2023-27
POWERLINK QUEENSLAND REVENUE PROPOSAL

Project Pack – PUBLIC

CP.02778
Calliope River to Wurdong Tee 275kV Transmission Line Rebuild

CP.02778 – Calliope River – Wurdong Tee 275kV Transmission Line Rebuild

Project Status: Not Approved

1. Network Need

The Calliope River to Gin Gin 275kV transmission lines, feeders 813 and 814, were commissioned in 1972 and 1976 respectively. The two single circuit lines run parallel to each other for approximately 15km to a point known as the Wurdong Tee; where they deviate onto independent alignments. The Calliope River to Gin Gin feeders are a key part of the 275kV network connecting Central and South Queensland (CQ-SQ). An outage of either feeder would leave up to 120MW and up to 1,600MWh of customer load per day at risk[2].

A Condition Assessment (CA) carried out in June 2020 identified that sections of line between Calliope River and the Wurdong Tee were in poor condition, exhibiting high percentages of Grade 3 (Medium) corrosion and moderate percentages of Grade 4 (High) corrosion across structure fasteners and members[1]. By 2024, an average of 11% of bolts are expected to have Grade 3 or higher corrosion if no additional maintenance is performed. This decline in asset condition increases the risk of structural failure that may cause safety incidents, network outages and additional network costs to replace assets under emergency conditions.

Energy Queensland's forecasts have confirmed there is an enduring need to maintain electricity supply into the Wide Bay load centres. Removal of these would violate Powerlink's Transmission Authority reliability obligations (for N-1-50MW/600MWh)[2]. Failure to address the condition of this asset is likely to result in non-compliance with Powerlink's reliability and safety obligations[6].

2. Recommended Option

As this project is currently 'Not Approved', project need and options will undergo a public Regulatory Investment for Transmission (RIT-T) consultation process to identify the preferred option closer to the time of investment. Through this process, feasible non-network options will be sought and assessed.

The current recommended option is to rebuild feeder 813 with a new double circuit 275kV transmission line on a widened easement between Calliope River and the Wurdong Tee, and decommission two sections of the single circuit 275kV transmission lines by June 2024[2].

The following options were considered but not proposed:

- Do Nothing – rejected due to non-compliance with reliability standards and safety obligations.
- Non Network Option parameters identified – at present no viable non network option has been identified.

Figure 2-1 shows the current recommended option may reduce the forecast risk monetisation profile of the Calliope River to Gin Gin line by up to $4m p.a. in 2024.

Where a 'Do Nothing' scenario is adopted, the forecast level of risk associated with the asset escalates to over $12m p.a. in 2030. This is predominantly due to network risks (the value of unserved energy) and safety risks to the public due to failed structures[3].

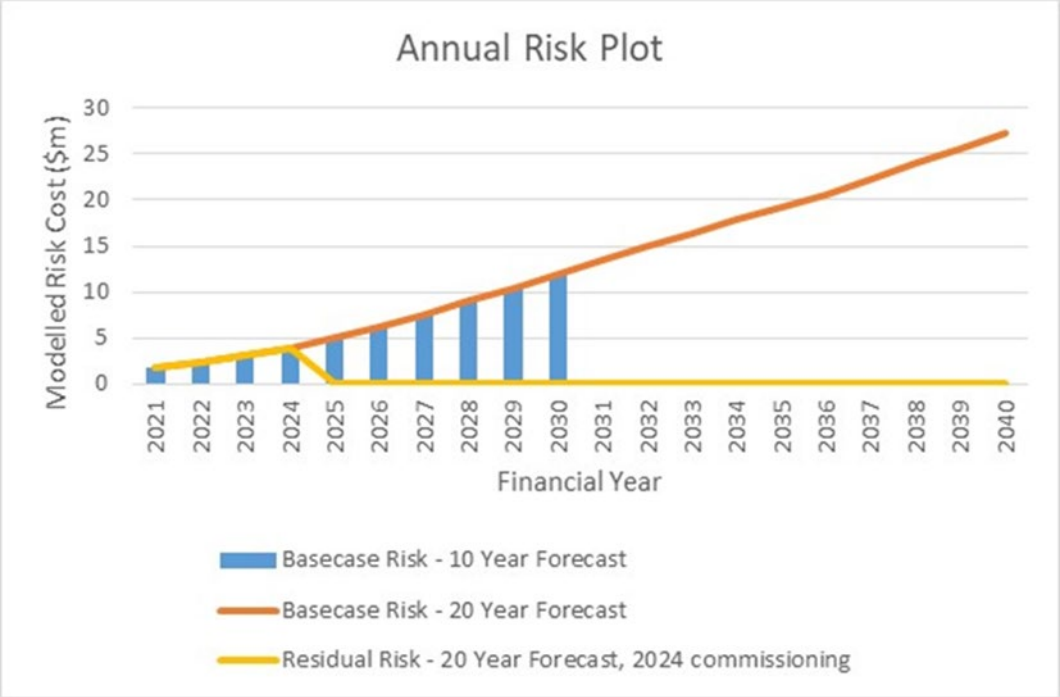

Figure 2-1 Annual Risk Monetisation Profile (Nominal)

3. Cost and Timing

The estimated cost to rebuild the Calliope River to Wurdong Tee 275kV feeders is $25.9m ($2021/22 Base)[5].

Target Commissioning Date: June 2024

4. Documents in CP.02778 Project Pack

Public Documents

1. Transmission Line Condition Assessment – Report Built Section 1122 Calliope River to Gin Gin 275kV
2. CP.02778 Calliope River to Wurdong tee 275kV DCST Transmission Line Rebuild (813/1 and 814/1) - Planning Statement
3. Base Case and Maintenance Costs Summary Report CP.02778 BS1122/1123 Calliope River – Wurdong Tee Rebuild
4. Project Scope Report CP.02778 BS1122/1123 Calliope River to Wurdong Tee Transmission Line Rebuild
5. Concept Estimate for CP.02778 – BS1122/1123 Calliope River to Wurdong Tee Transmission Line Rebuild

Supporting Documents

6. Asset Reinvestment Criteria - Framework
7. Asset Management Plan 2021

Transmission Line Condition Assessment – Report

Built Section 1122

Calliope River to Gin Gin 275kV

Record ID	A2444898	
Team	Delivery & Technical Solutions – Technology & Planning – Asset Strategies – Transmission Lines	
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Approved by	Asset Strategies Manager	[redacted]

Version history

Version	Date	Section(s)	Summary of amendment	Author	Approver
1.0	25/11/2015	All	Original Document	[redacted]	[redacted]
2.0	30/03/2016	All	Updated following a detailed site inspection	[redacted]	[redacted]
2.1	13/06/2016	All	Additional notification and condition data added.	[redacted]	[redacted]
3.0	19/6/2020	All	New condition information added and format updated.	[redacted]	[redacted]

Note: *Where indicator symbol ☼# is used (# referring to version number) it indicates a change/addition was introduced to that specific point in the document. If the indicator symbol ☼# is used in a section heading, it means the whole section was added / changed.*

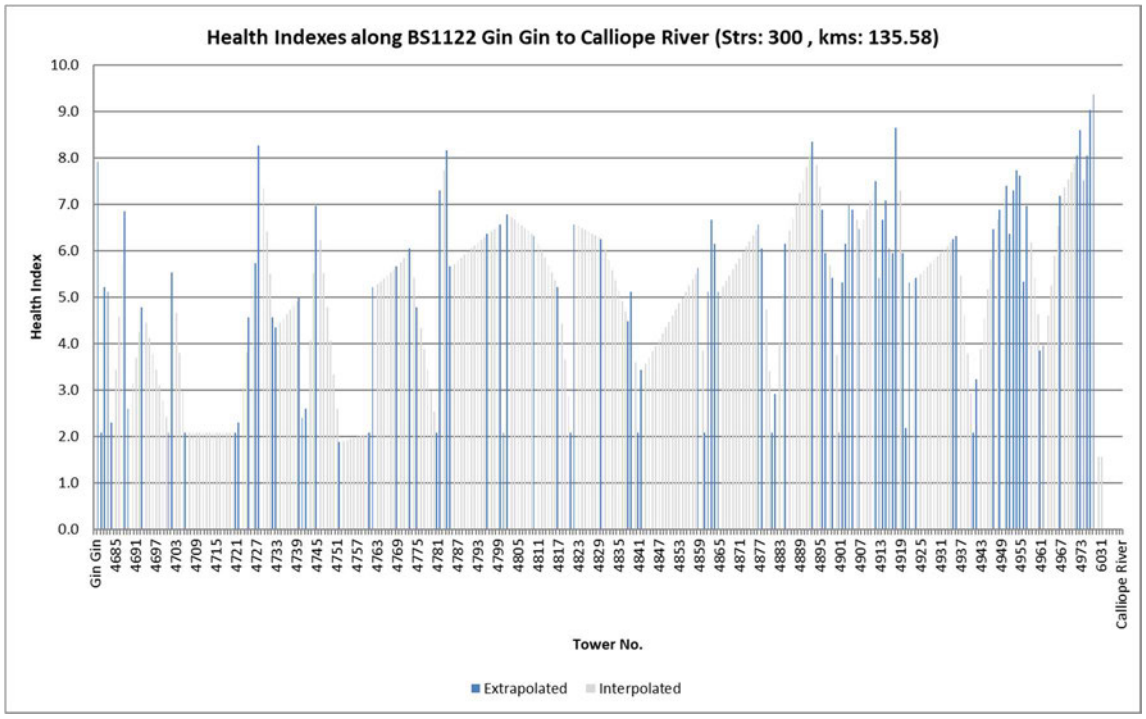
IMPORTANT: - This Condition Assessment Report provides a summary of the built section condition outlined in the Report's Scope. As it is snapshot in time based upon available data and the accuracy of the prediction methodology, any estimates of remaining life are valid for 3 years only from the date of the report's approval.

1. Executive Summary

Built Section 1122 connects Calliope River substation to Gin Gin substation and is a single circuit 275kV transmission line which was originally commissioned in 1972 under contract number 11/21. The built section is 136km long and consists of 300 steel lattice structures.

The transmission line sits in a medium rainfall area but with significant variation in atmospheric corrosion environment along the length of the line. The northern end (near Gladstone) is in a high atmospheric corrosion environment, and the condition of structures in this section will drive the need for a future project.

Below are health indices of structures along the built section. Extrapolated values represent measured health indices (adjusted for inspection date) and interpolated values are estimated based on the extrapolated values. These values are calculated based on visual inspection of structures between 2017 and 2019 using visual grading guides. The health indices along the line shows the northern area (right of graph) to be in the worst condition.



It is necessary to consider when and how to maintain these structures in order to avoid reaching the point where extensive replacement of steelwork is necessary. If left untreated the maintenance costs would drive replacement of structures.

All suspension insulators were replaced between 2000 and 2009 under OR projects, however some issues exist with grade 3 hardware that needs to be addressed within 8 to 10 years. An OR project is currently underway to replace corroded bolts and members associated with V-String attachment points. This project will remove some of the grade 4 bolts and members that exist on the suspension structures.

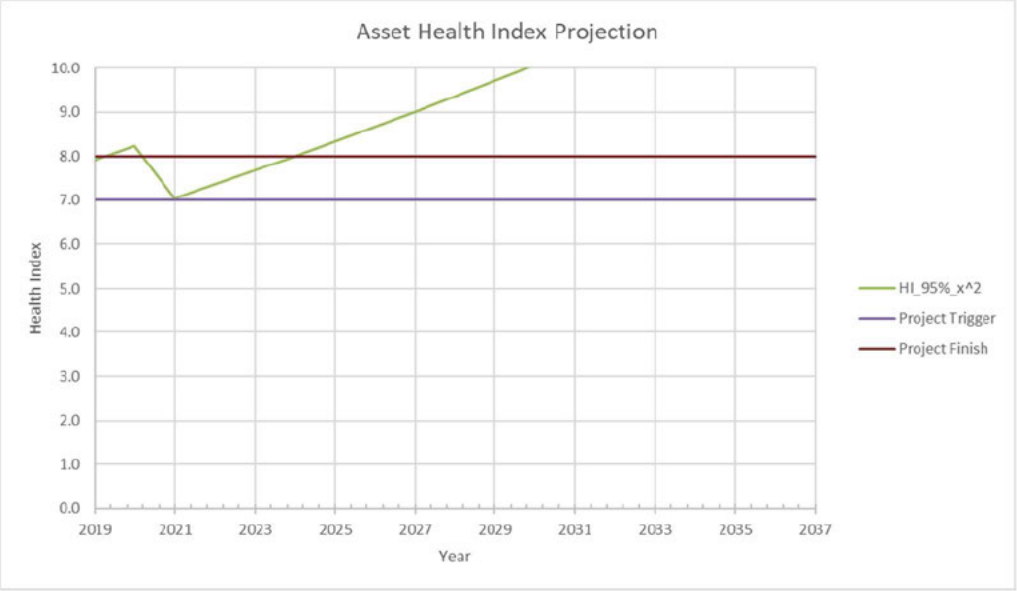
All tension insulators are original and some are showing signs of high grade 3 corrosion that will be addressed under an OR project currently underway to replace all grade 3 tension insulators including hardware. The project will also replace any grade 4 bolts that are corroded in the earthwire peak which were identified during climbing inspections.

All bridging insulators were replaced between 2000 and 2015, however hardware was not replaced. About 10% of the hardware is grade 4 and will need to be replaced in 0 to 3 years. Some insulators are showing signs of grade 3 corrosion and need to be replaced in 3 to 8 years.

The line has two earthwires which are both deteriorating and sections will need to be replaced in 3 to 5 years. The earthwires have had a number of broken strands repaired, most likely caused by lightning and related to the small strand size.

The phase conductors are in a serviceable condition with no work required.

Based on a statistical distribution of the structure health index, an Asset Health Index (AHI) was calculated. The above mentioned OR project currently underway has been taken into consideration to show a reduction in health index following the completion of the projects in 2021. The following graph shows a projection of the AHI based on a threshold of 95% of towers which excludes the worst 5% of towers. Based on the data it is recommended that another project be completed before 2024, when the AHI reaches 8.



Predicted end of service life summary table								
Cond	EW	OPGW	Foundation Bored	Foundation Grillage	Structures (HI 8)	Bridging Strings	Suspension Strings	Tension Strings
2042	2023	N/A	2052	N/A	2024	2020	2023	2033

Based upon the data presented in this report and health indices for 33% of the structures, this line will require reinvestment within the next 1 to 4 years.

2. Purpose

This report outlines the assessed condition of Built Section 1122 which traverses between Calliope River substation and Gin Gin substation. The report has been produced to assist in developing a future asset management strategy for the line.

3. Scope

The report examines the condition of the transmission line's major component groups, using field data and maintenance records based upon the asset management guidelines.

The Levels of Corrosion assigned to components are based on the corrosion/deterioration classifications used in Powerlink's Visual Inspection Guides and summarised below.

Level of Corrosion	Description
Grade 2 (G2)	Corrosion observed which should continue to be ***Monitored and Reviewed.***
Grade 3 (G3)	Corrosion which represents a loss of greater than 50% of the galvanising layer and in the worst cases unprotected carbon steel corrosion is about to commence.
Grade 4 (G4)	Corrosion which represents the total loss of galvanising and the onset of unprotected carbon steel corrosion.

4. Transmission Line Parameters

4.1 Overview

The single circuit 275kV transmission line traverses from Calliope River substation south east following the coast to Gin Gin substation. The line runs through rural and remote properties while sharing an easement with up to five other transmission lines between Calliope (near Gladstone Township) and Wurdong Tee. The line continues south east splitting away from all the other lines and heading further from the coast all the way to Gin Gin.

Figure 1: Geographical Overview

The tower geometry is single circuit lattice as shown in the photos below.

