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Content

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Note: Concerns queries and comments on this document should be referred to the compiler:

1. INTRODUCTION

The interaction of vegetation and power lines is complex. Plants are responsible for a high percentage of line faults including the provision of fuel for fires under power lines. The aspect of line faults originating from fires have not previously been documented and quantified.

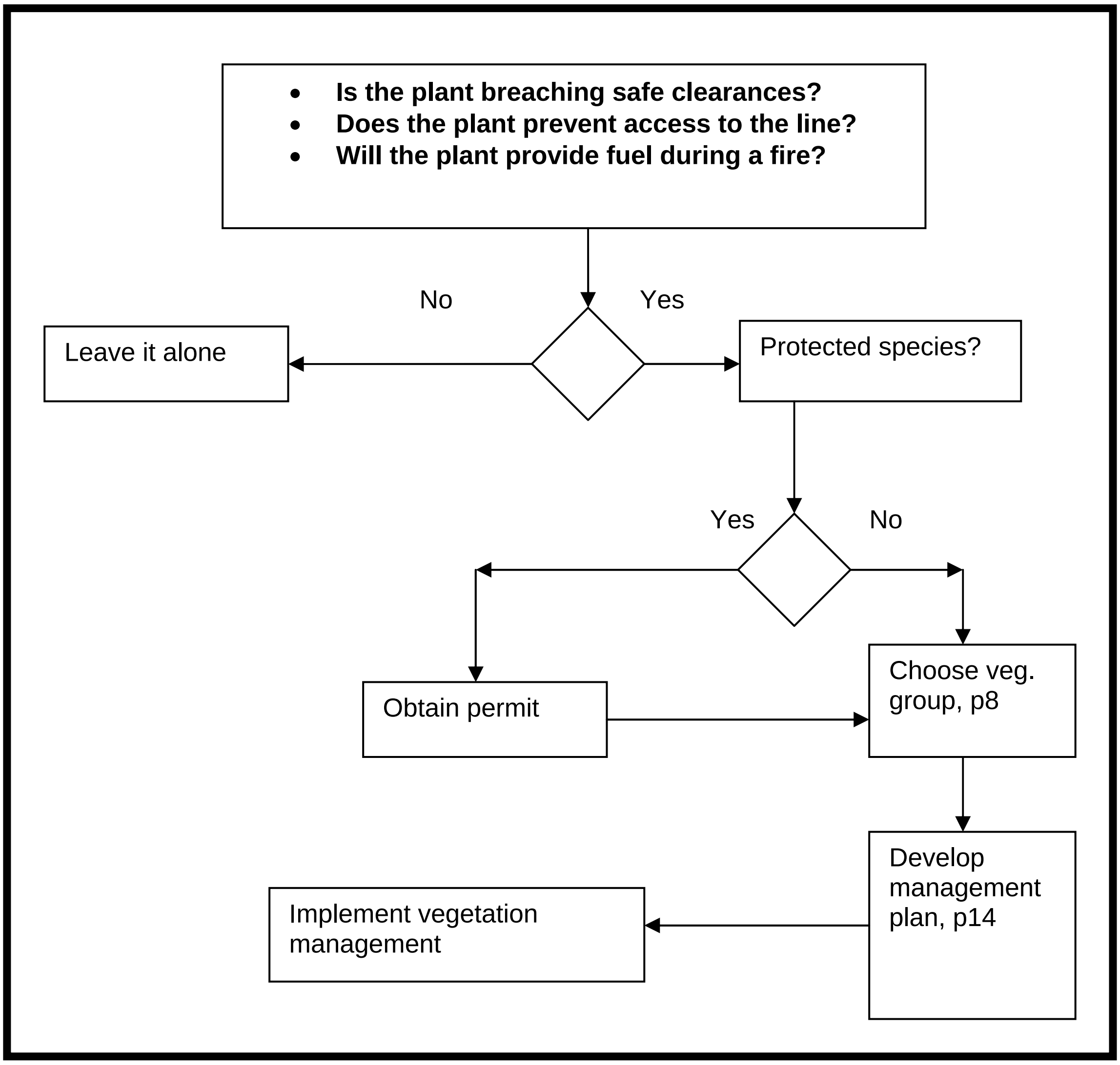
The main reasons for managing the vegetation under power lines are:

- **Ensuring safe clearances under and around power lines.**
- **Ensuring adequate access for inspection, maintenance and repair activities.**
- **Reduction of fuels for fires under power lines.**

The purpose of this document is to provide generic guidelines for the management of vegetation in Transmission's servitudes in a sustainable manner that will also reduce risk of line faults resulting from vegetation.

This document does not perscribe specifics, but rather provides general guidelines that should be applied according to specific circumstances and each case should be managed by way of an Environmental Management Plan (EMP).

Schematically, the simplified process can be shown as follows:



2. HISTORICAL OVERVIEW AND INTRODUCTION TO VEGETATION MANAGEMENT

The development of vegetation management is related in "The history of Utility Right-of-Way Management in the New York State". According to Jackson [2](p111) the first transmission power line in New York State was built between Niagara Falls and Buffalo, covering a distance of 26 miles or 42km.

Finch and Shupe [4] state that during 1951 ammate herbicides (soluble crystals for foliar application) were first introduced.

The publishing of Rachel Carson's book "The Silent Spring" in 1962 is credited with spawning the global environmental movement.

During 1972 legislation was introduced in the U.S.A. requiring environmental assessments.

A number of aspects such as the type, diversity and quantity of vegetation, burning regimes, the soils, hydrology, rainfall, the impact on wildlife and land use practices influence the vegetation management plan for a particular stretch of power line. These aspects will vary from one area to the other and a successful management plan will have to take these aspects into account. Because of highly variable local conditions, this document can only indicate broad principles and experts will have to be employed to compile site-specific Environmental Management Plan (E.M.P.) applicable to a particular stretch of line.

3. PURPOSE OF THE ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The purpose of an EMP is to facilitate the management of servitudes in a sustainable manner, in keeping with legislation, Eskom policies and sound business practices to ensure the safe, sustainable and optimal operation of the transmission grid. This programme should enhance access for emergency and routine maintenance of the power line. The management of vegetation should be a key factor in the EMP and should consider the aspects highlighted below.

4. PROBLEMS TO POWER LINES CAUSED BY VEGETATION

4.1. Safe Clearances.

The first problem associated with vegetation in the R.O.W. is that of plants growing into the safe clearance distance and causing flashovers [3].

In South Africa the Occupational Health and Safety Act (Act 85 of 1993) stipulates the minimum clearances to be adhered to for a range of voltages.

4.2. Falling Trees

The second problem associated with vegetation is that large trees which might fall on power lines could a short-circuit [3]. This type of problem only occurs on transmission power lines that run close to large trees associated with plantations.

4.3. Fires

According to some utilities in Europe and America, they do not experience fire as a major high frequency cause of power line faults, as is the case in South Africa.

Forest fires of a disastrous magnitude are sometimes reported in America, Australia and in South Africa. These fires cause enormous damage, but occur infrequently. As a result they are not normally considered a major threat to power supply.

Figure 1 Extensive forest fires in Colorado U.S.A. during 2002 (photo Tony Martinez)

Some utilities in South America also experience problems with fires resulting from agricultural activities such as the harvesting of sugar cane, the burning of fire breaks or veld management practices using fire.

In South Africa, veld fires are a normal sight during winter due to low fire management skills, negligence and arson.

Three main factors influence the occurrence and severity of these fires are:

- The cause of ignition.
- The type, quantity and condition of the available fuel.
- Atmospheric conditions.

