CHAPTER 5

Future network development

5 Future network development

Key highlights

- Market initiatives, such as the Integrated System Plan (ISP), have the potential to influence the future development and network topography of the transmission network in Queensland and the National Electricity Market (NEM) in the 10-year outlook period.
- Powerlink is responding to fundamental shifts in its operating environment by adapting its approach to investment decisions. 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.
- The Ross, Central West, Gladstone and Moreton zones have potential reconfiguration opportunities within the next five years.
- Powerlink anticipates a significant Regulatory Investment Test for Transmission (RIT-T) program for the replacement of network assets, particularly over the next two years.

Preface

AEMO will publish the inaugural ISP on 4 July 2018. The 2018 ISP is not the end of the process, but rather the first of many steps. Updates in successive years will improve analysis methodologies and take account of the dynamically changing nature of the power system and the need to continually innovate and evolve strategies.

As outlined in Section 3.3, Powerlink has worked closely with AEMO to support the development of the 2018 ISP. Modelling for the 2018 ISP included as its starting point the completed and committed projects defined in Section 9.2.

The objective of the ISP is to signal pathways for an integrated strategic plan. The plan must consider how the transmission system will continue to deliver reliability and security at the lowest long-term cost for consumers, in an environment of rapid technological transformation at both ends of the supply chain. The 2018 ISP signals these pathways under a range of scenarios. The objective is to determine a power system development pathway which is most robust to these different futures[1]. Common to all scenarios is the Queensland's commitment to a renewable energy target of 50% by 2030 (Queensland Renewable Energy Target (QRET)).

The ISP also considers the merits of different Renewable Energy Zones (REZ) and the role these may play in delivering long-term lowest costs for consumers. For these REZ the ISP explores what storage and transmission investment would be needed to support these developments.

The objective is to determine the optimal balance between a more interconnected NEM, which can reduce the need for local reserves and take advantage of regional diversity, thereby more efficiently sharing resources and services between regions, and a more regionally independent NEM with each region self-sufficient in system security and reliability.

As a Transmission Network Service Provider (TNSP) with jurisdictional planning responsibilities, Powerlink appreciates the national perspective that AEMO brings to the ISP analysis. Powerlink will build on this work taking into account regional considerations and joint planning with Distribution Network Service Providers (DNSP). Whilst generators will make investment decisions independently, the enhanced provision of information in the ISP will support their long-term decision making. This will contribute to achieving a coordinated approach to investment decisions, benefitting electricity consumers, while meeting emissions reduction targets.

5.1 Introduction

Powerlink Queensland as a TNSP in the 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.

[1] The ISP scenarios are outlined on AEMO's website.

The NER (Clause 5.12.2(c)(3)) requires the Transmission Annual Planning Report (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 or non-network alternatives. The NER (Clauses 5.12.2(c)(5)) also requires the TAPR to include information pertinent to all proposed:

- augmentations to the network
- replacements of network assets
- network asset retirements or asset-deratings that would result in a network constraint in the 10-year outlook period (NER 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[2] with potential to affect supply reliability including estimated load reductions required to defer these forecast limitations by 12 months (NER Clause 5.12.2(c)(4)(iii))
- 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 (NER 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) 2016 National Transmission Network Development Plan (NTNDP)[3]
- details in relation to the need to address the risks arising from ageing network assets remaining in-service and those limitations for which Powerlink Queensland intends to address or initiate consultation with market participants and interested parties
- 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

The most recent NTNDP was published by AEMO in December 2016. The focus of the NTNDP is to provide an independent, strategic view of the efficient development of the NEM transmission network over a 20-year planning horizon. The release of the 2017 NTNDP was deferred by the Australian Energy Regulator and will form part of the 2018 ISP to be published by AEMO in July 2018.

Due to the timing of the release of the ISP and subsequent overlap with the publication of the 2018 TAPR, where applicable Powerlink's 2019 TAPR will consider the expected outcomes of the ISP including:

- the demand and energy forecast
- discussion on Regulatory Investment Tests for Transmission (RIT-Ts) which may be required, either independently or jointly with other Network Service Providers (NSP).

[2] 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.

[3] The release of the 2017 NTNDP was deferred by the Australian Energy Regulator (AER) and will form part of the Integrated System Plan to be published by mid-2018. Powerlink has referred to the 2016 NTNDP as the most recent publication for the purpose of compliance with NER Clause 5.12.2(c)(6).

5 Future network development

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 Electricity (VRE) 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
- 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)
- existing network configuration
- condition 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.

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.
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 also 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 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 fundamental shifts in economic outlook, electricity consumer 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 taken a cautious approach in determining when it is appropriate to refit or replace ageing transmission assets and how to implement these works cost effectively. This approach is aimed at delivering better value to consumers.

The 10-year outlook period discussed in the 2018 TAPR runs from 2018/19 to 2028/29.

5.5 Forecast network limitations

As outlined in Section 1.7.1, under its Transmission Authority, Powerlink Queensland 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, Powerlink does not anticipate undertaking any significant augmentation works during this period other than those which could be triggered from economic drivers and/or the commitment of mining or industrial block loads (refer to Table 5.2). In Powerlink's Revenue Determination 2017-2022, the projects that would be triggered by these large loads were identified as contingent projects. These contingent projects and their triggers are discussed in detail in Section 7.2.

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 Regulatory Investment Test for Transmission (RIT-T) process. Solutions may include provision of network support from existing and/or new generators, demand side management initiatives (either from individual providers or aggregators) and network augmentations.

5.5.1 Summary of forecast network limitations within the next five years

Based on the medium economic load forecast in Chapter 2 there are no network limitations forecast to occur in Queensland in the next five years[4].

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 2017 TAPR which fall into this category in 2018.

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 Section 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, generally via the TAPR, on potential solutions to network limitations which may result in transmission network or non-network investments
- 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 non-network) is found to satisfy the RIT-T
- Alternatively, transmission investments maybe undertaken under the 'funded augmentation' provisions of the NER.

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

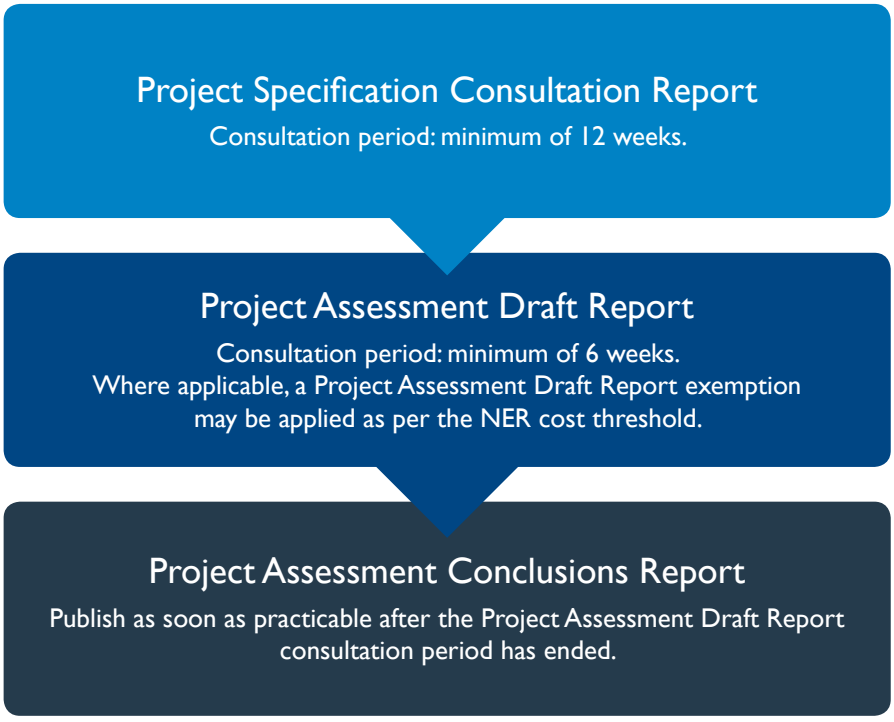
It should be noted that the information provided regarding Powerlink's network development plans may change and should therefore be confirmed with Powerlink before any action is taken based on the information contained in this TAPR.

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[5] to include the proposed replacement of network assets.

As a result, Powerlink anticipates a significant RIT-T program to address the risks arising from ageing network assets remaining in-service, particularly over the next two years. This initial 'heavier' program is due to the inclusion of public consultation into the planning timetable for proposed reinvestments in the nearer term (refer to Figure 5.1).

Figure 5.1 Overview of the RIT-T consultation process



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

The consultations currently under way are listed in Table 5.3. Registered Participants and interested parties are referred to consultation documents published on Powerlink's website for further information.

Table 5.3: Consultations currently under way

Consultation	Reference
Addressing the secondary systems condition risks at Dan Gleeson Substation	S5.7.2
Addressing the secondary systems condition risks at Baralaba Substation	S5.7.4
Maintaining reliability of supply to Ingham	S5.7.2

[5] Replacement expenditure planning arrangements Rule 2017 No. 5.

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 5.4 summarises consultations Powerlink anticipates undertaking within the next 12 months under the AER RIT-T to address either the proposed replacement of a network asset or limitation.

Table 5.4: Potential consultations in the forthcoming 12 months

Consultation	Reference
Maintaining reliability of supply at Kamerunga Substation	S5.7.1
Maintaining power transfer capability and reliability of supply at Ross Substation	S5.7.2
Maintaining reliability of supply between Strathmore and Townsville	S5.7.2
Maintaining reliability of supply at Townsville South Substation	S5.7.2
Addressing the secondary systems condition risks at Kemmis Substation	S5.7.3
Maintaining reliability of supply to the Rockhampton area	S5.7.4
Maintaining power transfer capability and reliability of supply at Lilyvale Substation	S5.7.4
Maintaining power transfer capability and reliability of supply at Bouldercombe Substation	S5.7.4
Addressing the secondary systems condition risks at Tarong Substation	S5.7.6
Addressing the secondary systems condition risks at Palmwoods Substation	S5.7.9
Maintaining reliability of supply to the Brisbane metropolitan area	S5.7.9
Addressing the secondary systems condition risks at Belmont Substation	S5.7.9
Addressing the secondary systems condition risks at Abermain Substation	S5.7.9
Maintaining reliability of supply to the southern Gold Coast area	S5.7.10
Expanding NSW-Queensland transmission transfer capacity	S5.7.12

5.6.3 Connection point proposals

Table 5.5 lists 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)[6] or be initiated by generators or customers.

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

Table 5.5 Connection point proposals

Potential project (1) (2)	Purpose	Zone
Kaban Wind farm	New wind farm	Far North
Kidston Hydro/Solar PV	New hydro generator with solar PV	Ross
Rollingstone Solar Farm	New solar farm	Ross
Majors Creek Solar Farm	New solar farm	Ross
Brampton Solar Farm	New solar farm	North
Rugby Run Solar Farm	New solar farm	North
Collinsville North Solar Farm	New solar farm	North
Burton Downs Mine	New mine	North
Ironbark Mine	New mine	North
Bouldercombe Solar Farm	New solar farm	Central West
Broadsound Solar Farm	New solar farm	Central West
Dingo Solar Farm	New solar farm	Central West
Dysart Solar Farm (RED)	New solar farm	Central West
Dysart Solar Farm (Dysart)	New solar farm	Central West
Rodds Bay Solar Farm	New solar farm	Gladstone
Lower Wonga Solar PV	New solar farm	Wide Bay
Dooroo Solar Farm	New solar farm	Surat
Columboola Solar Farm	New solar farm	Surat
Chinchilla Solar Farm	New solar farm	Surat
Beelbee Solar Farm	New solar farm	Bulli
Bulli Creek Solar PV	New solar farm	Bulli
Western Downs Solar Farm (Yellow)	New solar farm	Bulli
Western Downs Solar Farm (Neoen)	New solar farm	Bulli

Note:

(1) Table 5.5 lists the projects that are in the public domain, either as approved or through publication by the proponents. Powerlink does not include projects that are not public.

(2) 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.

5.7 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. Reinvestment in the transmission network to manage identified risks arising from these assets will form the majority of Powerlink's capital expenditure program of work moving forward.

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 and optimisation 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 and consumers.

Information regarding possible reinvestment alternatives and anticipated timing is updated annually within the TAPR and includes discussion on 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.

In addition, where technically feasible, Powerlink's Non-network Solution Feasibility Study process (refer to Section 1.9.2) will be applied to potential augmentations or network asset replacements which fall below the RIT-T cost threshold.

