January 2026

Powerlink 2027-32 Revenue Proposal

Project Pack

CP.02750 Ross to Chalumbin Life Extension

Project Status: Unapproved

Network Requirement

The Ross to Chalumbin 275kV transmission line was commissioned in 1989 to extend the 275kV transmission network north from Townsville towards Cairns. The line extends approximately 244km from south-west of Townsville to south of Ravenshoe on the Atherton Tablelands. It is a double circuit 275 steel tower transmission line operating in a corrosive tropical environment. In 2024 the line was segmented into two sections when the Guybal Munjan Substation was commissioned to connect the Kidston Pumped Hydro Energy Storage (PHES) facility to the transmission network.

The line is nearing the end of its technical service life with the majority of structures exhibiting signs of degradation. Detailed climbing inspection have been undertaken for 491 towers (out of 528) covering insulators, insulator hardware, overhead earthwire and general tower condition. This has identified the presence of grade 3 (G3) and grade 4 (G4) corrosion across bolts, members, insulators and hardware [1].

The two line sections are critical to supply to Far North Queensland as a failure of either section would place up to 469 MW and up to 7,668 MWh of customer load at risk per day. In addition, significant constraints would be placed on generation in Far North Queensland either due to the loss of system strength in Far North Queensland or to limit the maximum loss of generation should the one remaining 275kV circuit between Townsville and Cairns trip.

Powerlink's 2025 Central scenario forecast confirms there is an enduring need to maintain electricity supply to Far North Queensland. The removal of either of the Ross to Guybal Munjan or the Guybal Munjan to Chalumbin 275kV line segments at the end of their technical life would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard and significantly impact electricity supply and generation within Far North Queensland [2].

Consistent with the findings and recommendations of Powerlink's Asset Reinvestment Review Powerlink targets reinvestment in transmission line structures that will reach a health index (HI) of 8 or greater within the next five years. Powerlink must therefore take action to maintain existing electricity services, ensuring an ongoing reliable, safe and cost-effective supply to customers in Far North Queensland.

Recommended Option

As this project is currently 'Unapproved', project need and options will be subjected to the public RIT-T consultation process to identify the preferred option closer to the time of investment.

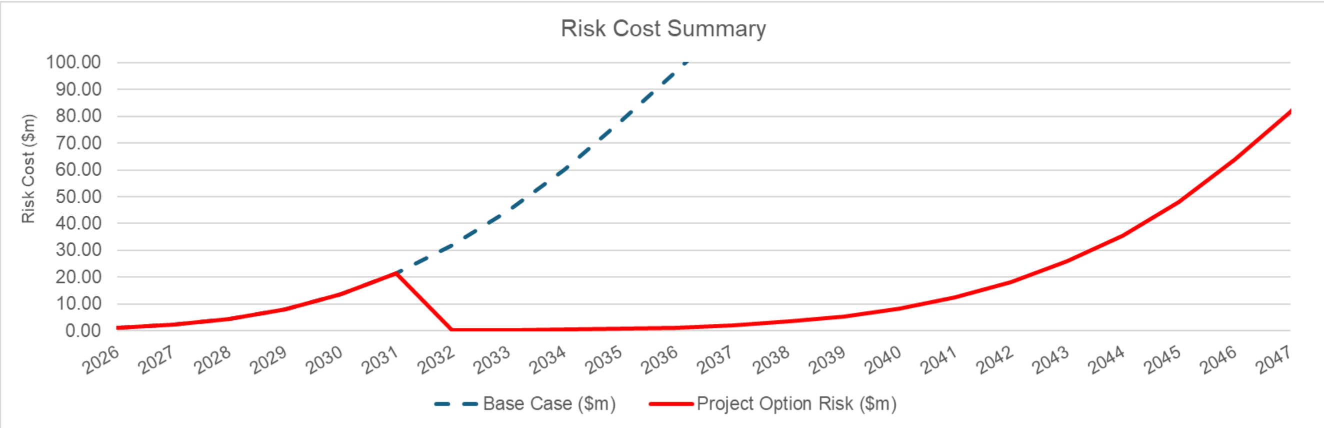
The current recommended option is to undertake staged refit works on selected structures to extend the service life of both the Ross to Guybal Munjan and the Guybal Munjan to Chalumbin 275kV transmission lines for a further 15 years. The two stages of refit works are targeted for June 2031 and June 2036 respectively [3].

Options considered but not proposed include:

- Single stage refit of selected structures on the Ross to Guybal Munjan and the Guybal Munjan to Chalumbin lines – expected to be greater overall cost.

Figure 1 shows the current recommended option reduces the forecast risk monetisation profile of the Ross to Guybal Munjan and the Guybal Munjan to Chalumbin transmission lines from around $21.4 million per annum in 2031 to less than $0.2 million from 2032 [4].

Figure 1 Annual Risk Monetisation Profile ($ Real, 2025/26)



Cost and Timing

The estimated cost of the first stage of refit works on the Ross to Guybal Munjan and the Guybal Munjan to Chalumbin 275kV transmission lines is $112.9 million ($2025/26) [5].

Target Commissioning Date: December 2031 (first stage).

Documents in CP.02750 Project Pack

Public Documents

1. BS1220 Ross to Chalumbin Transmission Line Condition Assessment Report
2. CP.02750 Ross to Chalumbin Life Extension – Planning Statement
3. CP.02750 Ross to Chalumbin Life Extension – Project Scope Report
4. CP.02750 Ross to Chalumbin Life Extension – Concept Estimate
5. CP.02750 Ross to Chalumbin Life Extension – Risk Cost Summary Report

Transmission Line Condition Assessment Report

Built Section 1220
Ross to Chalumbin 275kV

Record ID	A3339185	
Team	Delivery & Technical Solutions – Technology & Planning – Asset Strategies – Transmission Lines	
Authored by	Senior Lines Strategies Engineer	[redacted]
Reviewed by	Team Leader Lines Strategies	[redacted]
Approved by	Asset Strategies Manager	[redacted]

Version history

Version	Date	Section(s)	Summary of amendment	Author	Approver
1.0	25/03/2020	All	Original Document	[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 1220 is located between Ross and Chalumbin substations. The double circuit steel lattice tower line with single sulphur conductor is very long (244km) and consists of 528 structures built in 1989. The Built Section carries 275kV feeders 857 and 858, and is a critical feeder supplying Far North Queensland. The line traverses from south of Townsville over a number of significant mountain ranges, bordering the wet tropics, with a section within Australian Defence Force land. Most of the line is very remote and access to most structures is difficult.

The line was designed and built in accordance with a lower specification than current Australian Standard prescribes; utilizing members of smaller thickness and smaller bolt diameters. However the line has been exposed to several cyclones over its more than 30 years life and has not shown any signs of serviceability problems.

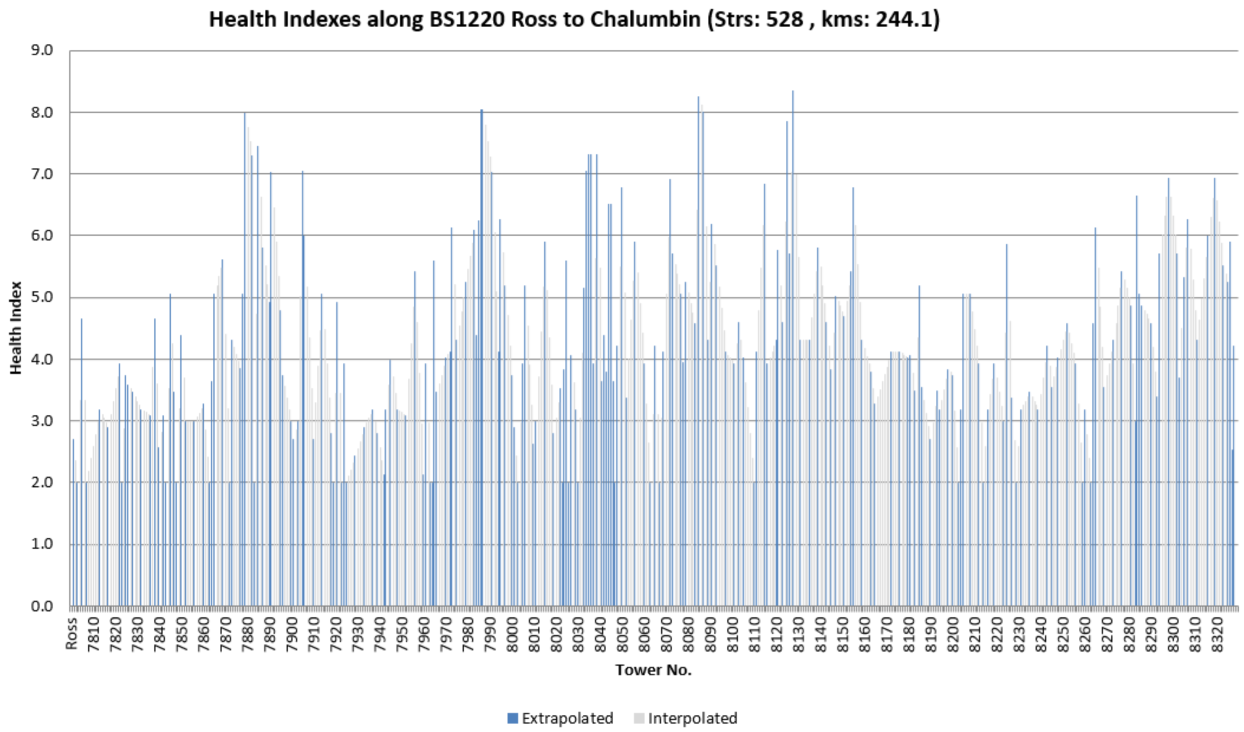
The majority of the line sits in a high rainfall environment, with high average humidity. Those sections of the line that are elevated and border on the Wet Tropics exhibit higher levels of atmospheric corrosion than sections in the more protected, low lying and dryer areas.

As a result, particularly in approximately six more exposed and elevated locations, galvanised tower bolts and members are exhibiting significant evidence of grade 3 and grade 4 corrosion. Between these areas of poor condition, corrosion levels vary from low to medium; relatively normal for the age of the line. Given the criticality and length of the feeders, and the difficulties of access to maintain the line in serviceable 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 could drive replacement of structures.

Figure 1: Built Section 1220 Ross- Chalumbin

Below are the health indices of structures along the built section. While structures in average condition are not of concern, structures in the more elevated and exposed locations are currently at a health Index of greater than 7 (representing a complete loss of galvanising on some members and bolts).

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 an estimated health index for those structures.



The highest risk on the line is related to the vertically installed and axially loaded bolts in the attachment areas of some towers.

The suspension insulator and bridging insulator assemblies are also of concern. While insulator strings are in relatively good condition, some of the insulators' originally installed hardware will require MSP attention in the next 12 months.

The worst third of the earthwire spans were replaced during the project in 2016. The remaining earthwire will need to be replaced in the next 4 years.

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

Based upon the data presented in this report and health indices for 36.7% of structures, this line will require increased maintenance on the worst structures in the short term to keep it in a serviceable condition with reinvestment suggested in the medium term. A health index of 7.1 or greater was calculated for 2% of towers which equates to 25 towers on this built section, which will need to be monitored by the MSP to keep them in a serviceable condition until a project is delivered.

Predicted end of service life summary table								
Cond	EW	OPGW	Foundation Bored	Foundation Grillage	Structures (HI 8)	Bridging Strings	Suspension Strings	Tension Strings
2069	2024	2026*	2069	N/A	2021	2021	2021	2030

* - OPGW hardware only has an estimated EOL[1] in 2026. The OPGW estimated EOL is 2087.

2. Purpose

This report outlines the assessed condition of Built Section 1220 which spans between Ross and Chalumbin substations. 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.

[1] EOL End of Life

4. Transmission Line Parameters

4.1 Overview

The line traverses from south of Townsville over the Hervey range, then bordering on the wet tropics areas of Paluma National Park, Girrungon National Park and Kirrama National Park reaching Koombooloomba National Park inside which Chalumbin substation is situated, about 60km from the Mission Beach coast.

Elevated sections of the line more exposed to salt laden winds appear in a more corroded condition than lower sections protected by natural shielding of terrain topography.