Some of the causes of ignition can be addressed by training and awareness programmes. Others, such as arson cannot. Preventing ignition and managing fires when they do occur can be addressed by measures proposed by the Veld and Forest Fire Act (Act 101 of 1998).

Vegetation management is aimed not only at managing the growth of plants that compromise safe clearances, but also at managing the fuel for fires.

Aspects relating to atmospheric conditions are discussed later in the document.

4.4. ACCESS TO POWER LINES FOR INSPECTION, REPAIR AND MAINTENANCE

Certain vegetation types such as large shrubs and trees may impede access to the power line. In the case of shrubs such as Sickle bush (Dichrostachys cinerea) are well known for their ability to cause punctures. In these cases the vegetation has to be managed to ensure adequate access.

5. INTEGRATED VEGETATION MANAGEMENT (I.V.M.)

I.V.M. is a methodology that found its roots in Integrated Pest Management (I.P.M) and Integrated Weed Management (I.W.M). I.P.M was associated mainly with insects whilst I.W.M. dealt with weeds [3](p.128).

I.V.M. is a structured approach to the management of vegetation that combines manual activities, mechanical tools, and chemical applications with cultural and biological methods to develop a vegetation community that requires minimal maintenance and benefits wildlife and its habitat [3]. It is a method that is highly recommended to the reader.

5.1. Key Elements of I.V.M.

- **Prevention of problem development.** This refers to the alteration or use of R.O.W. conditions (land use and vegetation types) that are not considered a threat to power supply. Examples are certain types of agricultural and recreational uses. [5](p119-120).
- **Assessment of the problem, current and potential.** A clear understanding of the problems that must be addressed (fire hazard or trees invading the air gap) is important for a successful plan. Environmental aspects that require consideration in R.O.W. management include aesthetics, wildlife interaction, rare and endangered plants, wetlands and water bodies [2](p105-106). The consequences of the management interventions, such as plant density and species composition must also be considered [2](p107-108). Nature management is complex and no management intervention is without flaw, the plan should also include thresholds of acceptable damage resulting from remaining vegetation [7].
- **Evaluation of alternative approaches.** The alternative methods available for vegetation management are listed below. The risks and consequences of each method must be considered. Methods such as allelopathy [5](p120) and green stripping [8] may also be considered.
- **Monitoring of effectiveness and adverse impacts.** The effectiveness of I.V.M. on the reduction of outages as well as the effects on plant composition and densities must be monitored on an ongoing basis in terms of the goals set. Negative impacts such as vigorous re-sprouting of trees after mechanical cutting alone [5](p119) or the change in species composition and density [2](p107) are examples that can be observed through a monitoring programme.
- **Adaptive management.** The management of vegetation is neither static nor ever finished [5](p124). Constant observation of results and adaptation of management measures is required.
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5.2. The Tools of I.V.M.

- Manual methods. These methods are labour intensive but have the advantage of being selective.
- Mechanical methods. These methods include the use of large machinery for the cutting and mulching of plant material. Whilst these machines are effective, especially in mono cultures of invasive aliens access to certain parts of the R.O.W. may prove problematic.

Figure 2. An example of a mechanical mulching machine.

- Biological methods. One of the principal goals of R.O.W. vegetation management is to establish plant communities that meet the management objectives. These may be to establish low growing, stable plant communities or the natural inhibition of growth. [5](p.120). Where fire suppression is the objective, certain plants may be selected for their fire retardant properties in a green stripping strategy [8]. Biological methods used on undesirable plants include the introduction of insects [2](p 107) (biological control) or plants, pathogens or micro-organisms that have an allelopathic effect on the target vegetation [3](p 128).
- Chemical Methods. These methods incorporate the use of herbicides and/ or growth inhibitors and may be applied in a number of ways, ranging from hand application, selective foliar and cut-stump applications to aerial spraying [4](p 71).
- Fire. Whilst European and American vegetation management rarely uses fire as a form of vegetation management, its use under South African conditions is well known and it is considered a natural and regular phenomenon in all parts of South Africa except for the arid regions [8](p 421). Where fire is used as a vegetation management tool on a electrical R.O.W., care must be taken against the dangers of runaway fires as well as the inherent danger to personnel working under the lines as a result of possible flashovers occurring during the burn. The common practice has been to execute these prescribed burns at night, when a low F.D.I. exists. In addition to the use of prescribed burns in vegetation management, fire breaks under power lines remain the most certain way of reducing the fire risk to these power lines. Care must however be taken in considering the possible effects of

fire on vegetation in the particular biome under consideration. This aspect will be discussed later in the document.

Figure 3 Prescribed burns at night with a low F.D.I. reduces the risk of runaway fires as well as the occurrence of flashovers.

6. BIOMES, PLANT SPECIES AND R.O.W. MANAGEMENT

Plant structure, moisture content and the quantity of material available as fuel, dictate the flammability and fire hazard of plants [9](423).

Different plant species pose different threats and require different treatments. For the purpose of this document, vegetation have been grouped into the following groups and management recommendations are made for each group:

1. Alien invasive plants.
2. Densifiers
3. Reeds
4. Grasses
5. Commercial forests
6. Sugar Cane
7. Fynbos
8. Karroo
9. Indigenous forests

Bush encroachment is defined as the “expansion of woody plants into vegetation previously dominated by non-woody plants or where woody and non-woody plants were co-dominant, resulting in reduced carrying capacity for domestic livestock (grazers). The phenomenon is widespread in southern Africa and is generally attributed to the removal of mega herbivores, the alteration of fire regimes, the reduced use of trees, overgrazing or a combination of these factors [10](p591). An example of this is the densification of Sickle bush (*Dichrostachys cinerea)* in the savanna biome. The management of plants that pose a fire risk will be referred to as fuel management.