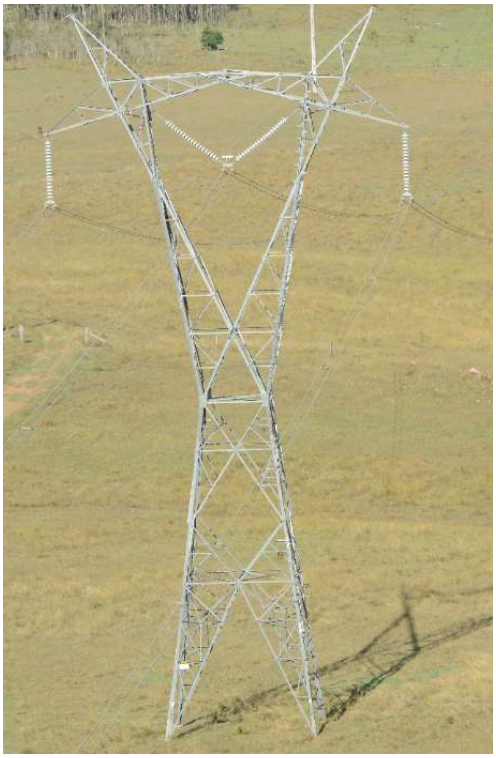


Figure 2: 1122-STR-4712 - Suspension Tower

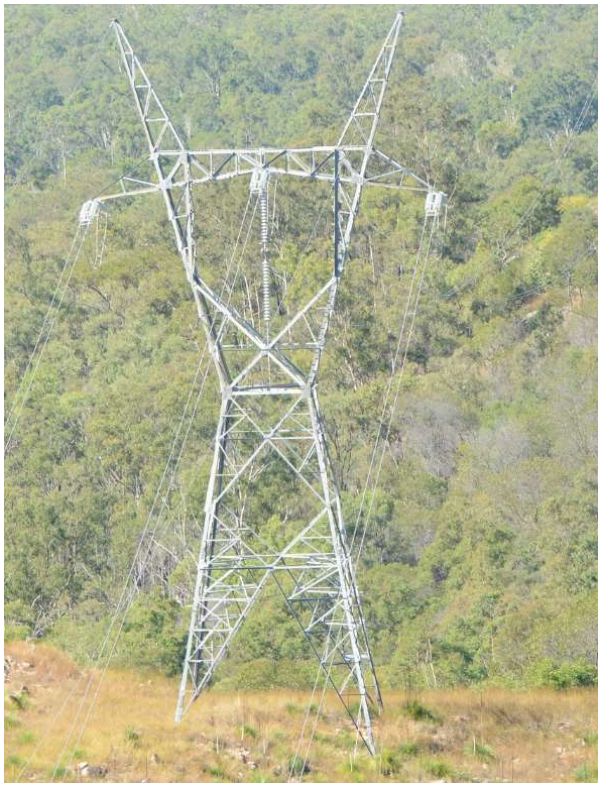


Figure 3: 1122-STR-4863 - Tension Tower

4.2 Asset Summary Table

Commissioning Date	1.12.1972
Voltage	275kV
Contract Number	11/21
No. of Circuits	1
Circuits	813
End 1	Calliope River H067
End 2	Gin Gin H006
Route Length (km)	135.58 km
No. of Towers	60 Tension, 240 Suspension
Type	Galvanised Steel Lattice Tower
Foundations	Standard steel reinforced concrete Piled Foundations (4977 only)
Conductor	ACSR/GZ GOAT, Normal 30/7/3.71 AAAC PHOSPHORUS, Normal 37/3.75 (3 spans)
Sub-Conductor /Phase	2
Conductor Line Clamps	AGSU
Conductor Vibration Dampers	Stockbridge 4D, installed 2000
No. of OHEW	2
Earthwire (Side A) **Installed in 2009**	SC/GZ 19/2.03 OPAL 19/3.25 (Calliope End)
OHEW Line Clamps	Overhead Trunnion
OHEW Vibration Dampers	Spiral, Installed mostly 2000 but some from 1972 and 2012
No. of OPGW	0
OPGW (Side B)	n/a
OPGW Line Clamps	n/a

OPGW Vibration Dampers	n/a
AVG Easement width	245m at Calliope end – 5 circuits 200m at Boyne Tee - 4 circuits Spare easement exists on the left from Calliope River to Boyne 132kV Tee. 160m at Wurdong Tee - 3 circuits 80m at Gin Gin end - 2 circuits

4.2.1 Insulators

Insulator Function	Strs	Material	Rating	Type	Discs	Installed
Suspension	66	Porcelain	125kN	Fog	21	2000 - 2004
	174	Porcelain	125kN	Normal	17	2004 - 2009
Bridging	22	Porcelain	125kN	Fog	21	2000 - 2004
	2	Porcelain	125kN	Normal	17	2004
	1	Porcelain	125kN	Fog	18	2012
	1	Porcelain	125kN	Fog	21	2013
	6	Porcelain	125kN	Fog	17	2015
	3	Porcelain	125kN	Fog	19	2015
Restraint Bridging	33	Porcelain	125kN	Fog	21	2000 - 2004
	6	Porcelain	125kN	Normal	19	2004
	19	Porcelain	125kN	Fog	18/19	2015
Tension	42	Porcelain	125kN	Normal	18	1974
	16	Porcelain	125kN	Fog	22	1974
	3	Porcelain	125kN	Fog	21	2012
	1	Porcelain	125kN	Fog	22	2013

Suspension insulators were replaced under OR.00737 and OR.00836.

The tension insulator structure count includes the beams at both substations.

5. Location and Environment

5.1 General Location

The transmission line is located in Central Queensland and runs south east from Gladstone to Gin Gin (west of Bundaberg). Given the line is 135km long and within 50km of the coast, there are a few highway, major road, minor road, railway, and river crossings.

5.2 Atmospheric Corrosion

The Built Section starts out on Calliope River in a marine environment which is only 4km from the coast and finishes at Gin Gin which is about 44km from the coast. Based on BOM data from three sites along the line, the average rainfall is 912mm and the mean annual humidity is approximately 63%.

At a high level the line appears to have three environmental areas. The top 10% of the line is within 14km of the coastline and is close to high salt environments. The next 20% of the line is between 14km and 35km from the coast while the remaining 70% of the line moves away from the coast to a maximum distance of approximately 44km. The northern section of the line is constantly exposed to medium levels of salt laden winds.

Based on the data it was very difficult to assign corrosion regions as the condition varied a lot and therefore changed between C2 and C3 corrosion region. The health index and notifications were used to determine a split in the corrosion regions. Most of the line (70%) sits in a C2 corrosion region. There are two other corrosion regions that can be determined from the data. The northern end from Calliope to just south of Wurdong tee (structure 4944) is considered to be C4 corrosion region. The section from just south of Wurdong tee (structure 4943) to structure 4876 is considered to be C3 corrosion region.

The structures in the C4 corrosion region are exhibiting high percentages of grade 3 corrosion and moderate percentages of grade 4 corrosion across structure fasteners and members. These observations are consistent with past Powerlink experience in multiple corrosion areas.

The highest rates of galvanised steel corrosion normally occur on sheltered or partially sheltered steel members, nuts, bolts and joint interfaces. Reduced exposure to cleansing rains and drying winds creates a microenvironment where the accumulation of air-borne pollutants and trapped moisture accelerates the corrosion process.

The thickness of the original coating also determines the subsequent service life of the coating as the rate of zinc loss is fairly constant for a given geographical area, although some localised variation due to structure orientation is possible.

This increased potential for corrosion based upon microclimatic conditions and coating thickness is, as a general rule, consistent with the observed condition of Powerlink's galvanised steel lattice towers, with spot rusting of major members accompanied by more advanced rusting of nuts, bolts and joint nodes.

Once the galvanised coating has been damaged or deteriorated to the point where visible corrosion is evident, the steel has effectively begun to break down (***AS/NZS 2312-2002 – Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings***). This point has been adopted as Level 2 corrosion in Powerlink's Visual Grading.

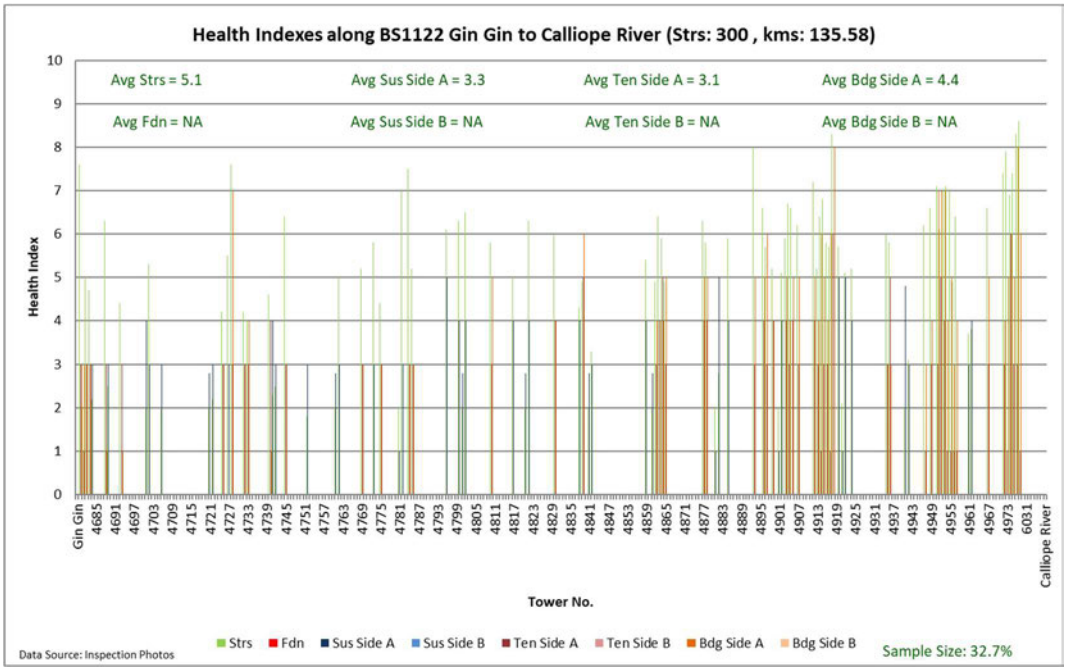
The Galvanizers' Association of Australia (refer Section 7) estimates the service life of nuts, bolts and members in this location as follows.

Component	Minimum coating thickness µm	Estimated life to First Service in Years *(First Appearance of Grade 2)*			
		C2	C3	C4	C5
Bolts & nuts	45	64	22	11	5
Members ≤ 6mm	70	100	33	17	8
Members > 6mm	85	121	40	20	10

The final stages of G3 Corrosion represent a total loss of galvanising and the onset of unprotected carbon steel corrosion. Rates of carbon steel corrosion can be between 10-300 times the rates of galvanised corrosion, depending upon the atmospheric conditions.

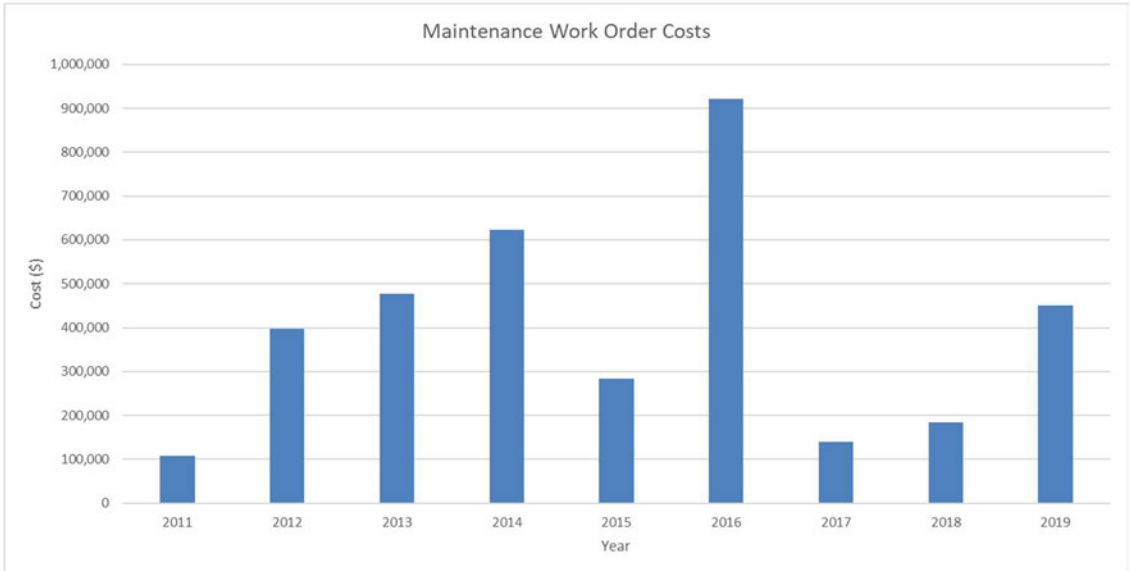
6. Condition Assessment

The condition data detailed in the below sections has been summarised in the following graph of available health indices for some major components.



Appendix 7 has two graphs of the number of notifications relating to corrosion. The notification graphs show reasonable correlation with the health indices and the percentages of corrosion which show the northern end as the most corroded section of line. The majority of the grade 4 corrosion relates to the bolts in the earthwire peak, conductor attachment plates, and superstructure which should be rectified during two OR projects currently underway.

The following work order costs show that on average $398k p.a. was spent on maintenance across 300 structures. The peak in 2014 relates to easement costs associated with tropical cyclone Oswald. The peak in 2016 relates to access track and vegetation maintenance.



6.1 Structure Condition

The table below summarises the average condition of each zone on the structure. Based on visual assessment and past experience the estimated remaining service life has also been provided for the structures.

Average Observed Corrosion Grades are based upon Powerlink Visual Inspection Guides, as applied by field crews or to photographic evidence from 2017 to 2019.

BS1122 Structure Zone	Average Level of Corrosion (%)				Sample Size	Installed Year	Health Index (95%)	Estimated Years
Structure								
Foundations	G1	G2	G3	G4		1972	1.8	45 to 52
Legs	99.8	0.2	0	0	85			
Structure Overall	G1	G2	G3	G4	99	1972	8.2	-4 to -1
Fasteners	77.8	17.8	3.4	1	99			
Members	91	8.8	0.2	0	99			
Climbing Aids	G1	G2	G3	G4				
Fasteners	77.4	19	2.5	1.4	99			
Tower Base	G1	G2	G3	G4				
Fasteners	79.7	16.3	3.3	0.7	99			
Members	95.2	4.6	0.1	0.1	99			
Tower Body	G1	G2	G3	G4				
Fasteners	86.5	11.7	1.6	0.2	99			
Members	91.7	8.1	0.2	0	99			
Superstructure	G1	G2	G3	G4				
Fasteners	74.8	19.8	4.1	1.3	99			
Members	88.7	11	0.2	0.1	85			
Cross Arms	G1	G2	G3	G4				
Fasteners	77	20.2	2.5	0.3	99			
Members	90.5	9.4	0.1	0	99			
Conductor Attachment Plate	G1	G2	G3	G4				
Fasteners	75.3	17.9	3.8	3	99			
EW Peak	G1	G2	G3	G4				
Fasteners	63.9	24.2	8	3.9	81			
Members	87	12.6	0.3	0.1	81			
	Min	Max	Avg					
Structure Earthing Resistance	0.1	4.3	1.1		289			

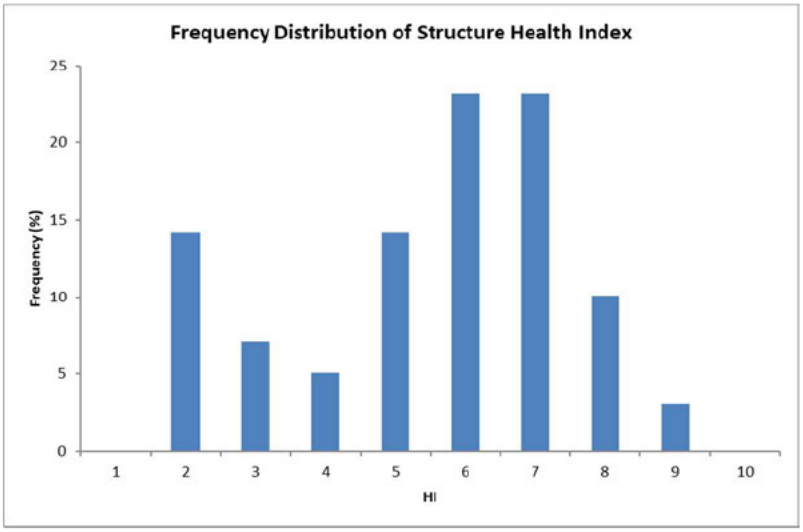
Table 1: Average Structure Corrosion Values

For this very long built section the health index is the 95th percentile value based on a normal distribution of the data sample. It is noted that the percentage of health indices which exceed this value (5%) equates to approximately 9 structures based on the 33% sample size. That is, it is estimated that 9 structures will have a health index equal to or greater than what is in Table 1.

