CHAPTER 5

Future network development

5 Future network development

Key highlights

- Powerlink continues to adapt and respond to shifts in its operating environment by adapting its approach to investment decisions to deliver better outcomes for customers. In particular:
  - assessing whether an enduring need exists for key assets and investigating alternate network configuration opportunities and/or non-network solutions, where feasible, to manage asset risks
  - implementing cost effective solutions, such as transmission line refits, that avoid or delay the need to establish new transmission network infrastructure.
- The changing generation mix may lead to increased constraints across critical grid sections. Powerlink will consider these potential constraints holistically with the emerging condition based drivers as part of the planning process.
- Powerlink and TransGrid have responded to the recommendations of the 2018 Integrated System Plan (ISP) and commenced a Regulatory Investment Test for Transmission (RIT-T) to assess the market benefits of expanding the New South Wales (NSW)-Queensland transmission transfer capacity to support more efficient generation sharing between NSW and Queensland and improve the overall reliability of the transmission system.
- Since the publication of the 2018 Transmission Annual Planning Report (TAPR), Powerlink has progressed through a RIT-T program targeting key areas of the transmission network in Queensland requiring capital expenditure.

5.1 Introduction

Powerlink Queensland as a Transmission Network Service Provider (TNSP) in the National Electricity Market (NEM) and as the appointed Jurisdictional Planning Body (JPB) by the Queensland Government is responsible for transmission network planning for the national grid within Queensland. Powerlink's obligation is to plan the transmission system to reliably and economically supply load while managing risks associated with the condition and performance of existing assets in accordance with the requirements of the National Electricity Rules (NER), Queensland's Electricity Act 1994 (the Act) and its Transmission Authority.

The NER (Clause 5.12.2(c)(3)) requires the TAPR to provide 'a forecast of constraints and inability to meet the network performance requirements set out in schedule 5.1 or relevant legislation or regulations of a participating jurisdiction over one, three and five years'. In addition, there is a requirement (Clause 5.12.2(c)(4)) of the NER to provide estimated load reductions that would defer forecast limitations for a period of 12 months and to state any intent to issue request for proposals for augmentation, replacement of network assets or non-network alternatives. The NER (Clause 5.12.2(c)) also requires the TAPR to be consistent with the TAPR Guidelines and include information pertinent to all proposed:

- augmentations to the network (Clause 5.12.2(c)(5))
- replacements of network assets (Clause 5.12.2(c)(5))
- network asset retirements or asset de-ratings that would result in a network constraint in the 10-year outlook period (Clauses 5.12.2(c)(1) and (1A)).

This chapter on proposed future network developments contains:

- discussion on Powerlink's integrated planning approach to network development
- information regarding assets reaching the end of their service life and options to address the risks arising from ageing assets remaining in-service, including asset replacement, non-network solutions, potential network reconfigurations, asset retirements or de-ratings
- identification of emerging future limitations[1] with potential to affect supply reliability including estimated load reductions required to defer these forecast limitations by 12 months (Clause 5.12.2(c)(4)(iii))

[1] Identification of forecast limitations in this chapter does not mean that there is an imminent supply reliability risk. The NER requires identification of limitations which are expected to occur some years into the future, assuming that demand for electricity grows as forecast in this TAPR. Powerlink regularly reviews the need and timing of its projects, primarily based on forecast electricity demand, to ensure solutions are not delivered too early or too late to meet the required network reliability.

- a statement of intent to issue request for proposals for augmentation, the proposed replacement of ageing network assets or non-network alternatives identified as part of the annual planning review (Clause 5.12.2(c)(4)(iv))
- a summary of network limitations over the next five years and their relationship to the Australian Energy Market Operator (AEMO) 2018 National Transmission Network Development Plan (NTNDP)
- details in relation to the need to address the risks arising from ageing network assets remaining in-service and those limitations for which Powerlink intends to address or initiate consultation with market participants and interested parties and
- a table summarising possible connection point proposals.

Where appropriate all transmission network, distribution network or non-network (either demand management or local generation) alternatives are considered as options for investment or reinvestment. Submissions for non-network alternatives are invited by contacting networkassessments@powerlink.com.au.

5.2 NTNDP alignment

In June 2018, the AEMO published the first ISP, which met the requirements of the NTNDP and provided an independent, strategic view of the efficient development of the NEM transmission network over a 20-year planning horizon. The 2018 NTNDP published in December 2018 builds on the ISP, assesses the short-term system adequacy of the national transmission grid over the next five years and reports on the implementation of the ISP.

Powerlink will proactively monitor the changing outlook for the Queensland region and take into consideration the impact of emerging technologies, withdrawal of gas and coal-fired generation and the integration of variable renewable energy (VRE) generation in future transmission plans. These plans may include:

- reinvesting in assets to extend their end of technical service life
- removing some assets without replacement
- determining optimal sections of the network for new connection (in particular renewable generation) as discussed in detail in Chapter 8
- replacing existing assets with assets of a different type, configuration or capacity
- investing in assets to maintain planning standards, including Powerlink's obligations for system strength
- non-network solutions.

5.3 Integrated approach to network development

Powerlink's planning for future network development will continue to focus on optimising the network topography based on the analysis of future network needs due to:

- forecast demand
- new customer access requirements (including possible Renewable Energy Zones (REZ))
- potential power system development pathways signalled in the ISP
- existing network configuration
- safety, condition and compliance based risks related to existing assets.

This planning process includes consideration of a broad range of options to address identified needs described in Table 5.1. Irrespective of the option or range of options used to address an identified need, where Powerlink identifies that there is a credible option greater than $6 million, Powerlink is required to undertake a RIT-T. The RIT-T demonstrates the need, the credible options identified and provides the requirements for non-network alternatives.

Table 5.1 Examples of planning options

Option	Description
Augmentation	Increases the capacity of the existing transmission network, e.g. the establishment of a new substation, installation of additional plant at existing substations or construction of new transmission lines. This is driven by the need to meet prevailing network limitations and customer supply requirements and in some cases to ensure system strength is maintained.
Reinvestment	Asset reinvestment planning ensures that existing network assets are assessed for their enduring network requirements in a manner that is economic, safe and reliable. This may result in like-for-like replacement, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity. Condition and risk assessment of individual components may also result in the staged replacement of an asset where it is technically and economically feasible.
Network reconfiguration	The assessment of future network requirements may identify the reconfiguration of existing assets as the most economical option. This may involve asset retirement coupled with the installation of plant or equipment at an alternative location that offers a lower cost substitute for the required network functionality.
Asset de-rating or retirement	May include strategies to de-rate, decommission and/or demolish an asset and is considered in cases where needs have diminished in order to achieve long-term economic benefits.
Line refit	Powerlink utilises a line reinvestment strategy called line refit to extend the service life of a transmission line and provide cost benefits through the deferral of future transmission line rebuilds. Line refit may include structural repairs, foundation works, replacement of line components and hardware and the abrasive blasting of tower steelwork followed by painting.
Non-network alternatives	Non-network solutions are not limited to, but may include network support from existing and/or new generation or demand side management (DSM) initiatives (either from individual providers or aggregators) which may reduce, negate or defer the need for network investment solutions.
Operational measures	Network constraints may be managed during specific periods using short-term operational measures, e.g. switching of transmission lines or redispatch of generation in order to defer or negate network investment.

5.4 Forecast capital expenditure

The energy industry is going through a period of transformation driven by shifts in economic outlook, electricity customer behaviour, government policy and regulation and emerging technologies that have reshaped the environment in which Powerlink delivers its transmission services.

In this changed environment, Powerlink is focussing on assessing the enduring need for key ageing assets that are approaching the end of their service life. Powerlink is also seeking alternative investment options through network reconfiguration to manage asset condition and/or non-network solutions where economic and technically feasible. As a result, Powerlink's ongoing capital expenditure program of work is considerably less than undertaken in previous regulatory periods.

Powerlink has a focussed and strategic approach in determining when it is appropriate to refit or replace ageing transmission assets and how to implement these works cost effectively, such as targeted asset replacement or staged works that avoid or delay the need to establish new transmission network infrastructure. This approach is aimed at delivering better value to customers.

The 10-year outlook period discussed in the 2019 TAPR runs from 2019/20 to 2029/30.

5.5 Forecast network limitations

As outlined in Section 1.7.1, under its Transmission Authority, Powerlink must plan and develop its network so that it can supply the forecast maximum demand with the system intact. The planning standard, which came into effect from July 2014, permits Powerlink to plan and develop the network on the basis that some load may be interrupted during a single network contingency event. Forward planning allows Powerlink adequate time to identify emerging limitations and to implement appropriate network and/or non-network solutions to maintain transmission services which meet the planning standard.

Emerging limitations may be triggered by thermal plant ratings (including fault current ratings), protection relay load limits, voltage stability and/or transient stability. Appendix E lists the indicative maximum short circuit currents and fault rating of the lowest rated plant at each Powerlink substation and voltage level, accounting for committed projects listed in Chapter 9 and existing and committed generation listed in Chapter 6.

Assuming that the demand for electricity remains relatively flat in the next five years and taking into consideration the new peak demand discussed in Chapter 2, Powerlink does not anticipate undertaking any significant augmentation works during this period based on load growth. However, the changing generation mix may lead to increased constraints across critical grid sections. Powerlink will consider these potential constraints holistically with the emerging condition based drivers as part of the planning process.

In Powerlink's Revenue Determination 2017-2022, projects that could be triggered by the commitment of large mining or industrial block loads were identified as contingent projects (refer to Table 5.2). These contingent projects and their triggers are discussed in detail in sections 7.2 and 7.3.

Table 5.2: Potential contingent projects

Potential project	Indicative cost
Northern Bowen Basin area	$56m
Bowen Industrial Estate	$43m
Central to North Queensland reinforcement	$55m
Central West to Gladstone area reinforcement	$105m
QNI upgrade (Queensland component)	$67m
Queensland to South Australia interconnection (Queensland component)	$120m

In accordance with the NER, Powerlink undertakes consultations with AEMO, Registered Participants and interested parties on feasible solutions to address forecast network limitations through the RIT-T process. Solutions may include provision of network support from existing and/or new generators, advancement in technologies, DSM initiatives (either from individual providers or aggregators) and network augmentations.

5.5.1 Summary of forecast network limitations within the next five years

Powerlink has identified that due to declining minimum demand and increasing penetration of VRE generation, particularly in NQ, there is an emerging need for additional reactive plant in central Queensland to manage potential overvoltages:

Project	Indicative Timing	Reference
Managing voltages in central and north Queensland	2021	Section 5.7.4

Based on the medium economic load forecast in Chapter 2 there are no additional network limitations forecast to occur in Queensland in the next five years[2].

[2] Refer to NER Clause 5.12.2(3).

5.5.2 Summary of forecast network limitations beyond five years

The timing of forecast network limitations may be influenced by a number of factors such as load growth, industrial developments, new and retiring generation, the planning standard and joint planning with other Network Service Providers (NSP). As a result, it is possible for the timing of forecast network limitations identified in a previous year's TAPR to shift beyond the previously identified timing. However, there were no forecast network limitations identified in Powerlink's transmission network in the 2018 TAPR which fall into this category in 2019.

5.6 Consultations

Network development to meet forecast demand is dependent on the location and capacity of generation developments and the pattern of generation dispatch in the competitive electricity market. Uncertainty about the generation pattern creates uncertainty about the power flows on the network and subsequently, which parts of the network will experience limitations. This uncertainty is a feature of the competitive electricity market and historically has been particularly evident in the Queensland region. Notwithstanding the discussion in sections 5.7.6 and 7.2, Powerlink has not anticipated any material changes to network power flows which may require any major augmentation driven network development. This is due to a combination of several factors including a relatively flat energy and demand forecast in the 10-year outlook period and Powerlink's planning criteria (refer to chapters 1 and 2).

Proposals for transmission investments and reinvestments over $6 million are progressed under the provisions of Clause 5.16.4 of the NER. In accordance with these provisions, and where action is considered necessary, Powerlink will:

- notify of anticipated limitations or risks arising from ageing network assets remaining in-service within the timeframe required for action
- seek input, initially via the TAPR, on potential solutions to network limitations which may result in transmission network or non-network investments in the 10-year outlook period
- issue detailed information outlining emerging network limitations or the risks arising from ageing network assets remaining in-service to assist non-network solutions as possible genuine alternatives to network investments to be identified
- consult with AEMO, Registered Participants and interested parties on credible options (network or non-network) to address emerging limitations or the risks arising from ageing network assets remaining in-service
- carry out detailed analysis on credible options that Powerlink may propose to address identified network limitations or the risks arising from ageing network assets remaining in-service
- consult with AEMO, Registered Participants and interested parties on all credible options (network and non-network) and the preferred option
- implement the preferred option in the event an investment (network and/or non-network) is found to satisfy the RIT-T

Alternatively, transmission investments maybe undertaken under the 'funded augmentation' provisions of the NER.

It should be noted that the information provided regarding Powerlink's network development plans may change and should be confirmed with Powerlink before any action is taken based on the information contained in this TAPR or the accompanying TAPR templates[3].

5.6.1 Current consultations – proposed transmission investments

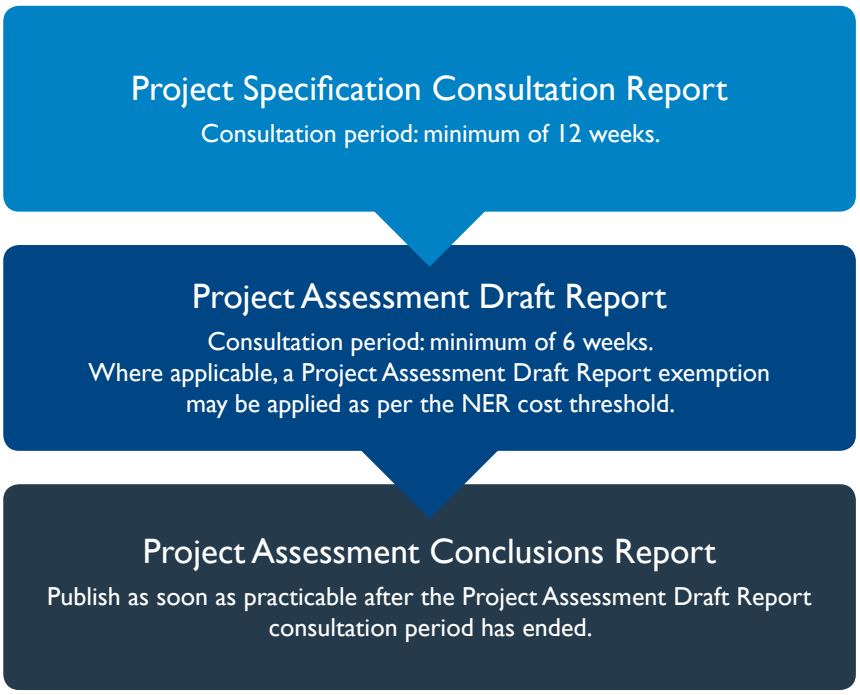
Commencing August 2010 proposals for transmission investments over $6 million addressing network limitations (augmentation works) are progressed under the provisions of Clause 5.16.4 of the NER. In September 2017 this NER requirement, i.e. to undertake a RIT-T, was extended[4] to include the proposed replacement of network assets.

[3] In accordance with the AER's Transmission Annual Planning Report Guidelines published in December 2018.
[4] Replacement expenditure planning arrangements Rule 2017 No. 5.

During 2018/19, Powerlink has made considerable progress through a significant RIT-T program to address the risks arising from ageing network assets remaining in-service, finalising 13 RIT-Ts since the publication of the 2018 TAPR.

This initial 'heavier' program was due to the inclusion of public consultation into the planning timetable for proposed reinvestments in the nearer term (refer to Figure 5.1) which is now expected to moderate in coming years.

Figure 5.1 Overview of the RIT-T consultation process



Powerlink carries out separate consultation processes for each proposed new transmission investment or reinvestment over $6 million by utilising the RIT-T consultation process.

The consultations completed since publication of the 2018 TAPR are listed in Table 5.3 (refer to Chapter 9).

Table 5.3: Consultations completed since publication of the 2018 TAPR

Consultation
Addressing the secondary systems condition risks at Woree Substation
Maintaining reliability of supply to Ingham
Addressing the secondary systems condition risks at Dan Gleeson Substation
Maintaining reliability of supply at Townsville South Substation
Maintaining power transfer capability and reliability of supply at Ross Substation
Maintaining reliability of supply to the Rockhampton area
Maintaining power transfer capability and reliability of supply at Bouldercombe Substation
Addressing the secondary systems condition risks at Baralaba Substation
Addressing the secondary systems condition risks at Palmwoods Substation
Addressing the secondary systems condition risks at Tarong Substation
Addressing the secondary systems condition risks at Abermain Substation
Maintaining reliability of supply to the Brisbane metropolitan area
Addressing the secondary systems condition risks at Belmont Substation

The consultations currently under way are listed in Table 5.4.

Table 5.4: Consultations currently under way

Consultation	Reference
Maintaining reliability of supply at Kamerunga Substation	Section 5.7.1
Maintaining reliability of supply between Clare South and Townsville South	Section 5.7.2
Maintaining reliability of supply in the Blackwater area	Section 5.7.4
Maintaining power transfer capability and reliability of supply at Lilyvale	Section 5.7.4
Expanding Transmission Transfer Capacity Between New South Wales and Queensland	Section 5.7.14

Registered Participants and interested parties are referred to the consultation documents which are published and made available on Powerlink's website for further information.

5.6.2 Future consultations – proposed transmission investments

Anticipated consultations

Reinvestment in the transmission network to manage the risks arising from ageing assets remaining in-service will form the majority of Powerlink's capital expenditure program of work moving forward. These emerging risks over the 10-year outlook period are discussed in Section 5.7.

Table 5.5 summarises consultations Powerlink anticipates undertaking within the next 12 months under the Australian Energy Regulator's (AER) RIT-T to address either the proposed reinvestment in a network asset or limitation.