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.

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 temporarily or permanently de-rate some assets as part of the 2018 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 5.7.10) and separated into two periods:

- *Possible network reinvestments within five years*

  This includes the financial period from 2018/19 to 2023/24 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.

7 Refer to 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 2024/25 to 2028/29, 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.

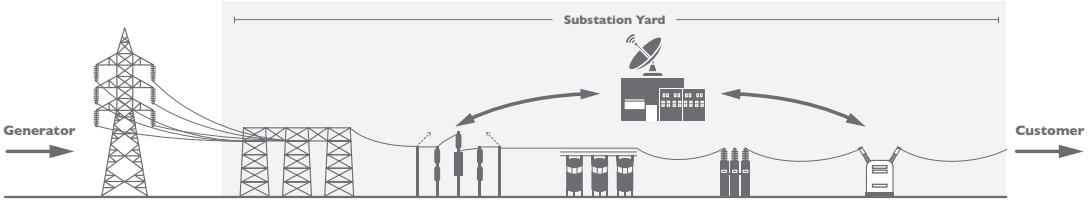
  In addition, due to the current dynamic operating environment, there is less certainty regarding the needs or drivers for reinvestments in these later years of the annual planning review period. As a result, considerations in this period have a greater potential to change when compared to near term investments. 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 necessary 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 2017 TAPR and 2018 TAPR. These timing differences are noted in the analysis of the program of work within this Chapter (refer to sections 5.7.1 to 5.7.10).

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.

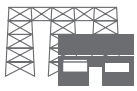
5 Future network development

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.

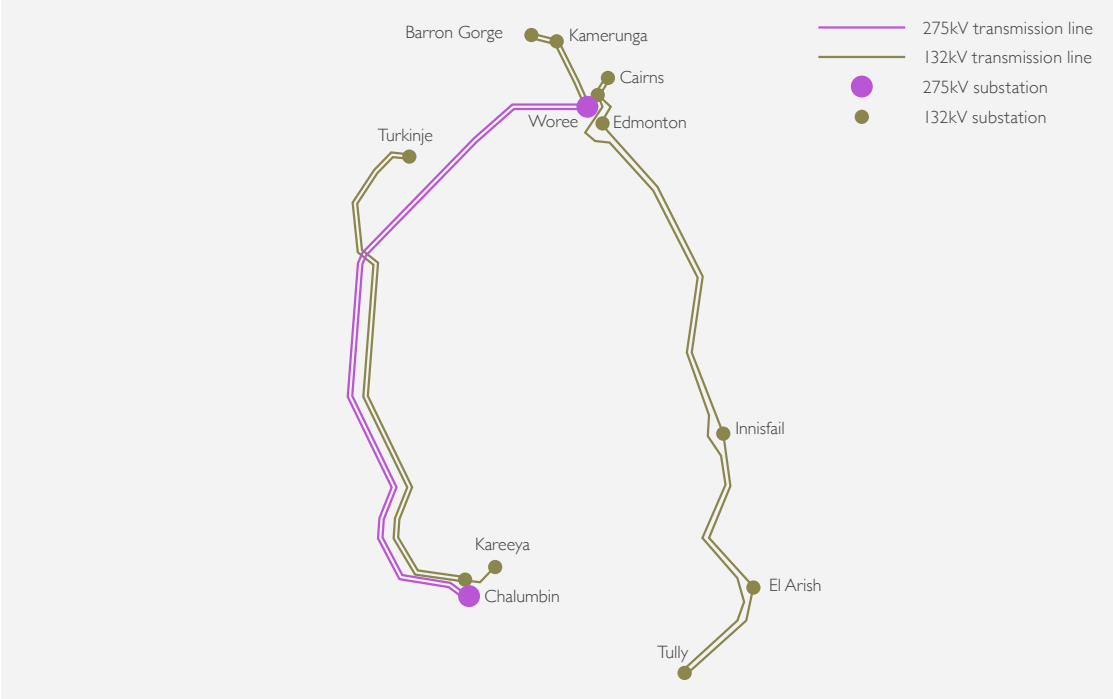
Telecommunication systems

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

Existing network

Figure 5.3 Far North zone transmission 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 in Chapter 2 there are no network limitations forecast to occur in the Far North zone within the next five years.

Possible network reinvestments within five years

Substations

Kamerunga 132/22kV Substation

Network requirement: 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: June 2021

Based on more recent analysis and assessment of the risks arising from the assets remaining in-service, the proposed network solution has been deferred by approximately 18 months to June 2021 compared to the possible commissioning date of summer 2019/20 as advised in the 2017 TAPR.

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 over the 10-year outlook period.
- Replacement of primary plant and secondary systems upfront by June 2021.
- Establishment of a new 132kV substation on an alternate site by June 2021.

Proposed network solution: Upfront replacement of all 132kV primary plant and secondary systems at an estimated cost of $21 million by June 2021

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 in the northern Cairns region. Any non-network solution would be required to be available on a firm basis to replace the network functionality provided by Kamerunga Substation. The substation provides supply to the 22kV network of up to 60MW, and up to 900MWh per day, on a continuous basis.

Woree 275/132kV Substation

Network requirement: Maintain power transfer capability and reliability of supply in Cairns

Woree Substation was established in 2002, initially with one 275/132kV transformer and 132kV switchyard, and was part of a major transmission network reinforcement to meet growing demand in the Cairns area.

Project driver:

Emerging condition, obsolescence and compliance risks for all of the 132kV secondary systems, and 275kV secondary systems associated with the establishment of the first 275/132kV transformer. The SVC secondary systems have also entered the discontinuation phase with only limited support and spares available.

Project timing: June 2022

Possible network solutions

- Replacement of selected 132kV, SVC and 275kV secondary systems by June 2022.
- Complete replacement of all secondary systems and associated panels by June 2022.

Proposed network solution: Replacement of selected secondary systems at an estimated cost of $19 million by June 2022

The change to the indicative costs of the proposed network solution from those identified in the 2017 TAPR is a result of the extension of the scope of works to address the risks arising from the SVC and selected 275kV secondary systems.

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

Possible non-network solutions

Woree Substation provides injection and switching 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, as such, the Woree SVC is considered vital to provide voltage support to this region.

Powerlink is not aware of any non-network proposals in the Cairns area that can address these requirements in their entirety and welcomes proposals from non-network providers that can significantly contribute to reducing the requirement in this region. Such proposals may present opportunities to reconfigure the network that could otherwise not be considered due to Powerlink's planning standard and obligations. Non-network solutions may include, but are not limited to, local generation or demand side management initiatives, and would be required to be available on a firm basis.

Cairns 132kV Substation

Network requirement: Maintain reliability of supply 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.

Project driver:

- One of the three 132/22kV transformers at Cairns Substation is approaching end of 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.
- Condition driven replacement to address emerging obsolescence and compliance risks on selected secondary systems.

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 132kV secondary systems at Cairns Substation in the existing or prefabricated building at an estimated cost of $8 million by June 2023

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 demand side management initiatives, and would be required to be available on a firm basis.

Table 5.6 Possible network reinvestments in the Far North zone within five years

Potential project	High-level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
Kamerunga Substation replacement	Full replacement of 132kV substation	Maintain supply reliability to the Far North zone	June 2021	Staged replacement of 132kV primary plant and secondary systems Non-network (1)	$21m
Woree 275kv and 132kV and SVC secondary systems replacement	Replacement of selected secondary systems equipment	Maintain supply reliability to the Far North zone	June 2022	Full replacement of all secondary systems Non-network (1)	$19m
Retirement of one 132/22kV Cairns transformer	Retirement of one 132kV Cairns transformer including primary plant reconfiguration works (2)	Maintain supply reliability to the Far North zone	December 2021	Replacement of the transformer	$0.5m (3)
Cairns secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	June 2023	Staged replacement of the 132kV secondary systems equipment Non-network (1)	$8m

Note:

(1) The envelope for non-network solutions is defined above in S5.7.1.

(2) 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.

(3) 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 2024/25 to 2028/29 (refer to Table 5.7).

Table 5.7 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
Transmission Lines					
Line refit works on the 275kV transmission lines between Chalumbin to Woree	Line refit works on 38 steel lattice structures	Maintain supply reliability to the Far North zone	December 2024	New transmission line	$13m
Woree to Kamerunga 132kV transmission line replacement	New 132kV double circuit transmission line	Maintain supply reliability to the Far North zone	December 2025	Two 132kV single circuit transmission lines	$30m
Substations					
Innisfail secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	December 2024	Replacement of selected secondary systems equipment	$8m
Tully 132/22kV transformer replacement	Replacement of the transformer	Maintain supply reliability to the Far North zone	June 2025	Refurbishment of the existing transformer	$4m
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
Chalumbin 275kV and 132kV primary plant and secondary systems replacement	Selected replacement of 275kV and 132kV primary plant and secondary systems	Maintain supply reliability to the Far North zone	June 2025	Full replacement of all 275kV and 132kV primary plant and secondary systems	$10m
Edmonton 132kV secondary systems replacement	Full replacement of 132kV secondary systems	Maintain supply reliability to the Far North zone	December 2026	Selected replacement of 132kV secondary systems	$8m
Turkinje 132kV primary plant replacement	Selected replacement of primary plant	Maintain supply reliability to the Far North zone	December 2027	Full replacement of primary plant	$6m

Possible asset retirements in the 10-year outlook period[9]

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 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.

[9] 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

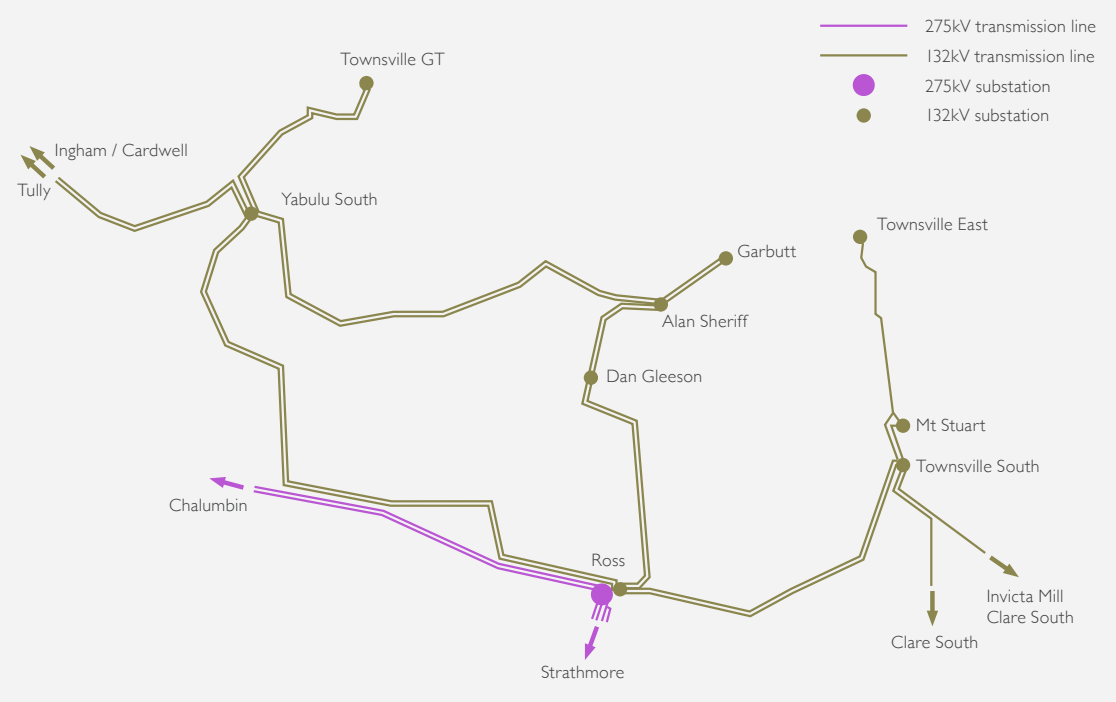


Figure 5.5 Southern Ross zone transmission network

5 Future network development

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 far north Queensland. 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 in Chapter 2 there are no network limitations forecast to occur in the Ross zone within the next five years.

Possible network reinvestments within five years

Transmission lines

Clare South to Townsville South 132kV transmission lines

Network requirement: Maintain reliability of supply between Strathmore and Townsville

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 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: June 2021

Taking into account the most recent analysis and understanding of the risks arising from 132kV transmission lines and network supply, the proposed network solution has been deferred by approximately 18 months to June 2021 compared to the possible commissioning date of summer 2019/20 as advised in the 2017 TAPR. 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 programmed for repair by micro piles in 2018.