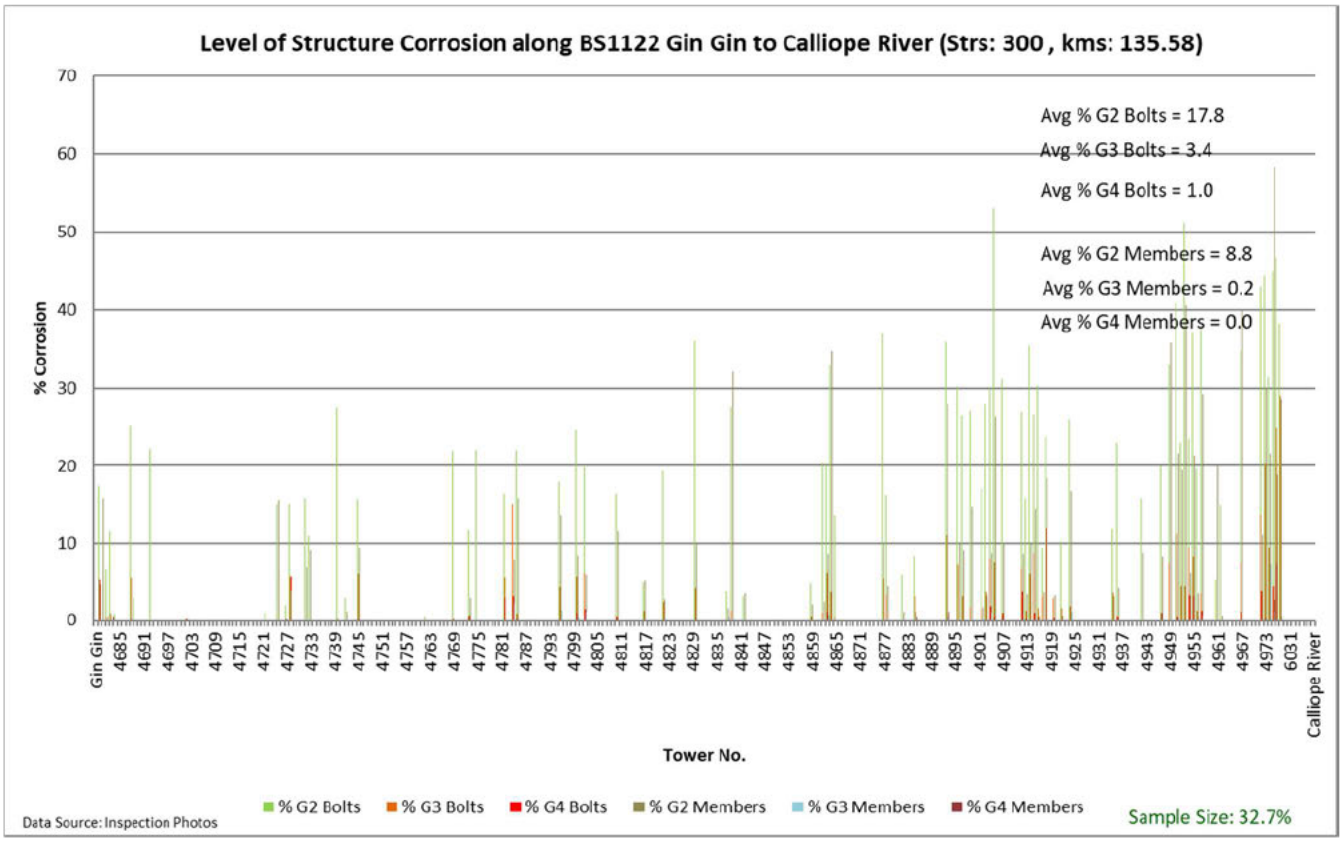
Based on the data presented in Table 1 the following commentary has been provided. The commentary relates to items of interest from the table and typically only represents the worst sections of the line. These notes highlight the key condition drivers that could be used to develop a project scope.

Structure Zone	Comment
Foundation	Generally the foundations are good, with only one foundation reported to have interface corrosion (G4), one cracked foundation, and seven with drainage issues.
Structure Overall	The condition of the structures represented in Table 1 does not take into consideration the two OR projects currently underway on this built section. It is expected that these projects will address the average 1% of the fasteners that are grade 4. The superstructure, conductor attachment zones, and earthwire peaks are the worst areas.
Climbing Aids	They do not meet the current Powerlink standard.
Tower Base	There is medium percentages of G4 corrosion recorded on fasteners and members.
Tower Body	Low percentage of G4 corrosion on fasteners with no recorded G3 corrosion on members.
Superstructure	The superstructure has a high percentage of G4 corrosion on fasteners and a low level of G4 corrosion on members.
Cross Arms	Relatively low percentage of G4 corrosion on fasteners compared to the rest of the tower. No record of G4 corrosion on members.
Cond. Attachment	A very high percentage of G4 corrosion on fasteners, however given there are only a small number of bolts on the attachment the actual quantity is quite low. Some of these are likely to be replaced as part of the current maintenance projects.
Earthwire Peak	A high percentage of G3 and G4 fasteners were observed. A low percentage of G3 and G4 members were recorded. Some of the fasteners are likely to be replaced as part of the current maintenance projects.
Anti-climbing Barrier	The majority of the barriers on this line are not in-line with the current barbed wire barrier standard. There were 14 cases of the anti-climbing barriers being replaced or repaired under maintenance.

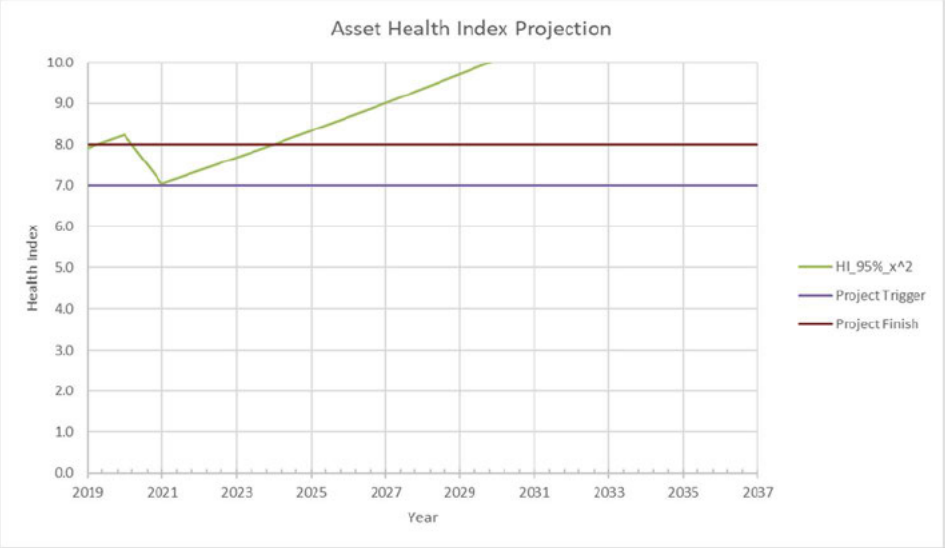
Below is the frequency distribution of structure health index based on the sample of data which can help to understand the spread of the data and determine if projects can have a staged delivery.



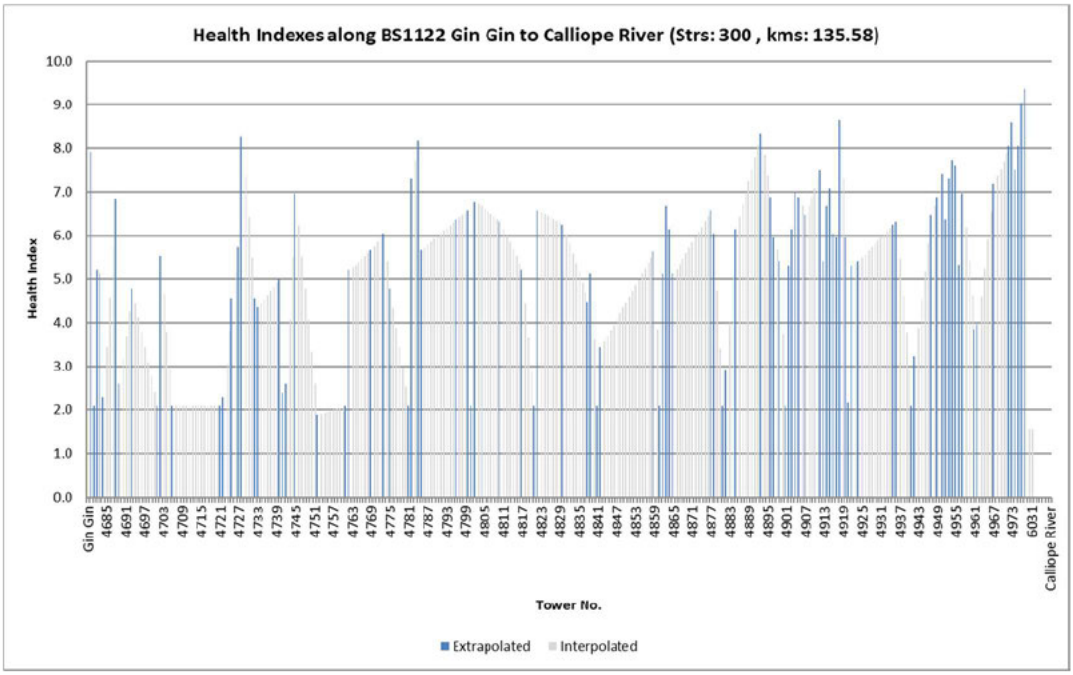
Below is the percentage corrosion of structures along the built section based on visual estimates on a sample of photos of the towers. The high spikes are the levels of grade 2 corrosion on both the fasteners and members.



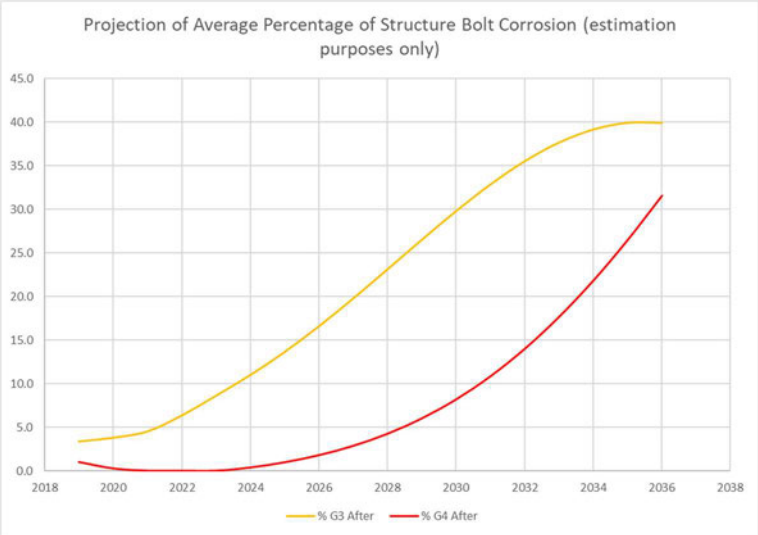
The percentages of corrosion are converted to a health index and based on statistical distribution of the results an Asset Health Index (AHI) was calculated. The following graph shows the AHI based on a threshold of 95% of towers which excludes the worst 5% of towers. There are a couple of refurbishment projects underway which are expected to remove approximately 1% of the worst bolts. The improved condition is estimated to reduce the health index by 1.5 in 2021. Based on the data it is suggested that another project be completed before 2024.



Below are the health indices of structures along the built section. These values are based on the calculated health index data for the sample of structures that were inspected. The calculated values have been extrapolated from the date they were recorded to the current year. The values for towers between known (calculated) points have been interpolated to determine a rough estimate of health index for those structures. The estimated values should not be used for calculating the asset health index.



To aid with estimation, the average levels of corrosion are calculated. Below is the projection of the average level of corrosion on the entire built section based on the sample of data and an estimated service life of 52 years for bolts. The dip in the graph represents the bolts changed under the refurbishment projects.



The figures from the above graph are shown in the table below. In 2024 it is estimated that on average across the built section 11% of bolts will have reached a level of corrosion of grade 3 or higher if no additional maintenance is performed.

Year	%G2 Bolts	% G3 Bolts	% G4 Bolts	%G2 Mem.	% G3 Mem.	% G4 Mem.
2020	53	3.8	0.26	18.3	0.3	0.01
2021	57	4.5	0.00	22.0	0.4	0.01
2022	61	6.4	0.00	26.0	0.7	0.02
2023	63	8.7	0.00	30.3	0.9	0.03
2024	65	11.0	0.37	34.9	1.3	0.05
2025	66	13.7	0.97	39.5	1.9	0.08

Table 2: BS1122 Estimated Average Percentage of bolts and members to be replaced

6.2 Insulators and Hardware

The table below summarises the average condition of each insulator string. Based on visual assessment and past experience the estimated remaining service life has also been provided.

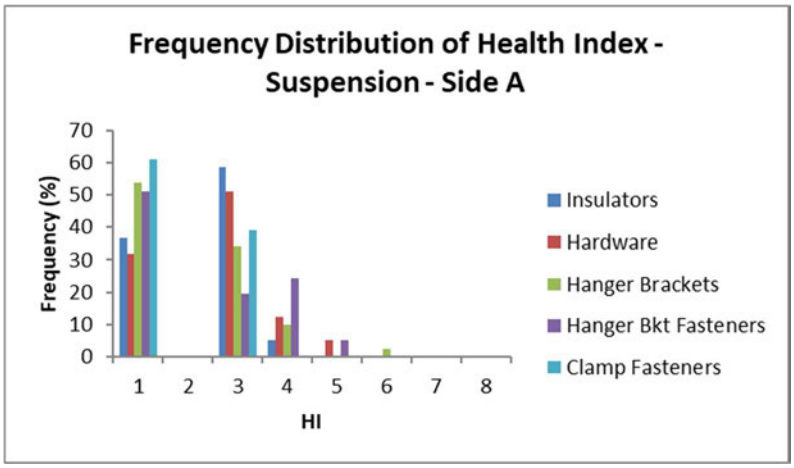
Corrosion Grades are based upon Powerlink Visual Inspection Guides, as applied by field crews or to photographic evidence from 2017 until 2019.