Table 5.5: Anticipated consultations in the forthcoming 12 months (to June 2020)

Consultation	Reference
Addressing the secondary systems condition risks at Cairns	Section 5.7.1
Maintaining reliability of supply in the Cairns area	Section 5.7.1
Addressing the secondary systems condition risks at Innisfail	Section 5.7.1
Addressing the secondary systems condition risks at Kemmis	Section 5.7.3
Maintaining reliability of supply to Gladstone South	Section 5.7.5
Addressing the secondary systems condition risks at Gladstone South	Section 5.7.5
Addressing the secondary systems condition risks at Murarrie	Section 5.7.10
Addressing the secondary systems condition risks at Mudgeeraba	Section 5.7.11

5.6.3 Connection point proposals

Table 5.6 lists possible connection works that may be required within the 10-year outlook period.

Planning of new or augmented connections involves consultation between Powerlink and the connecting party, determination of technical requirements and completion of connection agreements. New connections can result from joint planning with the relevant Distribution Network Service Provider (DNSP)[5] or be initiated by generators or customers. There are no new transmission connection works to supply loads resulting from agreements reached with relevant connected customers, generators or DNSPs since publication of the 2018 TAPR (refer to Chapter 9). Additional details on potential new generation connections are available in the relevant TAPR template located on Powerlink's website as noted in Appendix B.

Table 5.6 Connection point proposals

Generator Location (1)	Number of Applications	Generator Type and Technology
North	5	Solar, Pumped Hydro & Solar
Central	22	Solar, Wind, Gas
South	16	Solar, Wind, Combined (Solar & Wind)
Total	**43**	

Note:

(1) When Powerlink constructs a new line or substation as a non-regulated customer connection (e.g. generator, renewable generator, mine or industrial development), the costs of acquiring easements, constructing and operating the transmission line and/or substation are paid for by the company making the connection request.

[5] In Queensland, Energex and Ergon Energy (part of the Energy Queensland Group) are the DNSPs.

5.7 Proposed network developments

As the Queensland transmission network experienced considerable growth in the period from 1960 to 1980, there are now many transmission assets between 40 and 60 years old. It has been identified that a number of these assets are approaching the end of their technical service life and reinvestment in some form is required within the 10-year outlook period in order to manage emerging risks related to safety, reliability and other factors. Moving forward, Powerlink's capital expenditure program of work focusses on reinvestment in the transmission network to manage the identified risks arising from the condition of these ageing assets[6].

In conjunction with condition assessments and risk identification, as assets approach their anticipated end of technical service life, possible reinvestment options undergo detailed planning studies to confirm alignment with future reinvestment, optimisation and delivery strategies. These studies have the potential to provide Powerlink with an opportunity to:

- improve and further refine options under consideration
- consider other options from those originally identified which may deliver a greater benefit to customers.

Information regarding possible reinvestment alternatives and anticipated timing is updated annually within the TAPR and includes discussion on significant changes which have occurred since publication of the previous year's TAPR together with the latest information available at the time.

Where applicable, in relation to proposed expenditure for the replacement of network assets or network augmentations, Powerlink will consult with AEMO, Registered Participants and interested parties on feasible solutions identified through the RIT-T. The latest information on RIT-T publications can be found on Powerlink's website.

Proposed network developments discussed within this chapter identify the most likely network solution, although as mentioned this has the potential to change with ongoing detailed analysis of asset condition and risks, network requirements or as a result of RIT-T consultations.

Other than the 'Expanding NSW-Queensland transmission transfer capacity' RIT-T as identified in the 2018 ISP, based on the current information available, Powerlink considers all of the possible network developments discussed in this chapter are outside of the scope of the most recent NTNDP and Power System Frequency Risk Review[7].

Powerlink also reviews the rating of assets throughout the transmission network periodically and has not identified the need to permanently de-rate assets as part of the 2019 annual planning review[8].

For clarity, an analysis of this program of work has been performed across Powerlink's standard geographic zones (refer to sections 5.7.1 to 5.7.11) and separated into two periods.

Possible network reinvestments within five years

This includes the financial period from 2019/20 to 2024/25 for possible near term reinvestments when:

- confirmation of the enduring network need and timing occurs
- detailed planning studies are under way or have recently been finalised.

The results of detailed planning analysis and condition assessment are used in the development and consideration of network and non-network options to meet future reinvestment needs and to inform RIT-T consultations.

6 Generally these risks fall into four categories – safety, network, environmental and financial. Refer to Powerlink's website for more information.
7 NER Clauses 5.12.2(6) and (6A).
8 NER Clause 5.12.2(c)(1A).

Possible network reinvestments within six to 10 years

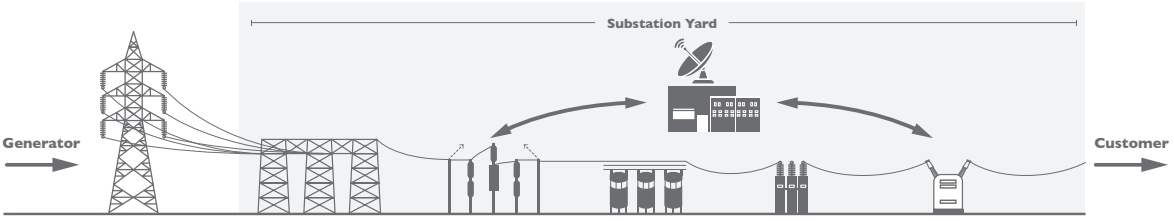
This includes the financial period from 2025/26 to 2029/30, for possible medium to long-term reinvestments. Powerlink takes a balanced, prudent and proportionate approach to the consideration of reinvestment needs to address the risks arising from network assets in the medium to long-term and undertakes detailed planning analysis and condition assessment closer to the possible reinvestment date, typically within five years.

In addition, due to the current dynamic operating environment, there is less certainty regarding the needs or drivers for reinvestments in these later years of the annual planning review period. As a result, considerations in this period have a greater potential to change when compared to near term investments. Possible reinvestment considerations within six to 10 years will need to be flexible in order to adapt to externally driven changes as the NEM evolves and customer behaviours change. Any significant adjustments which may occur as a result of changes will be updated and discussed in subsequent TAPRs.

Powerlink also takes a value-driven approach to the management of asset risks to ensure an appropriate balance between reliability and the cost of transmission services which ultimately benefits consumers. Each year, taking the most recent assessment of asset condition and risk into consideration, Powerlink reviews possible commissioning dates and where safe, technically feasible and prudent, capital expenditure is delayed. As a result, there may be timing variances between the possible commissioning dates identified in the 2018 TAPR and 2019 TAPR. Significant timing differences are noted in the analysis of the program of work within this chapter (refer to sections 5.7.1 to 5.7.11).

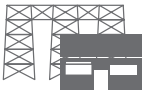
The functions performed by the major transmission network assets discussed in this chapter and which form the majority of Powerlink's capital expenditure in the 10-year outlook period are illustrated in Figure 5.2.

Figure 5.2 The functions of major transmission assets



Transmission line

A transmission line consists of tower structures, high voltage conductors and insulators and transports bulk electricity via substations to distribution points that operate at lower voltages.



Substation

A substation, which is made up of primary plant, secondary systems, telecommunications equipment and buildings, connects two or more transmission lines to the transmission network and usually includes at least one transformer at the site.

A substation that connects to transmission lines, but does not include a transformer, is known as a switching station.

- **Substation bay**
  A substation bay connects and disconnects network assets during faults and also allows maintenance and repairs to occur. A typical substation bay is made up of a circuit breaker (opened to disconnect a network element), isolators and earth switches (to ensure that maintenance and repairs can be carried out safely), and equipment to monitor and control the bay components.

- **Static VAR Compensator (SVC)**
  A SVC is used where needed, to smooth voltage fluctuations, which may occur from time-to-time on the transmission network. This enables more power to be transferred on the transmission network and also assists in the control of voltage.

- **Capacitor Bank**
  A capacitor bank maintains voltage levels by improving the 'power factor'. This enables more power to be transferred on the transmission network.

- **Transformer**
  A transformer is used to change the voltage of the electricity flowing on the network. At the generation connection point, the voltage is 'stepped up' to transport higher levels of electricity at a higher voltage, usually 132kV or 275kV, along the transmission network. Typically at a distribution point, the voltage is 'stepped down' to allow the transfer of electricity to the distribution system, which operates at a lower voltage than the transmission network.

Secondary systems

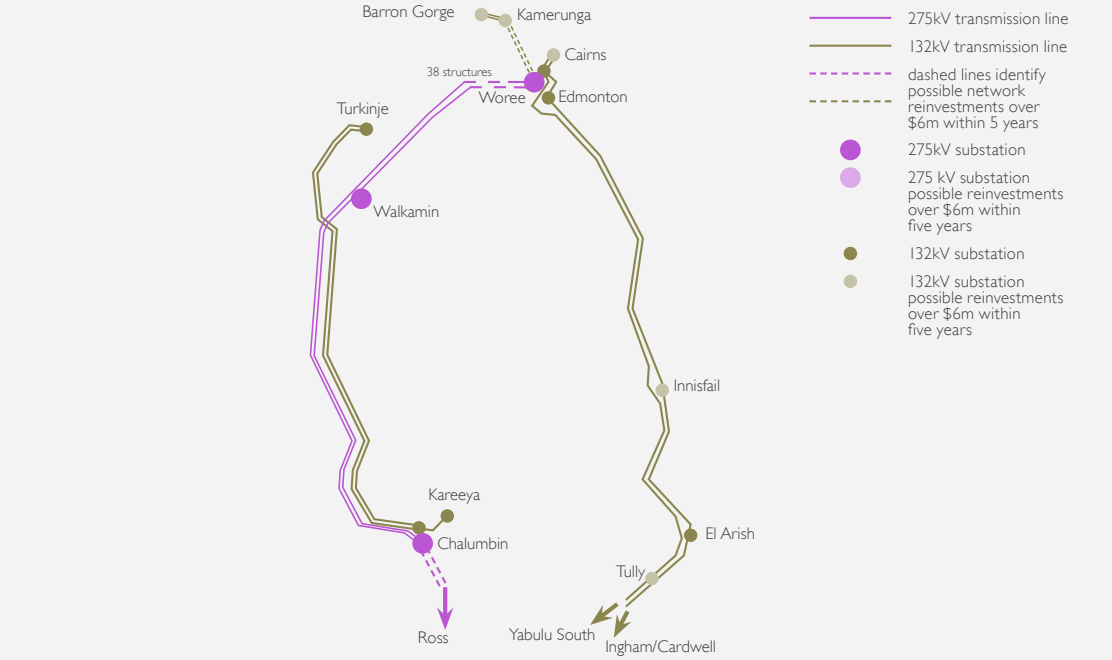
Secondary systems equipment assists in the control, protection and safe operation of transmission assets that transfer electricity in the transmission network.

Telecommunication systems

Telecommunication systems are used to transfer a variety of data about the operation and security of the transmission network including metering data for AEMO.

5.7.1 Far North zone

Figure 5.3 Far North zone transmission network



Existing network

The Far North zone is supplied by a 275kV transmission network with major injection points at the Chalumbin and Woree substations into the 132kV transmission network. This 132kV network supplies the Ergon Energy distribution network in the surrounding areas of Tully, Innisfail, Turkinje and Cairns, and connects the hydro power stations at Barron Gorge and Kareeya (refer to Figure 5.3).

Possible load driven limitations

Based on the medium economic load forecast defined in Chapter 2, there is no additional capacity forecast to be required as a result of network limitations in the Far North zone within the next five years to meet reliability obligations.

Possible network reinvestments within five years

Network reinvestments in Far North zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can deliver a safe, cost effective and reliable supply of electricity to meet the load requirements of customers in the Far North zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission lines

Woree to Kamerunga 132kV transmission lines

Potential consultation: Maintaining reliability of supply to Cairns northern beaches area

The Woree to Kamerunga 132kV double circuit transmission lines were constructed in 1963. Originally connected to Cairns, it provides critical supply to the Cairns northern beaches region, as well as connecting the Barron Gorge Hydro Power Station to the backbone 275kV network.

Project driver

Emerging conditions risks due to structural corrosion.

In 2014 life extension works were performed on certain components of this transmission line that were nearing the end of their operational life. However, it is anticipated that reinvestment will be required by 2024. The location of the existing structures poses access and construction work challenges. Possible end of technical service life strategies for this transmission line may include replacement on a new easement. Investigations for easement alternatives are currently underway.

Project timing: June 2024

Possible network solutions

- Maintaining the existing 132kV network topography through a new double circuit transmission line from Woree and Kamerunga substations by June 2024.
- Network reconfiguration by establishing two single circuit 132kV transmission lines between Woree to Kamerunga substations, or via Cairns North substation, by June 2024.

Proposed network solution: Maintaining 132kV network topology through a new double circuit transmission line on a new easement from Woree to Kamerunga substations at an estimated cost of $30 million[9], by June 2024

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 22kV network of up to a peak 60MW, and up to a peak 900MWh per day on a continuous basis. It should be noted that this transmission line also facilitates generation connection in the area.

Ross to Chalumbin to Woree 275kV transmission lines

Anticipated consultation: Maintaining reliability of supply in the Cairns region

The majority of electricity used in the Cairns region is transported from central and north Queensland on Powerlink's 275kV system to Ross, near Townsville. From Ross it is transferred via a double circuit 275kV transmission line to Chalumbin, then via a double circuit transmission line, between Chalumbin and the Woree Substation on the outskirts of Cairns. These 275kV transmission lines also provide supply to Turkinje, and connection to the Mt Emerald Wind Farm and Kareeya Hydro Power Station. Additional connections are made through the parallel 132kV transmission network that provides supply to the coastal communities between Townsville and Cairns.

The double circuit 275kV transmission line between Ross and Chalumbin substations is 244km in length and comprises of 528 steel lattice towers. The line was commissioned in 1989 and traverses the rugged terrain of the North Queensland tropical rain forest, passing through environmentally sensitive, protected areas and crossing numerous regional roads and rivers. Recent inspections have indicated these transmission lines display extensive corrosion and a major refit will be required at end of technical service life around 2026.

The Chalumbin to Woree section of line was built in 1998 and is approximately 140km in length. While the condition of a large majority of the line is consistent with its age, this is not the case for the final 16km into Cairns. This final section contains 32 towers that traverse the environmentally sensitive World Heritage Wet Tropics area and terminates near Trinity Inlet Marine Park. These towers have been designed to allow over spanning to minimise corridor clearing. However the extended height has increased exposure to coastal winds. It is subject to a comprehensive maintenance program. Recent inspections have indicated that it displays extensive corrosion to the extent that major member and bolt replacement needs to be undertaken in the near term on five towers, followed by an extensive refit including painting on all 32 towers by 2022.

Due to the environmentally sensitive and geographic conditions in this region, and to ensure reliability of supply to customers, the required renewal works will be complex and need to be completed in stages outside of summer peak load and wet seasons. As a result it has been identified that an extended delivery timeframe of at least six years will be required with consultation anticipated to commence within the next 12 months.

[9] This excludes easement costs yet to be determined.

Project driver

Emerging conditions risks due to structural corrosion.

Project timing: staged to December 2026

Taking into account the most recent information received, subsequent analysis and understanding of the risks arising from

- the condition and network connectivity of both of the 275kV transmission lines
- ongoing network supply needs in the Far North and Ross zones
- the complexity of undertaking works in environmentally sensitive areas and
- the associated delivery of any potential network solutions in the required timeframe including consideration of the impact of outages

There is an opportunity for Powerlink to consider an integrated approach to optimise any potential reinvestment required, delivering better outcomes for customers. Given the size of the proposed investment and the associated technical requirements, undertaking an integrated, staged approach may also increase the potential to utilise non-network solutions.

Possible network solutions

Maintaining the existing 275kV network topography and capacity through staged line refits or selective rebuild on:

- Chalumbin to Woree 275kV transmission line by 2022, and Ross to Chalumbin 275kV transmission line to achieve 20 to 25 year life extension by 2026
- Chalumbin to Woree 275kV transmission lines to achieve 20 to 25 year life extension by 2022, and line refit on Ross to Chalumbin to achieve seven to 10-year life extension followed by 275kV line rebuild on Ross to Chalumbin by 2026
- potential network reconfiguration through a combination of staged line refits or replacement of the existing 275kV transmission lines as per options above, and uprating one circuit of the 132kV coastal transmission line to 275kV by 2026.

Proposed network solution: Maintaining 275kV network topology through staged line refit projects of the Chalumbin to Woree 275kV transmission line at an estimated cost of $10 to $15 million by October 2023, and the Ross to Chalumbin 275kV transmission line at an estimated cost of $85 to $165 million by 2026.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

The Ross to Chalumbin transmission lines provide injection to the Far North area of over 300MW at peak.

The Chalumbin to Woree transmission lines provide injection to the Cairns area of over 250MW at peak. Voltage stability governs the maximum supportable power transfer that can be injected into the Cairns area.

It should be noted that the network configuration facilitates the provision of voltage control and system strength from local synchronous generation. This would need to be taken into consideration for all non-network solutions.

Substations

Kamerunga 132/22kV Substation

Current consultation: Maintaining reliability of supply at Kamerunga Substation

Kamerunga Substation was established in 1976 to supply the rapidly growing area north of Cairns. Kamerunga Substation is located in western Cairns and provides bulk electricity supply to Ergon Energy's distribution network in the northern Cairns region which includes Kamerunga, Smithfield and the northern beach areas, and also provides connection to the Barron Gorge Power Station, which was upgraded by Stanwell Corporation in 2011. The area surrounding the substation is residential and located along the flood plain of the Barron River.

Project driver

Addressing emerging condition, obsolescence and compliance risks on selected primary plant and all secondary systems and risks related to a potential future flood event.

Project timing: October 2022

Possible network solutions

- Replacement of selected primary equipment and full replacement of 132kV secondary systems by June 2021, followed by the remainder of the primary plant by 2028.
- Replacement of primary plant and secondary systems upfront with Air Insulated Switchgear (AIS) technology by October 2022.
- Replacement of primary plant including additional switching functionality and secondary systems upfront with Gas Insulated Switchgear (GIS) technology by October 2022
- Replacement of primary plant including additional switching functionality and secondary systems upfront with AIS technology by October 2022.

In accordance with the requirements of the RIT-T, Powerlink published a Project Assessment Draft Report (PADR) in April 2019 which identified upfront replacement with AIS technology by October 2022 as the proposed preferred option.