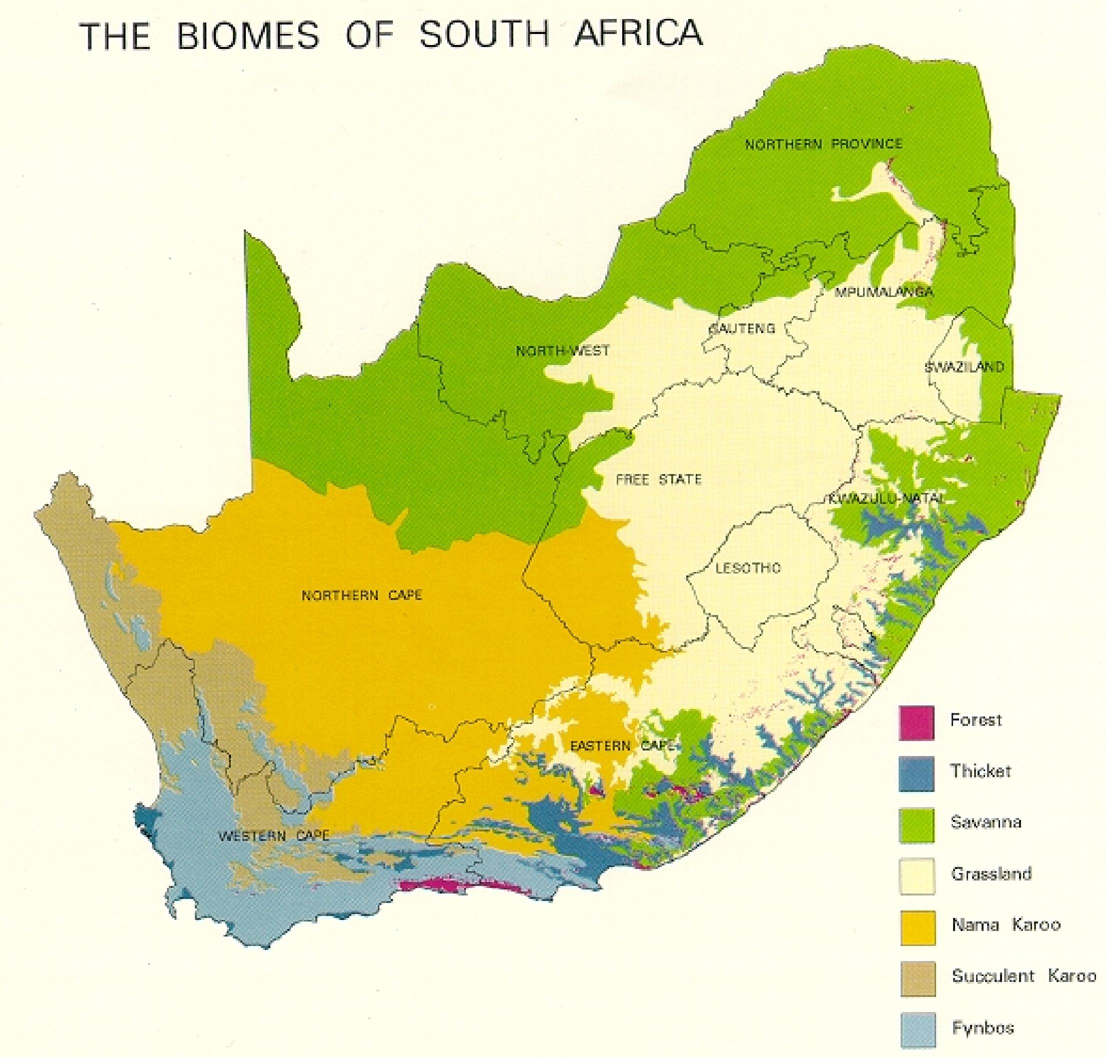


Figure 4. A map of the biomes of South Africa (Courtesy of the Dept. of Environment and Tourism)

6.1. Soils and topography

Plant species correlate closely with soils. Whilst plants pose a fire risk, they also stabilize soils and any plant management strategy should consider the effect on soils. Topographical features such as slopes not only add to the erosion risk, but have also been shown to add to the fire risk through the improved ventilation of the fire on sloped areas.

7. ATMOSPHERIC AND CLIMATIC CONDITIONS AND VEGETATION MANAGEMENT

7.1. Climate and Vegetation

Plant production is clearly influenced by weather. Plant production is high, especially if good rains are followed by enough sunshine to promote photosynthesis. The occurrence of fires is influenced by the availability of sufficient fuel and they rarely occur in the arid regions of the west and the interior of South Africa or in the palatable grasslands or the arid savanna when the off-take by herbivores leaves nothing to burn [9](p421).

Medium term weather forecasts can be used in the general prediction of plant production and the strategies to manage it. As is the case with many aspects of vegetation management, the reader is advised to consult a weather expert on this subject.

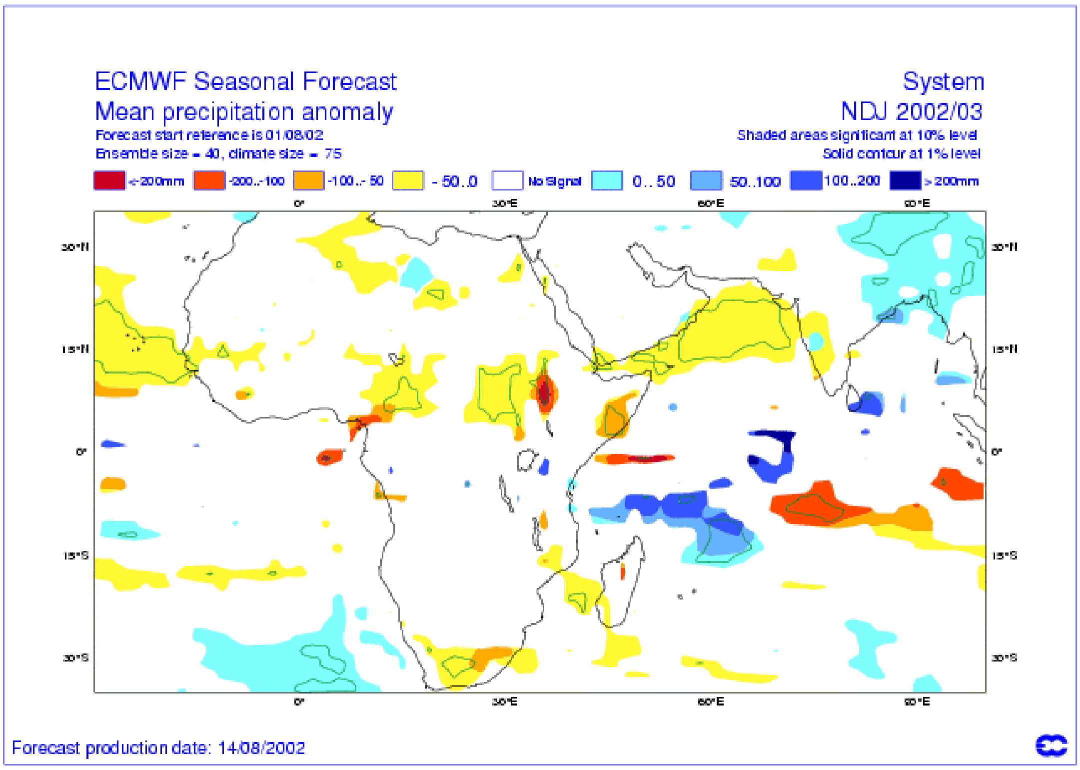


Figure 5. Example of a rainfall anomaly chart indicating predicted rainfall (Map courtesy of Sakkie Nigrini NETFORCAST)

7.2. Weather Systems and Fire Danger

The ignition of fires, fire behaviour and flame lengths are influenced in a major way by weather. In terms of the Mc-Arthur fire danger model used in South Africa, relative humidity, air temperature and wind speed are the main factors that are used to calculate the Fire Danger Index (F.D.I.) for a specific day (refer to the FDI page in Appendix F). Corrections are also applied for fuel moisture.

South Africa has both summer and winter rainfall areas. The Western Cape has a Mediterranean climate with winter rainfall and experiences dry windy conditions with a high fire danger [14] during the Austral summer months of December to March. The northern interior experiences fire weather during the winter months of April to September [15]. During these winter months, the subcontinent experiences frontal weather systems associated with pre-frontal Berg wind conditions [1](p 202).

During these hot, dry and windy conditions, plant material becomes very dry and ignition of fuel is aided. Fanned by the high winds, fires spread rapidly and are extremely difficult to control. The windy conditions also ventilate fires and with the high availability of oxygen, hot fires with long flame lengths occur. These conditions coupled with fire whirls lead to flashovers of transmission power lines. Even power lines with large clearances such as the 765kV lines suffer flashovers under these extreme conditions [11,12,13].

