MUNICIPAL ASSOCIATION OF VICTORIA

Developing a Risk-based Management Plan for Electric Line Clearance in Declared Areas.

A manual for Victorian councils.

Prepared for the Municipal Association of Victoria (MAV)

Table of Contents

1. ACKNOWLEDGMENTS

The Municipal Association of Victoria (MAV) and ENSPEC would like to acknowledge the work of representatives from the following councils who committed significant time and energy over a period of months to help develop this risk-based management approach for councils:

- City of Bayside
- City of Boroondara
- City of Manningham
- City of Melbourne
- City of Stonnington
- City of Yarra
- Shire of Yarra Ranges

Special thanks go to representatives from the City of Stonnington who played a leading role.

A number of other individuals and organisations contributed to the development of this document, including:

- Officers from approximately 18 councils, via the MAV Electric Line Clearance Reference Group
- Electricity Distribution Business representatives, and
- Energy Safe Victoria

Special contributions were made by Martin Norris of Wellington Shire Council, and Phil Walters of Energy Safe Victoria.

The lead research and development of this document was completed by Craig Hallam of ENSPEC Pty Ltd. Craig has been involved in the utility vegetation management industry since mid 1980 and is the founder of the Utility Arborist Association Australia.

Notes:

- Throughout this document the *Electricity Safety (Electric Line Clearance) Regulations 2010* will be referred to as the 2010 Regulations.

- This document has been designed as a manual, for use in the field by assessing arborists. A more detailed explanation of the methodology and risk matrix is provided in the "Developing a Risk-Based Management Framework for Electric Line Clearance in Declared Areas: Project Report", available from the MAV.

2. INTRODUCTION

This document, commissioned by the MAV, explains a risk-based management approach developed to enable councils, in their capacity as "responsible persons" under the Electricity Safety Act, to protect certain categories of trees that would be adversely affected if pruned in accordance with the *Electricity Safety (Electric Line Clearance) Regulations 2010*.

Clause 9 of the 2010 Regulations requires councils, in their capacity as responsible persons, to prepare before 31 March in each year a detailed Vegetation Management Plan relating to compliance with the Code of Practice for Electric Line Clearance.

Clause 10 of the 2010 Regulations provides that ESV may exempt a responsible person from any of the requirements of the Regulations, subject to any conditions specified by ESV.

Generally councils will be required to ensure that trees in their municipality in proximity to powerlines are maintained in compliance with the 2010 Regulations. Councils may apply to Energy Safe Victoria (ESV) to reduce the clearance space requirements under the Regulations using a risk management framework in order to preserve trees deemed to be of value due to their:

- Heritage significance
- Cultural significance
- Historical significance
- Environmental significance
- Habitat significance
- Landscape significance
- Aesthetic significance
- Significance as rare or endangered species or specimens
- Special Significance

In order to be granted an exemption under Clause 10, councils will need to demonstrate in their Electric Line Clearance Management Plan how the trees for which they are seeking an exemption will be managed to maintain a low level of risk. This manual, to be used with the risk-based matrix at Appendix 1, provides councils with a robust risk assessment methodology.

Once a council identifies the trees for which it wishes to seek an exemption, a risk-based management plan (incorporating the risk-based matrix) would be prepared and included as an appendix to council's Electric Line Clearance Management Plan. Council would then need to submit their Management Plan to ESV for evaluation. If deemed acceptable, an exemption under Clause 10 of the 2010 Regulations may be granted.

Note: vegetation touching powerlines or breaching the clearance spaces specified in the risk-based matrix at Appendix 1 will not be accepted at any time.

3. SCOPE OF RISK-BASED MANAGEMENT PLAN

This manual (including the risk-based matrix at Appendix 1) has been developed for use in the assessment of trees in Declared Areas, and covers vegetation clearances around High and Low Voltage powerlines.

This manual cannot be used for:

- Vegetation clearances in High Bushfire Risk Areas (HBRA) except for Declared Areas in HBRA, or
- Sub-transmission powerlines in Declared Areas, LBRA or HBRA.

This manual is to be read in conjunction with the 2010 Regulations. Vegetation will be deemed to be compliant with the 2010 Regulations if:

i. The requisite clearance as defined in the 2010 Regulations is achieved, or

ii. Vegetation is managed and maintained in accordance with an ESV-approved exemption.

It is intended that any applications for exemptions would be limited to individual trees or to individual stands of vegetation. It is not envisaged that exemptions would be granted at a municipal level.

4. HAZARD TREES

When assessing trees in the vicinity of powerlines, arborists should also keep in mind their responsibilities in relation to hazard trees.

Part 2, Clause 3 of the Code of Practice for Electric Line Clearance provides that:

If a person identifies a tree as likely to fall onto or otherwise come into contact with an electric line a responsible person may cut or remove the tree provided that—

(a) the tree has been assessed by a suitably qualified arborist; and

(b) that assessment confirms the likelihood of contact with an electric line having regard to foreseeable local conditions.

