Asset Management Plan

Poles and Towers

January 2023

PowerWater

Version control

This document has been approved in accordance with the Delegation of Authority (DoA) as evidenced by signatures and dates contained herein.

Rev	Date	Description	Author	Endorsed	Approved
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1. Introduction

ISO 55000 defines an Asset Management Plan (AMP) as documented information that specifies the activities, resources and timescales required for an individual asset, or a grouping of assets, to achieve the organisation's asset management objectives.

1.1 Purpose and context

The purpose of this Asset Management Plan (AMP) is aligned to the requirements specified in ISO 55000. This AMP:

- Defines what is included and excluded from its scope
- Describes the asset class being managed
- Defines how this asset class will contribute to achieving the Asset Management Objectives that are defined in the Strategic Asset Management Plan (SAMP)
- Identifies the challenges we are expecting to encounter over the AMP planning horizon
- Sets out the projects and programs that we will invest in to ensure we achieve the AM Objectives and address the identified challenges
- Quantifies the risk posed by this asset class with and without the proposed projects and programs of work

By reviewing this AMP and reassessing asset performance on an annual basis, we will ensure that any emerging issues are identified and can be addressed prior to becoming a significant risk. The outcome of the annual review will support the annual update of the Statement of Corporate Intent (SCI) and provide an input into the annual Transmission and Distribution Annual Planning Report (TDAPR).

1.2 Scope of the AMP

This AMP covers the Poles and Towers asset class. The scope is limited to the regulated assets that are classified as Standard Control Services (SCS) under the Framework and Approach applicable this regulatory period. It covers capital expenditure (replacement and growth) and operational expenditure (inspection and maintenance).

The AMP excludes:

- Non-regulated assets that are managed by Power and Water but not included in the regulated SCS classification, noting that strategies, performance and emerging issues are common across non-regulated portion of the asset population.
- Pole Top assets (crossarms, insulators)

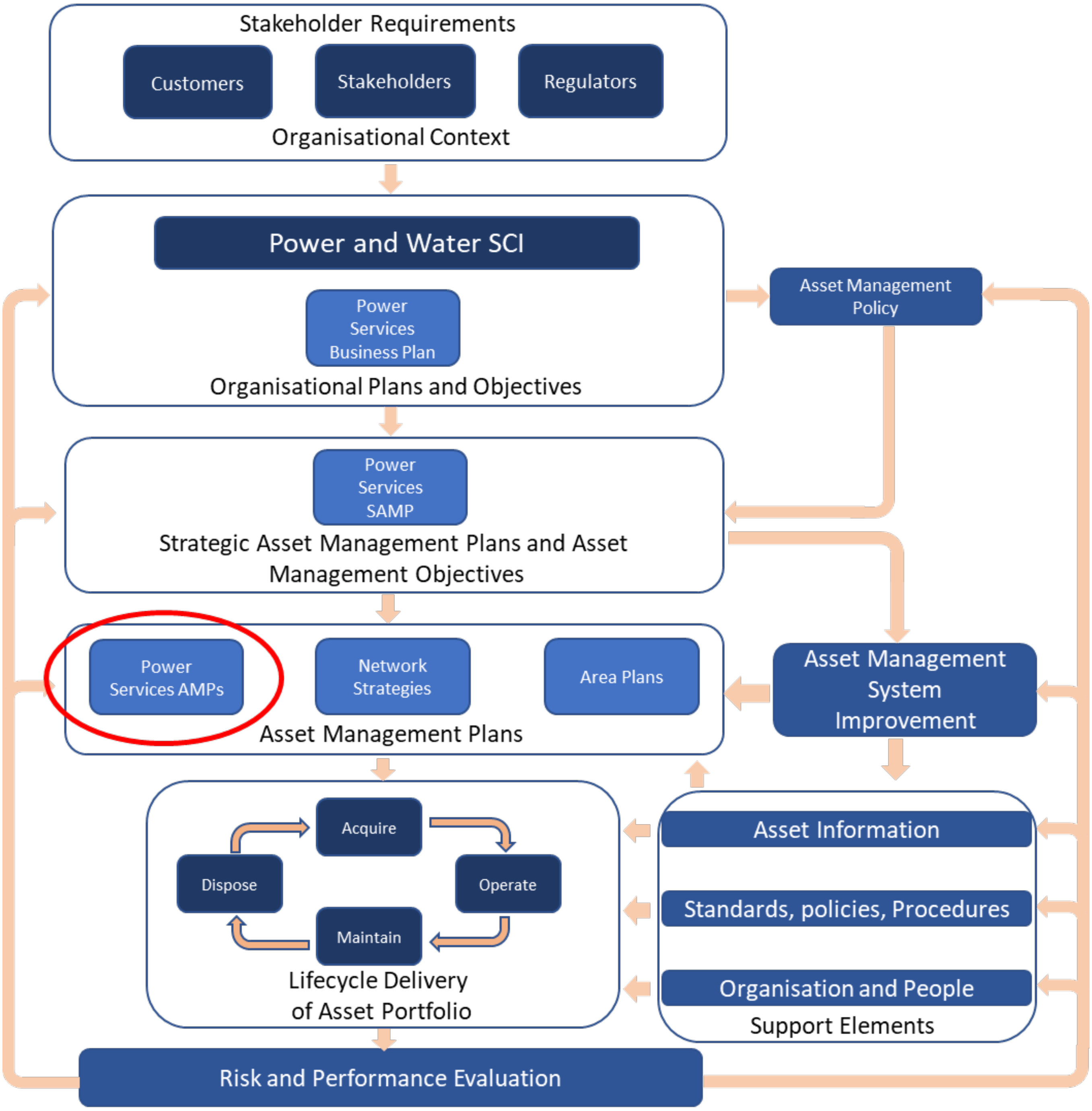
This AMP will avoid, as far as practicable, repeating information that is contained in other documentation. Instead, it will provide a reference to the relevant document or data source.