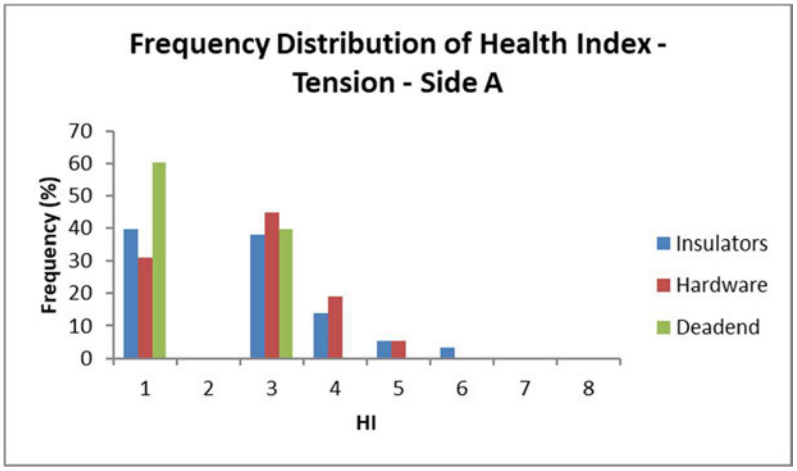
BS1122 Component	Corrosion Grade / Condition (%)								Sample Size	Installed Year	Health Index (95%)	Estimated Years until HI of 7
Suspension - Side A										1972	5	8
Insulators	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	36.6	0	58.5	4.9	0	0	0	0	41	2000		6 to 10
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	31.7	0	51.2	12.2	4.9	0	0	0	41	1972		8 to 24
Hanger Brackets	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	53.7	0	34.1	9.8	0	2.4	0	0	41	1972		3 to 24
Hanger Bkt Fasteners	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	51.2	0	19.5	24.4	4.9	0	0	0	41	1972		8 to 24
Clamp Fasteners	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	61	0	39	0	0	0	0	0	41	1972		24+
Clamps	Ok	Worn Rubber	Aged									
	100	0	0						41			
Insulator Shed	OK	Polluted	Dust	Moss	Fungi	Disc-cracked	Disc-chipped					
	75.6	0	0	0	0	0	0		41			
Tension - Side A										1972	5.1	8
Insulators	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	39.7	0	37.9	13.8	5.2	3.4	0	0	58	1972		3 to 24
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	31	0	44.8	19	5.2	0	0	0	58	1972		8 to 24
Deadend	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	60.3	0	39.7	0	0	0	0	0	58	1972		24+
Insulator Shed	OK	Polluted	Dust	Moss	Fungi	Disc-cracked	Disc-chipped					
	96.6	0	0	3.4	0	0	0		58			
Bridging - Side A										1972	7	0
Insulators	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	31	0	46.6	17.2	1.7	3.4	0	0	58	2000		1 to 10
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	5.2	0	25.9	24.1	27.6	6.9	6.9	3.4	58	1972		-4 to 24
Clamp Fasteners	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	20.7	0	60.3	12.1	6.9	0	0	0	58	1972		8 to 24
Insulator Shed	OK	Polluted	Dust	Moss	Fungi	Disc-cracked	Disc-chipped					
	98.3	0	0	0	0	0	0		58			

The health index is either the maximum value or the 95% value based on a normal distribution of the data sample. That is, 5% of insulator strings will be equal to or greater than the health indices listed in the above table.

Insulator String Function	Comment	Estimated Remaining Service Life (years)
Suspension	Approximately 6% of suspension insulators were changed in 2000, 29% changed in 2003-2004, and the remaining 65% changed in 2009. All have the original hardware. The hardware needs to be replaced in the medium term.	3-8
Tension	The tension insulators are original from 1972 and 3% are showing signs of high grade 3 corrosion.	3-8
Bridging	The bridging insulators were replaced between 2000 and 2015. About 10% of bridging strings have hardware corrosion issues that need to be resolved in the short term. Approximately 3% of insulators are due for replacement in the medium term.	0-3

Below is the frequency distribution of suspension and tension insulator health index based on the sample of data.





6.3 Conductor and Conductor Hardware

The original transmission line was strung with Twin ACSR/GZ Goat, Normal 30/7/3.71 conductor, comprising aluminium conductor with steel reinforced strands. A few spans of transmission line into Calliope River Substation uses Twin AAAC/1120 Phosphorus, Normal 37/3.75 conductor.

No issues have been identified with the conductor and it is estimated to last 70 years in this environment.

Component	Installation Year	Comment	Estimated Remaining Service Life (years)
Conductor	1972	No visible deterioration. No notification of broken conductor strands.	22
Conductor Dampers	1972-2012	Seven notification of damper issues. There are a range of damper ages with most (219 spans) from 2000, some (29 spans) from 1972, and a couple (2 spans) from 2012.	0-15
Conductor Spacers	1972	No issues.	10-15
Conductor Mid-Span Joints	1972	No midspan information.	-

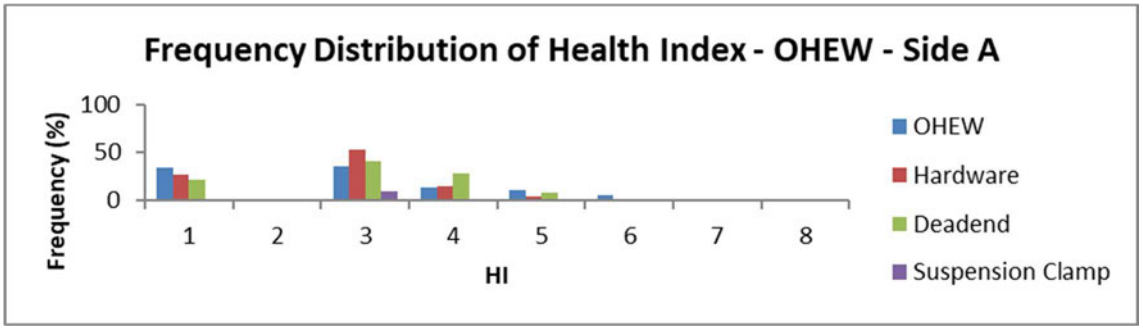
Deadend fittings are not covered under this section, refer to the tension insulator assembly condition for details on the condition of deadend fittings.

6.4 Earthwire / Optical Ground wire and Hardware

The table below summarises the average condition of each earthwire or OPGW. Based on visual assessment and past experience the estimated remaining service life has also been provided.

Corrosion Grades are based upon Powerlink Visual Inspection Guides, as applied by field crews or to photographic evidence.

BS1122 Component	Average Level of Corrosion (%)								Sample Size	Installed Year	Health Index (95%)	Estimated Years until HI of 7
OHEW - Side A										1972	5.5	6
OHEW	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	34.1	0	35.3	14.1	10.6	5.9	0	0	85	1972		3 to 24
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	26.5	0	53	15.7	4.8	0	0	0	83	1972		8 to 24
Deadend	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	22.1	0	41.2	27.9	8.8	0	0	0	68	1972		8 to 24
Suspension Clamp	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	0	0	9.8	0	0	0	0	0	41	1972		24+
OHEW - Side B										1972	5	8
OHEW	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	35.8	0	44.4	9.9	7.4	2.5	0	0	81	1972		3 to 24
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	27.2	0	55.6	14.8	2.5	0	0	0	81	1972		8 to 24
Deadend	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	24.2	0	50	19.7	6.1	0	0	0	66	1972		8 to 24
Suspension Clamp	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	0	0	14	0	0	0	0	0	43	1972		24+



Component	Installation Date	Comment	Estimated Remaining Service Life (years)
Earthwire	1972-2012	29 notifications for stranded OHEW which is a lot but the EW is 19/2.03 which could explain it. 33 Notifications of rusty earthwire. Sections of EW will need to be replaced in the medium term.	3-8
Earthwire Hardware	1972-2012	Some instances of low grade 3. Overhead trunnion is a problem as it provides no longitudinal movement and is prone to breaking strands underneath the clamps.	8-15
Earthwire Dampers	1972-2012	There are a range of damper ages with most (219 spans) from 2000, some (9 spans) from 1972, and a couple (2 spans) from 2012.	0-15
OPGW	n/a	n/a	n/a
OPGW Hardware	n/a	n/a	n/a
OPGW Dampers	n/a	n/a	n/a

6.5 Earthing

Resistance measurements dating from 1984 to 2015 are lower than expected given some towers are in rocky areas. Values from 0.1 ohm to 4.3 ohms were measured with an average of 1.1 ohms.

Component	Installation/Repair Date	Corrosion Grade/Comment	Estimated Remaining Service Life (years)
Earthing	1972	104 instances of broken connections to EW. 20 instances of broken earth connections at ground line.	10-15

7. Appendices

7.1 SAP Notifications Graph

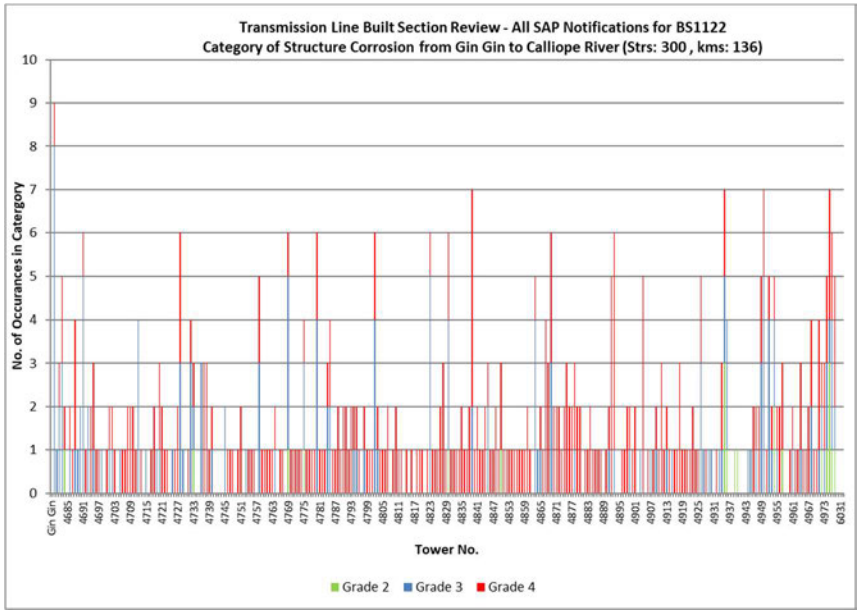


Figure 4: Graph of SAP all Notifications for Corrosion on Structures

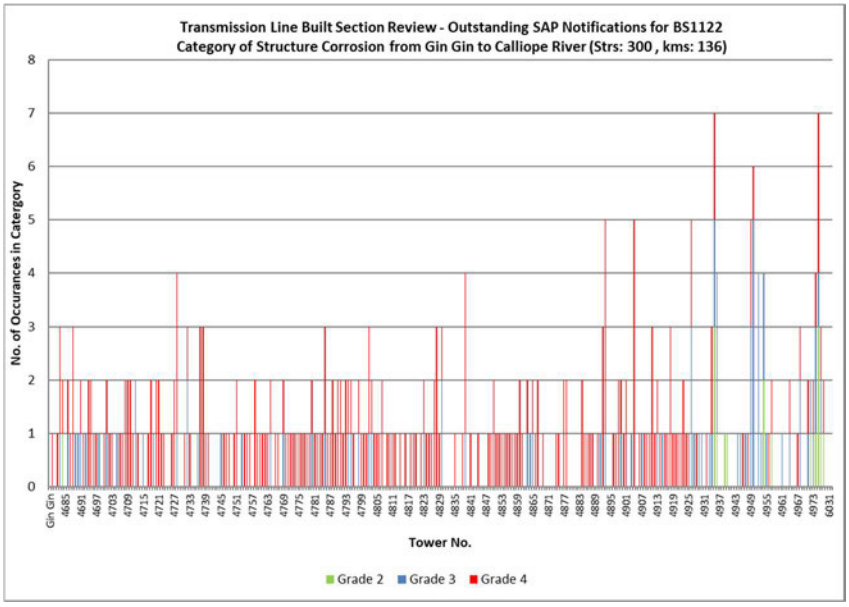
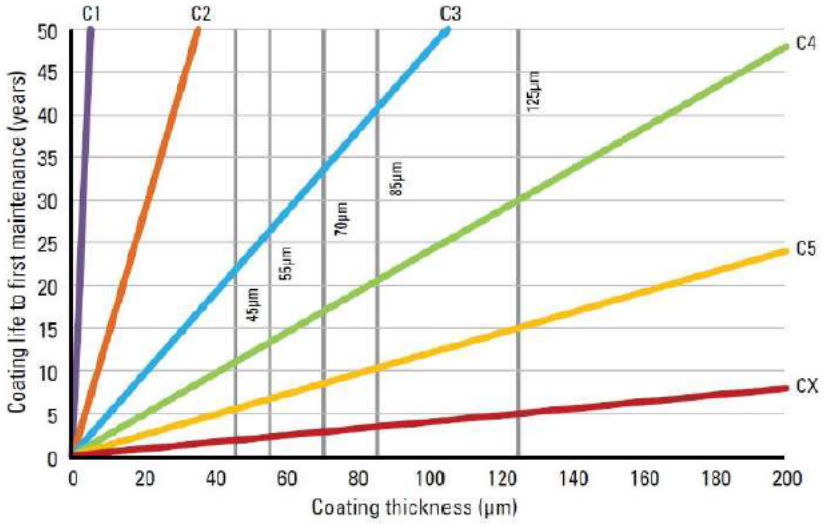


Figure 5: Graph of SAP Outstanding Notifications for Corrosion on Structures

7.2 Estimated Service Life of Galvanised Steel

Corrosivity Category	Corrosivity	Example
C2 (B)	Low	Very mild corrosion environment, such as semi-arid rural environment, with low humidity and rainfall, some rural activity, and/or minor vegetation encroachment into the easement.
C3 (C)	Medium	Mild corrosion environment, such as typical rural areas with moderate humidity and rainfall, average rural activity, and/or moderate vegetation encroachment into the easement.
C4 (D)	High	Moderate corrosion environment, such as in low density urban development or high activity rural areas, inland coastal regions, moderate to high humidity and rainfall, and/or moderate to heavy vegetation encroachment into the easement.
C5 (E)	Very High	Aggressive corrosion environment and/or close proximity to high salt coastal regions. Average Annual Rainfall may vary. Moderate to dense urbanised area with high public exposure will be included in this category.

Chart 1: Life to First Maintenance of Hot Dip Galvanized Steel



The LFM range for a particular hot dip galvanizing coating thickness and each corrosivity zone can be read from the chart. For example, the LFM range for a hot dip galvanized article with an 85 µm thickness and located in the C4 (High) corrosivity zone is 20 to 40 years.

Figure 6 - Life to First Maintenance of Galvanised Steel – Galvanisers Association of Australia

Region	Max Rate (µm/yr)	Bolts & Nuts (45µm)		Members <= 6mm (70µm)		Members > 6mm (85µm)	
		Min Yrs	Max Yrs	Min Yrs	Max Yrs	Min Yrs	Max Yrs
C2 (B)	0.7	64	450	100	700	121	850
C3 (C)	2.1	21	64	33	100	40	121
C4 (D)	4.2	11	21	17	33	20	40
C5 (E)	8.3	5	11	8	17	10	20

7.3 Estimated Service Life of Carbon Steel

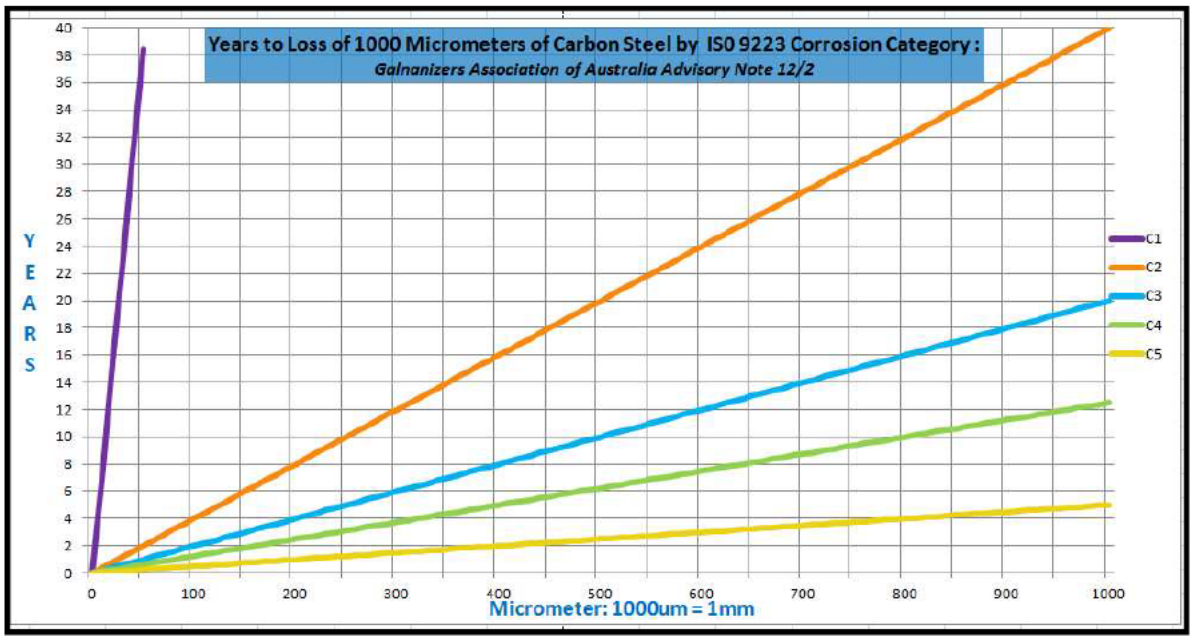


Figure 7 - Rate of Carbon Steel Loss

Source: Extrapolated from Table 2: Corrosion Rates for Steel and Zinc for the first year of exposure for different corrosivity categories. Galvanizers Association of Australia – Advisory Note GEN12/2 April 2012

7.4 References

Inspection Guides and Corrosion Models

- A2628257 Asset Strategies – Line Maintenance Principles – Specification
- A2791823 OSD – Transmission Line Patrol and Inspection – Guideline
- Galvanizers Association of Australia – Advisory Note GEN12/2 *"Atmospheric Corrosion Resistance of Hot Dipped Galvanized Coatings"* April 2012.
- AS/NZS 2312-2002 – Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings

Built Section Configuration

- SAP Reports

Condition Assessment Data

- M Drive Photos
- SAP IK17 Measurement Documents
- Notifications and Work Orders

Planning Statement	**24 September 2020**
Title	CP.02778 Calliope River to Wurdong tee 275kV DCST Transmission Line Rebuild (813/1 and 814/1) - Planning Statement[1]
Zone	Gladstone
Need Driver	Network and safety risks arising from the condition of existing lines, with an estimated 2024 end of life for the sections between Calliope River and Wurdong Tee.
Network Limitation	Feeders 813 and 814 are required to maintain power transfer capability between central and south Queensland, and to meet Powerlink Queensland's N-1-50MW/600MWh reliability obligations.
Pre-requisites	None

Executive Summary

The Calliope River to Gin Gin 275kV Single Circuit Steel Tower (SCST) transmission lines, feeders 813 and 814, were commissioned in 1972 and 1976 respectively. The condition of these transmission lines has deteriorated, with an estimated 2024 end of life for the sections between Calliope River and the Wurdong Tee.

