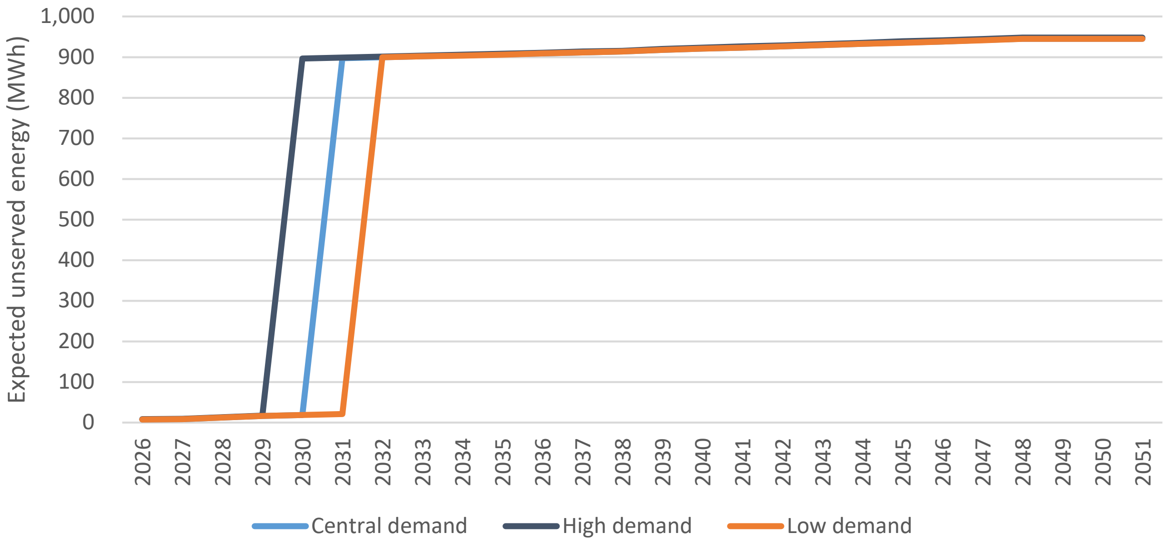
The cap applied to this third data centre load assumes the EUE values for the third connecting data centre reach the equivalent of 1 MW of load unserved each year, and we apply a 10% probability of proceeding as this customer is at early stages of the connection process.

We consider it appropriate to cap the level of EUE associated with the third potential data centre to avoid a situation where an exponential increase in EUE skews the assessment results, noting that this approach does not affect the identification of the preferred option as all options avoid that EUE equally.

Figure 2.4 shows the modelled levels of EUE under each of the three underlying demand forecasts investigated, over the next twenty-five years (which is the assessment period adopted for this RIT-D). For clarity, this figure illustrates the MWh of EUE assumed under each load forecast if no credible option is commissioned (i.e. under the 'do nothing' base case for that load forecast).

Appendix D of DPAR provides additional detail on the assumptions underpinning the identified need (i.e. the assumed load duration curve and how the probability of switchgear failure has been modelled).

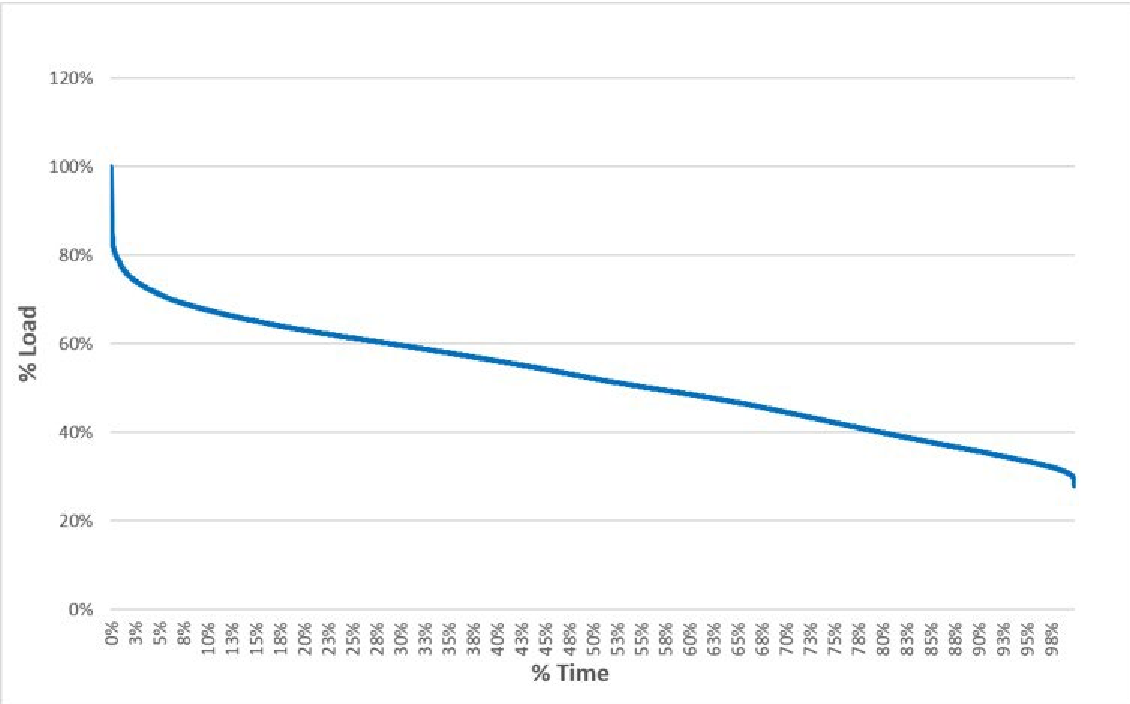
Figure 2.4 - Forecast EUE under each of the three demand forecasts



