Asset Management Plan

Overhead Line Structures - Distribution

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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

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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, including the basis upon which these forecasts are derived.

2 Scope

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

3 Strategic Alignment and Objectives

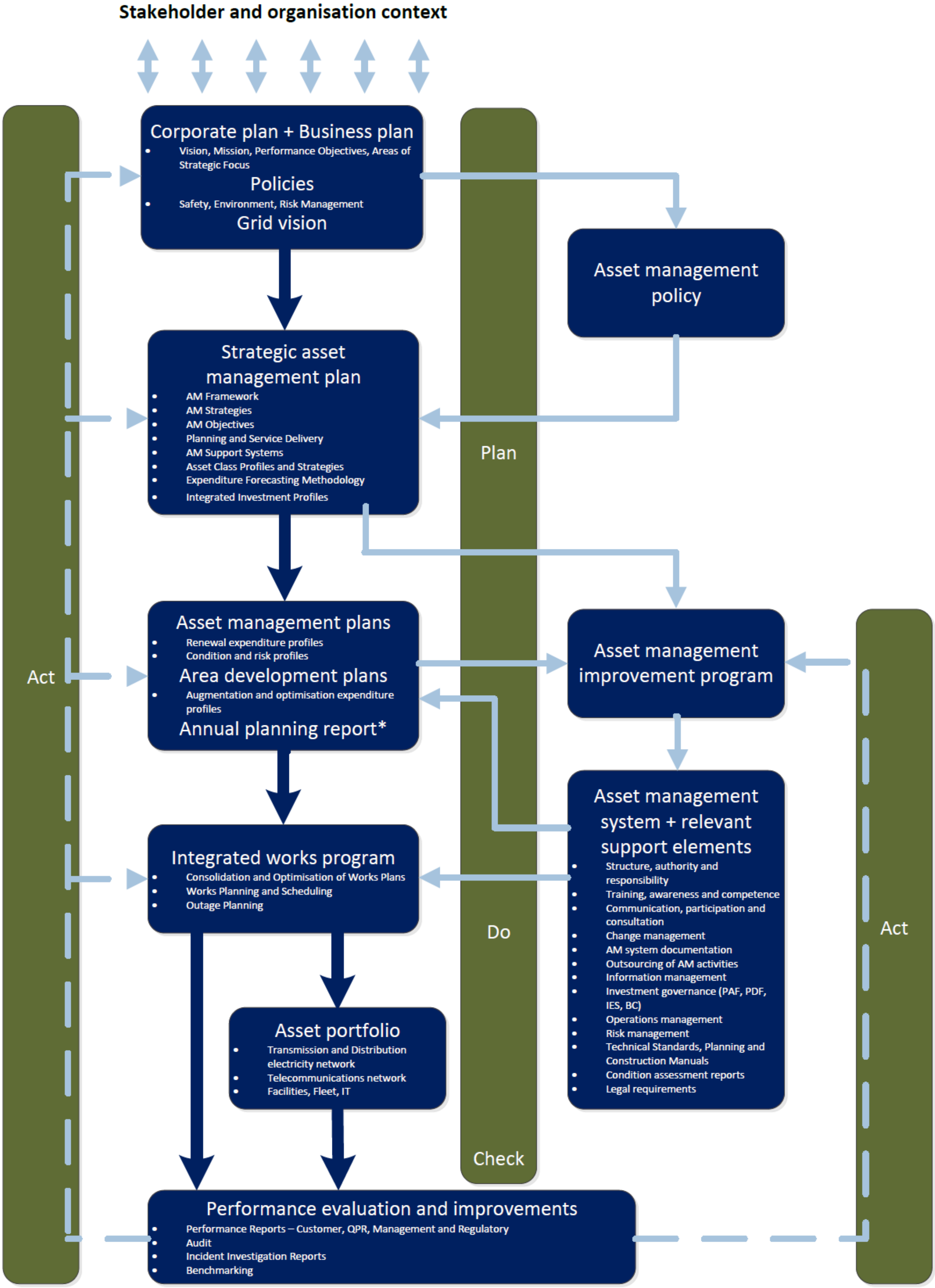
This asset management plan has been developed to align with both TasNetworks' Asset Management Policy and Strategic Objectives.

The asset management policy, contained within the Strategic Asset Management Plan, states 'Consistent with our vision and purpose, we strive for excellence in asset management and are committed to providing a safe working environment, value for our customers, sustainable shareholder outcomes, care for our assets and the environment, safe and reliable network services, whilst effectively and efficiently managing our assets throughout their life-cycle'.

It is part of a suite of documentation that supports the achievement of TasNetworks strategic performance objectives and, in turn, its mission. The asset management plans identifies the issues and strategies relating to network system assets and detail the specific activities that need to be undertaken to address the identified issues.

Figure 1 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.

4 Asset support 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.

5 Network performance

5.1 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 InService 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.

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*".

5.2 Benchmarking

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

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

6 Description of the assets

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

For asset management purposes, structures are divided into:

1. Poles and
2. Pole accessories.

6.1 Poles

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

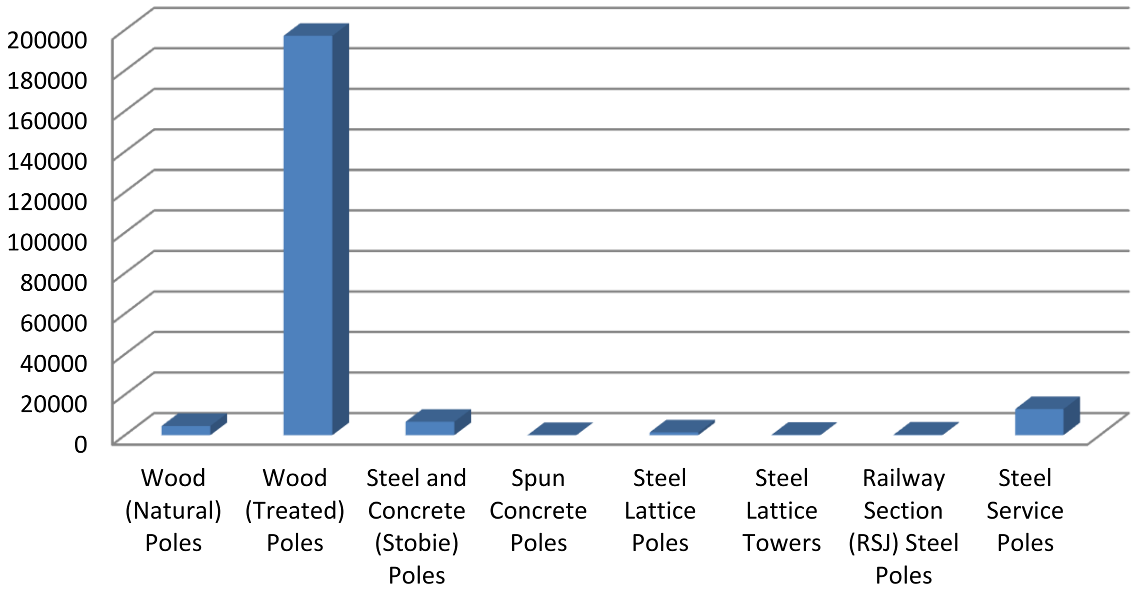
1. Wood poles, including:
    - Natural and
    - Copper-Chrome-Arsenate (CCA) Treated;
2. Steel and concrete poles (commonly known as Stobie poles)
3. Concrete poles, including:
    - Spun concrete
    - Pre-stressed concrete and
4. Steel structures, including:
    - Steel lattice poles
    - Steel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

There are some structures that are joint use with other services such as communications cables and road lighting.

Table 1: Pole types installed in TasNetworks' distribution system (as at Jan 2015)

Description	Number Installed (Total)	Number Installed (TasNetwork Owned)	Number Installed (Privately Owned)
Natural Wood Poles	5,628	4,019	1,609
CCA Treated Wood Poles	234,121	198,822	35,299
Steel and Concrete (Stobie) Poles	6,779	6,577	202
Spun Concrete Poles	86	63	23
Prestressed Concrete	80	80	0
Steel Lattice Poles	1,383	1,331	52
Steel Lattice Towers	339	148	191
Railway Section Steel Poles	527	216	311
Steel Other	45,011	8,701	36,310
Other/Unknown	449	261	188
Total	**294,403**	**220,218**	**74,185**

Figure 2: TasNetworks Pole Types



6.1.1 Natural wood poles

Natural wood poles come from an untreated eucalypt sourced from Tasmania. Previously sourced natural wood poles were of the 'ironwood' (Eucalyptus siberius) species procured under contract from the St Mary's district until 1994. These were originally sourced from old growth forest but in later years moved to regrowth.

It was soon discovered that regrowth poles wood had integrity issues due to an increased susceptibility to heart rot. This has resulted in historical failures of natural wood poles with a life 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.

6.1.2 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 3 and 4 timbers (as per AS5604 Timber – Natural Durability Ratings) (reference 13) , as 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 typically used in mainland Australia.

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

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.

CCA wood poles are considered to be cost effective and also afford a significant insulation medium for bare overhead lines.

Analysis has been performed comparing the annual equivalent cost for Class 1 and 2 wooden poles, Class 3 and 4 wooden poles, concrete poles and steel poles. The analysis demonstrates that Class 3 and 4 CCA wood poles are the most cost effective option for TasNetworks. For further details, refer to *Structures – Annual Equivalent Calculation* (reference 2).