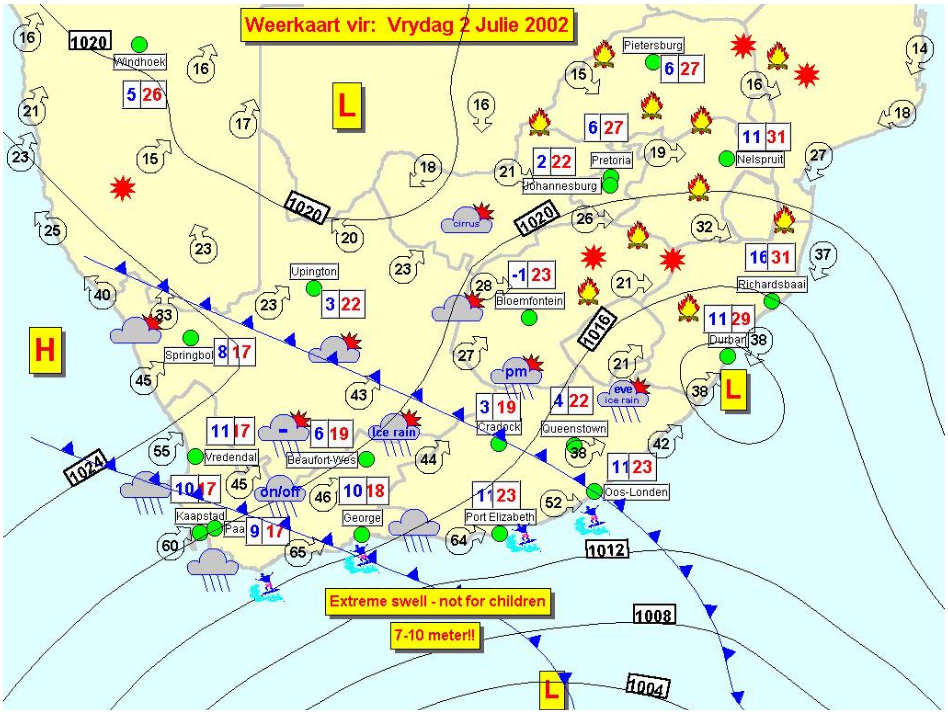


Figure 6 Example of a weather chart showing cold fronts with the associated inland hot conditions under the influence of a high pressure system, with Northerly to Westerly winds and associated fire risk (Map courtesy of Sakkie Nigrini NETFORCAST).

Whilst it is not possible to control the weather aspect of fire risk, the use of fire breaks on the windward (NW to W) side of servitudes will reduce the intensity and heat of a fire in close proximity to conductors. In the case of the Cape Peninsula, the south-eastern side of the servitude must be protected. Experience has shown that when high winds are present, a distance of 100 m outside the servitude must be clear, especially of alien invaders such as *Acacia cyclops* (Rooikrans) and *A. saligna* (Port Jackson Willow).

Diligent lookout during times of high fire danger is also an important way in which this aspect of fire management can be addressed. This is further discussed in this document.

8. VELD MANAGEMENT PRACTICES

The recommended veld management activities must be carried out, and should fit within a wide range of land use practices and the habits of the landowner or occupiers.

On one side of the spectrum, areas are managed as conservation areas. Under these conditions comprehensive veld management practices are employed that include burning programs as well as control of the herbivores and their effect on the vegetation. Under these conditions Eskom's management of the servitude will have to integrate with that of the landowner. In certain cases, the servitude might be used by the landowner as a firebreak as part of the fire prevention measures.

Figure 7. Example of a power line servitude used as a fire break at Thaba Tholo near Thabazimbi.

At the other side of the spectrum, areas exist that are overgrazed and suffer from extensive erosion. Here fire risks would be low but risks associated with erosion will be high and management strategies should attempt to stimulate plant growth where possible.

The introduction of appropriate grass species may not only contribute towards reducing the risk of erosion, but will also compete with any resprouting shrubs. Cognizance will however have to be taken of the landowners' grazing practices as domestic animals will favour the cleared areas and over grazing and consequential erosion may be experienced.

Figure 8. Example of the dangers of erosion to power lines (photo Jorge Correia).

The Government has also committed itself to the eradication of alien invasive plant species in terms of the Conservation of Agricultural Resources Act (Act 43 of 1983). The well-known Work-for-Water programme bears testament to the commitment of the government towards eradicating these plants.

The use of fires as a veld management tool by landowners and the appropriate skills in this regard, varies across the country. Eskom has in the past, and must in the future, engage landowners in the safe use of fires, especially in close proximity to power lines.

9. LAWS AND POLICIES

A number of laws govern Eskom's actions with specific regard to servitude management practices. These range from the imperative of the protection of certain rare and endangered plant species to the removal of alien invasive species. Issues such as the sustained use of resources, measuring Eskom's impact, soil erosion, the use of chemical substances, are all in one way or another controlled by legislation or policy.

Safety clearances for power lines are stipulated by the OHS Act and these dimensions are considerably less than those required to safeguard against fire threats.

The newly promulgated Veld and Fire Act proposes to regulate fire related matters between landowners and will supersede previous fire legislation (refer to http://www.dwaf.gov.za/Forestry/Fireawareness/eng.pdf).

More information on the Veld and Fire Act can be obtained from an interpretative document issued by the Department of Water Affairs and Forestry. It can be viewed at http://intranet.eskom.co.za/enviroweb/

The use of an EMP for the management on a servitude is prescribed and controlled in terms of legislation, Eskom Policies as well as Eskom's commitment in becoming SABS ISO 14001 compliant.

For a comprehensive list of laws refer to http://appserv/enviroleg/acts.asp

10. SUGGESTED VEGETATION MANAGEMENT PRACTICES

All vegetation management activities should be carried out in terms of an EMP as prescribed by 4.2 of ESKASABG3 (STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWERLINE SERVITUDES) and ESKPVAAZ1 (ENVIRONMENTAL MANAGEMENT PROGRAMME (EMP) PROCEDURE). These documents can be viewed at http://intranet.eskom.co.za/enviroweb/

All protected species shall be treated in terms of applicable legislation (refer to the above Enviroweb website).

The use of herbicides is prescribed by policies that can be viewed at http://teknowrep.eskom.co.za/EM_Herbicides/MM/main.htm

The following titles can be found there:
The Need for Herbicide usage in Eskom, Eskom Herbicide Policy and Strategy, Herbicide Use in Eskom, Herbicide Research in Eskom, Eskom Herbicide Guidelines, Safety Considerations and Responsible use of Herbicides, Recommendations on Herbicide Strategy in Eskom

10.1. Clearing of Reeds

These plants should be cleared for the total width of the servitude and an appropriate herbicide plan instituted (refer to http://teknowrep.eskom.co.za/EM_Herbicides/MM/main.htm for the Reed and Bulrush Management Plan). In areas of high winds such as the Western Cape, reeds should be cleared for 100 m outside the servitude or as local conditions may indicate. This should be done in full consultation with landowners and with an appropriate EMP as prescribed by ESKPVAAZ1 (ENVIRONMENTAL MANAGEMENT PROGRAMME (EMP) PROCEDURE) and ESKASABG3 (STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWER LINE SERVITUDES). See the Enviroweb website. Because the plants are associated with wetlands, care should be taken to minimize any impact by the management activities on the wetland.

10.2. Clearing Alien invasive vegetation

In terms of the Conservation of Agricultural Resources Act (Act 43 of 1983), all alien invasive species in the R.O.W. should be cleared and chemically treated for the total width of the servitude. Refer to "Problem Plants in Transmission and Distribution" on the Enviroweb website (refer to ESKASABG3 (STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWER LINE SERVITUDES).

In areas of high wind (e.g. Western Cape) alien vegetation should be cleared to a distance of 100 m outside the servitude or as local conditions may indicate, as a precaution against fire. Adjacent landowners should be included in the removal of alien plants as the Conservation of Agricultural Resources Act (Act 43 of 1983) also applies to them. Particular attention should be paid to alien plant infested rivers.

10.3. Management of savannas.

Savannas are described in broad terms by Scholes [16](p258) as consisting of a two layered structure (tree and grass layer) with an intermediate layer of shrubs that is sometimes present. These groups of plants are inter-linked and activity in the tree and bush layers will have an effect on the grass layer.

Fire in savannas is limited by the availability of grass fuels and the sparse grass production in arid savannas usually does not support fire [9](p 440, 439). Rainfall, soils and grass production should therefore form an important part of the vegetation management strategy.

