TasNetworks
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Asset Management Plan

Overhead Line Structures - Distribution

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Review cycle	2.5 Years	

Responsibilities

This document is the responsibility of the Asset Strategy Team, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Asset Strategy Team Leader with any queries or suggestions.

- Implementation	All TasNetworks staff and contractors.
- Compliance	All group managers.

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Record of revisions

Section number	Details
	New Document
3	Revised to include Bushfire Mitigation Overlay
All	Full review

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1 Purpose

The purpose of this document is to describe for Distribution Structures and related assets:

- TasNetworks' approach to asset management, as reflected through its legislative and regulatory obligations and strategic plans;
- The key projects and programs underpinning its activities; and
- Forecast CAPEX and OPEX volumes, including the basis upon which these forecasts are derived.

2 Scope

This document covers distribution support structures, including poles and pole accessories.

3 Strategic Alignment and Objectives

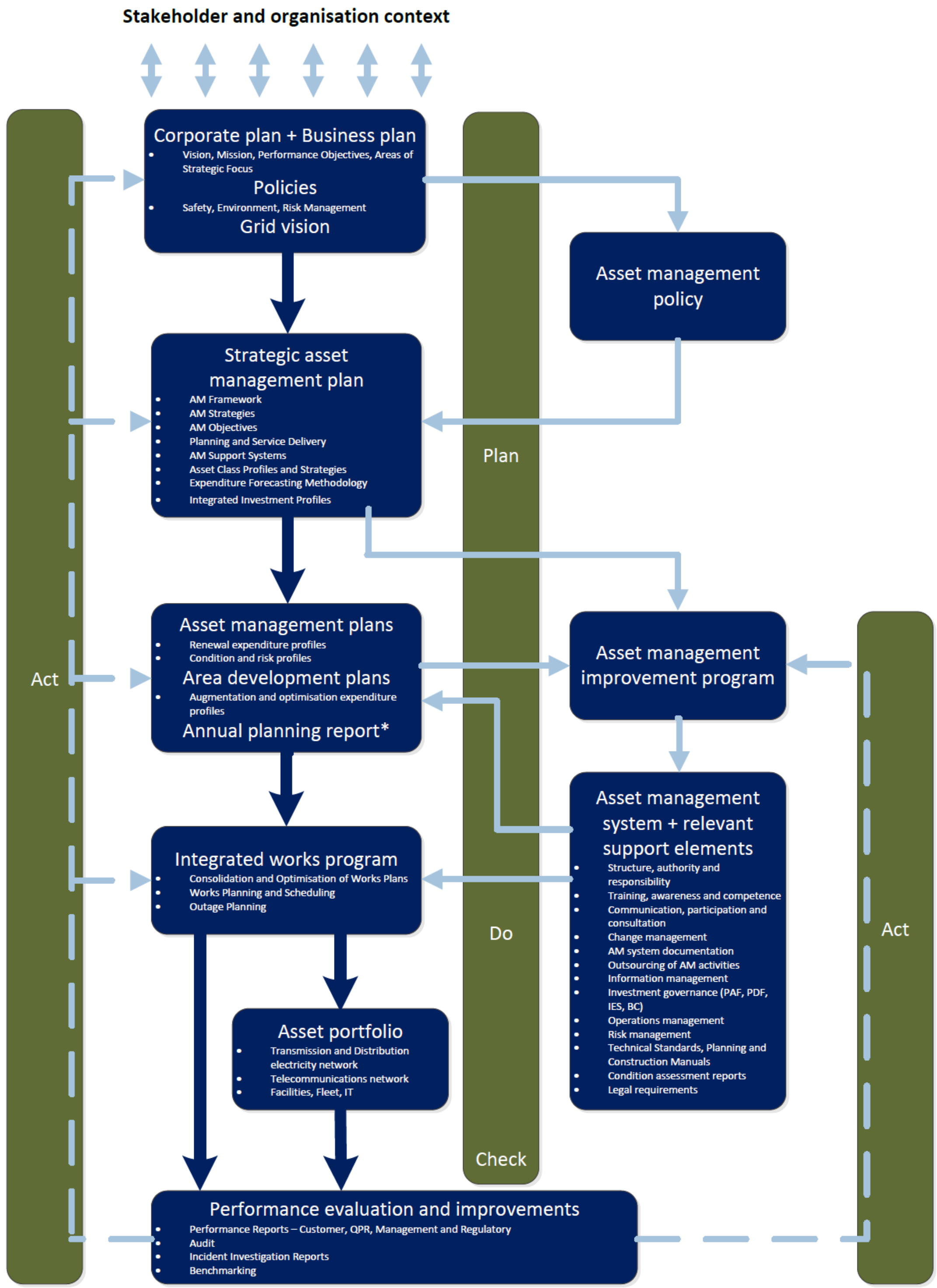
This asset management plan has been developed to align with both TasNetworks' Asset Management Policy and strategic objectives. This management plan describes the asset management strategies and programs developed to manage the distribution overhead switchgear assets, with the aim of achieving these objectives.

For these assets the management strategy focuses on the following objectives:

- Safety will continue to be our top priority and we will continue to ensure that our safety performance continues to improve
- Service performance will be maintained at current overall network service levels, whilst service to poorly performing reliability communities will be improved to meet regulatory requirements
- Cost performance will be improved through prioritisation and efficiency improvements that enable us provide predictable and lowest sustainable pricing to our customers
- Customer engagement will be improved to ensure that we understand customer needs, and incorporate these into our decision making to maximise value to them
- Our program of work will be developed and delivered on time and within budget

The asset management policy and strategic objectives are outlined within the Strategic Asset Management Plan. Figure 1, from the Strategic Asset Management Plan, represents TasNetworks documents that support the asset management framework. The diagram highlights the existence of, and interdependence between, the Plan, Do, Check, Act components of good asset management practice.

Figure 1: TasNetworks Asset Management Documentation Framework

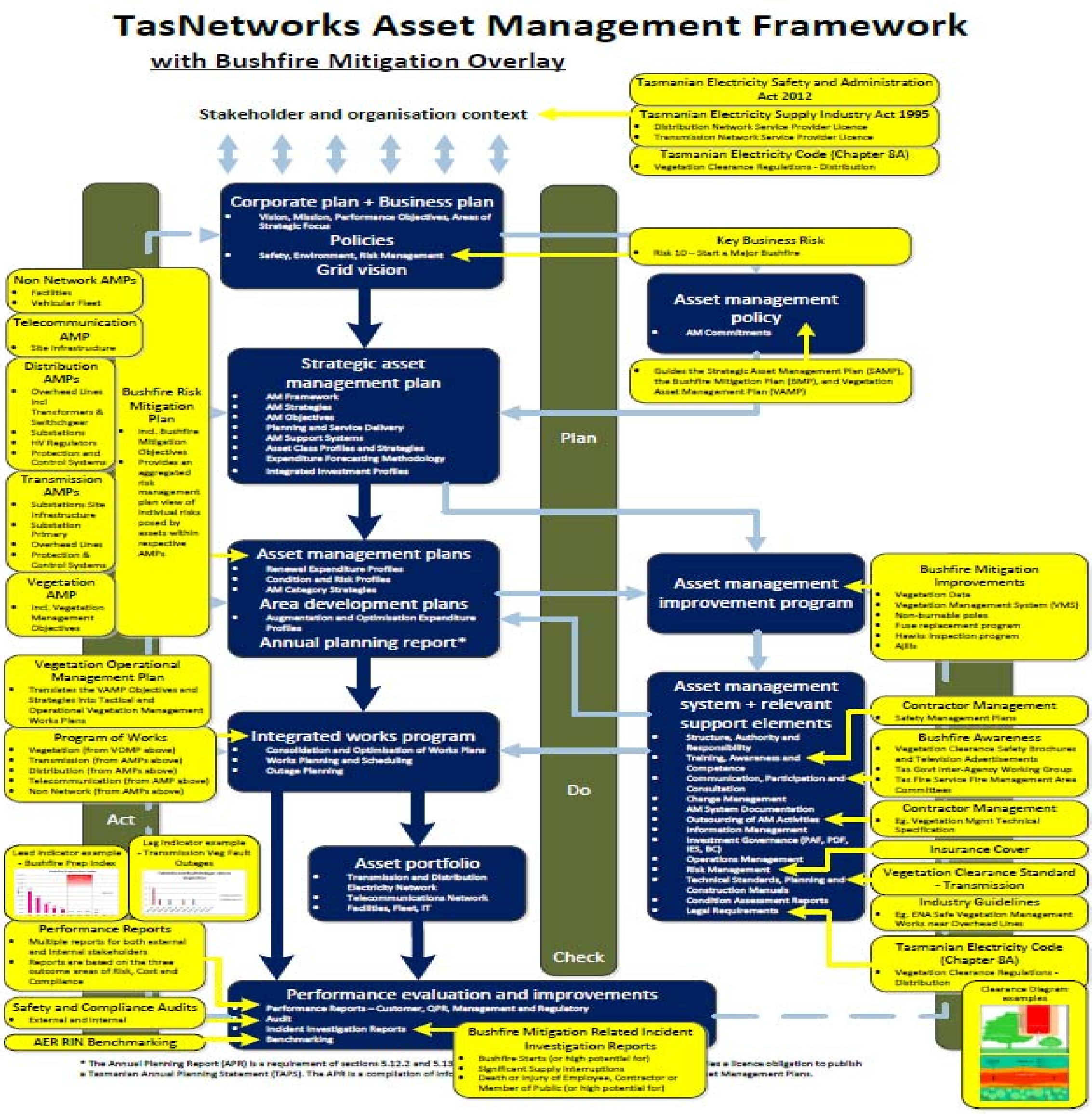


* The Annual Planning Report (APR) is a requirement of sections 5.12.2 and 5.13.2 of the National Electricity Rules (NER) and also satisfies a licence obligation to publish a Tasmanian Annual Planning Statement (TAPS). The APR is a compilation of information from the Area Development Plans and the Asset Management Plans.

3.1 Bushfire Mitigation Framework

Many TasNetworks assets, including distribution conductors and poletop hardware are located within areas of the state affected by bushfire. TasNetworks' bushfire mitigation framework has been overlaid onto the TasNetworks Asset Management framework to show the direct relationship between the two, and is shown in Figure 2. The Bushfire Mitigation Asset Management Plan provides guidance to other stakeholders in the preparation of asset management plans, ensuring effective bushfire risk mitigation outcomes are achieved, while also summarising some key bushfire risk mitigation outcomes and commitments made within those asset management plans.

Figure 2: TasNetworks Asset Management Documentation Framework with Bushfire Mitigation Framework Overlay



3.2 Business Objectives

Strategic and operational performance objectives relevant to this asset management plan are derived from TasNetworks 2017-18 Corporate Plan, approved by the board in 2017. This plan is relevant to the following areas of the corporate plan:

- We understand our customers by making them central to all we do;
- We enable our people to deliver value; and
- We care for our assets, delivering safe and reliable networks services while transforming our business.

Refer to TasNetworks Corporate Plan - Planning period: 2017-18: http://reclink/R0000745475

3.3 Business initiatives

The business initiatives reflected in TasNetworks Transformation Roadmap 2025 publication (June 2017) for transitions to the future that have synergy with this plan t are as follows:

- Voice of the customer: We anticipate and respond to your changing needs and market conditions.
- Network and operations productivity: We'll improve how we deliver the field works program, continue to seek cost savings and use productivity targets to drive our business.
- Electricity and telecoms network capability: To meet your energy needs and ensure power system security, we'll invest in the network to make sure it stays in good condition, even while the system grows more complex.
- Predictable and sustainable pricing: To deliver the lowest sustainable prices, we'll transition our pricing to better reflect the way you produce and use electricity.