Possible network solutions

Powerlink is considering a number of end of life strategies for the 275kV and 132kV transmission corridor and will holistically consider reliability of supply obligations and future network requirements as part of a RIT-T consultation. It has been identified that removal of one of the 132kV transmission lines between Townsville South and Clare South substations would require a substitute network or non-network solution to meet reliability obligations. A possible network solution to the resulting voltage limitation could include the installation of an additional transformer at Strathmore Substation.

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.

The RIT-T consultation is targeted to commence within the next 12 months and will assess a number of end of life strategies for the 132kV transmission lines between Townsville South and Clare South substations.

Feasible network solutions to address the risks arising from maintaining a reliable supply in the Townsville area include:

- 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 June 2021.
- Potential network reconfiguration through a combination of staged line refit projects and decommissioning of parts of the 132kV transmission lines by June 2021.

Proposed network solution: Reconfiguration through staged line refits and decommissioning of some assets at an estimated cost of $40 million, that may include:

- Structural refit of the coastal 132kV transmission line between Townsville South to Clare South substations by June 2021 at an estimated cost of $25 million.
- Decommission the inland 132kV transmission line between Townsville South to Clare South substations by June 2021 at an estimated cost of $10 million[10], as well as the installation of a transformer at Strathmore or Clare South substations by June 2021 at an estimated cost of $15 million.

Powerlink is currently analysing all possible network solutions, as part of an upcoming 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 and 1,000MWh in the Proserpine or Collinsville area. Non-network solutions may include, but are not limited to local generation, dynamic voltage support or demand side management.

Substations

Townsville South 132kV Substation

Network requirement: Maintaining reliability of supply at Townsville South 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.

132kV secondary systems

Project driver

Emerging condition, obsolescence and compliance risks arising from the 132kV secondary systems.

[10] 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.

Project timing: December 2021

Taking into account the most recent analysis and understanding of the risks arising from 132kV transmission lines and network supply, the proposed network solution has been deferred by approximately 18 months to December 2021 compared to the possible commissioning date of summer 2019/20 as advised in the 2017 TAPR.

Possible network solutions

- Complete replacement of all secondary systems and associated panels by December 2021.
- Staged replacement of all secondary systems and associated panels. The first stage would be completed by December 2021, followed by completion of a second stage in 2028.

Proposed network solution: Staged replacement of all secondary systems at Townsville South Substation at an estimated cost of $3 million by December 2021

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

132kV primary plant

Project driver

Emerging condition and compliance risks arising from the 132kV primary plant.

Project timing: December 2021

Possible network solutions

- Replacement of selected equipment in the existing bays by December 2021.
- Adjacent greenfield replacement of the entire switchyard by December 2021.

Proposed network solution: replacement of selected equipment of the 132kV primary plant at an estimated cost of $9 million at Townsville South Substation by December 2021

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

Possible non-network solutions

Townsville South Substation provides injection and switching to the central business district and south-eastern suburbs of Townsville of over 200MW at peak, as well as providing connection for over 450MW of generation.

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 demand side management initiatives in the area, and would be required to be available on a firm basis.

Dan Gleeson 132kV Substation

Network requirement: maintaining reliability of supply at Dan Gleeson Substation

Located in south-west Townsville, Dan Gleeson Substation is a major injection point into the Ergon Energy distribution network.

Project driver

Addressing the secondary systems condition risks at Dan Gleeson Substation.

Project timing: December 2020

Taking into account the most recent analysis and understanding of the risks arising from secondary systems at Dan Gleeson, the proposed network solution has been deferred by approximately 12 months to December 2020 compared to the possible commissioning date of summer 2019/20 as advised in the 2017 TAPR.

Possible network solutions

- Staged in-situ replacement of only those secondary systems components that are obsolete, using the existing building and secondary systems panels by December 2020.
- Complete replacement of all secondary systems and associated panels, using a prefabricated building with new secondary systems equipment and wiring preinstalled by December 2020.
- Staged replacement of all secondary systems and associated panels using a prefabricated building with new secondary systems equipment and wiring preinstalled. The first stage would occur by December 2020, followed by completion of a second stage in 2025.

Proposed network solution: complete replacement of all secondary systems at an estimated cost of $5.4 million by December 2020

In May 2018 Powerlink published a Project Specification Consultation Report (with Project Assessment Draft Report exemption) (PSCR) which identified complete replacement of all secondary systems by December 2020 at an estimated cost of $5.4 million as the proposed preferred option. Submissions to the PSCR close on 3 August 2018 and Powerlink anticipates publication of the Project Assessment Conclusions Report in September 2018.

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

Possible non-network solutions

Non-network solutions identified in the PSCR include the requirement to provide injection or demand response at Dan Gleeson, or into the meshed Townsville network in the vicinity of Dan Gleeson, of up to 50MW and up to approximately 850MWh per day. This requirement is based on the power transferred through the Dan Gleeson transformers through previous years, and accounting for steady demand in the future.

Ingham South 132/66kV Substation

Network requirement: Maintaining reliability of supply to Ingham

Ingham South Substation was established in 2005 to replace the original Ingham Substation and is critical to supply Ergon Energy's 66kV distribution network in the Ingham area. As a measure to minimise costs when the substation was established, two 132/66kV transformers from the Gladstone South Substation rebuild project were recovered and installed at Ingham South Substation.

Project driver

Emerging condition risks arising from the 132/66kV transformers.

Project timing: December 2019

Possible network solutions

- Life extension of both transformers by December 2019 followed by replacement with new transformers in 2032.
- Replacement of one transformer by December 2019 and life extension of the other transformer in December 2019, followed by its replacement in 2032.
- Replacement of both transformers with new transformers by December 2019.

Proposed network solution: Replacement of both transformers at Ingham South Substation at an estimated cost of $5.7 million by December 2019

In June 2018 Powerlink published a Project Specification Consultation Report (with Project Assessment Draft Report exemption) (PSCR) which identified replacement of both transformers by December 2019 at an estimated cost of $5.7 million as the proposed preferred option. Submissions to the PSCR close on 12 September 2018 and Powerlink anticipates publication of the Project Assessment Conclusions Report in November 2018.

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

Possible non-network solutions

Network support to supply the entire load at Ingham South would require injection to the 66kV network at Ingham of up to 20MW at peak and up to 300MWh per day on a continuous basis.

Alternative non-network options may include installation of a single 132/66kV transformer at Ingham South and:

- network support of up to 20MW and 300MWh per day
- dynamic voltage support of up to 15MVAr, and network support of up to 10MW and 110MWh per day.

Ross 275/132kV Substation

Network requirement: Maintaining power transfer capability and reliability of supply at Ross Substation

Ross Substation was established in the mid-1980s and is an essential switching station for 275kV power transfer into North and Far North Queensland, providing switching for five 275kV transmission lines from Strathmore and Chalumbin substations. Three 275/132kV bulk supply transformers provide connection to the 132kV switchyard. The 132kV switchyard provides supply to Townsville and surrounding areas through eight 132kV feeders connected from the Townsville South, Millchester, Alan Sherriff, Kidston and Yabulu South substations.

Project driver

Emerging condition risks arising from selective 275kV equipment and the majority of 132kV primary plant.

Project timing: December 2022

Possible network solutions

- Complete replacement of all 132kV bays and selective replacement of 275kV primary plant equipment bays by December 2022.
- Complete replacement of all 132kV and 275kV primary plant bays that have been identified to have equipment at risk of failure by December 2022.
- Complete replacement of the 132kV and 275kV switchyards at an adjacent site by December 2022.

Proposed network solution: Complete replacement of the 132kV bays and replacement of selective 275kV equipment in existing bays at an estimated cost of $24 million by December 2022

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

Possible non-network solutions

The Ross Substation provides an essential switching station for 275kV power transfer into North and Far north Queensland, with the 132kV switch yard providing supply to Townsville and the surrounding areas. The maximum demand at Ross Substation is forecast to approach 400MW.

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 demand side management initiatives in the area, and would be required to be available on a firm basis.

Table 5.8 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	Line refit works on steel lattice structures (1)	Maintain supply reliability in the Ross zone	June 2021	Line refit works on 132kV transmission line between Townsville South and Invicta, and additional reinforcement at Strathmore. New 132kV transmission line. Non-network (2)	$25m
Retirement of the inland 132kV transmission line between Clare South and Townsville South substations and network reconfiguration	Retirement of the transmission line and installation of a transformer at Strathmore Substation (2)	Maintain supply reliability in the Ross zone	June 2021	Targeted foundation repair on the 132kV transmission line, followed by line refit or decommissioning. New 132kV transmission line. Non-network (2)	$15m (4)
Substations					
Dan Gleeson 132kV secondary systems replacement	Full replacement of 132kV secondary systems (3)	Maintain supply reliability to the Ross zone	December 2020	Staged replacement of 132kV secondary systems equipment Non-network (2)	$5m
Townsville South 132kV primary and secondary systems replacement	Replacement of selective 132kV primary plant and staged replacement of 132kV secondary systems (1)	Maintain supply reliability to the Ross zone	December 2021	Full replacement of 132kV primary plant and secondary systems Non-network (2)	$12m
Ingham South 132/66kV transformers	Replacement of both transformers (3)	Maintain supply reliability to the Ross zone	December 2019	Refurbishment of both transformers Non-network (2)	$6m
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	June 2022	Selected replacement of 275 and 132kV secondary systems in existing panels	$5m
Ross 275kV and 132kV primary plant replacement	Full replacement of 132kV primary plant and selective replacement of 275kV primary plant	Maintain supply reliability in the Ross zone	December 2022	Full replacement of 275 and 132kV primary plant Non-network (2)	$24m

Table 5.8 Possible network reinvestments in the Ross zone within five years *(continued)*

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 above in S5.7.2.

(3) The scope of works, or the need to undertake this potential project, will rely upon the outcome of a RIT-T that is currently under way.

(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 service life and to maintain reliability of supply in the Ross zone from around 2024/25 to 2028/29 (refer to Table 5.9).

Table 5.9 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 2027	New 132kV transmission line	$7m
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 2026	New 132kV transmission line	$58m
Substations					
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	$3m
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	$4m
Townsville South 132kV secondary systems replacement	Selected replacement of 132kV secondary systems (1)	Maintain supply reliability to the Ross zone	June 2028	Full replacement of 132kV secondary systems	$15m
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	$11m
Strathmore SVC secondary systems replacement	Full replacement of secondary systems	Maintain supply reliability to the Ross zone	June 2026	Staged replacement of secondary systems	$6m

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.

Possible asset retirements in the 10-year outlook period

Townsville South to Clare South inland transmission line

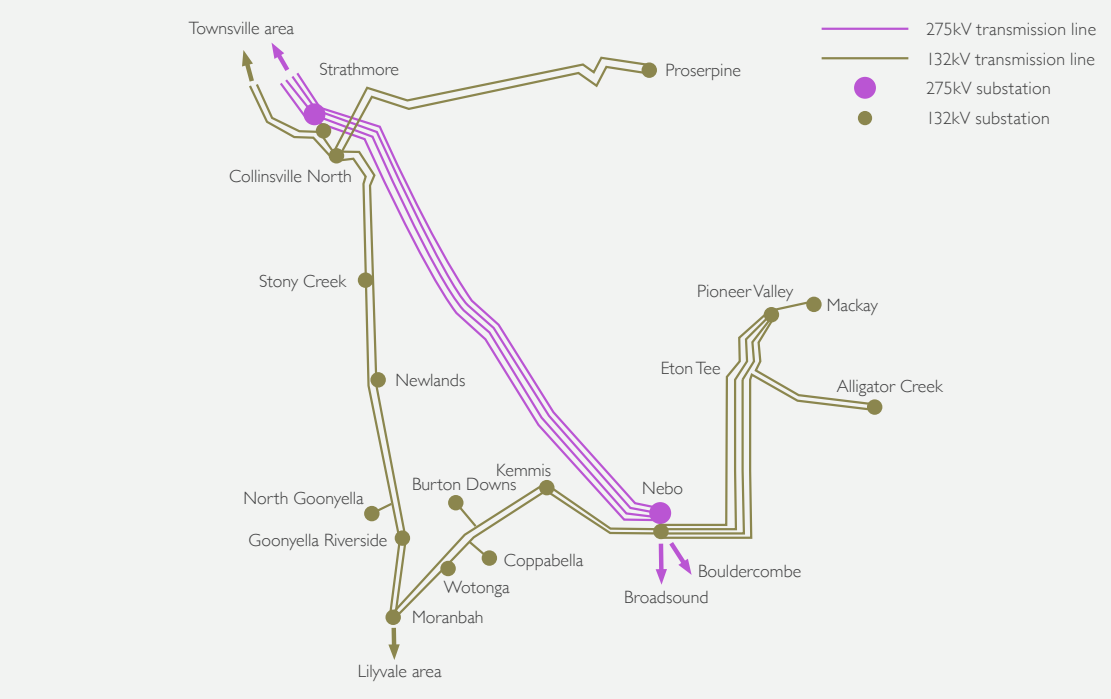
Subject to the outcome of further analysis and RIT-T consultation, Powerlink may retire the inland transmission line at the end of its service life anticipated around 2021.