1.3 Timeframe of the AMP

This AMP is focused on a 10-year planning horizon, with respect to expenditure forecasts, that aligns with the requirements of the SCI and TDAPR. However, when assessing future challenges and emerging trends we may consider longer timeframes and will comment by exception if any longer-term issues are expected to arise.

1.4 Asset management framework

Power and Water has developed a new Strategic Asset Management System[1] which sets out the framework for asset management and the hierarchy of documents. This provides line of sight from the corporate objectives through to the asset objectives and how management of this asset class will contribute to achieving those objectives. Figure 1 highlights how the AMP fits in with the overall asset management system.



[1] CONTROL0548

Figure 1 - The AMP within the context of the Asset Management System

1.5 Document structure

This document has been structured to align with the Asset Management Standard and fits under the SAMP in the hierarchy of documentation. The document has been designed to be concise and provide the outcomes of detailed analysis with references, and not repeat the analysis in this document.

The sections of the document have the following purpose:

- **Asset profile** provides an overview of what the asset is to provide context to the reader of the asset's role in the electricity transmission and distribution network. It provides a breakdown by asset characteristics and volumes as well as the age profile which is an important input to asset management.
- **Asset objectives and performance** sets out the asset objectives and how they apply to this asset class. Any gaps or emerging trends are identified and linked to a project or program, if relevant, to address the issue and ensure the asset objectives are achieved.
- **Asset challenges and emerging issues** outlines any existing or emerging challenges that may impact the performance of the asset class or may otherwise impact the management of, or need for, the asset class.
- **Implementation plan** sets out the project and programs with expenditure per year for the 10-year planning horizon. This is a point in time assessment that is updated periodically so it may not align fully to the SCI and TDAPR if additional analysis has been completed subsequent to the AMP update.
- **Risk quantification and mitigation** describes the approach to risk-based investment decision-making and demonstrates the risk mitigated by the proposed implementation plan.
- **Asset lifecycle management** describes the asset management approach at each stage in the asset lifecycle.
- **Continuous Improvement** outlines the improvement plans related to the asset class.

2. Asset Profile

Power and Water owns and maintains a portfolio of 44,920 poles and towers distributed across the four regions of Alice Springs, Darwin, Katherine, and Tennant Creek, with the largest population in the Darwin Region.

Poles and towers support overhead conductors and equipment in the power transmission and distribution network and are one of the largest fleets in the network by volume of assets. Their main purpose is to establish safe electrical and physical clearances between electrical conductors and the ground and other structures. Poles and towers must have sufficient strength to withstand forces (e.g. short circuit, wind) and to resist other environmental factors such as bushfires and termites. As a result, the fleet is primarily comprised of steel poles with some concrete poles in Darwin.

Transmission towers form the backbone of the network. Our 132kV transmission lines provide the connection from Channel Island power station to Hudson Creek substation and separately from Channel Island power station to Katherine. These assets are typically located in separate easements. Our 66kV transmission network transfers electricity between zone substations and other smaller power stations in Darwin and Alice Springs.

Zone substations convert the electricity to 11kV and 22kV and connect to the distribution network which traverses through suburban and rural areas. In overhead areas conductors are supported by poles, and distribution transformers attached on, or adjacent to, poles convert the electricity to 400V which is supplied to our customers.

2.1 Fleet characteristics

Table 1 provides an overview of the asset class.

Region	Quantity	Average Age	Nominal Life
Transmission Towers	1,099	40	60
Transmission Poles	2,099	31	60
HV Poles	28,396	34	60
LV Poles	6,896	39	60
Service Poles	6,430	30	35
Total	**44,920**	**34**	**-**

Table 1 - Overview of in-scope assets

2.2 Age profile

The asset age profile is shown in Figure 2 for transmission assets and Figure 3 for distribution assets.

There has been a steady growth in pole installations across the regions since the mid-1950s with the development of the distribution network in the Darwin and Katherine regions followed by developments in the Alice Springs and Tennant Creek regions from the mid-1960s.

Significant installations were made in the Darwin region following cyclone Tracy in the mid-1970s and equally material installations were made in the Alice Spring region around the same time. Katherine followed with substantial installations made in the early and mid-1980s. Over the last 12 years there was strong growth across the Darwin network as a result of a boom in resource development which has slowed in recent years.

The expected life of steel poles is 60 years, and the age profile shows that we have a significant population that is approaching 50 years old. This means that in the next 10 years we would expect to start observing an increase in the need for pole replacements. Managing the potential for high volumes of pole replacement will be a key focus for research into more sophisticated end-of-life triggers for poles, including corrosion modelling and risk management.

A higher level of replacement has already been encountered in Alice Springs where saline and alkaline soils have accelerated deterioration and resulted in a reduced expected life of closer to 45 years of the below ground section of these poles. A dedicated remediation program has been established to manage the early end of life of these assets (described further in section 4.2 and section 6).

Due to the materials and type of construction used for poles, it is not economic or efficient to obtain detailed condition data for all poles and pole sections through inspection and testing. The age profile is relied upon to provide insight into the expected condition of the network and an early indication of any potential life extension or renewal investment requirements. However, some additional information can be obtained for lattice towers from visual inspection and direct sample measurement of galvanising condition which enables corrective maintenance to be delivered to extend the asset life. This is discussed further in section 4.2.