  Enabling and harnessing new technologies and services: By investing in technology and customer service, we'll be better able to host the technologies you're embracing.

Refer to TasNetworks Transformational Roadmap 2025 (reference 19).[1]

4 Asset information systems

4.1 Systems

Distribution line structures asset data is stored in TasNetworks GI system (GTECH) and WASP Maintenance Regime Module.

TasNetworks maintains an asset management information system (AMIS) that contains detailed information relating to the distribution line structures asset populations. AMIS is a combination of people processes and technology applied to provide the essential outputs for effective asset management.

4.2 Asset information

Asset information is recorded in the WASP asset register, which is used throughout TasNetworks for nameplate data, spares management, works scheduling and defect management. WASP records the physical devices and maintenance history. This asset information in the future will be displayed in SAP as part of the Ajilis program.

Overhead line support structures asset information is collected as for say asset identity, and certain key attributes. For example for a wood pole, it includes - pole height, strength, age, type, condition assessments, date installed, dates of

[1] A list of references used in this plan are listed in Section 12 of this document.

periodic inspection, date and type of any remediation like staking, and links to photographic record to identify condition and pole dressings topology.

5 Description of the assets

Structures provide support, insulation and adequate clearances between the overhead conductors, overhead switchgear and pole mounted transformers to the ground, vegetation and building infrastructure.

For asset management purposes, structures are divided into 2 parts:

1. Poles and
2. Pole accessories.

5.1 Poles

There are four main types of structure used in the distribution system:

1. Wood poles, including:
    - Natural (untreated); and
    - Copper-Chrome-Arsenate (CCA) Treated.
2. Steel and concrete poles (commonly known as Stobie poles)
3. Concrete poles, including:
    - Spun concrete;
    - Pre-stressed concrete; and
    - Composite concrete (TITAN).
4. Steel structures, including:
    - Steel lattice poles;
    - Steel lattice towers;
    - Railway section (RSJ) steel poles;
    - Round steel service poles; and
    - Square section steel service poles.

There are some structures that are used by other services such as communications cables and road lighting.

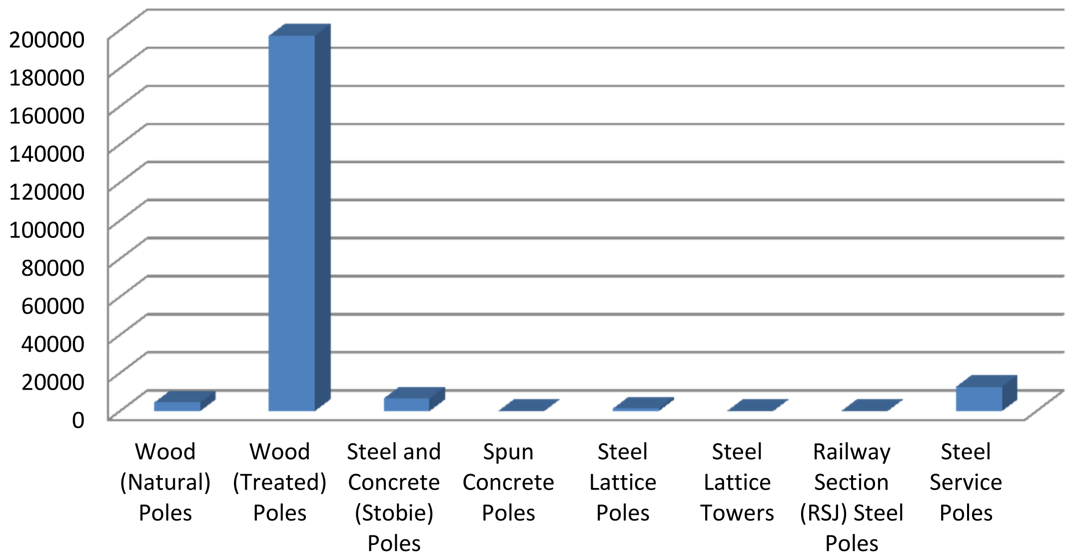
The various poles types are show in Table 1 and including an estimate of privately owned poles.

TasNetworks pole makeup by type is shown in Figure 5.

Table 1: Pole types installed in TasNetworks' distribution system (as at 15th June 2017)

Description	Number Installed (Total)	Number Installed (TasNetworks Owned)	Number Installed (Privately Owned)
Natural Wood Poles	4,027	2,935	1,092
CCA Treated Wood Poles	238,371	204,528	33,843
Insulated Composite Concrete poles	3	3	0
Steel and Concrete (Stobie) Poles	6,654	6,464	190
Spun Concrete /or prestressed concrete poles	175	161	14
Steel Lattice Poles	1,350	1,300	50
Steel Lattice Towers	341	151	190
Railway Section Steel Poles	469	200	269
Steel Other	47,275	14,229	33,046
Other/Unknown	284	161	123
Total	**298,946**	**230,129**	**68,817**

Figure 5: TasNetworks Pole Assets by Type



5.1.1 Natural wood poles

Natural wood poles are untreated eucalypt sourced within Tasmania. Natural wood poles that were installed were of the 'ironwood' (Eucalyptus siberius) species procured under contract from the St Mary's district up until 1994. Originally these were sourced from old growth forest but in later years were sourced from regrowth timber.

It was soon discovered that regrowth poles wood had integrity issues due to an increased susceptibility to heart rot. This has resulted in failures of natural wood poles with lives as little as seven years.

Natural wood poles have no preservative and therefore the sap wood is prone to deteriorate very quickly especially below ground level. The sapwood is not included in the calculation of pole strength on these poles.

5.1.2 Wood pole foundations

AS7000-2016 provides increased detailing for direct butt buried wood pole foundation design for distribution poles. Soil profile strengths are plotted on the GIS database (see Appendix I), practicality field testing and engineering studies were undertaken to refine pole foundation design, with more options for the few Tasmanian locations with poor strength soil profiles, such as stiff clays. AS7000-2016 allows for failure containment by design for natural wood distribution poles, and some allowance for pole head flex and some poletop lean angle was/is included in pole and pole footing design for in overhead line designs . New Network Standard Drawings detail pole foundations options are included in pending new Overhead Design and Construction Manuals.

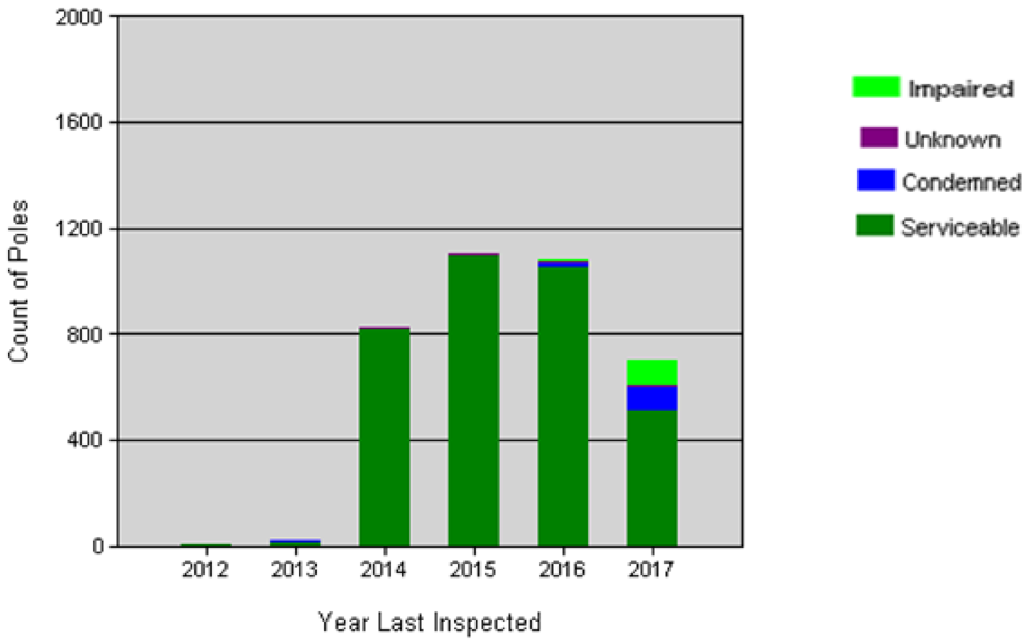
5.1.3 Wood pole Strength classification

Wood poles are rated in to durability classes S1, S2, S3 and S4 timbers (as per AS5604 Timber – Natural Durability Ratings) see reference 13. There are no Natural Durability Class 1 and 2 poles grown within Tasmania.

Natural Durability Class 3 and 4 timbers are less dense and more prone to decay and have a shorter life expectancy than the Natural Durability Class 1 and 2 timbers used in mainland Australia. Currently about 80 per cent of TN wood poles in the TasNetworks network are S3, and 20 per cent are S4. S3 TN wood is scarcer now and S4 TN wood pole subpopulation is rising as a percentage of the population.

The majority tree species is S3 Brown topped stringy bark (BT) at 54 per cent of the TN wood pole population, and next is S3 Mountain stringy bark (MS) at 22 per cent of population.

Figure 6: Treated Wood Poles with Calculated Safety Factors (PSFC) between 2.5 - 3.0



5.1.4 Copper-Chrome-Arsenate (CCA) treated wood poles

The treated wood poles used in the distribution system are harvested and treated locally. These poles are typically Natural Durability Class S3 and S4 timbers.

The treatment used on the poles is pressure impregnated Copper-Chrome Arsenate (CCA). The average treatment applied has increased over time as shown in Table 2.

Table 2: Level of CCA treatment

	Average Treatment (kg/m^3)	Minimum Treatment (kg/m^3)
Pre-1970	10	6.5
1971-1980	12	8
1981-1994	15	10
Post-1994	24	18

5.1.5 Wood pole selection

Wood poles are purchased with a metal pole cap attached over the top of the pole to reduce the ingress of water from the top of the pole through the pole centre thereby reducing the onset of pole decay. Gang nails are attached to pole wood faces at top and bottom to reduce the rate of star pattern end splitting.

CCA TN wood poles are considered to be cost effective and also afford a significant insulation medium for bare overhead lines. CCA treated wood poles do have a slight afterburn risk increase.

Analysis has been performed comparing the annual equivalent cost for S1 and S2 wooden poles, S3 and S4 wooden poles, concrete poles and steel poles. The analysis demonstrates that S3 and S4 CCA wood poles are the most cost effective option for TasNetworks. For further details, refer to *Structures – Annual Equivalent Calculation* (reference 2). However, this is not the case for role as higher cost to replace critical structure poles in bushfire risk prone locations (reference 14).

5.1.6 Concrete and steel, spun-concrete and steel structures

These types of poles or structures generally have a longer life than wood poles and require minimal maintenance other than the painting or regalvanising of the steelwork. However they have a higher initial capital cost and require more careful handling during installation than wood poles. Concrete cover thickness and cover integrity are important for reinforced steel concrete pole life. In particular, Stobie Poles that have exposed mild steel design may have a short service life of 41 years as reported by Spencer and Elder (reference 7).

Additionally, steel and concrete poles require all conductive components to be earthed to ensure greater public safety, effective protection and safe operational activities while working on or near the pole.

They also require greater insulation considerations between the conductors and the structure, particularly in areas where bird and wildlife interactions are an issue.

Steel hollow section poles are predominately used as service poles on the LV system as they have a small footprint on the streetscape and are easily manhandled in difficult situations.