The 2020 ISP classifies the expansion of CQSQ capacity as a 'Future ISP project', part of the ISP's optimal development path, not yet actionable but expected to be so in the future. Fundamentally, for the efficient operation of the National Electricity Market, there is an enduring need to maintain, and a potential need to expand, the capacity of CQSQ. The projects referred to in this planning statement maintain CQSQ transfer capacity.

Energy Queensland's forecasts have confirmed there is an enduring need to maintain electricity supply into the Wide Bay load centres. Removal of these lines to address emerging safety issues arising from the ageing asset would result in Powerlink breaching its N-1-50MW/600MWh Transmission Authority reliability obligations.

The preferred option is to rebuild the first section of existing 275kV SCST feeder 813 (from Calliope River to Wurdong Tee) to a Double Circuit Steel Tower (DCST) line by 2024. The first section of feeder 814 can then be decommissioned.

[1] *This report contains confidential information which is the property of Powerlink and the Registered Participant mentioned in the report, and has commercial value. It qualifies as Confidential Information under the National Electricity Rules (NER). The NER provides that Confidential Information:*

- *must not be disclosed to any person except as permitted by the NER;*
- *must only be used or copied for the purpose intended in this report;*
- ***must not be made available to unauthorised persons***

Table of Contents

1 Introduction

Feeders 813 (Built Section (BS) 1122) and 814 (BS1123) are two single circuit 275kV lines from Calliope River to Gin Gin that were originally commissioned in 1972 and 1976, respectively.

As shown in Figure 1, the geographical map of BS1122 and BS1123, these two lines run adjacent to each other for approximately 15km from Calliope River to a point known as Wurdong Tee, where they deviate onto independent alignments, with 813 taking a more western path and 814 taking a more eastern path along with another 275kV feeder 819.

Condition assessments of feeders 813 [2] and 814 [3] identified that the condition of these feeders has deteriorated, with an estimated 2024 end of life for the sections between Calliope River and the Wurdong Tee.

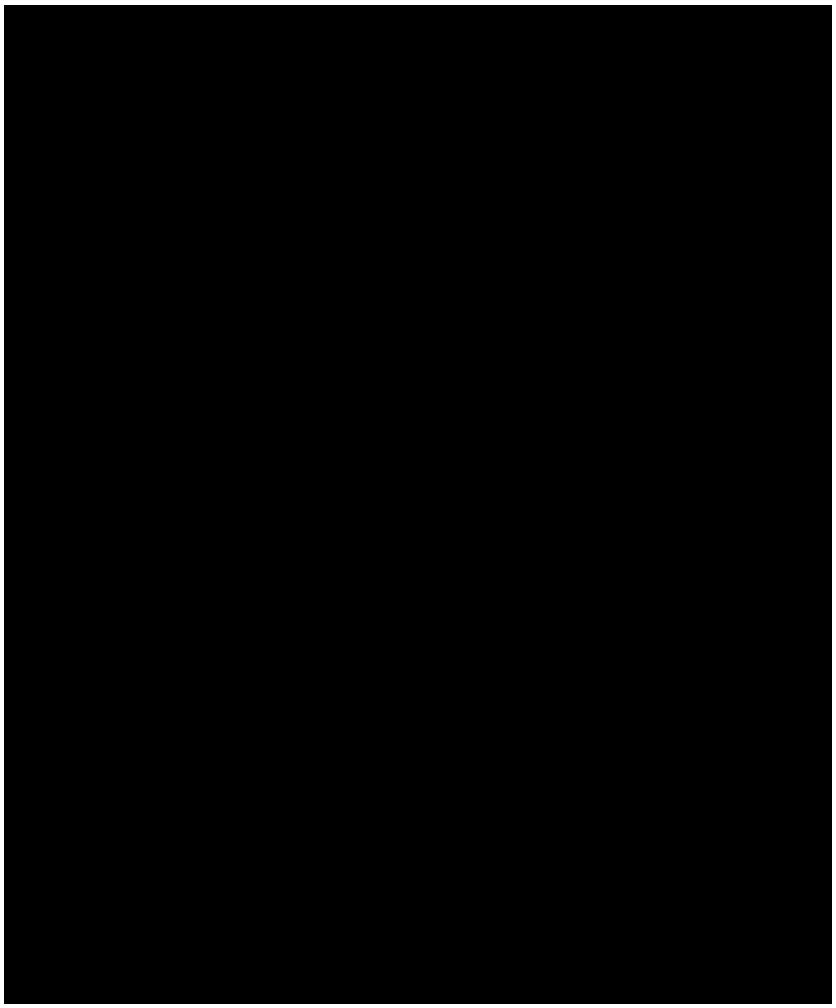


Figure 1: Geographical map of BS1122 and BS1123

This report assesses the impact that removal of the ageing line(s) would have on the performance of the network and Powerlink's statutory obligations. It also establishes the indicative requirements of potential alternative solutions to the current services supported by the line(s).

2 Central Queensland to South Queensland Transfer and Gin Gin Connection Point Forecast

Feeders 813 and 814 are two 275kV single circuit feeders connecting between Calliope River and Woolooga. This teed configuration, optimising the scope of Gin Gin primary plant replacement, has seen the renaming of Calliope River to Gin Gin lines 813 and 814 to be referred to as 813/1 and 814/1 and the Gin Gin to Woolooga lines 815 and 816 to be referred to as 813/2 and 814/2 respectively. Figure 2 illustrates this, along with the 132kV network to Teebar Creek.

Figure 2: Gin Gin/Bundaberg supply area

Figure 3 shows feeders 813 and 814 are also part of the 275kV network connecting Central Queensland and South Queensland (CQ-SQ grid section).

Note that Rodds Bay Solar Farm, a committed project, is planned to connect to feeder 819 and commence operation in 2022.

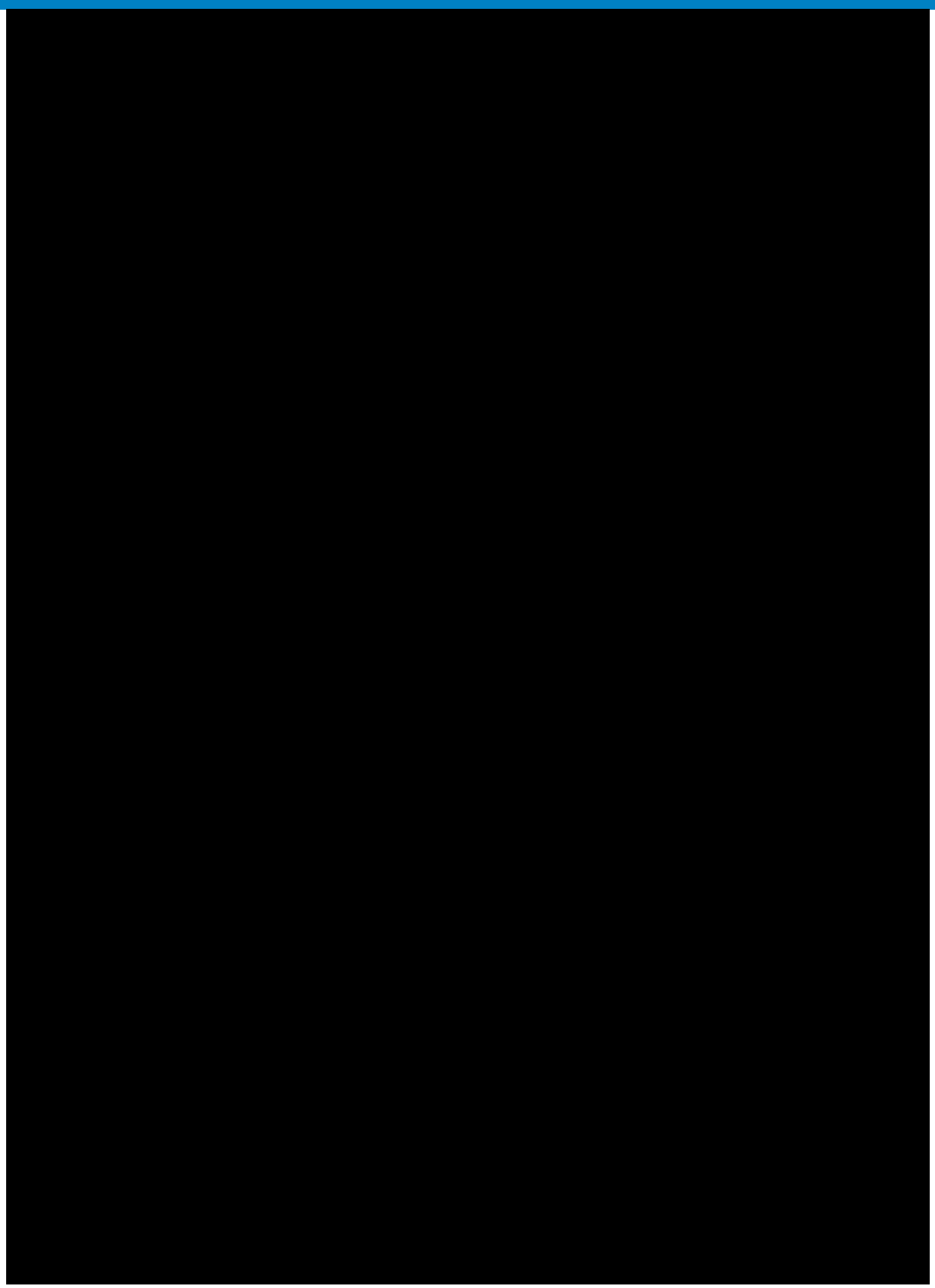


Figure 3: 275kV network connecting Central and Southern Queensland (CQ-SQ)

The maximum power transfer across the CQ-SQ grid section is limited by transient or voltage stability, typically set in anticipation of the potential loss of a Calvale to Halys 275kV circuit. However, it can also be thermally limited by the network between Calliope and Gin Gin/Wurdong, if one of the 275kV feeders south of Calliope River is out of service.

Figure 4 provides historical transfer duration curves of the CQ-SQ intra-connector showing continued increase in utilisation. This increase in transfer has been predominantly due to the ramping up of LNG gas loads in Surat and most recently, renewable generation in north Queensland.

The 2020 ISP includes a project expanding CQSQ capacity by 900MW in the optimal development path in 2028/29 to 2033/34 depending on the scenario. This is despite expected coal generator closures in Central Queensland. The CQSQ transfer capacity is therefore considered to have an enduring need.

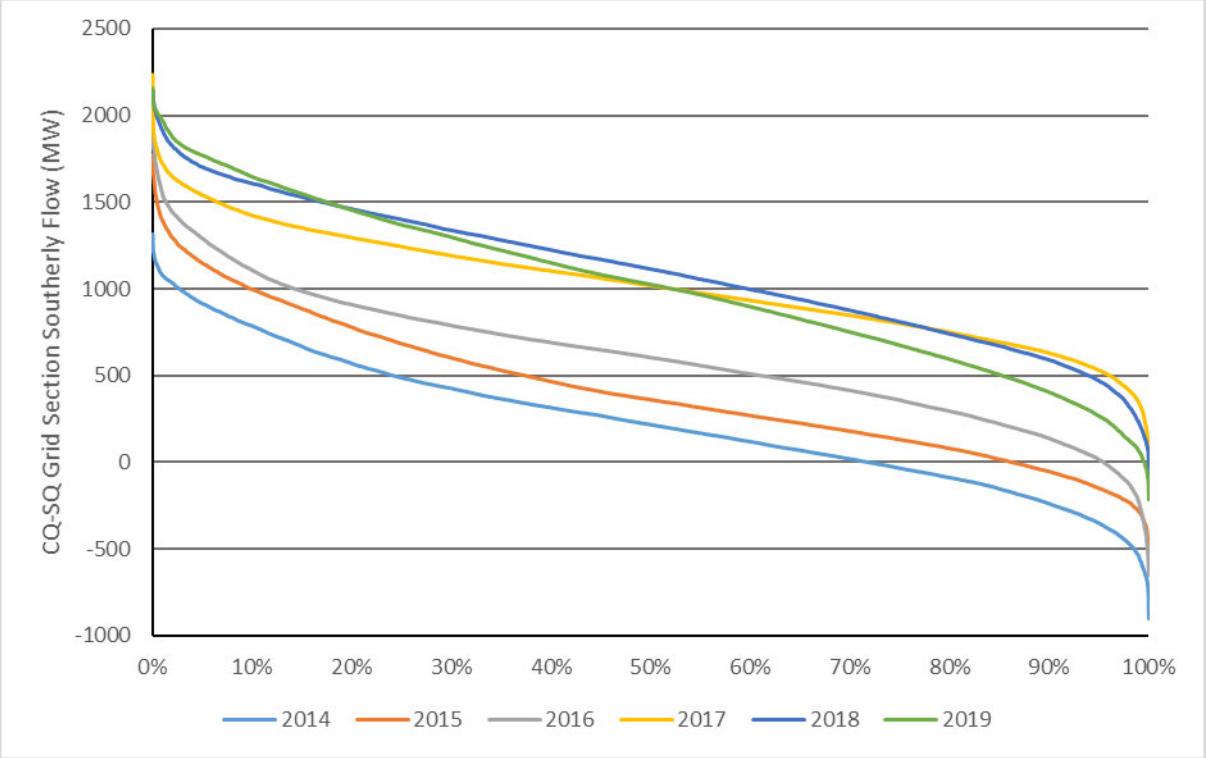


Figure 4: Historical CQ-SQ grid section transfer duration curves

Gin Gin Substation also delivers power to the Wide Bay region, with a 132kV network connecting to Bundaberg, Isis, Aramara, Maryborough and Teebar Creek substations. To manage a 275kV feeder outage, or a transformer outage at Gin Gin Substation, the 132kV connection between Bundaberg and Isis is often opened to avoid post-contingent overloading of the 132kV network. Consequently, only Bundaberg and the industrial and railway loads at T166 Granite Ck, T120 Korenan and T121 Clayton will remain connected to Gin Gin. The loss of Gin Gin 275kV injection would result in the loss of these loads.

Figure 5 shows the duration curve for Bundaberg plus the loads connected directly to Gin Gin Substation over the 2014-2019 period. Figure 6 presents the historical and forecast of peak load at Gin Gin for the next 10 years.