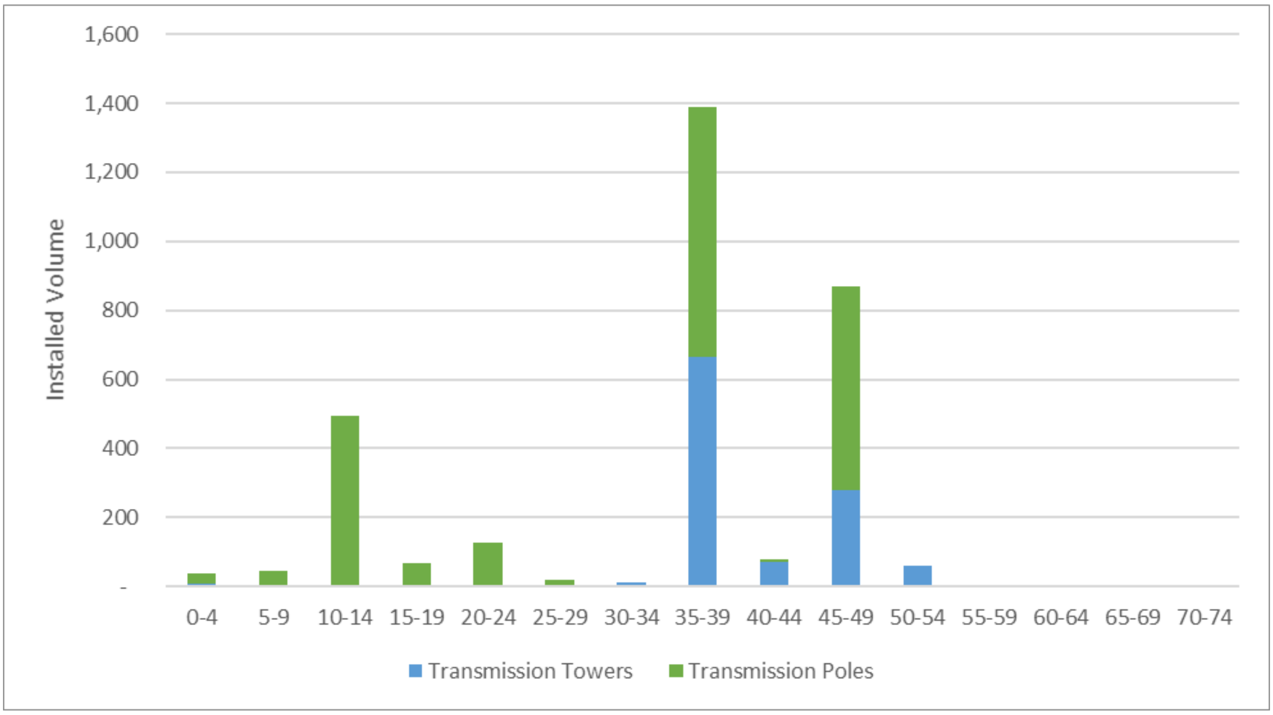


Figure 2 – Age profile for transmission poles and towers

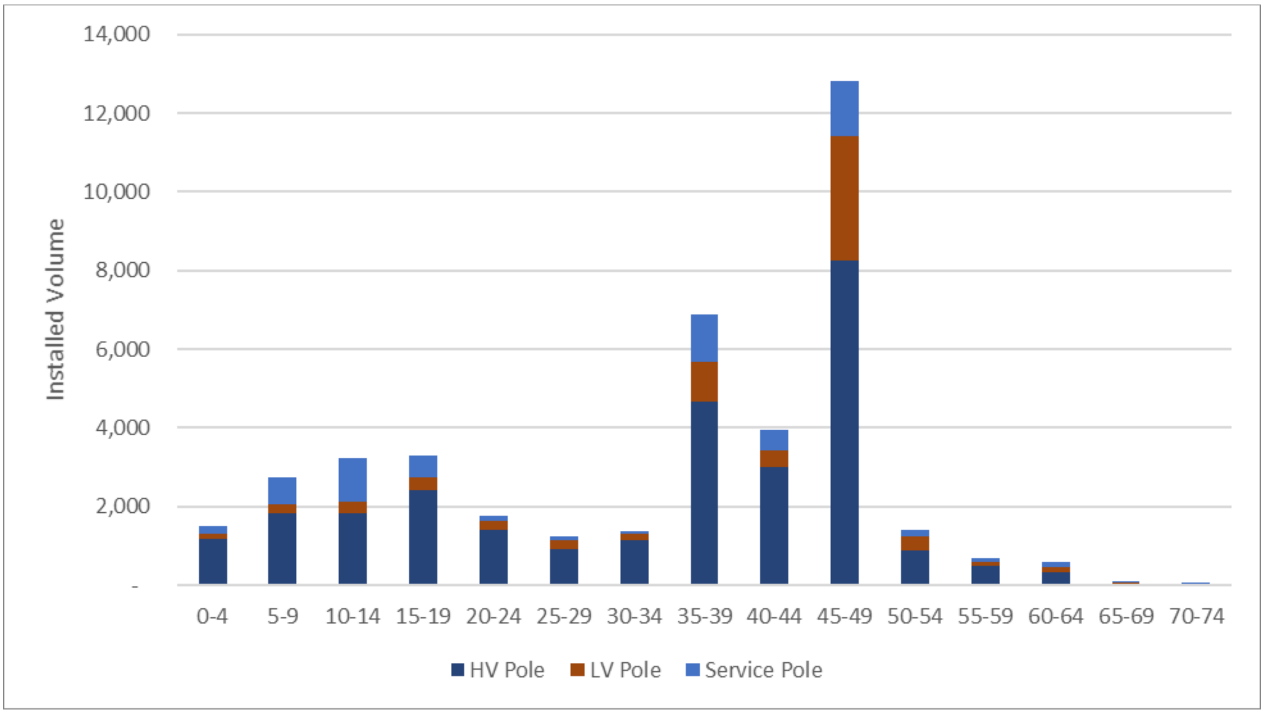


Figure 3 – Age profile for distribution poles

2.3 Criticality

Power and Water has established a Risk Quantification Procedure for Investment Decision Making to assess the overall risk posed by the asset fleet. However, when undertaking detailed scheduling and prioritisation of assets within the fleet for specific tasks, such as testing and inspection or replacement, we consider more localised characteristics of individual assets to account for relative criticality within the fleet.