Deterioration of steel, steel-lattice towers, and steel-concrete and spun-concrete poles is mainly due to corrosion and is dependent on the installation location and footing conditions. Corrosion occurs when both moisture and oxygen are present, typically in conditions from the ground level to approximately 300 mm below ground level. The existence of internally occurring corrosion that occurs internally is hard to detect.

Dogs urinating on urban located steel poles are another source of corrosion. The extent of the resulting corrosion is normally limited to about 100 mm below ground level and generally will be found on one side of the pole.

The foundations for this class of pole are more important and they are typically sunk with a concrete encased foundation, and near ground level corrosion protection...

5.1.7 Railway section (RSJ) steel poles

Steel poles made from railway section, have been banned from being used to support electricity service lines in new installations. This is because of railway steel's inherent risk of fracture due to its brittle nature.

Second hand railway steel sections have been used for service poles, crossover poles and private poles for many years. While the section and strength would appear to be strong enough for some applications, experience shows that second hand rail may not be safe due to their brittleness.

Around Australia, there have been a number of incidents of brittle fracture when rail sections have been subjected to additional shock loading, for example, failures when a ladder is placed against a pole and when making changes to pole top arrangements.

A rail section also has a relatively thin bottom flange that more susceptible to corrosion (particularly near ground level) than other parts of the section. Any significant corrosion leads to some reduction in cross section of the flange that reduces the strength of the pole.

Some rail sections were manufactured with notches at intervals along the bottom flange. These notches were used to facilitate breaking the rail into lengths and as a consequence are a weak spot.

Welding of railway section steel poles can cause a reduction in the cross-sectional area similar to a notch. Welding can also make the steel more brittle.

Most existing railway section (RSJ) steel poles support older, lighter conductor services, often with a wooden raiser to increase ground clearances. They may be of inadequate strength for the heavier 25 mm^2 standard aluminium services now used. As services for the heavier 25 mm^2 standard aluminium services are planned to be augmented, a matching design pole change should see RSJ pole replaced as needed.

5.1.8 Former transmission lattice steel line support structures

Where transmission lattice tower structures or lattice pole structures now are, or become part of the distribution network, from time to time, transmission –style inspection and treatment methods are used. These include corrosion assessment and cathodic protection as needed

5.1.9 Staking of wood poles

In Tasmania, without termites, most wood poles become impaired by wood rot growth which is limited by moisture availability and antifungal treatment like CCA or boron. Wood pole moisture availability is mainly at or just below ground level in oxygenated soil zone to a depth of 350 to 450mm. Pole top wood rot is limited by moisture access and is so is a secondary risk mostly in aged poles.

Proprietary designed and rated steel stake methods for staking of poles remediates rotted base of poles to extend pole life. Historically only short height above ground level driven into ground stakes have been used ,and so continuing from near ground wood rot is periodically tested for near stake securing kingbolts.

5.1.10 Age profile of wood poles

Figure 7 shows the installed date age distribution for poles with an overlay of those now staked. Staking is mostly needed for impaired aged in service wood poles, but is also used as a temporary emergency remediation as after a rod vehicle impact event.

Figure 7: Pole and staked pole age profile

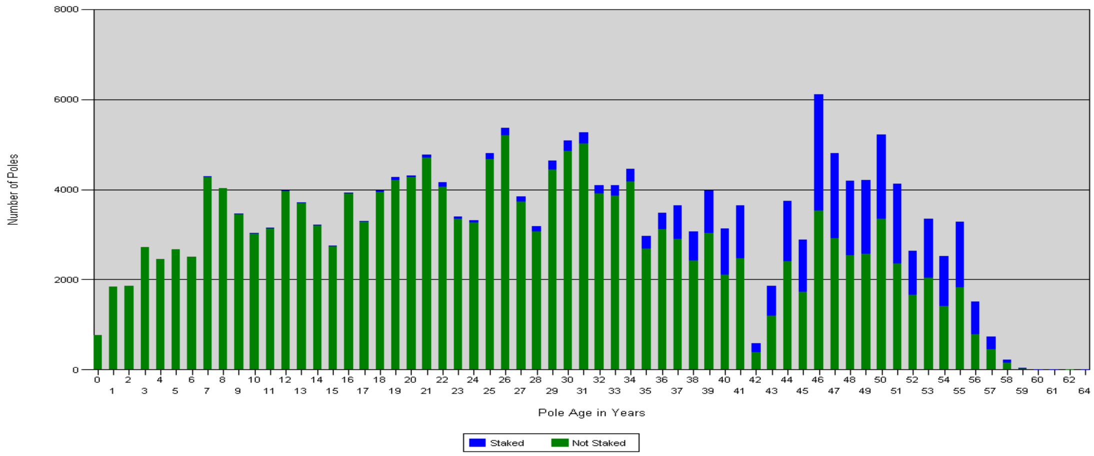


Figure 8 is a geographic hexagon pattern distribution of TasNetworks poles graded by the maximum installation date age. Reliability outages risks tend to rise with asset age. In Figure 8 local bushfire history pole loss dating skews pole age wood pole age to restoration after bush fire date.

Figure 8: TasNetworks Pole Distribution by Age based on pole installation date

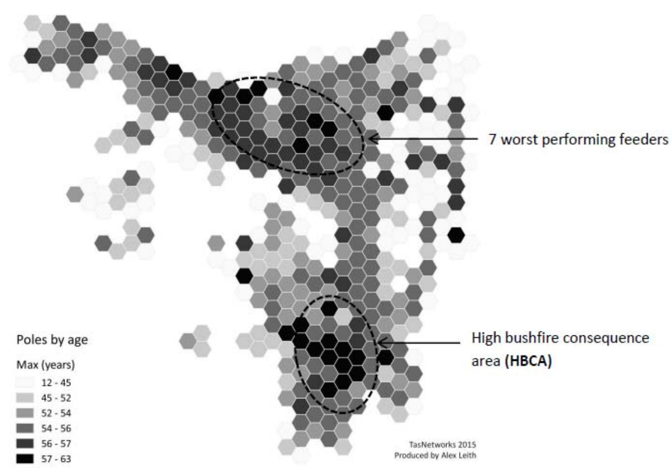


Table 3 shows the wood pole population by critical structure type and by location in Bushfire High Consequence Area (HBCA). There is a subtotal of 3,608 TN Wood poles that are both critical structure poles (either 2376 equipment supporting structures, and /or 1232 high loading stress poles) and located in HBCA.

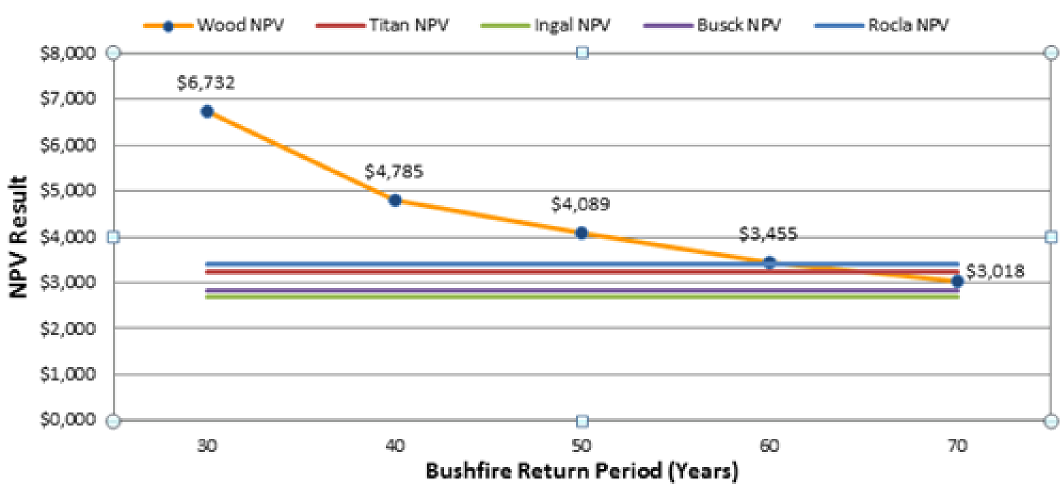
As the replacement cost and time delay is relatively high for burnt critical structure poles, opportunistic risk mitigation with condemned pole is to use replacement non-wood pole or apply a preventative in in situ retrofit a bushfire resistant (intumescent))coating treatment of wood pole. (Intumescent Coating rating testing would be to the ENA /CSIRO bushfire rating test requirements)

Table 3 Wood pole population by critical structure type and by location in High Bushfire Consequence Area (HBCA)

TN Wood Poles	Total in network	Located in High Bushfire Loss Consequence Area (HBCA)	Located in Other areas
Equipment structures	13,483	2,376	11,107
High stress structures	7,000	1,232	5,768
other poles	199,517	35,272	164,245
Total poles	220,000	38,880	181,120

A review of bushfire return sensitivity analysis in NPV for CCA wood compared to a range of alternative poles identified sensitivity for a 50-60 year bushfire return period in Alternative Structures for Equipment & other High Risk Structures Strategy (reference 14). If bushfire return period is expected to shorten with drought cycle in climate change predictions, this would favour bushfire- resilient non-wood poles or retrofit intumescent coatings.

Figure 9 Shows results for a Bushfire Proof Pole - Net Present Value (NPV) Sensitivity Analysis



From the analysis, for a reducing bushfire return period, anything less than 60 years the other non-wood material pole types become far more suitable options for new or replacement pole.

Where an existing TN wood pole exists with significant remaining service life expectation, the retrofitting of an intumescent coating for first 2.5 metres of pole height above ground level offers added resilience from fuel reduction burns and low level scrub or razor grass bushfire.

5.2 Pole accessories

Accessories associated with structures are:

- Stays;
- Pole stakes;
- Pole operating platforms;
- Fauna guards;
- Anti-climbing barriers and signage; and
- Pole caps.

5.2.1 Stays

Poles and structures are graded by their ability to withstand the forces placed on them by conductors and pole mounted equipment. Where the natural strength of the pole or structure is inadequate to withstand these forces, additional measures such as stays and guys are used in conjunction with the pole or structure. Stays by design, unless installed as with back up (n-1), need to be condition based tested visually aboveground and by non-destructive testing methods, to avoid need for age based replacement or replacement on failure.

5.2.2 Poles stakes

Wooden poles deteriorate by rot at a greater rate near or below the ground line than above because of the relative availability of water for rot biological growth rate. Thus, the above ground section may have many years of useful service left once the near or below ground section has deteriorated beyond its required safety factor. The rot zone extends with oxygenation below to 350 to 450mm below ground-line.

Stakes (or ground-line reinforcing) may be installed on wood poles to strengthen the pole at and below ground level and prolong the service life of the pole by at least 15 years. Existing staking materials and methodology as specified are limited in stake height to 1.5metres above ground line. Since existing TasNetworks Network Standard staking specifications were established, in 1990's, a range of pole reinstatement technologies has developed and need trialing.These include fibreglass reinforced /carbon fibre reinforced Pole Wraps, longer higher attachment height stakes , and pole rebutting.

5.2.3 Pole operating platforms

Pole operating platforms have been used previously to provide a safe working platform for overhead line workers working on the overhead system. These are now deemed as unsafe and are progressively being removed from the system. Current instruction is to no longer install them and remove them when working on a pole.

5.2.4 Fauna guards

Fauna guards are accessories installed on a structure to prevent animals and birds interfering with electricity assets and include:

1. Possum guards *(also functions as a rat, quoll and cat guard)*
2. Cattle/horse guards *(poletop/conductor sway from animal rubbing on stay)* and
3. Bird perches *(for bird species preferred perching away from energised conductor)*

Possum guards are installed on wooden poles carrying uninsulated HV conductors and equipment to prevent possums from climbing up the poles. When a pole is stayed, stay sighters are installed on the stay to prevent possums from climbing the stay to access the pole-top. (Possum related outage locations are illustrated in Appendix M) A possum guard can increase moisture retention accelerating wood rot if applied to tightly as demonstrated in photo in Appendix M..