Submissions to the PADR close in June 2019 and Powerlink anticipates publication of the Project Assessment Conclusions Report (PACR) in July 2019.

Proposed network solution: Upfront replacement of all 132kV primary plant and secondary systems with AIS technology at an estimated cost of $24 million by October 2022

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 22kV network of up to a peak 60MW, and up to a peak 900MWh per day on a continuous basis. This would allow for the decommissioning of Kamerunga Substation and bridging of the Woree to Kamerunga transmission lines to the Kamerunga to Barron Gorge transmission line.

Cairns 132kV Substation

Anticipated consultation: Addressing the secondary systems condition risks at Cairns Substation

Cairns Substation was established in the mid to late 1950s and was the principal connection point for all 132kV circuits in the Cairns area. In 2002 Woree Substation was established and included switching capability which allowed the Cairns Substation to be rebuilt with a reduced configuration.

One of the three 132/22kV transformers at Cairns Substation is approaching end of technical service life due to increasing risks arising from failure. Based on the medium economic load forecast in Chapter 2, this transformer is no longer required to maintain reliability of supply, and is being considered for retirement including the associated secondary systems.

Project driver:

Condition driven replacement to address emerging obsolescence and compliance risks on the 132kV secondary systems.

Project timing: December 2022

Possible network solutions:

- Staged replacement of the majority of secondary systems components by December 2022.
- Complete replacement of all secondary systems and associated panels by December 2022.

Proposed network solution: Complete replacement of 132kV secondary systems at Cairns Substation in the existing or prefabricated building at an estimated cost of $6 million by December 2022

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

To maintain the required reliability standards the non-network solution would need to inject at Cairns up to 65MW and up to 1000MWh per day based on steady demand in the future. Non-network solutions may include, but are not limited to, local generation or DSM initiatives.

Innisfail 132kV Substation

Anticipated consultation: Addressing the secondary systems condition risks at Innisfail Substation

Innisfail Substation is a 132/22kV bulk supply point for Ergon Energy in Far North Queensland (FNQ). The 132kV assets were built as part of the Kareeya Power Station hydro-electricity project during the late 1950s, which established the 132kV transmission system to provide electricity to expanding coastal communities in the region. Innisfail Substation was rebuilt in 2003 and the secondary systems installed as part of this rebuild are anticipated to reach end of technical service life around 2023.

Project driver:

Condition driven replacement to address emerging obsolescence and compliance risks on 32kV secondary systems.

Project timing: December 2023

Possible network solutions

- In-situ replacement of the secondary systems components by December 2023.
- Replacement of all secondary systems and associated panels in a new building by December 2023.

Proposed network solution: Complete replacement of all secondary systems and associated panels in a new building at an estimated cost of $7 million by December 2023.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 22kV network at Innisfail of up to a peak of 27MW, and up to a 550MWh per day on a continuous basis. This would facilitate the removal of Innisfail Substation and connection of the Innisfail to Tully transmission line to the Innisfail to El Arish transmission line.

Tully 132/22kV Substation

Potential consultation: Maintaining reliability of supply at Tully

Tully Substation, established in 1976, is an essential 132kV switching station and bulk supply point for Ergon Energy to supply the Tully township and surrounding area in FNQ. One of the transformers has now been in operation for 43 years and is anticipated to reach end of technical service life around 2024.

Project driver:

Emerging condition risks arising from the condition of the 132kV transformer.

Possible network solutions

- Refurbish the transformer by June 2024.
- Replace the transformer by June 2024.

Proposed network solution: Replace the transformer at an estimated cost of $5m by June 2024.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 22kV network at Tully of up to 15MW at peak and up to 270MWh per day. The non-network solution would be required to be operational within 48 hours of a contingency occurring and from that point operate on a continuous basis until normal supply is restored. Supply would also be required for planned outages.

Possible network reinvestments in the Far North zone within five years

Against the backdrop of a rapidly changing electricity sector, Powerlink's planning overview (10-year outlook period of the TAPR) includes consideration of a broad range of options to address the identified needs in the Far North zone. As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 5.7 will be subject to detailed planning to confirm alignment with future reinvestment, optimisation and delivery strategies. This near-term analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works and deliver greater benefits to customers. This will be achieved through improving and further refining options or considering other options, including the associated delivery strategies, from those described in Table 5.7. Information in relation to potential projects, alternatives and possible commissioning needs will be revised annually within the TAPR based on the latest information available at the time.

Table 5.7 Possible network reinvestments in the Far North zone within five years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Woree to Kamerunga 132kV transmission line replacement	New 132kV double circuit transmission line	Maintain supply reliability to the Far North zone	June 2024	Two 132kV single circuit transmission lines (1)	$30m
Line refit works on the 275kV transmission lines between Chalumbin and Woree substations	Staged line refit works on steel lattice structures	Maintain supply reliability to the Far North and Ross zones	Staged works by October 2023	New transmission line (1)	$10 to $15m
Line refit works on the 275kV transmission lines between Ross and Chalumbin substations	Staged line refit works on steel lattice structures	Maintain supply reliability to the Far North and Ross zones	Staged works by December 2026	New transmission line (1)	$85m to $165m (2)

Table 5.7 Possible network reinvestments in the Far North zone within five years *(continued)*

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
Kamerunga 132kV Substation replacement	Full replacement of 132kV substation	Maintain supply reliability to the Far North zone	October 2022	Staged replacement of 132kV primary plant and secondary systems (1)	$24m
Retirement of one 132/22kV Cairns transformer	Retirement of one 132kV Cairns transformer including primary plant reconfiguration works (3)	Maintain supply reliability to the Far North zone	December 2021	Replacement of the transformer	$0.5m (4)
Cairns 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	December 2022	Staged replacement of the 132kV secondary systems equipment (1)	$6m
Innisfail 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	December 2023	Replacement of selected secondary systems equipment (1)	$7m
Tully 132/22kV transformer replacement	Replacement of the transformer	Maintain supply reliability to the Far North zone	June 2024	Refurbishment of the existing transformer (1)	$5m
Barron Gorge 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	June 2025	Selected replacement of 132kV secondary systems	$4m

Note:

(1) The envelope for non-network solutions is defined in Section 5.7.1.

(2) The project cost will be dependent upon assessment of technical feasibility and commercial analysis of first intervention options to maintain network topography before second intervention is required.

(3) Due to the extent of available headroom, the retirement of this transformer does not bring about a need for non-network solutions to avoid or defer load at risk or future network limitations, based on Powerlink's medium economic load forecast outlook of the TAPR.

(4) Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget. However material operational costs, which are required to meet the scope of a network option, are included in the overall cost of that network option as part of the RIT-T cost-benefit analysis. Therefore, in the RIT-T analysis, the total cost of the proposed option will include additional costs to account for operational works for the retirement of the transformer.

Possible network reinvestments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Far North zone from around 2025/26 to 2029/30 (refer to Table 5.8).

Table 5.8 Possible network reinvestments in the Far North zone within six to 10 years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative costs
Substations					
Edmonton 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	June 2026	Selected replacement of 132kV secondary systems	$6m
Chalumbin 275kV and 132kV primary plant replacement	Selected replacement of 275kV and 132kV primary plant	Maintain supply reliability to the Far North zone	June 2026	Full replacement of all 275kV and 132kV primary plant and secondary systems	$4m
Turkinje 132kV primary plant replacement	Selected replacement of 132kV primary plant	Maintain supply reliability to the Far North zone	December 2026	Full replacement of 132kV primary plant	$6m
Woree 275kV and 132kV secondary systems replacement	Selected replacement of 275kV and 132kV secondary systems	Maintain supply reliability to the Far North zone	June 2028	Full replacement of 275kV and 132kV secondary systems	$16m

Possible asset retirements in the 10-year outlook period[10]

Retirement of one of the 132/22kV transformers at Cairns Substation

Planning analysis has shown that, based on the medium economic load forecast in Chapter 2, there is no enduring need for one of the three transformers at Cairns Substation, which is approaching end of technical service life within the next five years. Retirement of the transformer provides cost savings through the avoidance of capital expenditure to address the condition and compliance risks arising from the asset remaining in-service. Some primary plant reconfiguration may be required to realise the benefits of these cost savings at an indicative cost of $0.5 million. There may also be additional works and associated costs on Ergon Energy's network which requires joint planning closer to the proposed retirement in December 2021 (refer to table 5.7).

[10] Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget.

5.7.2 Ross zone

Figure 5.4 Northern Ross zone transmission network

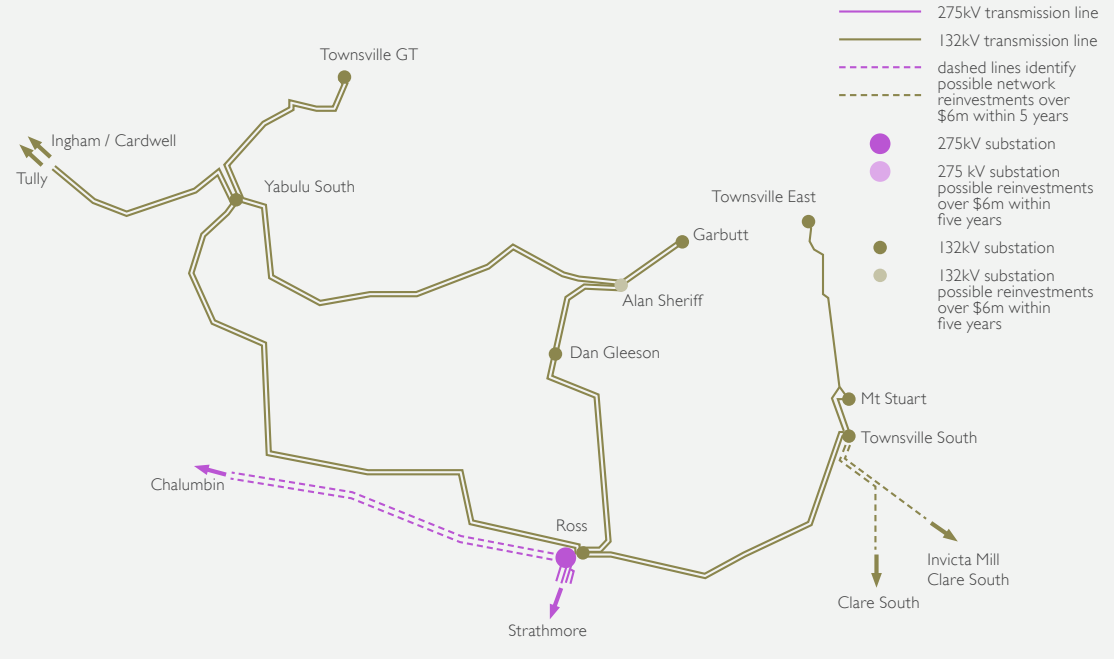


Figure 5.5 Southern Ross zone transmission network

Existing network

The 132kV network between Collinsville and Townsville was developed in the 1960s and 1970s to supply mining, commercial and residential loads. The 275kV network within the zone was developed more than a decade later to reinforce supply into Townsville and FNQ. Parts of the 132kV network are located closer to the coast in a high salt laden wind environment leading to accelerated structural corrosion (refer to figures 5.4 and 5.5).

Possible load driven limitations

Based on the medium economic load forecast defined in Chapter 2, there is no additional capacity forecast to be required as a result of network limitations in the Ross zone within the next five years to meet reliability obligations.

Possible network reinvestments within five years

Network reinvestments in Ross zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the Ross zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission lines

Clare South to Townsville South 132kV transmission lines

Current consultation: Maintaining reliability of supply between Clare South and Townsville South

The 275kV and 132kV network, which operates in parallel between Collinsville and Townsville, has developed over many years. The 132kV lines are reaching end of technical service life within the 10-year outlook of this TAPR, while the earliest end of technical service life trigger for the 275kV lines is beyond the 10-year outlook of this TAPR.

The 275kV transmission infrastructure is adequate for load requirements with minimal reliance on the 132kV transmission lines for intra-regional transfers. The main function of the current 132kV infrastructure is to provide connections to King Creek, Invicta Mill and Clare South substations, and to support power transfers in the area, including from renewable generation.

Project driver

Emerging condition and compliance risks on the following assets.

Within the next five years:

- Clare South to Townsville South 132kV inland single circuit transmission line built in 1963 (repair of majority of foundations).
- Clare South to Townsville South 132kV coastal single circuit transmission line built in 1967 (structural repair due to above ground corrosion).

Within the next six to 10 years:

- Clare South to Townsville South 132kV inland single circuit transmission line (structural repair due to above ground corrosion separate to the foundation repair described above).
- Strathmore/Collinsville to Clare South 132kV double circuit transmission line (structural repair due to above ground corrosion).

Project timing: December 2022

The inland Townsville South to Clare South transmission line has 156 structures with older style grillage foundations that have emerging condition-based risks that will need to be addressed in the next five years. As a precautionary measure to reduce the risk of tower failure during an extreme weather event, eight towers were repaired by micro piles in 2017 and a further 23 towers have been repaired by micro piles in 2018.

Possible network solutions

Powerlink's future investment strategy aims to focus on maximising value for customers to make the best use of Powerlink's existing assets, and to ensure that investment in the network provides the most value and flexibility for our customers moving forward. Given the nature of the proposed future investment strategies which have been developed, Powerlink has placed considerable emphasis on engaging with and obtaining feedback from customers in the area (refer to Section 1.9.2).

In accordance with the requirements of the RIT-T, Powerlink published a Project Specification Consultation Report (PSCR) In November 2018 which identified the proposed network options based on two themes:

- Maintaining the existing 132kV network topography and capacity through staged line refit projects, and foundation repair of the inland Townsville South to Clare South transmission line by December 2022 with proposed network options ranging from approximately $41 million to $55 million in 2018/19 prices.
- Potential network reconfiguration through a combination of staged line refit projects and decommissioning of parts of the 132kV transmission lines by December 2022 with proposed network options ranging from approximately $28 to $42 million in 2018/19 prices[11].

Submissions to the PSCR closed in April 2019 and Powerlink anticipates publication of the PADR in July 2019.

Proposed network solution: Subject to the RIT-T currently in progress, network reconfiguration through staged line refits of the coastal 132kV transmission line between Clare South and Townsville South, transformer installation at Strathmore Substation and decommissioning the inland 132kV transmission line between Clare South and Townsville South at an estimated cost of $28 million

Powerlink is analysing all possible solutions, as part the current RIT-T consultation.

Possible non-network solutions

Non-network solutions to enable the removal of the inland Townsville South to Clare South transmission line, and remain within Powerlink's planning standard, may include up to 10MW in the Proserpine, Clare or Collinsville area. Non-network solutions may include, but are not limited to local generation, dynamic voltage support or DSM. It should be noted that the network configuration facilitates the provision of voltage control and system strength from local synchronous generation. This would need to be taken into consideration for non-network solutions.

Strathmore to Ross 275kV transmission line

Potential consultation: Maintain reliability of supply between Strathmore and Ross

The two Strathmore to Ross 275kV single circuit transmission lines are 160km in length and were commissioned in 1978 and 1985. They are currently operated paralleled. The last 8km section of the line from Ross Substation was constructed as a double circuit transmission line. Currently one side is operated at 275kV and the other side of the double circuit provides supply to Milchester through an Ergon Energy 132kV feeder. Based on maintenance records and modelling of corrosion it is expected that the 8km section from Ross Substation may require some refit or additional refurbishment to align with the expected end of technical service life for the remainder of the line. A detailed assessment of condition is scheduled for 2020 to inform the required scope of works.

Project driver

Emerging conditions risks due to structural corrosion.

Project timing: June 2024

Possible network solutions

- Refit the section of transmission line.
- Replace the section transmission line with a new double circuit transmission line.

Proposed network solution: Line refit works on the 275kV transmission lines between Strathmore and Ross substations at an estimated cost of $6 million by June 2024

Powerlink considers the proposed network solution will not have a material inter-network impact.

[11] This excludes the cost of operational works, such as asset retirements, which do not form part of Powerlink's capital expenditure budget. However material operational costs, which are required to meet the scope of a network option, are included in the overall cost of that network option as part of the RIT-T cost-benefit analysis.

Possible non-network solutions

Potential non-network solutions to facilitate the removal of the 8km section from Ross Substation would need to provide injection to the 132kV or 66kV network at or near Milchester of up to 40MW at peak and up to 800MWh per day on a continuous basis while maintaining the CQ-NQ transfer limit.

Substations

Townsville South 132kV Substation

Townsville South Substation was established in 1978 to replace the 132kV switchyard at Mt Stuart Substation. It is a major substation supplying the city of Townsville and large industrial loads in the area and is a connection point for the Mt Stuart Power Station.

The 2017 and 2018 TAPR's identified a possible future requirement to address emerging condition, obsolescence and compliance risks arising from the condition of some of the 132kV secondary systems at Townsville South Substation by December 2021. Taking into account the most recent analysis, Powerlink has deferred any potential near term capital reinvestment to address the condition of one regulated bay. It is anticipated the risks arising from the condition of this bay will be considered in conjunction with other secondary systems condition risks, towards the end of the 10-year outlook period.

Alan Sherriff 132kV Substation

Potential consultation: Addressing the secondary systems condition risks at Alan Sherriff

Alan Sherriff Substation was established in 2002 as a two transformer 132/11kV substation, and replaced the 132kV switching functions at Garbutt in 2004. The substation is a major injection point into Ergon Energy's 66kV distribution network providing supply to the Townsville area.

Project driver

Addressing the secondary systems condition risks at Alan Sherriff Substation.

Project timing: June 2025

Possible network solutions

Full replacement of all secondary systems.

Selected replacement of secondary systems, with decommissioning or extended maintenance of the two bays associated with the Dan Gleeson to Alan Sheriff transmission line.

Proposed network solution: Selected replacement of secondary systems at estimated cost of $9 million by June 2025

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply to the 11kV network in north east Townsville of up to 25MW at peak and up to 450MWh per day. Reconfiguration of the 132kV network at Alan Sherriff, and of the Townsville 66kV network around Townsville, would be required to facilitate removal of Alan Sherriff Substation.

