AMS – Victorian Electricity Transmission Network

Line Easements

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Table of Contents

1 Executive Summary

This document defines the asset management strategies for the Victorian transmission line easements which are approximately 3,600 kilometres in length and cover a total area of approximately 21,600 hectares.

Transmission line easements are generally held through allocation statements under the Electricity Industry Act and secure access rights for all transmission lines to ensure security of supply and so that maintenance activities can be performed.

The volume of transmission line easements has increased marginally in recent years mainly to accommodate connections of new generators and the extension of the transmission network to the desalination plant at Wonthaggi.

Asset management strategies for transmission line easements are stated below.

1.1 Overhead Lines

- Implement risk management plans which outline steps required to address identified non-compliant developments on easements.
- Implement risk management plans which outline steps required to address any further non-compliant developments identified through aerial photography.
- Extend inspections using aerial photography to all other transmission line easements situated within Melbourne Metropolitan boundary.
- Store all identified non-compliant developments in the asset management system against the relevant line easement segment numbers including detailed descriptions and associated levels of risk.
- Take a more pro-active approach to the provision of information to, and education of, the public regarding easement use and development.

1.2 Underground Cables

- Continue the regular patrols of the BTS – RTS 220 kV cable easement.
- Continue the regular patrols of the CBTS – WGI 220 kV cable easement.

1.3 Vegetation Management

- Continue to remove inappropriate tree species and where appropriate, replace with low growing shrubs.
- Continue to treat regrowth at short intervals to ensure treatment has a minimal environmental impact and within the capacity of economical and low profile equipment.
- Continue to perform detailed vegetation treatment assessments including local environmental and landowner sensitivities to ensure the optimum solution for all stakeholders.
- Quantify the feasibility of aerial laser vegetation-clearance scanning of transmission lines.
- Ensure that data captured during aerial laser scanning assessments is used to support vegetation management functions.
- Identify hazardous trees and implement risk mitigation works.
- Work in conjunction with DEWLP and CFA to develop fire risk assessments for the critical transmission corridors that consider vegetation near the transmission line or easement to quantify the fire risk to the corridors.
- Perform feasibility studies on the implementation of vegetation management programs outside existing easements on critical corridors identified as presenting high risk to security of supply during bushfire events.
- Create a register of fuel loading and transmission corridors based on the fire risk assessments.

1.4 Access Track Maintenance

- Continue to work with the DEWLP to resolve outstanding issues relating to easements on Crown Land.
- Continue to identify and repair / replace damaged bridges that provide AusNet Services with minimum time access to line assets, subject to agreement with the DEWLP.
- Continue to reinstate access tracks that have been affected by heavy rains and flood events to acceptable conditions.

1.5 Field Assessment Tools

- Review FMI functionality to work efficiently with the new asset management system and implement any feasible enhancements identified.

2 Introduction

2.1 Purpose

The purpose of this document is to define the asset management strategies for AusNet Services' electricity transmission network's line easements.

2.2 Scope

This asset management strategy applies to all transmission line easements associated with AusNet Services' electricity transmission network. The plan does not include asset management aspects of line easements for the distribution network or areas within switching stations, zone substations or terminal stations.

3 Asset Summary

3.1 Population

Transmission line easements can generally be defined as the lands on which towers stand and conductors cross and include a buffer area to ensure the safe and secure operation of the lines.

There are three basic categories of transmission line easement lands:

1. Private freehold land with registered easements which make up the bulk of transmission line easements. Most of these easements were created by the SECV and allocated to AusNet Transmission Group Pty Ltd through the provisions of the various Electricity Industry Acts.
2. Crown Land including land vested in Parks Victoria. These lands do not have a Certificate of Title and as such cannot have easements registered over them. Transmission line assets have been constructed over these lands by agreement with various State Government Departments.
3. Generation Company and other Utility Service Provider lands. These lands were previously either under control of the SECV or other State Government Utility Service providers such as Melbourne Water, VicTrack, Melbourne Port Corporation and local governments. While generally all are private lands owned by the relevant corporations, easements for transmission lines were never granted due to common ownership of the State. Transmission line assets are on these lands by agreement or licence.

Operationally, all three categories of easements are treated the same by AusNet Services and have statutory protections provided by the Electricity Safety (Installations) regulations in addition to the registered easement rights and implied easement rights.

Easements include motor vehicle roads and tracks, bridges, gates and drainage culverts. Easements total approximately 3,600 km in length and 21,600 ha in area. They vary in width from approximately 36 m for some rural single-circuit tower lines to in excess of 100 m for multiple circuit transmission lines in both rural and urban environments. The easement area for each network voltage is shown below in Figure 1.