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. Condition assessment has identified moderate levels of structural corrosion and end of technical service life is expected within the next six to 10 years. Possible end of service life strategies for this transmission line may include replacement on a new easement or retirement.

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 in Chapter 2 there are no network limitations forecast to occur in the North zone within the next five years.

Increasing local demand in the Proserpine area is expected to lead to some load at risk under Powerlink's planning standard. 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 1.7).

Possible network reinvestments within five years

Transmission lines

Pioneer Valley to Eton tee transmission lines

Network requirement: 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.

Project driver

Emerging conditions risks due to structural corrosion.

Project timing: June 2023

Possible network solutions

- Refit the existing transmission line by June 2023.
- Rebuild the transmission line by June 2023.

Proposed network solution: Refit of the transmission line at an estimated cost of $8 million by June 2023

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 in the Pioneer Valley or Mackay area, along with reconfiguration of the 132kV network at Eton tee. Any non-network solutions to remain within Powerlink's planning standard may include up to 10MW and 50MWh per day in the Mackay or Pioneer Valley area.

Substations

Kemmis 132kV Substation

Network requirement: Maintaining reliability of supply at Kemmis Substation

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 T1 relocated from Proserpine and T2 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 $8 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.

Table 5.10 Possible network reinvestments in the North zone within five years

Potential project	High-level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 132kV transmission line between Eton tee and Pioneer Valley Substation	Line refit works on steel lattice structures	Maintain supply reliability to the North zone	June 2023	Line rebuild or reconfiguration of the 132kV network and network support. Non-network (1)	$8m
Substations					
Kemmis 132/66kV transformer replacement	Replacement of 132/66kV transformer	Maintain supply reliability to the North zone	December 2020	Refurbishment of 132/66kV transformer Up to 32MW and approximately 760MWh per day	$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 Non-network (1)	$8m
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 Up to 21MW and approximately 415MWh per day	$2m
Newlands 132kV primary plant replacement	Staged replacement of 132kV primary plant	Maintain supply reliability in the North zone	June 2023	Replacement of all 132kV primary plant Up to 23MW and approximately 460MWh per day	$4m

Note:

(1) The envelope for non-network solutions is defined above in S5.7.3.

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 2024/25 to 2028/29 (refer to Table 5.11).

Table 5.11 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 and Eton tee	Line refit works on steel lattice structures	Maintain supply reliability to the North zone	June 2026	New transmission line	$10m
Substations					
Nebo 132/11kV transformer replacements	Replacement of two 132/11kV transformers at Nebo Substation	Maintain supply reliability to the North zone	June 2025	Establish 11kV supply from surrounding network	$4m
Newlands 132/66kV transformer replacement	Replace one 132/66kV transformer	Maintain supply reliability in the North zone	June 2026	Establish 66kV supply from surrounding network	$4m

Possible asset retirements within the 10-year outlook period

Current planning analysis has not identified any potential asset retirements in the North zone within the next 10 years.

5.7.4 Central West and Gladstone zones

Figure 5.7 Central West and Gladstone transmission network

Existing network

The Central West 132kV network was developed between the mid 1960s to 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.

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 the Boyne Island Smelter (BSL) in the early 1990s (refer to Figure 5.7).

Possible load driven limitations

Based on the medium economic load forecast in Chapter 2 there are no network limitations forecast to occur in the Central West and Gladstone zones within the next five years.

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 constraint durations and levels are sensitive to highly uncertain variables including changes in bidding behaviour, environmental conditions, demand levels, etc.

Powerlink engaged market modelling specialists to inform the market implications of additional renewable energy projects in North Queensland (NQ). Key conclusions included:

- high levels of NQ renewable generation resources will play a major role in the overall market changes
- flows between NQ and Central Queensland (CQ) are expected to reverse during the day to southerly flows
- most of the displaced thermal generation resulting from NQ renewables is within CQ

- additional NQ renewables could create additional congestion in CQ
- results are sensitive to bidding behaviour of CQ generators.

Possible network reinvestments within five years

Transmission lines

Egans Hill to Rockhampton 132kV transmission line

Network requirement: Maintaining reliability of supply to the Rockhampton area

Rockhampton Substation is supplied via these 132kV transmission lines from Bouldercombe Substation. The section from Egans Hill to Rockhampton was constructed in the early 1960s.

Project driver

Emerging condition driven risks related to degraded foundations in the near term and corrosion issues to structures in the medium term.

Project timing: December 2020

Possible network solutions

- Life extension strategy for the entire transmission line by December 2020.
- Partial rebuild strategy that involves a new transmission line along the section from Egans Hill Substation to the Fitzroy river in 2020, with life extension works for the section of line from the Fitzroy river to the Rockhampton Substation by December 2020 that will require regular follow-up paint applications at 15 year intervals.

Proposed network solution: Life extension strategy for the entire transmission line at an estimated cost of $14 million by December 2020

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

Possible non-network solutions

The Bouldercombe to Rockhampton 132kV transmission lines, which includes the section of transmission line between Egan's Hill to Rockhampton, provides supply of up to 100MW at peak, injecting into the 66kV network at Rockhampton Substation. Rockhampton Substation is supported via Pandoin Substation to the north and Egans Hill Substation to the south through Ergon's 66kV network.

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 demand side management initiatives in the area, and would be required to be available on a firm basis.

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

Callide A to Moura 132kV transmission line

The 132kV transmission line was constructed in the early 1960s and there is an ongoing need for this asset to supply the Biloela and Moura substations. While the above-ground structures are in generally good condition, the transmission line was constructed with grillage foundations that require more detailed and ongoing condition assessment. Based on Powerlink's current understanding of the grillage foundations' condition, reinvestment in this transmission line will be required towards the end of the 10-year outlook period of this TAPR (refer to Table 5.13).

Calliope River to Wurdong tee 275kV transmission lines

Network requirement: Maintaining a reliable supply to the Gladstone, Wide Bay and Moreton zones

Project driver:

Emerging condition driven risks related to structural corrosion on the single circuit 275kV transmission lines from Calliope River to Wurdong tee.

Project timing: December 2023

Possible network solutions

- Refit the transmission lines by December 2023.
- Replace two single circuit transmission lines with a double circuit line by December 2023.

Proposed network solution: Replace the transmission lines at an estimated cost of $15 million by December 2023

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

Possible non-network solutions

The 275kV transmission lines between Calliope River and Wurdong tee facilitate power transfer from generation in Central and North Queensland, as well as the Gladstone Power Station, to BSL at Wurdong and on into South-East Queensland. Any removal or reconfiguration of these lines is expected to significantly reduce the transfer capability on these grid sections and as such, Powerlink is not aware of any non-network proposals in this area that can address this requirement in its entirety.

Substations

In the 2017 TAPR, Powerlink identified opportunities to reconfigure the network by summer 2018/19 to provide efficiencies and cost savings by:

- reducing the number of transformers within the zone, particularly at Lilyvale and Bouldercombe. These possible reinvestments are now subject to public consultation and are discussed within this section 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

Network requirement: 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: June 2021

Possible network solutions

- Selected replacement of 132/275kV primary plant by June 2021.
- Full 132/275kV primary plant replacement by June 2021.

Proposed network solution: selective primary plant replacement at an estimated cost of $9 million by June 2021

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

Possible non-network solutions

Lilyvale Substation is a major injection point to the Central West and Northern Bowen Basin regions, supplying over 370MW at peak, as well as providing switching for a number of connections in the region.

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 demand side management initiatives in the area, and would be required to be available on a firm basis.

132/66kV transformers

Project driver

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

Project timing: June 2021

Taking into consideration the most recent analysis and understanding of the risks arising from the transformers at Lilyvale Substation, the proposed network solution has been deferred by approximately 12 months from the possible commissioning date of winter 2020 as advised in the 2017 TAPR to June 2021.

Possible network solutions

- Replacement of three transformers with two larger transformers by June 2021.
- Replacement of three transformers with two smaller units (relative to option 1) by June 2021 (this option would require Powerlink to engage non-network support).
- Replacement of the transformers with three new transformers by June 2021.

Proposed network solution: Replacement of three transformers with two larger transformers at an estimated cost of $10 million by June 2021

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 in the Lilyvale areas. Any non-network solution would be required to be available on a firm basis to replace the network functionality provided by Lilyvale Substation which supports a load of up to 120MW at peak, and approximately 1,700MWh per day.

Network support, in conjunction with the installation of a single transformer at Lilyvale, would be required to support the full load of the substation of up to 120MW at peak, and over 1,700MWh per day and be available to operate within four hours of a contingency occurring.

Network support, in conjunction with the installation of two smaller transformers (relative to option 1) at Lilyvale would require injection of up to 25MW and 300MWh per day.

Blackwater 132kV Substation

Network requirement: 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.

Powerlink is considering a number of end of life strategies for the transformers, selected secondary systems within five years, and selected primary plant in the five to 10-year outlook, and will holistically consider reliability of supply obligations and future network requirements as part of a RIT-T consultation.

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.

Proposed network solution: Replace two transformers at Blackwater Substation with one transformer at an estimated cost of $5 million by June 2022

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

132kV secondary systems

Project driver

Emerging condition, obsolescence and compliance risks arising from the 132kV secondary systems.

Project timing: June 2023

Possible network solutions

- Complete replacement of all secondary systems and associated panels by June 2023.
- Staged replacement of all secondary systems and associated panels. The first stage would be completed by June 2023, followed by completion of a second stage in 2029.

Proposed network solution: Staged replacement of all secondary systems at Blackwater Substation at an estimated cost of $5 million by June 2023

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 66kV network in the Blackwater area. Any non-network solution would need to be available on a firm basis and provide support to the 66kV network of up to 260MW and up to 2,650MWh per day. Powerlink considers the proposed network solution will not have a material inter-network impact.

Bouldercombe 275/132kV Substation

Network requirement: Maintaining power transfer capability and reliability of supply at Bouldercombe Substation

Bouldercombe 132kV switchyard was established in 1975, with the subsequent establishment of a 275kV switchyard and installation of two transformers in 1977. A third transformer was installed in 2012 due to load growth experienced at that time. Bouldercombe Substation is a critical part of the 275kV transmission network, connecting the 275kV transmission lines north to Broadsound and Nebo, south to Raglan and Calliope River and west to Stanwell.

275kV and 132kV primary plant

Project driver

Emerging condition risks arising from 275kV and 132kV primary plant at Bouldercombe Substation.

Project timing: December 2022

Taking into consideration the most recent analysis and understanding of the risks arising from the primary plant at Bouldercombe Substation, the proposed network solution has been deferred from the possible commissioning date of summer 2020 as advised in the 2017 TAPR to December 2022.

Possible network solutions

- Replace selected primary plant by December 2022, followed by a second stage of replacement of selected plant in 2029 in the existing bays.
- Selective primary plant replacement by establishing new bays by December 2022.

Proposed network solution: Selective primary plant replacement by establishing new bays at an estimated cost of $26 million by December 2022

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

275/132kV transformers

Project driver

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

Project timing: June 2021

Taking into consideration the most recent analysis and understanding of the risks arising from the primary plant at Bouldercombe Substation, the proposed network solution has been deferred from the possible commissioning date of summer 2020 as advised in the 2017 TAPR to June 2021.

Possible network solutions

- Replace two transformers with one transformer by June 2021.
- Replace two transformers with two transformers by June 2021.