6.1.3 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 can 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, 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 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.

6.1.4 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.

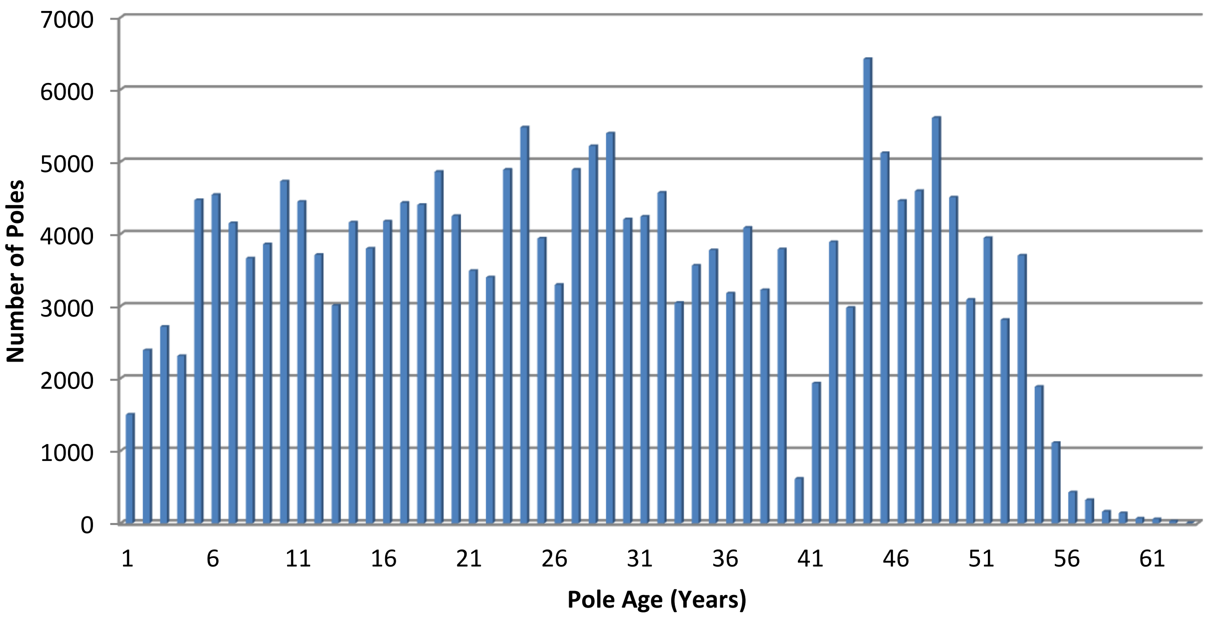
A rail section also has a relatively thin bottom flange that more susceptible to corrosion (particularly near ground level) than other parts of the section. Any significant corrosion leads to some reduction in cross section of the flange that reduces the strength of the pole.

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 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.

Figure 3: Pole Age Profile



6.2 Pole accessories

Accessories associated with structures are:

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

6.2.1 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.

6.2.2 Poles stakes

Wooden poles deteriorate at a greater rate below the ground line than above. Thus, the above ground section may have many years of useful service left once the below ground section has deteriorated beyond its required safety factor.

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.

6.2.3 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.

6.2.4 Fauna guards

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

1. Possum guards
2. Cattle/horse guards and
3. Bird perches

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.

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, hawks 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 steel poles to provide a safe location on the pole for the bird to land without risk of contact with live conductors.

6.2.5 Anti-climbing barriers and signage

Anti-climbing barriers 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

7 Failure modes

7.1 Pole failure modes

The main mechanisms of failure in poles are:

- Natural Wood and Treated Wood Poles rot over time (combination of internal and external);
- Corrosion of Stobie Poles
- Corrosion of Steel GI Poles
- Vehicle and machinery impact on timber pole
- Lightning strike on pole timber
- Flood damage to pole footings
- Pole fails due to carroty wood
- Pole burnt due to fire and
- Tree falls on pole or stay

7.2 Stay failure modes

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.

7.3 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
- Debris built up behind pole stake

8 Associated risk

TasNetworks' Integrated Risk Management Model (Risk Management Model) provides the essential supporting structure for risk management across the organisation. The Risk

Management Model is based on the international standard for risk management AS/NZS ISO3100 Risk Management – Principles and Guidelines.

Risks are assessed considering the potential impacts on:
1. Financial performance
2. Business continuity
3. Customer outcomes
4. Regulatory and legal obligations
5. Corporate reputation
6. Environment and community and
7. People and safety

The following section details the business risks specific to this project, as identified in TasNetworks Risk Management Framework as at March 2015 (see reference 8).

8.1 Risk matrix

TasNetworks business risks are analysed using the 5x5 corporate risk matrix, as outlined in TasNetworks Risk Management Framework.

Table 3 contains the relevant strategic business risk factors that apply to distribution line structures.

Table 3: Strategic business risk factors for distribution line structures

Risk Category	Risk	Likelihood	Consequence	Risk Rating
Financial	Excessive payout of reliability incentive schemes (STPIS, GSL, NCEF) from declining network reliability	Unlikely	Moderate	Medium
	Pole or overhead asset failure results in catastrophic bushfire, insurance providers refuse to cover TasNetworks for future events	Unlikely	Severe	High
	Pole or overhead asset failure results in serious injury or fatality	Possible	Major	High

Customer	Localised interruption to supply	Almost certain	Minor	Medium
Regulatory Compliance	Increased number of unplanned outages leads to systemic NCEF breaches	Possible	Moderate	Medium
Network Performance	Localised interruption to supply	Almost certain	Minor	Medium
Reputation	Pole failure results in bushfire with significant media coverage	Possible	Moderate	Medium
	Pole failure results in catastrophic bushfire with significant media coverage	Unlikely	Major	Medium
	Pole failure results in serious injury or fatality with significant media coverage	Unlikely	Major	Medium
Environment and Community	Pole or overhead asset failure results in bushfire with some loss to property	Possible	Major	High
	Pole or overhead asset failure results in catastrophic bushfire with widespread loss of property and potential fatality	Unlikely	Severe	High
Safety and People	Pole or overhead asset failure results in injury or death to member of the public	Unlikely	Severe	High

9 Management plan

9.1 Historical

9.1.1 Pole inspection cycle

Following review (Reference 4) in 12/13 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).

9.1.2 Private pole inspections

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 therefore internally funded.

9.2 Strategy

9.2.1 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 economic solution to satisfy this requirement.

9.2.2 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 therefore seen as prudent to inspect the condition of poles on a regular basis and replace or reinforce a poor condition pole before it fails.

9.2.3 Non Network Solutions

Remote Area Power Supply (RAPS) 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 sites are currently supplied by long spur lines. The proposed RAPS will result in the removal of these lines. The indicated saving for pole replacement is $177,216/year.

Other options do 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.

9.3 Routine maintenance

9.3.1 Overhead structures inspection and monitoring - AIOHS

TasNetworks' OH structures inspection and monitoring program consist of three components:

1. Inspection OH and Structures
2. Inspection Tower Structures and
3. Inspection of Natural Timber Poles under the Possum Guard and

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)

9.3.1.1 Inspection overhead and structures

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 5,600 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 15 and 25 years old.

Table 4 shows that the defect identification and condemning rates are increasing. This trend is expected to continue due to the ageing pole population.

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 4 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 4: Pole replacement and staking rates

Description	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
Number of Poles Inspected	99606	119034	69686	75426	62095	54183	52699
Number of Poles Staked	1333	1660	1728	1664	1606	2272	1660
Number of Poles Replaced	773	1027	861	809	1080	1236	1171

The future pole replacement program is based on:

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 4: Pole replacement historic volumes