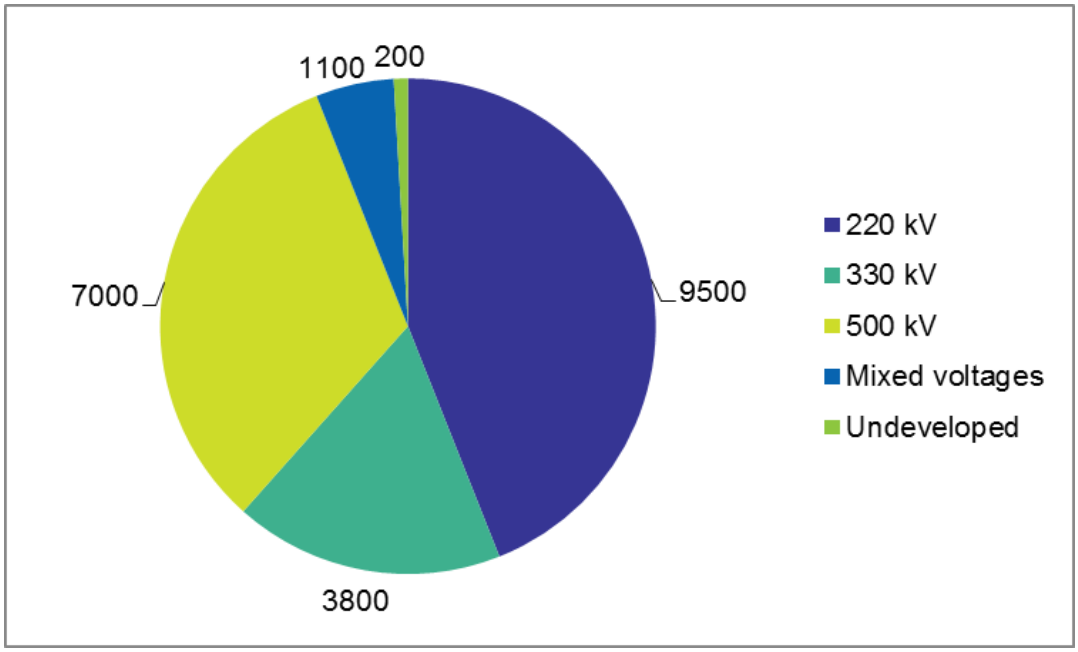

Figure 1 – Easement area in hectares (by network voltage)

Line Easements

The existing in-use easements often contain additional width as a provision for future lines. These, and the undeveloped easements, are managed by AusNet Services on behalf of Australian Energy Market operator (AEMO) to allow for future network development.

Easements over privately owned land make up approximately 90% of the total easement area. The remaining easements are over Crown Land. Registered easements on private land are shown on the property title. On Crown Land; AusNet Services is working towards an agreement in the form of a deed with the Department of Environment, Water, Land and Planning (DEWLP) for the use of Crown Land easements and access rights.

AusNet Services also manages an underground cable easement associated with the 9 kilometre BTS-RTS 220kV cable route. This is located primarily on road reserve and through parkland in the inner north eastern suburbs of Melbourne.

3.2 Condition

Line easement maintenance includes vegetation management and inspection and remediation of civil assets.

3.2.1 Vegetation Management

Vegetation patrols of transmission line easements are conducted by trained linesmen (Cert 2 or 3) on an annual basis. Patrols are required to ensure that the clearances between vegetation and lines infrastructure remain within acceptable limits. AusNet Services' line and easement vegetation management activities comply with the Electricity Safety (Electric Line Clearance) Regulations 2010 and its Schedule – Code of Practice for Electric Line Clearance (the Code). The Vegetation Management Plan[1] is reviewed annually to provide guidance for transmission line and easement vegetation management practices.

During scheduled easement patrols, linesmen identify impending or existing clearance breaches which require corrective actions such as tree trimming or tree removals. Subsequent corrective work orders are raised in the asset management system which includes a description of the required task. Emergency work orders are issued when a maintenance tasks is required urgently usually following an incident such as a tall tree fall, weather event or bushfire.

In the area of bushfire mitigation and vegetation management, significant long-term reductions in work load may be possible by implementing further strategies to change easement vegetation profiles to long-term minimum maintenance. It is also possible that future developments in technology will allow better monitoring of easement activity.

Laser scanning technologies have been used to identify substandard ground clearances on targeted transmission lines. Results obtained from the ground clearance assessments can also be used to assist in the development of vegetation management plans. All ground clearance assessments scheduled using laser technology have been completed.

[1] BFM 10-06 Vegetation Management Plan and Procedures (Transmission).