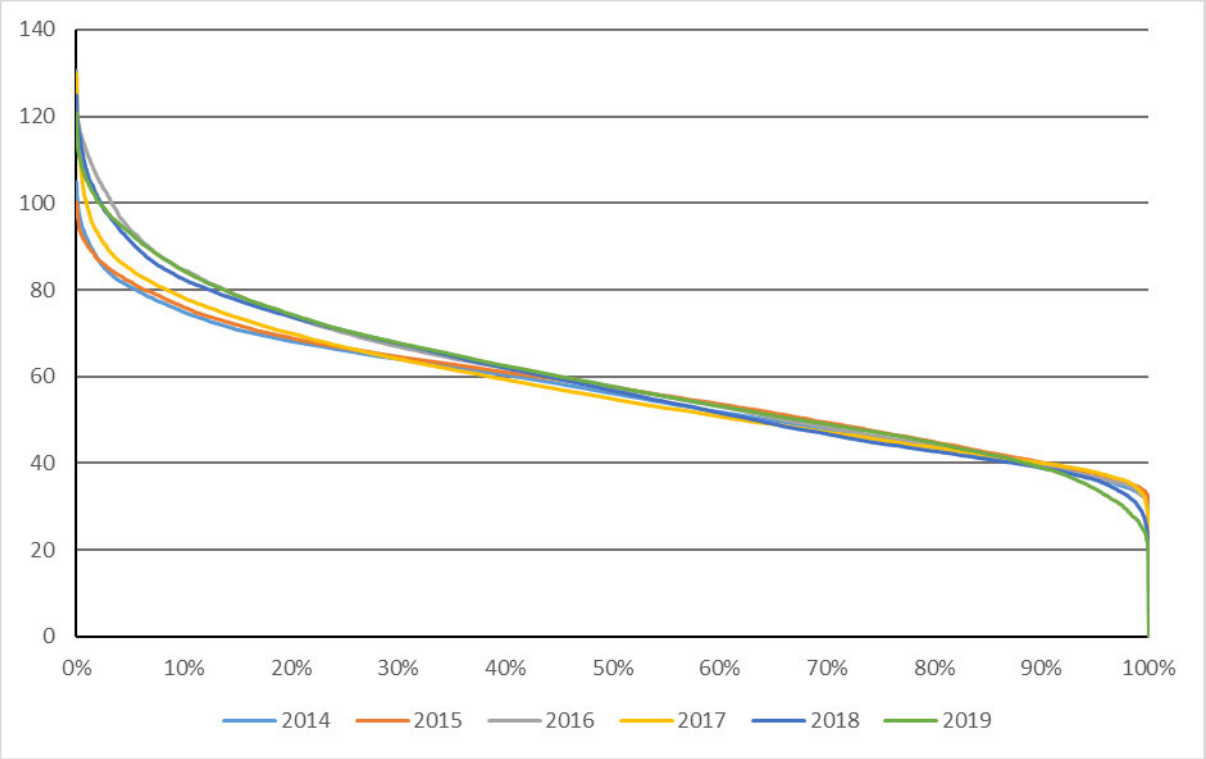


Figure 5: Load duration curve for Gin Gin supplied loads with 132kV open

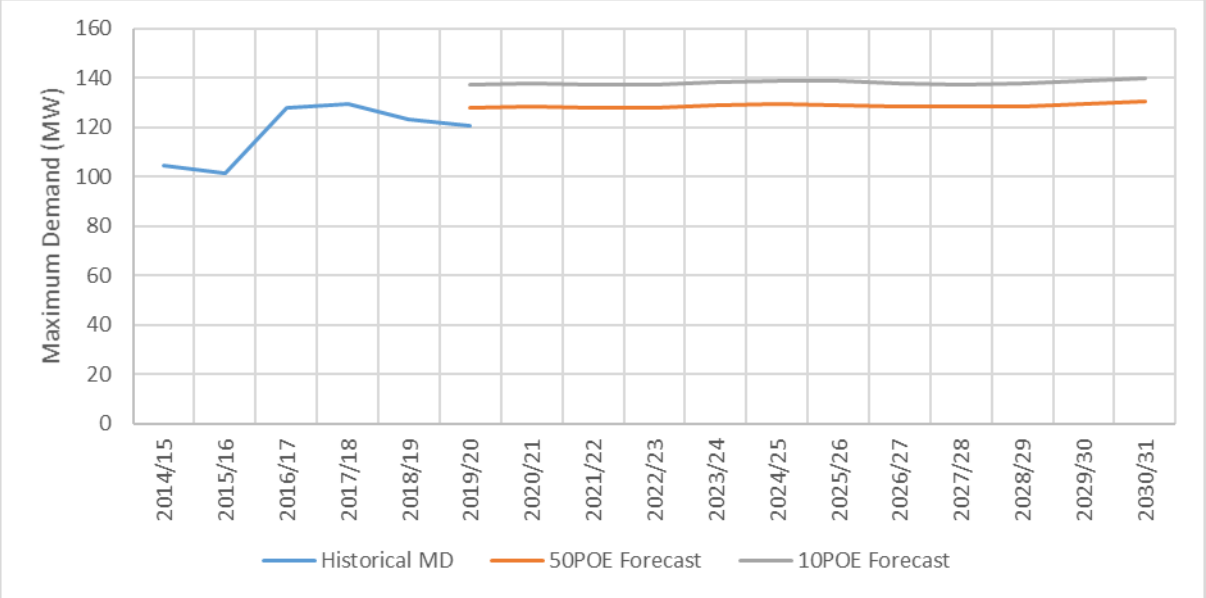


Figure 6: Historical and forecast demand for Gin Gin supplied loads with 132kV open

3 Statement of Investment Need

The removal of the functionality of feeder 813 (or feeder 814) would have a major impact to the loads in the Gin Gin/Bundaberg area, violating Powerlink's N-1-50MW/600MWh reliability standard. There would also be significant impact on the power transfer capacity of the CQSQ grid section with associated market impacts.

Powerlink must therefore preserve the functionality of the Calliope River to Gin Gin Transmission Lines to ensure ongoing compliance with its Transmission Authority reliability obligations.

4 Network Risk

Feeders 813 and 814 are essential transmission circuits providing power transfer capability between the Gladstone and Wide Bay zones. Disruption to circuitry connecting these zones can limit the transmission of energy between Central Queensland and South Queensland, resulting in substantial market impacts.

Table 1 presents the historical load at risk as well as the energy at risk in the Wide Bay zone if feeder 813 (or 814) was not replaced.

Table 1: Load at risk

Load at Risk	Contingency	Quantity	2014	2019
Gin Gin and Bundaberg load	Outage of feeder 813 (loss of 814 or Gin Gin 275/ 132kV transf.)	Max (MW)	104	121
		Average (MW)	5	12
		24h Energy Constrained Max (MWh)	1,607	1,313
		24h Energy Constrained Average (MWh)	112	300

Table 2 lists the extent to which the CQ-SQ grid section capacity would have been impacted in 2019 with an outage of either 813 or 814.

Table 2: Market impacts of an outage of 813 (or 814)

At Risk	Contingency	Metric	2019
CQ-SQ grid section	Outage of feeder 813 or 814	24h Max Time Constrained (h)	15
		24h Average Time Constrained (h)	0.6
		Max (MW)	306
		Average (MW)	3
		24h Energy Constrained Max (MWh)	2,222
		24h Energy Constrained Average (MWh)	63

5 Non Network Options

Potential non-network solutions for removal of 813 and/or 814 would need to provide reliable supply to the 132kV loads in Wide Bay. To meet the demand of the Gin Gin network, the non-network solution must be capable to deliver up to approximately 120MW of power at peak and up to 1,600MWh of energy per day (refer Table 1). The non-network solution would be required to be capable of operating during a contingency or outage on a continuous basis until normal supply is restored.

Powerlink is not aware of any Demand Side Management solutions (DSM) in the area. However, Powerlink will consider any proposed solution that can contribute significantly to the requirements of ensuring that Powerlink continues to meet its required reliability of supply obligations as part of the formal RIT-T consultation process.

6 Network Options

6.1 Preferred Option to address identified need

The recommended solution is to rebuild the first section of existing 275kV SCST feeder 813 (from Calliope River to Wurdong Tee) to a DCST line by 2024. The first section of feeder 814 can then be decommissioned at a later date e.g. when the refit of 818 is completed.

6.2 Option Considered but not proposed

This section discusses alternative options, which Powerlink has investigated but does not consider technically and/or economically feasible to address the above identified issues, and thus are not considered credible options.

6.2.1 Do Nothing

“Do Nothing” would not be an acceptable option as the primary driver (transmission line condition) and associated safety, reliability and compliance risks would not be resolved. Furthermore, the “Do Nothing” option would not be consistent with good industry practice and would result in Powerlink breaching their obligations with the requirements of the System Standards of the National Electricity Rules and the Transmission Authority.

7 Recommendations

There is an investment need to maintain the functionality of the 275kV feeders 813 and 814 between Calliope River and Gin Gin substations for Powerlink to continue to meet its reliability of supply obligations and provide network capacity to maintain the efficient running of the National Electricity Market. Rebuilding the first section of feeder 813 (between Calliope River and Wurdong Tee) to a 275kV DCST line by 2024, and followed by targeted refits of the remaining sections of these feeders when they reach their technical-end-of-life, will address the need to retain transmission capacity between Calliope River to Gin Gin to Woolooga. This also allows Powerlink to continue to meet its Transmission Authority reliability of supply obligations and jurisdictional safety obligations.

8 References

1. Transmission Annual Planning Report 2020.

2. Transmission Line Condition Report BS1122.

3. Asset Planning Criteria Framework.

4. Asset Management Plan 2020.

Appendix A – Network Risk methodology

Feeder 813 (or 814)

Load at risk

Gin Gin substation delivers power to the Wide Bay region, with a 132kV network connecting to Bundaberg, Isis, Aramara, Maryborough and Teebar Creek substations. To manage a 275kV feeder outage, or a transformer outage at Gin Gin Substation, the 132kV connection between Bundaberg and Isis is often opened to avoid post-contingent overloading of the 132kV network. Consequently, only Bundaberg and the industrial and railway loads at T166 Granite Ck, T120 Korenan and T121 Clayton will remain connected to Gin Gin. The loss of Gin Gin 275kV injection would result in the loss of these loads.

Load at risk calculations are based on 132kV network being opened if the combined Bundaberg and Gin Gin load exceeds 80MW.

Market impacts

For an outage of feeder 813 (or 814), AEMO presently applies Q-CPWO_814 which includes a thermal constraint to “avoid O/L Wurdong to Teebar Creek (819) line on trip of Calliope River to Woolooga (remaining 813 or 814) line”.

This also includes an upper limit on CQ-SQ flow of 1850MW.

Market impacts are estimated based on total flow through CQ-SQ cut set that historically exceeded the present limit of 1850MW.

Base Case Risk and Maintenance Costs Summary Report

CP.02778 BS1122/1123 Calliope River- Wurdong Tee Rebuild

Version Number	Objective ID	Date	Description
1.0	A4441952	10/11/2020	Original document

1 Purpose

The purpose of this model is to quantify base case risk cost profiles and maintenance costs for the two single circuit 275kV transmission lines between Calliope River and Wurdong Tee (built sections 1122 and 1123, Feeder 813/815 and F814/1) which are candidates for reinvestment under CP.02778.

Base case risk costs and maintenance costs have been analysed over a ten year study horizon.

2 Topography

BS1122 and BS1123 form part of the CQSQ 275kV grid section and are a critical source of supply to Gin Gin, Woolooga, Teebar Creek and, further south, the greater SEQ area. Built sections 1122 and 1123 are approximately 160km in length and run from Calliope River substation to Gin Gin substation. The sections of BS1122 and BS1123 which are candidates for reinvestment under CP.02778 cover the first 16km only (from Calliope River) up to Wurdong Tee.

Figure 1A – Network Topography (Calliope Substation End)

Figure 2B – Network Topography (Wurdong Tee)

3 Key Assumptions

In calculating the potential unserved energy (USE) arising from a failure of the ageing structures within BS1122 and BS1123, the following modelling assumptions have been made:

- Historical load profiles have been used when assessing the likelihood of unserved energy under concurrent failure events;
- Unserved energy generally accrues under concurrent failure events, and consideration has been given to potential failure events within the wider Queensland network;
- The Value of Statistical Life (VSL) published within the OBPR guidance note has been used when calculating safety risk cost;
- The 275kV transmission lines from Calliope River to Wurdong Tee supplies a mixture of load types within the central and south east Queensland area, and the QLD region VCR value of $40,030/MWh has been used for calculation of network risk cost; and
- VCR values published within the AER's 2019 Value of Customer Reliability Review Final Report have been used within the risk cost assessments.

4 Base Case Risk Analysis

4.1 Risk Categories

Four main categories of risk are assessed within Powerlink's risk approach; safety, network, financial and environmental. Safety, Network and Financial are considered material for this assessment and have been modelled in this analysis.

4.2 Transmission Line Analysis

This section analyses the risks presented by BS1122 and BS1123.

Table 1 – Risks associated with at risk structures

	Mode of failure	
Equipment	**Peaceful**	**Explosive**
Transmission Line Structure	Safety risks due to failed structures within habitable and vehicular areas. Network risks (unserved energy) due to a failed structure. Financial risks to replace a failed structure in an emergency manner.	Not applicable.

The probability that a structure will fail includes the probability that a wind event, sufficient to bring the tower down, has occurred.

4.2.1 Structures – Risk Cost by Year

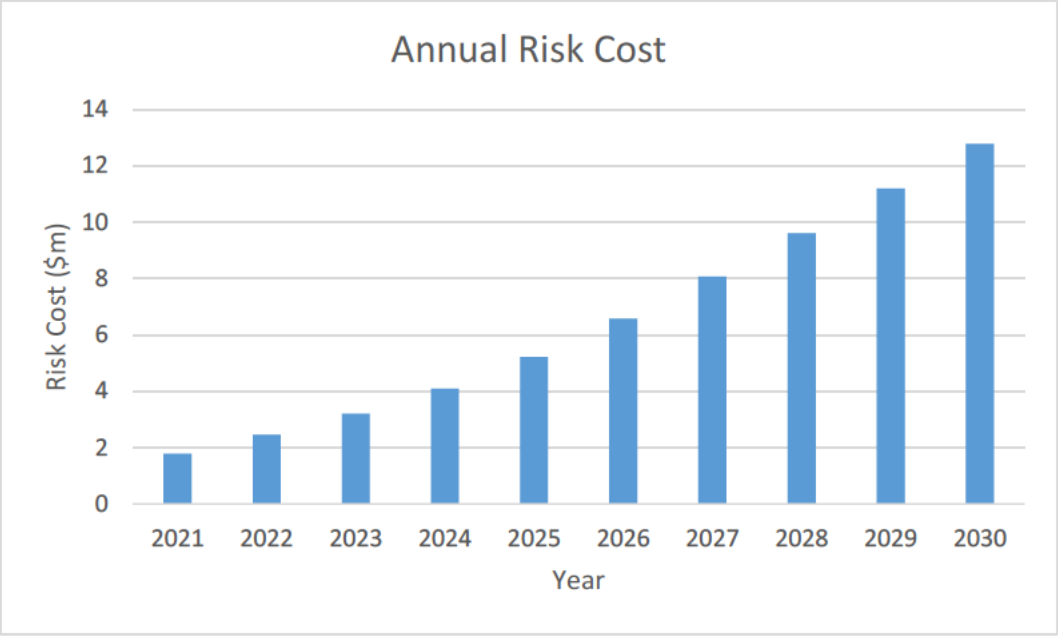


Figure 2 – Risk cost over time (10 years)