Cattle/horse guards are installed on stayed poles located in areas access by livestock to prevent the livestock from rubbing themselves against the pole stay.

Certain birds such as raptors (eagles, goshawks, owls and kites) tend to use poles and cross arms to perch and survey the surrounding area to hunt for prey. Bird perches are installed on poles to provide a safe location on the pole for the bird to land without risk of contact with live conductors. Poletop perches are angled to suit location prevailing windage to suit bird.

5.2.5 Anti-climbing barriers and signage

Anti-climbing barriers for humans and signage are required for steel lattice tower to discourage and prevent unauthorised access onto these structures.

ENA Guidelines for Design and Maintenance of Overhead Distribution and Transmission Lines AS/NZS 7000 (reference 1), Section 8.4.3 requires that:

Provision shall be made on all climbable structures for the fixing of signage and devices to ensure the protection of the public from hazards associated with access to electrical works, and to provide public awareness of operational safety issues

5.2.6 Pole caps

Pole caps prevent water ingress into splits, cracks , existing tree rot pipes and other voids in the wood pole top, that collect water from rainfall, hail, snow, mist to facilitate accelerated pole top rot and fungal spores entry .The pole cap protects poletop ganged nail used to reduce pole top opening with continued splitting and cracking as the wood ages. Most pole caps are of galvanised steel, and nailed to wood pole top. These are subject to rust and loosening of nails with wind and wood aging. Some modern plastic pole caps are in service.

The rusting out and /or loss or absence of a pole cap, is a reportable inspection defect, with relatively low priority, longer maximum time to replace. However excessive time spent without a pole cap, can reduce wood pole service life by the added moisture entry accelerated poletop rot.

The cost benefit for replacement or life extension remediation to pole tops from pole top rot could be trialled to assess pole cap replacement , and /or fibreglass reinforced expanding epoxy polymer concrete to repair structural damaged pole top, for example I-Pole by UK Solution Provider Ltd .

6 Standard of service

6.1 Technical Standards

Technical standards are primarily SAA AS 7000 -2016 and any legislative requirements.

6.2 Key Performance Indicators

TasNetworks monitors distribution assets for major faults through its outage and incident reporting processes.

Asset failures resulting in unplanned outages are recorded in the In-service outage management tool by field staff, with cause and consequence information being subsequently made available to staff for reporting and analysis. Those outages with a significant enough consequence are also recorded in RMSS and are investigated by the business to establish the root cause of the failure and to recommend remedial strategies to reduce the likelihood of reoccurrence of the failure mode. Reference to individual fault investigation reports can be found in RMSS. This database will be replaced by the Ajillis program.

TasNetworks also maintains a defect management system that enables internal performance monitoring and statistical analysis of asset faults and/or defects that either may not result in unplanned outages, or whose failure may only result in a minor consequence not requiring full investigation.

TasNetworks' Service Target Performance Incentive Scheme (STPIS), which meets the requirements of the Australian Energy Regulator's (AER's) Service Standards Guideline, imposes service performance measures and targets onto TasNetworks with a focus on outage duration and frequency. While the STPIS does not target specific asset classes, good asset performance will have a significant impact on TasNetworks' ability to meet the STPIS targets.

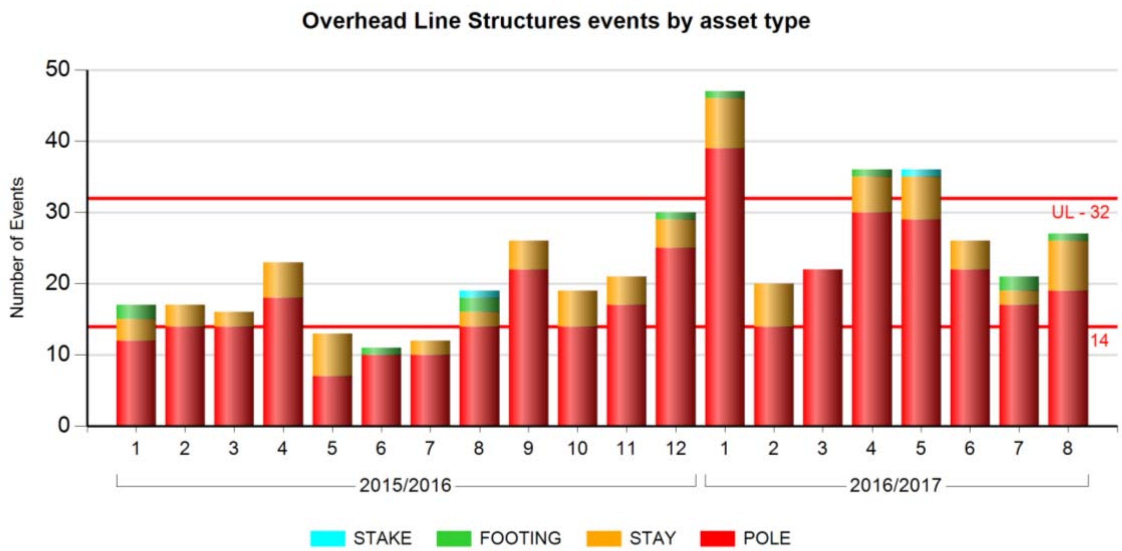
STPIS parameters include:

- System Average Interruption Duration Index (SAIDI) and
- System Average Interruption Frequency Index (SAIFI).

Details of the STPIS scheme and performance targets can be found in the "*Electricity distribution network service providers - Service target performance incentive scheme - November 2009"*.

The Overhead Line Structure outage events occurrences by asset type are shown in Figure 3 for 2015/16 and first 8 months of 2016/17.

Figure 3: Overhead line support structures events by asset type

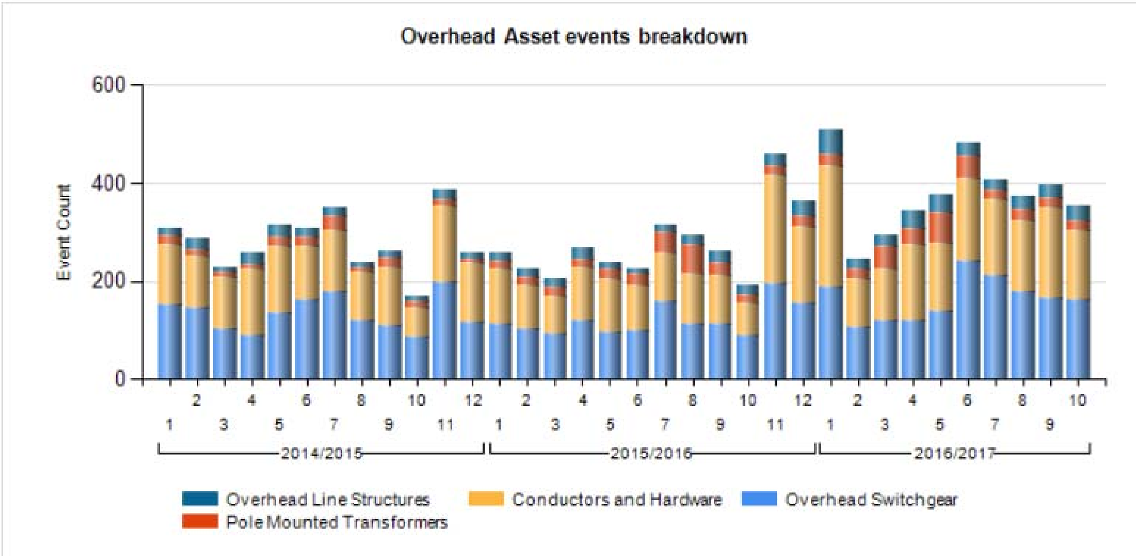


The pole as asset type remains the majority asset type cause of outage events, followed by the stay, then the footing, and lastly the remediation stake. There is seen a steady rise in pole related events with variance for seasonal and extreme weather events.

The Overhead Line Structure events breakdown for SAFI by asset type are shown in Figure 4 for 2014/15, 2015/16 and first 10 months for 2016/17.

Presently, overhead support structures are a small proportion of these SAFI events by asset type (as shown as blue section on top of columns).

Figure 4: Overhead line support structures SAIFI by asset type



6.3 Benchmarking

TasNetworks' service performance is benchmarked against other DNSPs through the AER's RIN framework.

In addition, TasNetworks works closely with its DNSP counterparts, to compare asset management practices and performance.

TasNetworks unassisted pole failure per annum is shown in Figure 22 for years 2005/06 to 2016/17...Unassisted pole failure per annum normalised per 100,000 pole population for comparison isrelatively low in available most recent ENA reported Australian industry figures, in Figure 23.

The average age of TasNetworks wood poles in 2016/17 was 29 years, and the typical TasNetworks TN wood pole is staked at 38 years' service.

7 Associated risk

TasNetworks has developed a Risk Management Framework for the purposes of

- Demonstrating the commitment and approach to the management of risk – how it is integrated with existing business practices and processes and ensure risk management is not viewed or practiced as an isolated activity;
- Setting a consistent and structured approach for the management of all types of risk; and
- Providing an overview on how to apply the risk management process.

Assessment of the risks associated with the distribution overhead switchgear has been undertaken in accordance with the Risk Management Framework. The risk assessment involves:

- Identification of the individual risks including how and when they might occur

- Risk analysis of the effectiveness of the existing controls, the potential consequences from the risk event and the likelihood of these consequences occurring to arrive at the overall level of risk.
- Risk evaluation where risks are prioritised based on their ratings and whether the risk can be treated) or managed at the current level.

The likelihood and consequence of risk events occurred are assessed using the following risk rating matrix in figure 5:

Figure 5 Risk Ranking Matrix

LIKELIHOOD		CONSEQUENCE: 1 NEGLIGIBLE	2 MINOR	3 MODERATE	4 MAJOR	5 SEVERE
• ≥ 99% probability • Impact occurring now • Could occur within "days to weeks"	5 ALMOST CERTAIN	MEDIUM	MEDIUM	HIGH	VERY HIGH	VERY HIGH
• 50% - 98% probability • Balance of probability will occur • Could occur within "weeks to months"	4 LIKELY	LOW	MEDIUM	HIGH	HIGH	VERY HIGH
• 20% - 49% probability • May occur shortly but a distinct probability it won't • Could occur within "months to years"	3 POSSIBLE	LOW	LOW	MEDIUM	HIGH	HIGH
• 1% - 19% probability • May occur but not anticipated • Could occur in "years to decades"	2 UNLIKELY	LOW	LOW	MEDIUM	MEDIUM	HIGH
• ≤1% probability • Occurrence requires exceptional circumstances • Only occur as a "100 year event"	1 RARE	LOW	LOW	LOW	MEDIUM	MEDIUM

The Risk Management Framework requires that each risk event is assessed against all of the following consequence categories:

- Safety and People
- Financial
- Customer
- Regulatory Compliance
- Network Performance

- Reputation
- Environment and Community

This asset management plan describes the major risks associated with distribution overhead line support structures current or proposed treatment plans.