Line Easements

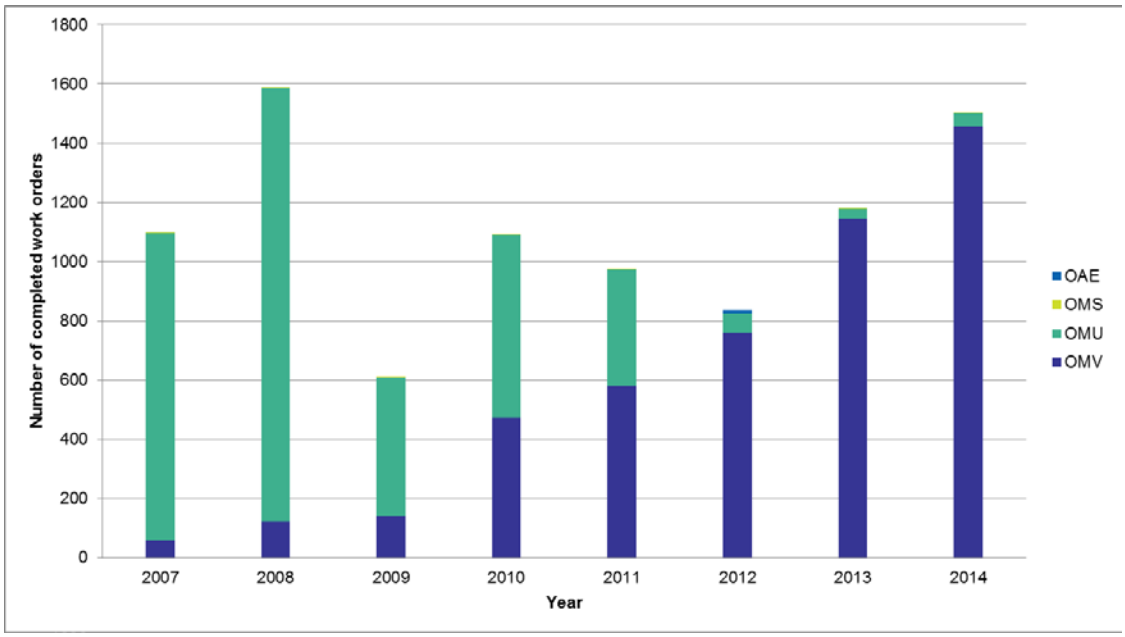

Figure 2 – Vegetation management related work orders on line easements.

Figure 2 above illustrates that a total of 8,886 work orders relating to vegetation have been completed over the past 8 years on line easements. Since 2012, the three year average has been 1,172 work orders per annum, a slight increase over the 1,073 work order average between 2007 and 2011. Operational Maintenance Vegetation (OMV) work orders began being raised in place of Operational Maintenance Unscheduled (OMU) work orders in 2010. Figure 2 illustrates the transitional change from 2010 onwards.

3.2.2 Civil Assets

Line easement civil assets include access tracks, tower sites, gates, culvert or drains and bridges. Condition assessments are performed by trained linesmen annually.

The vast majority of line easement civil assets are currently in good condition and require only routine maintenance.

Civil assets found to be in unacceptable condition require corrective actions which are assigned response times according to the extent of the asset deterioration. Civil assets in very poor condition which require urgent attention are assigned a short response time of 30 days. Assets which are not in very poor condition are assigned response times that range from 90 days to 900 days. Between 2007 and 2014, there have been 1,926 line easement civil assets requiring corrective action.

Figure 3 displays the number of assets found to be in unacceptable condition by specified response time.

Line Easements

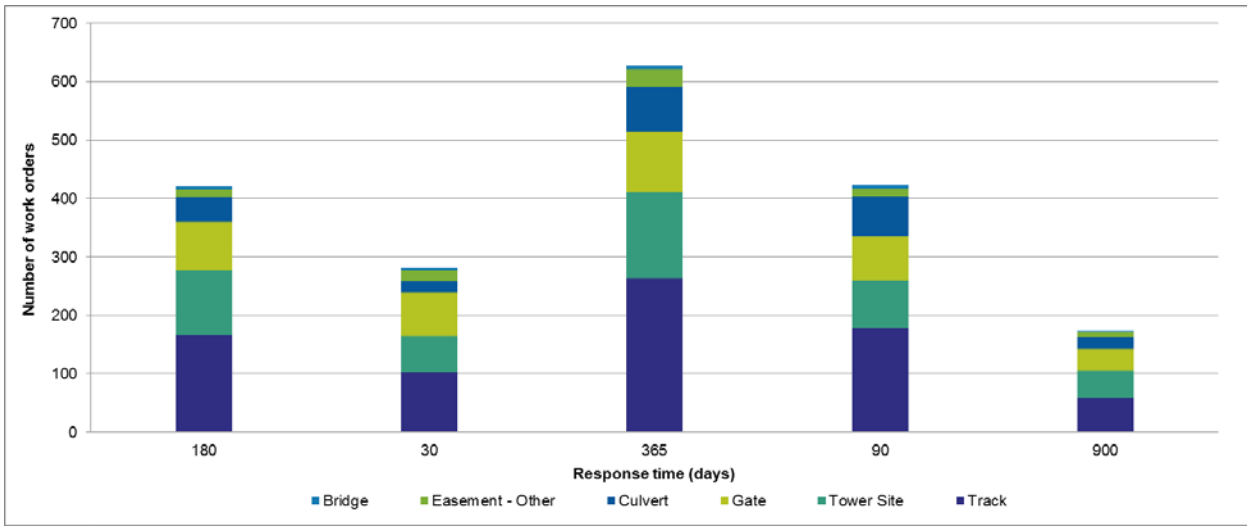

Figure 3 – Line easement assets in poor condition between 2007 and 2014.