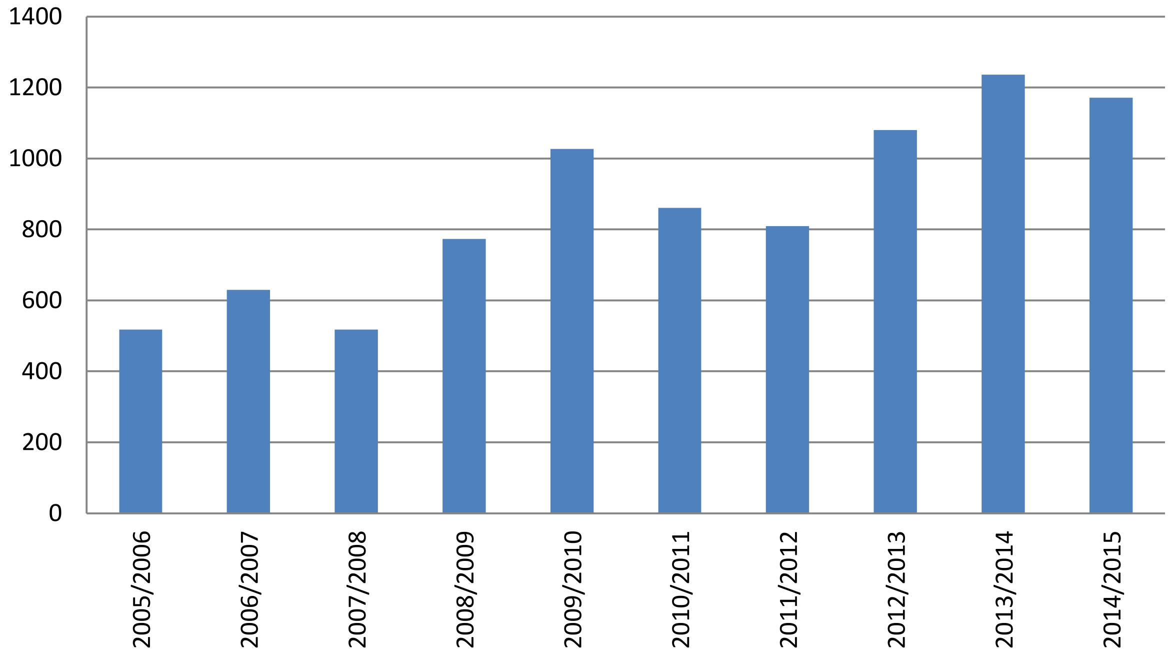
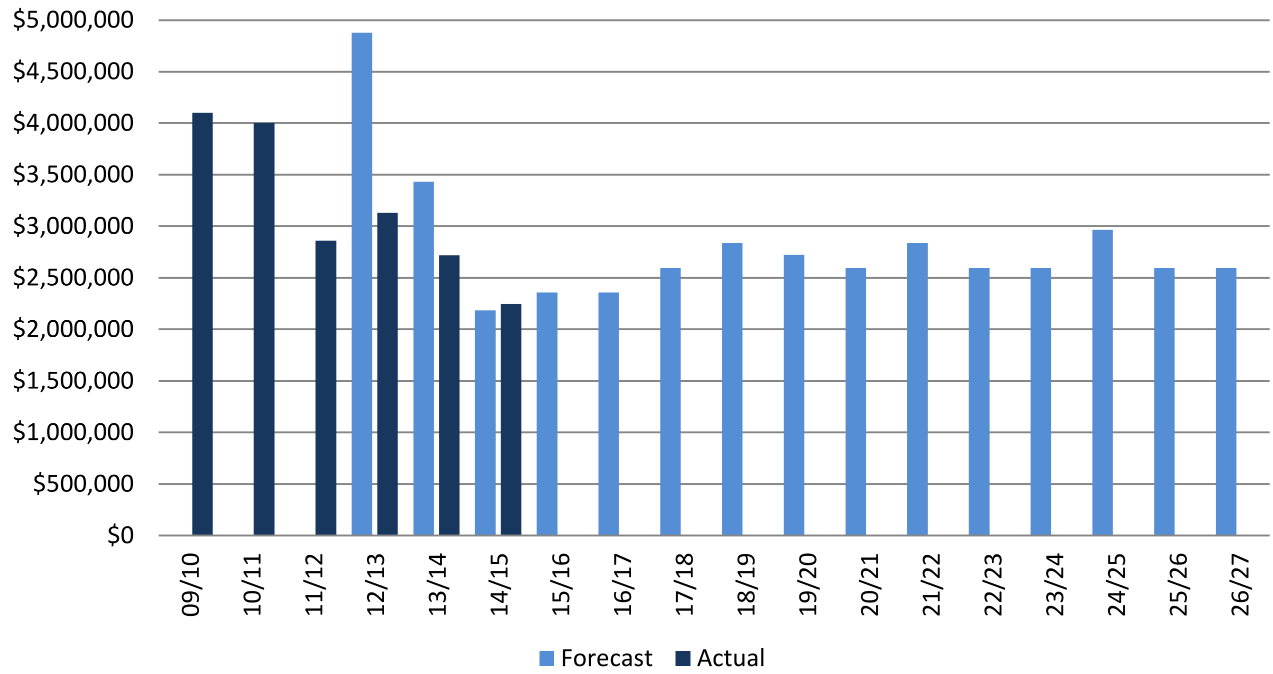


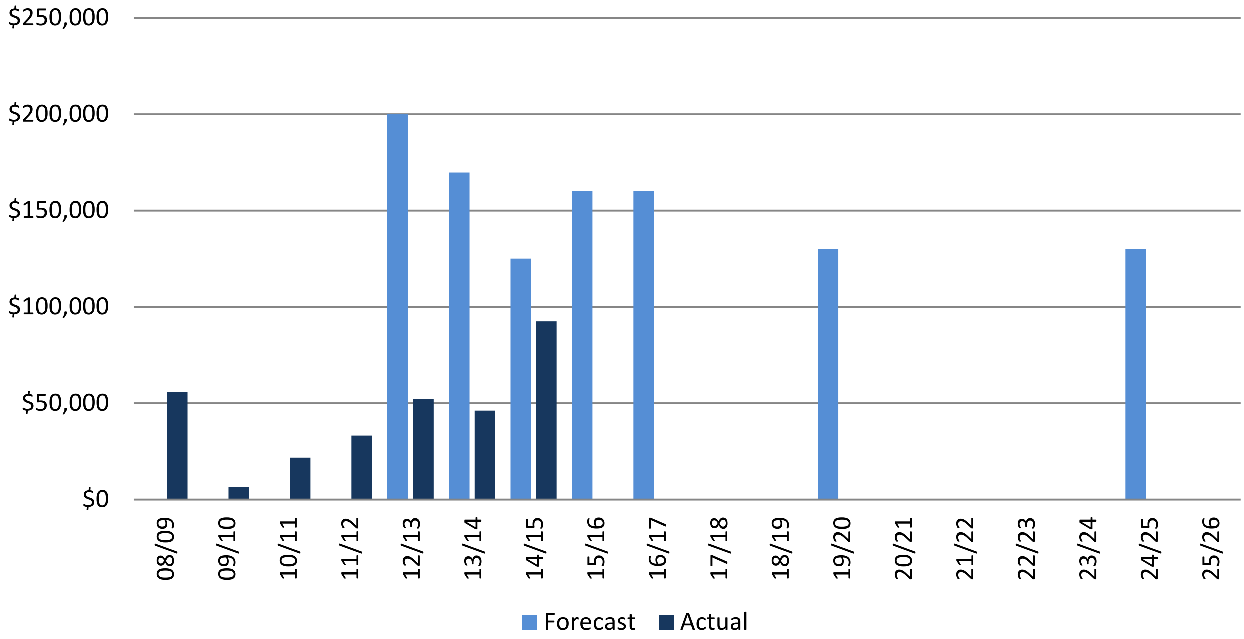
Figure 5: Overhead & structures inspection expenditure



9.3.1.2 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 1950's 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).

Figure 6: Inspection and treatment of steel towers expenditure



9.3.1.3 Inspection of natural timber poles under the possum guard

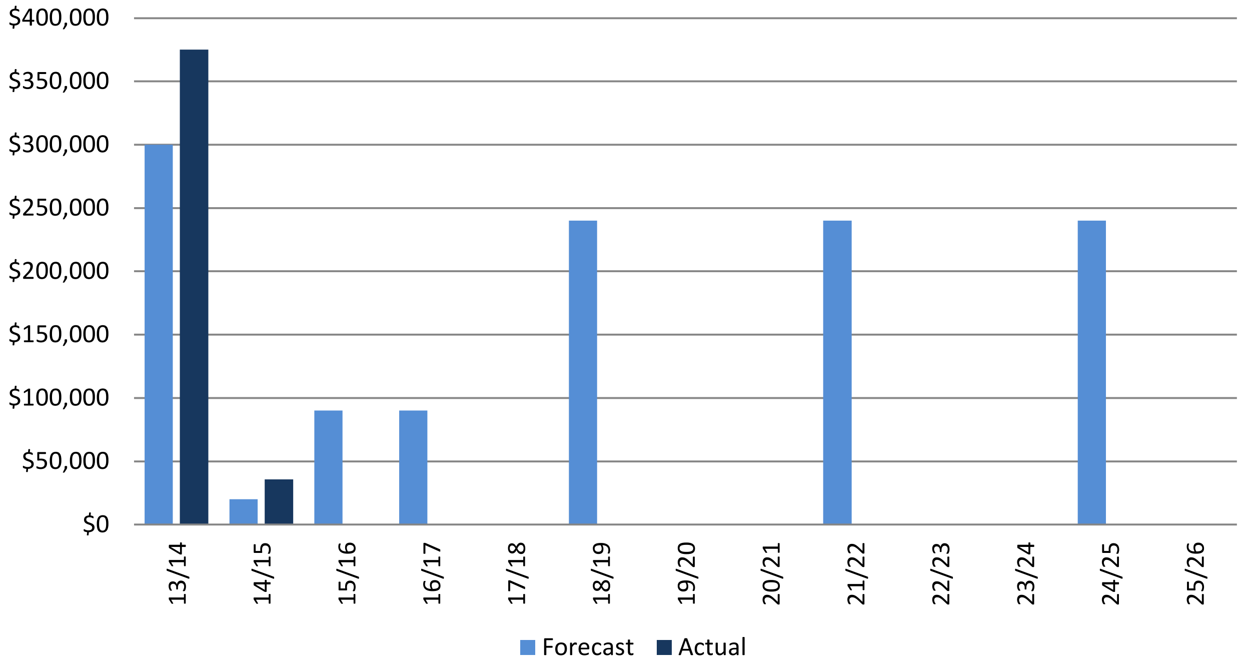
There have been failures of natural timber poles under the possum guard. The failure seems to be linked to the possum guard being too tightly wrapped around the pole preventing moisture from escaping which in turn allows wood rot to attack the pole.