7.1 Asset Risks

7.1.1 Poles

The main mechanisms of failure in poles are:

- Natural wood and treated wood poles rot over time (combination of internal and external, often undetected internal carroty rot);
- Corrosion of Stobie or steel poles
- Vehicle and machinery impact (Third party impact)
- Lightning strike on timber poles
- Flood damage to pole footings
- Pole burnt due to fire
- Tree falls on pole or stay
- Excess wind stress leading to pole footing failure

The impact or consequences of a pole failure may include; network outages, injury or fatalities, damage to other TasNetworks' plant and equipment, damage to third party assets, starting a bushfire, financial impacts for outage penalities and emergency replacements

The mitigation or elimination measures are described in detail in section 8. They include:

- Non destructive tests for detection for carroty rot
- Painting of stobie and steel poles (as used in an earlier program)
- The addition of vehicle barriers where there Is a high likelihood of a vehicle impact
- Vegetation management to eliminate or reduce the likelihood of trees striking poles
- Replacement of critical wooden poles in bushfire prone regions with less flammable poles

7.2 Stays

The main mechanisms of failure of stays are:

- Stay (7/12 old style) broken by livestock rubbing on it
- Screw-In-Stay incorrectly installed;
- Stay (bow) wooden anchor block rots over time;
- Cattle rubbing on stay causing pole-top movement and conductors to clash;
- Aerial stay (horizontal part) eye bolt (smaller old style) pulls through pole when pole dries out and pole splits; and
- Corrosion of steel components below ground.

The impact or consequences of a stay failure may include; network outages, injury or fatalities, damage to other TasNetworks' plant and equipment, damage to third party assets, starting a bushfire (through the stay failure causing a pole failure), financial impacts for outage penalties and emergency replacements.

Risk mitigation or elimination measures include:

- Trial of periodic Non Destructive Testing (NDT) using ultrasonics , microwave or gamma beam devices
- Painting of stays and early detection of corrosion
- The addition of vehicle barriers where there is a high likelihood of a vehicle impact
- Barriers to prevent cattle coming in contact with stay poles
- Replacement of stay poles with stronger poles that no longer require stays (eg a Rocla Supapole)Installation of n-1 reliability with duplicated stays

The risk mitigation measures presently used are described in detail in section 8.

7.3 Pole Stakes

Pole stake failure modes

The main mechanisms of failure of pole stakes are:

- Pole stake corrodes
- Pole stake bolts loose
- Debris built up behind pole stake
- Pole stake corrodes
- Pole stake bolts loose and
- Undetected wood pole rot at attachment point

The impact or consequences of a pole stake failure may include; network outages, injury or fatalities, damage to other TasNetworks' plant and equipment, damage to third party assets, starting a bushfire, financial impacts for outage penalties and emergency replacements

The mitigation or elimination measures are described in detail in section 8. They include:

- Clearing of debris around stakes
- Non-destructive tests for detection for carroty rot
- Painting or other corrosion prevention techniques
- Inspection of bolts to detect loose connections
- Vegetation management to eliminate or reduce the likelihood of trees striking poles
- Replacement of poles due to condition or age which eliminates the need for the stakes

7.4 Summary of Risks

Appendix A provides a summary of programs, risk drivers, risk level before and residual risk level after program controls.

The program specific overhead line structure risks, the mitigation strategy and residual risk levels, are provided in specific Investment Evaluation Summaries.

8 Management plan

8.1 Historical

8.1.1 Pole inspection cycle

Following a review (Reference 4) in 2012/13 TasNetworks pole inspection cycle was changed from a 3.5 year cycle to 5 year inspection cycle (with untreated wood poles remaining on a 3.5 year cycle to address Pole Inspector risk responsibility concerns). Untreated wood poles now total less than 2,000 poles, are a subpopulation exceeding 50 years in service, and now have a high condemning rate in periodic inspections. These occurrences of natural untreated wood poles are a legacy of emergency recovery from poles lost in 1967 Bushfire Storm when about 5, 000 wood poles were lost and replaced across the state.

8.1.2 Private pole inspections

Inspections and some maintenance of private poles are still currently being done by TasNetworks, however it is expected that a final decision ceasing this practice will be made in the foreseeable future. These inspections are presently unfunded either in TasNetworks Revenue determination or by the customer and are internally funded.

Private pole defects do asset failure impact on TasNetworks feeder reliability.

8.2 Strategy

8.2.1 Routine Maintenance

There is a fundamental requirement for TasNetworks to periodically inspect its structures to ensure their physical state and condition does not represent a hazard to the public. Other than inspecting and monitoring the assets, there is no other way to satisfy this requirement.

8.2.2 Planned Asset Replacement versus Reactive Asset Replacement

Pole failures have the potential to result in a serious injury or fatality to a member of the public. It is prudent to inspect the condition of poles on a regular basis and replace or reinforce a pole in poor condition before it fails.

Poles with a greater replacement cost and at a higher risk to loss to bushfire or fuel reduction burns, could at the time of replacement be replaced with non-wood alternative pole.

If poles are a critical structure (for example a river flood crossing or very long span over valley) requiring a complex design replacement or if it is a CCA wood pole replacement it could be further protected with retrofit intumescent coating protection to a height of 2.5 metres above ground , and 300mm below ground.

8.2.3 Non Network Solutions

Remote Area Power Supply (RAPS) systems are being implemented on the following sites:

1. Eddy Stone T760253 and T760252
2. Honey Suckle T840071
3. Heals Spur T770242
4. Murchison Dam T940058 and T940030
5. Plimsoll Lake T940049

These remote sites are supplied by long spur lines and the RAPS will enable the spur line removal resulting in an ongoing OPEX cost reduction. A number of the 65 SWER systems in TasNetworks could be reviewed for a RAPS replacement as they approach asset replacement need.

Other options exist to minimise customer disruption, including temporary mobile generation substitution while an asset is out of service. TasNetworks currently has one mobile generator and has leasing arrangements in place to source additional units as required.

8.2.4 Wood poles risk reduction strategies

The majority of poles in service are TN wood poles (88%) and because of their particular risk attributes, a number of specific new risk mitigation strategies are being trialled to address specific risk of these poles:

- Unassisted pole failure from undetected rot and/or high load stress fracture
- Bushfire damage CCA afterburn combustion minimisation
- Ageing staked wood pole population replacement or life extension
- Use of “Alternative” non-wood support structure to replace current wood poles for roles of critical structures such as
    - Equipment structures
    - High stress structures
    - Flood crossing damage

A number of trials have been undertaken by TasNetworks to investigate the effectiveness of new approaches to detection and management of these risks. Details of the trials are discussed in Section 8.8.

8.3 Routine maintenance – Inspection and Monitoring (AIOHS)

TasNetworks’ overhead structures inspection and monitoring program consist of three components:

- Inspection overhead structures
- Inspection Tower Structures and
- Inspection of Natural Timber Poles under the possum guard

The business objectives driving this program are

1. Managing Business Operating Risk (through identifying defects before they impact on safety or fire risks – primary driver) and
2. Maintaining Network Performance (through identifying defects before they impact on reliability – secondary driver)

8.3.2 Inspection of structures and overhead lines and equipment

This program mitigates the risks associated with timber poles failing in service.

The results of the tests undertaken during this inspection determine whether a pole is:

1. Serviceable – considered to be in an adequate condition to safely remain in service until the next pole inspection
2. Impaired – not considered to be in an adequate condition to safely remain in service until the next pole inspection, but suitable to be considered for staking (it may then be condemned if it does not meet the detailed staking criteria) or
3. Condemned – not considered to be in an adequate condition to safely remain in service until the next pole inspection and not suitable for staking

To slow the rate of deterioration and extend the life of wood poles, the application of boron pole saver rods and bandages to treat wooden poles for heart and soft rot are undertaken as part of the pole inspection program.

As overhead lines and equipment are inspected as part of the pole inspection, the inspection cycle is a compromise between asset defect detection and pole condemning.

In addition there are approximately 3,922 natural wooden poles in the system, which have unpredictable characteristics and have been known to fail at early ages (under 10 years). These poles are all between 35 and 55 years old.

Table 6 shows that the defect identification and condemning rates.

Historically, TasNetworks' timber pole failure rate, while sitting slightly above the national average, has remained reasonably consistent at around 12 poles per year. However in 2012/2013 there were no unassisted pole failures, although this was coupled with a significant increase in pole condemning/impairment rates. This has been mostly attributed to the lengthening of the pole inspection cycle from 3.5 years to 5 years having an influence on how pole inspectors interpret results (i.e. borderline poles are more likely to be condemned now than previously). An increase in the spread of soft rot, even possibly via contaminated tools, could also be a factor.

Table 6 details the number of poles inspected by TasNetworks' pole inspection program over the last seven years. It also details the number of poles staked and replaced each year.

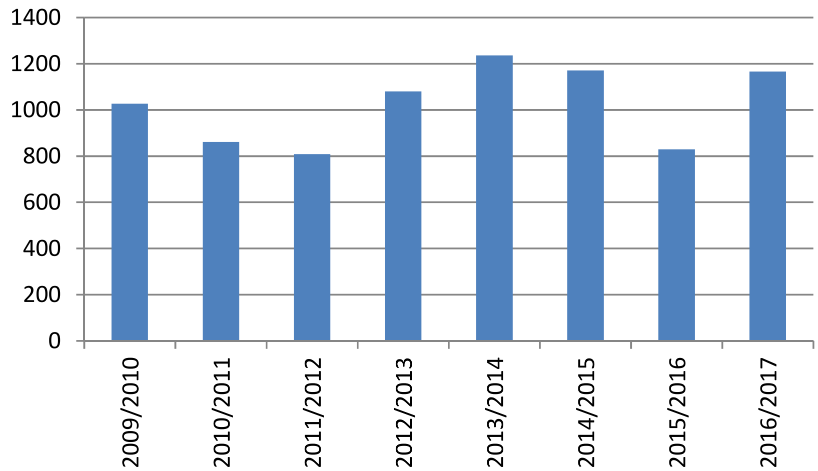
Table 6: Pole replacement and staking rates

Description	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017
Number of Poles Inspected	69686	75426	62095	54183	52699	62951	64975
Number of Poles Staked	1728	1664	1606	2272	1660	1187	867
Number of Poles Replaced	861	809	1080	1236	1171	830	1166

The future pole replacement program is based on the:

1. Current trend of condemning poles;
2. Age profile of current poles with significant increases in poles greater than 40 years old during the determination period; and
3. Expected failure of natural wood poles, which are unpredictable and reaching their expected lifetime.

Figure 14: Pole replacement historic volumes



8.3.2.1 Inspection and treatment of steel towers

TasNetworks has a small population of extreme high voltage steel lattice towers in its distribution system. The majority of towers were installed in the late 1950s and are approaching the end of their nominal asset life. TasNetworks undertakes sample inspections to monitor their condition for proactive maintenance works and undertakes minor remedial action to defer replacement expenditure. Major remedial action is undertaken under RESTK Reinforce below ground portion of tower leg. In 2011, a dedicated inspection program (performed by Incospec of South Australia) assessed the condition of the legs as requiring remedial action. The above ground sections were found to be good-condition by Incospec 2011 report (Reference 9).

9.3.1.3 Inspection of natural timber poles under the possum guard

There have been failures of natural timber poles under the possum guard. The failure seems to be linked to the possum guard being too tightly wrapped around the pole preventing moisture from escaping which in turn allows wood rot to attack the pole.

The purpose of the work is to check the condition of natural timber poles. Around 7% of inspected natural timber poles have been found to have sufficient wood rot to require condemning.

The majority of natural timber poles are located on the East Coast of Tasmania and were inspected in 2013/2014. The program finished testing the remaining natural timber poles over the 2016/17 financial year of a small volume scattered across the state. This inspection cycle will repeat every 3 years to closely monitor the condition of untreated possum guards and mitigate against the associated risks.