Approximately 38% of the total defective assets are sections of access tracks and 21% are tower site areas. Typical corrective actions for access tracks include reinstatement of eroded vehicle tracks and grading of tracks to remove deep ruts; both issues result from heavy rainfall. Tower sites often become overgrown and require clearing or can become flooded in winter months.

Figure 4 shows the number of civil assets maintenance work orders completed from 2007 to 2014. The rise in work orders completed in 2014 is due to itemised work orders for individual tasks. Historically, multiple tasks were contained in a single work order. The proportionate increase per category has been rectified through a data cleansing activity on the Asset Management System. Therefore there has been a steady profile of work orders from 2009 onwards.

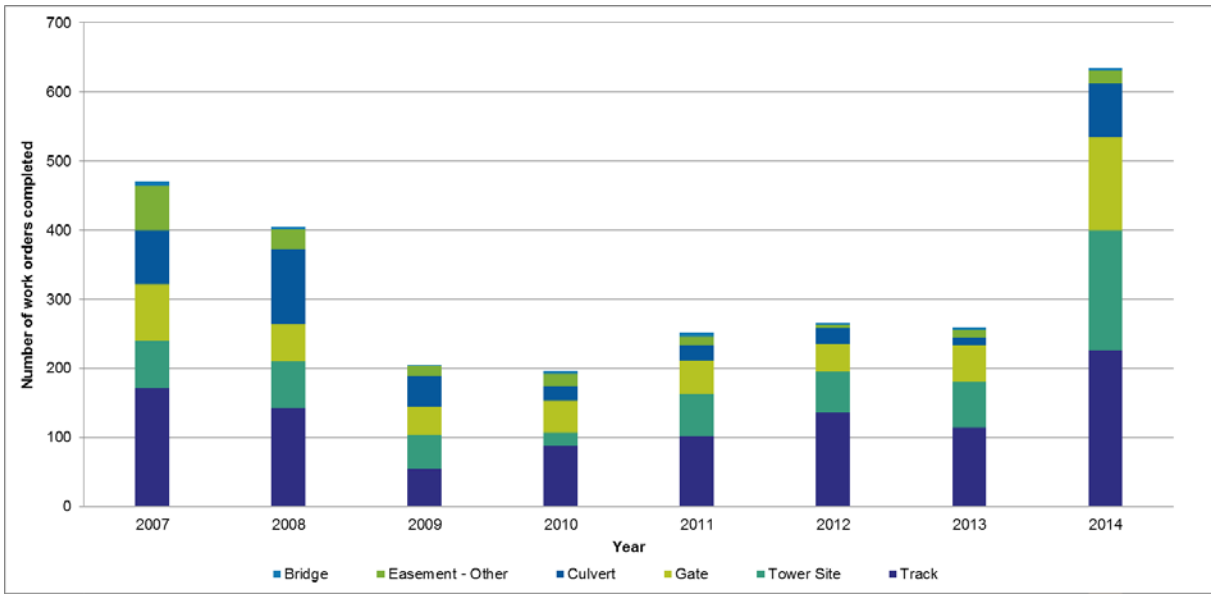

Figure 4 – Civil assets maintenance history from 2007 to 2014.

3.3 Performance

There have been no forced transmission line outages caused by vegetation infringements or defective line easement civil assets. However, there have been multiple forced outages caused by bushfires in close proximity or on transmission line easements. Thick smoke produced by bushfires can reduce the insulating properties of air in the vicinity of extra high voltage circuits and cause electrical flashovers to structures at earth potential.

Figure 5 displays the volume of bushfire related faults experienced over the last eight years. Seventy-five per cent of the total bushfire related faults took place in 2009 and the remaining 25% took place in 2014. These forced outages were caused by the 2009 Gippsland bushfires and wildfires at numerous locations including Bunyip state park, Kinglake national park, the Buckland Valley and a bushfire in 2014, 110km south of Red Cliffs where the smoke caused 4 line outages.