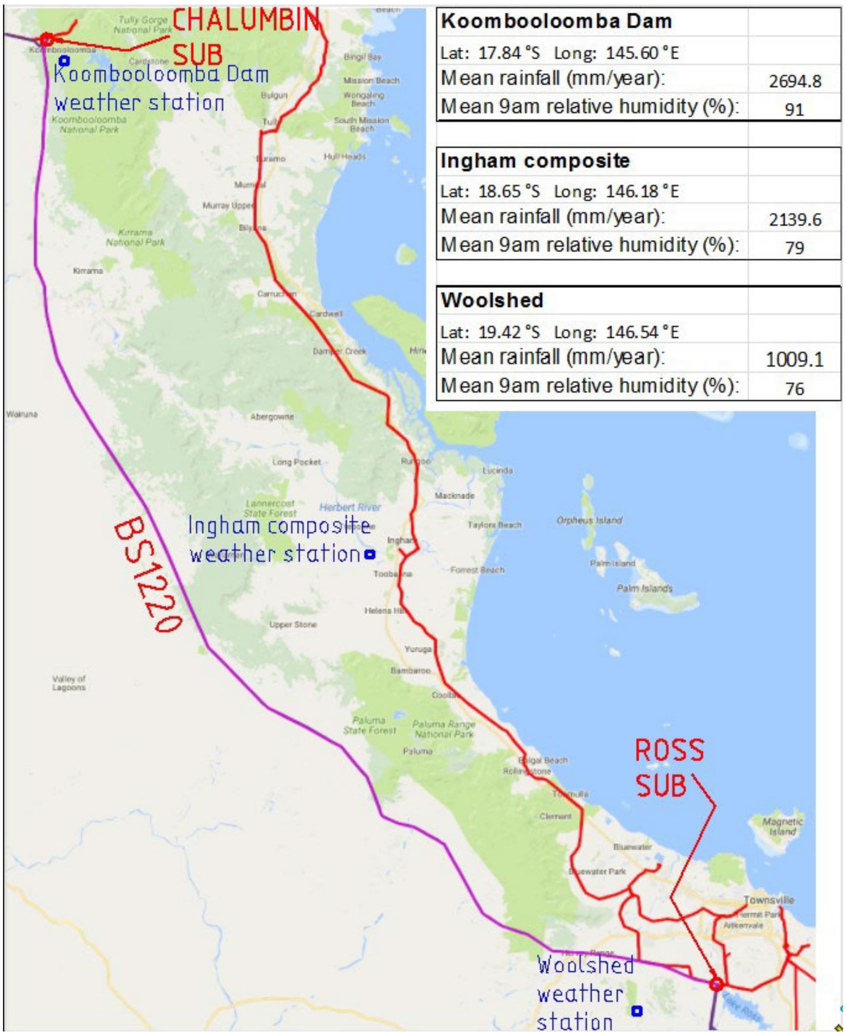


Figure 2: Geographical Overview

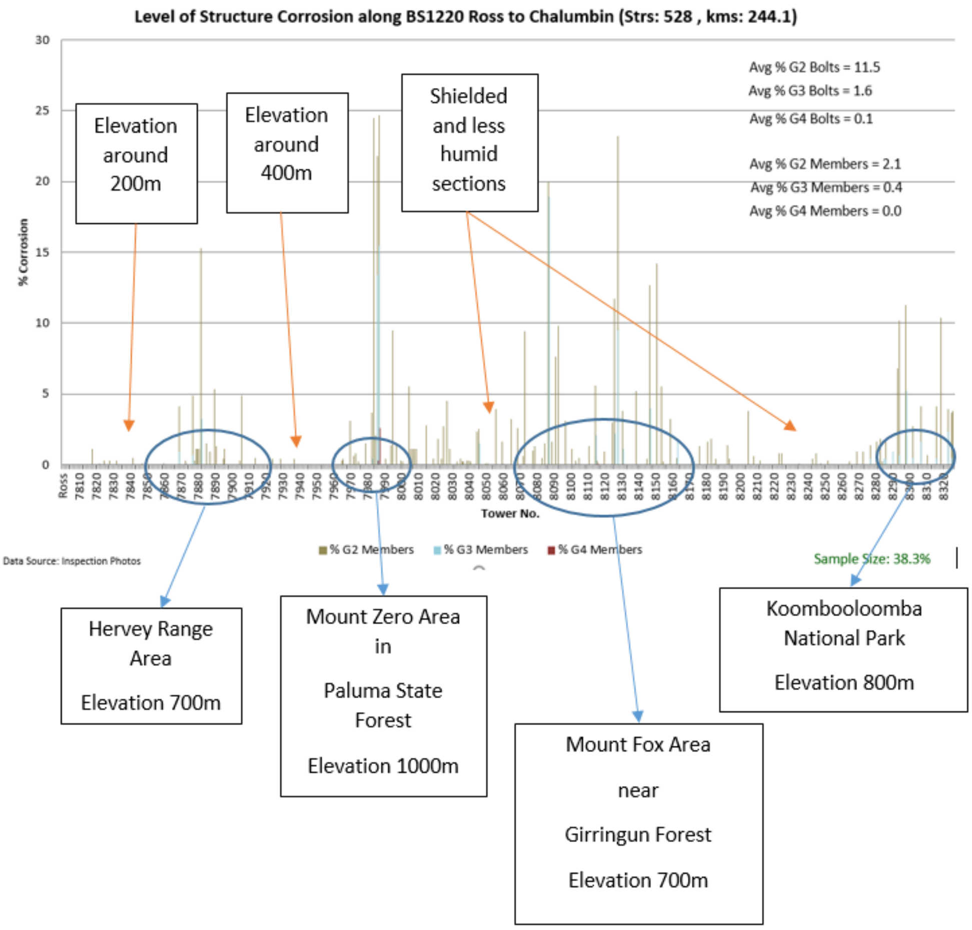


Figure 3: Line sections with towers exhibiting higher member corrosion levels

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

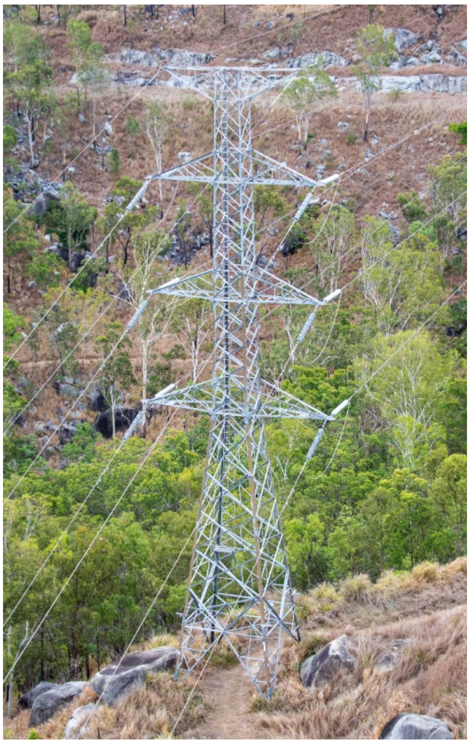


Figure 4: 1220-STR-7869 - Tension Tower

Figure 5: 1220-STR-7896 - Suspension Tower

4.2 Asset Summary Table

Commissioning Date	16.03.1989
Voltage	275kV
Contract Number	N399/87
No. of Circuits	2
Circuits	F857 (energized 1989) ; F858 (energized 1993)
Route Length (km)	244.1 km
No. of Towers	48 Tension, 480 Suspension
Type	Galvanised Steel Lattice Tower
Foundations	Standard steel reinforced concrete
Conductor	(61/3.75) AAAC/1120 Sulphur
Sub-Conductor /Phase	1
Conductor Line Clamps	Suspension - AGSU Tension – Aluminium and galvanised steel compression fittings
Conductor Vibration Dampers	Stockbridge - original
No. of OHEW	1
Earthwire	SC/GZ_7/3.25 - original; SC/AC/I_7/3.25 - repairs; Tennis 4/3/3.75 OD11.3mm - OR.02017
OHEW Line Clamps	Suspension - AGSU Tension - Preformed Deadend
OHEW Vibration Dampers	Spiral - original
No. of OPGW	1
OPGW	ALCOA_FUJI_24FIB_OPGW_11.4 (installed 2007)
OPGW Line Clamps	Suspension - AGSU Tension - Wedged Deadend
OPGW Vibration Dampers	Stockbridge
AVG Easement width	100 metres

4.2.1 Insulators

All insulators on the line were replaced since line was built and insulator strings are in good condition; however suspension and bridging insulators were replaced under the projects using live line techniques, while the original hardware remains. The insulator hardware in the areas with higher corrosiveness rates is likely to begin requiring MSP attention in the next 12 months.

Insulator Function	Strings	Material	Rating	Type	Discs	Installed
Suspension F857 (A side)	482	Porcelain	125kN	FOG	15	2002 to 2005
Suspension F858 (B side)	482	Porcelain	125kN	FOG	15	2008 to 2010
Bridging	78	Porcelain	125kN	FOG	15	2008 to 2010
Tension F857 (A side)	294	Porcelain	125kN	FOG	16	2014
Tension F858 (B side)	294	Porcelain	125kN	FOG	16	2014

5. Location and Environment

5.1 General Location

The transmission line is located in North Queensland north of Townsville in the Charters Towers and Tablelands regions. There is only one major and very few minor road crossings, meaning that line is not easily accessible along most of its length.

5.2 Atmospheric Corrosion

Built Section 1220 is located between 20km and 60km from the coast and experiences relatively high average rainfalls along the line; between 1000 and 2700 mm per annum. Humidity along the corridor is most likely directly related to its closeness to the rain forest.

The line traverses a corridor with non-homogenous corrosion conditions. The main contributors for higher corrosion levels are:

1. Tower elevation with consequent higher exposure to the salt laden winds; and
2. Proximity to the higher humidity environment of the Wet Tropics.

In contrast, towers installed in the areas with lower elevation benefit from the natural shielding from salty winds. While towers with larger distance from the Wet Tropics high humidity influence also display lower levels of corrosion deterioration. (Refer Figure 2)

The average corrosion region for the line is classed as C3, however many towers are installed in microclimatic areas consistent with C4 corrosion region characteristics.

On the single structure level; 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 guide.

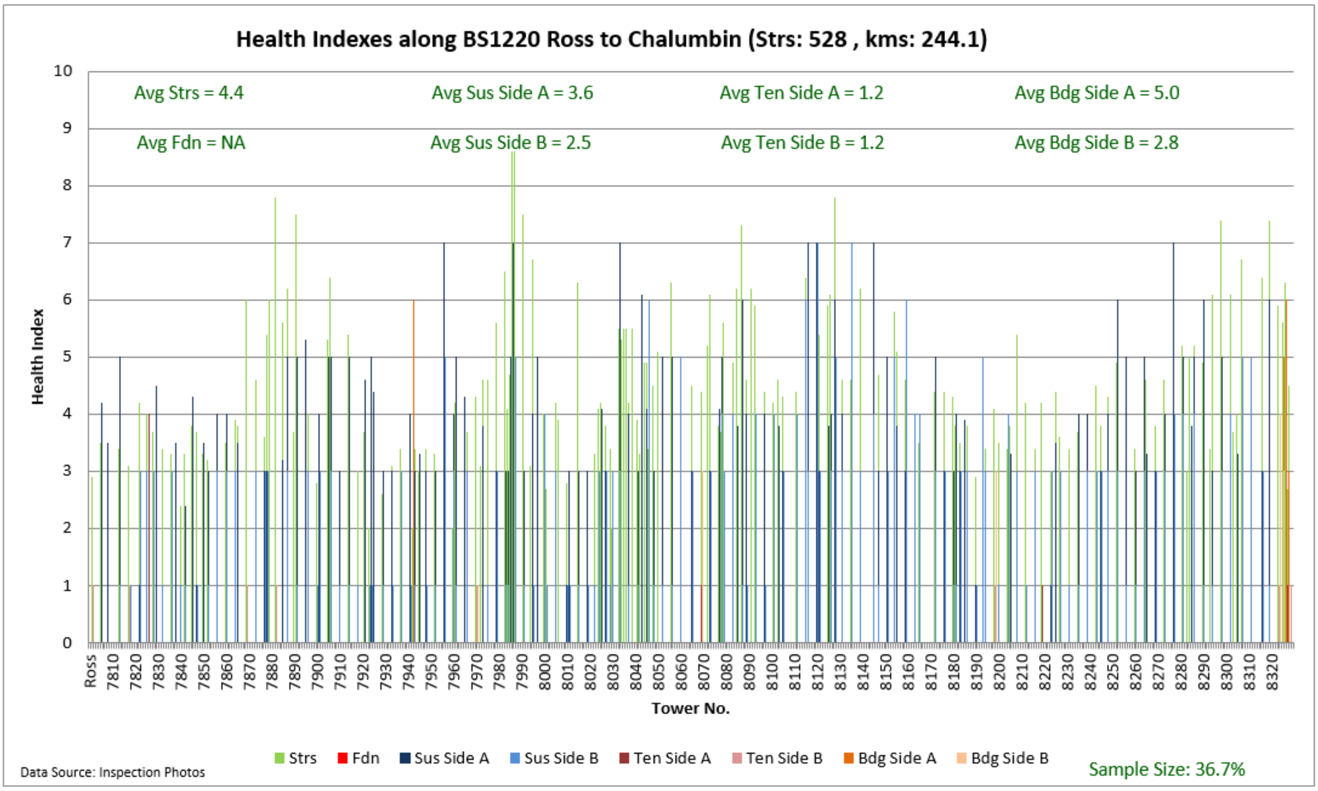
The Galvanizers' Association of Australia (refer Section 7) estimates the service life of nuts, bolts and members in this location to be as follows.

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.

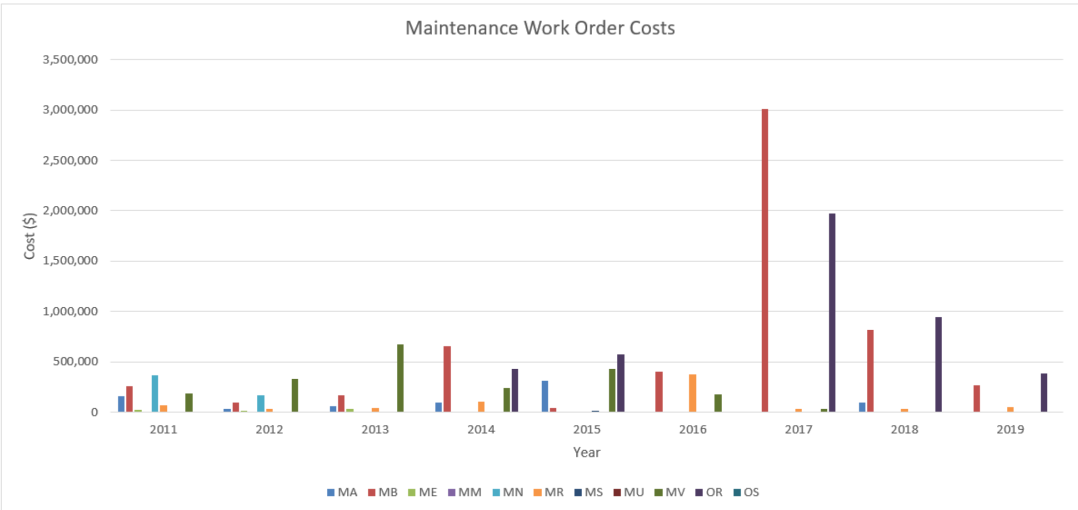
6. Condition Assessment

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 correlation with the health indices and the percentages of corrosion.

The following work order costs show that on average $1,588 k p.a. is spent on maintenance across 528 structures.



6.1 Structure Condition

The average condition of each zone on the structure is detailed in Table 1. Based on visual assessment and past experience the estimated remaining service life has also been provided for the structure.

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

Structure Zone		Average Level of Corrosion (%)				Sample Size	Installed Year	Health Index (98%)	Estimated Years until HI of 8
Structure									
Foundations		G1	G2	G3	G4		1989	1.5	40
	Legs	99.9	0.1	0	0	43			
Structure Overall		G1	G2	G3	G4	194	1989	7.1	1
	Fasteners	86.5	11.8	1.6	0.1	195			
	Members	97.4	2.1	0.5	0	195			
Climbing Aids		G1	G2	G3	G4				
	Fasteners	81.9	17	1	0	173			
Tower Base		G1	G2	G3	G4				
	Fasteners	97.7	2.3	0	0	174			
	Members	99.2	0.7	0.1	0	174			
Tower Body		G1	G2	G3	G4				
	Fasteners	88.7	10.1	1.1	0.1	170			
	Members	98.6	1.1	0.3	0	171			
Superstructure		G1	G2	G3	G4				
	Fasteners	82.2	15	2.7	0.1	180			
	Members	97	2.4	0.6	0	180			
Cross Arms		G1	G2	G3	G4				
	Fasteners	83.3	15	1.5	0.2	183			
	Members	97.6	2.2	0.2	0	183			
Conductor Attachment Plate		G1	G2	G3	G4				
	Fasteners	82.6	14.3	2.4	0.7	175			
EW Peak		G1	G2	G3	G4	174			
	Fasteners	76.2	20.2	3.3	0.3	184			
	Members	96.2	3.4	0.4	0	184			
		Min	Max	Avg					
Structure Earthing Resistance		0	0			0			

Table 1: Average Structure Corrosion Values

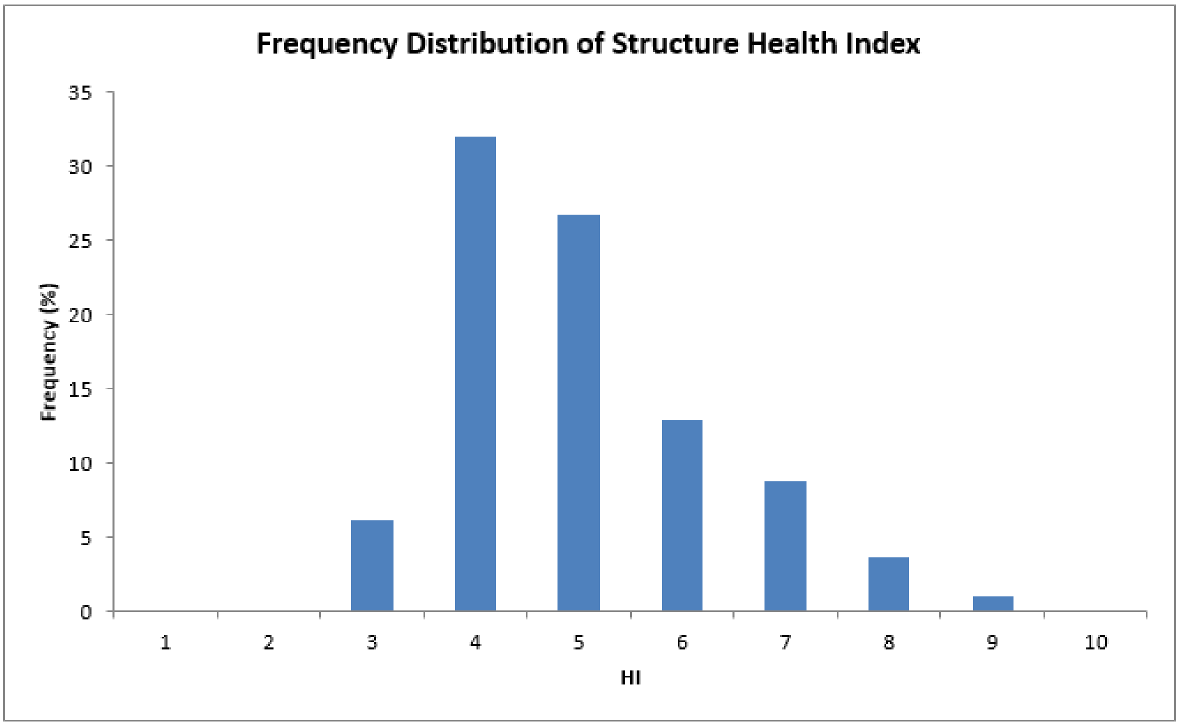
The health index is the 98th percentile value based on a normal distribution of the data sample. It is noted that the percentage which exceed this value (2%) equates to approximately 10 structures.

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.

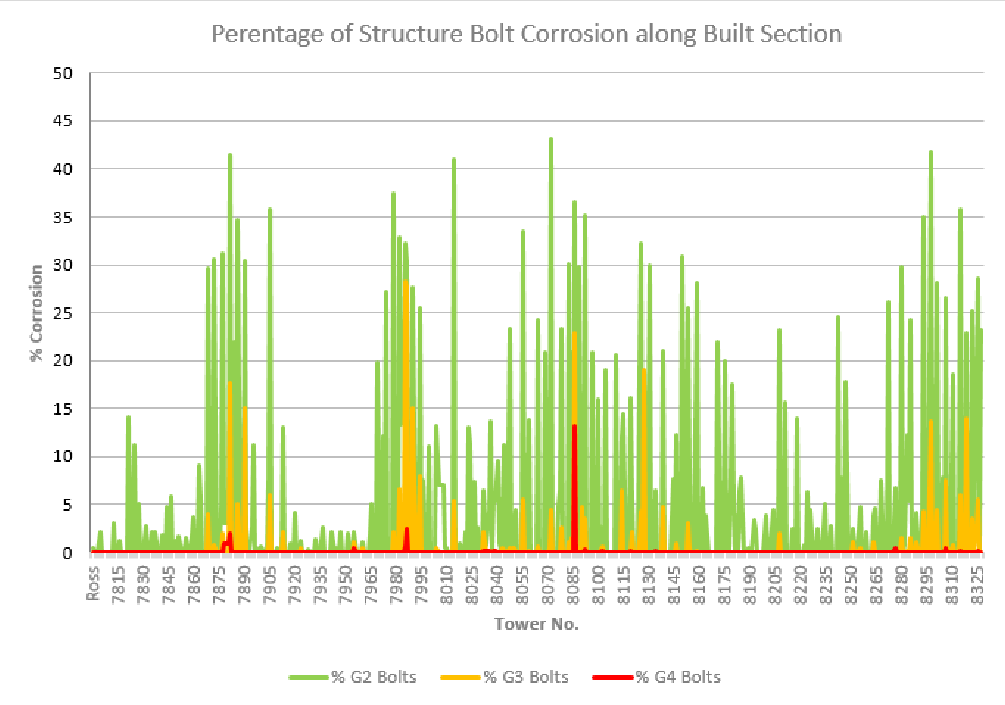
Structure Zone	Comment
Foundation	Structures utilise a standard steel reinforced concrete foundation. No foundation issues have been identified on this built section. ESL[2] is 80 years in this environment.
Climbing Aids	G2 corrosion has been observed on some step bolts and ladders however they are generally in acceptable condition. Isolated G4 corrosion is present on nuts associated with ladder attachments which should be addressed in the short term. These step bolts do not meet Powerlink current standards for climbing aids which incorporate a climbing attachment point.
Tower Base	G2 corrosion has been observed on a small percentage of nuts and bolts. Members are showing low levels of G2 with rare instances of G3 corrosion.
Tower Body	G2 and G3 corrosion has been observed on about 11% of nuts and bolts. Members are showing low levels of G2 with rare instances of G3 corrosion.
Superstructure	Close to 20% of fasteners have G2 and G3 corrosion, while rare instances of G4 bolt corrosion have been observed. A small percentage of G2 members are displaying instances of G3 corrosion.
Cross Arms	Similar condition to that of the Superstructure.
Cond. Attachment	The worst area of the tower where more than 3% of bolts have G3 and G4 corrosion.  1220-STR-7956
Earthwire Peak	Consistent with observed trend that shows more corrosion higher on the structures. Close to 25% of fasteners are at corrosion level G2 or worse. About 4% members are at corrosion level G2 or worse.
Anti-climbing Barrier	These towers are fitted with barbed wire barriers of current standard. These barriers are found to be in good condition.