Proposed network solution: Replace two transformers at Bouldercombe Substation with a single transformer at an estimated cost of $7 million by June 2021

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

Possible non-network solutions

Bouldercombe Substation solely supplies load of approximately 275MW at peak to the Ergon Energy 66kV network at Rockhampton, Pandoin and Egans Hill, and to customer loads at Stanwell, Wycarbah and Grantleigh. A non-network solution for Bouldercombe would need to provide an additional 132kV injection to ensure supply to these loads, specifically by considering the transformer size, configuration and consolidation of the transformers. Any non-network solution would require injection at either Bouldercombe, or closer to the loads on the Ergon Energy 66kV network, of up to 275MW and 3,500MWh per day.

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 demand side management initiatives in the area, and would be required to be available on a firm basis.

Gladstone South 132kV Substation

Network requirement: 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 major connection to Queensland Alumina Limited (QAL). In 2002, a substation was constructed on an adjacent site to manage the rising fault level and general condition 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: June 2023

Possible network solutions

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

Proposed network solution: Selective secondary systems replacement at Gladstone South Substation at an estimated cost of $15 million by June 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 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 demand side management initiatives in the area, and would be required to be available on a firm basis.

Baralaba 132kV Substation

Project driver

Addressing the secondary systems condition risks at Baralaba Substation.

Baralaba Substation is located approximately six kilometres south east of the Baralaba township in central Queensland. It was established as a switchyard in 1976 in conjunction with the development of the 132kV network between Callide A Power Station and Blackwater Substation to facilitate supply to increasing mining loads in the Blackwater area.

Network requirement: Maintaining reliability of supply at Baralaba Substation

Project timing: December 2020

Possible network solutions

- Full in-situ replacement – to replace all secondary systems panels and associated wiring for three bays within the existing secondary systems building by December 2020.
- Full replacement with prefabricated building – to replace all secondary systems for three bays using a modular prefabricated building with new secondary systems installed by December 2020.

Proposed network solution: full replacement with a prefabricated building at an estimated cost of $8 million by December 2020

In March 2018 Powerlink published a Project Specification Consultation Report (with Project Assessment Draft Report exemption) (PSCR) which identified full replacement with prefabricated building by December 2020 at an estimated cost of $8 million as the proposed preferred option.

Submissions to the PSCR closed in June 2018 and Powerlink anticipates publication of the Project Assessment Conclusions Report in August 2018.

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

Possible non-network solutions

Non-network solutions identified in the PSCR include network reconfiguration to bypass Baralaba Substation, coupled with a non-network option to provide support at Moura. Potential non-network options that could provide this support include:

- Local generation: injection at Moura to reduce the peak loads at Biloela and Moura by up to 36MW. This injection would need to be available on a continuous basis as required.
- DSM: bulk 66kV customers at Moura may be incentivised to reduce their demand. This could result in a peak combined reduction of 36MW or 34MWH (daily)[11] at Moura and Biloela.

[11] The estimated daily MWH has been derived from the 2017 historical load data.

Table 5.12 Possible network reinvestments in the Central West and Gladstone zones within five years

Potential project	High-level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the 132kV transmission line between Egans Hill and Rockhampton substations	Line refit works on steel lattice structures (1)	Maintain supply reliability in the Central West zone	December 2020	New 132kV transmission line Non-network (2)	$14m
Rebuild the 275kV transmission lines between Wurdong and Calliope River Substation	Rebuild the two single circuit 275kV transmission lines between Calliope River and Wurdong with one double circuit.	Maintain supply reliability in the Gladstone zone and CQ-SQ transmission corridor	December 2023	Refit the 275kV transmission lines between Calliope River and Wurdong Non-network (2)	$15m
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	June 2019	Rebuild the 132kV transmission line between Callemondah and Gladstone South substations Up to 180MW and approximately 3,200MWh (4)	$5m
Substations					
Lilyvale transformers replacement	Replacement of two of the three 132/66kV transformers (1)	Maintain supply reliability in the Central West zone	June 2021	Replacement of three 132/66kV transformers. Retire one of three 132/66kV transformers and implement non-network solution (2)	$10m
Lilyvale primary plant replacement	Selective replacement of 132kV and 275kV primary plant (1)	Maintain supply reliability in the Central West zone	June 2021	Full replacement of 132kV and 275kV primary plant Non-network (2)	$9m
Bouldercombe primary plant replacement	Selective replacement of 132kV and 275kV primary plant (1)	Maintain supply reliability in the Central West zone	December 2022	Full replacement of 132kV and 275kV primary plant Non-network (2)	$26m
Bouldercombe transformer replacement	Replacement of one 132/275kV transformer with a larger unit, and retirement of the other (1)	Maintain supply reliability in the Central West zone	June 2021	Replacement of two 132/275kV transformers Non-network (2)	$7m (4) (5)

Table 5.12 Possible network reinvestments in the Central West and Gladstone zones within five years *(continued)*

Potential project	High-level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Baralaba secondary systems replacement	Full replacement with prefabricated building (3)	Maintain supply reliability in the Central West zone	December 2020	Full in-situ replacement Non-network (2)	$8m
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 Up 160MW and approximately 2,000MWh per day	$5m
Blackwater 132kV secondary systems replacement	Staged replacement of 132kV secondary systems	Maintain supply reliability in the Central West zone	June 2023	Full replacement of the 132kV secondary systems Up to 260MW and approximately 2,650MWh per day	$5m
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 Up to 40MW and approximately 800MWhr per day (N-1-600 within 24 hours to ensure reliability criteria)	$5m
Gladstone South 132kV secondary systems replacement	Selective replacement of 132kV secondary systems	Maintain supply reliability in the Gladstone zone	June 2023	Full replacement of 132kV secondary systems Non-network (2)	$15m

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 above in S5.7.4.

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

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

(5) 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.

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 and Gladstone zones from around 2024/25 to 2028/29 (refer to Table 5.13).

Table 5.13 Possible network reinvestments in the Central West and Gladstone 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 275kV transmission line between Calliope 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 Calliope River and Larcom Creek substations	$14m
Rebuild the 275kV transmission lines between Wurdong and Gin Gin substations	Rebuild the single circuit 275kV transmission lines between Wurdong and Gin Gin with a double circuit transmission line	Maintain supply reliability in the Central West and transfer capacity between Central and Southern Queensland	December 2028	Refit the 275kV transmission lines between Wurdong and Gin Gin	$130m
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	$2m
Rebuild the 132kV transmission lines from Callide A to Biloela and Moura.	Rebuild the 132kV transmission lines from Callide A to Biloela and Moura as a double tee	Maintain supply reliability in the Central West and CQ-SQ transmission corridor	June 2029	Refit the 132kV transmission lines from Callide A to Biloela and Moura	$68m
Substations					
Blackwater 132kV primary plant replacement	Selective replacement of 132kV primary plant	Maintain supply reliability in the Central West	December 2024	Full replacement of 132kV primary plant	$4m
Alligator Creek 132kV primary plant replacement	Selective replacement of132kV primary plant	Maintain supply reliability in the Central West	June 2025	Full replacement of 132kV primary plant	$3m
Lilyvale 132kV secondary systems replacement	Selective replacement of 132kV secondary systems	Maintain supply reliability in the Central West	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	December 2026	Full replacement of 132kV secondary systems	$8m
Rockhampton 132kV secondary systems replacement	Selective replacement of 132kV secondary systems	Maintain supply reliability in the Central West	June 2027	Full replacement of 132kV secondary systems	$6m

Table 5.13 Possible network reinvestments in the Central West and Gladstone zones within six to 10 years

Potential project	High-level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Broadsound 275kV secondary systems replacement	Selective replacement of 275kV secondary systems	Maintain supply reliability in the Central West	June 2027	Full replacement of 275kV secondary systems	$3m
Calvale 275kV primary plant replacement	Selective replacement of 275kV primary plant	Maintain supply reliability in the Central West	December 2026	Full replacement of 275kV primary plant	$13.5m

Possible asset retirements within the 10-year outlook period[12]

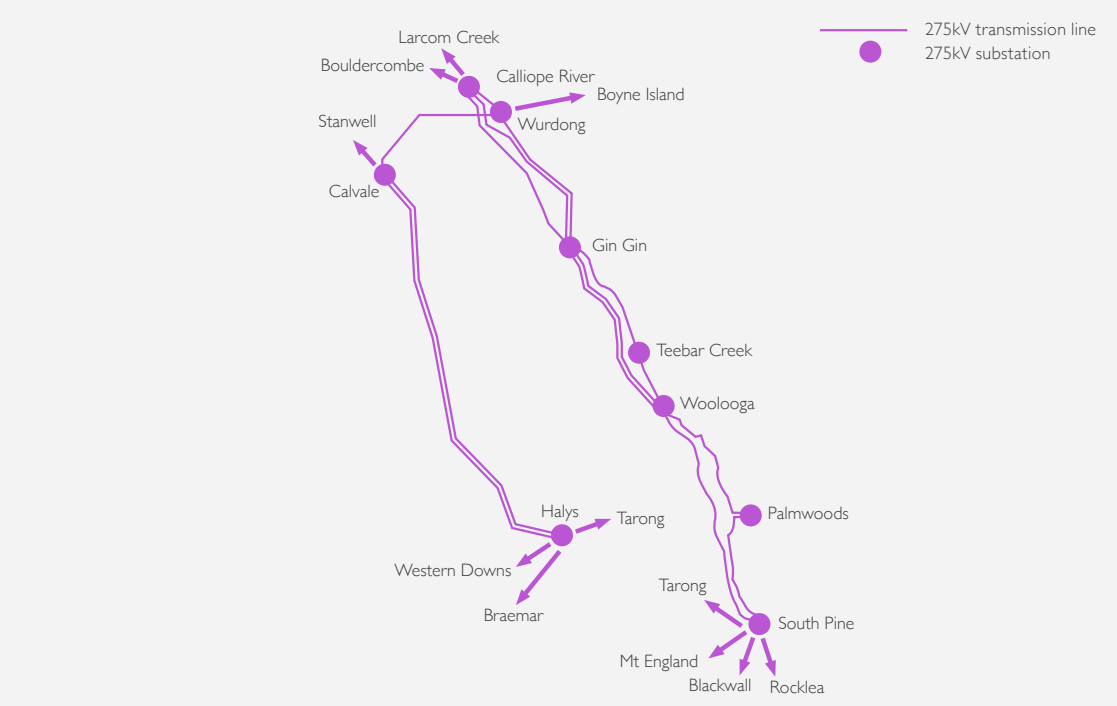
Callide A to Gladstone South 132kV transmission double circuit line

The 132kV transmission line was constructed in the mid 1960s to support the loads in the Gladstone area. Due to reconfiguration in the area, it is likely this transmission line will be retired from service at the end of technical service life, expected within the next six to 10 years.

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

5.7.5 Wide Bay zone

Figure 5.8 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 in Chapter 2 there are no network limitations forecast to impact reliability of supply in the Wide Bay zone within the next five years.

Possible network reinvestments within five years

Substations

Powerlink's routine program of condition assessments has not identified any reinvestment requirements in the Wide Bay zone within the next five years.

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 2024/25 to 2028/29 (refer to Table 5.14).