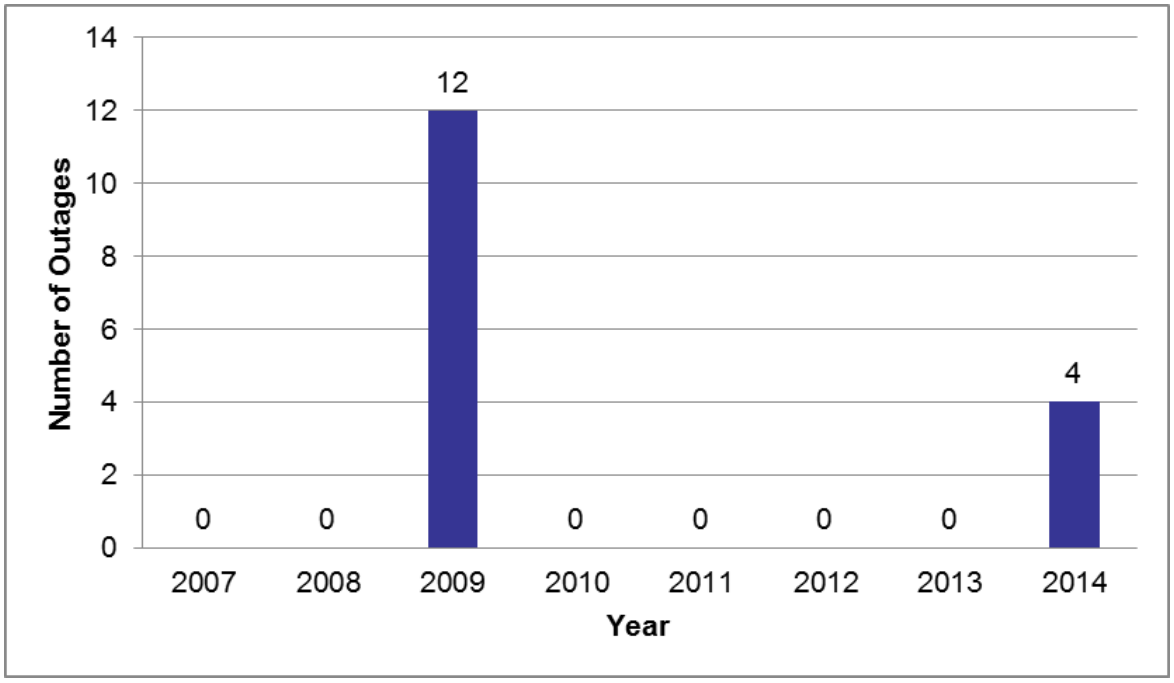

Figure 5 – Bushfire related transmission line outages

4 Risk Management

4.1 Land Use and Development

Easements are on both private and public land where public access to the easement, including towers, is not restricted. In many instances easements are shared or located next to other infrastructure such as roads, railway lines, pipes and fences.

Such shared usage or proximity requires management of the physical and electrical compatibilities. This forms part of the risk management activities.

AusNet Services has prepared Easement Use Guidelines[2] that prescribe the use and development of easements.

Land use in rural areas can include grazing, cropping, orchards and forestry. This presents challenges in the control of planting (e.g. wind-breaks and commercial plantations), construction (e.g. dams and hay sheds), machinery use (e.g. large vehicles often used in wheat or grape harvesting) and high pressure 'gun' irrigators.

Land use in urban areas can include some of the abovementioned items, plus subdivision, residential and commercial development and major infrastructure. This can present challenges in the control of clearances (e.g. to enable the construction and maintenance of buildings and structures), recreational use (e.g. kite flying and swimming pools), changed landform (e.g. freeway construction) and high-risk environments (e.g. petrol and gas refuelling sites). Subdivision brings a need for greater surveillance and often presents greater difficulty in access and patrol activities.

Owners of property in close proximity to line easements have increasing expectations for the provision of consultation and concessions to minimise the impact of line easement management activities on their assets, lifestyle and property values.

Certain usages and activities, which could increase the risk to line security or public safety, are not permitted under the conditions of easement. In order to maintain easement rights, AusNet Services has implemented risk assessments on selected lines aided by aerial photography. This assessment mostly focused on urban easements to determine the location and type of developments that appear to be non-compliant with easement rights. Inspection priorities were established based on risks associated with conductor drop. This program of aerial inspection targeted the oldest 220kV lines situated in the Melbourne metropolitan boundary as priorities. This program has been completed and aerial photography taken at different locations on five line easements has identified a total of 151 non-compliances. This aerial inspection technique will be extended to all other line easements situated within the Melbourne Metropolitan boundary and actions will be taken to address any further non-compliance identified. Figure 6 displays numbers of and the types of non-compliances identified.

[2] Easement Use Guidelines.