[2] ESL - Estimated Service Life

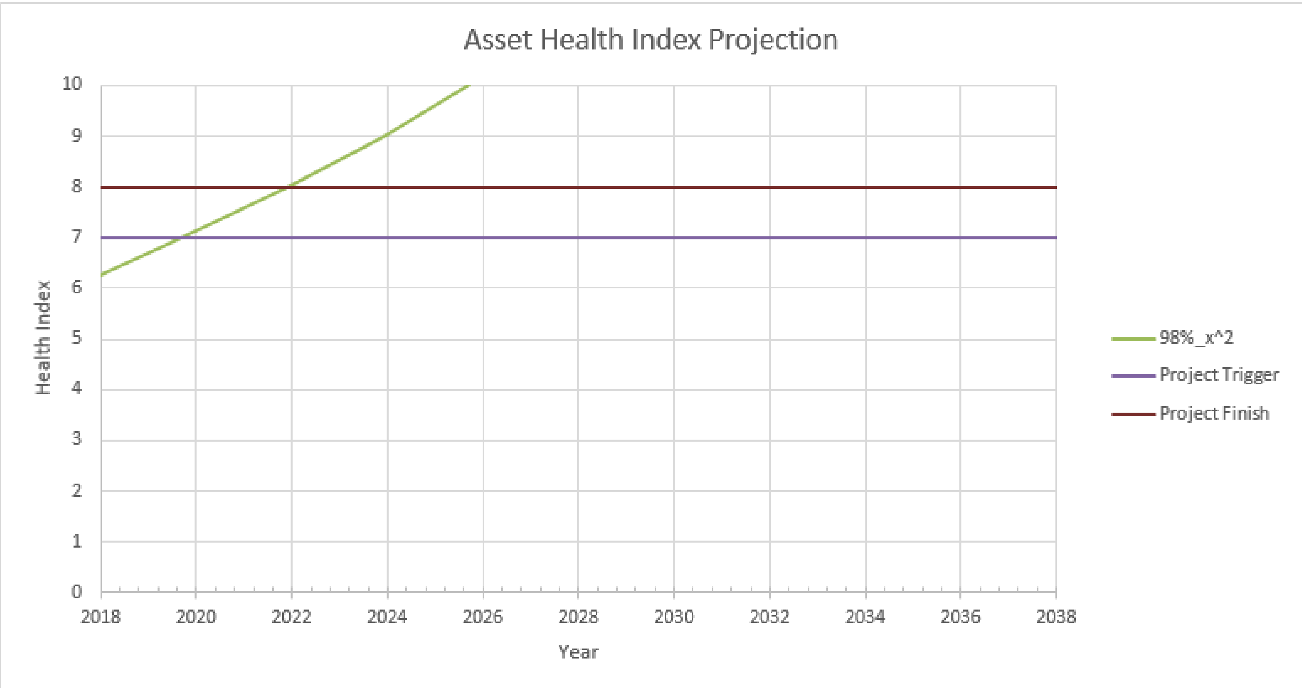
Below is the frequency distribution of structure health index based on the sample of data which can help to understand the spread of the data and determine if projects can have a staged delivery.



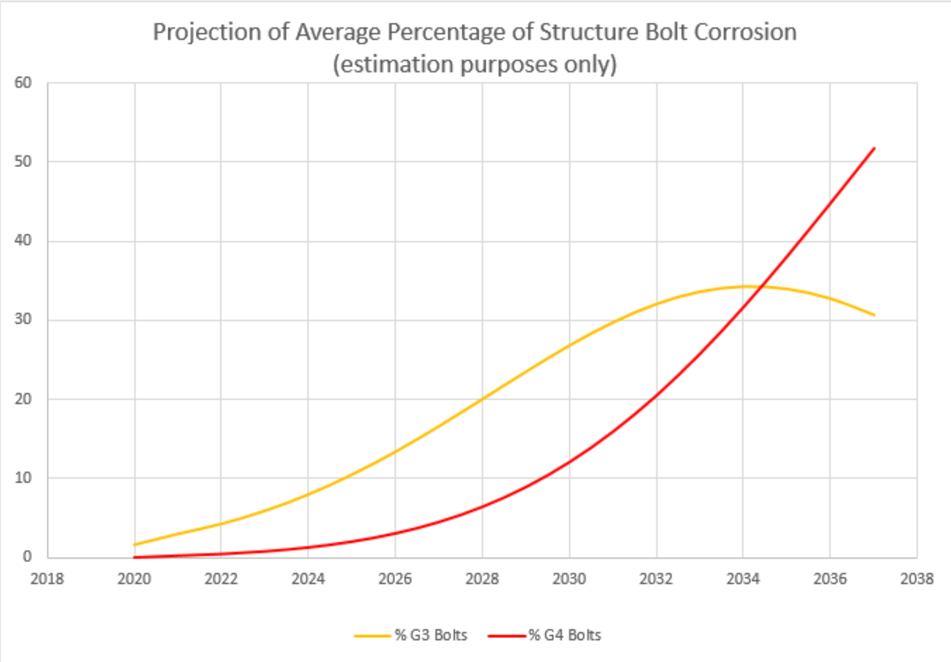
Below is the percentage corrosion of structures along the built section based on visual estimates on a sample of towers. The locations of structures with high nut, bot and member corrosion percentages along the line stands out clearly and correlates well with the SAP notifications graph (Appendix 7).



The percentages of corrosion are converted to a health index and based on statistical distribution of the results an Asset Health Index (AHI) is calculated. The following graph shows the AHI based on a threshold of 98% of towers which excludes the worst 2% of towers. The health index for the built section reflects the need to complete a project in the short term (2020-2022). However, since only a small percentage of bolts in a higher areas of towers is driving the need, a capital project could be deferred with increased maintenance or an operational refurbishment project.



To aid with estimation, the average levels of corrosion calculated. Below is the projection of average level of corrosion on the entire built section based on the sample of data.



As shown in the below table, in 2024 it is estimated that on average across the built section 8% of bolts will have reached grade 3 if no maintenance is performed. This table can be used for high level estimating.

Year	%G2 Bolts	% G3 Bolts	% G4 Bolts
2020	12	1.6	0.10
2021	38	3.0	0.32
2022	43	4.2	0.53
2023	48	5.9	0.86
2024	52	8.0	1.36
2025	55	10.5	2.10

Table 2: BS1220 Estimated Average Percentage of bolts to be replaced

6.2 Insulators and Hardware

The table below summarises the average condition of each insulator string. Based on visual assessment and 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.

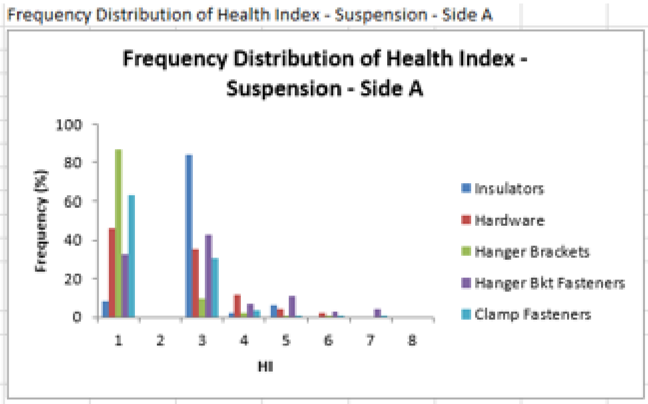
Component	Corrosion Grade / Condition (%)								Sample Size	Installed Year	Health Index (98%)	Estimated Years until HI of 8
Suspension - Side A										2002	6.5	1
Insulators	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	8	0	84	2	6	0	0	0	50			
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	46.3	0	35.2	11.7	4.3	2.5	0	0	162			
Hanger Brackets	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	87	0	9.6	2.1	0.7	0.7	0	0	146			
Hanger Bkt Fasteners	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	32.4	0	42.8	6.9	11	2.8	4.1	0	145			
Clamp Fasteners	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	63.2	0	30.7	3.7	1.2	0.6	0.6	0	163			
Clamps	Ok	Worn Rubber	Aged									
	99.4	0	0.6						163			
Insulator Shed	OK	Polluted	Dust	Moss	Fungi	Disc-cracked	Disc-chipped					
	99.2	0	0	0	0	0	0		133			
Suspension - Side B										2002	5.6	3
Insulators	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	46.2	0	46.2	0	7.7	0	0	0	13			
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	61.7	0	27.8	6	3	1.5	0	0	133			
Hanger Brackets	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	96.2	0	3	0	0.8	0	0	0	133			
Hanger Bkt Fasteners	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	66.9	0	23.8	3.8	3.1	0.8	1.5	0	130			
Clamp Fasteners	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	79.7	0	20.3	0	0	0	0	0	133			
Clamps	Ok	Worn Rubber	Aged									
	100	0	0						133			
Insulator Shed	OK	Polluted	Dust	Moss	Fungi	Disc-cracked	Disc-chipped					
	100	0	0	0	0	0	0		132			

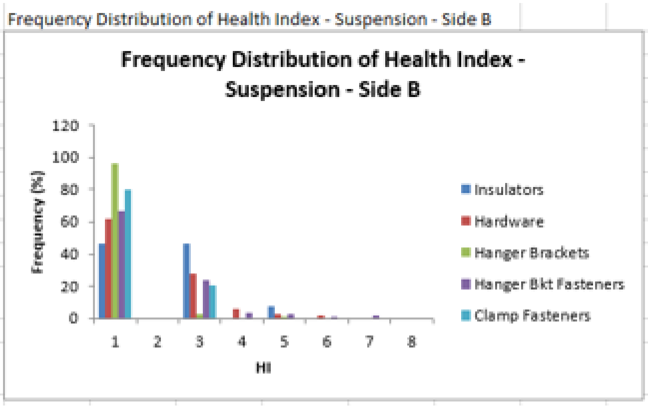
Component	Corrosion Grade / Condition (%)								Sample Size	Installed Year	Health Index (98%)	Estimated Years until HI of 8
Tension - Side A										2014	1	10
Insulators	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	92.3	7.7	0	0	0	0	0	0	13			
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	92.3	0	0	7.7	0	0	0	0	13			
Deadend	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	100	0	0	0	0	0	0	0	13			
Insulator Shed	OK	Polluted	Dust	Moss	Fungi	Disc-cracked	Disc-chipped					
	100	0	0	0	0	0	0		12			
Tension - Side B										2014	1	10
Insulators	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	100	0	0	0	0	0	0	0	10			
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	100	0	0	0	0	0	0	0	12			
Deadend	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	100	0	0	0	0	0	0	0	12			
Insulator Shed	OK	Polluted	Dust	Moss	Fungi	Disc-cracked	Disc-chipped					
	91.7	0	0	8.3	0	0	0		12			
Bridging - Side A										2008	6	1
Insulators	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
									0			
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	50	0	50	0	0	0	0	0	4			
Clamp Fasteners	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	0	0	25	0	25		0	0	4			
Insulator Shed	OK	Polluted	Dust	Moss	Fungi	Disc-cracked	Disc-chipped					
	100	0	0	0	0	0	0		4			
Bridging - Side B										2008	4	4
Insulators	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
									0			
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	20	0	60	20	0	0	0	0	5			
Clamp Fasteners	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	60	0	40	0	0	0	0	0	5			
Insulator Shed	OK	Polluted	Dust	Moss	Fungi	Disc-cracked	Disc-chipped					
	100	0	0	0	0	0	0		5			

The health index is either the maximum value or the 98% value based on a normal distribution of the data sample.

Insulator String Function	Comment
Suspension	Suspension insulators on F857 (side A) were replaced between 2002 and 2005 under project OR.00314. Suspension insulators on F858 (side B) were replaced between 2008 and 2010 under project OR.01717.  1220-STR-8043-INSSUS_B Both projects were delivered utilizing live line techniques; leaving therefore original hardware on the line. Those components are now becoming deteriorated with suspension insulators health indices in the range 5.6 to 6.5. A failure of the insulator hardware, which attaches the insulator string to the structure or connecting a conductor to the insulators will result in a conductor drop.
Tension	Tension insulators and associated hardware were replaced in 2014 under project OR.01884. All components of tension insulation assemblies are in very good condition.
Bridging	The bridging insulators appear to be in similar condition as suspension insulators; due to the presence of the original hardware their health indices are being driven to moderately high levels (up to HI6).

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





6.3 Conductor and Conductor Hardware

The transmission line is strung with Single AAAC/1120 Sulphur, 61/3.75 conductor, containing all aluminium alloy strands.

No issues have been identified with the conductor and it is estimated to last 80 years in this environment.

Component	Installation Year	Comment	Estimated Remaining Service Life (years)
Conductor	1989	No visible deterioration	49
Conductor Dampers	1989	There are 10 notification in relation to dampers. Dampers need to be replaced during next project.	4
Conductor Spacers	NA		
Conductor Mid-Span Joints	1989	No mid span joints are recorded in SAP.	

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.

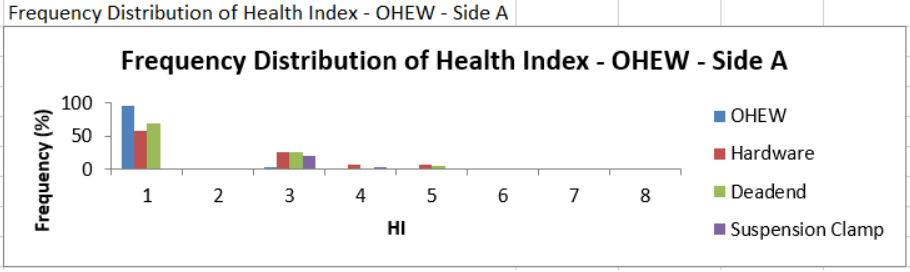
Corrosion Grades are based upon Powerlink Visual Inspection Guides, as applied by field crews or to photographic evidence.

Component	Average Level of Corrosion (%)								Sample Size	Installed Year	Health Index (98%)	Estimated Years until HI of 8
OHEW - Side A										1989/2016	5.2	4
OHEW	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	95.7	0	3.5	0	0.7	0	0	0	141			
Hardware	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	58.2	0	26.2	6.4	7.8	1.4	0	0	141			
Deadend	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	70	0	25	0	5	0	0	0	20			
Suspension Clamp	Nil	G1	G2L	G2H	G3L	G3H	G4L	G4H				
	0	0	19.7	3.9	0	1.6	0.8	0	127			

During 2015 and 2016 project OR.02017 replaced 181 spans of OHEW found to be in the worst condition (G3H and G4). An additional 21 spans of OHEW were replaced before the project under maintenance due to the damage, meaning that there are around 326 originally installed spans of the OHEW remaining on the line (around 62%).

Based on the latest visual inspection of the remaining original spans it is estimated that remaining service life of the OHEW system is 4 years.

Frequency Distribution of Health Index - OHEW - Side A



Component	Installation Date	Comment	Estimated Remaining Service Life (years)
Earthwire	1989	Low grade 3	7
Earthwire Hardware	1989	Low grade 4	4
Earthwire Dampers	1989	Some sagged dampers.	4-7

BS1220 was retrofitted with OPGW in 2007 under project CP.01313. Visual inspection found all major components of OPGW in relatively good condition. There are about 20 notifications on low G3 corrosion of the OPGW hardware; there are also around 50 notifications relating to the advanced corrosion of OPGW down lead clamps. Down lead clamps will need replacement in the very near future.