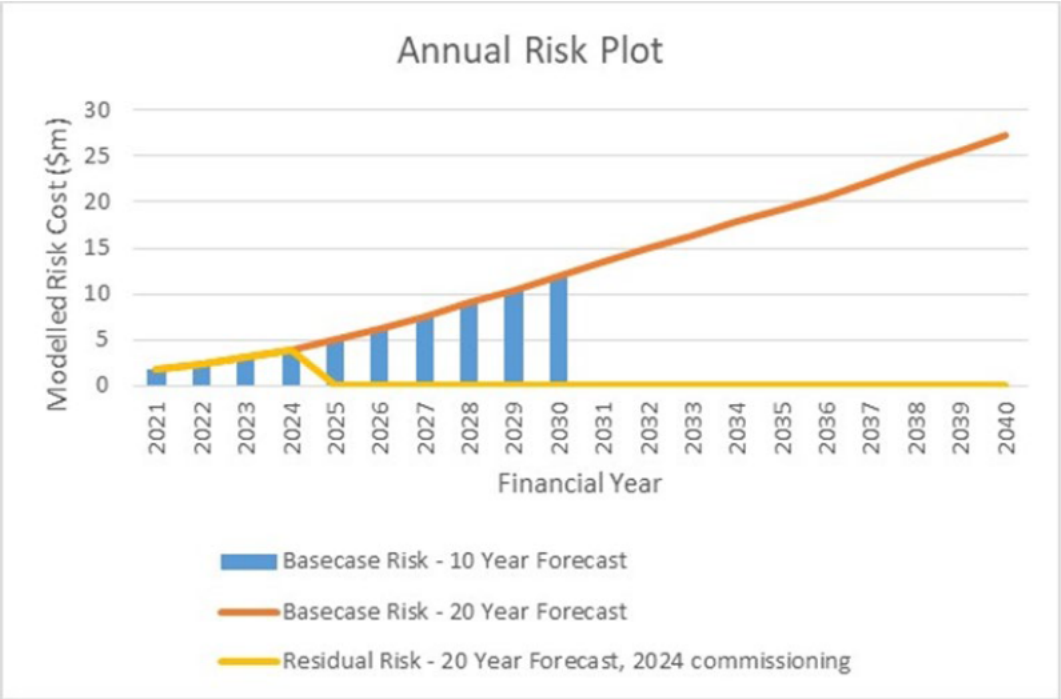


Figure 3 – Risk cost over time (10 years, extrapolated to 20 years)

4.2.2 Structures – Risk Breakdown by Risk Category

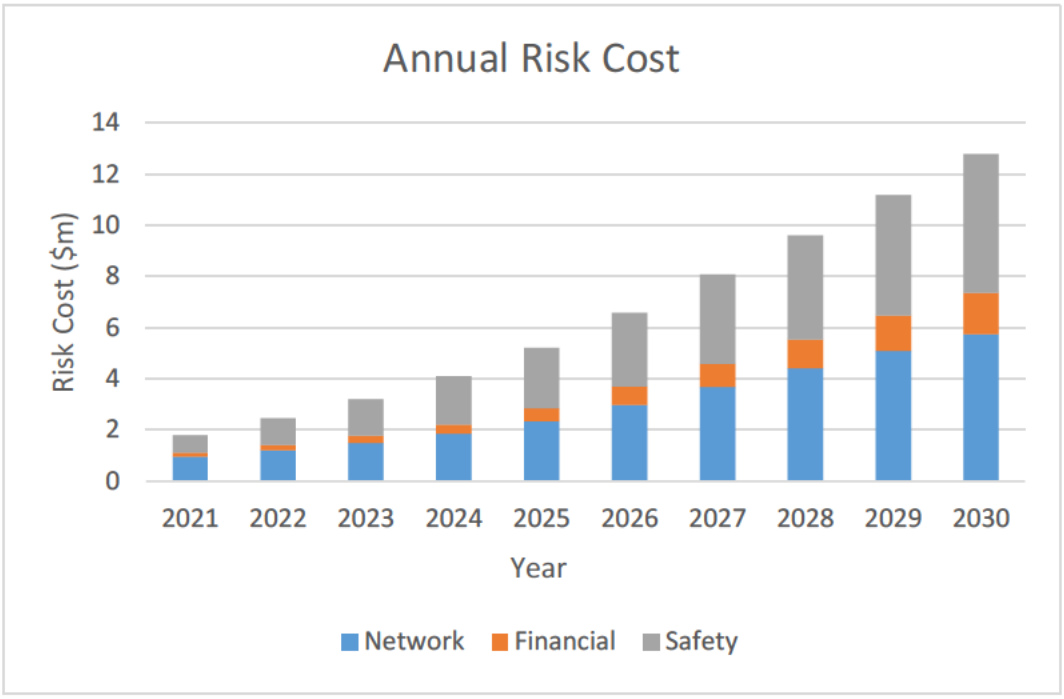


Figure 4 – Structure risk cost by category

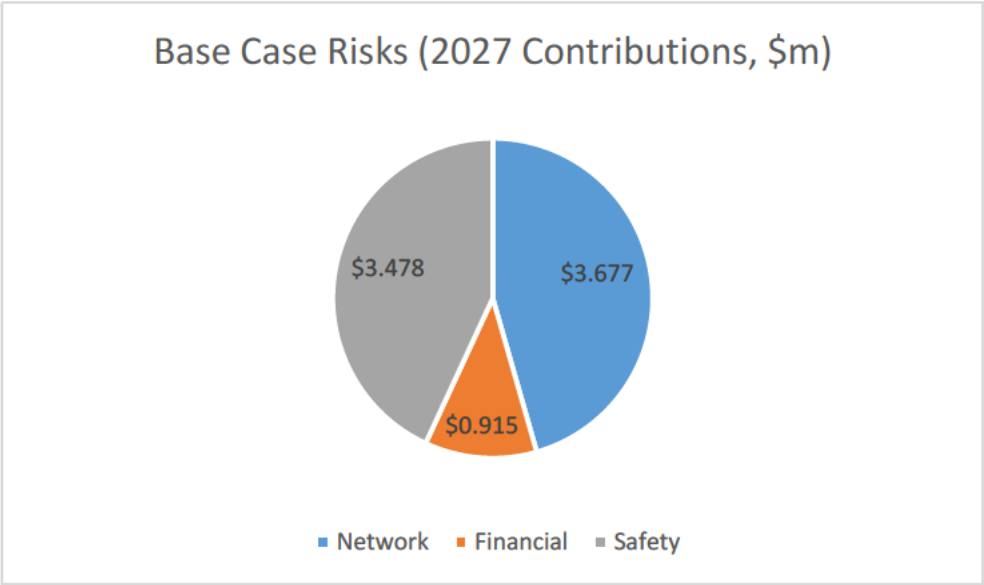


Figure 5 – Structure risk cost by category (2027)

4.3 Base case risk statement

The primary source of risks for the BS1122 and BS1123 Calliope River to Wurdong tee transmission line are financial risks and network risks (unserved energy) and related to failure of the overhead line structures.

5 Maintenance costs

Maintenance costs are still being developed. For the purposes of this report, maintenance has been modelled as 1.5% of the project capital. This is consistent with historical maintenance costs as a percentage of capital costs.

The total base case risk and maintenance cost is show below:

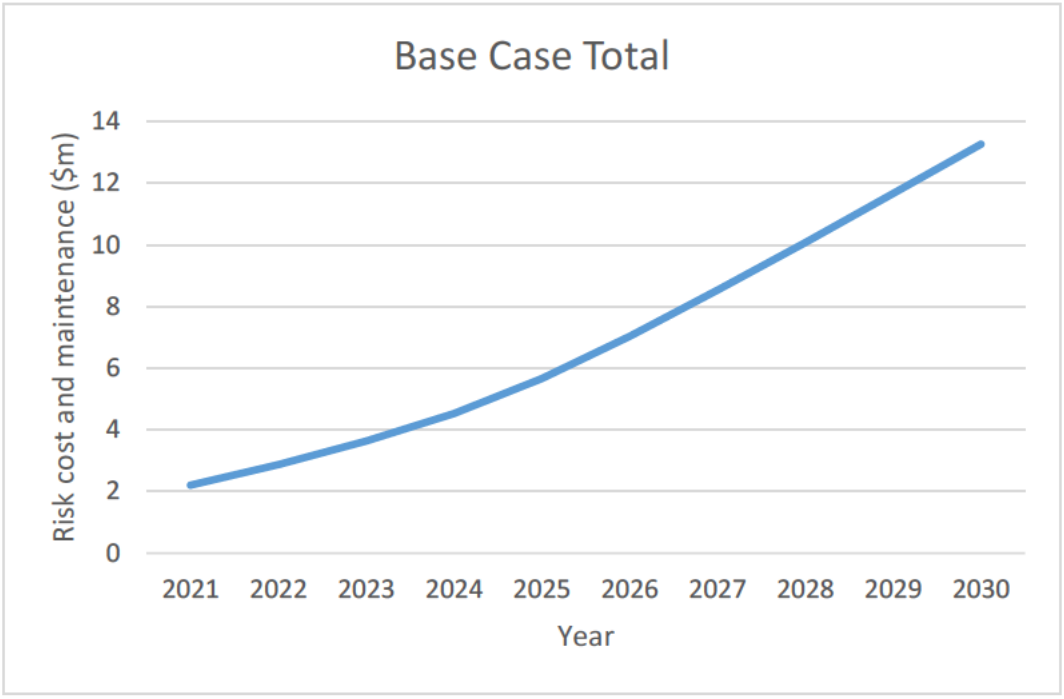


Figure 6 – Base case Total (Risk Cost + Maintenance)

6 Input participation

Risk Category	Input	Value	Unit
Network	VCR	40030	$/MWh
	Restoration time	120	hours
Financial	Tower restoration cost	0.8	$m
Safety	VSL	5	$m

Figure 3 – Transmission line risk cost model inputs

Sensitivity analysis has been carried out to determine which inputs the model is most sensitive to (how does a change input effect the modelled risk).

A 100% increase in the input values for VCR or tower restoration time will result in the overall risk increasing by approximately 56%.

A 100% increase in the input value for tower restoration cost will result in the overall risk increasing by approximately 4%.

The Value of Statistical Life (VSL) is another of the key inputs to the risk cost models, particularly with regards to safety risk cost.

Project Scope Report

CP.02778

BS1122/1123 Calliope River to Wurdong Tee Transmission Line Rebuild

Concept – Version 1

Document Control

Change Record

Issue Date	Responsible Person	Objective Document Name	Background
28/02/20	[redacted]	Project Scope Report CP.027788 Calliope River to Wurdong Tee Transmission Line Rebuild	Preliminary scope

Related Documents

Issue Date	Responsible Person	Objective Document Name
13/06/2016	[redacted]	BS1122 Gin Gin to Calliope River Condition Assessment Report 2016 (A2463702)

Project Contacts

Project Sponsor	[redacted]	[redacted]
Connection & Development Manager	<name>	Ext.
Strategist – HV/Digital Asset Strategies	<name>	Ext.
Planner – Main/Regional Grid	<name>	Ext.
Manager Projects	<name>	Ext.
Project Manager	<name>	Ext.
Design Coordinator	<name>	Ext.
<delete or insert more if needed>		

Project Details

1. Project Need & Objective

Built sections 1122 (F813) and 1123 (F814) are two (2) single circuit 275kV transmission lines from Calliope River to Gin Gin that were originally commissioned in 1972 and 1976 respectively. The two lines run alongside each other for approximately 15km to a point known as the Wurdong Tee, where they deviate onto independent alignments with built section 1122 (F813) taking a western path and built section 1123 (F814) taking an eastern path with another 275kV feeder 819.

A condition assessment of both built sections 1122 and 1123 identified that the sections of line between Calliope River and the Wurdong Tee were in a noticeably poorer condition than the sections between the Wurdong Tee and Gin Gin substation, with elevated levels of all grades of corrosion. This area is subject to harsher environmental conditions due to its proximity to the coastline and nearby industrial areas.

The objective of this project is to construct 15km of new double circuit 275kV transmission line on a widened easement between Calliope River and the Wurdong Tee and decommission two (2) sections of the single circuit 275kV transmission lines by 30 June 2024.

2. Project Drawing

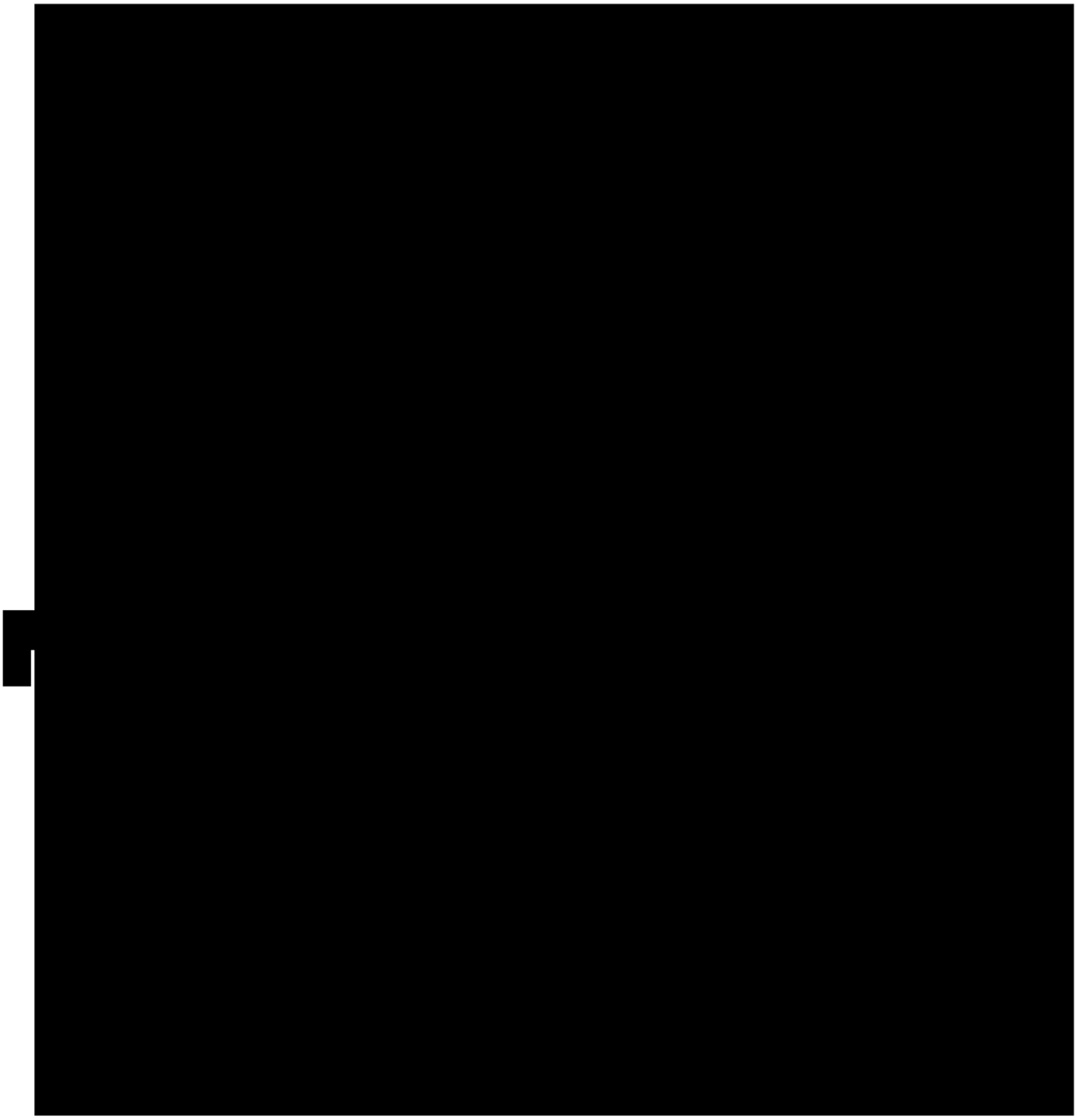


Figure 1 – Calliope River to Wurdong Tee

3. Project Scope

3.1. Original Scope

The following scope presents a functional overview of the desired outcomes of the project. The proposed solution presented in the estimate must be developed with reference to the remaining sections of this Project Scope Report, in particular *Section 5 Special Considerations*.

Briefly, the project consists of constructing 15km of new double circuit 275kV transmission line on a widened easement between Calliope River and the Wurdong Tee and decommissioning two (2) sections of the single circuit 275kV transmission lines by 30 June 2024.

3.1.1. Transmission Line Works

Design, procure, construct and commission approximately 15km of 275kV double circuit transmission line between Calliope River substation and the Wurdong Tee:

- Required minimum summer emergency rating 870MVA per circuit (rating of existing line). It assumed that a design using twin phosphorous conductor will meet this condition,
- The transmission line is to include two 48 fibre OPGW's to enable provision of dual optic fibre communications paths.

Decommission and recover two 15km lengths of 275kV single circuit transmission line between Calliope River substation and the Wurdong Tee, and

Update drawing records and SAP records accordingly.

3.1.2. H067 Calliope River Substation Works

Modify protection, control, automation and communications systems consequential to the replacement of the transmission lines as necessary.