The criticality assessment considers the diversity of the network including various topographies with varying degree of service conditions and risk. Failure of assets may result in public safety, service disruption (reliability) or environmental incidents. The location of an asset has a significant impact on the likelihood and severity of the consequences.

Details of the criticality assessment approach can be found in our Health and Criticality Method (D2018/72550).

3. Asset objectives and performance

The Strategic Asset Management Plan (SAMP) defines the Asset Objectives and how they support Power and Water achieving the corporate objectives. This section shows how the Asset Objectives are supported by this asset class by establishing the measures and targets to assess if the Asset Objectives are being achieved, and any gap in performance that needs to be addressed.

Table 2 states the asset management objectives from the SAMP, states if they are contributed to by this asset class, and defines the measures of success, targets, and performance gaps. This provides a 'line of sight' between the discrete asset targets and Power and Water corporate Key Result Areas.

The performance shown here represents the historical performance of the asset class to date. It is expected that benefits from investments proposed in the next regulatory period will manifest as benefits in these key objectives.

Objectives	Measures	Targets	Performance
Ensure appropriately skilled and qualified staff are employed to meet the current and future needs of the network. Embed a fit for purpose Asset Management System across the business that is consistent across Regulated, Non-Regulated and IES.	A capability development plan will include the requirements to ensure each asset class has defined capability requirements to enable effective management and performance. The development of our Capital and Operational Works Plan (COWP) will define capacity requirements across different capabilities to achieve asset management objectives.		
Maintain the safety of customers, community and staff demonstrated by reducing worker and public safety incidents and implementing public incident reporting metrics into asset plans.	Public injuries	0	0
	Worker injuries	0	0
	# Poles replaced / refurbished (NMP22)	As per program (approx. 250 pa)	443 done in FY22
Reduce by 50% the number of feeders and communities exceeding performance targets by more than 100% by 2025. Enable greater visibility of planned and unplanned interruptions to customers	SAIDI and SAIFI targets.	Target by feeder type as set by the Utilities Commission.	Targets achieved. Refer to section 3.2

through improved online services for all networks and improve accuracy and transparency of reliability performance metrics for isolated remote communities.			
Implement risk quantification for all regulated network (system) capital investment decisions by Jan 2023, and extend for remote generation and networks by 2025.	Implementation of risk quantification for decision making.	Use of Risk Quantification to assess investment needs for all aspects of the asset fleet.	Achieved.
Implement by EOFY 2023 asset criticality process to support granular prioritisation of corrective works based on public safety, reliability, security and other factors, and implement in the AMS and supporting systems by 2025	A quantitative criticality assessment criterion that can be integrated into defect management processes and supported by our ICT systems to be developed for all asset classes. Public exposure and reliability impacts of pole failure will be key inputs into this process and are able to be quantified. Pole condition is more challenging and requires further development as costs for direct testing are excessive.		
Preparing our network and systems to be ready for the future, including building in flexibility for future uncertainty, maximising hosting capacity for customer DERs and enabling the energy transition to reviewable energy according to the governments targets.	Development of specific capability requirements for various asset classes is a key focus of our Future Networks Strategy to support increased utilisation of DER while maintaining safety and reliability performance.		

Table 2 - Asset Management Objectives

3.1 Reliability performance

The Utilities Commission requires Power and Water to report performance targets for SAIDI and SAIFI by feeder category and network region. However, targets are only set by feeder category.

From a whole of system perspective, Power and Water has continued to improve its performance, although there has been mixed performance in each feeder category and region. These trends are discussed in the SAMP and are the subject of the network reliability performance improvement strategy.

Figure 4 shows the historical and forecast performance of the Poles and Towers asset class. The contribution of SAIDI from year to year is very volatile due to the poles being constructed from steel and being highly reliable assets. However, when there is an incident, the outage can impact a large number of customers and hence result in a high contribution to SAIDI performance.

Since 2012 there have been 43 incidents involving poles that have resulted in an outage. Of these, 33 events were caused by vehicles crashing into poles, 8 were due to weather and other incidents and 2 were due to pole failures. The two pole failures were in Alice Springs and caused by corrosion below ground. During severe storms, below-ground pole failures associated with trees fallen into lines have also extended repair times and reliability impacts. Refer to section 4.2 and 4.4 for further discussion on our response to vehicle impacts and accelerated pole corrosion, respectively.

By implementing targeted programs of work, we aim to address the underlying causes of these incidents and ensure our performance remains within our targets. We will also continue to manage the poor performing feeders so that any individual customer, or group of customers, does not consistently receive poor service.

We have not disaggregated the feeder category performance targets by asset class, instead we have assessed the performance of each asset class to identify if there is any trend that needs to be analysed further to determine if a specific program of works is required to maintain the service levels to ensure, on aggregate, to ensure we achieve our targets.

Analysis of the performance through linear regression identified a decreasing trend, however there is a low R2 value which indicates a poor fit to the data set. Instead, we forecast the poles performance based on a rolling average.