2.3.3 Characteric load duration curve

The load duration curve used in the analysis is present in Figure 2.5 below. It is assumed that the load types supplied will not change substantially into the future and therefore the load duration curve will maintain its characteristic shape.

Figure 2.5 - Load duration curve



2.3.4 Load transfer capacity and supply restoration

Willoughby STS load area is classified as urban and has 33kV connections with Chatswood and Gore Hill ZSs. For load transfer capacity, the CBA only considered Sydney Metro (North West Rail Link), which has a current forecast undiversified load of 11.19MW.

In the event of an equipment outage, the network may be returned to a normal configuration by one of the following actions:

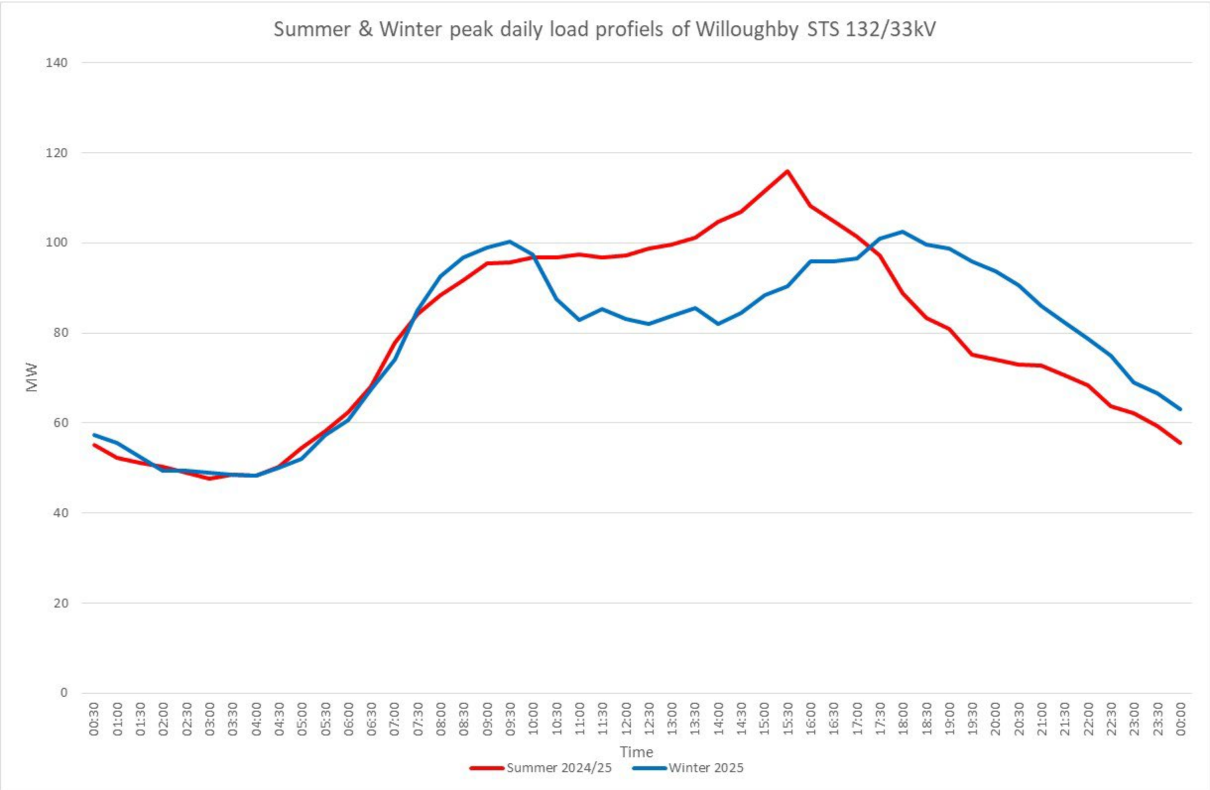
- repairing the failed equipment
- initiating a contingency plan
- replacing the failed equipment with spares.

The assumed supply restoration actions and the time taken to implement the action are detailed in the table of Appendix D.2 of DPAR. These actions are the most likely actions for the contingencies considered in this planning study.

2.3.5 Pattern of use

The Willoughby 132/33kV STS is in the Lower North Shore area which supplies about 28,000 customers via Chatswood and Gore Hill zone substations (ZS), as well as several major customers such as Sydney Trains, Sydney Metro, The Lane Cove Tunnel, and three data centres. Based on the financial year (FY2025), there are 87.9% residential customers using 21.2% of energy, 12.1% non-residential customers using 78.8% of energy. The peak time occurred in early evening in summer. Figure 2.6 below shows the approximate peak day profiles of Willoughby STS 132/33kV.