Possible network reinvestments in the Ross zone within five years

Against the backdrop of a rapidly changing electricity sector, Powerlink's planning overview (10-year outlook period of the TAPR) includes consideration of a broad range of options to address the identified needs in the Ross zone. As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 5.9 will be subject to detailed planning to confirm alignment with future reinvestment, optimisation and delivery strategies. This near-term analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works and deliver greater benefits to customers. This will be achieved through improving and further refining options or considering other options, including the associated delivery strategies, from those described in Table 5.9. Information in relation to potential projects, alternatives and possible commissioning needs will be revised annually within the TAPR based on the latest information available at the time.

Table 5.9 Possible network reinvestments in the Ross zone within five years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the coastal 132kV transmission line between Clare South and Townsville South substations with network reconfigurations	Repair or replace selected components on coastal line, and install new transformer at Strathmore Decommission inland line (1)	Maintain supply reliability in the Ross zone	December 2022	Line refit works on steel lattice structures and foundation repair of the inland 132kV transmission line New 132kV transmission line (2)	$28m (3) (4)
Line refit works on the 132kV transmission line between Townsville South and Ross substations	Targeted line refit works on steel lattice structures	Maintain supply reliability in the Ross zone	June 2023	New 132kV transmission line Targeted line refit works on steel lattice structures with painting	$2m
Line refit works on the 275kV transmission lines between Strathmore and Ross substations	Targeted line refit works on the 275kV steel lattice towers	Maintain reliability of supply between Strathmore and Ross	June 2024	New transmission line (2)	$6m
Substations					
Strathmore 275kV and 132kV partial secondary systems replacement	Selective replacement of 275 and 132kV secondary systems in a new prefabricated building	Maintain supply reliability to the Ross zone	December 2022	Selected replacement of 275 and 132kV secondary systems in existing panels	$5m
Ingham South 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2025	Selected replacement of 132kV secondary systems	$4m
Alan Sherriff 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2025	Full replacement of 132kV secondary systems (2)	$9m

Note:

(1) The scope of works, or the need to undertake this potential project, will rely upon the outcome of the RIT-T currently underway.

(2) The envelope for non-network solutions is defined in Section 5.7.2.

(3) The revised project estimate from the 2018 TAPR is based upon the change of scope in the potential network option that is considered likely in the RIT-T underway.

(4) Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget. However material operational costs, which are required to meet the scope of a network option, are included in the overall cost of that network option as part of the RIT-T cost-benefit analysis. Therefore, in the RIT-T analysis, the total cost of the proposed option will include an additional $10 million to account for operational works for the retirement of the transmission line.

Possible network reinvestments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Ross zone from around 2025/26 to 2029/50 (refer to Table 5.10).

Table 5.10 Possible network reinvestments in the Ross zone within six to 10 years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 132kV transmission line between Ross and Dan Gleeson substations	Line refit works on steel lattice structures	Maintain supply reliability to the Ross zone	June 2028	New 132kV transmission line	$8m
Line refit works on the 132kV transmission lines between Collinsville, Strathmore and Clare substations	Line refit works on steel lattice structures	Maintain supply reliability to the Ross zone	June 2028	New 132kV transmission line Line refit works on steel lattice structures with painting	$20m
Substations					
Garbutt 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2026	Selected replacement of 132kV secondary systems	$3m
Strathmore SVC secondary systems replacement	Full replacement of secondary systems	Maintain supply reliability to the Ross zone	June 2026	Staged replacement of secondary systems	$5m
Townsville East 132kV secondary systems replacement	Staged replacement of secondary systems	Maintain supply reliability to the Ross zone	June 2028	Full replacement of secondary systems	$3m
King Creek 132kV secondary systems replacement	Full replacement of secondary systems	Maintain supply reliability to the Ross zone	June 2028	Staged replacement of secondary systems	$2m
Townsville South 132kV secondary systems replacement	Selected replacement of 132kV secondary systems	Maintain supply reliability to the Ross zone	June 2029	Full replacement of 132kV secondary systems	$12m

Possible asset retirements in the 10-year outlook period

Townsville South to Clare South inland transmission line

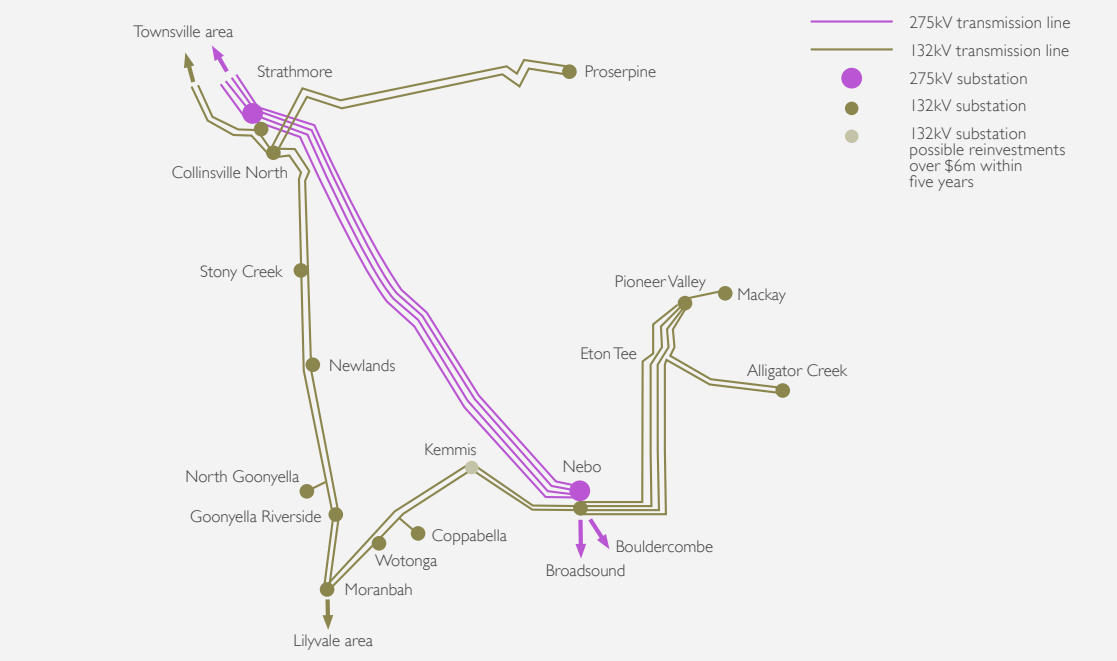
Subject to the outcome of further analysis and RIT-T consultation, Powerlink may retire the inland transmission line at the end of its service life anticipated around 2021.

Dan Gleeson to Alan Sherriff 132kV transmission line

The 132kV transmission line between Dan Gleeson and Alan Sherriff substations was constructed in the 1960s and is located in the south-western suburbs of Townsville. Foundation repair on this transmission line was completed in 2016 to allow the continued safe operation in the medium term. Planning studies are currently underway to assess the viability of potentially retiring this transmission line.

5.7.3 North zone

Figure 5.6 North zone transmission network



Existing network

Three 275kV circuits between Nebo (in the south) and Strathmore (in the north) substations form part of the 275kV transmission network supplying the North zone. Double circuit inland and coastal 132kV transmission lines supply regional centres and infrastructure related to mines, coal haulage and ports arising from the Bowen Basin mines (refer to Figure 5.6).

The coastal network in this zone is characterised by transmission line infrastructure in a corrosive environment which make it susceptible to premature ageing.

Possible load driven limitations

Based on the medium economic load forecast defined in Chapter 2, there is no additional capacity forecast to be required as a result of network limitations in the Far North zone within the next five years to meet reliability obligations.

Increasing local demand in the Proserpine area is expected to lead to some load at risk. The critical contingency is an outage of the 275/132kV Strathmore transformer. Based on the medium economic load forecast of this TAPR, this places load at risk of 10MW from summer 2020/21, which is within the 50MW and 600MWh limits established under Powerlink's planning standard (refer to Section 1.8).

High voltages associated with light load conditions are currently managed with existing reactive sources. However, midday power transfer levels are forecast to reduce as additional VRE generators are commissioned in North Queensland (NQ). As a result, voltage control is forecast to become increasingly challenging for longer durations. This is discussed in sections 5.7.4 and 6.6.2.

Possible network reinvestments within five years

Network reinvestments in the North zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the North zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission lines

Pioneer Valley to Eton tee 132kV transmission lines

Potential consultation: Maintaining reliability of supply to the Mackay area

The 132kV line between Pioneer Valley Substation and Eton tee was constructed in 1977 as part of the transmission line between Nebo and Mackay substations to meet the growing load in the Mackay region. A second transmission line was constructed on the original towers in 1981. The establishment of Alligator Creek Substation resulted in one transmission line in and out at the Eton tee point in 1982, followed by a reconfiguration in 1998 when Pioneer Valley Substation was established. The transmission line is located in a harsh saline and corrosive environment.

Taking into account the most recent analysis, Powerlink has deferred any potential near term capital reinvestment to address the condition of the Pioneer Valley to Eton tee transmission line. It is anticipated the risks arising from the condition of this transmission line will be considered in conjunction with the risks arising from the condition of the Nebo to Eton tee 132kV transmission line, within the next seven years.

Substations

Kemmis 132kV Substation

Potential consultation: Addressing the secondary systems risk at Kemmis

Kemmis Substation was established in 2002 to support the load growth arising from the expansion of mining in the Northern Bowen Basin. Two 40MVA 132/66kV transformers are installed, with Transformer 1 relocated from Proserpine and Transformer 2 relocated from Townsville South substations.

Project driver

Addressing the secondary systems condition risks at Kemmis Substation.

Project timing: June 2023

Possible network solutions

- Staged replacement of the majority of secondary systems components by June 2023.
- Complete replacement of all secondary systems and associated panels by June 2023.

Proposed network solution: Complete replacement of all secondary systems at Kemmis Substation at an estimated cost of $7 million by June 2023

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Kemmis provides supply to local mining and town loads as well as switching of 132kV circuits that provide essential supply to the Northern Bowen Basin. Network support for the local load would need to provide injection or demand response of up to 32MW on a continuous basis, and up to 760MWh per day, alongside reconfiguration of the 132kV network at Kemmis and surrounding substations. Due to the nature of the load at Kemmis, short duration peaks of up to 70MVA must also be able to be supported.

Possible network reinvestments in the North zone within five years

Against the backdrop of a rapidly changing electricity sector, Powerlink's planning overview (10-year outlook period of the TAPR) includes consideration of a broad range of options to address the identified needs in the North zone. As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 5.11 will be subject to detailed planning to confirm alignment with future reinvestment, optimisation and delivery strategies. This near-term analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works and deliver greater benefits to customers. This will be achieved through improving and further refining options or considering other options, including the associated delivery strategies, from those described in Table 5.11. Information in relation to potential projects, alternatives and possible commissioning needs will be revised annually within the TAPR based on the latest information available at the time.

Table 5.11 Possible network reinvestments in the North zone within five years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
North Goonyella 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the North zone	December 2020	Selective replacement of 132kV secondary systems	$2m
Nebo 132/11kV transformer replacements	Replacement of two 132/11kV transformers at Nebo Substation	Maintain supply reliability to the North zone	June 2022 (2)	Establish 11kV supply from surrounding network	$3m
Newlands 132kV primary plant replacement	Staged replacement of 132kV primary plant	Maintain supply reliability in the North zone	June 2022	Replacement of all 132kV primary plant	$4m
Kemmis 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the North zone	June 2023	Staged replacement of 132kV secondary systems equipment (1)	$7m
Alligator Creek 132kV primary plant replacement	Selective replacement of132kV primary plant	Maintain supply reliability in the North zone	June 2024	Full replacement of 132kV primary plant	$4m

Note:

(1) The envelope for non-network solutions is defined in Section 5.7.3.

(2) The revised timing from the 2018 TAPR is based upon the latest condition assessment.

Possible network reinvestments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the North zone from around 2025/26 to 2029/30 (refer to Table 5.12).

Table 5.12 Possible network reinvestments in the North zone within six to 10 years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 132kV transmission line between Nebo Substation, Eton tee and Pioneer Valley Substation	Line refit works on steel lattice structures	Maintain supply reliability to the North zone	December 2026	New transmission line	$31m
Substations					
Pioneer Valley 132kV primary plant replacement	Staged replacement of 132kV secondary systems equipment	Maintain supply reliability to the North zone	December 2028	Full replacement of 132kV secondary systems	$6m

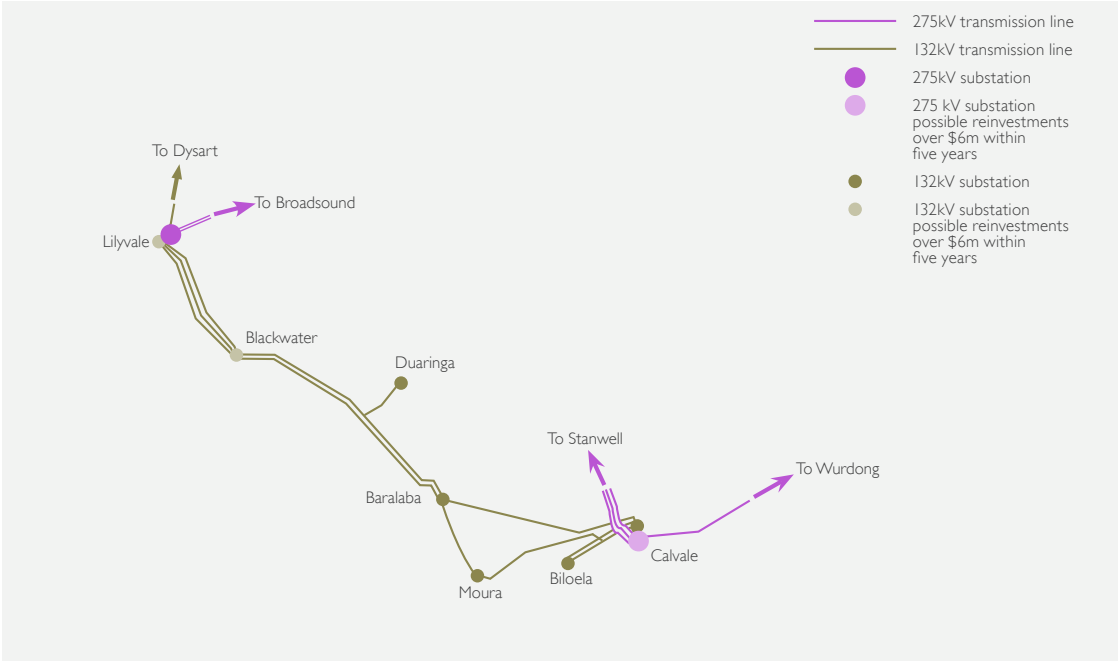
Possible asset retirements within the 10-year outlook period

Pioneer Valley to Eton tee transmission line

Subject to the outcome of further analysis, Powerlink may retire the inland transmission line at the end of its service life anticipated around 2026.

5.7.4 Central West zone

Figure 5.7 Central West transmission network



Existing network

The Central West 132kV network was developed between the mid-1960s and late 1970s to meet the evolving requirements of mining activity in the southern Bowen Basin. The 132kV injection points for the network are taken from Calvale and Lilyvale 275kV substations. The network is located more than 150km from the coast in a dry environment making infrastructure less susceptible to corrosion. As a result transmission lines and substations in this region have met (and in many instances exceeded) their anticipated service life but will require replacement or rebuilding in the near future (refer to Figure 5.7).

Possible load driven limitations

Based on the medium economic forecast outlined in Chapter 2 and the committed generation described in tables 6.1 and 6.2, there is no additional capacity forecast to be required in the Central West zone within the next five years to meet reliability obligations.

High voltages associated with light load conditions are currently managed with existing reactive sources. However, midday power transfer levels are forecast to reduce as additional VRE generators are commissioned in NQ, leading to greater utilisation of voltage control plant in the Central Queensland (CQ) and NQ zones. As a result, voltage control is forecast to become increasingly challenging for longer durations and potentially lead to high voltage (HV) violations (that is, voltages exceed defined safe operating limits).

Powerlink has in the past used operational line switching to reduce voltages to within safe operating limits. Line switching can lead to reduced reliability arising from non-credible events, and can lead to reduced system strength.

The lines required to be switched to mitigate higher operational voltages in NQ and CQ, are the lines that have the largest impact on the system strength in NQ. The reduction in system strength from line switching may breach Powerlink's obligations under clauses 11.101.2 and 4.6.6 of the NER, as amended by the National Electricity Amendment (Managing power system fault levels) Rule 2017 No. 10 (Fault Levels Rule) and this may result in VRE generators in NQ being constrained to ensure system strength is maintained.

Powerlink has identified a need for additional reactive support, to:

- Maintain voltages within operational and design limits during minimum demand periods, and to maintain the power system in a secure operating state
- Reduce reliability impact from the de-energisation of 275kV transmission lines, and
- Reduce market constraints to meet system strength requirements

Project timing: December 2020

Possible network solutions

- Installation of an 84MVAr bus reactor at Broadsound
- Installation of an 84MVAr bus reactor at Nebo.

Proposed network solution: Installation of an 84MVAr bus reactor at Broadsound at an estimated cost of $5 million by 2021.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

To address the requirement, Powerlink would be seeking additional voltage control in the northern CQ or southern NQ zone, being south of Strathmore and north of Stanwell, which is able to provide sufficient voltage control to Nebo or Broadsound. The nature of this limitation is that the voltage control would be required to operate on a continuous basis.

Possible network reinvestments within five years

Network reinvestments in Central West zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the Central West zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Substations

Powerlink has identified opportunities to reconfigure the network in the Central West zone providing efficiencies and cost savings by:

- reducing the number of transformers at Bouldercombe Substation, where as an outcome of a recently completed RIT-T, two of the existing transformers will be retired and replaced by a single transformer by December 2021 and
- re-arrangement of the 132kV network around Callide A Substation by the establishment of a second transformer at Calvale Substation and retirement of Callide A Substation and the Callide A to Gladstone South transmission line. A committed project is underway to establish a second transformer at Calvale Substation (refer to Table 9.5).

Lilyvale 275/132kV Substation

Current consultation: Maintaining power transfer capability and reliability of supply at Lilyvale Substation

Lilyvale Substation was established in 1980 to supply the mining load in the Bowen Basin and Blackwater regions of central Queensland. Lilyvale Substation connects the generation points at Gladstone, Stanwell and Callide to the central Queensland mining area. The substation also supplies the central Queensland region owned and operated by Ergon Energy.