6.5 Earthing

Generally the earthing is in an acceptable condition with 15 known instances of earth strap damage or deterioration.

Resistance measurements are dating from 2015. There are 8 towers with footing earth resistances higher than 50 ohms (one of these towers [1220-STR-7910] has additional earthing installed). An additional 20 towers have earth resistance measurement in the range between 49 and 30 ohms. The remaining 95% of towers on the line have readings below 30 ohms.

Component	Installation Date	Corrosion Grade/Comment	Estimated Remaining Service Life (years)
Earthing	1989	15 instances of broken or worn earth straps.	4-8

7. Appendices

7.1 SAP Notifications Graph

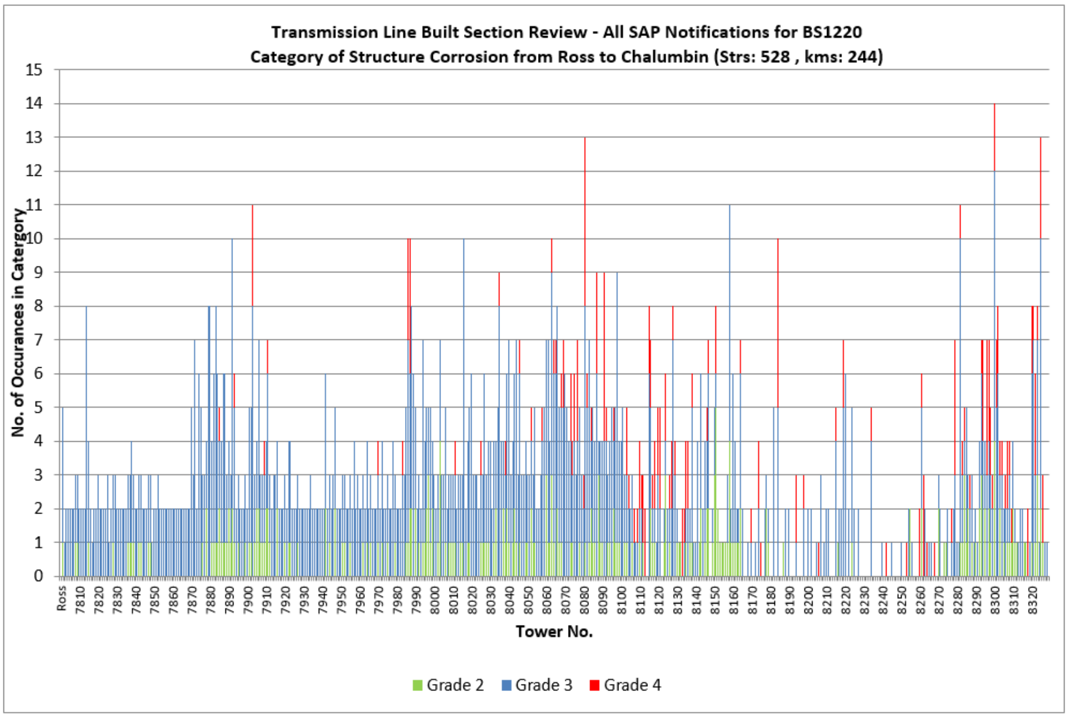


Figure 5: Graph of SAP all Notifications for Corrosion on Structures

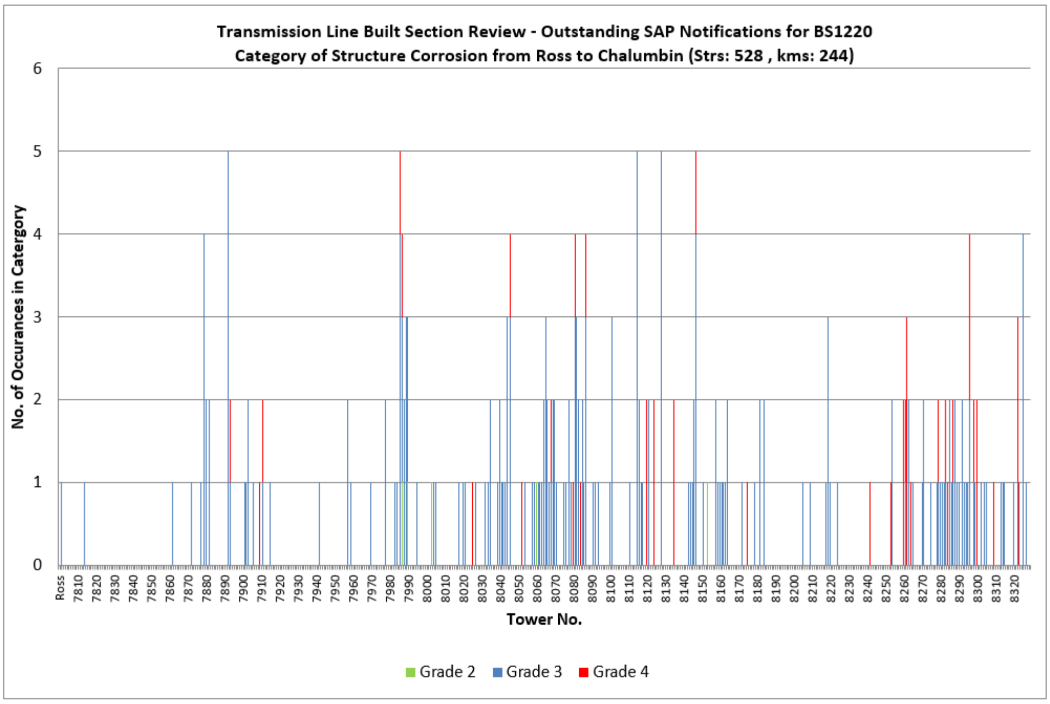
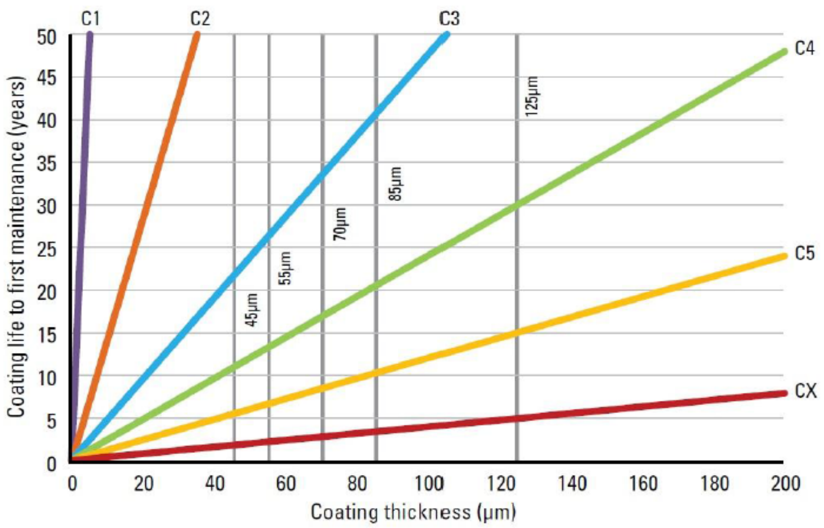


Figure 6: Graph of SAP Outstanding Notifications for Corrosion on Structures

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 7 - 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

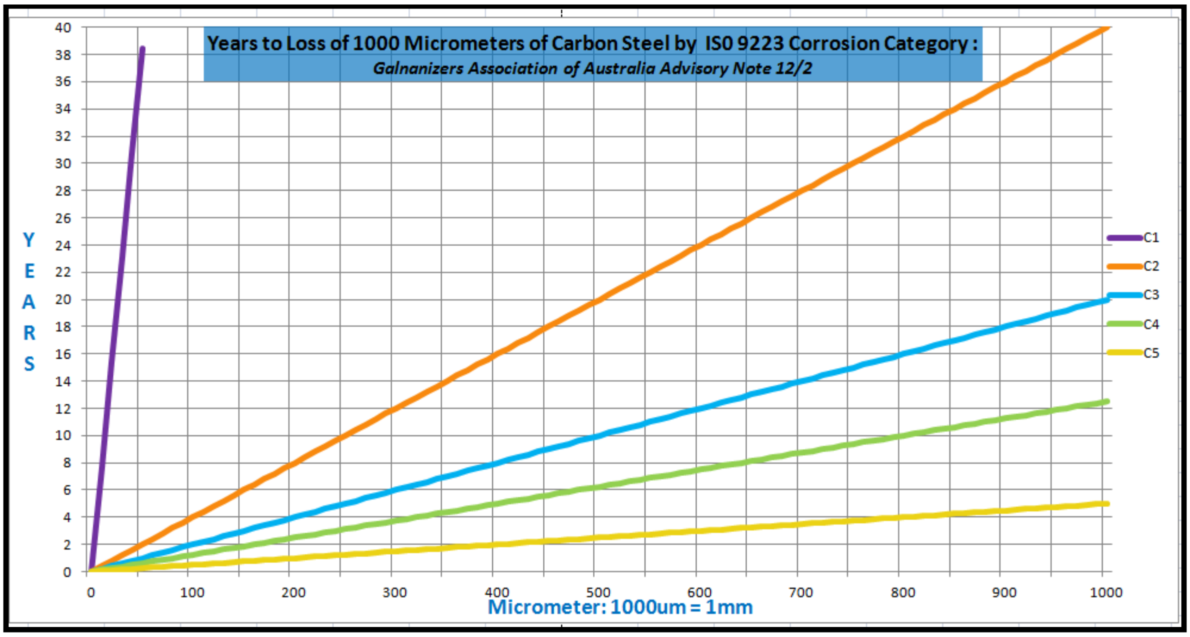


Figure 8 - Rate of Carbon Steel Loss

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 Report	**6/10/2025**
Title	CP.02750 - BS1220 and BS1671 Ross – Chalumbin Structure Refit
Zone	Far North Queensland (FNQ)
Need Driver	Condition assessment of the transmission line recommending selective refit to ensure ongoing compliance with Electricity Act, Electrical Safety Act and Electricity Safety Regulation obligations.
Network Limitation	The Ross to Chalumbin Transmission Line is required to meet Powerlink Queensland's N-1-50MW/600MWh Transmission Authority reliability standards in Far North Queensland. It also connects significant generation in FNQ to the NEM.
Pre-requisites	None

Executive Summary

The Ross to Chalumbin 275 kV line was commissioned in 1989. It consists of 528 steel lattice towers, spanning 244 km.

In 2024, the Guybal Munjan Substation was commissioned. This substation sectionalises the original line into two build sections, and is the connection point for the 250MW Kidston Pumped Hydro Energy System (PHES):

- BS1220 (Ross to Guybal Munjan) – 270 structures over 126.8 km
- BS1671 (Guybal Munjan to Chalumbin) – 263 structures over 117.9 km.

The condition assessment [1] identifies a number of emerging compliance and safety risks arising from the condition of the ageing asset.

Removal of the Ross to Chalumbin 275kV transmission line to address the emerging condition risks would result in Powerlink breaching its N-1-50MW / 600MWh Transmission Authority reliability standard.

The recommended option to address the compliance, safety and network risks arising from the ageing asset is to maintain the existing topology and refit the at-risk assets to ensure ongoing compliance with Powerlink's Electricity Act, Electrical Safety Act and Electricity Safety Regulation obligations.

Table of Contents

1. Introduction

The Ross to Chalumbin 275 kV line was commissioned in 1989.

It consists of 528 steel lattice towers, spanning a 244 km. In 2024, the Guybal Munjan Substation was commissioned. This substation sectionalises the original line into two build sections, and is the connection point for the 250MW Kidston Pumped Hydro Energy System (PHES):

- BS1220 (Ross to Guybal Munjan) – 270 structures over 126.8 km
- BS1671 (Guybal Munjan to Chalumbin) – 263 structures over 117.9 km.

The 244km transmission line, built section BS 1220 between Guybal Munjan and Chalumbin, and BS 1671 from Ross to Guybal Munjan substations, traverses rugged terrain of the North Queensland tropical rain forest, environmentally sensitive and protected areas, and regional roads and rivers.

Figures 1 and 2 show the geographical location of both sections of this double circuit line.

Figure 1. Geographical map of Guybal Munjan to Chalumbin circuits (857 and 858)

Figure 2. Geographical map of Guybal Munjan to Chalumbin feeders (8917 and 8916)

With the conversion of the Ross to Tully to Woree coastal circuit to 275kV in 2024, there are now three 275kV feeders supporting Far North Queensland (FNQ) from Ross Substation.

The Mt. Emerald Wind Farm (180 MW) connects to feeder 876 (between Chalumbin and Woree).

The Kaban Wind Farm (152 MW) is connected to feeder 8932, also between Chalumbin and Woree substations.

The Kidston PHES (250MW) connects to the Guyban Munjan Substation.

Figure 3 shows a single line diagram of the FNQ network.

[redacted]

Figure 3. Single Line Diagram of FNQ network

Figure 4 shows the network single line diagram the 275kV and 132kV FNQ network

[redacted]

Figure 4. Single Line Diagram of FNQ Region

The condition assessment [1] identifies a number of emerging compliance and safety risks arising from the condition of the ageing asset.

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

2. Far North Queensland (FNQ) Demand Forecast

The coincident FNQ maximum demand forecast is shown in Figure 5.

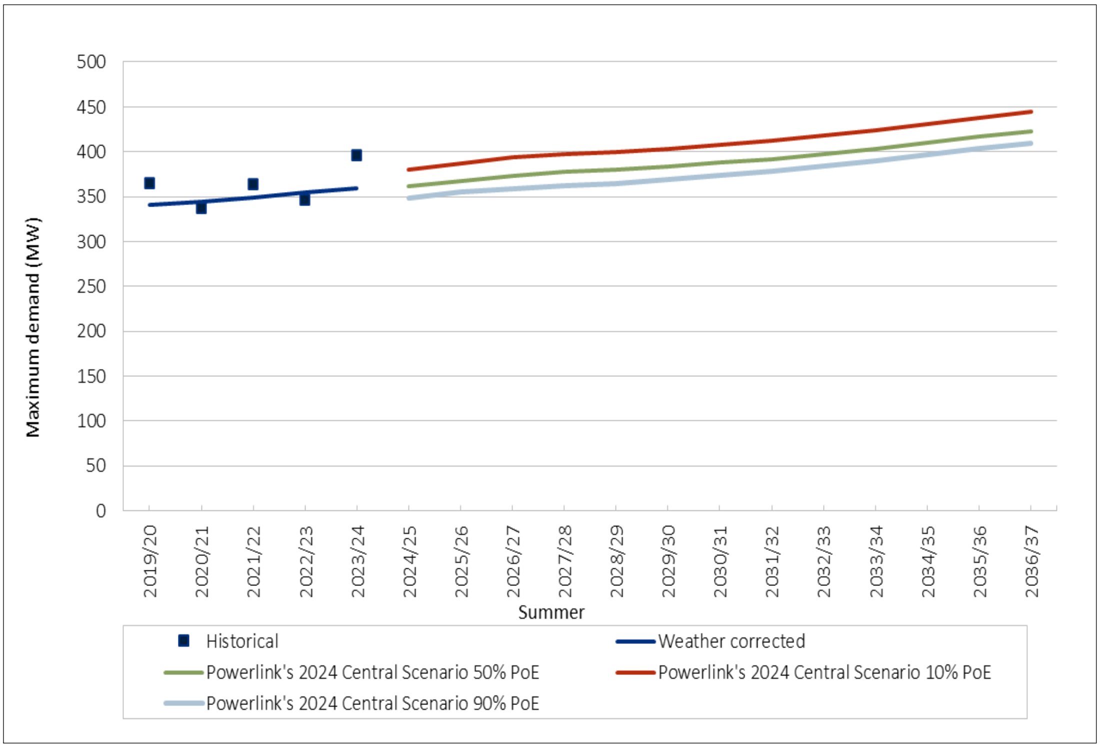


Figure 5. FNQ maximum demand forecast

Historical load duration curves for the FNQ area are shown in Figure 6.