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 will finish testing the remaining natural timber poles over the 2015/16 and 2016/17 financial years, of which there is only a small volume although they are scattered across the state.

Figure 7: Inspection of Natural Wood Poles under Possum Guard Expenditure



9.4 Non routine maintenance

9.4.1 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).

When a pole is leaning between 6º and 10º from vertical, there is a higher risk of conductor clashing, 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.

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 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.

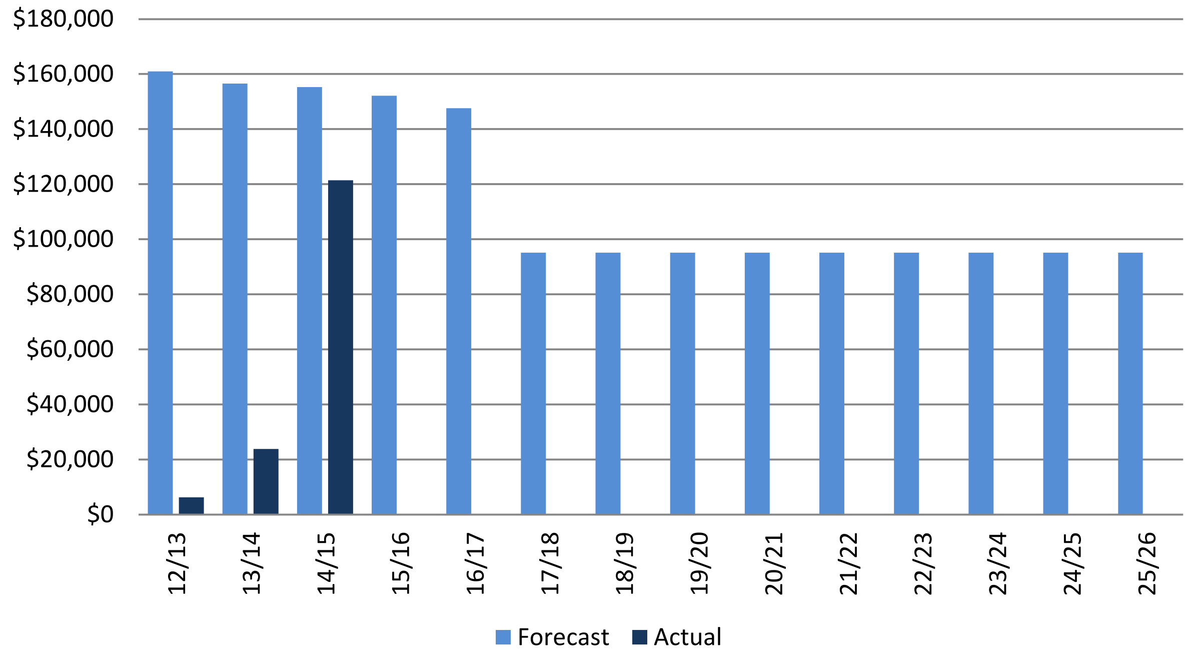
Approximately 170 leaning poles are recorded by Asset Inspectors per year and currently a defect pool exists of approximately 750 leaning poles. This category of work has historically been done under overhead asset repairs (AROCO), hence the backlog of defects due to other higher priority tasks being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

A review of pole footings is currently being undertaken as there have been instances of leaning poles that have been straightened repeatedly leaning. Methods being explored currently are pole rebutting technology and 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 projects highlighted the need to change TasNetworks pole footing practices.

Figure 8: Pole leaning more than 6º (or more than 4 pole tops)

Figure 9: Straightening leaning pole expenditure



9.4.2 Repair steel and concrete poles - RMOHS

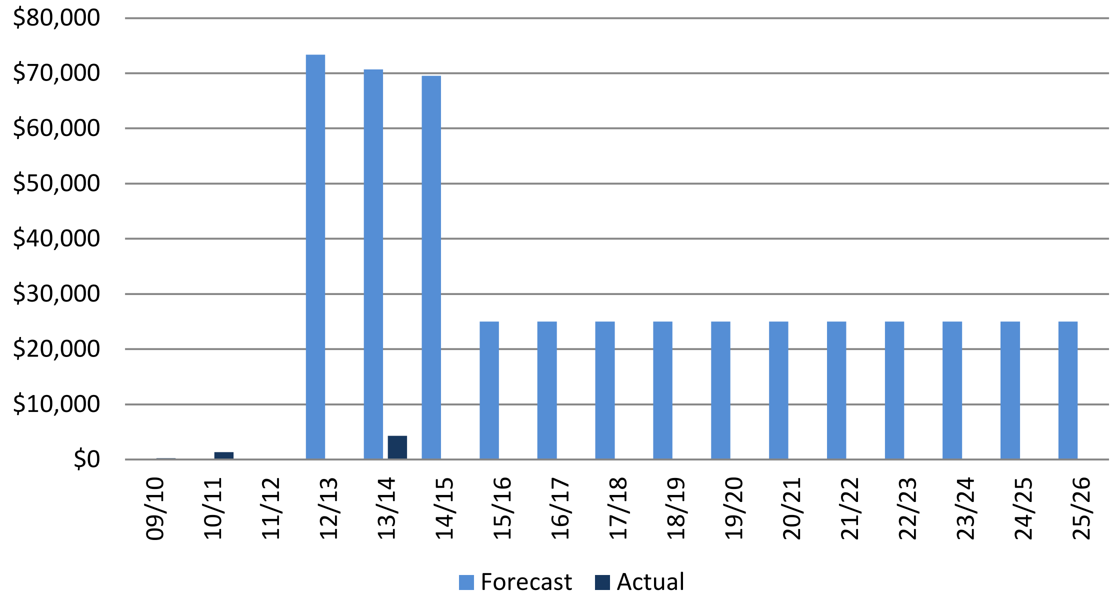
The driver for this program is managing business operating risks (safety). The program involves maintaining steel and Stobie structures in serviceable condition by repairing components found to be defective through the various inspection programs.

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 10: Poor condition steel and cncrete (Stobie) pole

Figure 11: Repair steel and concrete poles historic expenditure



9.5 Reliability and quality maintained

9.5.1 Replace damaged/condemned poles - REPOL

The drivers for this 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)

9.5.1.1 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.

The rate of wood pole deterioration depends on the species of timber, the initial preservative treatment, splits in the wood pole, installation location, soil conditions, 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.

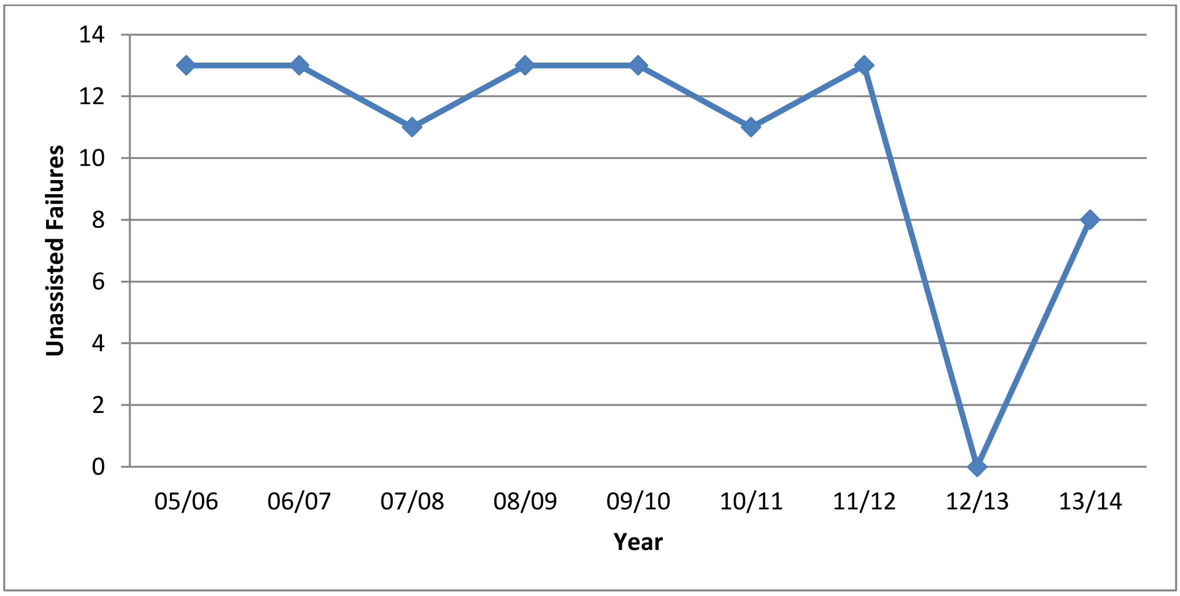
The volumes for this program are based on historical data and condition information that is gathered about the poles during audits (safety factor, amount of rot).

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 12: 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 13 shows this comparison collected from Energy Networks Australia (ENA) working group and shows TasNetworks compares favourably within its peer group.