275kV and 132kV primary plant

Project driver

Emerging condition risks arising from selective 275kV and 132kV primary plant.

Project timing: October 2022

Possible network solutions

- Selected replacement of 132/275kV primary plant by October 2022.
- Full 132/275kV primary plant replacement by October 2022.

132/66kV transformers

Project driver

Emerging condition risks arising from the three original transformers at Lilyvale Substation.

Project timing: October 2022

Taking into consideration the most recent analysis and understanding of the risks arising from the condition of the primary plant and transformers at Lilyvale Substation, the proposed network solution has been deferred by approximately 15 months from the possible commissioning date of June 2021 as advised in the 2018 TAPR to October 2022.

Possible network solutions

- Replacement of two 80MVA transformers with two 100MVA transformers and full replacement of 132kV and 275kV primary plant in selected bays by October 2022 combined with replacement of the third transformer in 2027
- Replacement of two 80MVA transformers with two 160MVA transformers and full replacement of 132kV and 275kV primary plant in selected bays by October 2022.

In accordance with the requirements of the RIT-T, Powerlink published a PSCR (with PADR exemption) in May 2019 which identified replacement of two 132/66kV 80MVA transformers with two 160MVA transformers and the full bay replacement of primary plant in selected bays by October 2022 as the preferred option.

Submissions to the PSCR close on 21 August 2019 and Powerlink anticipates publication of the PACR in October 2019.

Proposed network solution: Replacement of two 80MVA transformers with two 160MVA transformers and full replacement of 132kV and 275kV primary plant in selected bays with an estimated capital cost of $26 million by October 2022

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Non-network solutions may include, but are not limited to local generation or DSM initiatives in the Lilyvale areas.

A full non-network option that avoids replacement of ageing primary plant and all three 132/66kV transformers would need to provide injection or demand response at Lilyvale of over 200MW at peak, as well as providing switching for a number of connections in the region from October 2022.

A partial non-network solution could provide support from as early as June 2021 by the replacement of one of the two at risk transformers. More detailed information on the technical requirements of possible non-network solutions is available in the PSCR.

Blackwater 132kV Substation

Current consultation: Maintaining reliability of supply to Blackwater

Blackwater Substation is an essential 132kV switching and load substation in the central Queensland network, originally established in 1969 to supply the mining load in the Blackwater area. The substation was further expanded in 1987 to meet the demand of the rail system to support local mining development in the southern Bowen Basin and to enable the transport of coal to port. Ergon Energy also operates a 66kV and 22kV distribution network from within the site.

132/66kV transformers

Project driver

Emerging condition risks arising from the original transformers at Blackwater Substation.

Project timing: June 2022

Possible network solutions

- Replace both transformers with one transformer by June 2022.
- Replace both transformers with two transformers by June 2022.

In accordance with the requirements of the RIT-T, Powerlink published a PSCR (with PADR exemption) in May 2019 which identified replacing the two 132/66/11kV 80MVA transformers with one 132/66/11kV 160MVA transformer by June 2022 by as the preferred option.

Submissions to the PSCR close on 27 August 2019 and Powerlink anticipates publication of the PACR in October 2019.

Proposed network solution: Replace two transformers at Blackwater Substation with one transformer at an estimated cost of $6 million by June 2022

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Non-network solutions may include, but are not limited to, local generation or DSM initiatives on the 66kV network in the Blackwater area. Any non-network solution would need to provide support to the 66kV network of up to 150MW and up to 2650MWh per day.

Calvale 275/132kV Substation

Potential consultation: Maintaining reliability of supply at Calvale

Calvale 275/132kV Substation, located in central Queensland, was established in 1988 and is a key switching station for the region with power flowing to the north and east of the state as well as to southern Queensland. Originally the substation was established to connect to Callide A and B power stations. Calvale Substation was extended to connect to Callide Power Plant and Tarong Substation in 1998 and further expanded in 2013 as part of the Calvale to Stanwell augmentation to meet increased demand in the region.

Project driver

Addressing the 275kV primary plant condition risks.

Project timing: June 2025

Possible network solutions

- Selected replacement of 275kV primary plant by June 2025.
- Full 275kV primary plant replacement by June 2025.

Proposed network solution: Selected replacement of 275kV primary plant at an estimated cost of $13 million by June 2025

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Calvale Substation provides an essential switching function on the Central Queensland to South Queensland (CQ-SQ) grid section, including marshalling 275kV circuits from Halys, Wurdong and Stanwell and providing connection to Callide B Power Station and Callide Power Plant.

Removal of the Calvale Substation would have a very material impact on the performance, capability and operability[12] of critical grid sections (CQ-SQ and Gladstone grid section) and on the reliability of the generator connections. As such, removal of the substation in its entirety this is not a technically viable option.

However, Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the scope of the replacement project, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to generation or DSM initiatives that may facilitate reconfiguration of the network.

Additionally, Calvale Substation provides 132kV supply to the central west mining area. A viable non-network solution would be required to provide network support in the Biloela or Moura area of up to 85MW at peak and up to 1800MWh per day on a continuous basis.

Possible network investments in the Central West zone within five years

Against the backdrop of a rapidly changing electricity sector, Powerlink's planning overview (10-year outlook period of the TAPR) includes consideration of a broad range of options to address the identified needs in the Central West zone. As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 5.13 will be subject to detailed planning to confirm alignment with future reinvestment, optimisation and delivery strategies. This near-term analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works and deliver greater benefits to customers. This will be achieved through improving and further refining options or considering other options, including the associated delivery strategies, from those described in Table 5.13. Information in relation to potential projects, alternatives and possible commissioning needs will be revised annually within the TAPR based on the latest information available at the time.

[12] Outages would require multiple network elements to be taken out of service.

Table 5.13 Possible network investments in the Central West zone within five years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
84MVAr bus reactor at Broadsound	Installation of an 84MVAr bus reactor at Broadsound Substation	Voltage control in CQ	December 2021	84MVAr bus reactor at Nebo	$5m
Lilyvale primary plant and transformers replacement	Selective replacement of 132kV and 275kV primary plant and replacement of two of the three 132/66kV transformers (1)	Maintain supply reliability in the Central West zone	October 2022	Full replacement of 132kV and 275kV primary plant and replacement of three 132/66kV transformers (2)	$26m
Blackwater 132/66/11kV transformers replacement	Replacement of two 132/66/11kV transformers with one transformer	Maintain supply reliability in the Central West zone	June 2022	Replace both 132/66/11kV transformers with two transformers	$6m
Calvale 275kV primary plant replacement	Selective replacement of 275kV primary plant	Maintain supply reliability in the Central West zone	June 2025	Full replacement of 275kV primary plant (2)	$13m

Note:

(1) The scope of works, or the need to undertake this potential project, will rely upon the outcome of a RIT-T.

(2) The envelope for non-network solutions is defined in Section 5.7.4.

Possible network reinvestments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Central West zone from around 2025/26 to 2029/30 (refer to Table 5.14).

Table 5.14 Possible network reinvestments in the Central West zones within six to 10 years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 132kV transmission line between Bouldercombe to Egans Hill substations	Line refit works on a section of the 132kV transmission line	Maintain supply reliability in the Central West and CQ-SQ transmission corridor	June 2027	Rebuild the section with a new 132kV transmission line	$4m
Line refit works on the 132kV transmission line between Bouldercombe and Stanwell substations	Line refit works on the 132kV transmission line	Maintain supply reliability in the Central West zone	June 2028	Rebuild the section with a new 132kV transmission line	$2m
Rebuild the 132kV transmission lines from Callide A to Biloela and Moura	Rebuild the 132kV transmission lines as a double circuit from Callide A to Moura, and retire the single circuit transmission lines between Callide A and Baralaba, and Baralaba to Moura	Maintain supply reliability in the Central West zone	June 2028	Maintain existing topology through line refits of the existing single circuit transmission lines and repair to all foundations	$60m
Substations					
Broadsound 275kV primary plant replacement	Selective replacement of 275kV primary plant	Maintain supply reliability in the Central West Zone	June 2026	Full replacement of 275kV primary plant	$10m
Lilyvale 132kV secondary systems replacement	Selective replacement of 132kV secondary systems	Maintain supply reliability in the Central West zone	June 2026	Full replacement of 132kV secondary systems	$3m
Biloela 132kV secondary systems replacement	Selective replacement of 132kV secondary systems	Maintain supply reliability in the Central West zone	June 2026	Full replacement of 132kV secondary systems	$7m
Rockhampton 132kV secondary systems replacement	Selective replacement of 132kV secondary systems	Maintain supply reliability in the Central West zone	June 2027	Full replacement of 132kV secondary systems	$5m
Broadsound 275kV secondary systems replacement	Selective replacement of 275kV secondary systems	Maintain supply reliability in the Central West zone	June 2027	Full replacement of 275kV secondary systems	$4m

Note:

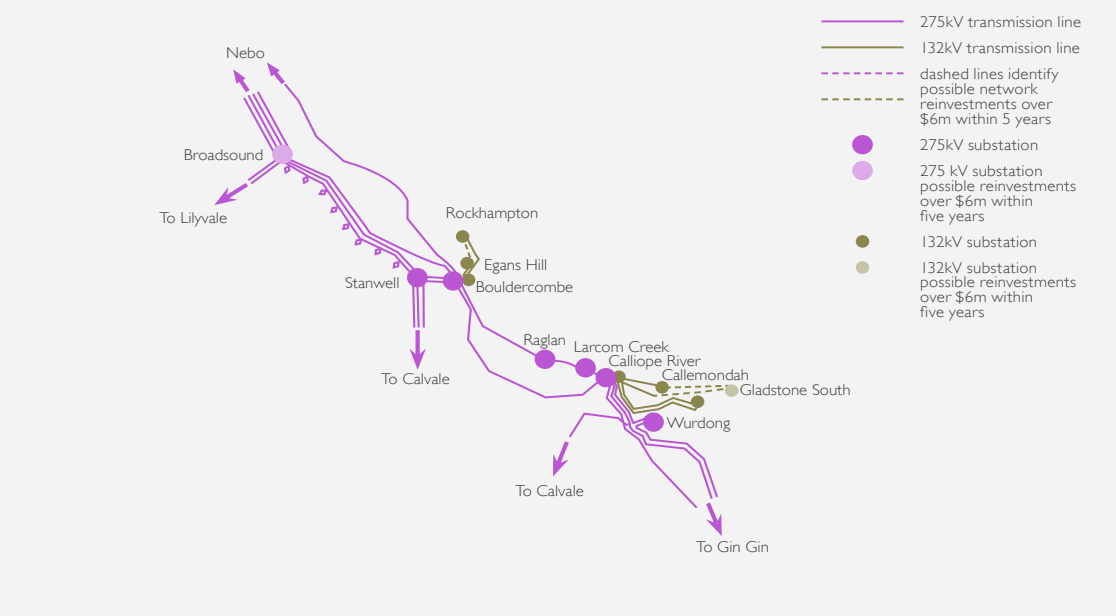
(1) The scope of works of the potential option excludes associated easement costs.

Possible asset retirements within the 10-year outlook period[13]

Subject to the outcome of further analysis and RIT-T consultation, Powerlink may retire the single circuit transmission lines between Callide and Baralaba, and Baralaba and Moura at the end of its technical service life anticipated around 2028.

5.7.5 Gladstone zone

Figure 5.8 Gladstone transmission network



Existing network

The Gladstone 275kV network was initially developed in the 1970s with the Gladstone Power Station and has evolved over time with the addition of the Wurdong Substation and supply into Boyne Smelter Limited (BSL) in the early 1990s (refer to Figure 5.8).

Possible load driven limitations

Based on the medium economic load forecast defined in Chapter 2, there is no additional capacity forecast to be required in the Gladstone zone within the next five years to meet reliability obligations.

Possible network reinvestments within five years

Network reinvestments in Gladstone zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations – resulting in poor customer, safety and environmental outcomes.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can deliver a safe, cost effective and reliable supply of electricity to meet the load requirements of customers in the Gladstone zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission lines

Callemondah to Gladstone South 132kV transmission lines

Potential consultation: Maintaining reliability of supply to Gladstone South

The Callemondah to Gladstone South 132kV double circuit transmission line was constructed in 1977. The transmission line facilitates supply to Gladstone South Substation which is an Ergon Energy bulk supply point and the connection point for Queensland Alumina Limited (QAL).

[13] Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget.

Project driver

Emerging conditions risks due to structural corrosion.

Project timing: December 2021

Possible network solutions

- Line refit works on steel lattice structures
- Rebuild the 132kV transmission line between Callemondah and Gladstone South substations

Proposed network solution: Refit the double circuit transmission line between Callemondah and Gladstone South substations, at an estimated cost of $10 million, by December 2021

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Potential non-network solutions would need to provide supply up to 180MW/3,200MWh daily.

Substations

Gladstone South Substation

Potential consultation: Maintaining reliability of supply at Gladstone South 132kV Substation

The Gladstone South site consists of two substations. The original Gladstone South Substation was built in the early 1960s as a 132kV supply point for transformation to the distribution network and as a major connection to QAL. In 2002, a substation was constructed on an adjacent site to manage the rising fault level and condition risks of the original substation. The transformers, metering and harmonic filter bank are retained at the old substation site.

Project driver

Addressing the secondary systems condition risks at Gladstone South Substation.

Project timing: December 2023

Possible network solutions

- Selective secondary systems replacement by December 2023.
- Full secondary systems replacement by December 2023.

Proposed network solution: Selective secondary systems replacement at Gladstone South Substation at an estimated cost of $17 million by December 2023

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Gladstone South Substation supplies the Ergon Energy and customer loads at Gladstone South of over 200MW at peak. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Possible network reinvestments in the Gladstone zone within five years

Against the backdrop of a rapidly changing electricity sector, Powerlink's planning overview (10-year outlook period of the TAPR) includes consideration of a broad range of options to address the identified needs in the Gladstone zone. As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 5.15 will be subject to detailed planning to confirm alignment with future reinvestment, optimisation and delivery strategies. This near-term analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works and deliver greater benefits to customers. This will be achieved through improving and further refining options or considering other options, including the associated delivery strategies, from those described in Table 5.15. Information in relation to potential projects, alternatives and possible commissioning needs will be revised annually within the TAPR based on the latest information available at the time.

Table 5.15 Possible network reinvestments in the Gladstone zone within five years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 275kV transmission line between Larcom Creek Substation and Mt Miller	Line refit works on steel lattice structures (1)	Maintain supply reliability in the Gladstone zone	June 2024	Rebuild the 275kV transmission line between Calliope River and Larcom Creek Substation (3)	$4m
Line refit works on the 132kV transmission line between Callemondah and Gladstone South substations	Line refit works on steel lattice structures	Maintain supply reliability in the Gladstone zone	December 2021	Rebuild the 132kV transmission line between Callemondah and Gladstone South Substation (2)	$10m
Line refit works on the 275kV transmission line between Wurdong and Boyne Island	Line refit works on steel lattice structures	Maintain supply reliability in the Gladstone zone	June 2022	Rebuild the 275kV transmission line between Wurdong and Boyne Island	$5m
Substations					
QAL West 132kV secondary systems replacement	Selective replacement of 132kV secondary systems	Maintain supply reliability in the Gladstone zone	December 2022	Full replacement of the 132kV secondary systems	$5m
Gladstone South 132kV secondary systems replacement	Selective replacement of 132kV secondary systems	Maintain supply reliability in the Gladstone zone	December 2023	Full replacement of 132kV secondary systems (3)	$17m

Note:

(1) More detailed option analysis and consideration of the associated scope of works to address emerging condition risks on this transmission line has been undertaken since the publication of the 2018 TAPR. This new analysis has supported the development of new strategies and options providing an opportunity to deliver a more cost effective solution than previously identified, delivering better outcomes for customers.

(2) Powerlink would exceed reliability criteria (N-1-50) if network support was not available pre-contingent.

(3) The envelope for non-network solutions is defined in Section 5.7.5.

Possible network reinvestments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Gladstone zone from around 2025/26 to 2029/30 (refer to Table 5.16).

Table 5.16 Possible network reinvestments in the Gladstone zone within six to 10 years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 275kV transmission line between Calliope River and Bouldercombe Substation (from Mt Miller)	Line refit works on steel lattice structures	Maintain supply reliability in the Gladstone zone	December 2026	Rebuild 275kV transmission line between Mt Miller and Bouldercombe Substation	$15m
Line refit works on the 275kV transmission line between Raglan and Larcom Creek substations	Line refit works on steel lattice structures	Maintain supply reliability in the Gladstone zone	December 2025	Rebuild the 275kV transmission line between Raglan and Larcom Creek	$15m
Substations					
Stanwell 275kV primary plant replacement	Selective replacement primary plant	Maintain supply reliability in the Gladstone zone	June 2027	Full replacement of primary plant	$12m
QAL South 132kV secondary systems replacement	Selective replacement of 132kV secondary systems	Maintain supply reliability in the Gladstone zone	June 2028	Full replacement of the 132kV secondary systems	$2m

Possible asset retirements within the 10-year outlook period[14]

Callide A to Gladstone South 132kV transmission double circuit line

The 132kV transmission line was constructed in the mid-1960s to support the loads in the Gladstone area. Due to reconfiguration in the area, this transmission line will be retired from service at the end of technical service life within the 10-year outlook period.

[14] Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget.

5.7.6 Wide Bay zone

Figure 5.9 CQ-SQ transmission network

Existing network

The Wide Bay zone supplies loads in the Maryborough and Bundaberg region and also forms part of Powerlink's eastern CQ-SQ transmission corridor. This corridor was constructed in the 1970s and 1980s and consists of single circuit 275kV transmission lines between Calliope River and South Pine (refer to Figure 5.8). These transmission lines traverse a variety of environmental conditions and as a result exhibit different corrosion rates and risk profiles.

Possible load driven limitations

Based on the medium economic load forecast defined in Chapter 2, there is no additional capacity forecast to be required in the Wide Bay zone within the next five years to meet reliability obligations.