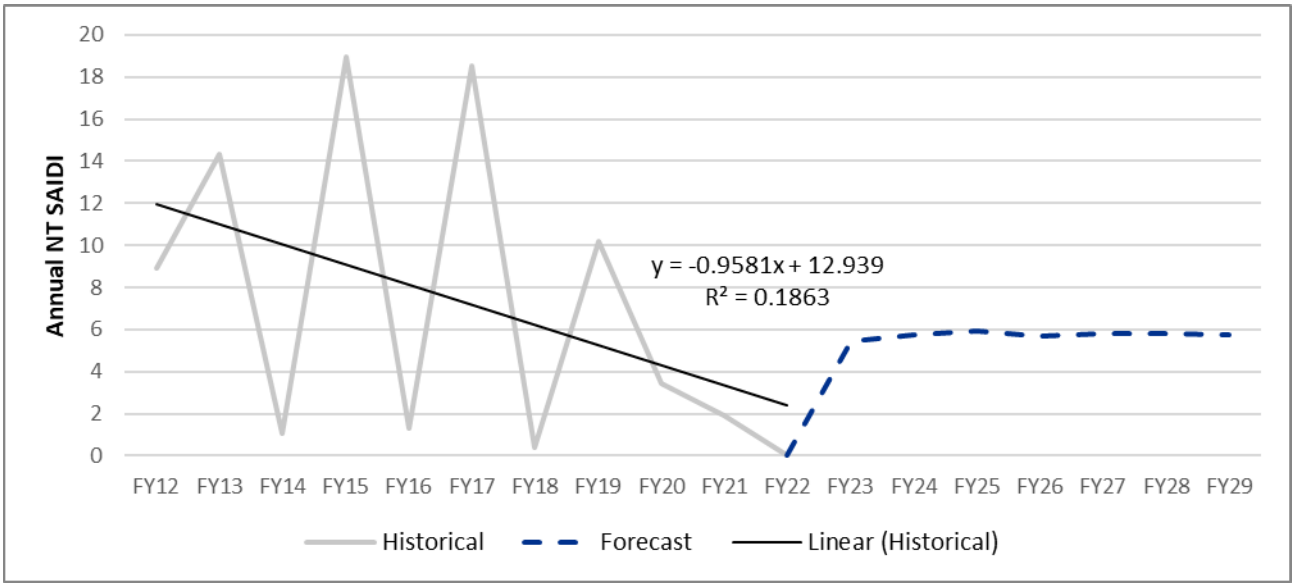


Figure 4 - SAIDI performance of the Poles and Towers asset class

3.2 Asset safety

As noted above, there were 43 incidents that involved poles that resulted in an outage and 33 of these were the result of a vehicle impacting a pole. This is an average of three vehicle incidents per year. In addition to this, there were many more incidents that did not result in an outage but still represented a safety risk.

Notably, there was recently an incident where a car crashed into a dual-circuit transmission tower that supplies the Darwin CBD. This event, supported by the historical volume of vehicles impacting distribution poles, identified a risk that had been previously assessed as non-credible. We have proposed a new program to implement protection against vehicles for transmission towers identified to be in high-risk locations.

Asset failures in Alice Springs have led to the poles falling over, which has a secondary impact of bringing live conductors to within touching distance of the public. This is a significant safety risk. We have established the Alice Springs corroded poles program to address this issue.

There have also been incidents where members of the public have received an electric shock – either by contacting our assets or within their residences as a result of a failure of our assets. The majority of these incidents have been caused by neutral connector failures. This issue is being addressed by our service inspection and replacement programs, as well as an investigation into our earthing and bonding design and testing regime to improve mitigation of hazards when failures occur.

Pole climbing is also presenting an increasing risk to public safety. While the majority of incidents have been in the non-regulated network, there have still been a significant number of reports in the regulated network. As a result, we are reviewing our pole anti-climb designs as discussed in section 4.5.

The reported safety incidents and/or asset failures creating a hazard for the past 10 years are documented in Table 3.

Category	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	Total
Shock	1	1	1	1	-	-	2	-	-	1	**7**
Vehicle/ impact damages	14	68	68	61	72	61	63	61	50	41	**559**
Unassisted pole failures	1	0	1	2	0	0	0	0	0	0	**4**
Climb	0	0	1	1	1	1	1	0	0	0	**5**

Table 3 - Safety incidents in the last 10 years

4. Asset challenges and emerging issues

Power and Water has undertaken a review of the asset class including asset age and condition, condition deterioration drivers, economic drivers, assessed trend in the asset population and trends in the operating environment. We have identified the challenges described below that are expected to impact this asset class during the 10-year planning horizon.

4.1 Asset replacement wall

As shown in the age profile a significant portion of our poles and towers were installed between 1975 and 1985. With an expected life of 60 years, we expect an increasing volume of these assets to require replacement during the next 10 years. This is supported by Table 4 and Table 5 which demonstrate that across the network the volume of poles exceeding their expected functional life will more than triple from 1.6% to 5.6%. In 2035, just beyond the capital planning horizon, all the poles installed following Cyclone Tracy will reach their expected functional life.

Further, the impact of saline and alkaline soil on accelerating corrosion and reducing the functional life of poles is likely to increase the volume of poles requiring remediation. The impact of accelerated corrosion is considered in the next section.

Asset	Darwin	Katherine	Alice Springs	Tennant Creek	Total
Transmission 132kV	-	-	-	-	**-**
Sub transmission 66kV	0.2%	-	-	-	**0.2%**
HV distribution (11kV and 22kV)	1.3%	1.0%	0.3%	4.4%	**1.3%**
LV distribution (400V)	2.6%	4.3%	0.4%	1.6%	**2.5%**
Total	**1.5%**	**2.0%**	**0.3%**	**3.6%**	**1.6%**

Table 4 - Percentage of assets exceeding their expected 60-year life in 2022

Asset	Darwin	Katherine	Alice Springs	Tennant Creek	Total
Transmission 132kV	-	-	-	-	-
Sub transmission 66kV	0.2%	-	-	-	0.2%
HV distribution (11kV and 22kV)	1.5%	2.5%	13.0%	30.8%	5.6%
LV distribution (400V)	2.8%	6.2%	14.1%	28.2%	7.0%
Total	**1.7%**	**3.6%**	**13.0%**	**30.1%**	**5.6%**

Table 5 - Percentage of assets exceeding their expected 60-year life in 2032

4.2 Pole corrosion and pole condition

Pole failures in 2016 and the subsequent investigation identified that there was an issue with saline and alkaline soil causing accelerated corrosion of the below ground sections of poles. This was exacerbated by the installation techniques that were used where the footing was not fully encased in concrete. A program (NMP22) has been established to manage the issue in Alice Springs and more information can be obtained from the business case.