Figure 13: Comparison of wood pole failure rates

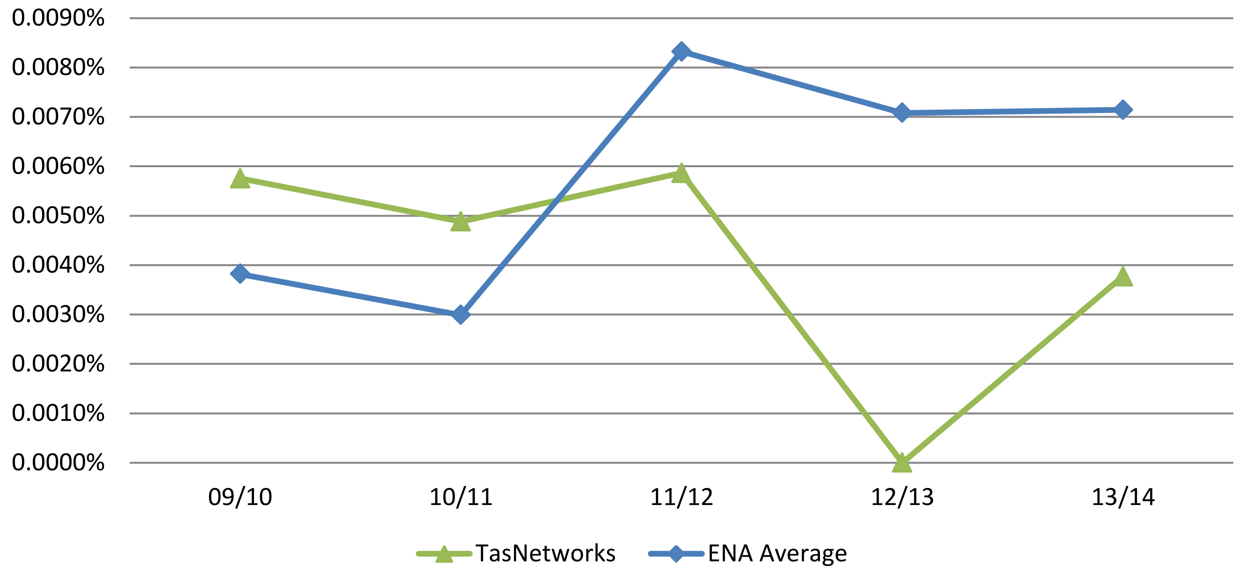
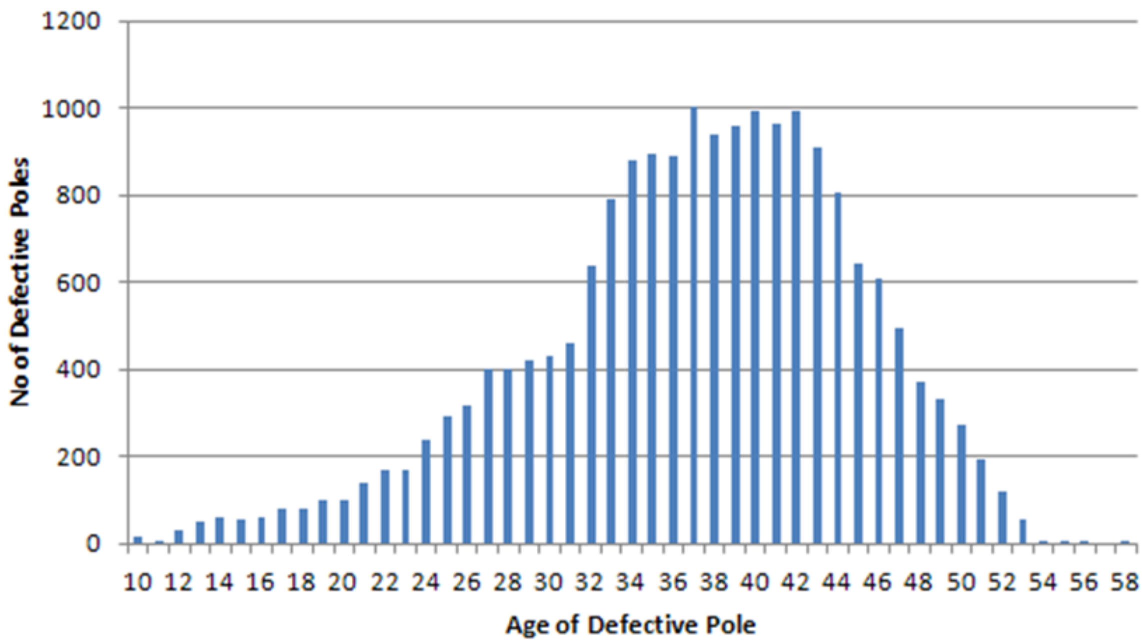


Figure 14 shows the age distribution of defective poles identified over the last decade shows a pole age of late 30s to early 40s as the average condemning/failure age for wooden poles.

Figure 14: 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.

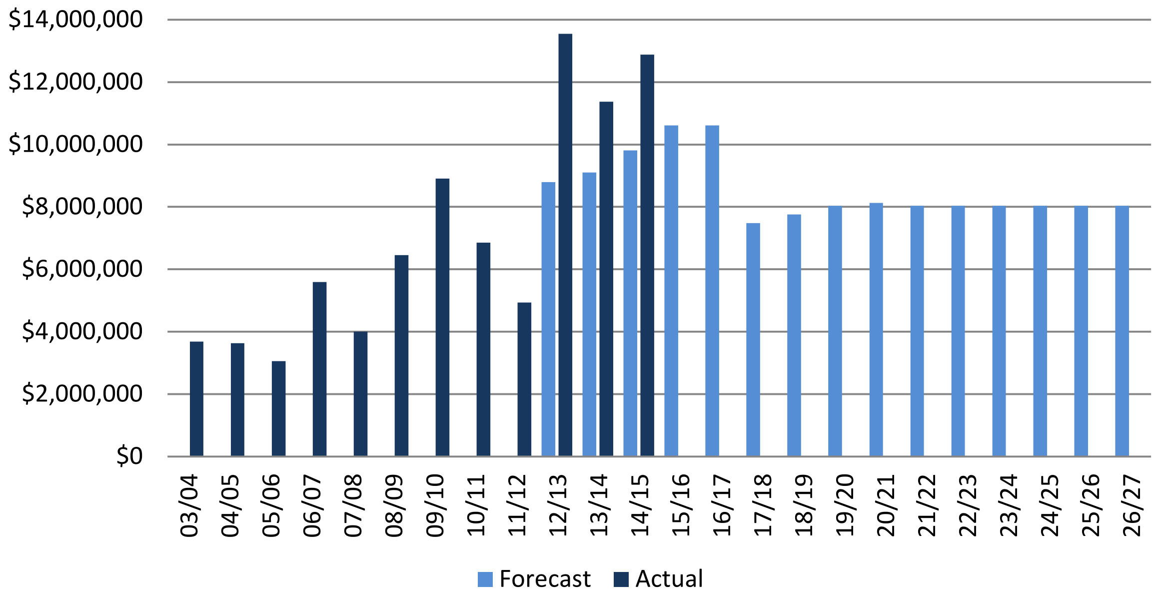
9.5.1.2 Replace poles MRBA (extreme events such as storms)

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.

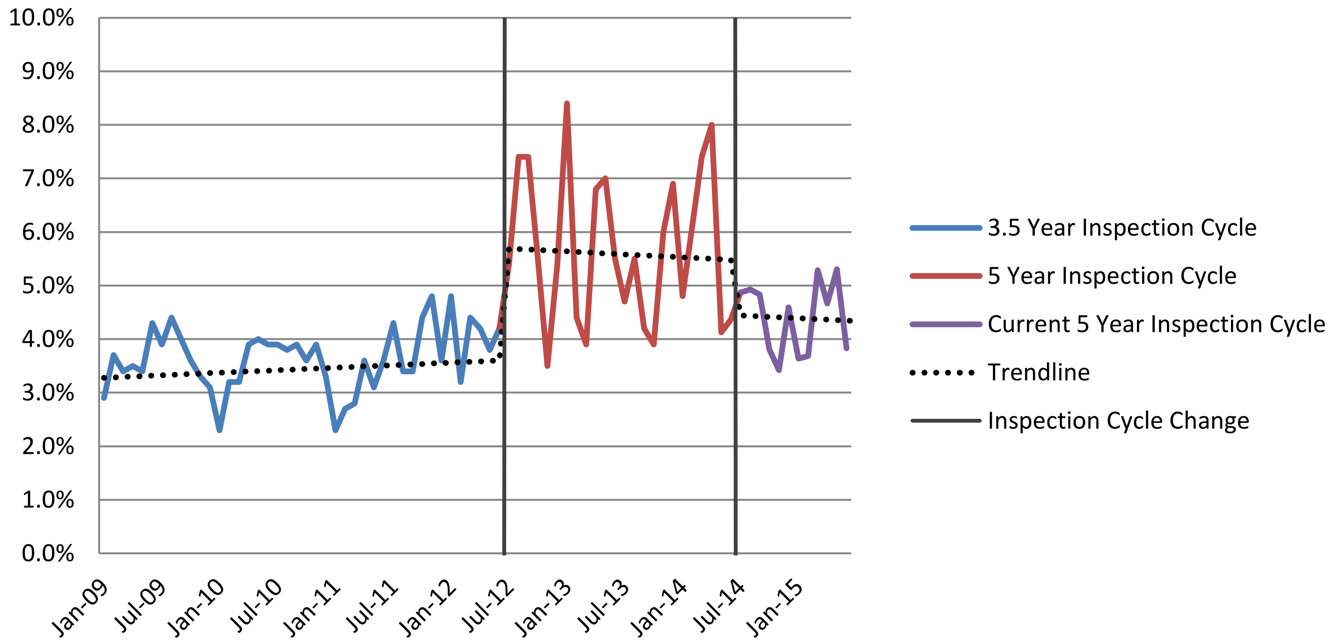
Figure 15: Wood Pole that has Failed in Service



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. Inspectors took a very conservative approach to condemning wood poles and as a result the number of condemned wood poles had a stepped increased as shown in figure 17.