Figure 2.6 - Peak daily load profiles of Willoughby STS 132/33kV



2.3.6 Customer characteristics

Willoughby 132/33kV STS serves a mixture of residential and non-residential customers. A breakdown of the customer characteristic for the 2024/25 period is shown in Table 2.1 as follows.

Table 2.1 - customer characteristics of Willoughby STS 132/33kV

Item	Residential	Small Non-Residential	Large Non-Residential	Total
Number of Customers	24,803	3,208	221	28,232
% of Customers	87.9%	11.4%	0.8%	
Annual Consumption (MWh)	112,154	61,340	354,637	528,132
% of Annual Consumption	21.2%	11.6%	67.1%	
Number of Solar Customers	2,987	118	22	3,127
% of Customers with Solar	0.6%	1.9%	4.8%	
Average Annual Consumption (MWh)	5	19	1,605	19

3 Two credible options have been assessed

This section provides details of the two credible network options that Ausgrid has identified as part of its network planning activities. Each option has been developed following an assessment of the various potential choices for addressing:

- The ageing 33 kV switchgear and switchroom to ensuring reliable supply of electricity; and
- The expected future data centre loads to ensure requested customer loads are accommodated.

All costs and benefits presented in this DPAR are in 2025/26 dollars, unless otherwise stated.

3.1 Option 1 – Single stage replacement of switchgear

Option 1 involves the construction of a new 33kV switchroom building, installation of new 33kV switchgear equipment and a fourth 132/33kV transformer, and retirement of existing buildings (i.e. existing 33kV switchrooms and control room).

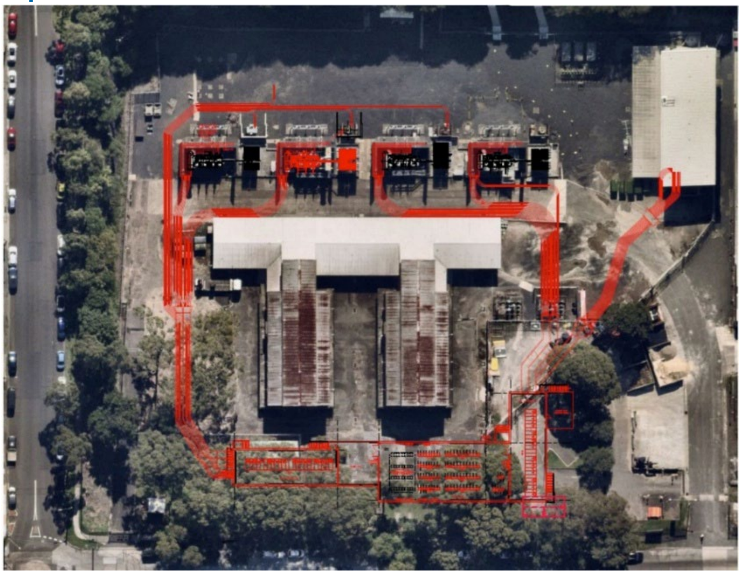
To accommodate the new expected data centre loads, Option 1 expands the switchgear at Willoughby STS to include 30 feeder bays (an increase of six from the current configuration) and to include a fourth 132/33kV transformer. That is, the new 33kV switchroom will be larger than the existing switchroom. The fourth transformer is required under Option 1 (and Option 2) even if just one of the three new expected data centre loads connects.

The specific scope of works for Option 1 includes:

- Early works to clear the area required for the new switchroom building;
- Construction of a new 33kV switchroom located within the existing Willoughby STS footprint;
- Installation of new 33kV indoor switchgear and associated controls and protection equipment;
- Installation of underground 33kV conduits and cables (to transfer connected loads to the new 33kV switchgear);
- Installation and commissioning of a new (fourth) 132/33kV transformer unit; and
- Decommissioning of redundant equipment and demolition of the existing 33kV switchroom (to slab level).[3]

Figure 3.1 below illustrates the location of the existing 33kV switchroom and enclosed 33kV switchgear (to be decommissioned and replaced under this option) and the proposed new switchroom and associated works (shown in red).