5. QUALIFICATIONS & CERTIFICATIONS TO CONDUCT ASSESSMENT

The minimum level of qualification required to assess a tree using the risk-based matrix at Appendix 1 is as per the definition of a 'suitably qualified arborist' under the 2010 Regulations:

- National Certificate Level IV in Horticulture and Arboriculture, including the 'Assess Trees' module, or an equivalent qualification; and
- At least three years of field experience in assessing trees.

The assessing arborist will also be required to complete and be competent in two additional training courses:

1. Safe Approach Distance for an Authorised Person, as specified in the *Code of Practice of Electrical Safety for Work On or Near High Voltage Electrical Apparatus* (The Blue Book). This is an ESV-approved training course, currently: NUE 260 – Electrical Systems Identification and Powerline Clearance Requirements, or UETTDREL04.

2. A two day above-ground assets inspection course that will include asset hardware identification, understanding in engineering solutions and powerline construction methods as approved by ESV.

6. VEGETATION ASSESSMENT – SAFE APPROACH DISTANCE

Safe Approach Distance for an Authorised Person is specified in the *Code of Practice of Electrical Safety for Work On or Near High Voltage Electrical Apparatus* (The Blue Book). The Authorised Person is normally the person conducting the powerline pruning. It is essential that the arborist assessing the risk clearly understands the constraints the authorised person has to comply with when tree pruning works are being completed.

An authorised person is a person who:

- Has completed the ESV-approved training course, currently NUE 260 – Electrical Systems Identification and Powerline Clearance Requirements, or UETTDREL04
- Has technical knowledge or sufficient experience to perform the duty concerned, and
- Has been endorsed in writing by the organisation (eg the employer) to perform the work.

Only arborists who are authorised persons may undertake risk-based assessments and they need to be fully aware of the clearances as described in the table below.

Type of electric line	Authorised Person, Tool & equipment (mm)	Uninsulated Part of Mobile Plant (mm)	Insulated Parts of Mobile Plant
LV insulated	Insulated Contact	1000	Contact Allowable
1500V DC or less	Insulated Contact	1000	700
LV bare or covered	Insulated Contact	1000	Contact Allowable
6.6kV	700	1200	700
11kV	700	1200	700
22kV	700	1200	700
33kV	700	1200	700
66kV	900	1400	1000

Summary of Blue Book requirements for Authorised Persons Safe Approach Distance from Overhead Electric lines of 66kV or less

A detailed explanation on clearance requirements can be found on the ESV website document ESI G1 - Guidelines for Tree Clearing Work by Authorised Person under Electricity Safety (Installations) Regulations 2009. The Blue Book can also be accessed on the ESV website.

7. METHODOLOGY

The process begins with the development of council's Electric Line Clearance Management Plan, prepared in accordance with Clause 9 of the 2010 Regulations.

A suitably qualified arborist would assess compliance with the 2010 Regulations of all trees on council land in Declared Areas that are within the vicinity of powerlines.

Details of all trees that are identified as not compliant with the 2010 Regulations would be recorded. Those that are considered to be of sufficient value to warrant an application for an exemption from the Regulations would then be assessed using the risk-based matrix at Appendix 1.

If the tree is assessed to be climbable, or within the specified clearance space, or could grow/fall into the specified clearance space prior to the next inspection, council can either:

- Prune the tree to the clearances specified in the 2010 Regulations; or
- Apply for an exemption to manage the tree to a low risk level using a risk-based management plan. As part of the exemption application, council must set clear KPI to demonstrate how it is going to manage the tree to a low risk over a specific period of time; or
- Apply for an exemption for those trees that require a transition period to bring them into compliance with the 2010 Regulations. Exemption requests for transition periods should include the timeframe in which council intends to achieve compliance and the KPI against which ESV can assess progress.

If council wants an exemption from the 2010 Regulations, it must submit its Electric Line Clearance Management Plan (including a Risk-based Management Plan and a copy of the risk Matrix assessments) to ESV for approval.

The ESV may accept or reject the Management Plan submitted. If a rejection occurs council can review their Electric Line Clearance Management Plan and resubmit to the ESV for reconsideration.

Figure 1 (below) illustrates when a risk-based management plan would be implemented.