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 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 17.

Figure 17: Rate of Condemned/Impaired Wood Poles



9.5.2 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.

9.5.2.1 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 18: Staked wood pole

Figure 19: Pole staking historic volumes

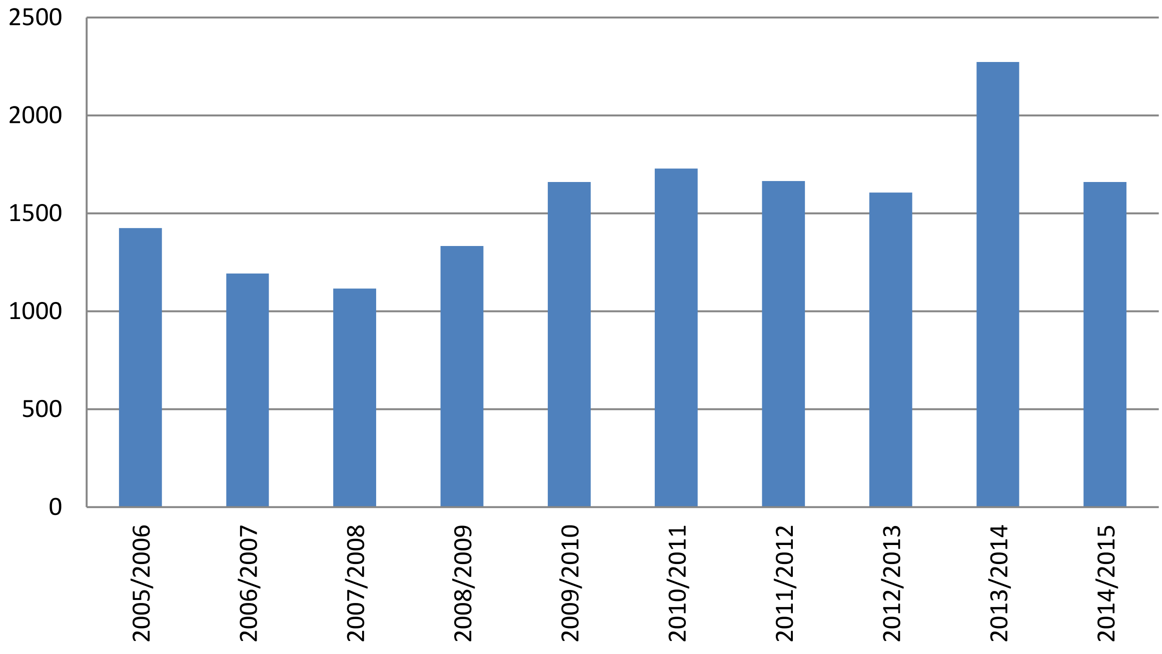
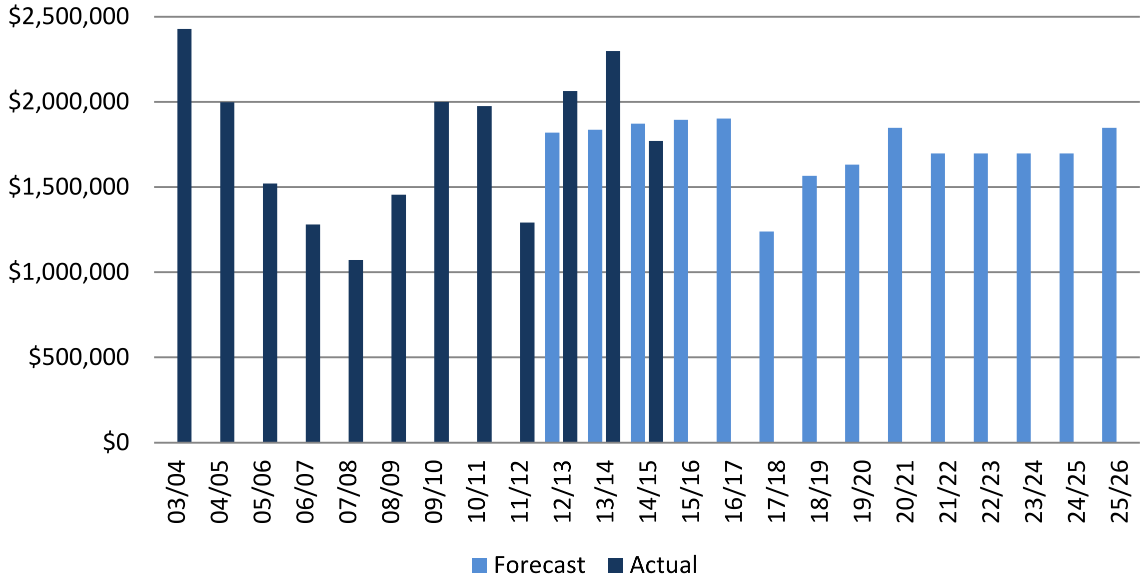


Figure 20: Pole Staking Historic Expenditure



9.5.2.2 Reinforce tower leg

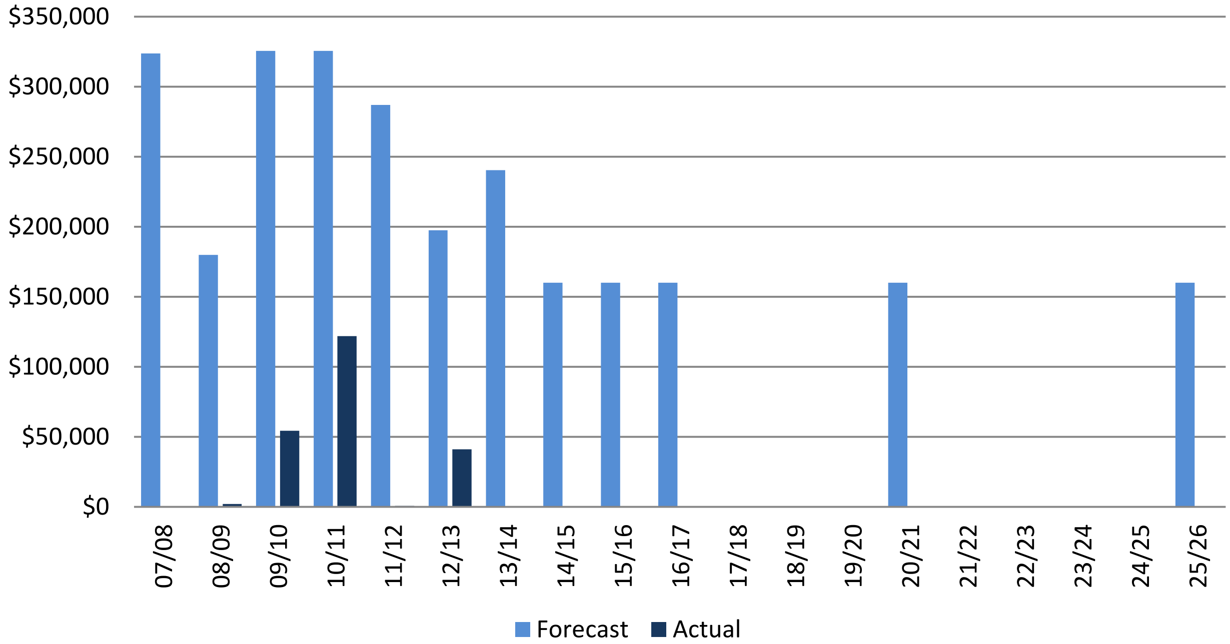
The aim of this program is to undertake major remedial works on the below ground portion of TasNetworks' distribution line steel towers. As with wood poles, steel towers deteriorate below ground at a faster rate than above ground.