Line Easements

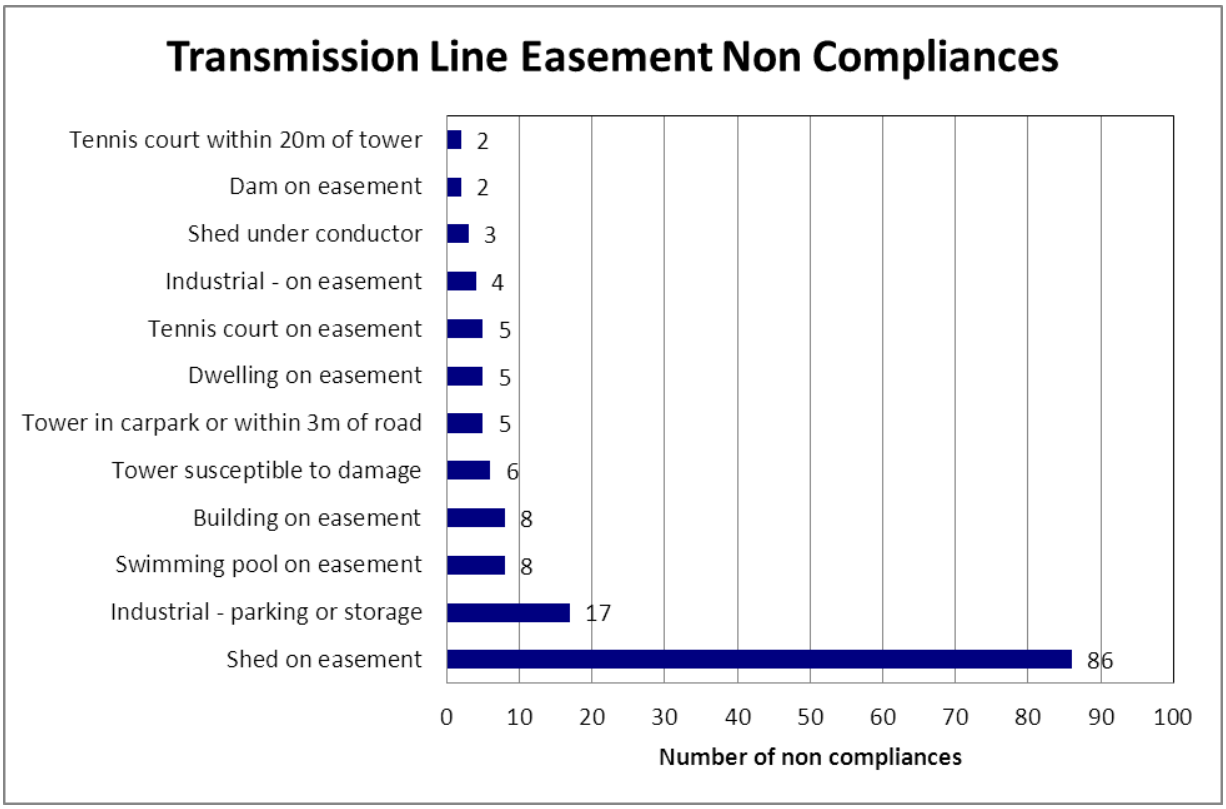

Figure 6 – Transmission Line Easement Non Compliances

The majority of non-compliances identified were sheds which have been constructed on line easements contributing to 58% of the total. Quantification of risks associated with each of the non-compliances is required to establish the scope and priorities of rectification steps. If the non-compliance can be removed, AusNet Services or the appropriate planning authority will advise the land owner to do so. Conversely, when removal of the non-compliance is not possible appropriate steps must be taken to ensure that the associated risks are reduced so far as is practical (SFAIP).

Aerial photography of all remaining transmission line easements situated within the Melbourne metropolitan boundary are required in order to identify any additional easement non-compliances.

Once identified, risk reduction measures will be developed and implemented for all non-compliances.

4.2 Electrical Safety

AusNet Services must provide for the safety of employees, contractors and the general public by ensuring safe clearances are maintained between electrical conductors, structures, vegetation and the ground. Under fault conditions, abnormal voltages are created on tower structures and on the ground near the faulted location. Also, under normal and fault conditions, magnetic induction can cause unwanted voltage sources on adjacent pipes, fences, rails, and telecommunication cables. These hazardous and nuisance voltages are controlled by system design, operations and maintenance, and the management of land usage on the easement.

Transmission lines generate electric and magnetic fields (EMF) which has been the subject of health concerns. Public and scientific debate has prompted numerous scientific studies aimed at assessing negative impacts of EMF to human health; however, no clear link has been identified. AusNet Services' transmission lines EMF levels are within health guidelines on EMF set by the National Health and Medical Research Council (NHMRC). AusNet Services publishes an EMF position statement[3] which outlines the general approach to managing EMF levels.

[3] All about electric and magnetic fields from transmission lines (2010).

4.3 Vegetation Density

Fuel densities on line easements must be kept low enough to minimise asset damage, particularly to insulators, conductors and OPGW and associated joints in the event of a bushfire. Easements containing lines require vegetation heights to be kept below three metres for the lines entire length and a tree clear area within 15 m of each tower. Prudent management of easement fuel densities can also reduce the likelihood of forced outages caused by bushfires.