Transmission network overview

In the NEM, generators compete for dispatch. Briefly, a generator's dispatch level depends on its bid in relation to other generators' bids, demand and available transmission capacity. Congestion occurs when transmission capacity prevents the optimum economic dispatch. Affected generators are said to be 'constrained' by the amount unable to be economically dispatched. Forecast of market constraint durations and levels are sensitive to highly uncertain variables including changes in bidding behaviour, environmental conditions and demand levels. It is important to note that there is no load at risk or potential for loss of supply to customers associated with network congestion.

In its current form, the CQ-SQ transmission network offers a great deal of flexibility for possible generation dispatches, seldom imposing constraints to market operation. Over time the utilisation of the CQ-SQ grid sections is expected to increase as new NQ and CQ VRE generating systems connect to the transmission network (refer to Section 5.7.5, Section 6.6.4 and Section 7.3.2). Powerlink's modelling shows that congestion across the CQ-SQ grid section will occur with maximum transfer levels reached. At these times, generators in central and northern Queensland will be constrained to reduced levels in accordance with the outcomes of security constrained dispatch and market arrangements.

In addition, the incidence of congestion will increase if additional southerly transfer capacity on Queensland/New South Wales Interconnector (QNI) is shown to be economically justified. If material emerging market constraints are forecast, Powerlink must demonstrate that the economic benefit to the market exceeds the cost of addressing the constraint. In the case of emerging constraints across CQ-SQ, the potential investments to address these constraints are likely to be significant. Powerlink will consider these constraints holistically with the emerging condition based drivers as part of the planning process.

Possible network reinvestments within five years

Network reinvestments in Wide Bay zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the Wide Bay zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission Lines

Potential consultation: Maintain reliability of supply on the coastal CQ-SQ 275kV transmission corridor

The coastal CQ-SQ transmission network between Calliope River and South Pine substations was progressively developed in the 1970s and 1980s to support loads in the Gladstone area and facilitate power transfer between central and southern Queensland. This corridor provides the major injection points at Gin Gin, Teebar Creek, Woolooga and Palmwoods 275/132kV for the Wide Bay and Sunshine Coast areas. The Ergon Energy 132kV and Energex 132/110kV sub-transmission systems supply bulk supply points in these areas.

The coastal CQ-SQ transmission network assets are expected to reach the end of their technical service life within the next 20 years. A key consideration is that this corridor is comprised solely of single circuit 275kV towers that may make cost effective refit strategies less viable compared to double circuit tower rebuilds.

Project driver

Emerging condition and compliance risks related to structural corrosion on the Calliope River to South Pine 275kV single circuit transmission lines.

With varying distance from the ocean, and localised industrial pollution, these transmission lines are subject to different environmental and atmospheric conditions and have, over time, experienced structural degradation at different rates.

Emerging condition and compliance risks on the following assets.

Within the next five years:

- Three 275kV single circuit transmission lines from Calliope River to Wurdong Tee built in 1972, 1976 and 1981 (structural repair due to above ground corrosion)
- One 275kV single circuit transmission line from Woolooga to South Pine built in 1972 (structural repair due to above ground corrosion)

Within the next six to 10 years:

- Two 275kV single circuit transmission lines from Woolooga to Gin Gin built in 1972 and 1976 (structural repair due to above ground corrosion)
- Three 275kV single circuit transmission lines from Wurdong Tee to Gin Gin built in 1972, 1976 and 1981 (structural repair due to above ground corrosion)
- One 275kV single circuit transmission line form South Pine to Palmwoods built in 1976 (structural repair due to above ground corrosion)

Project timing: December 2024 to December 2029

Possible network solutions

The current long-term network solution strategy based on existing network topology and requirements, is to rebuild the 275kV single circuit transmission lines from Calliope River to South Pine as a double circuit and to supply Wurdong from Calliope River via a dedicated 275kV double circuit. This strategy will be commercially assessed and adjusted to align with future generation and network developments, in particular if further planning analysis identify triggers to increase capacity or alternative network configuration options.

Strategies to address the transmission line sections with advanced corrosion in the five-year outlook will be commercially assessed in consideration of long-term options for reconfiguring the 275kV transmission lines. The longer term network solution options include:

- network rationalisation (potentially three single circuits to one double circuit) involving a staged program of line rebuild of the coastal corridor as a new double circuit 275kV transmission line at the end of the technical service life of the existing circuits;
- network rationalisation (potentially three single circuits to one double circuit) involving a staged rebuild of the coastal corridor as a new double circuit 275kV transmission line at the end of the technical service life of the existing circuits, using a program of targeted line refits to defer rebuild of individual CQ-SQ sections (where this deferral is economic)
- maintaining the existing three single circuit 275kV transmission lines through a combination of stage rebuild and line refit projects; or
- network rationalisation (potentially three single circuits to one double circuit in sections) of the coastal corridor involving staged line refit and rebuild on the coastal corridor, and reinforcement of the CQ-SQ section via reinforcement of the western CQ-SQ transmission corridor.

Proposed network solution within the next five years:

- Partial rebuild of the transmission line between Calliope River and Gin Gin substations (up to Wurdong Tee) at an estimated cost of $18 million by December 2024.
- Line refit works on the 275kV transmission line between Calliope River Substation and Wurdong Tee at an estimated cost of $6 million by December 2024.
- Line refit works on the 275kV transmission line between Woolooga and South Pine substations at an estimated cost of $20 million by June 2024.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

The coastal CQ-SQ transmission network provides essential supply between the generation in central and north Queensland and the loads in southern Queensland. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Powerlink considers that a non-network solution may have material intra-regional and other impacts.

Possible network reinvestments in the Wide Bay zone within five years

Against the backdrop of a rapidly changing electricity sector, Powerlink's planning overview (10-year outlook period of the TAPR) includes consideration of a broad range of options to address the identified needs in the Wide Bay zone. As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 5.17 will be subject to detailed planning to confirm alignment with future reinvestment, optimisation and delivery strategies. This near-term analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works and deliver greater benefits to customers. This will be achieved through improving and further refining options or considering other options, including the associated delivery strategies, from those described in Table 5.17. Information in relation to potential projects, alternatives and possible commissioning needs will be revised annually within the TAPR based on the latest information available at the time.

Table 5.17 Possible network reinvestments in the Wide Bay zone within five years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Partial rebuild of the transmission line between Calliope River and Gin Gin substations (up to Wurdong Tee)	New double circuit transmission line for the first 15km out of Calliope River substation	Maintain supply to the Moreton zone	December 2024	Refit the two single circuit 275kV transmission lines (1)	$18m
Line refit works on the 275kV transmission line between Calliope River Substation and Wurdong Tee	Refit the 275kV transmission line between Calliope River Substation and Wurdong Tee	Maintain supply reliability in the CQ-SQ transmission corridor (and Gladstone zone)	December 2024	Rebuild the 275kV transmission line as a double circuit (1)	$6m
Line refit works on the 275kV transmission line between Woolooga and South Pine substations	Refit the 275kV transmission line between Woolooga and South Pine substations	Maintain supply to the Moreton zone	June 2024	Rebuild the 275kV transmission line between Woolooga and South Pine substations (1)	$20m

Note:

(1) The envelope for non-network solutions is defined in Section 5.7.6.

Possible network reinvestments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Wide Bay zone from around 2025/26 to 2029/30 (refer to Table 5.18).

Table 5.18 Possible network reinvestments in the Wide Bay zone within six to 10 years

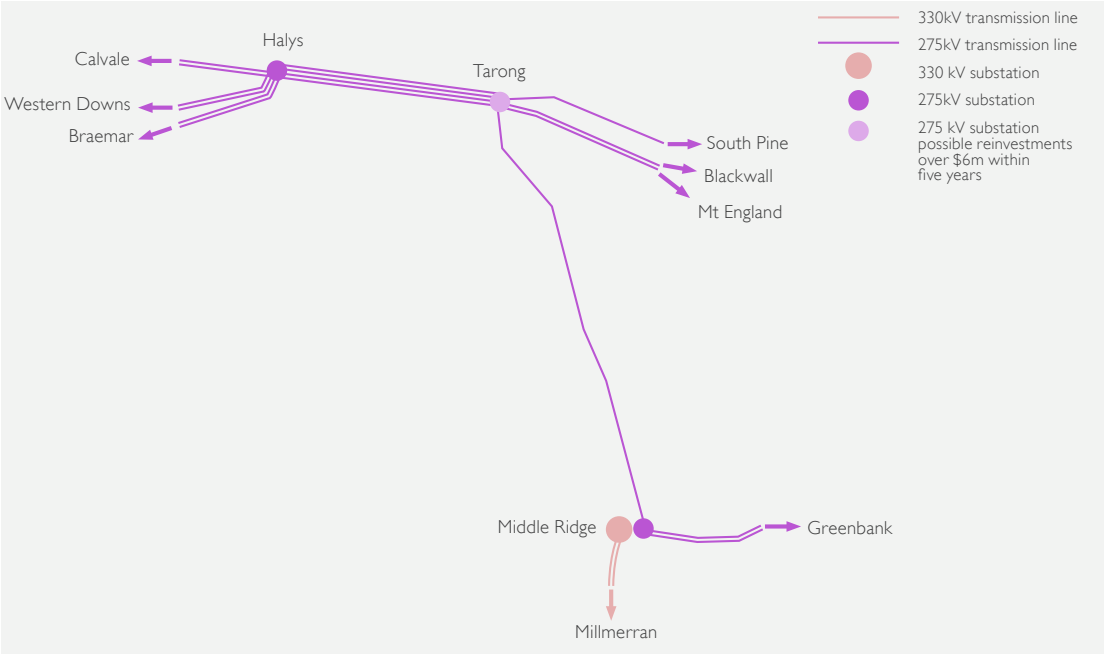
Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 275kV transmission line between Gin Gin and Woolooga substations	Refit the 275kV transmission line between Gin Gin and Woolooga substations	Maintain supply to the Wide Bay zone	June 2027	Rebuild the 275kV transmission line between Gin Gin and Woolooga substations	$40m
Line refit works on the 275kV transmission line between South Pine and Palmwoods substations	Line refit works on steel lattice structures	Maintain supply to the Wide Bay zone	December 2027	Rebuild 275kV transmission line between South Pine and Palmwoods substations	$12m
Rebuild the 275kV transmission lines between Wurdong Tee and Gin Gin Substation	Double circuit rebuild of the 275kV transmission line between Wurdong Tee and Gin Gin Substation	Maintain supply to the Wide Bay zone	June 2029	Refit the 275kV transmission line between Wurdong Tee and Gin Gin Substation	$130m
Substations					
Woolooga SVC secondary systems replacement	Replacement of secondary systems of the SVC	Maintain supply to the Moreton zone	June 2026	Staged replacement of secondary systems of the SVC	$6m
Teebar Creek secondary systems replacement	Full replacement of 132kV and 275kV secondary systems	Maintain supply to the Moreton zone	June 2027	Selective replacement of 132kV and 275kV secondary systems	$14m
Woolooga 275kV and 132kV secondary systems replacement	Full replacement of 132kV and 275kV secondary systems (including SVC)	Maintain supply to the Moreton zone	June 2029	Selective replacement of 132kV and 275kV secondary systems	$25m

Possible asset retirements within the 10-year outlook period

Current planning analysis has not identified any potential asset retirements in the Wide Bay zone within the next five years

5.7.7 South West zone

Figure 5.10 South West area network



Existing network

The South West zone is defined as the Tarong and Middle Ridge areas west of Postman's Ridge (refer to Figure 5.10).

Possible load driven limitations

Based on the medium economic load forecast defined in Chapter 2, there is no additional capacity forecast to be required as a result of network limitations in the South West zone within the next five years to meet reliability obligations.

Possible network reinvestments within five years

Network reinvestments in South West zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the South West zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Substations

Tarong 275kV Substation

Tarong Substation is located in the South West Queensland transmission network and is a critical part of the 275kV network supplying South East Queensland. Located approximately 130km north-west of Brisbane, Tarong Substation is a major part of the 275kV transmission backbone connecting generators to the major load centres in the south-east of the State. It also provides the major injection point for local, rural and bulk mining loads in south-west Queensland.

The Tarong Substation was established in conjunction with the Tarong Power Station in 1982. The substation consists of one switchyard of 275kV operating voltage and one switchyard of 132kV and 66kV operating voltages. Powerlink owns the 275kV, 132kV and 66kV assets on site.

Potential consultation: Maintain supply reliability in the South West zone and Tarong 66kV load

Project driver

Emerging condition risks arising from the condition of the existing 275/66kV and 275/132kV transformers.

Project timing: June 2024

Possible network solutions

- Maintain network topology by replacement of the two 275/66kV and two 275/132kV transformers
- Network reconfiguration by replacement of the two 275/66kV and decommissioning the two 275/132kV transformers
- Network reconfiguration by replacement of the two 275/66kV and one 275/132kV transformers (while decommissioning the other)
- Network reconfiguration by replacement of one 275/132kV and decommissioning the two 275/66kV transformers and replacing with two 132/66kV transformers

Proposed network solution: Network reconfiguration by replacement of the two 275/66kV transformers at an estimated cost of $16 million by June 2024. The two 275/132kV transformers are to be decommissioned.

Compared to the 2018 TAPR, the increase in the estimated cost of the proposed network solution is based upon updated information in relation to the construction costs of recently completed projects.

Possible non-network solutions

To replace the functionality of both of the existing transformers, a non-network solution would be required to provide up to 40MW and up to 850MWh per day on an ongoing basis to meet the requirements of Powerlink's planning criteria.

To replace the functionality of one of the existing transformers, a non-network solution would be required to provide up to 40MW and up to 850MWh per day on a continuous basis following an outage of the transformer, and to be in-service within six hours following a contingency to meet the requirements of Powerlink's reliability criteria. The network support would also be required to provide supply for planned outages.

The non-network solution must also be able to provide auxiliary supply to Tarong Power Station, which can be up to 38MVA.

Possible network reinvestments in the South West zone within five years

Against the backdrop of a rapidly changing electricity sector, Powerlink's planning overview (10-year outlook period of the TAPR) includes consideration of a broad range of options to address the identified needs in the South West zone. As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 5.19 will be subject to detailed planning to confirm alignment with future reinvestment, optimisation and delivery strategies. This near-term analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works and deliver greater benefits to customers. This will be achieved through improving and further refining options or considering other options, including the associated delivery strategies, from those described in Table 5.19. Information in relation to potential projects, alternatives and possible commissioning needs will be revised annually within the TAPR based on the latest information available at the time.

Table 5.19 Possible network reinvestments in the South West zone within five years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
Chinchilla 132kV primary plant replacement (3)	Reduced scope replacement and transformer ending from Columboola	Maintain supply reliability in the South West zone	June 2024	Replacement of the entire 132kV switchyard	$5m
Tarong 275/66kV transformers replacement	Replacement of 275/66kV transformers and decommissioning the 275/132kV transformers at Tarong Substation (2)	Maintain supply reliability in the South West zone	December 2024	Refurbishment of existing transformers (1)	$16m
Tarong 275kV primary plant replacement	Selected replacement of 275kV primary plant	Maintain supply reliability in the South West zone	June 2025	Full replacement of 275kV primary plant	$2m

Note:

(1) The envelope for non-network solutions is defined in Section 5.7.7.

(2) Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget.

(3) Based on the most recent analysis and understanding of the risks arising from the condition of the primary plant at Chinchilla Substation, the proposed network solution has been advanced from the possible commissioning date of December 2026 as advised in the 2018 TAPR.

Possible network reinvestments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the South West zone from around 2025/26 to 2029/30 (refer to Table 5.20).

Table 5.20 Possible network reinvestments in the South West zone within six to 10 years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
Chinchilla 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability in the South West zone	December 2026	Staged replacement of 132kV secondary system	$4m
Oakey 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the South West zone	June 2028	Staged replacement of 110kV secondary system	$3m

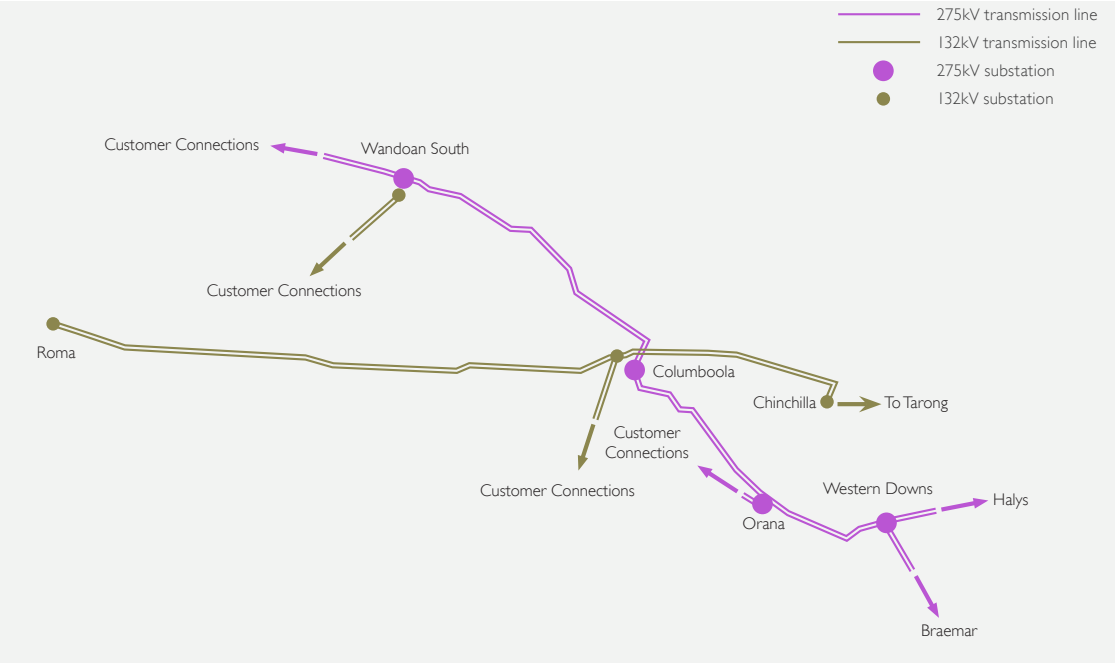
Possible asset retirements within the 10-year outlook period[15]

Condition assessment has identified emerging condition risks arising from the condition of two 275/132kV transformers at Tarong Substation by 2024. Planning studies have confirmed the potential to subsequently retire both transformers based on the medium economic load forecast in Chapter 2. On this basis, it is considered likely the 275/132kV transformers at Tarong Substation will be retired at end of technical service life.