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 21: Corrosion on surfaces of underground portion of Steel Tower Leg

Figure 22: Reinforce tower legs historical expenditure



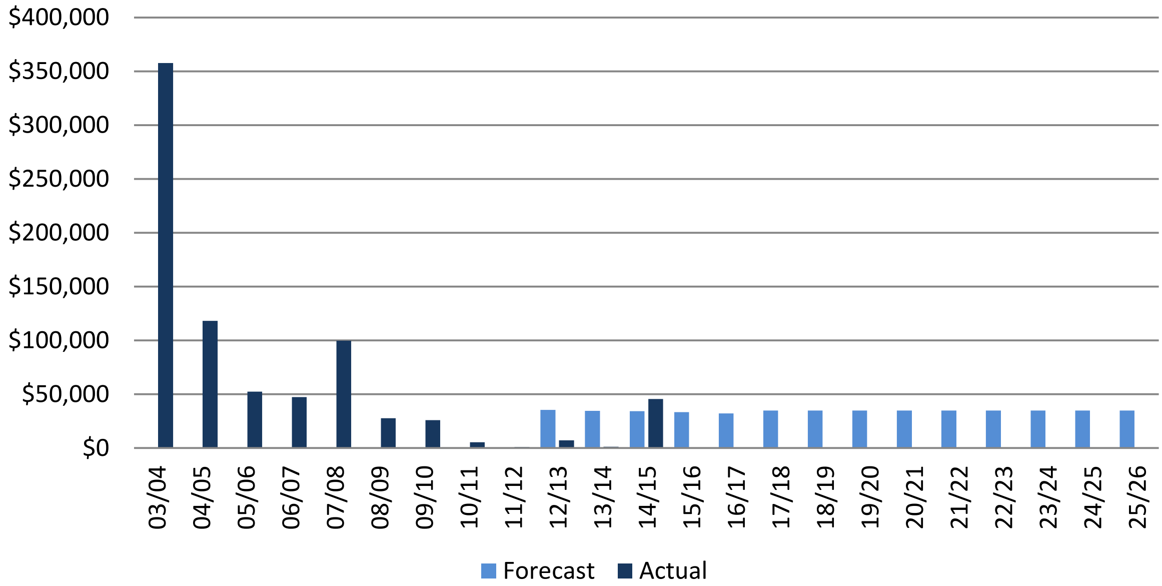
9.5.3 Install overhead LV – change over/upgrade service on telstra poles - RESTE

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.

Figure 23: Change over/upgrade service on Telstra poles expenditure



9.6 Regulatory obligations

9.6.1 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:

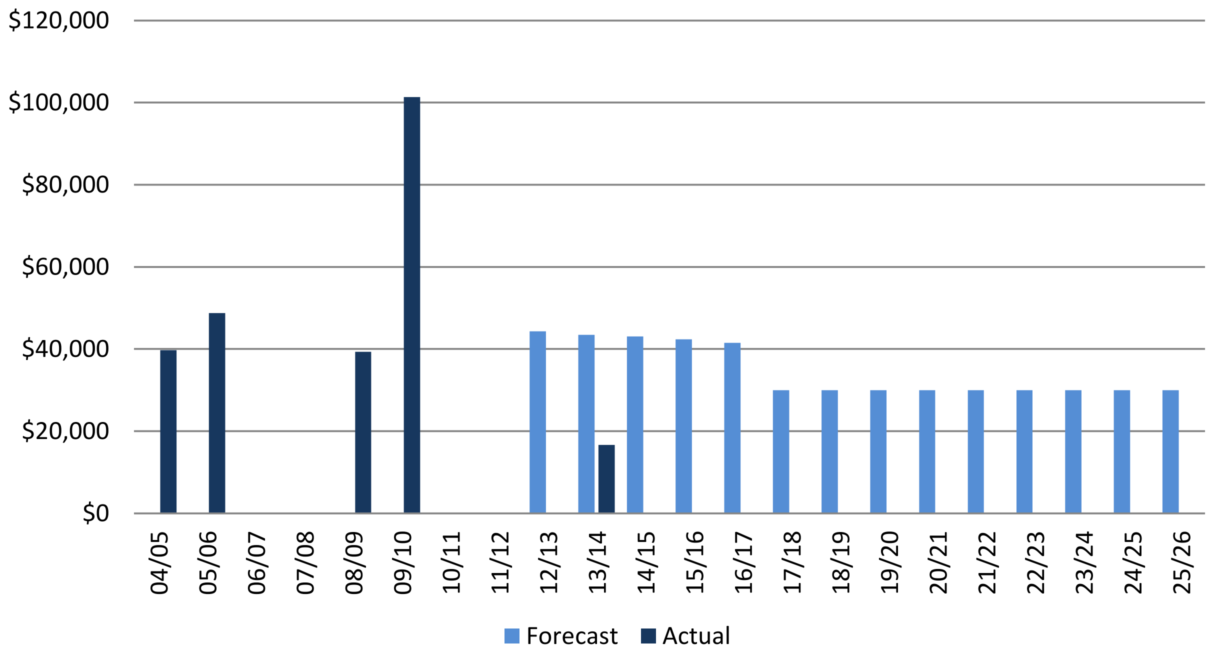
> *Unauthorized climbing of structures supporting energized overhead lines is a public safety issue that requires a national uniform standard of approach. Consideration should be given to anti climbing devices or measures to prevent or significantly deter unauthorized climbing.*

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 24: Anti-climbing Barrier with Faded Signage

Figure 25: Anti-climbing Barriers/Signage Program Historical Expenditure



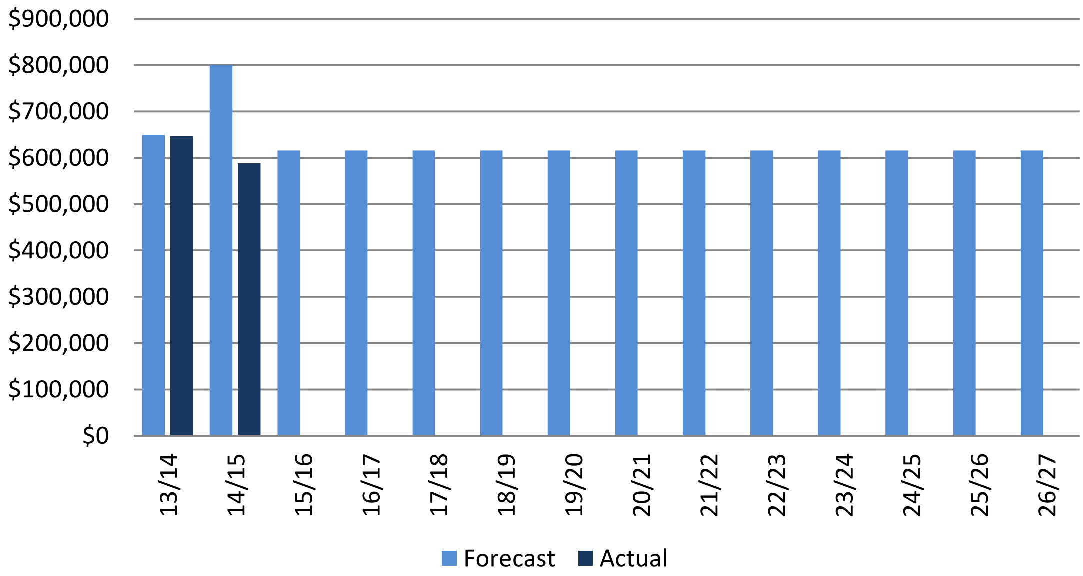
9.7 Unregulated

9.7.1 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 therefore internally funded.

Figure 26: Private Pole Inspections Historical Expenditure

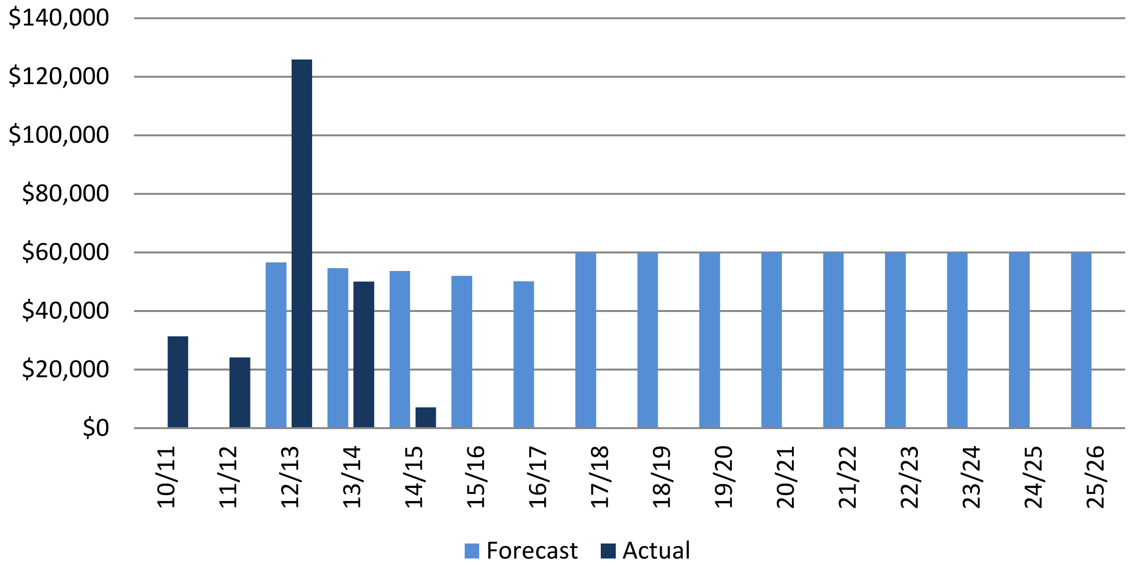


9.7.2 Supply disconnection / pole removal / asset inspection / making safe - CCPPS

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.

Figure 27: Supply Disconnection/Pole Removal/Asset Inspection/Make Safe Expenditure



9.8 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.

9.9 Summary of Programs

Table 5 provides a summary of all of the programs described in this management plan.

Table 5: 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

Work Program	Work Category		Project/Program
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

10 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.