8.4 Non routine maintenance

8.4.1 Straighten leaning poles - RMPOL

The drivers for this program are managing business operating risks and minimising costs to the customer.

The aim of this program is to rectify leaning poles in TasNetworks' system. A pole is considered leaning, and is a reportable defect when it is leaning more than 6º from vertical (or approximately four pole head widths out of vertical).

Pole footing failure containment by overhead line design for natural TN wood poles is usually allowed for a pole lean of up to 6 º.

When a pole is leaning between 6º and 10º from vertical, there is a higher risk of conductor clashing and ground clearance defects, but the pole itself is structurally sound. A lean of greater than 10º indicates that the foundations of the pole are potentially compromised and the pole may be in danger of collapsing: the pole is condemned.

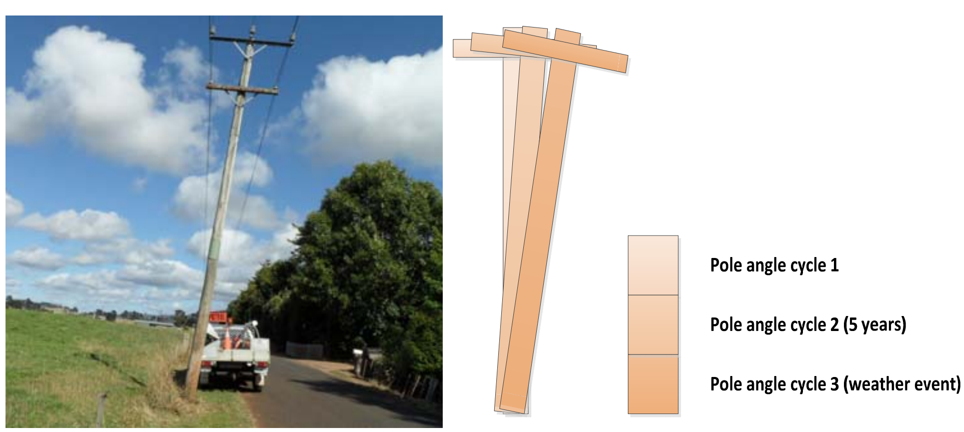
Leaning wood poles are mainly due to problems associated with ground and foundation strengths, backfill medium, compactness at foot and heel of the pole and inadequate counterforce infrastructure (stays, baulks, etc.).

Historically there has been a policy of condemning any leaning pole that was over 10 years old regardless of its condition. This policy has now been replaced and the condition of the pole rather than the age is now the decider as to whether the pole is suitable for straightening.

Approximately 170 leaning poles are recorded by Asset Inspectors per year and currently a defect pool exists of approximately 750 leaning poles. This category of work has historically been done under overhead asset repairs (AROCO), hence the backlog of defects due to other higher priority tasks being completed first.

A review of pole footings was undertaken as there have been instances of leaning poles that have been straightened repeatedly leaning. Improved pole footing design and retrofit methods being explored currently such as pole rebutting technology, various pole footing methods and technologies. In 2013/2014 TasNetworks had its pole footing design reviewed reference 11~~)~~ and also undertook a pole footings test project which tested four methods of pole footings; Aurora typical footing (backfilled soil and tamping), compacted footing (backfilled soil in 150mm layers with each layer tamped individually), concrete and new technology quick-setting foam (reference 12)~~.~~ These trial projects confirmed alternatives for changes in TasNetworks pole footing practices, that have been incorporated into new TasNetworks Network Standard Drawings for pole footings in draft TasNetworks Overhead Line Design and Construction Manuals (as exampled in Appendix I)

Figure 18: Pole leaning more than 6º (or more than 4 pole top diameters)



8.4.2 Repair steel and concrete poles - RMOHS

The driver for this program is managing business operating risks (safety). The program involves maintaining steel and Stobie structures in serviceable condition by repairing components found to be defective through the various inspection programs.

These poles were installed predominately from the 1950s through to the 1970s. They are very expensive to manufacture and are susceptible to corrosion at or just below ground line as the steelwork is generally only protected by enamel paint. However they can be repaired in situ by welding a steel plate across the affected area.

Repairing the below section of direct buried Steel and Concrete poles is cost effective as it will extend their lives by 15 to 20 years.

Figure 20: Poor condition steel and concrete (Stobie) pole

8.5 Reliability and quality maintenance

8.5.1 Replace damaged/condemned poles - REPOL

The drivers for this major asset type program are managing business operating risks (safety) and maintaining network performance.

This program has two components:

1. Replace condemned poles (planned); and
2. Replace Poles MRBA (unplanned)

Planned replacement is more economical that unplanned emergency replacement and avoids safety risks and bushfire risks, and unplanned outage penalty costs, hence there is great incentive to improve preventative condition based planned replacement.

8.5.1.1 Replace condemned poles

The aim of this program is to replace poles that are classified as condemned by TasNetworks' pole inspection program (refer Section 8.3.1). These condemned poles require replacement within a set period not exceeding 4 months. Wooden poles, whether natural or treated, are prone to natural deterioration.

Soft rot attacks the outside of the pole and occurs from the ground line to a depth of 300 to 400 mm below the ground. Heart rot is a fungal attack on the interior of the pole and generally occurs within 300 mm of the ground line.

There are presently no termites in Tasmania, so wood rot is primary deterioration risk for wood poles.

The rate of wood pole deterioration depends on the species of timber, the initial preservative treatment, wood cracks/splits in the wood pole, installation location, soil conditions, and method of inspection, drilling, excavation and reinstatement. Decay occurs when both moisture and oxygen are present.

The driver for this program is public safety. TasNetworks is responsible to ensure that a pole at the end of its life is removed from service before it fails and impacts public safety.

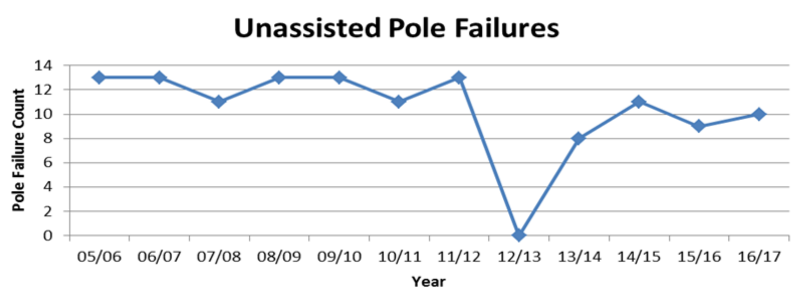
The volumes for this program are based on historical data and condition information that is gathered about the poles during audits (safety factor, amount of rot).

There are no major changes to this program and expenditure in the next regulatory period is based on the:

1. Current trend of condemning poles; and
2. Age profile of current poles with significant increases in poles greater than 40 years old during the determination period.

Historically TasNetworks has experienced on average 12 unassisted pole failures per annum as shown in Figure 12. In 2012/2013 TasNetworks experienced no unassisted pole failures and in 2013/2014 8 unassisted pole failures, with a majority of these a result of major wind storms.

Figure 22: TasNetworks owned unassisted pole failures trend



TasNetworks pole failure rates are consistent with the national average based on other distribution network service provider's wood pole failure rates. Figure 23 shows this comparison collected from Energy Networks Australia (ENA) working group and shows TasNetworks compares favourably within its peer group (ENA now restructuring).

Figure 23: ENA average and TasNetworks comparison of wood pole unassisted pole failure rates

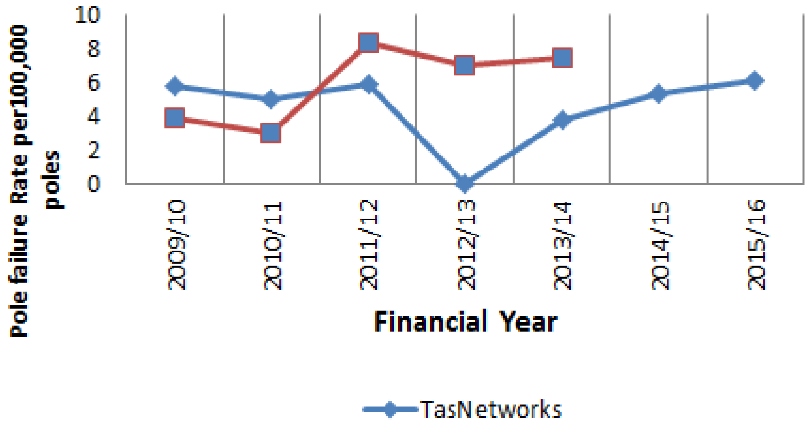
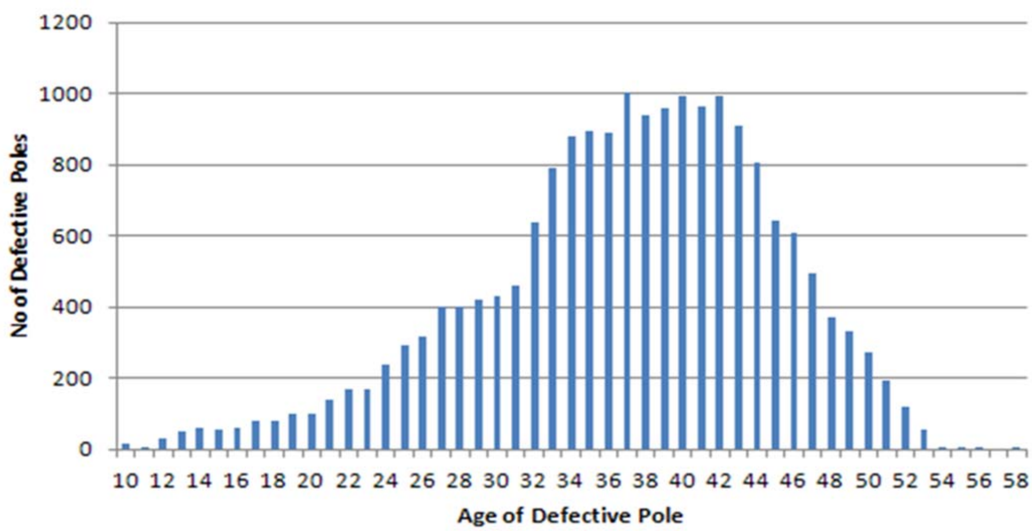


Figure 24 shows the age distribution of defective poles identified over the last decade shows a pole age of late 30s to early 40s as the average condemning/failure age for wooden poles.

Figure 24: Age of poles when identified as defective (condemned/staked) (from 2000 to 2013)



Note: This analysis omits a large amount of data where the original recorded install date of the pole has been overwritten by the renewal date.

8.5.1.2 Replace poles MRBA (extreme events such as storms)

This is a reactive work program to cover the capitalisation of pole replacements undertaken under fault during major events such as during a storm or bushfire.