A phenomenon known as bush densification occurs when the natural balance between the grass, shrub and tree layers is disturbed through change in interaction with grazers, browsers and the exclusion of fire [16](p 271) [9](p 439). Bush densification, as defined above, represents a problem in the savanna biome as it produces an abundance of fine fuels for fire and many fire-induced flashovers of transmission lines are experienced under these conditions.

Figure 9 An example of bush densification in the savanna biome and the amount of cut material that is generated during bush clearing (photo Theuns de Bruin, Pottie Potgieter)

The clearing of this biome generates a high volume of cut material, which poses a fire risk of its own. The clearing activities should therefore be done in a way that reduces the fire risk in the vicinity of the power line but without creating a new risk. These activities should also be done in a way that will not have a negative effect on the remaining plants and soils. Methods of disposing of this unwanted material will differ from one farm to the other as farming methods and owner preferences differ while suitable methods of disposal exist under certain farming practices

10.3.1. Fire critical zones in savanna

From observations of burn sites in a savanna biome, during the 2001 fire season, it was concluded that the fire-critical zone for flashovers resulting from fires in densifiers, happens within 5 m from the vertical below the conductor, predominantly in the mid span area. These values are highly influenced by the atmospheric conditions at the time of the fire.

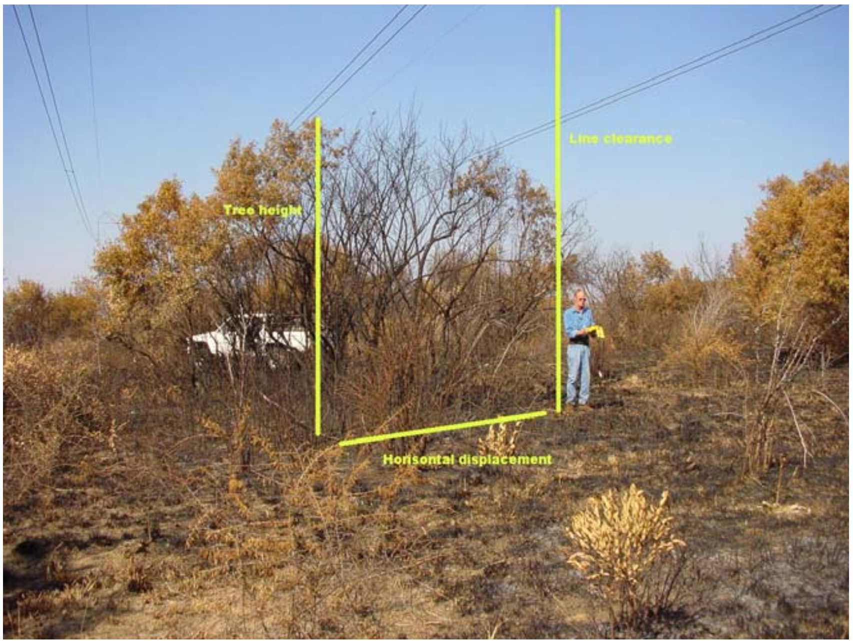


Figure 10 Measurements taken at a flash site after a fire.

Based on these results, the area of the servitude within 5 m from the outside conductors should be considered as critical for clearing any densifiers or any other plants that pose a fire risk. The areas closer to the towers carry a lower fire risk than the mid-span area. Local conditions have a marked effect on the fire risk and may indicate the removal of fire risk in a curved fashion as indicated in the sketches at the end of the document. See appendices A, B and C.

The secondary zone of the servitude refers to the remainder of the servitude. Local plant and other fire risk conditions will determine the action with regard to determining the fire risk of the plants in this area.

10.3.2. Fuel management in the servitude

Not all plants in the servitude pose a fire risk. The excessive removal of plants not only leads to a risk of erosion in certain soils and generates large quantities of unwanted plant material, but will also have an impact on the species of grass that will grow in the servitude in this newly modified habitat. It can be expected that higher than normal growth of grasses will follow the removal of shrubs. The removal of large amounts of vegetation will also have an effect on the aesthetics, in particular on farms where eco-tourism is practised.

Atmospheric conditions such as wind speed, relative humidity and air temperature will greatly influence fire behaviour and this must be borne in mind with the clearing of the servitude.(see annexures A - D) As densifiers do not carry any legal protection and as they signify abnormal situation, they may normally be removed especially where they restrict access or pose further fire risks. Protected species, slow growing plants that, due to their structure, do not pose a fire risk should be identified during the compilation of the management plan and left intact in the interest of preventing soil erosion.

In the compilation of the vegetation management plan consideration should also be given to plants with agricultural value. An example of such a plant that is found in the savanna biome is *Grewia flava* (Brandy bush; Rosyntjiebos, Moretlwa). This plant is highly favoured by both domestic animals as well as game and is often associated with grass, thereby adding to its fire risk. In cases where large plant specimens grow in the fire critical zone, these may be removed. In the rest of the servitude others should be left.

The removal of plants in the servitude should be preceded by a vegetation assessment where that actual condition of the veld is assessed and protected and other beneficial species are identified. The amount of densification should also be determined coupled with the associated local farming practices and vegetation removal strategy should be based on these facts and included in the EMP.

Where access to a botanists and a comprehensive vegetation survey is totally not possible, the following method may be applied: It is proposed that all shrubs, acacias and compound fine-leafed trees with a stem diameter smaller than 100 mm are cut. This should be revised after the first 10 spans have been cut to determine an appropriate standing stem count for the area. The remaining trees should then be assessed individually for their own risk in terms of fires or clearance [Butch Rossouw, SURICATA, pers comm).

Vegetation in valleys as depicted in appendix E can also be left if they do not pose as a fire risk?

In cases where a rigorous fire management plan exists on the land in question, this should also be taken into account in the determination of the fire risks. In cases where no control over fires exists, as is sometimes the case with Government-owned land, more extensive clearing would be called for than in the case where strict fire control measures are in force.

Care must however be taken with the extensive removal of plants not to destabilize soils. The appropriate EMP with an herbicide plan will ensure that this aspect as well as any other consequential reaction of plants (such as the growth of weeds or aliens) will be managed. The introduction of grass species may be considered as a remedy in these cases. The spreading of the cut material on areas of sparse plant growth may also contribute to the establishment of a micro-cosmos that will encourage the establishment of grass. The close contact between the cut material and the soil will also aid the decomposition of the cut material.

As mentioned above, the existing land use practices (livestock or game farming) will also have to be taken into account during this process. The landowner should at all times be consulted and be made part of the process.

Where eco-tourism is practised, effective use can be made of plants as a visual screen next to roads and tracts to screen towers and cleared areas. The management plan should identify and use plants with a low fire risk for this purpose.

Protected species shall be treated as prescribed by the law and only be cut after obtaining an appropriate permit. "Hot spots" where protected species (or unwanted species such as weeds) are likely to occur, may be used as a screening method in the compilation of the EMP.

The chemical or biological follow-up treatment should be discussed with the landowner and should follow the guidelines in ESKASABG3 (STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWER LINE SERVITUDES).

10.3.3. DISPOSING OF CUT MATERIAL

The disposing of large quantities of cut material generates its own problems. The stacking of cut material in windrows at the edge of a servitude poses a further fire threat to the line. It also has the potential to sterilize the seedbed under hot burning conditions. Farmers also complain about the effect that these windrows have on the free movement of game and stock animals.

As a result the above selective cutting procedure is proposed. This should adequately reduce fire risk without generating an unnecessarily large quantity of cut material that has to be disposed of.