Table 5.14 Possible network reinvestments in the Wide Bay zone within six to 10 years

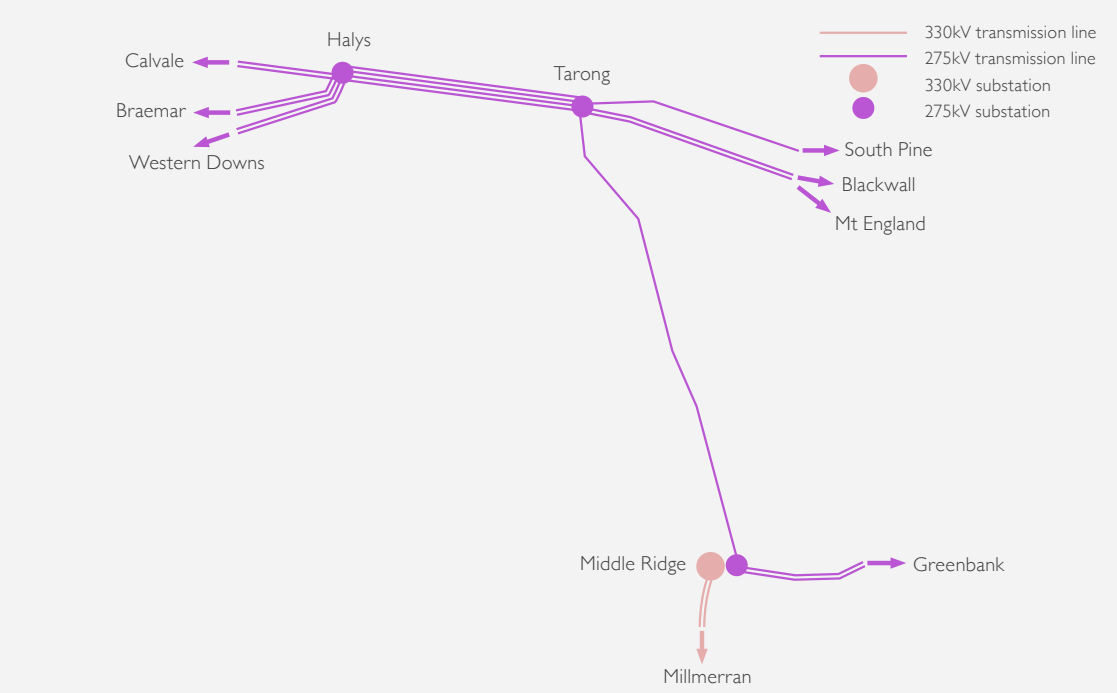
Potential project	High-level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission lines					
Line refit works on the transmission lines between Gin Gin and Woolooga substations	Refit the 275kV transmission lines between Gin Gin and Woolooga substations	Maintain supply to the Wide Bay zone	June 2027	Rebuild the 275kV transmission lines between Gin Gin and Woolooga substations	$17m
Substations					
Woolooga 275kV and 132kV secondary systems replacement	Full replacement of 132kV and 275kV secondary systems (including SVC)	Maintain supply to the Moreton zone	December 2027	Selective replacement of 132kV and 275kV secondary systems (including SVC)	$30m
Teebar Creek secondary systems replacement	Full replacement of 132kV and 275kV secondary systems	Maintain supply to the Moreton zone	December 2027	Selective replacement of 132kV and 275kV secondary systems	$14m

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

5.7.6 South West zone

Figure 5.9 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 5.9).

Possible load driven limitations

Based on the medium economic load forecast in Chapter 2 there are no network limitations forecast to occur in the South West zone within the next five years.

Possible network reinvestments within five years

Substations

Tarong 275/132kV/66kV substation

Project driver

Addressing the secondary systems condition risks at Tarong Substation.

Tarong Substation was established in conjunction with the Tarong Power Station in 1982 and connects the 275kV transmission circuits from the central and south west parts of Queensland into the South East Queensland load centre. The Tarong Substation is also the connection point for the Tarong and Tarong North base load coal fired power stations and provides supply to local, rural and bulk mining loads.

Network requirement: Maintaining reliability of supply at Tarong Substation

Project timing: December 2021

Possible network solutions

- Replace all selected secondary systems panels and associated wiring for selected equipment within the existing secondary systems building by December 2021.
- Replace all selected secondary systems panels using a modular prefabricated building with new secondary systems installed by December 2021.

Proposed network solution: selected replacement within the existing building at an estimated cost of $11 million by December 2021

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

Possible non-network solutions

Tarong Substation provides connection for generation of approximately 1,850MW, supplies local loads of over 55MW and power transfer capacity of over 3,600MW to meet the SEQ load. Switching at Tarong Substation facilitates power transfer from the CQ-SQ, Tarong and SWQ cut sets into SEQ. A non-network solution for Tarong would need to maintain adequate transfer capability and switching capability in the area.

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 demand side management initiatives in the area, and would be required to be available on a firm basis.

Table 5.15 Possible network reinvestments in the South West zone within five years

Potential project	High-level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
Tarong secondary systems replacement	In situ staged replacement of secondary systems equipment (1)	Maintain supply reliability in the South West zone	December 2021	Full replacement of 275kV secondary systems Non-network (2)	$11m
Tarong 66kV cable replacement	Overhead transmission line	Maintain supply reliability in the South West zone	June 2019	Replacement of underground cable Up to 24MW and approximately 200MWh per day	$3m

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 above in S5.7.6.

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 South West zone from around 2024/25 to 2028/29 (refer to Table 5.16).

Table 5.16 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					
Tarong 275/66/11kV transformers replacement	Replacement of 275/66/11kV transformers at Tarong Substation	Maintain supply reliability in the South West zone	December 2024	Refurbishment of existing transformers	$8m
Tarong 275/132kV transformers replacement	Decommissioning of 275/132kV transformers (1)	Maintain supply reliability in the South West zone	December 2024	Replacement of one or both the 275/132kV transformers	$1m
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	$10m
Chinchilla 132kV primary plant and secondary replacement	Reduced scope replacement and transformer ending from Columboola	Maintain supply reliability in the South West zone	December 2026	Replacement of the entire 132kV switchyard	$10m

Note:

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

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

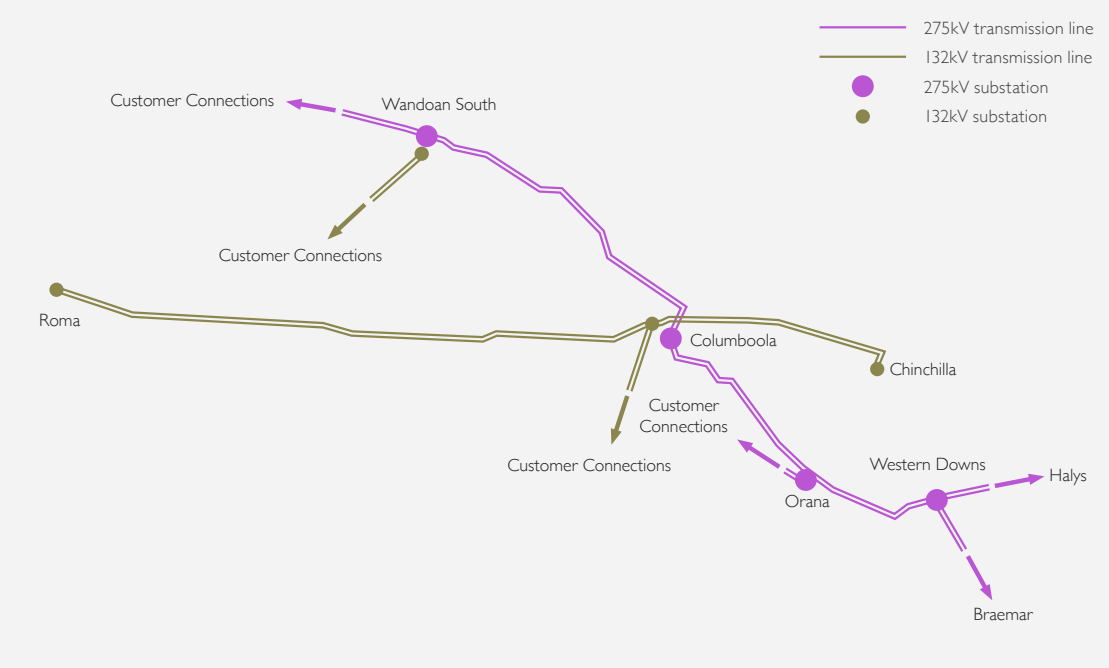
Condition assessment has identified emerging condition risks arising from the condition of two 275/132kV transformers at Tarong Substation by 2024. Planning studies have confirmed the potential to subsequently retire both transformers based on the medium economic load forecast in Chapter 2. On this basis, 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 and secondary systems at Chinchilla Substation by 2026. At this time, an option would be a reduced scope replacement that would involve transformer ending from Coolumboola 132kV Substation, and retire the 132kV primary plant and secondary systems arising from the connection to Tarong Substation.

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

5.7.7 Surat zone

Figure 5.10 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 5.10).

Possible load driven limitations

Based on the medium economic load forecast in Chapter 2 there are no network limitations forecast to occur in the Surat zone within the next five years.

Possible network reinvestments within the 10-year outlook period

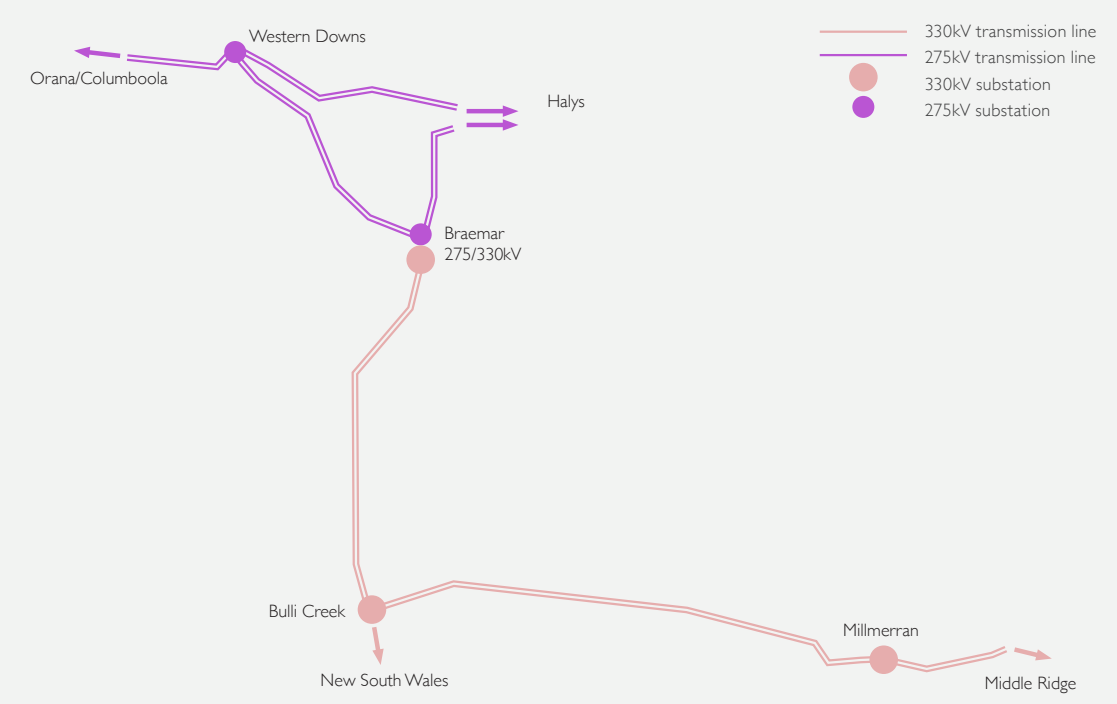
There are no reinvestment requirements within the 10-year outlook period.

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.

5.7.8 Bulli zone

Figure 5.11 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 5.11).

Possible load driven limitations

Based on the medium economic load forecast in Chapter 2 there are no network limitations forecast to impact reliability of supply in the Bulli zone within the next five years.

Possible network reinvestments within five years

There are no reinvestment requirements within the next five years.

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 2024/25 to 2028/29 (refer to Table 5.17).

Table 5.17 Possible network reinvestments in the Bulli zone within six to 10 years

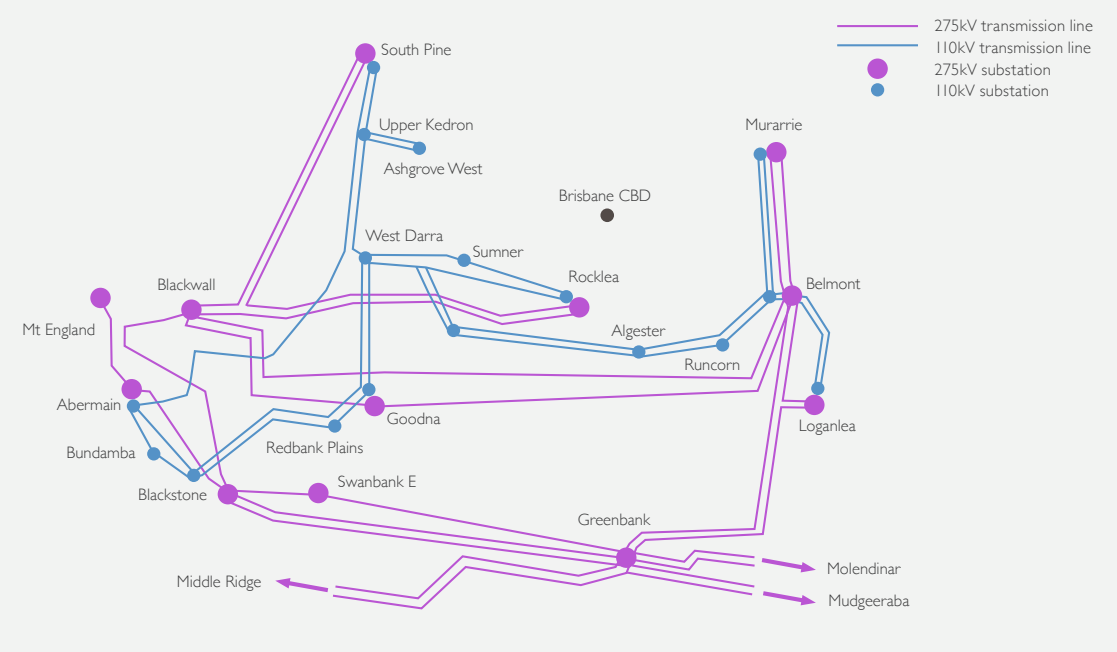
Potential project	High-level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
Bulli Creek 132kV secondary systems replacement	Selected replacement of secondary systems	Maintain supply reliability in the Bulli zone	December 2024	Full replacement of secondary systems	$2m
Middle Ridge 275kV and 110kV secondary systems replacement	Full replacement of secondary systems	Maintain supply reliability in the Bulli zone	December 2024	Selected replacement of secondary systems	$41m
Middle Ridge 110kV primary plant replacement	Selected replacement of primary plant bays and transformer refurbishment	Maintain supply reliability in the Bulli zone	December 2025	Selected replacement of equipment in bay and transformer refurbishment	$4m
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	$8m

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.