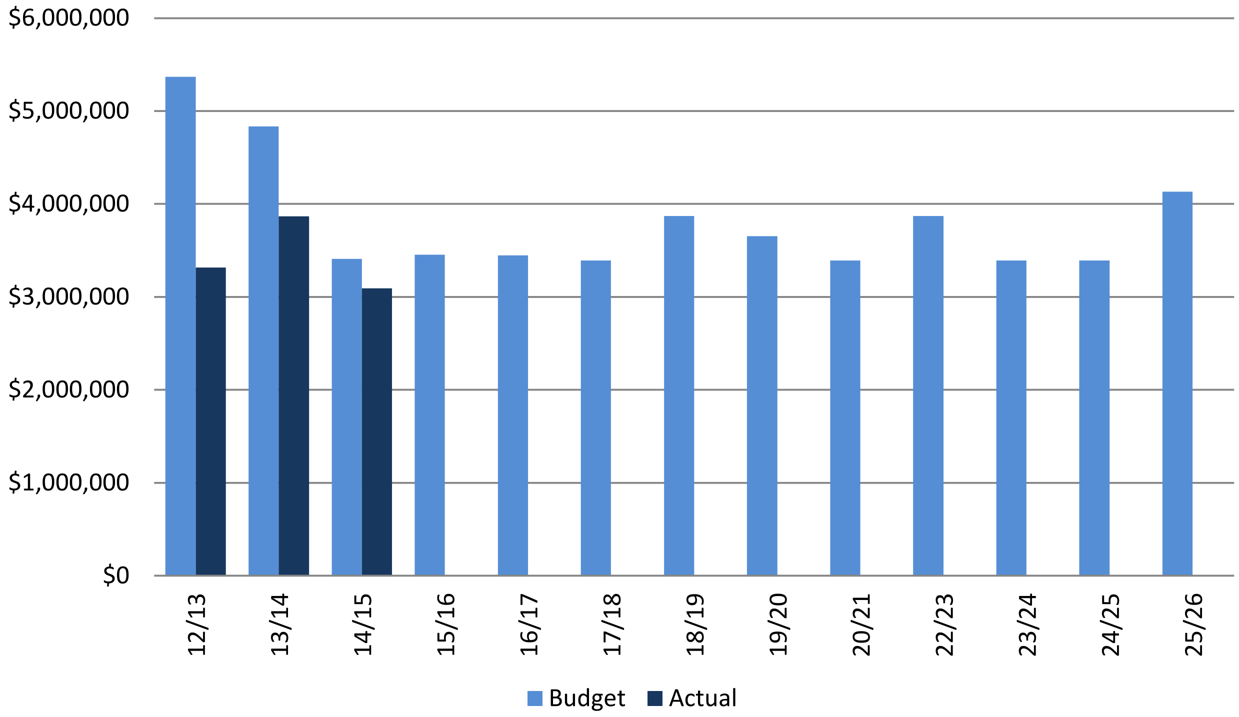
10.1 Proposed OPEX Expenditure Plan

TasNetworks proposes a total capital expenditure of $17.8 million over the next 5 years (2015/2016-2019/2020), with an average expenditure of $3.6 million per annum.

Table 6: OPEX for period between 12/13 and 19/20 financial years

	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Budget	$5,369,611	$4,833,405	$3,409,425	$3,455,280	$3,448,788	$3,392,190	$3,872,190	$3,652,190
Actual	$3,316,553	$3,866,722	$3,092,875	-	-	-	-	-

Figure 28: OPEX Expenditure Profile



10.2 Proposed CAPEX Expenditure Plan

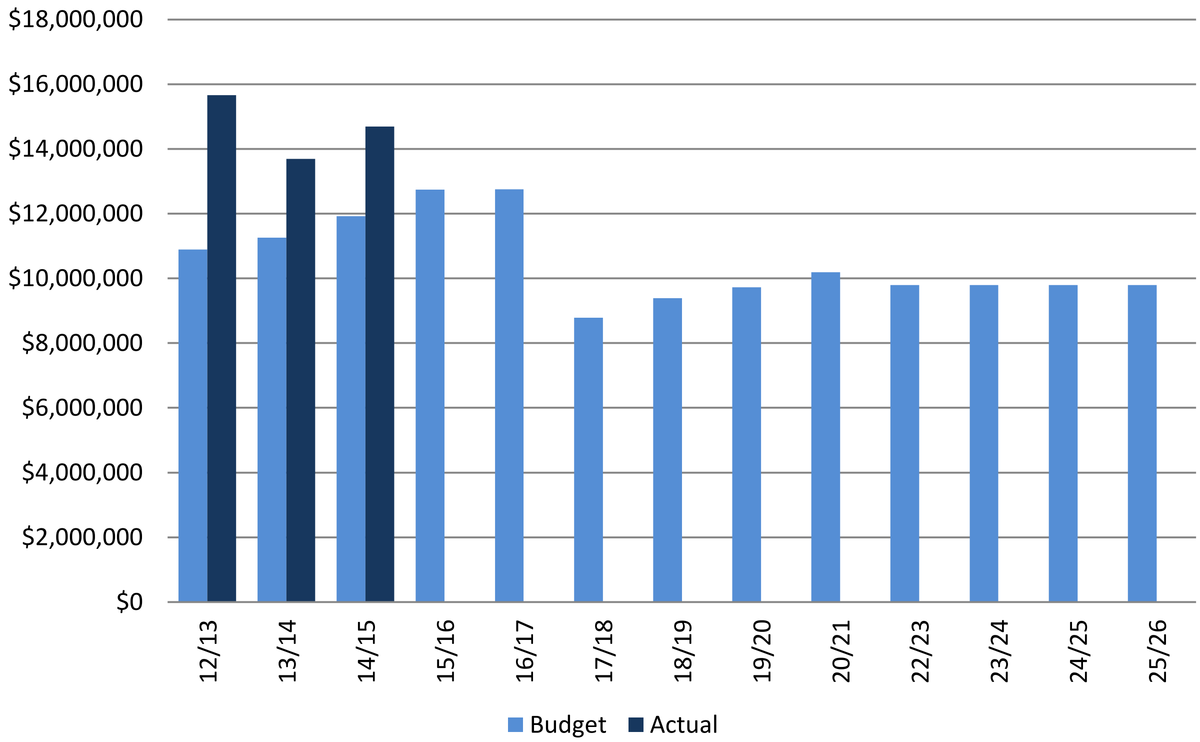
The capital programs and expenditure identified in this management plan are necessary to manage operational and safety risks and maintain network reliably at an acceptable level. All capital expenditure is prioritised expenditure based on current condition data, field failure rates and prudent risk management.

TasNetworks proposes a total capital expenditure of $53.4 million over the next 5 years (2015/2016-2019/2020), with an average expenditure of $10.7 million per annum.

Table 7: CAPEX for period between 12/13 and 19/20 financial years

	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Budget	$10,887,138	$11,254,139	$11,921,948	$12,745,148	$12,750,810	$8,780,860	$9,383,960	$9,726,100
Actual	$ 15,656,672	$13,691,795	$14,691,024	-	-	-	-	-

Figure 29: CAPEX Expenditure Profile



11 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 and Performance Leader.

12 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

13 Appendix A – Summary of Programs and Risk

Description	Work Category	Risk Level	Driver	Expenditure Type	Residual Risk	11/12	12/13	13/14	14/15	15/16 Forecast	16/17 Forecast
OH & Structures inspection	AIOHS	High	Safety	OPEX	Medium	$2,946,431	$3,184,473	$3,155,044	$2,720,122	$4,866,039	$ 4,787,294
Inspection of towers/steel lattice poles	AIOHS	High	Safety	OPEX	Medium	$33,195	$52,146	$46,137	$0	$160,000	$160,000
Inspection of natural timber poles under possum guard	AIOHS	High	Safety	OPEX	Medium	-	-	$374,996	$35,661	$90,000	$90,000
Repair Steel and Concrete Poles	RMOHS	High	Safety	OPEX	Medium	$0	$0	$4,325		$25,000	$25,000
Straighten Leaning Poles	RMPOL	High	Safety	OPEX	Medium	-	-	$23,859	$121,385	$152,195	$147,651
Replace damaged/ condemned poles	REPOL	High	Safety	CAPEX	Medium	$4,937,546	$13,545,578	$11,376,046	$12,875,548	$10,614,500	$10,614,500
Pole Staking	RESTK	High	Safety	CAPEX	Medium	$1,291,262	$2,063,019	$2,297,721	$1,769,893	$1,902,578	$1,894,809
Reinforce tower legs	RESTK	High	Safety	CAPEX	Medium	$503	$40,921	$0	$0	$160,000	$160,000

Change over / upgrade service on Telstra Poles	RESTE	High	Safety	CAPEX	Medium	$893.17	$7,152.97	$1,378.61	$45,584	$33,479	$32,262
Install anticlimbing barriers / signage program	RECBA	High	Regulatory	CAPEX	Medium	$0	$0	$16,650	$0	$30,000	$30,000
Private Pole Safety (Private Assets)	CCPPS	High	Safety	OPEX	Medium	$24,146	$125,850	$50,063	$7,197	$60,000	$60,000
Private OH Structures inspection & monitoring	CCPPI	High	Safety	OPEX	Medium	-	-	$647,221	$588,001	$616,000	$616,000