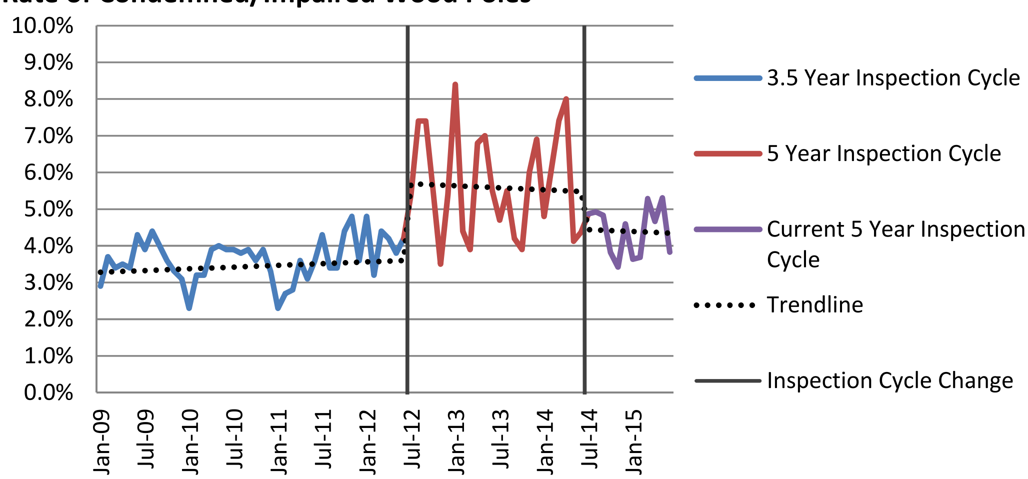
The work is initially performed under the fault and emergency budget and later transferred to this program.

This is a pre-existing program and there are no major changes to this program and the proposed expenditure is to remain consistent with historical spend but subject to unexpected variation depending on event occurrences.

Figure 25: a wood pole that has failed in service

In 2012 interventions aimed at improving cost efficiencies were introduced. These included extending inspection cycles from 3.5 years to 5 years and increasing the safety factors from 2.5 to 3. Asset Inspectors took a very conservative approach to condemning wood poles and as a result the number of condemned wood poles had a stepped increase as shown in figure 27.
There is word-of-mouth evidence that inspectors were still wary of their liability, as a result of a pole failure that occurred on Bruny Island in 1990's and this contributed to this stepped increase. As a mitigation measure to stem this high condemning rate trend targeted asset inspector education and training that was undertaken commencing mid-2014. This intervention resulted in a halt to the increased condemning rates and is now showing condemning rates consistent with post 2012 levels as shown in figure 27.

Figure 27: Rate of Condemned/Impaired Wood Poles



The rate of condemned /impaired wood poles has been further reviewed in 2015/16, 2016/17 to identify a variation pattern in the impairment rate based on moisture limiter for wood rot as biological growth, primarily variance based on seasonal precipitation /rainfall, and possibly local irrigation variation. Aging poles are prone to more cumulative wood splitting for moisture access.

A longer term study shows increased pole defect condemning rate for number of poles inspected as plotted in Figure 47 in Appendix R. However the impairment rate varies significantly year to year and may relate to external moisture variance.

8.5.2 Pole staking - RESTK

The driver for this project is minimising asset life-cycle costs and cost to customers through deferring more costly pole replacements.

There are two components to this program:

1. Stake Impaired Poles; and
2. Reinforce tower leg.

8.5.2.1 Stake impaired poles

The purpose of this program is to defer replacement of poles by staking suitable poles. As wooden poles deteriorate at a greater rate below ground level than above reinforcement at ground level using staking technique defers the replacement of the decayed wood pole by up to and in excess of 15 years.

Whole of life analysis has indicated that staking is a cost effective method of extending the life of a wooden pole (Reference 2).

Wood poles are staked as per Network Policy *NN R AM 11 Wood pole reinstatement by ground-line reinforcement* (reference 5).

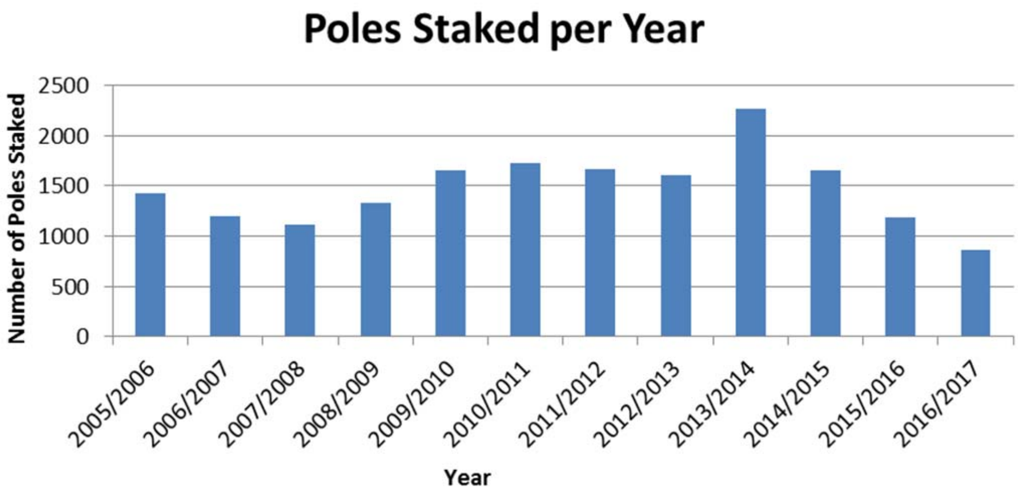
After staking, testing of the pole continues on the new standard 5 year cycle, however additional testing is undertaken further up the pole to ensure appropriate strengths are maintained above the reinforcement.

There has been a relatively constant trend of pole staking over the last five or so years, although 2012/2013 is higher than previous years.

Defect identification may also increase due to a large number of poles moving into the higher risk portion of their age profile during the determination period.

Figure 28: Staked wood pole with possum guard

Figure 29: Pole staking historic volumes



8.5.2.2 Reinforce tower leg

The aim of this program is to undertake major remedial works on the below ground portion of TasNetworks' distribution line steel towers. As with wood poles, steel towers deteriorate below ground at a faster rate than above ground.

The remedial action proposed is the reinforcement or replacement of the below ground section of the legs. The alternative is to replace the entire steel tower structure, which is very costly. The remedial action costs only a fraction of the amount to replace the entire tower and extends the life of the tower in the order of twenty to thirty years.

This program has been in place for a number of years but was underutilised and the issues that were raised by the inspection undertaken in 2006 largely unaddressed. The inspections are being re-run and will be run on an ongoing five year cycle in the future. The results from that inspection program will inform the makeup and scale of this program.

Figure 31: Corrosion on surfaces of underground portion of Steel Tower Leg

8.5.3 Install overhead LV – changeover/upgrade service on Telstra poles - RESTE

The driver for this program is compliance with contractual and legal responsibilities.

This program covers the upgrade and reconfiguration of any LV that is attached to Telstra owned poles and, if major work is required or a problem exists with the pole, TasNetworks a will negotiate transfer of ownership of the asset.

While these poles are maintained appropriately, upgrades and reconfigurations may occur in which TasNetworks-owned LV or other assets are to be attached to the Telstra pole. In such cases Aurora takes over ownership of the pole so the appropriate standards and policies can be applied to it with regard to installation, access inspections and maintenance.

8.6 Regulatory obligations

8.6.1 Install overhead equipment – anti-climbing barriers/signage program - RECBA

The drivers for this project are compliance with regulatory requirements and managing business operating risks (safety).

The aim of this program is to install anti-climbing barriers and signage on certain types of overhead equipment to deter public access to assets. AS/NZS 7000 Section G7 (reference 1) states that:

> *Unauthorized climbing of structures supporting energized overhead lines is a public safety issue that requires a national uniform standard of approach. Consideration should be given to anti climbing devices or measures to prevent or significantly deter unauthorized climbing.*

ENA DOC 015-2006 National Guidelines for Prevention of Unauthorised Access to Electricity Infrastructure (reference 6) provides a national uniform standard approach for signage and fencing for electrical infrastructure which TasNetworks aims to comply with.

Tasks in this program are undertaken as they are identified and reported.

Figure 34: Anti-climbing Barrier with Faded Signage

8.7 Risk Reduction Trials

8.7.1 Flood Crossing Risk Mitigation Trial

This trial is to reduce overhead feeder outages and damage caused by flooding at fifteen flood crossings in the North Region, based on recent 2015/16 flood levels. These locations were recommended in priority order for trunk feeder performance impacts in North Region, starting with Longford township supply outages on Hadspen Feeder 67087. This feeder was TasNetworks' worst performing feeder in 2015/16. The sole overhead span in the Feeder 67087 is the flood crossing span over South Esk River at the Bass Highway crossing. The proposed program would use taller poles that do not require stays such as Titan Poles as Critical Structures on these fifteen flood crossings. See reference 15.

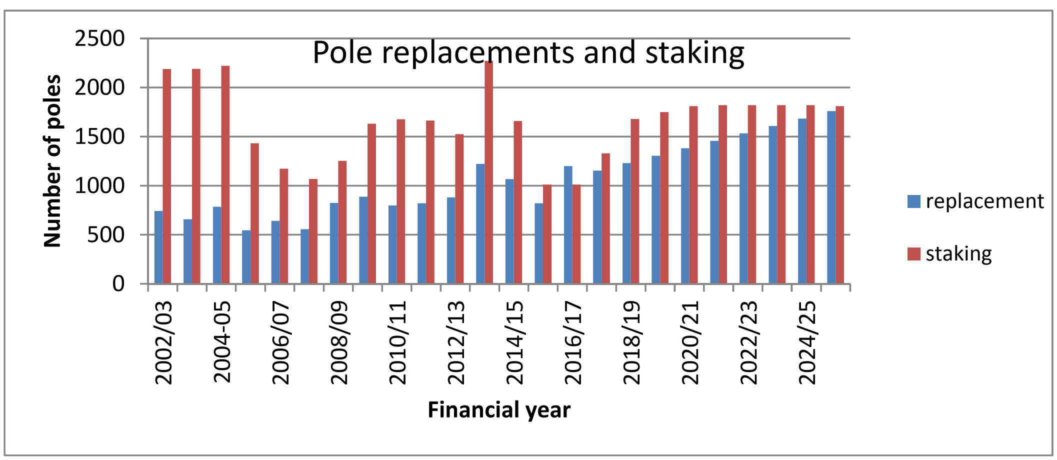
8.7.2 Proposed Trial of longer than 1.5m height limited staking alternative refurbishment technologies for impaired CCA wood poles

These trials would rely on an improved method for detection of internal carroty rot (soft rot) such as RADAR and/ or whole of pole gamma ray or X-ray scan methods. Possible alternatives for the staking of impaired poles include:

- Pole rebutting (e.g. Adapt Australia) with prework RADAR whole of pole scan (rebut to same pole top height) to remaining true wood. Also allows for pole to be heightened to increase ground clearances
- Longer stake attachment kits (e.g. Pole Enforcer or LWS brand for up to 6 metres above ground attachment to remaining true wood)
- Pole top, pole base, and cracked pole refurbishment with FRP wrapping reinforcement sleeve (e.g. Quakewrap, Pile Doctor)

Figure 13 shows expected R19 programmed rates of pole replacement and staking based on pole aging without technology innovations in new staking options to reduce staked pole replacement at 15 years' service age wrt staking peak years in the timeline.

Figure 13 Forecast pole replacements and pole staking based on pole population aging



8.7.3 Increased pole bushfire resilience/resistance and use of alternative poles

TasNetworks wood poles are vulnerable to both bushfires and lower level preventative fuel reduction burns especially in button grass heath and scrub. As in Western Power, WA, CCA Wood poles can be given increased bushfire resilience/resistance by an Intumescent paint coating from below the ground line to 2.5 metres above ground. A trial on bushfire risk located TasNetworks' wood poles to reduce incidence of CCA afterburn charring and candling burn failures of poles impacted by bushfires or fuel reduction burns is proposed. Figure 10 shows a bushfire resilient / intumescent coated wood pole base and examples of CCA Wood poles lost to CCA afterburn after fuel firing pole base, fire darts to splits and /or candling in the 2014 Dunalley Bushfire.