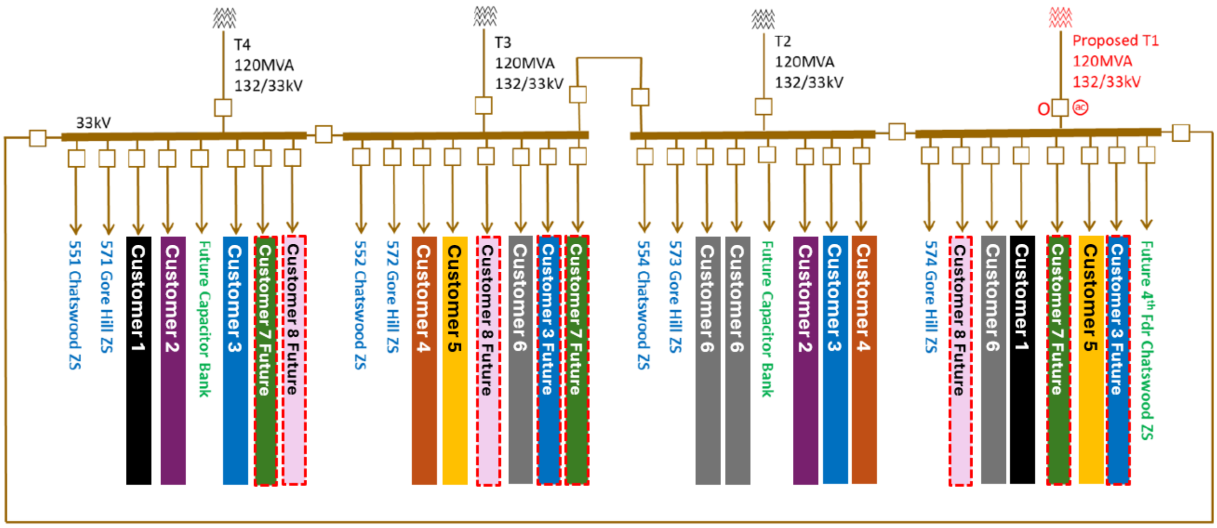
Figure 3.1 – Proposed location of the new switchroom relative to the existing 33kV buildings



[3] Removal of abandoned cables and services (e.g., sewer and water pipes) are excluded from the scope.

Figure 3.2 provides a single-line diagram for Option 1 with the new transformer shown in red. All major loads have been redacted in the figure below to ensure confidentiality.

Figure 3.2 – Single-line diagram for Option 1*



** The allocation of feeder bays depicted in this diagram is indicative and provided for illustration purposes.*

The estimated capital cost of Option 1 is $70.3 million (2025/26), which includes decommissioning cost of $4.3 million. Table 3.1 shows the breakdown of the estimated capital costs across key cost categories for this option.

Table 3.1 – Breakdown of expected capital costs by key category for Option 1, $m (2025/26)

Component	Labour	Materials	Contracted Services	Indirect cost	Total
Option 1 – Single stage replacement	17.8	10.5	29.3	12.7	70.3

Table 3.2 shows the breakdown of the estimated capital costs by component and over time for this option.

Table 3.2 – Breakdown of expected capital cost over time for Option 1, $m (2025/26)

Component	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33
Early works for new switchroom	0.2	1.5	-	-	-	-	-	-
New 33kV switchroom	-	5.2	7.6	-	-	-	-	-
New 33kv switchgear	2.9	6.7	8.3	8.3	4.5	3.0	1.4	
New 33kv conduits and cables	0.3	-	0.4	4.3	3.1	1.7	1.1	-
4th 132/33kV 120 MVA transformer	-	-	0.6	4.5	0.2	-	-	-
Decommissioning cost	-	-	-	-	-	-	0.1	4.2

The design, construction and equipping requirements are reasonably well understood for Option 1, taking into account the experience gained through similar projects recently completed (i.e., replacement of 33kV switchgear at Peakhurst STS with a new switchroom building).

Also included in the scope and estimated capital costs are works at remote ends of 33kV feeders supplying Gore Hill and Chatswood zone substations, as well as Sydney Trains and Lane Cove Tunnel, to upgrade protection systems.

We note that both options have a relatively high upfront design cost given the complexity of the solutions.

The first year of capital costs above includes expenditure to-date on these design costs. This has also been included in the first year of costs for Option 2 (discussed below). While these costs are equal across both options and thus do not affect the identification of the preferred option under the RIT-D, they have been included in the cost estimates for continuity with our wider regulatory cost recovery process.

The operation of the new switchgear in the new switchroom is expected to take several years to fully implement, as the 33kV feeder changeovers must be carried out in stages. This staged process is usually undertaken in shoulder load periods (i.e., we have assumed no transfers will occur during summer/winter peaks).

However, there are significant benefits to the construction and equipping phases being able to occur largely independent of normal substation operations. Having the cable works complete and substation equipped provides significant redundancy for any equipment failure that may occur in the interim.

Overall, Option 1 is expected to take seven years to complete, with commissioning of all work by 2031/32. However, the timing of the bulk of the replacement works under Option 1 is determined by the timing of the new data centre load requirement, i.e., from 2029/2030.

Specifically, the works required to accommodate the new data centre loads under Option 1 (i.e., new building and new switchgear in new bays) will be completed by 2029/30, from which point the avoided EUE associated with those loads will begin to be realised. After this timing, the project works are focused on the transfer of the existing loads at the STS to the new switchgear and switchroom.

Once fully commissioned, Option 1 will require approximately $25,700/year in planned routine maintenance costs.

3.2 Option 2 – Multiple stage replacement of switchgear

Option 2 involves a staged approach to addressing asset condition issues at Willoughby STS, whereby the existing 33kV switchgear is replaced like-for-like within the existing 33kV switchroom initially (i.e., an 'in situ' replacement), with construction of the new switchroom with new switchgear deferred by ten years (relative to Option 1).