Trees are not permitted to be planted in underground cable easements and tree roots must not be permitted to grow into the easement such that damage could be caused to cables. Large trees must be planted well clear of the easement. Certain grasses, ground covers and smaller shrubs may be acceptable provided that there is no disturbance of cable cover. Metal stakes must not be driven into a cable easement and non-metallic stakes may be driven up to a maximum depth of 300mm.

Cable maintenance works can also cause damage to planted vegetation areas, so it is best to keep any vegetation to a minimum on cable easements.

A study commissioned by AusNet Services and performed by Dr Kevin Tolhurst from Melbourne University concluded that the impact of bushfires on live transmission lines could be minimised by reducing fuel loads both on and adjacent to line easements. This fuel reduction could be achieved by prescribed burning or mechanical treatment of existing vegetation.

Detailed descriptions of vegetation management procedures and guidelines for transmission line easements are set out in AusNet Services' Vegetation Management Plan[4] document which is updated annually.

4.4 Network Performance

Easement patrol is aimed at securing reliable line operation. The aim is to manage the height and type of vegetation in the network's environment so as to prevent flashovers due to insufficient clearances or damage from falling trees. A reduction in fuel would also help to minimise the number of bushfire related outages experienced. Corrective maintenance works for line easement assets ensures safe and adequate access to lines assets is possible at all times.

Inquiries relating to 'Dial Before You Dig' must be managed for underground cable easements where third parties indicate plans to work in the vicinity of the network. These inquiries usually lead to site meetings with contractors and survey marking of the cable alignment.

4.5 Easement Erosion

Soil erosion has occurred affecting three 220 kV tower foundations resulting in risk to the structural integrity of the towers. Soil erosion will start reducing the design capacity of the tower foundation. The erosion is ongoing and if sites are not reinstated and protected the towers may collapse during a high wind event.

[4] BFM 10-06 Vegetation Management Plan and Procedures (Transmission).

5 Strategic Factors

The prime drivers of investment are risk minimisation, the cost effective control of vegetation and maintenance of access. Primary risks include risks to the community, ensuring appropriate electrical clearances (mainly through vegetation management) and the control of easement activities.

5.1 Easement Use

Easement use is monitored through an office based administrative process (planning and work applications, etc.) and field involvement in the review and approval of works and operation of equipment in the vicinity of lines. Field liaison with contractors and routine patrols also help to ensure landowner and contractor compliance. However, unapproved works do take place and remedial action must be negotiated with other stakeholders.

AusNet Services provides brochures and other information to land owners and consultants upon request. However, the supply of information to the public needs to be more pro-active so as to ensure that landowners are more aware of their rights and responsibilities for the use of easement land under their control. A program of educating the public will be undertaken through a direct mail-out to all owners or occupiers of land containing a transmission line easement. Direct mail outs will be supplemented with stakeholder communication initiatives using various media outlets and the AusNet Services' website.

Cable markers have been introduced on the BTS – RTS 220 kV cable easement. The markers have been installed as flush-set concrete blocks in parkland and streamside reserves. Adhesive markers have also been installed on poles and lighting masts in paved areas to indicate the cable alignment is in the vicinity.

5.2 Bushfire Mitigation

Transmission line assets can cause ground fires under fault conditions. The risks associated with bushfire ignition prompts the annual implementation of the bushfire mitigation program[5]. Forced outages of the transmission network can be caused by bushfires on or in close proximity to line easements. Forced outages caused by bushfires can reduce network reliability during critical periods and so steps must be taken to minimise the likelihood of such events occurring.

Vegetation control is an ongoing activity to ensure that a line can be operated without any fire hazard or risk to line security. Many sections of lines are constructed in environmentally sensitive areas where the extent of clearing is kept to a minimum to satisfy the needs of the relevant land managers.

In less sensitive areas, trees are generally removed to reduce future maintenance activity. A balance exists between keeping easements completely clear of trees and environmental pressures to retain trees and trim only the minimum necessary. Environmental pressures may arise from landowners and managers, community groups, councils and statutory bodies.

The scope of work is driven by the requirement to meet the mandatory provisions of the Bushfire Mitigation Policy. The policy covers inspections, minimum clearances, auditing and the objectives of reducing long-term maintenance needs and raising inspection and audit confidence levels through the early identification and removal of unsuitable tall-growing species. Current strategies rely on negotiation to remove or trim, including replacement with suitable species, preferably off the easement.

The bushfire mitigation program for transmission assets manages bushfire-related risks in order to ensure the safety of the public, of AusNet Services' personnel and assets, and to maintain the reliability of the transmission system. This program is set out in the Bushfire Mitigation Management Plan, which is reviewed and re-issued annually. The Plan focuses on the following elements as the main requirements to reduce bushfire risk on the transmission network:

[5] BFM 10 – 02 Bushfire Mitigation Management Plan.