Figure 10: An intumescent coated wood pole and poles lost to reduce risk of CCA afterburn

TasNetworks is trialling "Alternative" non-wood poles, called Titan poles by supplier Dulhunty Engineering, that are already CSIRO bushfire tested to be bushfire resilient. These poles are also electrically insulated, and capable of higher stress loading in critical structure roles. The trial field tests bushfire risk mitigation and feeder supply restoration resilience as use of electrically insulated TITAN poles to support higher replacement cost roles for equipment poles and highly mechanical stress loaded structure poles. Other alternative conductive poles as already used in TasNetworks network include Busck cast reinforced concrete, Bluescope hot dipped galvanised steel, and lattice steel poles. References for Bushfire Testing are AS 1530.1 and Energy Network Association (ENA) Pole Fire Test (reference 17).

Figure 11: alternative line support structures

These Alternative Support Structures for Equipment and other High Stress Risk Structures are detailed in Reference 14. They are alternative pole structures for where Chromated Copper Arsenate (CCA) TasNetworks wood poles do not survive in Net Present Value (NPV) terms for service life duty of 50 years. These alternative structures/poles are for use in the following conditions, prioritised as

- Structures located in bushfire prone locations, that need to withstand bushfires

- Equipment structures that are required to support transformers, reclosers and other equipment and
- Structures subject to high stress such as strain structures or structures subject to high wind.

Figure 12: Critical Structure poles

8.7.4 Better Carroty Rot Detection Methods

The University of Tasmania, UTas, has been contracted to laboratory test samples of drilled wood shavings to support Asset Inspectors Pole Inspection DNA analysis diagnosis for identifying presence of carroty rot (a form of soft rot) to improve detection in suspect aged poles. Improved detection of carroty rot will reduce the number of unassisted pole failures per annum, later forensically identified as undetected carroty rot. An explanation of this trial is provided in Appendix G, and the 2016/17 Final Report is included in reference 19. As a result of UTas as test reported in Reference 19, it's noted a number of different fungi with bacteria symbotic communities have been identified as 'soft rot' and it's even been found in new delivered poles. The soft rot rate of growth in the wood is directly related to the moisture levels present and so poles with increasing splits and pole wood drillings are at greater risk, especially with pole aging. Aged poles acquire more splits with windage, adding moisture and spore access to aged wood. The worldwide R&D knowledge of soft rot growth and its feeding is negligible, and more research is recommended for detection and developing biocontrols. UTas recommended use of Non Destructive Testing pole inspection methods to minimise drilled holes and to help identify rot by density differences, and better correlate density differences to specific rot behaviour by UTas DNA sample tests to better diagnose and scan to monitor poles for presence of internal soft rot, the rot extent, the rot rate in progress and utilise Non Destructive Testing (NDT) to assess periodic progressive deterioration risk and optimal remediations.

Figure 12 Non-Destructive Testing Methods for minimising need for wood drilling

The TasNetworks aged pole population in 2017 numbers over the age of 50 years numbers 18,000, and over 45 years as 42,000 poles. The number of poles aged over 45 years will increase as a proportion of pole population over the period. The current pole replacement rate is based on condition assessment that has limited preventative carroty rot detection unless UTas recommended non-invasive Radar scan testing for rot density detection is used and calibrated by samples for Utas laboratory testing confirmation to improve the UTas report sample statistical significance and also the significance of trial NDT values detected. The first TasNetworks NDT /Scan trial by Electrix and PortaCAT occurred in July 2017/18. PortaCAT has identified soft rot by density in Western Australia, but UTas identified 16 different carroty (soft) rot communities in sampled Tasmanian CCA treated woodpoles,some concurrent in same pole,hence greater complexity to assess and to likely risk manage in Tasmanian poles.

8.8 Unregulated

8.8.1 Private pole inspection - CCPPI

The driver for this program is managing business operating risks (safety).

This program covers the inspection of private customer poles and follows a similar scope to the Inspection OH and Structures program (AIOHS). This category was created in 2013/2014 to address the need for financial separation between private and TasNetworks poles, prior to this all pole inspections where funded under AIOHS. At present inspections and maintenance of private poles are still currently undertaken by TasNetworks; however it is expected that a final decision to either cease or continue this practice indefinitely will be made in the foreseeable future. These inspections are presently unfunded by the Regulator or the customer and are internally funded.

8.8.2 Supply disconnection / pole removal / asset inspection / making safe - CCPPS

The driver for this program is managing business operating risks (safety).

This program provides for the disconnection and removal of identified substandard private power lines in accordance with approved Policy documentation and construction standards. Work is generally done at the request of the pole owner or when a private pole is identified as being in an unsafe condition.

8.9 Investment evaluation

Investment evaluation is undertaken using TasNetworks' investment evaluation tool, see Gated Investment Framework (Reference 10). Investment Evaluation Summaries (IES) are used to provide information in support of a project for inclusion in the Capital Works Program. This information provides a record of the project as it progresses from initiation to finalisation and is required to support a request for funding approval. This IES aims to improve the efficiency and delivery of the capital investment justification and approval process and is a requirement for regulatory and governance purposes.

8.10 Summary of Programs

Table 7 provides a summary of all of the programs described in this management plan.

Table 7: Summary of Structures Programs

Work Program	Work Category		Project/Program
Routine Maintenance	OH Structures inspection & monitoring	AIOHS	OH & Structures inspection
			Inspection of towers/steel lattice poles
			Inspection of natural timber poles under possum guard
Non-Routine Maintenance	OH Structures maintenance	RMOHS	Repair Steel and Concrete Poles
	OH Structures Maintenance Pole Straightening	RMPOL	Straighten Leaning Poles
Reliability and Quality Maintained	Pole Replacements	REPOL	Replace damaged/ condemned poles
	Pole Staking	RESTK	Pole Staking
			Reinforce tower legs
	Changeover / upgrade service on Telstra Poles	RESTE	Change-over/upgrade service on Telstra Poles
Regulatory Obligations	Install anti-climbing barriers / signage program	RECBA	Install anti-climbing barriers/signage program
Unregulated Other	Private Pole Safety (Private Assets)	CCPPS	Private Pole Safety (Private Assets)
	Private OH Structures inspection & monitoring	CCPPI	Private OH Structures inspection & monitoring

9 Financial summary

TasNetworks' makes a concerted effort to prepare a considered deliverability strategy based on the planned operational and capital programs of work for distribution network assets. A number of factors contribute to the successful delivery of the program of work. These factors are utilised as inputs to prioritise and optimise the program of work and to ensure sustainable and efficient delivery is maintained. This program of work prioritisation and optimisation can impact delivery of individual work programs in favour of delivery of other programs. Factors considered include:

- Customer-driven work we must address under the National Electricity Customer Framework (NECF).
- Priority defects identified through inspection and routine maintenance activities.
- Identified asset risks as they relate to safety, the environment and the reliability of the electrical system.

- Adverse impacts of severe storms and bushfire events.
- System outage constraints.
- Changes to individual project or program delivery strategy.
- Size and capability of its workforce.
- Support from external contract resources and supplementary service provision.
- Long lead equipment and materials issues.
- Resolution of specific technical and functional requirement issues.
- Complex design/construct projects with long lead times.
- Approvals, land acquisition or wayleaves.
- Access issues.

Specific to overhead overhead line structures distribution asset management plan, these factors have resulted in the delayed delivery of the operational and over delivery of the capital programs of work.

9.1 Proposed OPEX Expenditure Plan

TasNetworks proposes a total capital expenditure of $30.79 million over the 5 years (2019/20-2023/2024), with an average expenditure of $6.2 million per annum. Appendix B provides more details on OPEX Expenditure Plan over the five years, and a highlight summary is included in Appendix T.

9.2 Proposed CAPEX Expenditure Plan

The capital programs and expenditure identified in this management plan are necessary to manage operational and safety risks and maintain network reliably at an acceptable level. All capital expenditure is prioritised expenditure based on current condition data, field failure rates and prudent risk management.

TasNetworks proposes a total capital expenditure of $69.9 million over the 5 years (2019/20-2023/24), with an average expenditure of $14 million per annum.

Appendix C provides more details on CAPEX Expenditure Plan over the five years, and a highlight summary is included in Appendix T.

10 Responsibilities

Maintenance and implementation of this management plan is the responsibility of Asset Strategy Team.

Approval of this management plan is the responsibility of Asset Strategy Team Leader.

11 Related Standards and Documentation

The following documents have been used either in the development of this management plan, or provides supporting information to it:

1. Standard for Design and Maintenance of Overhead Distribution and Transmission Lines AS/NZS 7000 - 2010
2. Structures – Annual Equivalent Calculation (R295175)
3. Asset Management Strategic Plan (R94876)
4. Economic Evaluation of Treated Wooden Pole Inspection Cycles (R295189)
5. Network Policy NN R AM 11 Wood pole reinstatement by ground-line reinforcement (NW10149727)

6. ENA DOC 015-2006 National Guidelines for Prevention of Unauthorised Access to Electricity Infrastructure
7. Nathan Spencer, Leith Elder, Pole Service Life - An analysis of Country Energy Data , White Paper it is published accessible on http://www.koppers.com.au/Utility-Poles/default.aspx
8. TasNetworks Risk Management Framework 2015 (R209871)
9. Needles Tower Line Incospec Report 2011 (R295154)
10. Gated Investment Framework – Investment Evaluation Summary (R150791)
11. Pitt and Sherry Pole Footing Design Review (R229781)
12. Pole Footing Test Report (R295166)
13. Timber – Natural Durability Ratings AS 5604 – 2005
14. Alternative Structures for Equipment & other High Risk Structures (R452795)
15. North Region Overhead feeder flood crossings flood height augmentation (BC1234)
16. UTAS Final Report _Identification of soft rot decay fungi in eucalypt power pole samples”(R 719238)
17. Energy Network Association (ENA) Pole Fire Test.
18. TasNetworks Transformation Roadmap 2025
    https://www.tasnetworks.com.au/customer-engagement/submissions/
19. TasNetworks Corporate Plan –
    Planning period: 2017-18 http://reclink/R0000745475

12 Appendix A – Summary of programs, risk level, drivers, residual risk

Description	Work Category	Risk Level	Driver	Expenditure Type	Residual Risk
OH & Structures inspection	AIOHS	High	Safety	OPEX	Medium
Inspection of towers/steel lattice poles	AIOHS	High	Safety	OPEX	Medium
Inspection of natural timber poles under possum guard	AIOHS	High	Safety	OPEX	Medium
Repair Steel and Concrete Poles	RMOHS	High	Safety	OPEX	Medium
Straighten Leaning Poles	RMPOL	High	Safety	OPEX	Medium
Replace damaged/ condemned poles	REPOL	High	Safety	CAPEX	Medium
Replace damaged/ condemned Critical Structure poles with Alternative Pole based on bushfire risk	REPOL	High	Safety and bushfire or fuel reduction fire resilience	CAPEX	Medium
Retrofit Intumescent coating to 2.5m on TN pole based on bushfire risk	REPOL	High	Safety and bushfire or fuel reduction fire resilience	CAPEX	Medium
Pole Staking	RESTK	High	Safety	CAPEX	Medium
Pole Staking life extension	RESTK	High	Safety	CAPEX	Medium
Reinforce tower legs	RESTK	High	Safety	CAPEX	Medium
Changeover / upgrade service on Telstra Poles	RESTE	High	Safety	CAPEX	Medium
Install anticlimbing barriers / signage program	RECBA	High	Regulatory	CAPEX	Medium
Private Pole Safety (Private Assets)	CCPPS	High	Safety	OPEX	Medium
Private OH Structures inspection & monitoring	CCPPI	High	Safety	OPEX	Medium