Although the existing 33kV circuit breakers are outdoor bulk oil type, they have been installed in enclosed rooms – a common practice of the NSW Electricity Commission in the 1960s. Consequently, replacing them with modern equivalent circuit breakers in the existing building and enclosures while maintaining electrical clearances is complex, time-consuming and costly.

To provide sufficient feeder bays at the Willoughby STS to accommodate the expected data centre loads, Option 2 offloads the current load at the Gore Hill ZS in order to decommission the site, disconnects it from Willoughby STS, and repurposes the four feeder bays that currently serve it. As with Option 1, it also involves the installation of a new (fourth) 132/33kV transformer at Willoughby STS to facilitate these loads.

The specific scope of works for Option 2 occurs in two stages:

Stage 1 (completed by 2032/33):

- Installation of new 33kV switchgear in the existing 33V switchroom;
- Installation and commissioning of a new (fourth) 132/33kV transformer unit; and
- Transfer of 11kV load at Gore Hill ZS (80% to Royal North Shore Hospital and 20% to Chatswood ZS) and decommissioning of Gore Hill ZS.

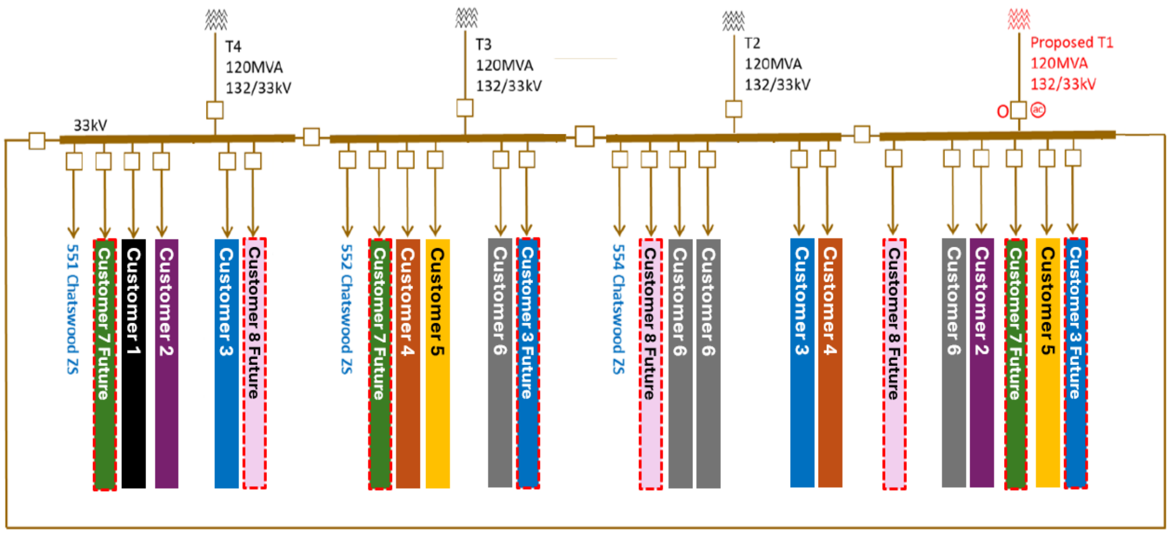
Stage 2 (completed by 2042/43):

- Early works to clear the area required for the new switchroom building;
- Construction of a new 33kV switchroom located within the existing Willoughby STS footprint;
- Installation of new 33kV indoor switchgear and associated controls and protection equipment;

- Installation of underground 33kV conduits and cables (to transfer connected loads from the existing 33kV switchgear to the new 33kV switchgear); and
- Decommissioning of redundant equipment and demolition the existing 33kV switchroom (to slab level).[4]

Figure 3.3 provides a single-line diagram for Option 2 after the Gore Hill ZS load has been transferred (and prior to the Stage 2 works to establish the new switchroom and switchgear with the new transformer shown in red. All major loads have been redacted in the figure below to ensure confidentiality.

Figure 3.3 – Single-line diagram for Option 2*



** The allocation of feeder bays depicted in this diagram is indicative and provided for illustration purposes.*

The estimated construction capital cost of Option 2 is $115.7 million, with an estimated decommissioning cost of $7.4 million. Table 3.3 shows the breakdown of the estimated capital costs across key cost categories for this option.

Table 3.3 – Breakdown of expected capital costs by key category for Option 2, $m (2025/26)

Component	Labour	Materials	Contracted Services	Indirect cost	Total
Option 2 – Multiple stage replacement	**30.0**	**18.0**	**48.3**	**19.4**	**115.7**

Table 3.4 shows the breakdown of the estimated construction capital costs over time for this option for the first stage of work (i.e., everything excluding the new 33kV switchgear at Willoughby STS in the new switchroom).

Table 3.4 – Breakdown of expected capital cost over time for Option 2 – first stage, $m (2025/26)

Component	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34
Replacement of 33kV switchgear	**3.1**	**2.9**	**4.3**	**5.7**	**5.7**	**4.3**	**3.6**	**0.7**	**-**
4th 132/33kV 120 MVA transformer	**-**	**-**	**0.6**	**4.5**	**0.2**	**-**	**-**	**-**	**-**
Gore Hill ZS 11kV load transfers	**-**	**0.3**	**1.2**	**6.1**	**4.5**	**-**	**-**	**-**	**-**
Decommission Gore Hill ZS	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.8**	**2.3**

[4] Removal of abandoned cables and services (eg, sewer and water pipes) are excluded from scope.