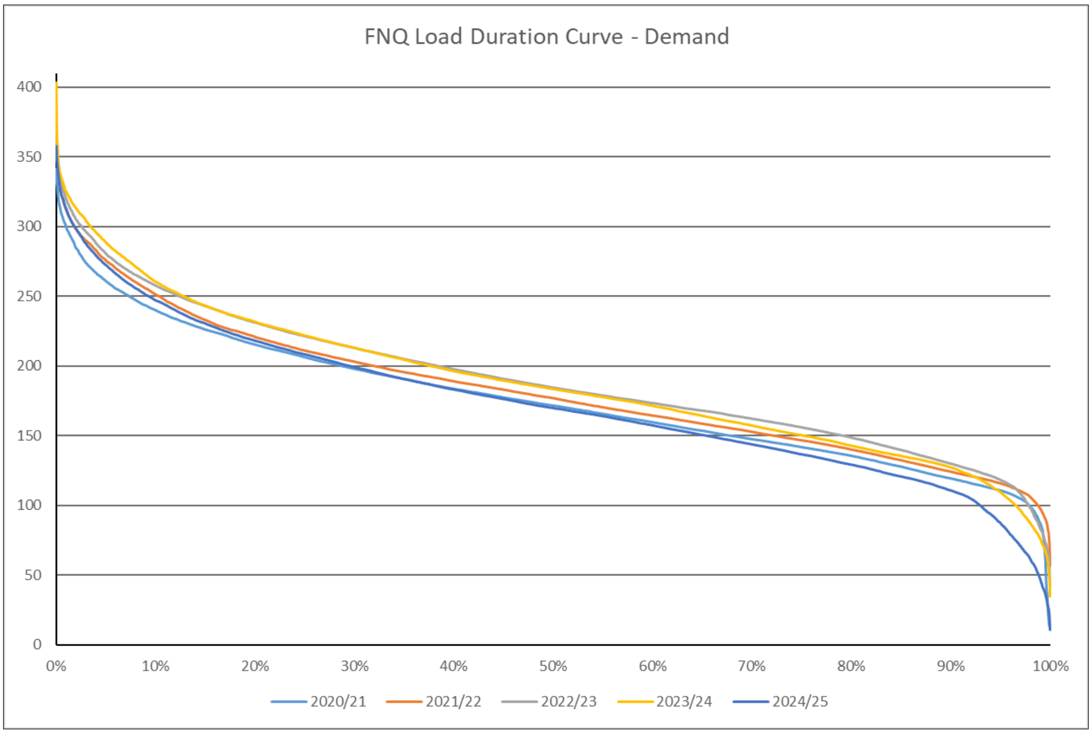


Figure 6. Historical Load Duration Curves for FNQ

With consideration of rooftop PV, the Ergon Energy loads supplied from the FNQ network, is significantly higher than the delivered demand. Figure 7 shows that rooftop PV meets nearly 150MW of underlying demand.

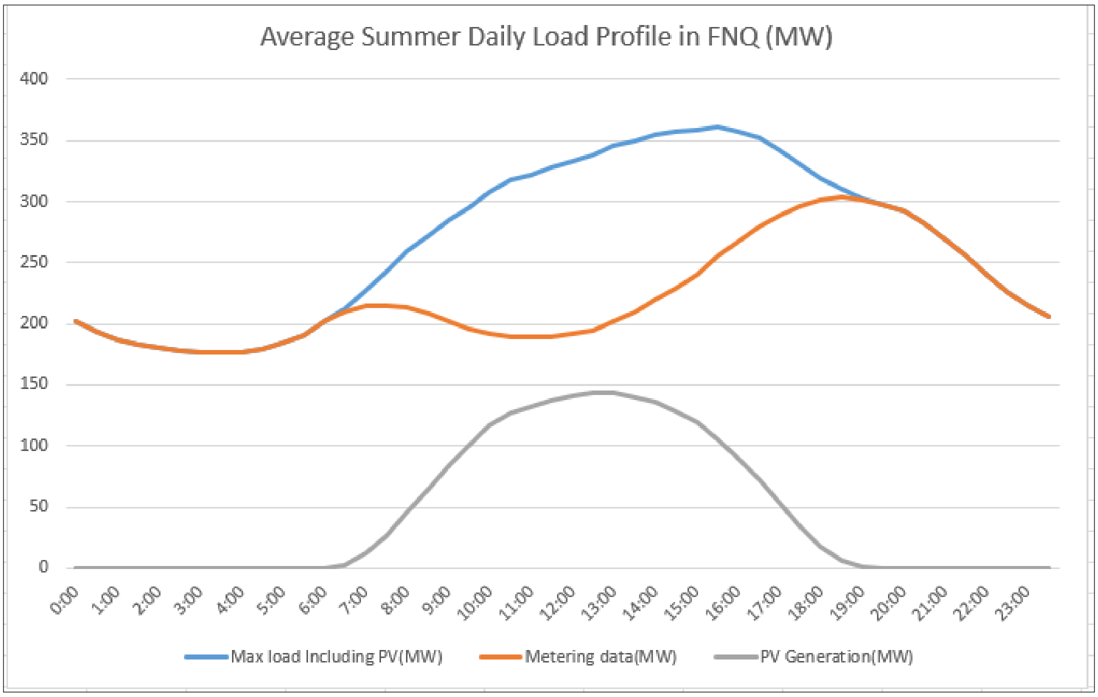


Figure 7. Average Summer Daily Load Profile for FNQ

3. Statement of Investment Need

The central scenario load forecast confirm that there is an enduring need to maintain electricity supply to FNQ.

The removal of the Ross to Chalumbin transmission line to address emerging condition-based safety issues would have a major impact on reliability of supply to loads in FNQ and violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard.

Powerlink must therefore preserve the functionality of BS1220 and BS1671 Ross to Guybal Munjan to Chalumbin transmission line to ensure ongoing compliance with its Transmission Authority reliability obligations for the supply of electricity to Far North Queensland.

4. Network Risk

Table 1 summarises the load and energy at risk in FNQ. If BS1220 (Ross to Guybal Munjan) or BS1671 (Guybal Munjan to Chalumbin) were to fail, then all of FNQ load (north of Innisfail and Turkinje) will be lost following a trip of the remining coastal 275kV line (refer to Figure 3)[1]. As the 132kV coastal circuit is open, between Edmonton and Innisfail, following an outage of the 275kV inland double circuit line, the load at Edmonton is also at risk for a trip of the 132kV line between Woree and Edmonton (7284).

Table 1. Far North Queensland Load at Risk

[1] The 132kV coastal circuit is split following an outage of the inland 275kV double circuit lines between Ross, Guybal Munjan, Chalumbin and Woree substations between Edmonton and Innisfail substations.

At Risk	Contingency	Metric	2025	2034
Far North Queensland Load (Turkinje, Edmonton, Cairns, Kamerunga)	Failure of BS1220 OR BS1671 (Ross to Chalumbin 275kV feeders) And trip of Ross to Woree (8905) (incl. PV)	Max (MW)	469	672
		Average (MW)	229	302
		24h Energy Unserved Max (MWh)	7,668	10,136
		24h Energy Unserved Average (MWh)	5,497	7,234
Far North Queensland Load (Turkinje, Edmonton, Cairns, Kamerunga)	Failure of BS1220 OR BS1671 (Ross to Chalumbin 275kV feeders) And trip of Ross to Woree (8905) (excl. PV)	Max (MW)	358	418
		Average (MW)	173	202
		24h Energy Unserved Max (MWh)	5,877	6,864
		24h Energy Unserved Average (MWh)	4,146	4,842
Edmonton	Failure of BS1220 OR BS1671 (Ross to Chalumbin 275kV feeders) And trip of Woree to Edmonton (7284) (incl. PV)	Max (MW)	101	164
		Average (MW)	34	50
		24h Energy Unserved Max (MWh)	1,259	1,893
		24h Energy Unserved Average (MWh)	803	1,189
Edmonton	Failure of BS1220 OR BS1671 (Ross to Chalumbin 275kV feeders) And trip of Woree to Edmonton (7284) (excl. PV)	Max (MW)	48	60
		Average (MW)	19	24
		24h Energy Unserved Max (MWh)	706	881
		24h Energy Unserved Average (MWh)	459	573

5. Market impact

If BS1220 or BS1671 fail, all semi-scheduled generation will be subjected to system strength constraints. Based on current operational system strength advice, Mt Emerald Wind Farm will be constrained to 0MW and Kaban Wind Farm to 80%, for double circuit outages between Ross – Guybal Munjan – Chalumbin substations.

Tables 2, 3 and 4 define the maximum and average difference in total system costs (including emission reduction benefits) per 24-hour period for outages of the respective transmission equipment in Far North Queensland. The analysis assumes that there is not impact on the generation investment pathway as a result of this outage.

The methodology used to assess these market impacts is outlined in Appendix B.

Table 2. Market impact during the double circuit outage of either build sections

At Risk	Contingency	Metric	$M
Constraint on Mt Emerald WF and Kaban WF	Failure of BS1220 OR Failure of BS1671	Max 24h incremental system cost ($m)	0.716
		Average 24h incremental system cost ($m)	0.135

Table 3. Market impact of Chalumbin to Guybal Munjan and trip of 8905

At Risk	Contingency	Metric	$M
Schedule and Semi Schedule generation (Kareeya PS, Barron Gorge PS, Mt Emerald WF, Kaban WF)	Failure of BS1671 (between Chalumbin and Guybal Munjan) And outage of Ross to Woree (8905)	Max 24h incremental system cost ($m)	1.708
		Average 24h incremental system cost ($m)	0.394

Table 4. Market impact of Ross to Guybal Munjan and trip of 8905

At Risk	Contingency	Metric	$M
Schedule and Semi Schedule generation (Kareeya PS, Barron Gorge PS, Kidston PHES, Mt Emerald WF, Kaban WF)	Failure of BS1220 (between Ross and Guybal Munjan) And outage of Ross to Woree (8905)	Max 24h incremental system cost ($m)	2.006
		Average 24h incremental system cost ($m)	0.613

6. Non-Network Options

If BS 1220 and BS1671 were decommissioned at end of life, the non-network solution would be required to supply up to 420MW and 6900MWh per day. The non-network support would also be required to provide approximately 85MVAr or sufficient voltage support for FNQ load.

In addition, the non-network solution would need to provide fault current such that the existing and committed renewable generators in the area are capable of meeting their Generator Performance Standards.

The non-network solution would be required to meet the required N-1-50/600MWh Transmission Authority reliability standard and capable of operating on a continuous basis.

Powerlink is not aware of any Demand Side Solutions (DSM) in FNQ area capable to meet the requirement. 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 prior to project approval.

7. Network Options

1.1 Preferred Option to address the identified need

The recommended solution is to refurbishment of the double circuit transmission line BS1220 and BS1671 between Ross and Chalumbin.

Options Considered but Not Proposed

This section discusses alternative options that 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.

1.1.1 Do Nothing

"Do Nothing" would not be an acceptable option as the primary drivers (primary system 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 its Transmission Authority.

1.1.2 Rebuild

Rebuilding a new double circuit 275kV line from Ross to Chalumbin would provide extra capacity to, or from, the region. This is not considered economic, as it would require a new easement and new transmission line to be constructed before the existing line could be decommissioned.

8. Recommendations

Removal of the Ross to Chalumbin 275kV transmission line to address the emerging condition risks would result in Powerlink breaching its N-1-50MW / 600MWh Transmission Authority reliability standard.

The recommended option to address the compliance, safety and network risks arising from the ageing asset is to maintain the existing topology and refit the at-risk assets to ensure ongoing compliance with Powerlink's Electricity Act, Electrical Safety Act and Electricity Safety Regulation obligations.

9. References

1. Transmission Line Condition Assessment Report – BS1220 Ross to Chalumbin 275kV March 2020
2. CP_02750 BS1220 Ross to Chalumbin Life Extension (Presentation Power Point)
3. 2025 Transmission Annual Planning Report (A6049612)
4. Asset Planning Criteria - Framework (ASM-FRA-A2352970)
5. Powerlink Queensland's Transmission Authority T01/98
6. CP.02750 BS1220 & BS1671 Ross to Chalumbin Life Extension - Project Scope Report– A5897858

10. Appendix A – Network Risk methodology

For calculating the Risk Costs, it is assumed that:

- If there is an outage of the 275kV Ross to Chalumbin double circuit, FNQ load will be only connected through single 275kV feeder and single 132kV coastal circuit. 132kV coastal feeder will be run split as such network will be at risk. If the outage occurs at 275kV feeder, the entire FNQ load will be lost initially. Single 132kV coastal feeder can only supports up to 65MW depending on voltage stability.

- For non-network solution, need to support the load of 425MW at all times. Assume 0.95pf → 85MVAr

11. Appendix B – Market Impact Assessment

Market modelling was used to assess the operational market impact from failure of build section between Ross and Chalumbin substations. The outages impact the availability and capacity of the wind farms and hydro power stations in Far North Queensland.

The market modelling approach is consistent with the regulatory investment test for transmission requirements that a market benefit “must be a benefit to those who consume, produce and/or transport electricity in the market, that is, the change in producer plus consumer surplus.” Critically, a market benefit must not “include the transfer of surplus between consumers and producers”.[2]

As such, the market impact is assessed by comparing the changes in costs for market participants due to the differences in the operational and maintenance costs (including fuel costs), changes in involuntary load shedding (at the value of customer reliability [VCR] [3]), and changes in greenhouse gas emissions (at the value of emissions reduction [VER] [4])

The market modelling simulations considered committed and anticipated generators were commissioned on time, coal units closed according to their announced dates (as of December 2025), and modelled generation and storage projects consistent with the Queensland Energy Roadmap 2025.[5] The profiles of demand and energy available for variable energy resources followed the 2015 weather reference year as published by AEMO, as being a year found to result in ‘median’ outcomes.

A schedule of generator planned outages was modelled. However, generator forced outages were not considered. Instead, a reserve requirement is maintained via a reserve constraint equation, and therefore unserved energy may be underestimated in some circumstances.

Appropriate network detail (in the form of network constraints or sub-regional transfer limits) was added to adequately represent the network capability across major grid sections.

The outage (and corresponding impact on Far North Queensland generation) was modelled as occurring in perpetuity to approximately capture the effect of this occurring at any time.

The market impact was then quantified as the differential total system cost (as above) for each hour between a base case with the full generation capacity available against the state of the world with an outage or constraint on this generation. Both the hourly and a moving 24-hour differential cost were determined.

The values in the report tables capture the maximum differential total system cost for any 24-hour period (averaged over the 5-year analysis period) and the average differential total system cost for a 24-hour period (over the 5-year analysis period).

[2] AER, November 2024, “Regulatory investment test for transmission”, p4

[3] AER, December 2024, “Values of customer reliability: Final report on VCR values” available at

[4] AER, May 2024, “Valuing emissions reduction: AER guidance and explanatory statement”

[5] The State of Queensland (Queensland Treasury), October 2025, “Energy Roadmap”

Project Scope Report

CP.02750

BS1220 & BS1671 Ross to Chalumbin Life Extension

Concept – Version 2

Document Control

Change Record

Issue Date	Revision	Prepared by	Reviewed by	Approved by	Background
27/06/25	1	[redacted]	[redacted]	[redacted]s	Initial issue
15/10/25	2	[redacted]	[redacted]	[redacted]	Scope updated to align with advice from Strategies

Related Documents

Issue Date	Responsible Person	Objective Document Name
25/03/2020	[redacted]	BS1220 Ross to Chalumbin Transmission Line Condition Assessment - Report 2020 (A3339185)
04/06/2024	[redacted]	Project Initiation Form - BS1220 & BS1671 Ross to Chalumbin Life Extension v3_1 (A5993774)

Document Purpose

The purpose of this Project Scope Report is to define the business (functional) requirements that the project is intended to deliver. These functional requirements are subject to Powerlink's design and construction standards and prevailing asset strategies, which will be detailed in documentation produced during the detailed scoping and estimating undertaken by DTS, i.e. it is not intended for this document to provide a detailed scope of works that is directly suitable for estimating.

Project Contacts

Project Sponsor	[redacted]
Connection & Development Manager	TBA
Strategist – Lines Asset Strategies	[redacted]
Planner – Main/Regional Grid	[redacted]
Manager Projects	[redacted]
Project Manager	TBA
Design Manager	TBA

Project Details

1. Project Need & Objective

The Ross–Chalumbin 275 kV transmission line comprises two built sections: BS1220, which includes feeders 857 and 858, and BS1671, which includes feeders 8916 and 8917. Originally constructed under contract N399/87 and commissioned in 1989, the line was made up of 528 steel lattice towers spanning a 244 km corridor. In 2024, the commissioning of the Guybal Munjan Substation resulted in the line being split into two distinct sections:

- BS1220 (Guybal Munjan to Chalumbin 857/858) – 270 structures over 126.8 km;
- BS1671 (Ross to Guybal Munjan 8916/8917) – 263 structures over 117.9 km.

During the establishment of Guybal Munjan substation, eight steel poles were constructed and three existing steel lattice towers removed. These steel poles will not be considered for this life extension project.

These transmission lines operate in a corrosive environment ranging from C3 to C5. The geographical location of BS1220 and BS1671 is shown in Figure 1.

Detailed climbing inspections have been undertaken for 491 towers. These inspections generated SAP notifications for identified defects and collected measurement data (MDs) covering insulators (excluding pin corrosion), insulator hardware, overhead earth wire (OHEW), and general tower condition. This information was analysed alongside historical condition data from an additional 176 towers recorded in SAP. The condition assessments have identified the presence of G3 and G4 corrosion across bolts, members, insulators and hardware.

The objective of this project is to carry out targeted refit works to extend the service life of BS1220 and BS1671 to 2046 by June 2031 for Option 1 and 2036 for Option 2.

This project will follow the two (2) stage approval process.

2. Project Drawing

Figure 1: Geographical Location

3. Deliverables

The following deliverables are to be provided in response to this Project Scope Report. The requirement dates for these deliverables will be communicated separately.

This project will follow the two stage approval process. The following deliverables are to be provided:

1. A report (e.g. Concept Estimate Report) detailing the works to be delivered, high level staging, resource requirements and availability, and outage requirements and constraints for each option.

2. A class 5 estimate (minimum) for each option.

3. A basis of estimate document and risk table, detailing the key estimating assumptions and delivery risks for each option.