5.7.9 Moreton zone

Figure 5.12 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 5.12).

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 in Chapter 2 there are no network limitations forecast to occur in the Moreton zone within the next five years.

Possible network reinvestments within five years

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.

As such, 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 and would involve consultation with potentially impacted parties.

South Pine to Upper Kedron and West Darra to Rocklea transmission lines

Network requirement: Maintaining reliability of supply to the Brisbane metropolitan area

South Pine to Upper Kedron 110kV transmission line

The South Pine to Upper Kedron 110kV transmission line was constructed in 1963 and is approximately 13km in length. The transmission line is within 20km of the coast and is moderately protected from any prevailing coastal winds by virtue of its alignment through undulating forestry, semi-rural and residential areas.

Project driver

Emerging condition driven risks related to specific components of the transmission line are exhibiting an unacceptable level of corrosion.

Project timing: April 2022

Rocklea to Sumner to West Darra 110kV transmission line

The Rocklea to Sumner to West Darra 110kV transmission line was constructed in 1963 and is approximately 10km in length. The line is within 20kms of the coast and subject to the conditions of both a highly industrial and dense urban environment in which it operates.

Project driver

Emerging condition driven risks related to specific components of the transmission line, in particular some of the overhead earth wire and associated equipment are exhibiting an unacceptable level of corrosion.

Project timing: June 2021

Possible network solutions

Due to the connectivity of both the above 110kV transmission lines, Powerlink will undertake a RIT-T consultation to collectively assess feasible network and non-network solutions to address the risks arising from maintaining a reliable supply in greater Brisbane area include:

- Staged refit of the transmission lines.
- Refitting both of the transmission lines by June 2021.
- Selective retirement of one or both of the transmission lines by June 2021.

Proposed network solution: Refit both transmission lines at an estimated cost of $24 million by June 2021

Powerlink anticipates the commencement of a RIT-T within the next 12 months. The Brisbane Metropolitan area RIT-T will holistically address the risks arising from these 110kV transmission lines to analyse potential synergies which may be gained and to arrive at an optimal solution.

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

Possible non-network solutions

The 110kV lines between Rocklea, Sumner and West Darra provide supply to the south western suburbs of Brisbane through Sumner and Richlands substations of over 150MW at peak. The 110kV lines between South Pine and Upper Kedron provide supply to part of the Brisbane CBD and the inner western suburbs of Brisbane of over 150MW at peak.

Powerlink is not aware of any non-network proposals in this area that can address these 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 demand side management initiatives in the area, and would be required to be available on a firm basis.

South Pine to Karana Downs 275kV transmission line

The 275kV transmission line between Karana Downs and South Pine was constructed in 1970 and is approximately 32km in length. The transmission line is between 10kms and 40kms from the coast and is, for the most part, geographically located in forest reserve with continual changes in elevation. At its lowest point, which is the South Pine Substation, the transmission line is only 20 metres above sea level. However it rises to 250 metres above sea level behind the Enoggera Reservoir.

Condition assessment previously indicated that specific components of the transmission line are exhibiting corrosion and the associated emerging risks need to be addressed within the next five years. Based on the most recent analysis and understanding of the risks arising from this transmission line, the likely proposed network solution has been deferred from the possible commissioning date of summer 2022 as advised in the 2017 TAPR to December 2025 (refer to Table 5.19).

Substations

Abermain 110/33kV Substation

Network requirement: Maintaining reliability of supply at Abermain Substation

Abermain Substation was established in 1994 to meet demand in the expanding Ipswich area. Further extensions at the substation due to ongoing load growth have resulted in a mixture of secondary systems from the early 1990s through to 2009.

Project driver

Addressing the secondary systems condition risks at Abermain Substation.

Project timing: June 2021

Taking into consideration the most recent analysis and understanding of the risks arising from the 110kV secondary systems requiring replacement at Abermain Substation, the likely proposed network solution has been deferred by approximately 12 months from the possible commissioning date of winter 2020 as advised in the 2017 TAPR to June 2021.

Possible network solutions

- Full replacement of the 110kV secondary systems by June 2021.
- Staged replacement of the 110kV secondary systems by 2021.

Proposed network solution: Full replacemement of the 110kV secondary systems at Abermain Substation at an estimated cost of $7 million by June 2021

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

Possible non-network solutions

Abermain Substation provides injection and switching to Ipswich, Lockrose, Gatton areas and into the south-western suburbs of Brisbane of over 200MW 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 demand side management initiatives in the area, and would be required to be available on a firm basis.

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

Palmwoods 275/132/110kV Substation secondary systems replacement

Project driver

Addressing the secondary systems condition risks at Palmwoods Substation.

Palmwoods Substation was established in 1978, initially operating at 132/110kV to supply the increasing demand in the Sunshine Coast and surrounding areas. The 275kV switchyard was built in 1993 with subsequent extensions to both switchyards in the 2000s.

Network requirement: Maintaining reliability of supply at Palmwoods Substation

Project timing: December 2020

Possible network solutions

- Staged replacement of all of the 275kV secondary systems in new protection panels in the existing control building, with the first stage of works being completed by December 2020 and the second stage of works completed by June 2024.
- Replacement of all of the 275kV secondary systems by June 2021.

Proposed network solution: Replacement of all of the 275kV secondary systems at Palmwoods Substation at an estimated cost of $7 million by June 2021

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

Possible non-network solutions

Palmwoods Substation is a major node in the wider interconnected network supplying power into South-East Queensland, as well as providing injection to Energex for the Sunshine Coast and Caboolture areas of over 400MW 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 demand side management initiatives in the area, and would be required to be available on a firm basis.

Murarrie 275/110kV Substation secondary systems replacements

Project driver

Addressing the secondary systems condition risks at Murarrie Substation.

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.

Network requirement: Maintaining reliability of supply at Murarrie Substation

Project timing: June 2023

Possible network solutions

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

Proposed network solution: Replace the 110kV secondary systems at Murarrie Substation at an estimated cost of $25 million by June 2023

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 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 demand side management initiatives in the area, and would be required to be available on a firm basis.

Belmont 275/110kV Substation

Project driver

Addressing the secondary systems condition risks at Belmont Substation.

Belmont Substation is a major substation in the Brisbane transmission network and was established in the early 1970s. Extensions as a result of load growth and equipment replacements have resulted in a mixture of primary and secondary plant ranging from the 1970s, early 1980s through to the 1990s.

Network requirement: Maintaining reliability of supply at Belmont Substation

Project timing: December 2020

Possible network solutions

- Staged replacement of the 275kV secondary systems by December 2020.
- Full replacement of all of the 275kV secondary systems upfront by December 2020.

Proposed network solution: Selective replacement of 275kV secondary systems at Belmont Substation at an estimated cost of $9 million by December 2020

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

Possible non-network solutions

Belmont Substation provides injection and switching to the CBD and south-eastern suburbs of Brisbane of over 700MW 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 demand side management initiatives in the area, and would be required to be available on a firm basis.

Table 5.18 Possible network reinvestments in the Moreton zone within five years

Potential project	High-level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Transmission Lines					
Line refit works on the 110kV transmission lines between South Pine to Upper Kedron	Line refit works on steel lattice structures	Maintain supply reliability in the CBD and Moreton zone	June 2021	New 110kV transmission line/s Non-network (1)	$9m
Line refit works on the 110kV transmission lines between Rocklea, to Sumner to West Darra	Line refit works on steel lattice structures	Maintain supply reliability in CBD and Moreton zone	June 2021	New 110kV transmission line/s Non-network (1)	$15m
Line refit works on the 275kV transmission lines between Belmont and Murarrie	Line refit works on steel lattice structures	Maintain supply reliability in the Moreton zone	June 2022	New 275kV transmission line/s	$2m
Substations					
Abermain 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	June 2021	Staged replacement of 110kV secondary systems Non-network (1)	$7m
Palmwoods 275kV secondary systems replacement	Full replacement of 275kV secondary systems	Maintain supply reliability in the Moreton zone	June 2021	Staged replacement of 275kV secondary systems	$7m
Belmont 275kV secondary systems replacement	Staged replacement of 275kV secondary systems	Maintain supply reliability in the CBD and Moreton zone	December 2020	Full replacement of 275kV secondary systems Non-network (1)	$9m
Swanbank E 275kV secondary systems replacement	Full replacement of 275kV secondary systems	Maintain supply reliability in the CBD and Moreton zone	June 2021	Selective replacement of 275kV secondary systems	$4m
Redbank Plains 110kV primary plant replacement	Selective replacement of 110kV primary plant	Maintain supply reliability in the CBD and Moreton zone	June 2022	Full replacement of 110kV primary plant Up to 25MW and approximately 350MWh per day	$3m
Murarrie 110kV secondary systems replacement	Full replacement of 110kV secondary systems	Maintain supply reliability in the CBD and Moreton zone	June 2023	Selective replacement of 110kV secondary systems Non-network (1)	$25m

Table 5.18 Possible network reinvestments in the Moreton zone within five years *(continued)*

Potential project	High-level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Redbank Plains 110/11kV transformers replacement	Replace two 110/11kV transformers	Maintain supply reliability in the Moreton zone	June 2024	Replace one 110/11kV transformer and engage non-network support Up to 25MW and approximately 350MWh per day	$5m
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 above in S5.7.9.

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 2024/25 to 2028/29 (refer to Table 5.19).

Table 5.19 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 lines between Woolooga and South Pine	Refit the 275kV transmission lines between Woolooga and South Pine substations	Maintain supply reliability in the Moreton zone	December 2024	Rebuild the 275kV transmission lines between Woolooga and South Pine substations	$4m
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	June 2025	Rebuild the 110kV transmission lines between Swanbank, Redbank Plains and West Darra	$11m
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	$21m
Line refit works on the 110kV transmission line between West Darra and Upper Kedron	Refit the 110kV transmission line between West Darra and Upper Kedron substations	Maintain supply reliability in the Moreton zone	June 2027	Potential retirement of the transmission line between West Darra and Upper Kedron	$21m
Line refit works on the 110kV transmission line between Richlands and Algester	Refit the 110kV transmission line between Richlands and Algester substations	Maintain supply reliability in the Moreton zone	June 2025	Potential retirement of the transmission line between Richlands and Algester	$5m
Replacement of the underground 110kV transmission line between Upper Kedron and Ashgrove West	Replace the 110kV underground transmission line between Upper Kedron and Ashgrove West substations using an alternate easement	Maintain supply reliability in the Moreton zone	December 2025	Replace the 110kV underground transmission line between Upper Kedron and Ashgrove West substations using the existing easement	$15m
Line refit works on the 110kV transmission line between Blackstone and Abermain	Refit the 110kV transmission line between Blackstone and Abermain substations	Maintain supply reliability in the Moreton zone	June 2026	Rebuild the 110kV transmission line between Blackstone and Abermain substations	$9m