Table 3.5 shows the breakdown of the estimated construction capital costs over time for the second stage of this option, i.e. the eventual new 33kV switchgear at Willoughby STS in the new switchroom.

Table 3.5 – Breakdown of expected capital cost over time for Option 2 – second stage, $m (2025/26)

Component	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42	2042/43
New 33kV switchgear at Willoughby STS in new switchroom	**1.2**	**2.2**	**13.4**	**16.3**	**12.7**	**7.6**	**4.7**	**2.5**	**-**
Decommissioning costs	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.1**	**4.2**

The in-situ replacement of the 33kV switchgear under Option 2 is expected to take eight years to complete, with commissioning expected in 2032/33. This is one year longer than for Option 1.

The extended program duration reflects the complexity associated with replacing the enclosed circuit breakers in-situ, whilst maintaining required electrical clearances and keeping the existing STS operational during construction.

Notwithstanding the additional complexity associated with in-situ replacement of the existing 33kV switchgear, Option 2 is staged similarly to Option 1 such that works required to accommodate new data centre loads will be completed by 2029/30, from which point avoided EUE associated with those loads will begin to be realised.

The remaining works are focused on the in-situ replacement of existing switchgear, which must be completed before EUE associated with existing connections can be avoided. Full commissioning of Option 2 is expected in 2032/33, at which point all avoided EUE will be realised.

The in-situ replacement works have significant risks that mean that there is a higher level of uncertainty around costs and timing than for the works under Option 1 (as outlined in section 4.3) – namely:

- A large volume of planned outages is required to do the staged replacement works, exposing a high number of customers to the risk of experiencing supply interruptions.
  - In particular, the replacement of the bus section circuit breakers will be a critical task.
  - Planned dual outages will be required for the bus section circuit breaker replacements, which in some combinations will cause Willoughby STS to operate with only one transformer in service (out of three) and Chatswood ZS to operate with only one transformer (out of three).
  - Such dual bus section outages can only occur in Spring or Autumn of each year, and obtaining permission from Ausgrid's control room to implement these planned outages for each step of work will be very challenging and could impact project timing.
- High demand of internal labour resources, with simultaneous field services groups/crews to be allocated at the same time for each circuit breaker replacement.
  - Senior technicians will be required due to the complexity of the work and committed to this project over a long period of time, which in turn will have impacts on other programs of work across Ausgrid.
- Unknown conditions in ground services.
  - There are several out-of-service cables that require identification and cutting/capping.
- Control and protection drawings not being fully up to date.
- Replacement of secondary cables (i.e., cables connecting control switches, protective relays and monitoring devices, used for transmitting electrical signals and data to monitor and operate equipment) will be difficult.
  - Firestopping barriers between rooms and around groups of cables will either require new routes or make stage replacement of cables difficult (i.e., removal of firestopping around a group of secondary cables while needing to keep many cables operational).
  - Segregation of secondary cables cannot be achieved for this option (i.e. old and new wiring will follow the same route, including the same floor and wall openings).

- Stage 1 works cannot support an expansion of the Chatswood ZS as no feeder bays will be available to provide 33kV supply to an additional transformer at this ZS site in the event all future customer loads are materialised.

Following commissioning of the first stage, Option 2 is expected to require $54,200/year in planned routine maintenance costs. The higher cost relative to Option 1 reflects the fact that, after this first stage, the deteriorating condition of the 33kV switchroom has not been addressed under Option 2. Routine maintenance is expected to increase annually at two per cent until the new switchroom is commissioned in 2042/43, after which Option 2 will require approximately $25,700/year in planned routine maintenance costs (i.e., the same as under Option 1).

A key uncertainty with Option 2 is the remaining life of the switchroom, and when it will ultimately need replacement. As noted in section 2.1, the most recent condition assessment of the 33kV switchroom recommends immediate building replacement in the event that works are undertaken on the assets housed within the switchroom. While the ten-year deferral of building replacement under Option 2 is inconsistent with this recommendation, it has nonetheless been modelled as a potential credible option to capture potential uncertainty around the remaining serviceable life of the existing building.

Ausgrid has further considered the impact of being able to achieve an additional extension to the serviceable life of the switchroom building, by way of a sensitivity. In particular, Ausgrid assumes that the switchroom can remain in service for a further five years beyond the 2042/43 replacement adopted under Option 2, i.e., that replacement is not needed until 2047/48. This sensitivity finds that even if the life of the existing switchroom did extend for this long (counter to the most recent condition assessment), the ability to defer its replacement does not change the conclusion of this DPAR (see section 5.4.3).

Overall, while Option 2 has been included as a credible option in this DPAR, it is considered an inferior option to Option 1 given it is more complex, higher cost, slower to deliver and more uncertain (regarding both cost and timing).

3.3 Social licence considerations

For the two credible options assessed in this RIT-D, the impact to the community will be minimal since the proposed works are to be undertaken within the existing substation site. Notwithstanding, the local community, Willoughby Council and surrounding neighbours have been, and will continue to be, notified of the project.