4. Project 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 7 Special Considerations*.

Briefly, the project consists of undertaking selective refit works to extend the service life of BS1220 and BS1671 for a further 15 years.

Two credible options have been identified to refit BS1220 and BS1671, a selective refit by 2031 or a two-stage selective refit by 2036.

Option 1 includes selective refit works by 2031 to extend the life of BS1220 and BS1671 to 2046.

Option 2 Stage 1 includes selective refit and painting by 2031 and Option 2 Stage 2 includes selective refit works by 2036 to extend the life of BS1220 and BS1671 to 2046.

Table 1 below summarises the expected number of structures that will require intervention under each option and stage (quantities are to be confirmed following analysis of recent condition assessment data).

	Option 1	Option 2			Comment
	Stage 1 (2031)	Stage 1 (2031)	Stage 2 (2036)	Total	
Paint Refit	16	16	0	16	
Heavy Refit	42	42	0	42	
Light Refit	140	34	106	140	
Bridging assembly replacement	22	22	0	22	
Suspension assembly replacement	326	283	43	326	
OPGW/OHEW hardware replacement	102	82	20	102	
Structure earthing repair	20	10	10	20	Assume 10% of structures being refit will require earthing repair
Ground interface repair	70	70	0	70	Structure list provided
Downlead Clamps replacement	38	38	0	38	Structure list provided – assumed 38 out of 47 will require clamps to be replaced
Anti Climb Barriers (ACB) / signage replacement	53	53	10	63	Assume 10% of structures being refit will require ACB repairs or signage replacement during each project phase

Table 1: Number of structures being refit under each option and stage

These options will be presented in the RIT-T public consultation. Concept estimates are required for each option to inform feasibility and cost assessments.

4.1. Transmission Line Works

4.1.1. Option 1 – Selected Refit of BS1220 and BS1671 by 2031

The transmission line works consists of:

- Undertake “paint refit” works on 16 towers, including replacing all climbing bolts with new style climbing attachments with loops.

- Undertake “heavy refit” works on 42 towers, including replacing all climbing bolts with new style climbing attachments with loops.
- Undertake “light refit” works on 140 towers, including replacing all climbing bolts with new style climbing attachments with loops.
- Replace bridging insulators and associated hardware including trunnion clamps on 22 towers.
- Replace suspension insulators and associated hardware including bolts on the armour grip suspension units (AGSUs) and vibration dampers on 326 towers (for both circuits).
- Measure structure footing resistances of all 198 towers being refit and install additional earthing to achieve compliance to Powerlink standards where necessary (assume 10% will require additional or repairs to earthing). Footing resistance results to be updated in SAP.
- Repair ground level (interface) of 70 towers, spot painting as required.
- Replace OPGW/OHEW hardware and fittings on 102 towers.
- Replace the OPGW downlead clamps, where corroded to G2 level or worse, on 38 towers (it is expected that a total 380 clamps will need to be replaced).
- Repair or replace all damaged or defective anti-climb barriers on towers being refit (assume 10%).
- Access track work to improve access to facilitate maintenance and project work as required.
- Update SAP, drawings and corporate data systems in accordance with the Asset Information Requirements Standard.
- Perform a LAMP and condition assessment of all affected structure on completion of works and provide measuring point data for input in SAP.
- All open SAP notifications shall be addressed under this project.

4.1.2. Option 2 – Two-Staged Selective Refit of BS1220 and BS1671 by 2036

4.1.2.1. Stage 1 Refit Works by 2031

The transmission line works consist of:

- Undertake “paint refit” works on 16 towers, including replacing all climbing bolts with new style climbing attachments with loops.
- Undertake “heavy refit” works on 42 towers, including replacing all climbing bolts with new style climbing attachments with loops.
- Undertake “light refit” works on 34 towers, including replacing all climbing bolts with new style climbing attachments with loops.
- Replace bridging insulators and associated hardware including trunnion clamps on 22 towers.

- Replace suspension insulators and associated hardware including bolts on the armour grip suspension units (AGSUs) and vibration dampers on 283 towers (for both circuits).

- Measure structure footing resistances of all 105 towers being refit and install additional earthing to achieve compliance to Powerlink standards where necessary (assume 10% will require additional or repairs to earthing). Footing resistance results to be updated in SAP.

- Repair ground level (interface) of 70 towers, spot painting as required.

- Replace OPGW/OHEW hardware and fittings on 82 towers.

- Replace the OPGW downlead clamps, where corroded to G2 level or worse, on 38 towers (it is expected that a total 380 clamps will need to be replaced).

- Repair or replace all damaged or defective anti-climb barriers on towers being refit (assume 10%).

- Access track work to improve access to facilitate maintenance and project work as required.

- Update SAP, drawings and corporate data systems in accordance with the Asset Information Requirements Standard.

- Perform a LAMP and condition assessment of all affected structure on completion of works and provide measuring point data for input in SAP.

- All open SAP notifications shall be addressed under this project.

4.1.2.2. Stage 2 Refit Works by 2036

The transmission line works consists of:

- Undertake “light refit” works on 106 towers, including replacing all climbing bolts with new style climbing attachments with loops.

- Replace suspension insulators and associated hardware including bolts on the armour grip suspension units (AGSUs) and vibration dampers on 43 towers (for both circuits).

- Measure structure footing resistances of all 106 towers being refit and additional earthing to achieve compliance to Powerlink standards where necessary (assume 10% will require additional or repairs to earthing). Footing resistance results to be updated in SAP.

- Replace OPGW/OHEW hardware and fittings on 20 towers.

- Repair or replace all damaged or defective anti-climb barriers and replace damaged or missing signage on structures not being refit (assume 10%).

- Access track work to improve access to facilitate maintenance and project work as required.

- Update SAP, drawings and corporate data systems in accordance with the Asset Information Requirements Standard.
- Perform a LAMP and condition assessment of all affected structure on completion of works and provide measuring point data for input in SAP.
- All open SAP notifications shall be addressed under this project.

4.1.3. Description of Refit Works for Options 1 and 2

- Structural Refit:
    - Light Refit: Replacement of G3 and G4 bolts and nuts and replacement of G3 and G4 secondary members if any. For estimation purposes, assume 2% of bolts and 0.3% of members are to be replaced.
    - Heavy Refit: Replacement of G2, G3 and G4 bolts and nuts and replacement of G3 and G4 secondary members, G3 and G4 heavy members should be repaired if more economic than replacement. Assume 41% of bolts and 0.7% of members are to be replaced.
    - Paint Refit: Abrasive blasting, replacement of G3 and G4 nuts and bolts, replacement of G4 members to Powerlink Painting Specification. It is assumed that 17% of bolts and 0.5% of members shall be replaced.
    - Additional inspection and data collection to decide on the level of intervention.
- Insulator and Hardware Replacement:
    - Replace all insulator hardware and suspension insulators rated G2H or worse.
    - Replace all bridging insulator hardware rated G3H or worse.
    - Perform nut and bolt replacements in exclusion zones under Structural refit works in conjunction with insulator and hardware work.
- Ground- Level Remediation
    - Improve ground level condition of nominated towers using manual or power tool cleaning to remove G2/G3 corrosion at stub interfaces.
    - Apply protective paint coating (~100µm DFT).
    - For interfaces with G4 corrosion and more than 5% loss of steel, ensure that the interface has been structurally repaired before painting.
    - Refer to Appendix A for the list of Towers nominated for ‘Ground Level’ repairs.
- OPGW/OPGW Hardware Replacement:
    - Replace all OPGW downlead clamps with G2-level corrosion or worse. Refer to Appendix B for the list of Towers with OPGW joint boxes and downlead clamps (47 towers). For estimation purposes assume 10 clamps will need replacement on 38 towers.

- Rectify all open notifications related to OPGW connections.
- Replace all OHEW and OPGW hardware where there is at least one component with G2H or worse (HI ≥ 4) corrosion.

4.2. Substation Works

Not Applicable

4.3. Telecoms Works

Not applicable

4.4. Easement/Land Acquisition & Permits Works

The transmission line is on existing Powerlink easements. Site access shall be reviewed for project work and include:

- Review of easement term and conditions to confirm the works to be undertaken can be completed under the easement conditions;
- Undertaking a desktop review to identify any sites of cultural heritage significance; and
- Securing any additional approvals or permits required to complete the project.

4.5. Key Scope Assumptions

The following assumptions should be included in the estimation of this scope:

- Nominal replacement quantities have been assumed for estimating purposes.

4.6. Variations to Scope (post project approval)

Not applicable

5. Key Asset Risks

Asset risk management shall be in accordance with the Asset Risk Management Process Guideline (A4870713).

6. Project Timing

6.1. Approval Date

The project is anticipated to be Stage 1 approved by December 2026.

6.2. Site Access Date

Access is available immediately.

6.3. Commissioning Date

The latest commissioning date is 30 June 2031.

7. Special Considerations

Urgent Sections – High Risk of Structural Failure Sections of the line have been identified as being in poor condition, posing an elevated risk of structural failure during extreme weather events (e.g., cyclones). These high-risk sections are a top priority and should be addressed as soon as possible.

Lower-Risk Sections – Lower Priority: Other areas of the line exhibit less severe deterioration and can be scheduled for later intervention based on available resources and risk assessments.

Mitigation of High-Risk Structures: Short-term mitigation of the most critical structures may be achievable through Maintenance Service Providers (MSPs). However, delaying the broader project and relying solely on corrective maintenance should be avoided, as it may result in inefficient resource use and duplicated costs.

8. Asset Management Requirements

All equipment must comply with Powerlink's equipment strategies.

The Project Sponsor must be involved in any discussions with other areas of Network and Business Development, including Asset Strategies & Planning.

The Project Sponsor should be kept informed of any communications or discussions with the customer.

9. Asset Ownership

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

10. 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.

11. Options

Not applicable

12. Division of Responsibilities

Not applicable

13. Related Projects

Project No.	Project Description	Planned Comm Date	Comment
Pre-requisite Projects			
Co-requisite Projects			
Other Related Projects			

Appendix A

Towers nominated for 'Ground Level' repairs

Towers nominated for 'Ground Level' repairs				
Tower numbers:				
1671-STR-7870	1671-STR-7990	1671-STR-8004	1220-STR-8074	1220-STR-8136
1671-STR-7885	1671-STR-7991	1671-STR-8005	1220-STR-8076	1220-STR-8150
1671-STR-7886	1671-STR-7992	1671-STR-8006	1220-STR-8080	1220-STR-8158
1671-STR-7887	1671-STR-7993	1671-STR-8007	1220-STR-8081	1220-STR-8165
1671-STR-7894	1671-STR-7994	1671-STR-8008	1220-STR-8084	1220-STR-8189
1671-STR-7904	1671-STR-7995	1671-STR-8009	1220-STR-8087	1220-STR-8208
1671-STR-7905	1671-STR-7996	1671-STR-8010	1220-STR-8091	1220-STR-8209
1671-STR-7906	1671-STR-7997	1671-STR-8017	1220-STR-8098	1220-STR-8210
1671-STR-7918	1671-STR-7998	1671-STR-8019	1220-STR-8101	1220-STR-8278
1671-STR-7921	1671-STR-7999	1671-STR-8020	1220-STR-8107	1220-STR-8281
1671-STR-7981	1671-STR-8000	1671-STR-8028	1220-STR-8109	1220-STR-8284
1671-STR-7985	1671-STR-8001	1671-STR-8037	1220-STR-8110	1220-STR-8287
1671-STR-7988	1671-STR-8002	1220-STR-8067	1220-STR-8128	1220-STR-8297
1671-STR-7989	1671-STR-8003	1220-STR-8068	1220-STR-8030	1220-STR-8299

Appendix B

Towers with OPGW joint boxes and downlead clamps

For estimation purposes, assume 10 clamps will need replacement on 80% of nominated towers.
(I.e. clamp on every 3m for 36m high tower)

Tower numbers:			
1671-STR-7814	1671-STR-7959	1220-STR-8081	1220-STR-8215
1671-STR-7825	1671-STR-7970	1220-STR-8091	1220-STR-8224
1671-STR-7838	1671-STR-7983	1220-STR-8103	1220-STR-8234
1671-STR-7852	1671-STR-7994	1220-STR-8115	1220-STR-8245
1671-STR-7867	1671-STR-8003	1220-STR-8127	1220-STR-8256
1671-STR-7879	1671-STR-8013	1220-STR-8138	1220-STR-8268
1671-STR-7892	1671-STR-8023	1220-STR-8151	1220-STR-8279
1671-STR-7903	1671-STR-8035	1220-STR-8164	1220-STR-8291
1671-STR-7911	1671-STR-8047	1220-STR-8174	1220-STR-8303
1671-STR-7922	1671-STR-8058	1220-STR-8184	1220-STR-8314
1671-STR-7934	1220-STR-8064	1220-STR-8194	1220-STR-8323
1671-STR-7946	1220-STR-8069	1220-STR-8206	

CP.02750 BS1220 & BS1671 Ross to Chalumbin Life Extension

Concept Estimate

Table of Contents

1. Executive Summary

This Concept Estimate document has been developed based on the CP.02750 BS1220 & BS1671 Ross to Chalumbin Life Extension Project Scope Report (PSR).

The Ross–Chalumbin 275 kV transmission line comprises two built sections (BS): BS1220, which includes feeders 857 and 858, and BS1671, which includes feeders 8857 and 8858. Originally constructed under contract N399/87 and commissioned in 1989, the line was made up of 528 steel lattice towers spanning a 244 km corridor. In 2024, the commissioning of the Guybal Munjan Substation resulted in the line being split into two distinct sections:

- BS1220 (Ross to Guybal Munjan) – 270 structures over 126.8 km.
- BS1671 (Guybal Munjan to Chalumbin) – 263 structures over 117.9 km.

The transmission line operates in a corrosive environment ranging from C3 to C5. Condition assessments have identified the presence of G3 and G4 corrosion across bolts, members, insulators, and hardware.

A detailed climbing inspection has been undertaken for 491 towers. These inspections generated SAP notifications for identified defects and collected measurement data (MDs) covering insulators (excluding pin corrosion), insulator hardware, overhead earth wire (OHEW), and general tower condition. This information was analyzed alongside historical condition data from an additional 176 towers recorded in SAP.

Two credible options have been identified to refit BS1220 and BS1671, a selective refit by 2031 or a two-stage selective refit by 2036.

- Option 1 includes selective refit works by 2031 to extend the life of BS1220 and BS1671 to 2046.
- Option 2 Stage 1 includes selective refit and painting by 2031, and Option 2 Stage 2 includes selective refit works by 2036 to extend the life of BS1220 and BS1671 to 2046.

Table 1 below summarises the expected number of structures that will require intervention under each option and stage (quantities are to be confirmed following analysis of recent condition assessment data).

	Option 1	Option 2			Comment
	Stage 1 (2031)	Stage 1 (2031)	Stage 2 (2036)	Total	
Paint Refit	16	16	0	16	
Heavy Refit	42	42	0	42	
Light Refit	140	34	106	140	
Bridging assembly replacement	22	22	0	22	
Suspension assembly replacement	326	283	43	326	
OPGW/OHEW hardware replacement	102	82	20	102	
Structure earthing repair	20	10	10	20	10% of structures being refit will require earthing repair
Ground interface repair	70	70	0	70	Structure list provided

Download Clamps replacement	38	38	0	38	Structure list provided – 38 out of 47 will require clamps to be replaced
Anti Climb Barriers (ACB) / signage replacement	53	53	10	63	10% of structures being refit will require ACB repairs or signage replacement during each project phase

The assessment in Table 1: Number of structures being refit under each option and stage this proposal has established that the project will be delivered by December 2031 for Option 1 and September 2036 for Option 2.

This project will follow the two (2) stage approval process.

Figure 1: Geographical Location of BS1220 & BS1671

1.1 Project Estimate

1.1.1 Option 1 - Single Stage Selective Refit BS1220 & BS1671 by 2031

No escalation costs have been considered in this estimate.

		Total ($)
Estimate Class	5	
Base Estimate – Un-Escalated (2025/2026)		141,691,953
TOTAL		**141,691,953**

1.1.2 Option 1 - Project Financial Year Cash Flows

DTS Cash Flow Table	Un-Escalated Cost ($)
To June 2026	206,898
To June 2027	6,828,861
To June 2028	827,593
To June 2029	15,220,316
To June 2030	43,184,794
To June 2031	43,184,794
To June 2032	32,230,554
To June 2033	8,143
TOTAL	**141,691,953**

1.1.3 Option 2 - Staged Selective Refit BS1220 & BS1671 by 2036

No escalation costs have been considered in this estimate.