- Describe the strategies and programs implemented to mitigate the risk of fire ignition from supply network assets.
- Describe the processes and procedures for monitoring the implementation and effectiveness of the bushfire mitigation strategies and programs.
- Describe the corrective action processes and procedures for ensuring effectiveness of the bushfire mitigation program.
- Describe the processes and procedures that apply to operation and maintenance of the supply network in high bushfire risk areas during the fire season period and total fire ban days.
- Nominate persons responsible for preparation and implementation of the Plan and their contact details.
- Provide contact details in the event of an emergency.
- Demonstrate compliance with the Electricity Safety (Bushfire Mitigation) Regulations 2013.

5.3 Lines Ground Clearance

Laser scanning of older transmission lines suspected of non-compliance with current transmission line design standards[6] and AusNet Services' accepted Electricity Safety Management Scheme (ESMS) has been completed. Processing of the data collected is now required so that ground clearance reports can be generated for each of the scanned lines. These reports will assist in identifying spans which do not meet the requirements of AusNet Services' ESMS and will form the basis for a conductor ground clearance risk management plan[7].

5.4 Maintenance of Access Tracks

Adequate access for routine maintenance and for reconstruction activities is essential on all transmission line easements. In forest areas, the majority of access is via basic (4WD standard) tracks established for line construction. Access in rural areas is usually over open ground.

In some cases, access tracks are constructed in areas of poor access, particularly in mountain areas. Maintenance of tracks and culverts is required to prevent soil erosion. Floods have caused significant damage. Tracks on private land were generally constructed without track easements, on a negotiated and often shared-use basis.

Access arrangements need regular review to keep up with subdivisions and property developments. Existing tracks or access arrangements can be lost due to a lack of track easements. Negotiation is required to recover patrol and maintenance access.

Currently, deficiencies in track, gate and bridge or culvert conditions are recorded during line patrols. Work orders are then created for repair under contract.

Additionally, there is a current unresolved issue with easement tracks, bridges, etc, on Crown Land. The "Roads Act" allocates ownership and responsibility for tracks on Crown land to the Department of Environment, Water, Land and Planning (DEWLP). AusNet Services is currently working with the DEWLP to establish the detail of future arrangements regarding ongoing access, liability, related costs and the process to be followed where upgrades or replacements of infrastructure such as bridges are required.

5.5 Field Assessment Tools

Field Mobile Inspection (FMI) tools are currently used to assist inspectors to record information gathered during easement patrols and inspections. The FMI tool acts as an interface between the user and the asset management system facilitating automatic data updates from the field.

A review of the tools functionality is required due to an update in the asset management system. This will assist in identifying any possible enhancement opportunities. This review will allow system administrators to ensure that the tool is well embedded within business processes and procedures whilst providing opportunities to users to give feedback regarding ease of use.

[6] AS/NZS 7000:2010 Overhead Line Design – Detailed Procedures.

[7] AMS 10-79 Transmission Line Conductors.

6 Key Issues

The key issues associated with transmission line easements are as follows:

- Some line easements share usage with other infrastructure such as roads, railways, pipelines and fences posing increased health and safety risks.
- Non-compliant developments have been identified on transmission line easements which compromise the levels of safety and reliability of the overhead line.
- Additional non-compliant developments may exist on line easements which have not yet been assessed using aerial photography.
- Forced outages of transmission lines can be caused by bushfire on or in close proximity to easements.
- Easement tracks can be adversely affected by heavy rainfall and require remedial works so that adequate access is maintained.
- Flashovers caused by the operation of equipment with no permission granted.
- Erosion due to land owner activity near towers placing tower integrity at risk.

7 Strategies

7.1 Overhead Lines

- Implement risk management plans which outline steps required to address identified non-compliant developments on easements.
- Implement risk management plans which outline steps required to address any further non-compliant developments identified through aerial photography.
- Extend inspections using aerial photography to all other transmission line easements situated within Melbourne Metropolitan boundary. Store all identified non-compliant developments in the asset management system against the relevant line easement segment numbers including detailed descriptions and associated levels of risk.
- Take a more pro-active approach to the provision of information to, and education of, the public regarding easement use and development.

7.2 Underground Cables

- Continue the regular patrols of the BTS – RTS 220 kV cable easement.
- Continue the regular patrols of the CBTS – WGI 220 kV cable easement.

7.3 Vegetation Management

- Continue to remove inappropriate tree species and where appropriate, replace with low growing shrubs.
- Continue to treat regrowth at short intervals to ensure treatment has a minimal environmental impact and within the capacity of economical and low profile equipment.
- Continue to perform detailed vegetation treatment assessments including local environmental and landowner sensitivities to ensure the optimum solution for all stakeholders.
- Quantify the feasibility of aerial laser vegetation-clearance scanning of transmission lines.
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- FMI functionality to work efficiently with the new asset management system and implement any feasible enhancements identified.