Given this is an industrial area and construction works will be contained within the existing substation site, community consultation has been focused on the neighbouring properties.

A summary of the stakeholder engagement outcomes to-date is as follows:

- The current tenant occupying the ex-Gore Hill depot did not raise concerns. Whilst they share a common driveway, access will be maintained for both Ausgrid's project and the tenant's activities throughout construction.
- Surrounding neighbours have not raised concerns besides from enquiring about parking impacts in adjacent roads or about the impacts of asbestos removal during any demolition work, for which Ausgrid will provide responses once the project progresses to the detailed design/development stage.
- Sydney Trains and Lane Cove Tunnel customers are impacted by having to upgrade protection relays to be suitable for use over fibre. This work is expected to take place between 2030 and 2032 and will increase future reliability, and Ausgrid will continue to engage with these customers as the project progresses to the detailed design/development stage.

Willoughby Council has not raised any issues from the notification. The Council did send a reminder that, although Ausgrid is exempt, it would like us to consider replanting three trees for every single tree removed. Consideration will be given to implementing this recommendation during the construction stage of the project.

Ausgrid will also implement a plan to donate tree trunks that will be removed to make space for the new building (common to both credible options) to the local Men's Shed to support mental health, so that they can be repurposed to make woodwork/craft/furniture.

Given there are no material social licence concerns, credible options are not expected to impose social licence costs in this case.

3.4 Options considered but not progressed

Ausgrid also considered several other options that have not been progressed because they were found to be technically or economically infeasible. The table below summarises Ausgrid's consideration and position on each of these options.

Table 3.6: Options considered but not progressed

Description	Reason why option was not progressed
Like-for-like switchgear replacement only	Only undertaking like-for-like switchgear replacement has been ruled out as it would not address the building condition issues or enable the additional load. This option is therefore not considered technically feasible.
Repairing, instead of replacing, the switchroom building under Option 2	Only some of the condition issues can be repaired and doing so would not extend the service life of the building. The building has fundamental conditions issues (e.g. concrete cancer) that mean that the entire building needs replacing. This option is therefore not considered technically feasible.
Commissioning a new greenfield STS	A greenfield STS was ruled out due to it requiring a longer delivery timeframe that would not accommodate data centre loads (and so is therefore considered not technically feasible). The construction of a new STS would also cost orders of magnitude more than the credible options assessed, without providing a commensurate increase in expected market benefits, and is also therefore considered to not be economically feasible under the RIT-D.
Using non-network solutions either in combination with, or in-place of, a network option.	Ausgrid has considered how non-network solutions (e.g., demand management) could potentially defer the timing of the preferred network solution and whether the EUE could be cost effectively reduced. An assessment of the potential for non-network options has shown that these alternatives would not be cost effective due to the magnitude of the load reduction required. This result is driven primarily by the significant amount of EUE that the identified network options allow to be avoided, compared to the base case, and the likely cost of non-network solutions. In addition, these solutions would not resolve the escalating safety risk costs and reactive maintenance costs associated with continued use of the switchgear. This is detailed further in the separate Options Screening Notice released in accordance with clause 5.17.4(d) of the NER.
Transferring and/or connecting customers to SAPS	Ausgrid has considered the feasibility of SAPS, informed by its trial of SAPS with selected customers living in fringe-of-grid areas of Ausgrid's network. Based on Ausgrid's trial, the cost of SAPS would limit the number of customers available to reduce demand given the deferral funds available and consequently, the reduction in demand would not be sufficient to defer or postpone the network solution. In addition, these solutions would not resolve the escalating reactive maintenance costs associated with continued use of the ageing switchgear. This is detailed further in the separate Options Screening Notice released in accordance with clause 5.17.4(d) of the NER.

3.5 Preferred option at this stage

Ausgrid considers that Option 1 is the preferred option that satisfies the RIT-D. It involves the construction of a new 33kV switchroom building, installation of new 33kV switchgear equipment and a fourth 132/33kV transformer, and retirement of existing buildings (i.e., existing 33kV switchrooms and control room).

This finding is found to be robust to a range of general sensitivity tests investigated (covering assumed network costs, VCR values and discount rates), as well as a specific sensitivity that assumes that the existing switchroom lasts five years longer than assumed under Option 2.

Moreover, Option 1 addresses the range of condition and compliance issues at the existing switchroom, i.e., those that Qubist recommended be addressed through immediate replacement. While the consequences of leaving these unaddressed under the base case have not been modelled as part of the DPAR, doing so would further support the identification of Option 1 as the preferred option for the RIT-D.

The specific scope of works for Option 1 includes:

- Early works to clear the area required for the new switchroom building;
- Construction of a new 33kV switchroom located within the existing Willoughby STS footprint;
- Installation of new 33kV indoor switchgear and associated controls and protection equipment;
- Installation of underground 33kV conduits and cables (to transfer connected loads to the new 33kV switchgear);
- Installation and commissioning of a new (fourth) 132/33kV transformer unit; and
- Decommissioning of redundant equipment and demolition of the existing 33kV switchroom (to slab level).[5]

The estimated capital cost of Option 1 is $70.3 million, which is comprised of:[6]

- $35.1 million for the new 33kv switchgear;
- $14.5 million for the new 33kV switchroom (which includes $1.7 million of early works costs);
- $10.9 million for the new 33kV conduits and cables;
- $5.3 million for the 4th 132/33kV 120 MVA transformer; and
- $4.3 million of decommissioning costs.