		Total ($)
Estimate Class	5	
Base Estimate – Un-Escalated (2025/2026)		149,556,223
TOTAL		**149,556,223**

1.1.4 Option 2 - Project Financial Year Cash Flows

DTS Cash Flow Table	Un-Escalated Cost ($) Option 2 Stage 1	Un-Escalated Cost ($) Stage 2 Stage 2	Un-Escalated Cost ($) - Total
To June 2027	174,179	0	174,179
To June 2028	6,720,276	0	6,720,276
To June 2029	696,716	0	696,716
To June 2030	16,519,690	0	16,519,690
To June 2031	50,828,720	0	50,828,720
To June 2032	37,934,872	0	37,934,872
To June 2033	0	4,634,738	4,634,738
To June 2034	0	1,407,811	1,407,811
To June 2035	0	6,804,630	6,804,630
To June 2036	0	17,342,655	17,342,655
To June 2037	0	6,491,936	6,491,936
TOTAL	**112,874,453**	**36,681,770**	**149,556,223**

2. Project and Site-Specific Information

2.1 Project Dependencies & Interactions

This project is related to the following projects:

Project No.	Project Description	Planned Commissioning Date	Comment
Dependencies			
Interactions			
Other Related Projects			

2.2 Site Specific Issues

- The 244km transmission line between Ross and Chalumbin substations is built through the rugged terrain of the North Queensland tropical rain forest, traversing environmentally sensitive and protected areas, regional roads and rivers.
- Approximately 83km of the existing alignment is not covered by registered easements. This is predominantly associated with several protected areas (National Parks, State Forests) which cover 52km of the existing alignment. The other significant area (30km) is the Australian Army High Range Live Fire Area north-west of Townsville
- Construction of infrastructure in National Parks and Wet Tropics areas is subject to the Queensland Electricity Supply Industry (QESI) Maintenance Code for the Wet Tropics World Heritage Area.
- The line traverses a wide range of topography from flat to hilly to very steep terrain. The most significant environmental features are the crossings of Herveys Range and Mount Zero, the Hidden Valley area and the Herbert River crossing (longest span in Queensland at 1.8km).
- There are at least six Native Title parties along this line. Further research is necessary to correctly identify all parties and which areas they speak for –
    - At Ross – Gurambilbarra Wulgurukaba People
    - Unclaimed portion of about 52km, further research would be needed to identify the party/parties.
    - Gugu Badhun
    - Warrgamay
    - Warrungnu
    - Jirrbal People #3
    - At the Chalumbin end - Jirrbal People #4
- The alignment is generally free of any mapped Unexploded Ordnance (UXO) zones, as well as Department of Environment and Resource Management (DERM) protected areas.
- The site is subject to seasonal wet weathers, generally December to April each year.
- The project site is an existing asset and will be subject to the standard maintenance-oriented conditions and controls, i.e. weed wash downs, property access notifications.
- Chalumbin area is subject to the following average number of days of rain. Consideration was given to this when developing the project schedule.

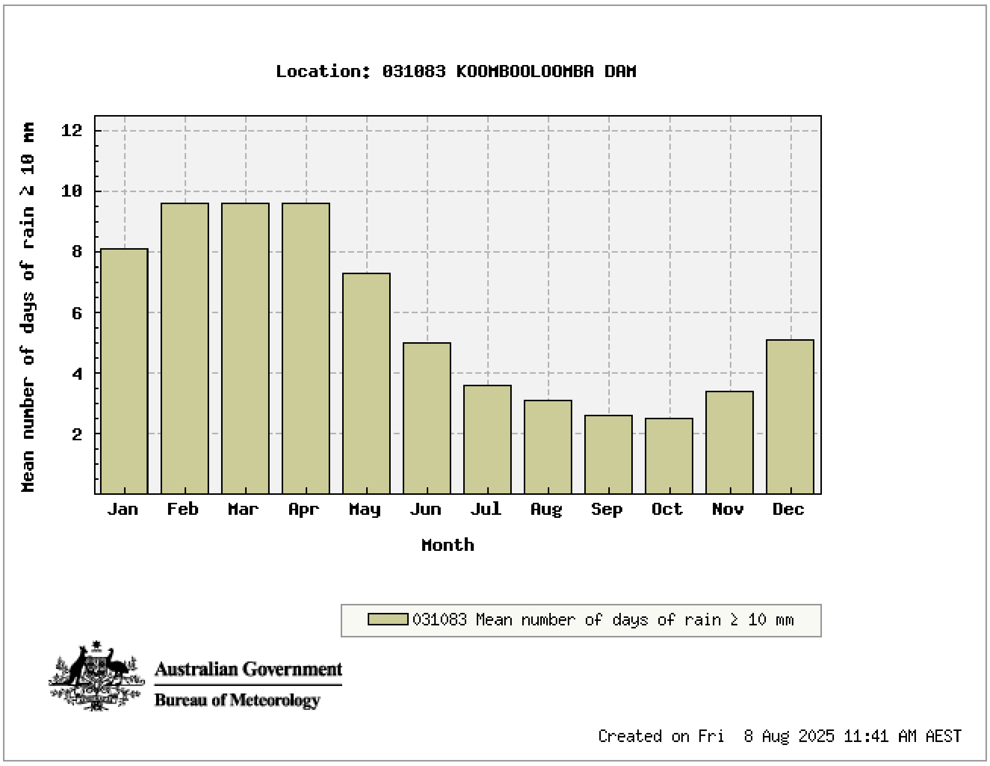


Figure 2 - Number of days of Rain>=10mm Koombooloomba Dam (Source: Bureau of Meteorology 8th August 2025)

3. Project Scope

The project scope involves transmission line refit works on the Bult Section 1220 and 1671, 275kV transmission line between Ross and Chalumbin. The scope will also involve aspects of vegetation management, access track repair, biosecurity management, cultural heritage assessment, landholder relations, to enable the required refit works.

3.1 Major Scope Assumptions

The following key assumptions were made for this Project Estimate.

- Nominal replacement quantities have been assumed for estimating purposes.
- "Paint refit" works require painting of entire structures.
- On average, BS1220 and BS1671 structures have 3000 fasteners, 200 step bolts, and 800 members.
- No new clearing or significant new access works required.
- Maintenance Service Provider (MSP) resources (Energy Queensland) will undertake core works.
- Line refit scope will be performed by a Line Refit Contractor.
- Suitable outage/s will be available, during non-peak load periods, i.e. April to December.
- Access to site will be available at project approval.
- Any existing paints on structures are free of any hazardous materials, i.e. lead, asbestos, etc.
- All works are within existing access tracks and towers footprint.

3.2 Scope Exclusions

- Easement acquisitions work, including permits, approvals, development applications are excluded.

- Additional time and cost for Design, Planning and Implementation of any restoration plans required for outages is not included in this estimate.
- Compensations to landholders to gain access to structures.
- Impact of major weather events, e.g., cyclone, major flooding, or major bushfire.
- Defects in open SAP notifications that are not specified in the PSR.

3.3 Option 1 - Single Stage Selective Refit BS1220 & BS1671 by 2031

The following works have been costed for in the estimate:

3.3.1 Transmission Line Works

Undertake transmission line refit works on Built Section 1220 and 1671 as follows:

- Perform a full Line Asset Measuring Points (LAMP) and condition assessment of all structures to inform scope and provide measuring point data for input into SAP.
- Undertake "paint refit" works on 16 towers, including replacing all climbing bolts with new style climbing attachments with loops (17% of bolts or 8160 bolts and 0.5% members or 64 members).
- Undertake "heavy refit" works on 42 towers, including replacing all climbing bolts with new style climbing attachments with loops (41% of bolts or 51660 bolts and 0.7% members or 236 members).
- Undertake "light refit" works on 140 towers, including replacing all climbing bolts with new style climbing attachments with loops (2% of bolts or 8400 bolts and 0.3% of member or 336 members).
- Replace bridging insulators and associated hardware including trunnion clamps on 22 towers.
- Replace suspension insulators and associated hardware including bolts on the armour grip suspension units (AGSUs) and vibration dampers on 326 towers (for both circuits).
- Measure structure footing resistances of all 198 towers being refit and install additional earthing to achieve compliance to Powerlink standards (10% or 20 towers will require additional or repairs to earthing). Footing resistance results to be updated in SAP.
- Repair ground level (interface) of 70 towers, spot painting (140 legs).
- Replace OPGW/OHEW hardware and fittings on 102 towers.
- Replace the OPGW downlead clamps, where corroded to G2 level or worse, on 38 towers (it is expected that a total 50 clamps will need to be replaced for each tower).
- Repair or replace damaged or defective anti-climb barriers on towers being refit (10% or 20 structures).
- Access track work to improve access to facilitate maintenance and project work.
- Update SAP, drawings and corporate data systems in accordance with the Asset Information Requirements Standard.
- Perform a LAMP and condition assessment of all affected structure on completion of works and provide measuring point data for input in SAP.

3.4 Option 2 - Staged Selective Refit BS1220 & BS1671 by 2036

The following works have been costed for in this estimate.

3.4.1 Transmission Line Works

Undertake staged transmission line refit works on Built Section 1220 & 1671 as follows:

Stage 1 (by 2031):

- Perform a full LAMP and condition assessment of all structures to inform scope and provide measuring point data for input into SAP.

- Undertake “paint refit” works on 16 towers, including replacing all climbing bolts with new style climbing attachments with loops (17% of bolts or 8160 bolts and 0.5% members or 64 members).
- Undertake “heavy refit” works on 42 towers, including replacing all climbing bolts with new style climbing attachments with loops (41% of bolts or 51660 bolts and 0.7% members or 236 members).
- Undertake “light refit” works on 34 towers, including replacing all climbing bolts with new style climbing attachments with loops (2% of bolts or 2040 bolts and 0.3% of members or 82 members).
- Replace bridging insulators and associated hardware including trunnion clamps on 22 towers.
- Replace suspension insulators and associated hardware including bolts on the armour grip suspension units (AGSUs) and vibration dampers on 283 towers (for both circuits).
- Measure structure footing resistances of all 105 towers being refit and install additional earthing to achieve compliance to Powerlink standards (10% or 11 towers will require additional or repairs to earthing). Footing resistance results to be updated in SAP.
- Repair ground level (interface) of 70 towers, spot painting (140 legs).
- Replace OPGW/OHEW hardware and fittings on 82 towers.
- Replace the OPGW downlead clamps, where corroded to G2 level or worse, on 38 towers (it is expected that a total 50 clamps will need to be replaced for each tower).
- Repair or replace all damaged or defective anti-climb barriers on towers being refit (10% or 10 structures).
- Access track work to improve access to facilitate maintenance and project work.
- Update SAP, drawings and corporate data systems in accordance with the Asset Information Requirements Standard.
- Perform a LAMP and condition assessment of all affected structure on completion of works and provide measuring point data for input in SAP.

Stage 2 (by 2036):

- Undertake “light refit” works on 106 towers, including replacing all climbing bolts with new style climbing attachments with loops (2% of bolts or 6360 bolts and 0.3% of member or 255 members).
- Replace suspension insulators and associated hardware including bolts on the armour grip suspension units (AGSUs) and vibration dampers on 43 towers (for both circuits).
- Measure structure footing resistances of all 106 towers being refit and additional earthing to achieve compliance to Powerlink standards (10% or 11 structures will require additional or repairs to earthing). Footing resistance results to be updated in SAP.
- Replace OPGW/OHEW hardware and fittings on 20 towers.
- Repair or replace all damaged or defective anti-climb barriers and replace damaged or missing signage on structures not being refit (10% or 11 structures).
- Access track work to improve access to facilitate maintenance and project work.
- Update SAP, drawings and corporate data systems in accordance with the Asset Information Requirements Standard.
- Perform a LAMP and condition assessment of all affected structure on completion of works and provide measuring point data for input in SAP.

4. Project Execution

4.1 Project Schedule

4.1.1 Option 1 – Single Stage Selective Refit BS1220 & BS1671 by 2031

This project will follow the two (2) stage approval process.

A high-level Project Schedule has been developed for the project stages:

Milestones	High-Level Timing
Undertake Condition Assessment	July 2026 - December 2026
Request for Class 3 Estimate	March 2027
Class 3 Project Proposal Submission	August 2027
RIT-T (assumed 9 months)	November 2027 – July 2028
Stage 2 Approval (PAN2)	October 2028
Line Refit Contract Award	March 2029
MSP Construction	April 2030 – December 2031
Line Refit Construction	May 2029 – December 2031
Project Commissioning	December 2031

4.1.2 Option 2 - Staged Selective Refit BS1220 & BS1671 by 2036

This project will follow the two (2) stage approval process.

A high-level Project Schedule has been developed for the project stages:

Milestones	High-Level Timing
Undertake Condition Assessment	June 2027 December 2027
Request for Class 3 Estimate	March 2028
Class 3 Project Proposal Submission	August 2028
RIT-T (assumed 9 months)	October 2028 – July 2029
Stage 2 Approval (PAN2)	September 2029
Line Refit Contract Award for Project Stage 1	March 2030
MSP Construction for Project Stage 1	July 2030 – October 2031
Line Refit Construction for Project Stage 1	May 2030 – December 2031
Project Commissioning for Project Stage 1	December 2031
Line Refit Contract Award for Project Stage 2	December 2034
Line Refit Construction for Project Stage 2	April 2035 – September 2036
MSP Construction for Project Stage 2	April 2036 – September 2036
Project Commissioning for Project Stage 2	September 2036

4.2 Network Impacts

The targeted outages for refit works are from late April to mid-December to avoid construction works in the wet season. The feasibility of acquiring outages is also dependent on the following:

Powerlink Net Ops – Operating Manual 04 – Northern provides the following recommendations for outages of H032 Chalumbin feeders.

An outage on feeder 857 has the following network requirements and impacts.

- Network Requirements:
    - 275kV feeder 858 in service.
    - 275kV feeder 8905 in service.
    - Manage voltages using H039 Woree SVC, H013 Ross SVC and available reactors/capacitors banks.
- Outage has system strength impact. See section 5 - System Strength for outage advice or requirements to minimise impacts to IBR generator.
- Voltage stability constraint for loss of 8905.
- Customer impact
    - Load Risk – Mt Emerald WF.

An outage on feeder 8857 has the following network requirements and impacts.

- Network Impacts
  - 275kV feeder 8858 in service.
  - 275kV feeders 879+8911 in service.
- Outage may be restricted to summer guideline restrictions as defined by AEMO Guideline for Transmission Network Outage Planning.

4.3 Project Staging

Each stage of the project scope of works can be carried out in 3 stages:

Stage	Description/Tasks
1	Climbing and aerial inspection of BS1220 and BS1671 by a Line Refit Contractor
2	Line refit works by a Line Refit Contractor, including blast and paint if required
3	Earthwire, insulator and conductor hardware replacement by MSP

4.4 Resourcing

Design for the project will be completed by internal design resources with support from external design partners if required. The construction works will be completed by a combination of the MSP and Line Refit Contractors.

5. Project Asset Classification

5.1 Option 1 - Single Stage Selective Refit BS1220 & BS1671 by 2031

Asset Class	Base ($)	Base (%)
Substation Primary Plant	-	0
Substation Secondary Systems including New Building and associated civil works	-	0
Telecommunications	-	0
Overhead Transmission Line	141,691,953	100
TOTAL	**141,691,953**	**100**

5.2 Option 2 - Staged Selective Refit BS1220 & BS1671 by 2036

Asset Class	Base ($)	Base (%)
Substation Primary Plant	-	0
Substation Secondary Systems including New Building and associated civil works	-	0
Telecommunications	-	0
Overhead Transmission Line	149,556,223	100
TOTAL	**149,556,223**	**100**

6. References

Document name and hyperlink	Version	Date
Project Scope Report	2.0	15/10/2025

Risk Cost Summary Report

CP.02750

BS1220 BS1671 Ross to Chalumbin Life Extension

Document Control

Change Record

Issue Date	Revision	Prepared by
19/01/2026	1.0	Asset Strategies

Related Documents

Issue Date	Responsible Person	Objective Document Name

Document Purpose

The purpose of this model is to quantify the base case and option risk cost profiles for the structures on the Ross to Chalumbin 275kV transmission line (BS1220, BS1671), which is proposed for a refit under CP.02750. These risk cost profiles are then included as part of an overall cost-benefit analysis (CBA) to understand the economic benefit of the proposed upgrades. This process provides a benchmarking and internal gate process to support Powerlink in effectively identifying prioritised infrastructure upgrades.

The CBA was designed to demonstrate and quantify the value to be gained through specific infrastructure investment. To evaluate the CBA, an NPV is derived based on the present values of costs and benefits. The flow chart in Figure 4 below designates the methodology used in designing the CBA process.

Key Assumptions

In calculating the risk cost arising from a failure of the ageing structures on the Ross to Chalumbin line , the following modelling assumptions have been made:

- The capability of the structures to perform their function is assumed to decay according to decay curves calculated by Powerlink, and associated probability of failure (PoF).
- The health of structures with no condition data has been imputed from the known condition of nearby structures.
- Where structures in scope are refit, post project the structure's Health Index (HI) reverts to a HI such to meet a 15-year life extension beyond the original economic life.
- For the purposes of the cost-benefit analysis, the refit will extend the service life of BS1220 and BS1671 by a further 15 years.
- A feeder-specific value of customer reliability (VCR) of $ 25,750 /MWh has been applied when calculating network risks.
- The consequence of Bushfire Risk was modelled by the FLARE Wildfire Research Group at The University of Melbourne as part of Project IGNIS.