Table 5.19 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
Substations					
Palmwoods 275kV primary plant replacement	Selective replacement of 275kV primary plant	Maintain supply reliability to the Wide Bay zone	December 2026	Full replacement of 275kV primary plant	$10m
South Pine 275/110kV transformer replacement	Replacement of a single 275kV/110kV transformer	Maintain supply reliability in the Moreton zone	June 2025	Retirement of a single 275kV/110kV transformers with non-network support	$7m
Ashgrove West 110kV secondary systems replacement	Staged replacement of 110kV secondary systems	Maintain supply reliability in the Moreton zone	December 2026	Full replacement of 110kV secondary systems	$8m
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	$5m
South Pine SVC secondary systems replacement	Replacement of the South Pine 275kV SVC secondary systems	Maintain supply reliability in the Moreton zone	December 2027	Staged replacement of 275kV SVC secondary systems	$7m
Belmont selected 275kV primary plant replacement	Selective replacement of 275kV primary plant	Maintain supply reliability in the Moreton zone	December 2028	Full replacement of 275kV primary plant	$22m
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	$14m
Goodna 110kV and 275kV secondary systems replacement	Full replacement of 110kV and 275kV secondary systems	Maintain supply reliability in the Moreton zone	December 2026	Staged replacement of 110kV and 275kV secondary systems	$19m
Greenbank 275kV secondary systems replacement	Full replacement of 275kV secondary systems (including SVC)	Maintain supply reliability in the Moreton zone	December 2027	Stage replacement of 275kV secondary systems (including SVC)	$20m

Possible asset retirements within the 10-year outlook period

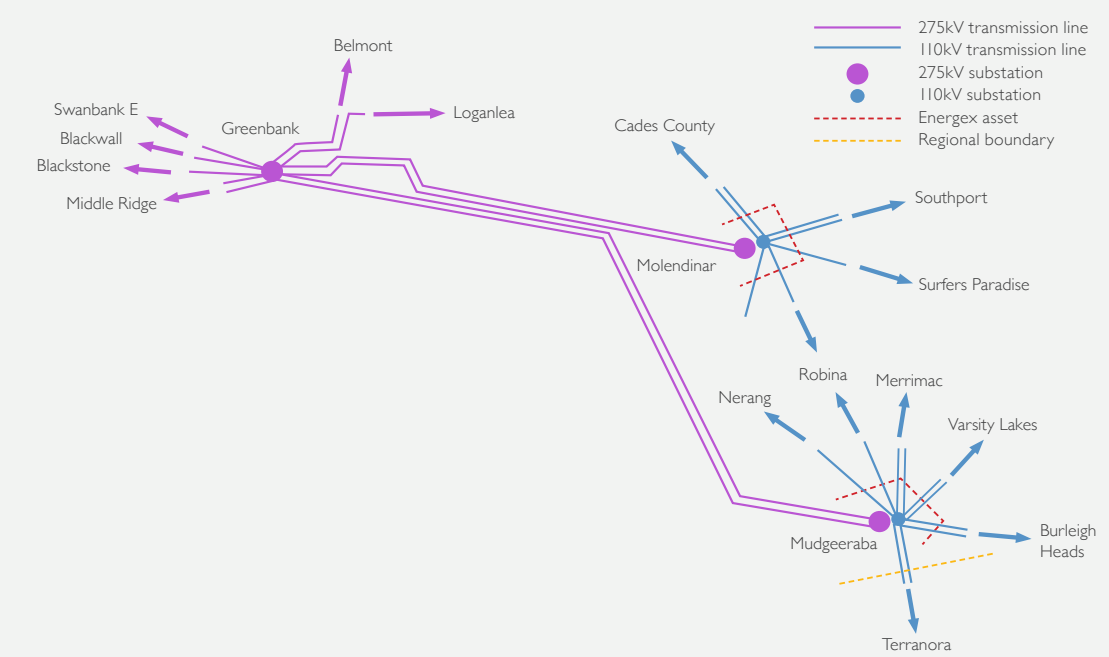
Belmont 275/110kV transformers

Within the forecast period, two 275/110kV transformers will be sufficient to meet the network need at Belmont substation. Within the next five years, the opportunity to retire two of the four 275/110kV transformers, based on condition, has been identified.

Planning analysis has confirmed that retirement of these transformers will not result in load at risk in the Brisbane area, and that there is adequate headroom to accommodate moderate growth above the medium economic load forecast in Chapter 2.

5.7.10 Gold Coast zone

Figure 5.13 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 5.13).

Possible load driven limitations

Based on the medium economic load forecast in Chapter 2 there are no network limitations forecast to occur in Moreton zone within the next five years.

Possible network reinvestments within five years

Transmission lines

Greenbank to Mudgeeraba 275kV transmission lines

Network requirement: 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 New South Wales.

Project driver

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

Project timing: December 2025

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 2025.
- 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 $20 million by December 2025

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 demand side management initiatives in the area, and would be required to be available on a firm basis.

Mudgeeraba to Terranora 110kV transmission lines

The 110kV line was constructed in the mid-1970s and forms an essential part of the interconnection between Powerlink and Essential Energy's network in northern NSW, with 13km of the transmission line owned by Powerlink. The transmission line operates in a metropolitan/semicoastal environment with moderate rates of atmospheric pollution impacting on the life of its galvanised components and is subject to prevailing salt laden coastal winds. Condition assessment has identified that, line refit or replacement of the 13km transmission line section will be required in the latter part of the 10-year outlook period (refer to Table 5.21).

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. Planning studies have confirmed the potential to subsequently retire the other transformer given the current flat demand forecast. However, the reliability and market impacts of retiring a transformer across a broader range of demand forecast scenarios may potentially have a material inter-network impact and will require consultation.

Powerlink is currently analysing all possible network solutions, including if there is the potential for material inter-network impact, as part of an upcoming RIT-T consultation.

275kV secondary systems

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 majority of secondary systems components by December 2021.
- Complete replacement of all secondary systems by December 2021.

Proposed network solution: Complete replacement of all secondary systems at an estimated cost of $16 million by December 2021

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 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 demand side management initiatives in the area, and would be required to be available on a firm basis.

Table 5.20 Possible network reinvestments in the Gold Coast zone within five years

Potential project	High-level scope	Purpose	Possible commissioning date	Alternatives	Indicative cost
Substations					
Retirement of one Mudgeeraba 275/110kV transformer and associated works	Retirement of the transformer (1) including protection schemes and bay rating upgrade (2)	Maintain supply reliability in the Gold Coast zone	June 2020	New 275/110kV transformer	$3m (3)
Mudgeeraba 275kV secondary systems replacement	Full replacement of 275kV secondary systems (2)	Maintain supply reliability in the Gold Coast zone	December 2021	Staged replacement of 275kV secondary systems equipment	$16m

Note:

(1) 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 demand forecast outlook of the TAPR.

(2) 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.

(3) 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.

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 2024/25 to 2028/29 (refer to Table 5.21).

Table 5.21 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					
Targeted line refit works on sections of the 275kV transmission lines between Greenbank and Mudgeeraba substations	Targeted line refit works on steel lattice structures	Maintain supply reliability in the Gold Coast zone	December 2025	New double circuit 275kV transmission line Full line refit on one or both existing 275kV single circuit transmission lines Non-network (1)	$20m
Line refit works on the 110kV transmission line between Mudgeeraba and Terranora	Full line refit	Maintain supply reliability from Queensland to NSW Interconnector	June 2025	Targeted line refit New transmission line	$4m
Substations					
Molenindar 275kV secondary systems replacement	Full replacement of 275kV secondary systems	Maintain supply reliability in the Gold Coast zone	December 2024	Selected replacement of 275kV secondary systems	$16m
Mudgeeraba 110kV secondary systems replacement	Partial replacement of 110kV secondary systems	Maintain supply reliability in the Gold Coast zone	June 2025	Full replacement of 110kV secondary systems	$2m
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 2026	Staged replacement of 110kV primary plant in existing bays and selected 275kV equipment	$20m
Greenbank SVC secondary systems replacement	Full replacement of 275kV secondary systems	Maintain supply reliability in the Gold Coast zone	June 2027	Staged replacement of secondary systems	$7m

Note:

(1) The envelope for non-network solutions is defined above in S5.7.10.

Possible asset retirements within the 10-year outlook period

Mudgeeraba 275/110kV Transformer

Subject to the outcome of further analysis and RIT-T consultation, Powerlink may retire the third Mudgeeraba 275/110kV transformer at the end of technical service life anticipated around 2020.

5.7.11 Supply demand balance

The outlook for the supply demand balance for the Queensland region was published in the AEMO 2017 Electricity Statement of Opportunities (ESOO)[14]. Interested parties who require information regarding future supply demand balance should consult this document.

5.7.12 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 thermal ratings, transient stability and oscillatory stability (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.

Interconnector upgrades

Powerlink and TransGrid have assessed whether an upgrade of QNI could be technically and economically justified on several occasions since the interconnector was commissioned in 2001. Each assessment and consultation was carried out in accordance with the relevant version of the AER's Regulatory Investment Test in place at the time.

The most recent assessment was carried out as part of the joint Powerlink and TransGrid regulatory consultation process which concluded in December 2014. At that time, in light of uncertainties, Powerlink and TransGrid considered it prudent not to recommend a preferred upgrade option, however would continue to monitor market developments to determine if any material changes could warrant reassessment of an upgrade to QNI.

Since the conclusion of the 2014 consultation the NEM has, and continues to, undergo rapid change as the sector transitions to a world with lower carbon emissions and greater uptake of emerging technologies.

The Independent Review into the Future Security of the National Electricity Market[15], Electricity Network Transformation Roadmap[16] and AEMO's 2016 NTNDP suggest that transmission interconnections will play a stronger role in the future. Greater levels of interconnection allows the diversity of VRE generation, particularly wind generation, across regions during summer and winter peaking conditions, to deliver fuel cost savings by improving utilisation of renewable generation and reducing reliance on higher-cost generation.

VRE is making up an increasing proportion of the national energy mix. Going forward, even more of Australia's existing electricity generation is likely to be replaced by lower emission alternatives to meet policy commitments, including the nation's COP21 pledge to reduce carbon emissions by 26-28% below 2005 levels by 2030[17].

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14 Updated by AEMO in September 2017.

15 Independent Review into the Future Security of the National Electricity Market, Dr Alan Finkel et al, June 2017 (page 127).

16 Electricity Network Transformation Roadmap – Final Report, April 2017 (page 99).

17 The 2015 United Nations Climate Change Conference (also known as 'COP 21' or 'CMP 11') was held in Paris, France, from 30 November to 12 December 2015.

The Council of Australian Governments (COAG) Energy Council also noted that interconnectors provide a range of benefits that facilitate this energy transition, in particular:

- enabling the lowest cost generation in the NEM to reach more consumers
- mitigating the risk of supply shortfall through imports from other regions
- sharing system stability support services, such as frequency and voltage control
- improving system resilience to high impact, low probability events (such as interconnector failures) through a further interconnected NEM.

Since Powerlink and TransGrid completed the 2014 RIT-T there have been specific changes that may impact the forecast utilisation and congestion on QNI. These changes include:

- gas prices increasing markedly in Queensland (and the east coast) on account of liquefied natural gas (LNG) exports
- retirement of Redbank, Munmorah and Wallerawang power stations
- committed retirement of Liddell Power Station in March 2022[18]
- commitment of wind farms in northern NSW
- commitment of approximately 2,700MW of VRE generation in the Queensland region.

As a result of these developments, preliminary market modelling studies undertaken in 2017 indicate that there may be net market benefits arising from upgrading the interconnector capability on QNI. These preliminary findings are consistent with the 2016 NTNDP. AEMO's modelling indicated that bi-directionally increasing the capability of QNI may deliver net positive market benefits from 2026–27 depending on the scenario.

As a result of this and previous analysis, both TransGrid and Powerlink sought to have an upgrade of QNI classified as a contingent project in their Revenue Proposals for the 2018-2023 and 2017-2022 periods, respectively. Both applications were successful due to uncertainties regarding the preferred option to practicably achieve the lowest sustainable cost of delivering the prescribed transmission services. Successful application of this RIT-T is one of the triggers proposed for these contingent projects.

Accordingly, TransGrid and Powerlink are currently undertaking preparatory work to progress a RIT-T to investigate the net market benefits of options for increasing the transfer capacity between NSW and Queensland. The first stage of this RIT-T (PSCR) is anticipated to commence in the third quarter of 2018.

As required by the NER the net market benefits of options for increasing the transfer capacity between NSW and Queensland are being assessed for a range of plausible scenarios. These will be broadly consistent with the scenarios developed for the ISP which will be released in July 2018. All scenarios will model a 50% Queensland Renewable Energy Target (QRET) by 2030.

[18] In 2017, AGL notified AEMO that it will close the 2,000 MW Liddell Power Station in NSW in March 2022.