Local farming practices will indicate which disposal method is to be followed. The following methods are available:

- Cut material can be spread equally inside and outside the servitude to protect new grasses from grazing pressure. The fire risk of this method must be assessed for each case and cognisance should be taken of the fire- critical zones as well as local farming and burning practices. In some cases stock farmers do not like this method as they claim that it prevents their cattle from grazing there. Under these conditions a high risk of overgrazing exists and these servitudes must be monitored closely. The cut material should as far as possible, not be stacked, but placed in close contact with the soil to aid the decomposition of the cut material.
- Excessive plant material may in certain cases also be removed by mulching, provided that the mulched material is spread in such a way that it does not sterilize the soil. This method has, to date, not proved very successful as the densifiers consist of high-density woods and equipment failure has been experienced.
- In certain areas the cut wood may be utilized as firewood by the landowner or by third parties. Local conditions and landowner preference will indicate the appropriate course of action.
- A proposal worth exploring would be to determine the viability of establishing a BEE/SMME contractor to chip and process the removed shrubs for the manufacture of compost or game pellets.
- In cases where the removal of plant material is not feasible, prescribed burning of the servitude may take the place of vegetation removal. Prescribed burns can take place with the line switched out and can be carried out during the day or at night. In cases of high phytomass, night burns are preferable. Certain plant types such as *Tagetes minuta* (Tall khakiweed) and *Cosmos bipinnatus* (Cosmos) have been reported to be implicated as high-risk plants with regard to fire flashovers. These plants occur where the soil has been disturbed as a result of agricultural or other activities and require special attention during fire prevention planning.

- The F.D.I. must be obtained and burns must be carried out by people with the correct training and equipment appropriate for the task. Cognisance should be taken of the possibility of soil sterilisation and consequential plant succession during these burns. As a general rule, landowners must report all burns to Eskom so that the necessary arrangements can be made to safeguard the lines.

10.3.4. FURTHER MANAGEMENT OF THE VELD

Further management of the veld after the removal of plants should be established and contained in a site-specific E.M.P. The aim should be to establish a stable and low maintenance situation with a minimum fire risk. The use of fire should play an important role here. The involvement of landowners in this process is extremely important. A monitoring programme should indicate any corrective actions.

11. COMMERCIAL FORESTS

Commercial forests normally do not pose a fire risk to power lines, except under severe conditions. Servitudes are normally maintained by or in conjunction with the forestry industry and are often used as fire breaks in the fire management plan for the plantation.

The forestry industry is well organized to prevent fires as well as the early spotting and fighting of fires. Fire fighting associations (FFA) exist in Mpumalanga, KwaZulu Natal and the Western Cape.

Refer to ESKASABG3 (STANDARD FOR BUSH CLEARANCE AND MAINTENANCE WITHIN OVERHEAD POWER LINE SERVITUDES) and the Commercial Timber Growers Guideline for Maintenance and Maintenance Agreement in Forest plantation areas and servitude areas.

12. SUGAR CANE

Sugar cane is harvested after excess plant material has been burnt off. Where this process takes place in the proximity of, or underneath, power lines, a flashover occurs [17].

Cane-free servitudes have been used as a remedy but this reduces the landowners' production capability. Early notification of intended burns is reported to Eskom's Operation Fire Break. If possible, lines are switched out for the duration of the burn. During 2001 more than a thousand reports of intended burns were received which resulted in successful switch-outs and the prevention of fire faults. Unplanned burns still remain a problem.

Other methods such as green harvest or thrashing are used. Innovative work on the alternative harvesting of cane in the vicinity of power lines has been done.

13. KAROO BIOME

This biome is not known for fire risk. It is however vulnerable to erosion and veld management activities must be addressed in the site-specific E.M.P.

14. FYNBOS

This is a highly diverse and prized floral kingdom that also poses a high fire risk to power lines. The fire risk to power lines from plants in this biome, is further compounded by the atmospheric conditions prevalent in the Western Cape during the Austral summer.

The management of this biome is highly specialized and has a complex response to variation in the fire regime. Changes in species composition are attributed to the interaction between fire and the regenerative properties of the plant [9](p 433). Bond [9] states that because some proteoid shrubs only regenerate from seed stored in canopy seed banks, some fires may drastically alter species composition. Short fire frequency can eliminate certain non-sprouting proteas, whilst favouring serotinous species.

The management of servitudes in Fynbos areas is clearly a very complex matter. Fire must be used with great caution and veld management practices have to be developed in a site-specific E.M.P. for this biome by experts with the appropriate knowledge.

15. INDIGENOUS FORESTS.

Indigenous forests normally do not pose a fire risk as they seldom burn [9](p 423).

The plants are worthy of conservation and a site-specific veld management E.M.P. must be developed for each case.

16. FIRE PROTECTION AND FIRE FIGHTING ASSOCIATIONS

In addition to commercially operated Fire Fighting Associations (F.F.A.), formed mainly by the forestry industry and mentioned above, the Veld and Forest Fire Act promotes the formation of Fire Protection Associations (F.P.A.). The F.F.A. may be employed to act as a fire watch on specified days (ORANGE and RED). These associations have spotter planes and fire fighting ground crews to enable the early extinguishing of fires that are reported. In extreme cases, air borne water bombers are also employed to extinguish large fires.

The formation of Fire Protection Associations (F.P.A.) in terms of the Veld and Forest Fire Act is an ongoing process where the community is organized to prevent and control fires. These associations will benefit Eskom once formed, as they will result in a more controlled situation with regard to fires. For more information refer to http://www.dwaf.gov.za/Forestry/Fireawareness/eng.pdf

17. CONCLUSION

The management of plants on transmission servitudes is an important and complex matter as plants potentially have an important impact on the power quality of supply. At the same time, activities throughout the life cycle of the transmission power line, have a profound impact on flora and fauna. A comprehensive but practical management plan that takes care of both aspects appears to be the optimal way to manage servitudes.

18. Supporting Clauses

NOT APPLICABLE.

19. Index of Supporting Clauses

19.1. Scope

This document covers the reasons and principles applicable to the management of vegetation under Transmission power lines. It also discusses vegetation management in broad categories.

19.1.1. Purpose

The purpose of this document is to inform the management of vegetation under Transmission power lines.

19.1.2. Applicability

This document will apply to all Transmission power line servitudes.

19.2. Normative/Informative References

Parties using this guideline shall apply the most recent edition of the documents listed below.

19.2.1. Normative

ISO 9001:2000 Quality Management Systems.

19.2.2. Informative

[1] Tyson, P.D., Preston-Whyte, R.A. 2000. *The Weather and Climate of Southern Africa.* Oxford, New York; Oxford University Press.

[2] Jackson, L.W. c1997*. Vegetation Dynamics on a Managed New York Right-of-Way (1977-1996)* in Williams, R.W., Goodrich-Mahoney, J.W., Wisniewski, J.R., Wisniewski, J. (eds.) c1997.*The Sixth International Symposium on Rights-of-Way Management;* New Orleans, Louisiana, USA; Elsevier Science.

[3] Morrow S.D. c1997. *Effective Integrated Vegetation Management* in Williams, R.W., Goodrich-Mahoney, J.W., Wisniewski, J.R., Wisniewski, J. (eds.) c1997.*The Sixth International Symposium on Rights-of-Way Management;* New Orleans, Louisiana, USA; Elsevier Science.

[4] Finch K.E., Shupe S.D. c1997*. Nearly Two Decades of Integrated Vegetation Management on Transmission Rights-of-Ways* in Williams, R.W., Goodrich-Mahoney, J.W., Wisniewski, J.R., Wisniewski, J. (eds.) c1997.*The Sixth International Symposium on Rights-of-Way Management;* New Orleans, Louisiana, USA; Elsevier Science.