The corroded poles issue is currently only confirmed to exist in Alice Springs; however, we suspect that this may be a more widespread issue that has not yet been confirmed. Evidence to support this being more widespread across all three networks includes:

- Poles are known to be installed in flood plains across the network. This provides similar conditions to the high-risk areas identified through GIS analysis is Alice Springs
- Anecdotal evidence of pole failures that indicate corroded footings of the replaced poles
- Similar construction techniques were applied across the network, so older pole footings in other areas are unlikely to be fully encased in concrete

We plan to undertake further investigations into this issue through GIS analysis of our network to identify likely high-risk areas and then undertake the ‘pot holing’ inspection technique to sample a number of poles and develop our understanding of the risk. There is a significant population of poles on our network that are a similar age to the poles experiencing accelerated corrosion in Alice Springs. If the high corrosion conditions exist in other parts of the network, then there is an elevated level of risk. This is likely to be in small, localised areas, requiring broad sampling to identify.

We will also continue with our routine testing of pole section loss at the ground-air interface. This testing is performed on the wider asset fleet to ensure that the structural integrity of poles is maintained above minimum specified levels.

4.3 Deteriorated earthing increasing safety risk

We have identified that the earthing on a number of transmission lines are not performing adequately due to physical damage and corrosion of earthing conductors. Earthing requires connecting of the metallic surfaces and structural components to exposed metal (normally copper) that is buried in the ground as a mesh surrounding the asset and rods inserted several meters into the ground. Earthing is a specialist discipline, and each site requires measurement of the soil conductivity and modelling to ensure the step and touch potentials are within allowable limits.

If the integrity and connectivity of the earthing is deteriorated, it will impact our network through:

- Increased step and touch potentials when there is a fault putting the safety of our field crews and the public at risk
- Reduced reliability due to increased outages caused by ineffective fault current dissipation along the line and back-flash causing premature failure of insulators.

We have a program (NMP11) to address earthing issues with our transmission towers during the current regulatory period. We expect that this program will address the known issues, however, we will need to continue monitoring the earthing integrity as the assets age and there is potential for increased corrosion of the exposed below ground metal components due to salinity and alkalinity of the soil.

4.4 Vehicle impact risk

A significant cause of pole related outages is caused by vehicles crashing into the poles. The number of vehicle impact events that have caused outages, as recorded over the last 10 years, is shown in Figure 5. This has resulted in an average of three incidents per year.

Most recently, a vehicle crashed into a transmission tower that was the main supply to the Darwin CBD. This had the potential to cause a major outage in Darwin. The tower withstood the impact but was severely damaged, putting it at risk of failure from high winds or low intensity cyclones. It highlighted the significant risk posed to the transmission towers that are located along high speed roads such as Tiger Brennan Drive.

To manage this risk, we have proposed a program of works (NMP28) to improve vehicle protection on specific, high risk transmission towers along Tiger Brennan Drive.

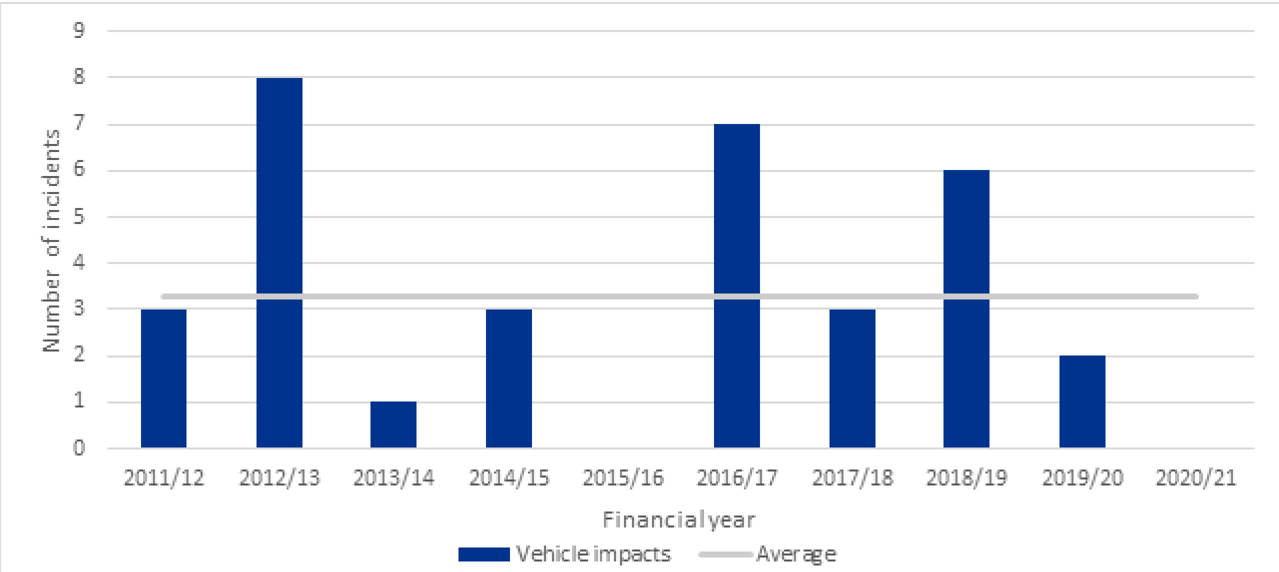


Figure 5 - Historical vehicle impacts on poles that caused an outage

4.5 Safety of pole design

Our distribution poles are designed with safety as a key consideration as they are in public areas. The poles include anti-climb measures designed to prevent unauthorised access to the pole tops. However, there have been several instances where members of the public have bypassed the anti-climb, and this has resulted in injuries and deaths. This has primarily occurred in remote areas, however, there have also been incidents on the regulated network.

We are currently assessing our existing anti-climb designs and investigating how they can be improved.