3.1.3. H006 Gin Gin Substation Works

Modify protection, control, automation and communications systems consequential to the replacement of the transmission lines as necessary.

3.1.4. Telecoms Works

Retrofit of an OPGW from the Wurdong Tee to Wurdong substation is required under a separate project to ultimately provide the dual optic fibre communications paths between Calliope River, Gin Gin and Wurdong substation.

3.1.5. Easement/Land Acquisition & Permits Works

Easement acquisition works to obtain all necessary title and approvals, including ministerial designation, to enable construction of the transmission line is to be obtained under project CP.0xxxx Calliope River to Wurdong Tee Easement Acquisition.

Preliminary investigations indicate that widening the western corridor alongside built section 1122 (F813) is likely to be the most feasible option for an adjacent rebuild.

4. Project Timing

4.1. Project Approval Date

The anticipated date by which the project will be approved is 31 December 2021.

4.2. Site Access Date

The expected site access date (SAD), when the site is available for Powerlink construction works to commence, is 30 June 2023.

4.3. Commissioning Date

The latest date for the commissioning of the new assets included in this scope and the decommissioning and removal of redundant assets, where applicable, is 30 June 2024.

5. Special Considerations

Not applicable

6. Asset Management Requirements

Equipment shall be in accordance with Powerlink equipment strategies.

Unless otherwise advised [redacted] will be the Project Sponsor for this project. The Project Sponsor must be included in any discussions with any other areas of Strategy and Business Development.

7. Asset Ownership

The works detailed in this project will be Powerlink Queensland assets.

8. System Operation Issues

Operational issues that should be considered as part of the scope and estimate include:

- interaction of project outage plan with other outage requirements;
- likely impact of project outages upon grid support arrangements; and
- likely impact of project outages upon the optical fibre network.

9. Options

Not applicable

10. Division of Responsibilities

A division of responsibilities document will not be required for this project.

11. Related Projects

Project No.	Project Description	Planned Comm Date	Comment
Pre-requisite Projects			
CP.0xxxx	Calliope River to Wurdong Tee Easement Acquisition	30/06/2023	
Co-requisite Projects			
Other Related Projects			
CP.0xxxx	Wurdong Tee to Gin Gin Easement Acquisition	30/10/2024	
CP.02643	Wurdong Tee to Gin Gin Rebuild	30/10/2026	

Concept Estimate for CP.02778 - BS1122/1123 Calliope River to Wurdong Tee Transmission Line Rebuild

Record ID	A3328041	
Policy stream	Asset Management	
Authored by	Project Manager	[redacted]
Reviewed by	Team Leader	[redacted]
Approved by	Manager Projects	[redacted]

Table of Contents

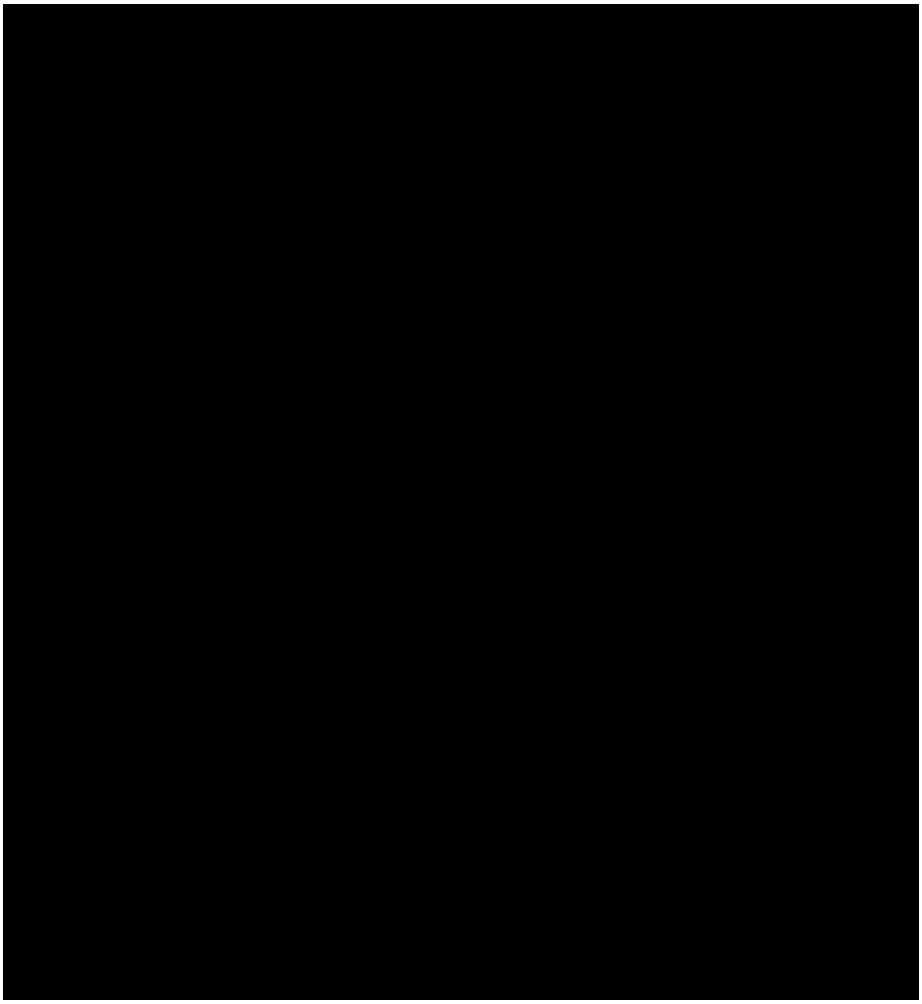
1. Executive Summary

Built sections 1122 (F813) and 1123 (F814) are two single circuit 275kV transmission lines from Calliope River to Gin Gin, that were originally commissioned in 1972 and 1976 respectively. The two lines run parallel to each other for approximately 15km to a point known as the Wurdong Tee, where they deviate onto independent alignments, with built section 1122 (F813) taking a western path and built section 1123 (F814) taking an eastern path with another 275kV feeder 819.

A condition assessment of both built sections 1122 and 1123 identified that the sections of line between Calliope River and the Wurdong Tee were in a noticeably poorer condition than the sections between the Wurdong Tee and Gin Gin Substation, with elevated levels of all grades of corrosion. This area is subject to harsher environmental conditions due to its proximity to the coastline and nearby industrial areas.

The objective of this project is to construct 15km of new double circuit 275kV transmission line on a widened easement between Calliope River and the Wurdong Tee and decommission two (2) sections of the single circuit 275kV transmission lines by June 2024.

Transmission line alignment as below:



1.1 Project Estimate

Estimate Components		Base $	Escalated $
Estimate Class	5		
Estimate Accuracy	+100% / -50%		
Base Estimate		**25,878,731**	**29,566,900**
Mitigated Risk	[redacted]	[redacted]	[redacted]
Contingency Allowance	[redacted]	[redacted]	[redacted]
TOTAL		[redacted]	[redacted]

1.2 Project Financial Year Cash Flows

	June 2020 Base $	Escalated $
To June 2022	4,517,626	4,892,808
To June 2023	8,899,634	10,039,784
To June 2024	12,461,470	14,634,309
TOTAL	**25,878,731**	**29,566,900**

2. Project and Site Specific Information

2.1 Project Dependencies & Interactions

This project is dependent on the completion delivery of the following projects:

Project No.	Project Description	Planned Commissioning Date	Comment
Dependencies			
CP.0xxxx	Calliope River to Wurdong Tee Easement Acquisition	30/06/2023	
Interactions			
Other Related Projects			
CP.0xxxx	Wurdong Tee to Gin Gin Easement Acquisition	30/10/2024	
CP.02643	Wurdong Tee to Gin Gin Rebuild	30/10/2026	

2.2 Site Specific Issues

Issues specific to the project are as follows:

- The project site is within immediate surrounds of the township of Gladstone. Accommodation, infrastructure and facilities are considered readily available for construction crews and project staff,
- the alignment is free of any known or identified UXO risk, World Heritage Areas and/or Biosecurity mapped zones,
- there is some Regional Ecosystem mapping along the alignment, but appears to be classed “Least Concern” and likely to not impact easement acquisition/line build,
- there is known “Endangered” Habitat mapping at the northern end of the line, adjacent Calliope River, which may present some constraints for structure positioning, as well as possible issues during construction, i.e. clearing, tension stringing over,
- a short section of the alignment (<3km) is within Mount Maurice National Park. Given the presence of the five existing Built Sections already contained within this tenure, it is unlikely to present any issues for the easement acquisition/line rebuild, however, consideration may need to be given to extra tower heights in this section,
- the alignment traverses sections of steep, undulating terrain in sections,
- there are a small number of dwellings in the northern third of the alignment.

3. Construct New Double Circuit 275kV Transmission Line Between Calliope River and Wurdong Tee

3.1 Definition

3.1.1 Scope

Briefly, the project consists of constructing 15km of new double circuit 275kV transmission line on a widened easement between Calliope River and the Wurdong Tee, and decommissioning two existing sections of the single circuit 275kV transmission lines.

3.1.1.1 Substations Works

For both Calliope River and Gin Gin Substations, the scope of works includes protection setting changes, automation and communications systems consequential to the replacement of the transmission lines as necessary.

3.1.1.2 Transmission Line Works

The scope of works includes the design, construction and commissioning of approximately 15km of 275kV double circuit steel tower transmission line between Calliope River Substation and the Wurdong Tee, as well as the demolition/decommissioning of the two redundant sections of BS1122 and BS1123.

The scope also includes the establishment of new access tracks as required, as well as the upgrading of existing access to suit construction activities, and the rehabilitation of redundant BS1122 and BS1123 access and structure locations as applicable.

3.1.1.3 Telecommunication Works

Installation of double 48 fibre OPGW's on the new transmission line, including into Calliope River Substation for connection/commissioning under separate project.

3.1.1.4 Easement/Land Acquisition & Permit Works

Easement acquisition works do not form part of this project scope, however, liaison with the Network Property Group should be considered during the easement procurement process to ensure selection of a suitable, constructible alignment for the new transmission line.

Preliminary investigations indicate that widening the easement to the western side of BS1122 (F813) is likely to be the most feasible option for an adjacent rebuild.

3.1.2 Major Scope Assumptions

It is assumed that:

- Q-Series structures (double circuit cyclonic) will be suitable for the new line build,
- twin phosphorous conductor (or equivalent) will meet the required minimum summer emergency rating of 870MVA per circuit,
- soil conditions are generally suitable for bored, reinforced concrete transmission line structures,
- short duration outages will be available to both feeders Fdr813 and Fdr814 to allow cut-overs onto the new transmission line,
- The new transmission line will be constructed on a widened easement to the Western side of existing BS1122,
- existing structures 1122-STR-6030 and 1125-STR-6032 shall be utilised for the connection of the new structures into Calliope River Substation,
- adequate distance is available between the existing structure 1122-STR-4974 and the Calliope River to allow construction of the DCST line without jeopardising operational clearances. (Note: Roughly measured at approximately 75m, which is believed adequate),

- the rehabilitation works to the redundant access and structure sites will be limited to 12 months following transmission line decommissioning, i.e. will be carried out during project post-commissioning,
- suitable contractor/s will be available for the line construction, (currently PATL), as well as suitable MSP resources for the cut-over works and commissioning,
- the allocation of suspension and tension towers is comparable to the two existing built sections, BS1122 and BS1123,
- “Dolphin Structures” will not be required for the new transmission line,
- the new transmission line will be constructed adjacent BS1122 all the way to the Wurdong Tee, i.e. where BS1172 crosses BS1122, with the continuation of that line to occur under project CP.02643 along the same general alignment.
- there may be a requirement for additional steel towers or poles to effect the transition from the new line to the existing at the Wurdong Tee,
- additional height structures will likely be required for the structures within the Mount Maurice National Park,
- tension stringing practices may be required at sections with sensitive habitat, regional ecosystems, vegetation etc,
- there may be a number of foundation problems, i.e. soil collapse, high water table, that could require utilisation of special foundations to some towers,
- there will be a number of delays during delivery as a result of easement acquisition, cultural heritage constraints, under crossing and/or rail and road constraints, as well as project costs resulting from things such as Principal Supplied hardware quality issues, special tower or access rehabilitation requirements and so forth.

3.1.3 Scope Exclusions

The below is excluded from the scope of works:

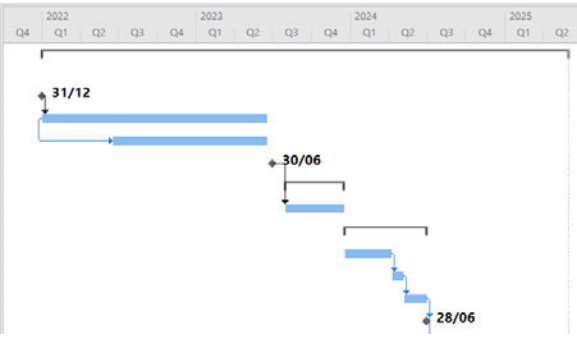
- Easement acquisition works, including any permits, approvals, development applications or the like,
- Connection of the new OPGW’s from the Calliope River Substation landing beam into control building.

3.2 Project Execution

3.2.1 Project Schedule

High level schedule for the works is as per the extract below:

Task Name	Duration	Start	Finish
CP.02778 BS1122 1123 Calliope River to Wurdong Tee Transmissoin Line Rebuild	**891 days**	**Fri 31/12/21**	**Fri 30/05/25**
Project Approval	0 days	Fri 31/12/21	Fri 31/12/21
Project Mobilisation, i.e. Scoping, PMP, Designs, WBS, etc	19 mons	Fri 31/12/21	Thu 15/06/23
Project Procurement, MSP and Contractor	13 mons	Fri 17/06/22	Thu 15/06/23
Site Access Date (SAD)	0 days	Fri 30/06/23	Fri 30/06/23
Line Construction Contractor Works (PATL)	**100 days**	**Mon 31/07/23**	**Fri 15/12/23**
Construct 15km New Double Circuit 275kV Transmission Line	5 mons	Mon 31/07/23	Fri 15/12/23
MSP (EQ) Cut-over Works	**140 days**	**Mon 18/12/23**	**Fri 28/06/24**
Outage Unavailability and Wet Season - NO SCHEDULED WORK	4 mons	Mon 18/12/23	Fri 5/04/24
Cut-over both Feeders onto new line	1 mon	Mon 8/04/24	Fri 3/05/24
Demolish redundant BS1122 and BS1123	2 mons	Mon 6/05/24	Fri 28/06/24
Project Commissioned	0 days	Fri 28/06/24	Fri 28/06/24



The project schedule has considered working during non-peak load periods and outside traditional wet seasons.

3.2.2 Network Impacts

These works will require suitable short duration outages, (one week approximately each), to both feeders Fdr813 and Fdr814 to allow cut-overs onto the new transmission line.

3.2.3 Project Staging

The staging of the project is as detailed below:

Stage	Description/Tasks
1	Transmission line construction works (PATL)
2	Cut-over works to both feeders by MSP
3	Demolition/decommissioning of the two redundant transmission lines by transmission line contractor (PATL)

3.2.4 Resourcing

This project will require the utilisation of both Refit Contractor and MSP resources during execution.

3.3 Project Estimate

Estimate Components		Base $	Escalated $
Estimate Class	5		
Estimate Accuracy	+100% / -50%		
Base Estimate		**25,878,731**	**29,566,900**
Mitigated Risk	[redacted]	[redacted]	[redacted]
Contingency Allowance	[redacted]	[redacted]	[redacted]
TOTAL		[redacted]	[redacted]

3.4 Project Financial Year Cash Flows

	June 2020 Base $	Escalated $
To June 2022	4,517,626	4,892,808
To June 2023	8,899,634	10,039,784
To June 2024	12,461,470	14,634,309
TOTAL	**25,878,731**	**29,566,900**

3.5 Project Asset Classification

Asset Class	Asset Life	Base $	Percentage
Secondary systems	15 years	820,932	3%
Communications	15 years		
Transmission line refit	35 Years		
Primary plant	40 years		
Transmission lines	50 years	25,057,799	97%
TOTAL		**25,878,731**	

4. References

Document name	Version	Date
Project Scope Report	1.0	28/02/2020