Base Case Risk Analysis

Risk Categories

Four main categories of risk are assessed as part of this project as consistent with Powerlink's Asset Risk Management Framework:

- Financial Risk
- Safety Risk
- Network Risk (including market impact if applicable)
- Environmental / Bushfire

Risk Category	Failure Types	Equipment in scope
Safety Risk	Structural / Mechanical/ failure	All equipment
	Electrical Failure	All equipment with the potential to fail electrically
Financial Risk	Structural / Mechanical failure	All equipment
	Electrical Failure	All equipment with the potential to fail electrically
Network Risk	Structural / Mechanical failure	All equipment
	Electrical Failure	All equipment with the potential to fail electrically
Environmental Risk	Structural / Mechanical failure	All equipment
	Electrical Failure	All equipment with the potential to fail electrically
Bushfire Risk	Structural / Mechanical failure	All equipment
	Electrical Failure	All equipment with the potential to fail electrically

Table 1: Risk Categories

Base Case Risk Cost

The modelled and extrapolated total base case risk costs are shown in Figures 1 and 2 below.

Risk costs associated with the equipment in scope are expected to increase from $1.21 million in 2026 to $32.06 million by the end of the 2027-32 regulatory period. Key highlights of the analysis include.

Key highlights of the analysis include:

- The financial risk associated with the failure assets is predominantly driving the risk on this built section. This is due to the number of assets at an advanced stages of corrosion on these built sections. Financial consequences include emergency restoration costs associated with the failure of structures, insulators or associated hardware in addition to 3rd party damage in special locations such as utility crossings .

- Although the condition is poor, network risks are only moderate as loss of load is contingent on complete loss of BS1220/BS1671 and another feeder.

- Bushfire risk has been calculated and is immaterial to the overall base case risk.

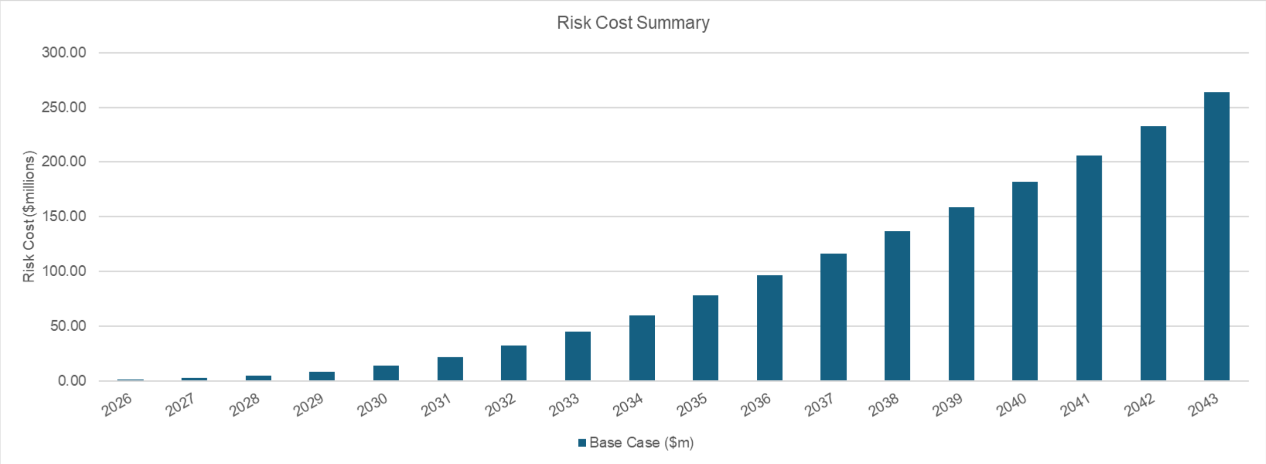


Figure 1: Total Risk Cost

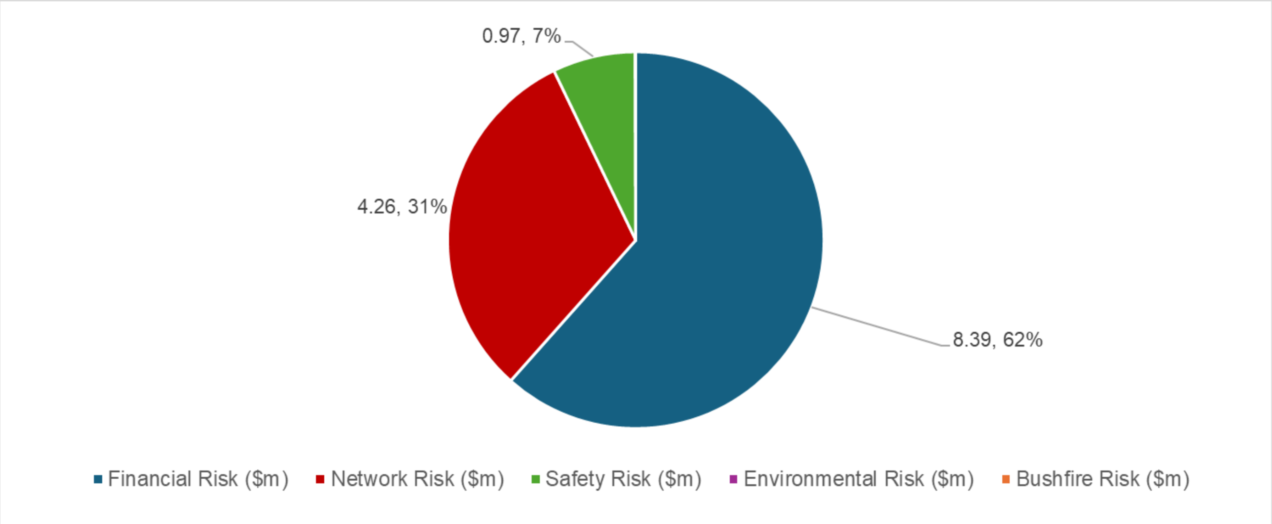


Figure 2: Base Case Risk Cost Contributions (2030)

Option Risk Cost

Refitting structures on the BS1220/BS1671 Ross to Chalumbin transmission line reduces effective HI scores to 4.2–5.3, depending on the corrosion region, which lowers both failure probability and risk cost. For the transmission line refit activities, a life extension of 15 years has been considered in the model.

The figures below set out the total project case risk cost, and associated risk cost savings incremental to the base case.

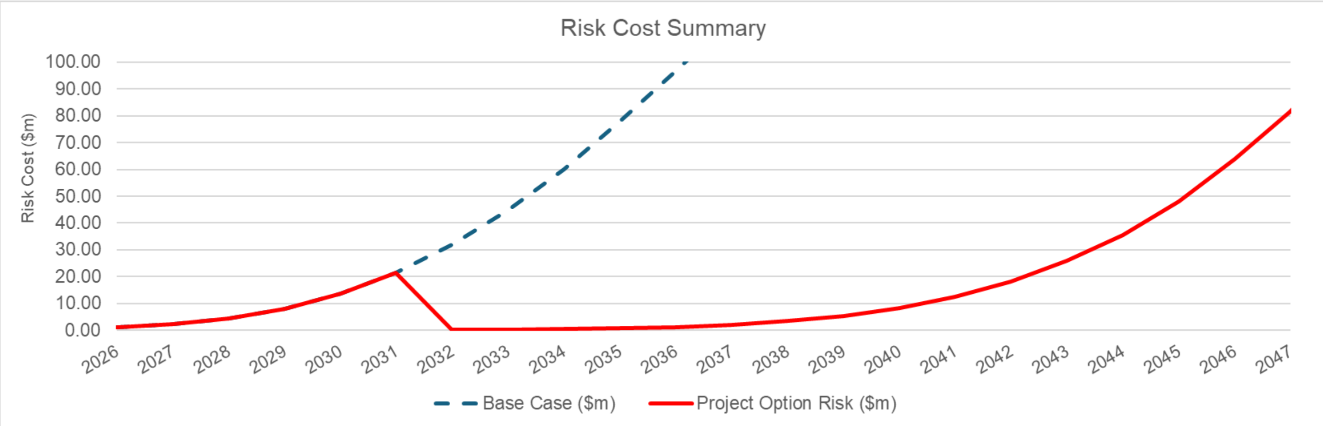


Figure 3: Project Option Risk Cost – Stage 1

Following the year of investment (2031) the risk cost associated with the equipment in scope effectively reduces to $0.14m. By 2047, the annualised risk cost of the project option is approximately $ 81.63 million, compared with the annualised base case risk cost of $408.77 million.

Further investment will be required to maintain the risk in future regulatory periods to achieve the 15-year life extension.

Cost Benefit Analysis

The methodology designed for the cost benefit is set out as per Figure 4 below.

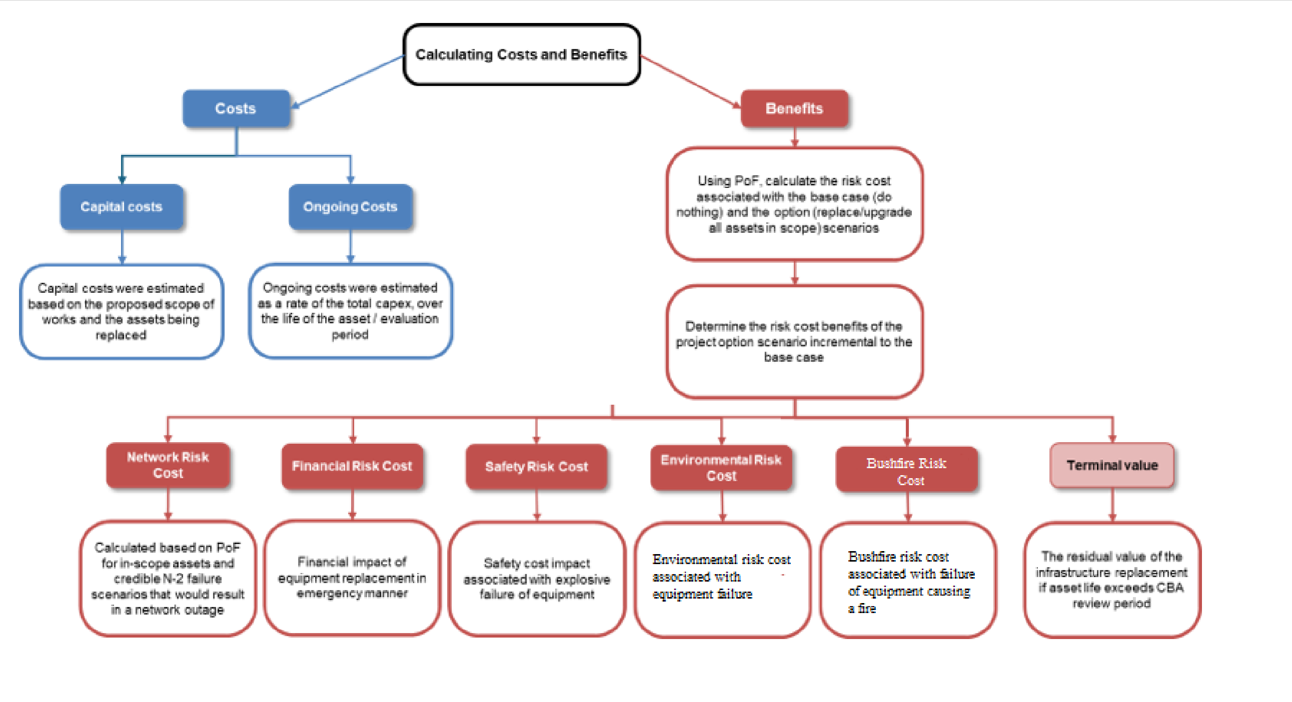


Figure 4: CBA Methodology

The project is estimated to cost approximately $112.87million. This represents a significant cost saving over the estimated financial risk cost of replacing assets individually in an emergency manner, due to the efficiencies associated with planned upgrades.

Based on a baseline discount factor of 7%, the project has a net present value (NPV) of $813.4 million over a 15-year period, and a benefit-cost ratio (BCR) >10.

The project also has a positive NPV and BCR when a discount factor of 10% is applied.

Given this, replacement of the nominated assets within this project is considered appropriate.

		Present Value Table ($m)		
Discount rate	%	**3%**	**7%**	**10%**
NPV of Net Gain/Loss	$m	$1,554.4	$813.4	$512.7
Benefit-Cost Ratio	ratio	17.44	11.81	9.05

Table 2: Net Present Value and Optimal Year of Investment

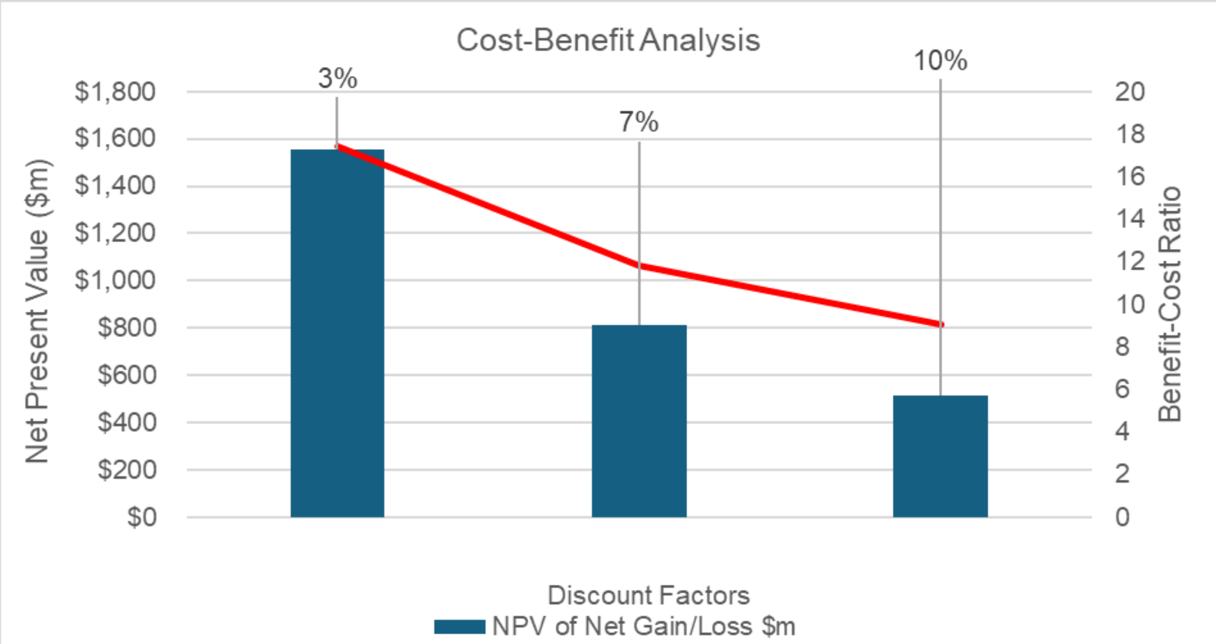


Figure 5: Cost Benefit Summary

Participation Factors

A sensitivity analysis was undertaken to determine the participation factors for key inputs to the risk cost models (i.e. to identify which inputs are most sensitive to overall risk cost).

The participation factor is defined as the ratio of percentage change in output (i.e. risk cost) to a percentage change in input (e.g. VCR). The participation factors for key model inputs are shown in the table below.

Due to the non-linear nature of the risk cost model, the participation factor can change depending on the magnitude of input percentage change.

The model is most sensitive to:

- **changes in the Value of Customer Reliability (VCR) or Restoration time** in the event of a network outage (halving the return to service time) represents decrease in risk cost of approximately $1.46 million, or approximately 10.7% of the original base case risk.

- **changes in the baseline Financial Cost of 3rd Party Damage cost of consequence** in the event of a tower collapse. Halving the cost of consequence results in a decrease in risk cost of $1.34 – $1.96 million, or approximately 9.8 – 14.4% of the original base risk.

Input	Baseline value	Sensitivity value (-50%)	Change in risk cost at 2030 ($m)	Participation (%)
Safety				
Tower Collapse				
Local Road - Likelihood of Safety Incident	2.000%	1.000%	-$0.01	-0.10%
Population None - Likelihood of Safety Incident	0.500%	0.250%	-$0.18	-1.35%
Population 0 -500 - Likelihood of Safety Incident	0.667%	0.333%	-$0.17	-1.22%
Cost consequence of multiple fatality	$11,400,000	$5,700,000	-$0.06	-0.41%
Cost consequence of single fatality	$5,700,000	$2,850,000	-$0.08	-0.61%
Cost consequence of multiple serious injury	$4,206,600	$2,103,300	-$0.12	-0.90%
Cost consequence of single serious injury	$2,103,300	$1,051,650	-$0.10	-0.75%
Financial				
Tower Collapse				
Emergency premium	20%	10%	-$0.14	-1.056%
Unit Cost (Tension)	$451,245	$225,622	-$0.29	-2.135%
Unit Cost (Suspension)	$428,683	$214,341	-$0.57	-4.202%
Local Road - Financial Cost of 3rd Party Damage	$900,000	$450,000	-$0.02	-0.126%
Population None - Financial Cost of 3rd Party Damage	$2,000,000	$1,000,000	-$1.96	-14.397%
Population 0 -500 - Financial Cost of 3rd Party Damage	$2,000,000	$1,000,000	-$1.34	-9.823%
Network				
Tower Collapse				
VCR ($/MWh)	$25,750.00	$12,875.00	-$1.46	-10.699%
Restoration Time (hours)	72	36	-$1.46	-10.748%

Table 3: Participation Factors