[5] Mc Loughlin K.T. c1997 *Application of Integrated Pest Management to Electric Utility Rights-of-Way Vegetation Management in New York State* in Williams, R.W., Goodrich-Mahoney, J.W., Wisniewski, J.R., Wisniewski, J. (eds.) c1997.*The Sixth International Symposium on Rights-of-Way Management;* New Orleans, Louisiana, USA; Elsevier Science.

[6] Vosloo H.F., van Rooyen C. *Investigation into Biologically induced Line faults on Eskom's Transmission system, 2001.* CIGRé 4th Southern Africa Regional Conference Oct 2001 Cape Town South Africa.

[7] Norris L. *Eskom/EPRI Right-of-Way Technology Transfer Workshop, April 9-11 2002*

[8] Hogenbirk, J.C. c1997 *Integrating Greenstripping into Right-of-Way Vegetation Management* in Williams, R.W., Goodrich-Mahoney, J.W., Wisniewski, J.R., Wisniewski, J. (eds.) c1997.*The Sixth International Symposium on Rights-of-Way Management;* New Orleans, Louisiana, USA; Elsevier Science.

[9] Bond W.J. *Fire* c1997 in Cowling R.M., Richardson D.M., Pierce S.M. (eds.) c1997. V*egetation of Southern Africa.* Cambridge, U.K. Cambridge University Press

[10] Cowling R.M., Richardson D.M., Pierce S.M. (eds.) c1997. V*egetation of Southern Africa.* Cambridge, U.K. Cambridge University Press

[11] Vosloo H.F. 2002. *Report on fire incidents on the 765kV lines on 29 July 2002* Eskom Transmission Technology report TT/05/02.

[12] Vosloo H.F. 2002. *Report on fire fault on the 765kV lines in the Standerton area on 29 July 2002* Eskom Transmission Technology report TT/07/02.

[13] Vosloo H.F. 2002. *Report on fire fault on the 765kV lines in the Virginian area on 29 July 2002* Eskom Transmission Technology report TT/08/02.

[14] van Wilgen B.W. 1984 *Fire Climates in the Southern and Western Cape Province and their potential use in fire control and management.* South African Journal of Science.

[15] Barclay J.J., Jury M.R.& Washington R. 1993. *Meteorology of fire danger in the Natal Drakensberg.* South African Journal of Science.

[16] Scholes R.J. *Savanna* c1997 in Cowling R.M., Richardson D.M., Pierce S.M. (eds.) c1997. V*egetation of Southern Africa.* Cambridge, U.K. Cambridge University

Press

[17] Cowan P.M., Dunn J.A., Naidoo P., Masters J. 1991. *Sugar cane fire induced transmission line flashovers.* Elektron, January 1991.

19.3. Definitions

Servitude "the right to use someone else's land, for a specified purpose". In the case of an overhead line servitude, is the right to erect, operate and maintain an electric line as well as enter that land for the execution of those activities. It does not constitute full ownership and access and activities should always be carried out with due respect for the landowner. Servitude is registered in the Deeds office and forms part of the title deed of a property.

19.4. Abbreviations

EMP- Environmental Management Plan
ROW- Right of way, also meaning servitude in Transmission
IVM- Integrated Vegetation Management
FDI-Fire Danger Index

19.5. Roles and Responsibilities

The Line and Servitude managers of each grid shall be responsible for the implementation of these guidelines in their respective Grids.

19.6. Implimentation date

The implementation date is November 2006

19.7. Process for monitoring

The Line and Servitude managers of each grid shall be responsible for the monitoring of adherence of these guidelines in their respective Grids.

19.8. Related/Supporting Documents

n/a

20. Authorisation

This document has been seen and accepted by:

Name	Designation
W. Majola	GM (Services)
J Machinjike	GM (Grids)

21. Revisions

Date	Rev.	Remarks

November 2006	1	Review document and reformat.

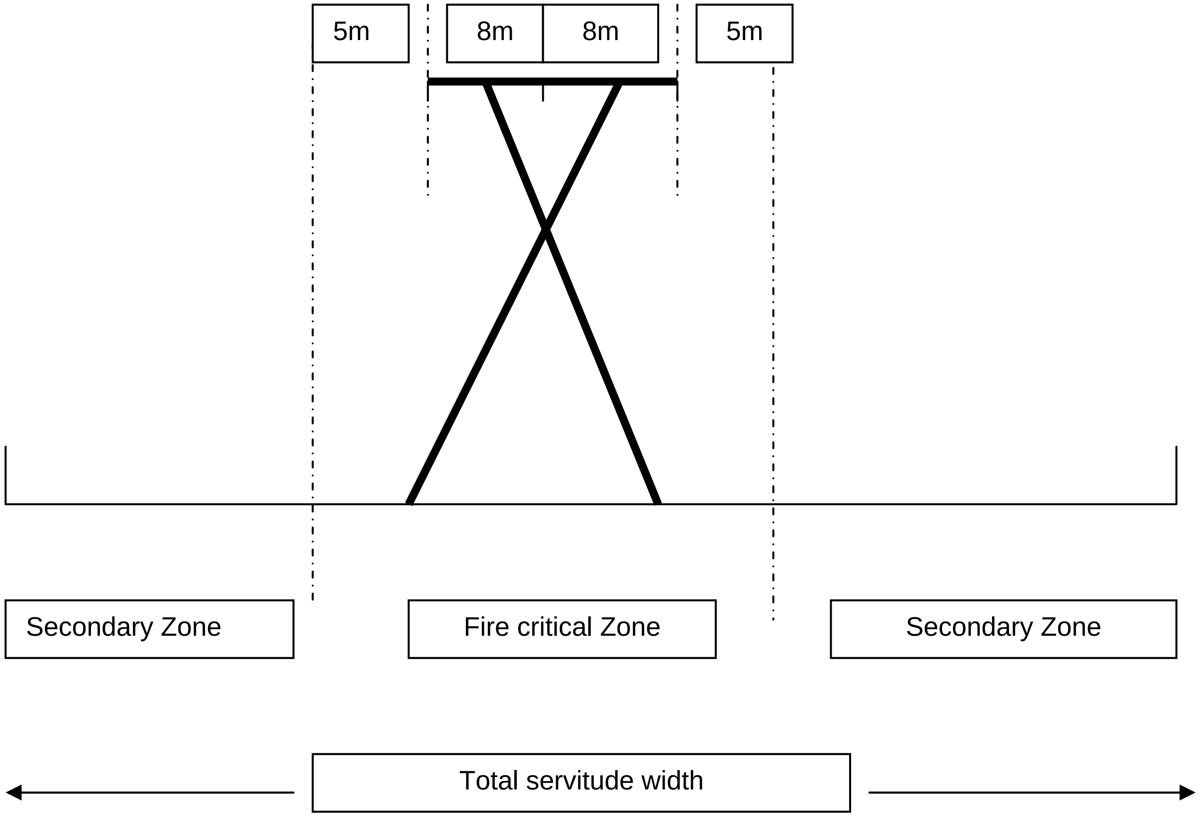
22. Development team

List of people involved in the development of the document.

The author wishes to acknowledge the contributions made by the Regional line and servitude managers and their staff as well as other Eskom colleagues in gathering information that was used in the compilation of this document.
The contribution of Peter Nelson and dr Eugene van Rensburg is also acknowledged.
The author wishes to thanks Butch Rossouw, Francois de Wet, Chris Austin and Joggie van Staden for their valuable input and shaping the ideas contained in this document.