4.6 Compliance

There are spans of conductor in the HV and LV network that do not comply with minimum clearance requirements. These are typically identified through visual inspection or by reports from customers. The affected spans are assessed on a risk basis to determine whether the cost of replacement is justified by the risk presented. Generally, such clearance breaches are not addressed if the breaches are low risk – i.e. they are infrequently accessed locations, and not crossing roads or driveways.

4.7 SY-HD 66kV line conductor clearance

The 66 kV Transmission Line from Strangways to Humpty Doo is around 22 km long and was constructed in late 1970s. It is a radial transmission line feeding Humpty Doo Zone Substation and extends 44 km further to Marrakai and Mary River Zone substations. The conductor used between Strangways and Humpty Doo is GREYLING (26.65/4.247 ACSR 6/1 Compacted). The line is thermally rated to carry maximum load of 15 MVA but line to ground clearances is not sufficient to operate at this rating.

The current peak demand load on this transmission line is close to 7 MVA but is forecast to increase steadily through to 2026, further reducing line to ground clearances. At 7MVA the line has 35 spans that do not meet current standard clearance requirements. This transmission line has very low clearance on 48 spans identified based on LiDAR survey conducted in 2017. Most of the transmission poles are I-beam or welded poles (a very old standard), with some bolted poles. The old I-beam and welded poles are typically 12-14 meters high with suspension arrangement and an average span of around 200 meters that has resulted in low clearance issues at some locations.

The forecast load increases on this line will directly increase the operational risk. A replacement program has been established, with an optimised approach to target highest risk spans and utilise existing alignments where possible.

5. Implementation plan

The following set of projects and programs have been developed to address the gaps in the asset fleet performance compared to the asset objectives and our long-term view to start planning for forthcoming asset challenges.

5.1 Replacement expenditure

Replacement expenditure is defined as the non-demand driven capex to replace an asset with its modern equivalent where the asset has reached the end of its economic life. Capex has a primary driver of replacement expenditure if the factor determining the expenditure is the existing asset's inability to efficiently maintain its service performance requirement.

The identified projects and programs are listed below. The indicative cost (real FY22) of the project or program for the 10-year horizon is provided and includes the entire project, not only the poles and towers component:

- All regions condition and failure-based replacement program ($55.6 million)
- Alice Springs - replacement of corroded poles ($19.5 million)
- Cockatoo conductor replacement program ($7.9 million)
- SY-MR 66kV line replacement ($5.3 million)
- Transmission tower earthing system refurbishment program ($1.3 million)

5.2 Augmentation expenditure

Augmentation expenditure is defined as work to enlarge the system or to increase its capacity to transmit or distribute electricity. It also includes work relating to improving the quality of the network, for example, to meet regulatory obligations.

The identified projects and programs are listed below. The indicative cost (real FY22) of the project or program for the 10-year horizon is provided and includes the entire project, not only the poles and towers component:

- Transmission line uprating ($7.1 million)
- Transmission tower physical protection - Tiger Brennan Drive ($2 million)
- Power quality compliance program ($6.8 million)
- Low clearance or easement compliance ($3.5 million)

5.3 Operational expenditure

The forecast annual expenditure on maintenance activities is outlined in Table 6 below.

Maintenance Type	All Assets	Poles and Towers
Routine Maintenance	$7.0	$0.3
Non-Routine Maintenance	$7.7	$0.7
Emergency Response	$7.6	$0.5
Total	**$22.3**	**$1.5**

Table 6 - Forecast annual maintenance expenditure ($ Million FY22)

5.4 Delivery plan

There have been a number of challenges during the current regulatory period that have resulted in under-delivery of capital plans. We have undertaken a detailed analysis of our internal processes and activities to identify the causes and compiled a detailed plan to address this issue. The analysis and resulting plan to enable delivery of the proposed program of works is described in our Capital Delivery Plan.

6. Risk quantification and mitigation

Power and Water has established a Risk Quantification Procedure for Investment Decision Making to assess the overall risk posed by the asset fleet. Our procedure considers the asset's condition and failure modes, the likely risks of failure on safety, security and reliability of services to customers, and the relative maintenance and capital costs. In some cases, our decision making will be influenced by demand growth or customer upgrade requirements. Essentially, our decision making is based on an economic assessment of risks, costs, and benefits.

Figure 6 below shows our forecast of risk on the network that is contributed by the poles and towers asset fleet. The unmitigated risk shows increasing risk cost if no actions are taken to address known issues. The risk in the unmitigated case decreases until 2024 due to programs that are currently underway and have been incorporated in the risk forecast. The mitigated risk shows the decreasing risk cost incurred if the suite of proposed programs is implemented. The current risk level provides a reference to the current level of risk.

The Alice Springs corroded poles are the key drivers of increasing risk in the unmitigated case. By addressing the known defects, we are able to reduce network risk for this asset class. Our risk based economic analysis demonstrates that implementing the Alice Springs corroded poles replacement program and reducing the contribution of risk cost is efficient and has a net benefit to our customers.

We note that while poles are replaced as part of other programs, such as the Cockatoo Conductor replacement program, the risk benefit attributed to pole has not been isolated and all the risk benefit of those programs has been allocated to the main asset class for the program.