Condition assessment has identified emerging condition risks arising from the condition of 132kV primary plant at Chinchilla Substation by 2024. At this time, an option would be a reduced scope replacement that would involve transformer ending from Columboola 132kV Substation, and retirement of the 132kV primary plant arising from the connection to Tarong Substation.

5.7.8 Surat zone

Figure 5.11 Surat Basin North West area transmission network



Existing network

The Surat Basin Zone is defined as the area north west of Western Downs Substation. The area has significant development potential given the vast reserves of gas and coal and more recently VRE. Electricity demand in the area is forecast to continue to grow due to new developments of VRE projects, CSG upstream processing facilities by multiple proponents, together with the supporting infrastructure and services (refer to Figure 5.11).

Possible load driven limitations

Based on the medium economic load forecast defined in Chapter 2, there is no additional capacity forecast to be required as a result of network limitations in the Surat zone within the next five years to meet reliability obligations.

Possible network reinvestments within the 10-year outlook period

There are no reinvestment requirements within the 10-year outlook period.

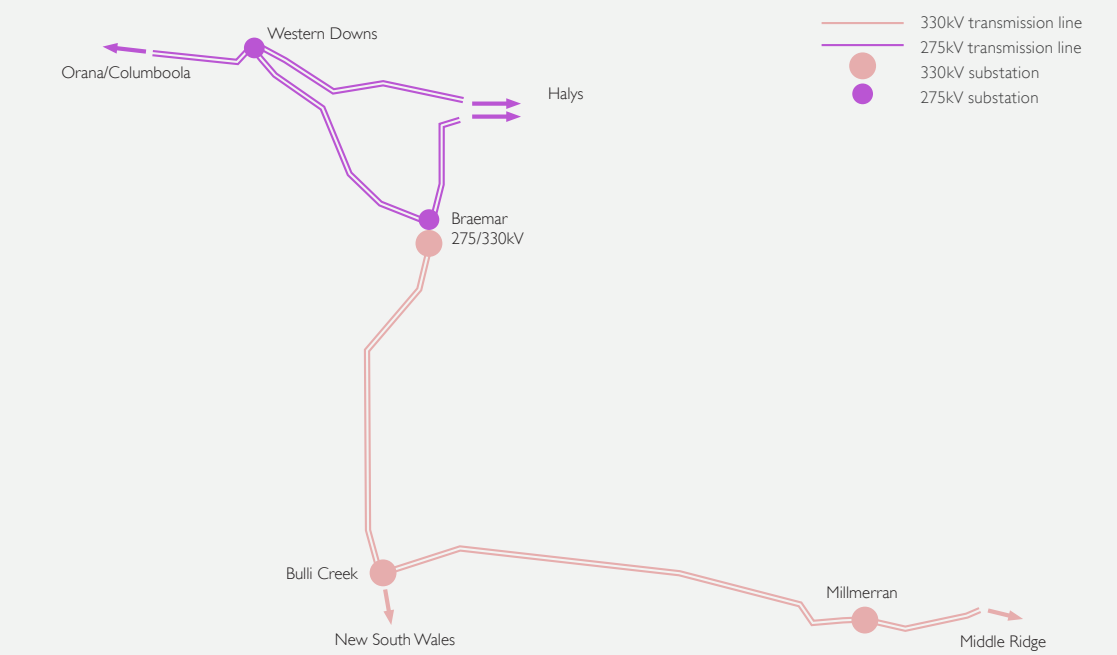
Possible asset retirements within the 10-year outlook period

Current planning analysis has not identified any potential asset retirements in the South West zone within the 10-year outlook period.

[15] Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget.

5.7.9 Bulli zone

Figure 5.12 Bulli area transmission network



Existing network

The Bulli Zone is defined as the area surrounding Goondiwindi and the 275/330kV network south of Kogan Creek and west of Millmerran (refer to Figure 5.12).

Possible load driven limitations

Based on the medium economic load forecast defined in Chapter 2, there is no additional capacity forecast to be required as a result of network limitations in the Bulli zone within the next five years to meet reliability obligations.

Possible network reinvestments in the Bulli zone within five years

Against the backdrop of a rapidly changing electricity sector, Powerlink's planning overview (10-year outlook period of the TAPR) includes consideration of a broad range of options to address the identified needs in the Bulli zone. As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 5.21 will be subject to detailed planning to confirm alignment with future reinvestment, optimisation and delivery strategies. This near-term analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works and deliver greater benefits to customers. This will be achieved through improving and further refining options or considering other options, including the associated delivery strategies, from those described in Table 5.21. Information in relation to potential projects, alternatives and possible commissioning needs will be revised annually within the TAPR based on the latest information available at the time.

Table 5.21 Possible network reinvestments in the Bulli zone within five years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
Bulli Creek 132kV secondary systems replacement	Selected replacement of secondary systems	Maintain supply reliability in the Bulli zone	June 2025	Full replacement of secondary systems	$2m

Possible network reinvestments within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Bulli zone from around 2025/26 to 2029/30 (refer to Table 5.22).

Table 5.22 Possible network reinvestments in the Bulli zone within six to 10 years

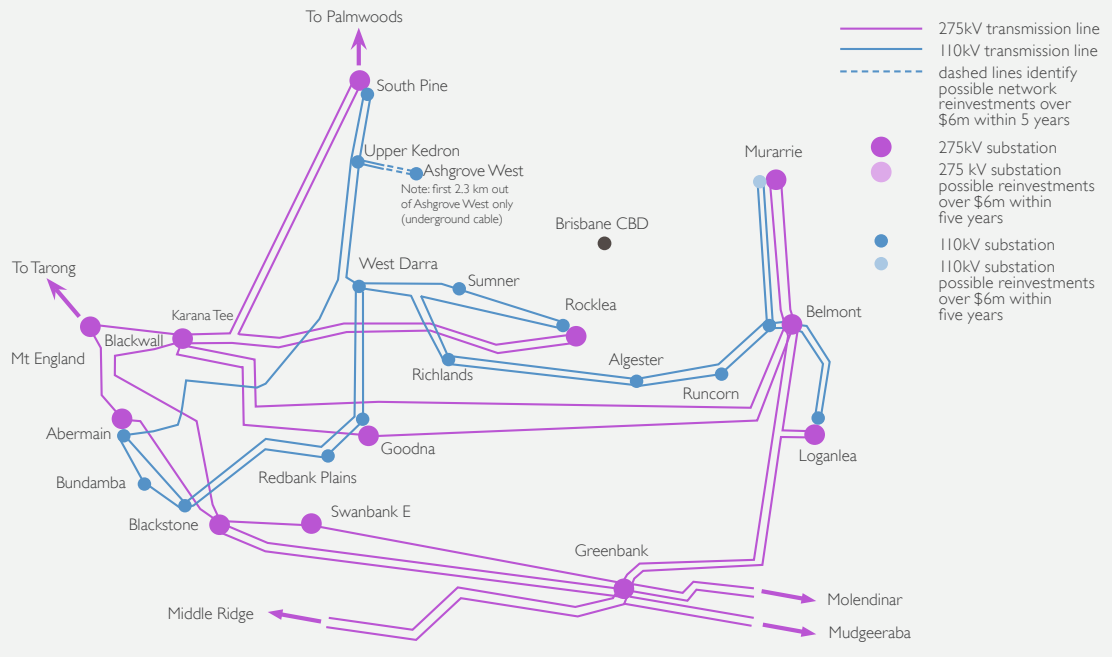
Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
Middle Ridge 275kV and 110kV secondary systems replacement	Full replacement of secondary systems	Maintain supply reliability in the Bulli zone	December 2025	Selected replacement of secondary systems	$41m
Middle Ridge 110kV primary plant replacement	Replacement of primary plant in transformer bays	Maintain supply reliability in the Bulli zone	June 2026	Refurbishment of primary plant in transformer bays	$3m
Millmerran 330kV AIS secondary systems replacement	Selected replacement of secondary systems	Maintain supply reliability in the Bulli zone	June 2027	Full replacement of secondary systems	$5m
Bulli Creek transformer replacement	Replace one 330/132kV transformer at Bulli Creek Substation	Maintain supply reliability in the Bulli zone	December 2028	Retirement of 330/132kV transformers with non-network support	$7m

Possible asset retirements within the 10-year outlook period

Current planning analysis has not identified any potential asset retirements in the Bulli zone within the 10-year outlook period.

5.7.10 Moreton zone

Figure 5.13 Greater Brisbane transmission network



Existing network

The Moreton zone includes a mix of 110kV and 275kV transmission networks servicing a number of significant load centres in SEQ, including the Sunshine Coast, greater Brisbane, Ipswich and northern Gold Coast regions (refer to Figure 5.13).

Future investment needs in the Moreton zone are substantially arising from the condition and performance of 110kV and 275kV assets in the greater Brisbane area. The 110kV network in the greater Brisbane area was progressively developed from the early 1960s and 1970s, with the 275kV network being developed and reinforced in response to load growth from the early 1970s. Multiple Powerlink 275/110kV injection points now interconnect with the Energex network to form two 110kV rings supplying the Brisbane Central Business District (CBD).

Possible load driven limitations

Based on the medium economic load forecast defined in Chapter 2, there is no additional capacity forecast to be required as a result of network limitations in the Moreton zone within the next five years to meet reliability obligations.

Possible network reinvestments within five years

Network reinvestments in Moreton zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the Moreton zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission lines

The 110kV and 275kV transmission lines in the greater Brisbane area are located between 20km and 40km from the coast, traversing a mix of industrial, high density urban and semi-urban areas. The majority of assets are reasonably protected from the prevailing coastal winds and are exposed to moderate levels of pollution related to the urban environment. These assets have, over time, experienced structural corrosion at similar rates, with end of technical service life for most transmission line assets expected to occur between 2020 and 2025.

With the maximum demand forecast relatively flat in the next five years, and based on the development of the network over the last 40 years, planning studies have identified a number of 110kV transmission line assets that could potentially be retired. Given the uncertainty in future demand growth, Powerlink proposes to implement low cost maintenance strategies to keep the transmission lines in-service for a reasonable period. Future decommissioning remains an option once demand growth is better understood.

Detailed analysis will be ongoing to evaluate the possible retirement of the following transmission lines at the end of technical service life:

- West Darra to Upper Kedron
- West Darra to Goodna
- Richlands to Algester.

This ongoing review, together with further joint planning with Energex, may result in a future RIT-T in the 2020s.

Underground 110kV cable between Upper Kedron and Ashgrove West

Potential consultation: Maintain reliability of supply to the Brisbane metropolitan area

The 110kV transmission line between Upper Kedron and Ashgrove West substations was established in 1978, as one of the principle sources of supply to the north-west Brisbane area. Predominantly an overhead transmission line, with the final 2.3km long section to Ashgrove West Substation being an underground cable.

Project driver

Emerging condition, end of technical service life and compliance risks for the Upper Kedron to Ashgrove West oil-filled cables.

Project timing: June 2024

Possible network solutions

- Replacement of the existing cables with new cables in a new easement by June 2024. Replacement of the existing cables with new cables from Rocklea
- Replacement of existing cables with new cables in the existing easement by June 2024.

Proposed network solution: Replacement of the oil-filled cables with new cables in a new easement at an estimated cost of $13 million by June 2024

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

The Upper Kedron to Ashgrove West cables provide supply of up to 220MVA at peak to Brisbane's inner north-west suburbs. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Substations

Redbank Plains 110kV Substation

Potential consultation: Maintaining power transfer capability and reliability of supply at Redbank Plains Substation

Redbank Plains Substation was established to provide electricity to the expanding communities west of Brisbane in 1986 and serves as a bulk supply injection point to the Energex distribution network.

Project driver

Addressing the 110kV primary plant condition risks.

Project timing: June 2024

Possible network solutions

- Replacement of selected 110kV primary plant by June 2024.
- Full replacement of 110kV primary plant by June 2024.

Project driver

Emerging condition driven risks arising from the condition of the existing 110/11kV transformers.

Redbank Plains 110/11kV 25MVA transformers 1 and 2 were installed onsite in 1985 and 1984 respectively. The transformers exhibit aged paper insulation and increased moisture levels in oil, possibly due to the numerous oil leaks from the main tanks. The high voltage bushings are the original porcelain housed oil insulated paper bushings, which have been in service well past their 25 year technical service life. The paint on the main tank is also compromised and does not provide adequate protection.

Project timing: June 2024

Possible network solutions

- Replace both 110/11kV transformer by June 2024.
- Replace one 110/11kV transformer and engage non-network support by June 2024.

Proposed network solution: Replacement of selected 110kV primary plant and both 110/11kV transformers at Redbank Plains Substation at an estimated cost of $10 million by June 2024.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Non-network solutions may include, but are not limited to, local generation or demand side management initiatives on the 11kV network in the area. Any non-network solution would need to be available on a firm basis and provide support to the 11kV network of up to 25MW and up to 400MWh per day.

Murarrie 275/110kV Substation secondary systems replacements

Anticipated consultation: Addressing the secondary systems condition risks at Murarrie

Murarrie Substation was established in 2003 as a bulk supply point to service the industrial load around the Brisbane River and port areas. Murarrie secondary systems were commissioned between 2003 and 2006.

Project driver

Emerging condition and compliance risks arising from the 110kV secondary systems at Murarrie Substation.

Project timing: December 2023

Possible network solutions

- Full replacement of all of the 110kV secondary systems upfront by December 2023.
- Staged replacement on 110kV secondary systems by December 2023.

Proposed network solution: Full replacement of the 110kV secondary systems at Murarrie Substation at an estimated cost of $21 million by December 2023

Compared to the 2018 TAPR, the decrease in the estimated cost of the proposed network solution is based upon updated information in relation to the construction costs of recently completed projects.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Murarrie Substation provides injection and switching to the CBD and south-eastern suburbs of Brisbane of over 300MW at peak. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Possible network reinvestments in the Moreton zone within five years

Against the backdrop of a rapidly changing electricity sector, Powerlink's planning overview (10-year outlook period of the TAPR) includes consideration of a broad range of options to address the identified needs in the Moreton zone. As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 5.23 will be subject to detailed planning to confirm alignment with future reinvestment, optimisation and delivery strategies. This near-term analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works and deliver greater benefits to customers. This will be achieved through improving and further refining options or considering other options, including the associated delivery strategies, from those described in Table 5.23. Information in relation to potential projects, alternatives and possible commissioning needs will be revised annually within the TAPR based on the latest information available at the time.

Table 5.23 Possible network reinvestments in the Moreton zone within five years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission Lines					
Replacement of the 110kV underground cable between Upper Kedron and Ashgrove West substations	Replace the 110kV underground cable between Upper Kedron and Ashgrove West substations using an alternate easement	Maintain supply reliability in the Moreton zone	June 2024	Replace the 110kV underground cable between Upper Kedron and Ashgrove West substations using the existing easement (1)	$13m
Line refit works on the 275kV transmission line between Belmont and Murarrie substations	Line refit works on steel lattice structures	Maintain supply reliability in the Moreton zone	June 2025	New 275kV transmission line/s	$2m
Substations					
Redbank Plains 110kV primary plant and 110/11kV transformers replacement	Selective replacement of 110kV primary plant and replacement of two 110/11kV transformers	Maintain reliability of supply at Redbank Plains Substation	June 2024	Full replacement of 110kV primary plant, replace one 110/11kV transformer and engage non-network support (1)	$10m
Murarrie 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the CBD and Moreton zone	December 2023	Staged replacement of 110kV secondary systems (1)	$21m
Mt England 275kV secondary systems replacement	Full replacement of 275kV secondary systems	Maintain supply reliability in the Moreton zone	December 2022	Selective replacement of 275kV secondary systems	$5m

Note:

(1) The envelope for non-network solutions is defined in Section 5.7.10.

Possible network reinvestments in the Moreton zone within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Moreton zone from around 2025/26to 2029/30 (refer to Table 5.24).