Also included in the scope and estimated capital costs are works at remote ends of 33kV feeders supplying Gore Hill and Chatswood zone substations, as well as Sydney Trains and Lane Cove Tunnel, to upgrade protection systems.

Once fully commissioned, Option 1 will require approximately $25,700/year in planned routine maintenance costs.

Overall, Option 1 is the lowest cost of the two credible options assessed in this DPAR and delivers the greatest net benefits. It is also the least complex option and the option we consider has the most accurately estimated costs and timeframe.

The works required to accommodate the new data centre loads under Option 1 (i.e., new building and new switchgear in new bays) will be completed by 2029/30, from which point the avoided EUE associated with those loads will begin to be realised. After this timing, the project works are focused on the transfer of the existing loads at the STS to the new switchgear and switchroom.

Ausgrid considers that the DPAR, and the accompanying detailed analysis, identify Option 1 as the preferred option and that this satisfies the RIT-D. Ausgrid is the proponent for Option 1.

Refer to the Draft Project Assessment Report for further details about the options assessment.

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[5] Removal of abandoned cables and services (e.g., sewer and water pipes) are excluded from the scope.

[6] Due to rounding, the sum of the individual component costs listed here adds to $70.1 million rather than the actual total estimated expenditure of $70.3 million.

4 Assessment of SAPS and non-network solutions

4.1 Required demand management characteristics

To be considered a feasible option, any demand management solution must be technically feasible, commercially feasible, and able to be implemented in sufficient time by 2029/30 for deferral of the network investment.

4.2 Available demand management funds

To identify the available funds for a possible demand management solution, Net Present Value (NPV) analysis was carried out where the net NPV for the network option is compared against the net NPV benefit of deferral scenarios of the preferred network option.

Table 4.1 shows the available funds for a deferral of the network investment for 1, 2 and 3 years.

Table 4.1 - Required demand reduction and available funds at Willoughby STS load area

Required peak demand reduction	Available demand management funds ($)		
	1 Yr deferral	2 Yr deferral	3 Yr deferral
25MVA*	$2.55m	$5.02m	$7.44m

*To be viable, DM solutions must materially reduce demand at times other than at peak due to the replacement driver. Note that the 25MVA of DM reduction does not change the optimal replacement timing of the project. This figure has been selected to reflect the available funds for a possible demand management solution for a large DM reduction. Even at this point, it is not possible for DM solutions to offer more cost-effective solutions.

Available funds have been calculated accordingly.

- For a 1-year deferral, a 25MVA demand reduction in 2029/30 results in total available demand management funds of $2.55m, which is equivalent to $102.2kVA/year,
- For 2-year deferral, a 25MVA demand reduction in 2029/30 and 2030/31 results in total available demand management funds of $5.02m, which is equivalent to $100.4/kVA/year, and
- For 3-year deferral, a 25MVA of demand reduction in 2029/30, 2030/31, and 2031/32 results in total available demand management funds of $7.44m, which is equivalent to $99.2/kVA/year.

4.3 Options considered

Ausgrid has considered Stand Alone Power Systems (SAPS) and other demand management solutions to determine their commercial and technical feasibility to assist with the identified need for Willoughby STS load area. Each of the solutions considered is summarised below.

4.3.1 Stand Alone Power Systems (SAPS)

SAPS self-generate, store and supply electricity to connected customers that are physically disconnected to the wider electricity grid. Typical SAPS are made up of solar panels, a battery storage system and a back-up diesel generator.

Ausgrid is currently trialing SAPS with selected customers living in fringe-of-grid areas of Ausgrid's network[7]. The program aims to explore how SAPS can provide an alternative electricity supply solution that improves reliability and safety of our service to remote and rural customers, as well as being sustainable and cost-effective.

[7] https://www.ausgrid.com.au/In-your-community/Stand-Alone-Power-Systems

Ausgrid’s experience with proposals from SAPS providers during the trial has provided insights on the cost of SAPS. On average it would cost $50k-100k or more to supply a typical residential customer (based on their annual energy usage) using a SAPS. Assuming a mid-point SAPS cost of $75k each, the amount of load that Ausgrid would be able to supply via SAPS using all the available funds would be about one residential customer. This is not sufficient to reduce, defer or postpone the proposed preferred network solution.

4.3.2 Other demand management options

There is no demand management solution mix that could meet the required demand reductions with the funds that are available. The costs of all demand management solutions considered exceed the $/kVA available for this project.

5 Conclusion

Based on the demand management options considered in Section 4, it is not considered possible that sufficient demand management measures could be feasibly implemented to achieve the required demand reduction to make project deferral technically and economically viable. Consequently, an Options Screening Report has not been prepared in accordance with rule 5.17.4(c) of the National Electricity Rules.