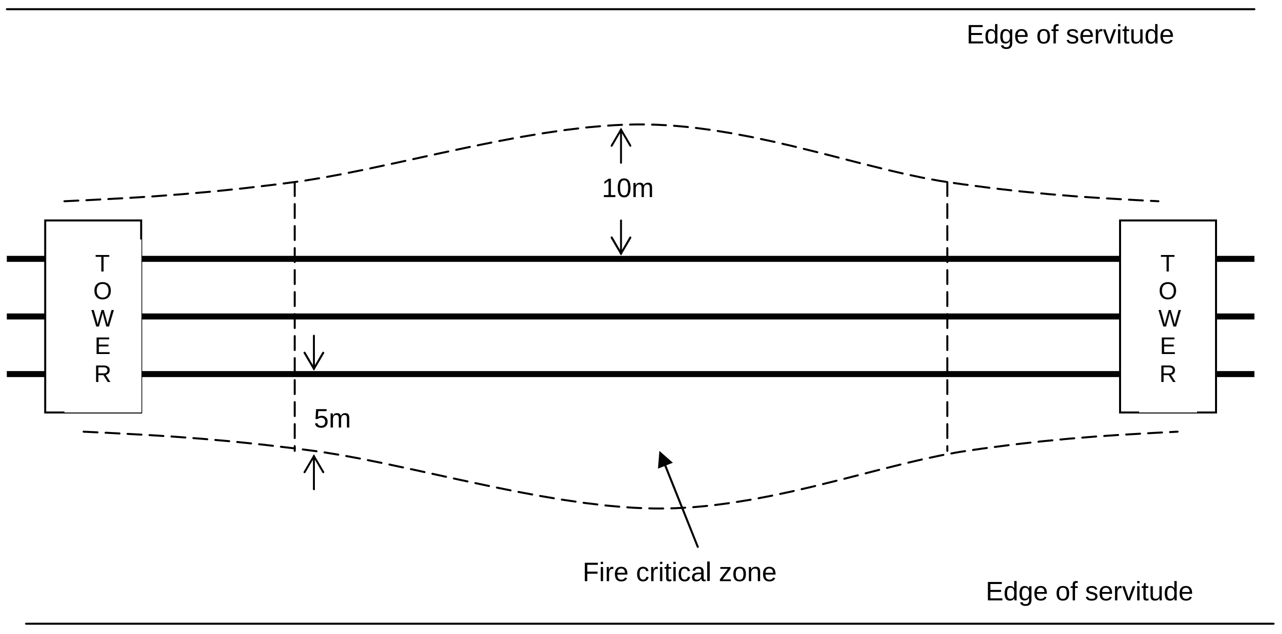
23. Annexures

Appendix A: Typical cross section of power line

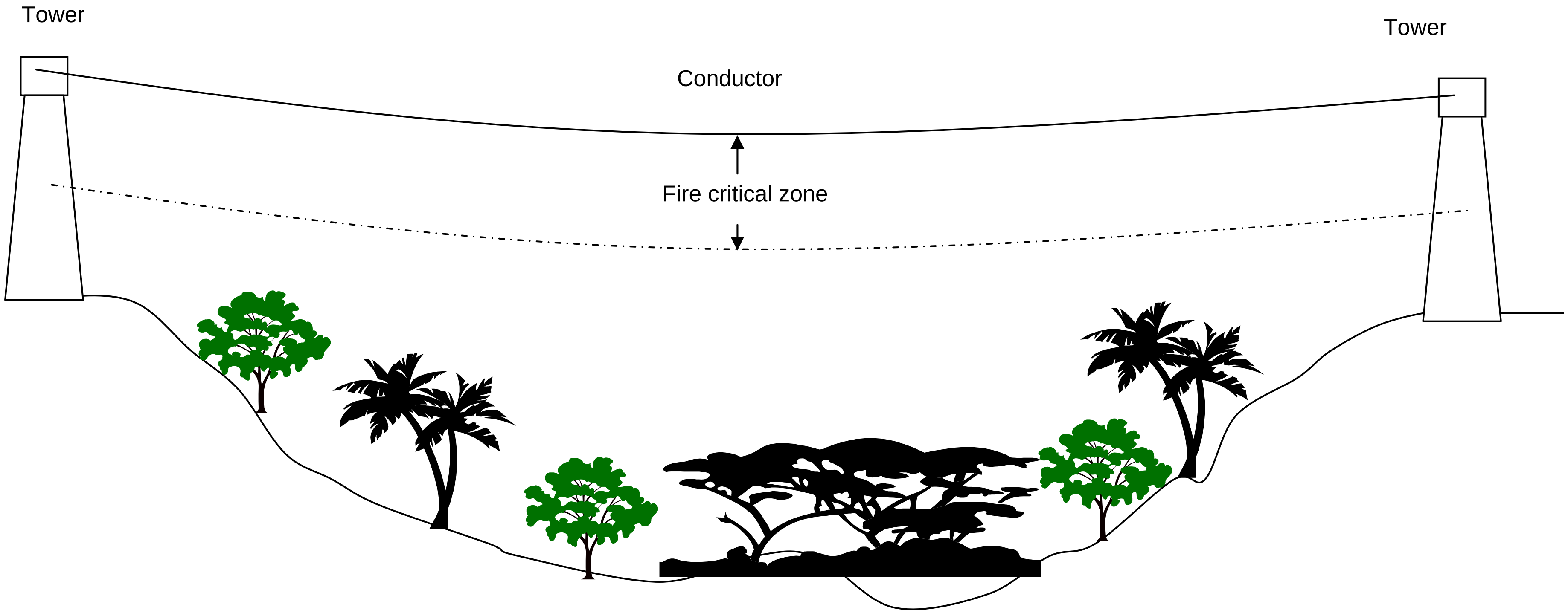


Note: Concerns queries and comments on this document should be referred to the compiler:

Appendix B: Typical plan view of power line



Appendix C: Typical long section of the servitude



Appendix D: A TYPICAL FIRE DANGER RATING SYSTEM

FIRE ALERT STAGES	BLUE	GREEN	YELLOW	ORANGE	RED
FIRE DANGER INDEX	0 – 20	21 – 45	46 – 60	61 – 75	78-100
FIRE BEHAVIOUR FLAME LENGTHS (m)	SAFE 0-1m	MODERATE 1 –1,2m	DANGEROUS 1,2 – 1,8m	VERY DANGEROUS 1,8 – 2,4m	EXTREMELY DANGEROUS 2,4m +
FIRE CONTROL GUIDE	Fires are not likely to start. If started, they spread very slowly or may go out without aid from suppression forces. There is little flaming combustion and intensity is low under all conditions. Control is readily achieved and little or no mopping up is required.	Ignition may take place near prolonged heat sources (camp fires, etc.), spread is slow in forests, moderate in open areas. These are light surface fires , with low flames. Control is readily achieved by direct manual attack and with minimum forces, difficulty may be experienced on exposed dry slopes and some light mopping up will be necessary.	Extreme caution should be taken when controlled burning is carried out. Aircraft should be called in at the early stages of a fire.	Ignition can occur readily, spread may be fast in the forests though not for sustained periods. Grass fires could outstrip forces with a spread of approximately 7km/h. Fires may be very hot with local crowning and “short to medium range” spotting. Control will be very difficult, requiring indirect attack methods with major assistance necessary. Mopping up may require and extended effort.	Ignition can occur from sparks. Rate of spread will be extremely fast for extended periods. Fires will be extremely hot with a dangerous heat effect on people within 10m of the fire and there may be extensive crowning, fire whirls and “long range” spotting. Control may not be possible by frontal attack during the day and fire fighters should limit their actions to containing lateral spread, until the weather changes. Damage potential total and mopping up operations mat be very extensive and difficult. Full assistance necessary throughout.