Table 5.24 Possible network reinvestments in the Moreton zone within six to 10 years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 275kV transmission line between Karana Downs and South Pine	Refit the 275kV transmission line between Karana Downs and South Pine substations	Maintain supply reliability in the Moreton zone	December 2025	Rebuild the 275kV transmission line between Karana Downs and South Pine substations	$8m
Line refit works on the 110kV transmission line between West Darra and Upper Kedron substations	Refit the 110kV transmission line between West Darra and Upper Kedron substations (2)	Maintain supply reliability in the Moreton zone	December 2026	Potential retirement of the transmission line between West Darra and Upper Kedron substations	$5m
Line refit works on the 110kV transmission lines between Swanbank, Redbank Plains and West Darra	Refit the 110kV transmission lines between Swanbank, Redbank Plains and West Darra	Maintain supply reliability in the Moreton zone	December 2026	Rebuild the 110kV transmission lines between Swanbank, Redbank Plains and West Darra	$6m
Line refit works on the 110kV transmission line between South Pine and Upper Kedron substations	Refit the 110kV transmission line between South Pine and Upper Kedron substations	Maintain supply reliability in the Moreton zone	June 2028	Replacement of the transmission line between South Pine and Upper Kedron substations	$4m
Line refit works on the 110kV transmission line between Richlands and Algester substations	Refit the 110kV transmission line between Richlands and Algester substations (2)	Maintain supply reliability in the Moreton zone	June 2026	Potential retirement of the transmission line between Richlands and Algester substations	$2m
Line refit works on the 110kV transmission line between Blackstone and Abermain substations	Refit the 110kV transmission line between Blackstone and Abermain substations (2)	Maintain supply reliability in the Moreton zone	December 2026	Rebuild the 110kV transmission line between Blackstone and Abermain substations	$6m
Line refit works on the 110kV transmission line between Rocklea to Sumner to West Darra	Line refit works on steel lattice structures	Maintain supply reliability in CBD and Moreton Zone	June 2028	New 110kV transmission line/s (1)	$5m

Table 5.24 Possible network reinvestments in the Moreton zone within six to 10 years *(continued)*

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Line refit works on the 275kV transmission line between Bergins Hill and Karana Downs	Refit the 275kV transmission line between Bergins Hill and Karana Downs substations	Maintain supply reliability in the Moreton zone	June 2026	Replacement of the transmission line between Bergins Hill and Karana Downs substations	$4m
Substations					
South Pine 275/110kV transformer replacement	Replacement of a single 275kV/110kV transformer	Maintain supply reliability in the Moreton zone	December 2025	Retirement of a single 275kV/110kV transformers with non-network support	$6m
South Pine primary plant replacement	Selective replacement of 275kV primary plant	Maintain supply reliability in the Moreton zone	June 2026	Full replacement of primary plant	$12m
South Pine SVC secondary systems replacement	Replacement of the South Pine 275kV SVC secondary systems	Maintain supply reliability in the Moreton zone	June 2027	Staged replacement of 275kV SVC secondary systems	$6m
Ashgrove West 110kV secondary systems replacement	Staged replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	June 2026	Full replacement of 110kV secondary systems	$6m
Sumner 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	June 2026	Staged replacement of 110kV secondary systems	$4m
Algester 110kV secondary systems replacements	Full replacement of 110kV Algester secondary systems	Maintain supply reliability in the Moreton zone	June 2028	Staged replacement of 110kV secondary systems	$10m
West Darra 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	December 2027	Staged replacement of 110kV secondary systems	$10m
Rocklea 275/110kV transformer replacement	Replacement of one 275/110kV transformer at Rocklea	Maintain supply reliability in the Moreton zone	June 2029	Refurbishment of Rocklea transformer	$5m
Rocklea 110kV primary plant replacement	Full replacement of 110kV primary plant	Maintain supply reliability in the Moreton zone	June 2029	Selective replacement of 110kV primary plant	$13m
Loganlea 275kV primary plant replacement	Full replacement of 275kV primary plant	Maintain supply reliability in the Moreton zone	June 2029	Selective replacement of 275kV primary plant	$9m

Table 5.24 Possible network reinvestments in the Moreton zone within six to 10 years *(continued)*

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Goodna 110kV and 275kV secondary systems replacement	Full replacement of 110kV and 275kV secondary systems	Maintain supply reliability in the Moreton zone	June 2026	Staged replacement of 110kV and 275kV secondary systems	$16m
Bundamba 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	June 2028	Selective replacement of 110kV primary plant	$6m
Greenbank 275kV secondary systems replacement	Full replacement of 275kV secondary systems	Maintain supply reliability in the Moreton and Gold Coast zones	June 2027	Staged replacement of 275kV secondary systems (including SVC)	$25m
Greenbank SVC secondary systems replacement	Full replacement of SVC secondary systems	Maintain supply reliability in the Moreton and Gold Coast zones	December 2027		$6m

Note:

(1) Compared to the 2018 TAPR, the decrease in the estimated cost of the proposed network solution is based upon updated information in relation to the construction costs of recently completed projects.

(2) More detailed option analysis and consideration of the associated scope of works to address emerging condition risks on this transmission line has been undertaken since the publication of the 2018 TAPR. This new analysis has supported the development of new strategies and options providing an opportunity to deliver a more cost effective solution than previously identified, delivering better outcomes for customers.

Possible asset retirements within the 10-year outlook period

Loganlea 110/33kV transformer

Based on the condition of one of the 110/33kV transformers at Loganlea, it is proposed to retire this transformer at the end of technical service life by December 2021. Powerlink considers that this will not impact on the ability to meet the obligations of Powerlink's reliability criteria. Further joint planning will be undertaken prior to a final decision being made.

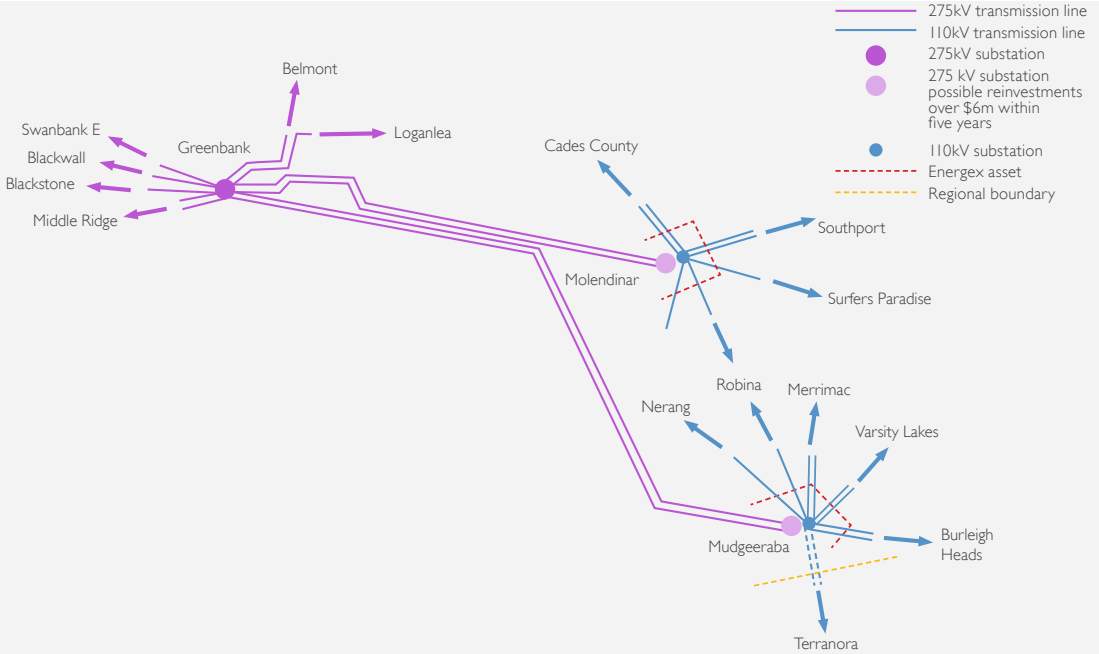
Belmont 275/110kV transformers

Based on the condition of the two transformers at Belmont Substation, Powerlink proposes to retire two of the four 275/110kV transformers by December 2020.

Since publication of the 2018 TAPR, it has been confirmed that retirement of these transformers will not result in load at risk in the Brisbane area. Powerlink considers the retirement of these two transformers will not have a material inter-network impact or a material impact to network users.

5.7.11 Gold Coast zone

Figure 5.14 Gold Coast transmission network



Existing network

The Powerlink transmission system in the Gold Coast was originally constructed in the 1970s and 1980s. The Molendinar and Mudgeeraba substations are the two major injection points into the area (refer to Figure 5.13) via a double circuit 275kV transmission line between Greenbank and Molendinar substations, and two single circuit 275kV transmission lines between Greenbank and Mudgeeraba substations (refer to Figure 5.14).

Possible load driven limitations

Based on the medium economic load forecast defined in Chapter 2, there is no additional capacity forecast to be required as a result of network limitations in the Gold Coast zone within the next five years to meet reliability obligations.

Possible network reinvestments within five years

Network reinvestments in Gold Coast zone are related to addressing the risks arising from the condition of the existing network assets, which without corrective action, would result in Powerlink being exposed to breaching a number of its jurisdictional network, safety, environmental and Rules' obligations.

By addressing the condition of these existing assets, Powerlink is seeking to ensure it can safely deliver an adequate, economic, and reliable supply of electricity to meet the load requirements of customers in the Gold Coast zone into the future. This may result in like-for-like replacement, non-network solutions, network reconfiguration, asset retirement, line refit or replacement with an asset of lower capacity.

Transmission lines

Greenbank to Mudgeeraba 275kV transmission lines

Potential consultation: Maintain reliability of supply to the southern Gold Coast area

The two 275kV single circuit transmission lines were constructed in the mid-1970s and support the supply to Gold Coast and northern NSW.

Project driver

Emerging condition driven risks related to an unacceptable level of corrosion.

Project timing: December 2026

Possible network solutions

Feasible network solutions to address the risks arising from these transmission lines may include:

- Maintaining the existing 275kV transmission line topography and capacity by way of a targeted line refit by December 2026.
- Replacement at the end of technical service life of the existing single circuits between Mudgeeraba and Greenbank with a new double circuit line, through staged rebuild.
- Decrease in transfer capacity into the Gold Coast and rationalisation of the transmission lines supplying the Gold Coast through a combination of line refit projects and decommissioning of some assets.

Proposed network solution: Maintain the existing topography by way of a targeted line refit at an estimated cost of $36 million by December 2026

The increase in the estimated cost of the proposed network solution since 2018 TAPR is based upon more detailed option analysis and consideration of the associated scope of work to address the emerging condition risks. However, to ensure reliability of supply to customers, the required renewal works will be need to be completed in stages outside of summer peak load and outage co-ordination will be complex due to the significant renewal program in the Gold Coast area within the 10-year outlook. Due to these challenges it has been identified that an extended delivery timeframe of at least four years would be required.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

The Greenbank to Mudgeeraba 275kV transmission lines provide injection to the southern Gold Coast and northern NSW area of over 250MW at peak. Powerlink is not aware of any non-network proposals in this area that can address this requirement in its entirety. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Substations

Mudgeeraba 275/110kV Substation

Network requirement: Maintaining reliability of supply to the southern Gold Coast area

Mudgeeraba 110kV Substation was established in 1972 and extended from the 1980s to 2000s due to load growth and is located within the southern end of zone of the Gold Coast. Further extensions included the establishment of a 275kV switchyard and associated secondary systems in 1992, which was further expanded in 2002. Mudgeeraba 275/110kV Substation is one of two 275kV injection points on the Gold Coast and is a major connection point for supply to the Gold Coast and northern NSW with the 110kV substation supplying distribution points including Robina, Nerang, Broadbeach, Burleigh and Terranora.

275/110kV Transformers

Project driver

Emerging condition risks arising from the condition of one of the existing 275/110kV transformers.

Project timing: June 2020

Possible network solutions

- Decommission the transformer and uprate No.1 transformer bay and install high speed protection schemes by June 2020.
- Refurbish the transformer by June 2020, and decommission by 2022 as above.
- Replace the transformer by June 2020.

Proposed network solution: Decommission the transformer at an estimated cost of $3 million by June 2020

One of the original transformers was replaced in 2017, and the remaining existing transformer requires renewal or decommissioning by 2020. Powerlink has analysed possible network solutions through joint planning with Energex, Transgrid and Essential Energy. Planning studies have confirmed the potential to subsequently retire the remaining transformer given the current flat demand forecast. Powerlink proposes to retire the transformer by 2020 and considers the proposed network solution will not have a material inter-network impact or a material impact to network users.

275kV secondary systems

Mudgeeraba 275/110kV Substation

Anticipated consultation: Addressing the secondary systems condition risks at Mudgeeraba

Project driver

- Emerging condition risks arising from the condition of the 275kV secondary systems.
- The 275kV secondary systems at Mudgeeraba were commissioned between 2001 and 2004.

Project timing: December 2021

Possible network solutions

- Staged replacement of the secondary systems components by December 2021.
- Full replacement of all secondary systems by December 2021.

Proposed network solution: Full replacement of secondary systems at an estimated cost of $9 million by December 2021

Compared to the 2018 TAPR, the decrease in the estimated cost of the proposed network solution is based upon updated information in relation to the construction costs of recently completed projects.

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Mudgeeraba Substation provides injection and switching to the southern Gold Coast and northern NSW area of over 250MW at peak. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Molendinar 275/110kV Substation

Potential consultation: Maintaining reliability of supply at Molendinar substation

Project driver

- Emerging condition risks arising from the condition of the 275kV secondary systems.
- The 275kV secondary systems at Molendinar was originally established in 2003 and 2007, and is expected to reach the end of technical service life within the 10-year outlook.

Project timing: June 2024

Possible network solutions

- Staged replacement of all secondary systems components.
- Full replacement of all secondary systems.

Proposed network solution: Full replacement of all secondary systems at an estimated cost of $13 million by June 2024

Powerlink considers the proposed network solution will not have a material inter-network impact.

Possible non-network solutions

Molendinar Substation provides injection and switching to the northern Gold Coast area of over 250MW at peak. Powerlink would consider proposals from non-network providers that can significantly contribute to reducing the requirement in this region, as this may present opportunities in reconfiguring the network that would otherwise not be able to meet Powerlink's planning standard. Non-network solutions may include, but are not limited to local generation or DSM initiatives in the area.

Possible network reinvestments in the Gold Coast zone within five years

Against the backdrop of a rapidly changing electricity sector, Powerlink's planning overview (10-year outlook period of the TAPR) includes consideration of a broad range of options to address the identified needs in the Gold Coast zone. As assets approach their anticipated end of technical service life, the potential projects and alternatives (options) listed in Table 5.25 will be subject to detailed planning to confirm alignment with future reinvestment, optimisation and delivery strategies. This near-term analysis provides Powerlink with an additional opportunity to assess the needs and timing of asset replacement works and deliver greater benefits to customers. This will be achieved through improving and further refining options or considering other options, including the associated delivery strategies, from those described in Table 5.25. Information in relation to potential projects, alternatives and possible commissioning needs will be revised annually within the TAPR based on the latest information available at the time.

Table 5.25 Possible network reinvestments in the Gold Coast zone within five years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
Mudgeeraba 275kV secondary systems replacement	Full replacement of 275kV secondary systems (1)	Maintain supply reliability in the Gold Coast zone	December 2021	Staged replacement of 275kV secondary systems equipment	$9m
Molendinar 275kV secondary systems replacement	Full replacement of 275kV secondary systems	Maintain supply reliability in the Gold Coast zone	June 2024	Selected replacement of 275kV secondary systems (2)	$13m

Note:

(1) The scope of works, or the need to undertake this potential project, will rely upon the outcome of a RIT-T undertaken in the next one to two years.

(2) The envelope for non-network solutions is defined in Section 5.7.11.

Possible network reinvestments in the Gold Coast zone within six to 10 years

As a result of the annual planning review, Powerlink has identified that the following reinvestments are likely to be required to address the risks arising from network assets reaching end of technical service life and to maintain reliability of supply in the Gold Coast zone from around 2025/26 to 2029/30 (refer to Table 5.26).

Table 5.26 Possible network reinvestments in the Gold Coast zone within six to 10 years

Potential project	High level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 110kV transmission line between Mudgeeraba Substation and Terranora	Full line refit	Maintain supply reliability from Queensland to NSW Interconnector	December 2025	Targeted line refit New transmission line	$5m
Targeted line refit works on sections of the 275kV transmission line between Greenbank and Mudgeeraba substations	Targeted line refit works on steel lattice structures (1)	Maintain supply reliability in the Gold Coast zone	December 2026	New double circuit 275kV transmission line (2)	$36m
Substations					
Mudgeeraba 110kV secondary systems replacement	Partial replacement of 110kV secondary systems (3)	Maintain supply reliability in the Gold Coast zone	December 2025	Full replacement of 110kV secondary systems	$9m
Mudgeeraba 275kV and 110kV primary plant replacement	Full replacement of 110kV primary plant and selected 275kV equipment	Maintain supply reliability in the Gold Coast zone	December 2025	Staged replacement of 110kV primary plant in existing bays and selected 275kV equipment	$20m

Note:

(1) Compared to the 2018 TAPR, the increase in the estimated cost of the proposed network solution is based upon updated information in relation to required scope of works.

(2) The envelope for non-network solutions is defined in Section 5.7.11.

(3) The 2018 TAPR reported project cost of $2 million was a typographical error.

Possible asset retirements within the 10-year outlook period

Mudgeeraba 275/110kV Transformer

Recent investigations have highlighted emerging issues related to the condition of 275/110kV Transformer 3 at Mudgeeraba Substation which is reaching its end of technical service life in 2020.

Joint Planning studies have confirmed the potential to subsequently retire the transformer given the current flat demand forecast. Powerlink considers the proposed network solution will not have a material inter-network impact or a material impact to network users. Powerlink proposes to retire the third Mudgeeraba 275/110kV transformer at the end of technical service life anticipated around 2020. Operational works, such as asset retirements, do not form part of Powerlink's capital expenditure budget.

5.7.12 Supply demand balance

The outlook for the supply demand balance for the Queensland region was published in the AEMO 2018 Electricity Statement of Opportunities (ESOO)[16]. Interested parties who require information regarding future supply demand balance should consult this document.

5.7.13 Existing interconnectors

The Queensland transmission network is interconnected to the NSW transmission system through the QNI transmission line and Terranora Interconnector transmission line.

The QNI maximum southerly capability is limited by voltage stability, transient stability, oscillatory stability, and line thermal rating considerations (as detailed in Section 6.6.9).

The combined QNI plus Terranora Interconnector maximum northerly capability is limited by thermal ratings, voltage stability, transient stability and oscillatory stability (as detailed in Section 6.6.9).

The capability of these interconnectors can vary significantly depending on the status of plant, network conditions, weather and load levels in both Queensland and NSW. It is for these reasons that interconnector capability is regularly reviewed, particularly when new generation enters or leaves the market or transmission projects are commissioned in either region.

5.7.14 Expanding NSW-Queensland transmission transfer capacity

Preliminary assessment of the impact of dynamic changes in the external environment, including the upturn in VRE developments, has indicated that it could be technically and economically justified to expand the NSW to Queensland transmission capacity. TransGrid and Powerlink are undertaking joint planning relating to existing and forecast network congestion between Queensland and NSW. A RIT-T process to consider investment options on the QNI has now commenced. This process includes consideration of the ISP recommended Group 1 and Group 2 investments.

In November 2018, Powerlink and TransGrid released a PSCR on 'Expanding NSW-Queensland transmission transfer capacity', as the first step in the RIT-T process. This RIT-T is investigating options to increase overall net market benefits in the NEM through relieving congestion on the transmission network between NSW and Queensland. The PSCR outlines a range of credible options to meet the identified network need.

In addition, a variety of public submissions were received on network, non-network options or combinations of both following the PSCR. Powerlink and TransGrid are currently working through these submissions. Plausible options identified in submissions may supplement existing network or non-network options identified (including Group 1 and 2 projects). Due to the complexity of submissions, it is likely more modelling and analysis will be required.

Powerlink and TransGrid are currently performing power system analysis and market modelling to assess various network and non-network options. Findings will be published in the Project Assessment Draft Report (PADR) anticipated later in 2019.

The TAPR template for Expanding NSW-Queensland transmission transfer capacity is available on TransGrid's website.

[16] Updated by AEMO in September 2017.

5 Future network development