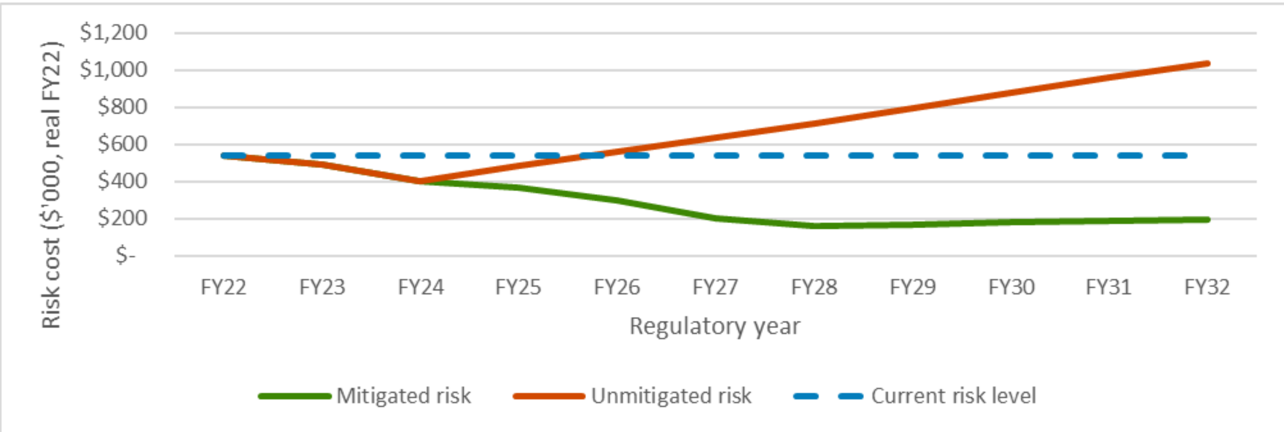


Figure 6 - Forecast total unmitigated and mitigated risk compared to the current risk level

7. Lifecycle asset management

Power and Water's asset management approach considers the entire asset lifecycle. This approach supports prudent asset management decision making to effectively balance risk, cost and performance over the life of the asset. The intended outcomes of a lifecycle approach are to:

- Maximise asset utilisation
- Minimise asset lifecycle costs
- Keep asset risk as low as reasonably practical
- Review and continuously improve asset management practices

The following sections detail Power and Water's lifecycle management activities

7.1 Planning

Asset planning identifies the need for an asset, outlines its functional requirements, and identifies the lowest cost solution that maintains risk within tolerable levels. Key planning inputs include asset condition, performance, criticality, and forecast demand.

For poles and tower assets, key planning considerations include route selection and environmental and cultural heritage constraints.

7.2 Design

The design phase involves the detailed specification of the asset function and physical characteristics.

Power and Water develops and maintains standard designs and technical specifications for most distribution assets, including distribution poles, and all new distribution pole assets installed in the Power and Water network must comply. Standardisation has many benefits, including staff familiarity, asset and component interchangeability, increased production and productivity, and standardisation of construction equipment and processes. This is especially the case for assets with a high volume of installation and replacement.

Transmission assets have a relatively low volume and new assets are installed infrequently. As a result, Power and Water does not have standard designs for transmission assets. When required, we design based on the latest industry standards and develop detailed designs to optimise transmission performance and reliability based on the specific operating environment and alignment to maximise asset life and efficiency of construction.

7.3 Maintenance

Asset maintenance involves the upkeep of assets to ensure they will function to their required capability in a safe and reliable manner from their commissioning through to their disposal. Maintenance requirements can evolve as the condition and performance requirements of the assets change throughout its life.

Maintenance activities can be classified into three distinct areas:

- **Preventative maintenance** involves the activities carried out to reduce the probability of failure or degradation of asset performance. It includes routine inspection and monitoring, upkeep and repair, testing and component replacements. Preventative maintenance requirements are documented in our

Asset Strategies Procedure. For distribution poles this involves routine visual inspection as well as relative loss section testing at the air / ground interface.
Transmission poles and towers undergo a similar visual inspection, and a subset of lattice towers are climbed to enable closer inspection to detect any emerging issues. Transmission lines are also subject to an annual aerial patrol in which a helicopter is used to rapidly assess all transmission line assets following the storm season.
- **Corrective maintenance** involves planned activities to repair defects or restore asset condition. Defects are typically identified during preventative maintenance and are prioritised for rectification based on the risk they pose to the network.
- **Unplanned maintenance** involves activities to immediately restore supply or make a site safe in response to asset functional failure.

7.4 Renewal

Asset renewal is the establishment of a new asset in response to an existing asset's condition, or the extension of life of an existing asset. The need for asset renewal is typically identified during maintenance and is verified in the asset planning stage. Asset renewal aims to optimise the utilisation of an asset whilst managing the safety and reliability risk associated with the failure of the asset.

Where it is practical to do so, Power and Water has targeted asset replacement programs which aim to proactively replace assets when the risk of asset failure is higher than the cost of the replacement. In some cases, proactive replacement is not justified, and the asset is replaced upon failure.

Section 5 outlines the implementation plans relevant to poles and towers.

7.5 Disposal

Assets are assessed for potential reuse prior to disposal. Where it is economical to do so, assets may be retained as essential spares or components of the asset salvaged for spare parts. This is particularly the case for legacy assets since like-for-like replacements may not be available. Assets with remaining value are offered for sale prior to disposal.

Power and Water ensures that all assets identified for disposal are disposed of in an environmentally responsible manner.

8. Continuous improvement

Table 7 below outlines the improvement plans related to the asset class.

Improvement Area	Today	Tomorrow / In Development	Future
Condition monitoring	RLS testing of air/surface interface. Thickness testing corrosion protection on transmission towers.	Sampling of below ground conditions in wider network to identify localised corrosion risks.	Clear understanding of below ground condition of pole fleet. Corrosion forecasts to estimate remaining life
Asset inspection	Visual inspection of pole and tower assets using check sheets	Develop asset inspection manuals and training materials and competencies.	Risk based optimisation of inspection frequency and condition
Defect prioritisation	Prioritisation using high level risk assessment and staff experience	Systemisation of asset criticality and improved failure codes	Risk based defect prioritisation supported by asset systems
Earthing and bonding	Visual inspection of service wire connections	Review testing and condition assessment requirements for neutral bonds	Implemented neutral bonding maintenance strategy
Cyclone resilience	Targeted improvements for critical lines and towers with known issues	Transmission tower design review and develop risk-based resilience improvement plan	Staged implementation of improvement plan

Table 7 - Asset improvement plan

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