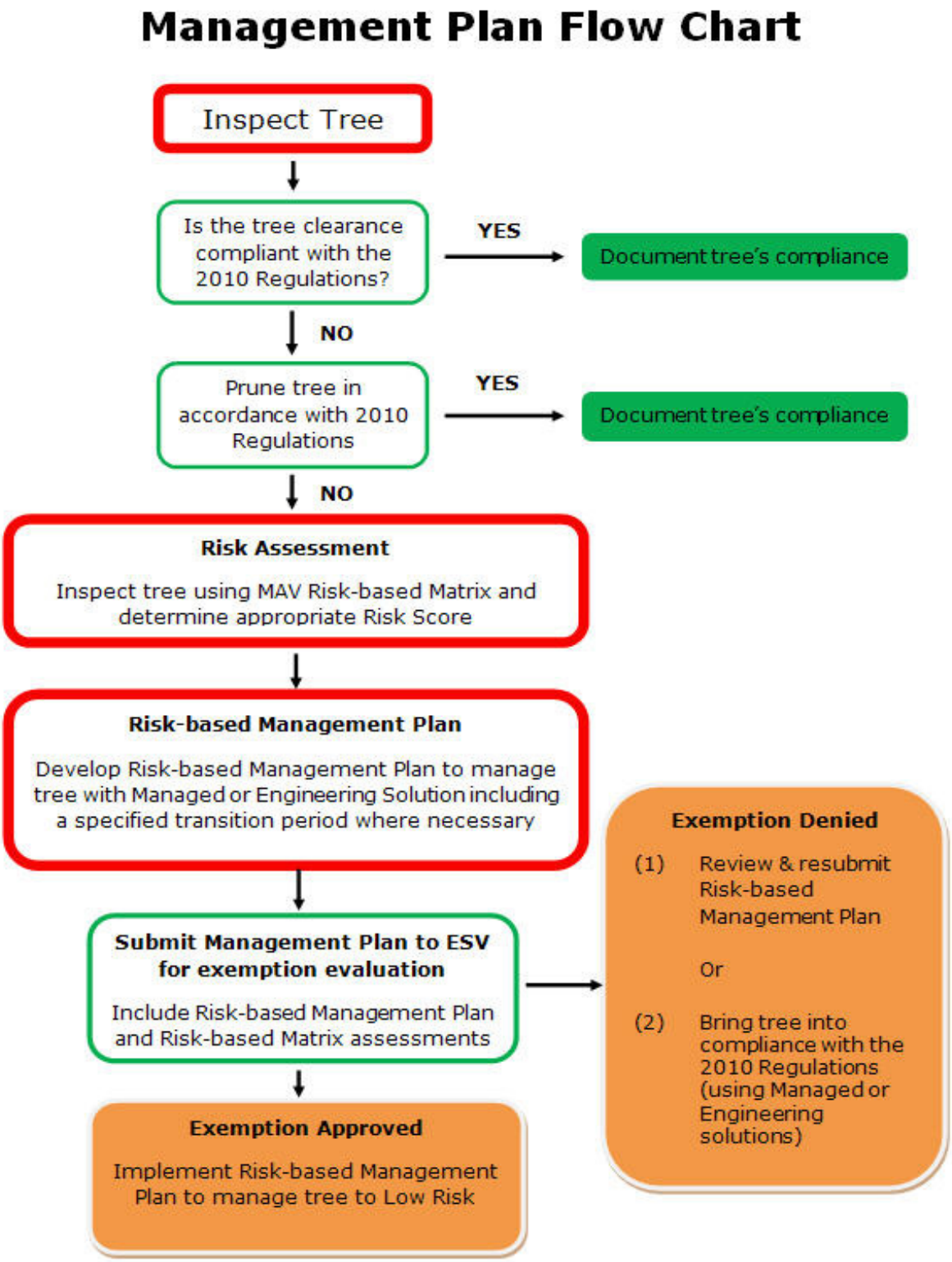


Figure 1. Risk-based Management Plan Flow Chart.

8. OVERVIEW OF RISK-BASED MATRIX METHODOLOGY

For vegetation management around powerlines, risk is defined by the combination of:

- Likelihood that an event will occur, and
- Consequences (electrocution, fire or power outage) of an event occurring.

The three categories of Likelihood to be assessed by an arborist for each tree are:

A. Climbability of a tree - likelihood of a tree being climbed by a child and the child then touching powerlines

B. Foliage impacting on powerlines - likelihood of foliage or re-growth entering the clearance space within the next inspection period

C. Branch failure or movement impacting on powerlines - likelihood of branch failure or movement entering the clearance space and contacting powerlines, especially under wind loading.

The Consequences of each level of Likelihood are pre-determined by the electrical industry and have been pre-calibrated into the risk-based matrix at Appendix 1.

Specific information must be collected and recorded for each tree (see Section 8 – How to Document the Risk Assessment). The risk-based matrix at Appendix 1 is then used to identify the risk score (high, medium or low) for each of the three categories (climbability, foliage, and branch failure or movement).

A high risk score (colour coded red in matrix) will identify trees that need immediate or urgent action to reduce the risk to medium or low.

A medium risk score (colour coded yellow in matrix) will identify trees that need action, but not with the same urgency as trees at high risk.

A low Risk Score (colour coded green in matrix) will identify trees that may not need immediate action but still need to be managed under the risk-based management plan. Low risk trees may be maintained to the current status within defined limits to prevent any future medium or high risk situations occurring before the next inspection period.

Inspection details and risk score records will need to be well documented by council in their Management Plan.

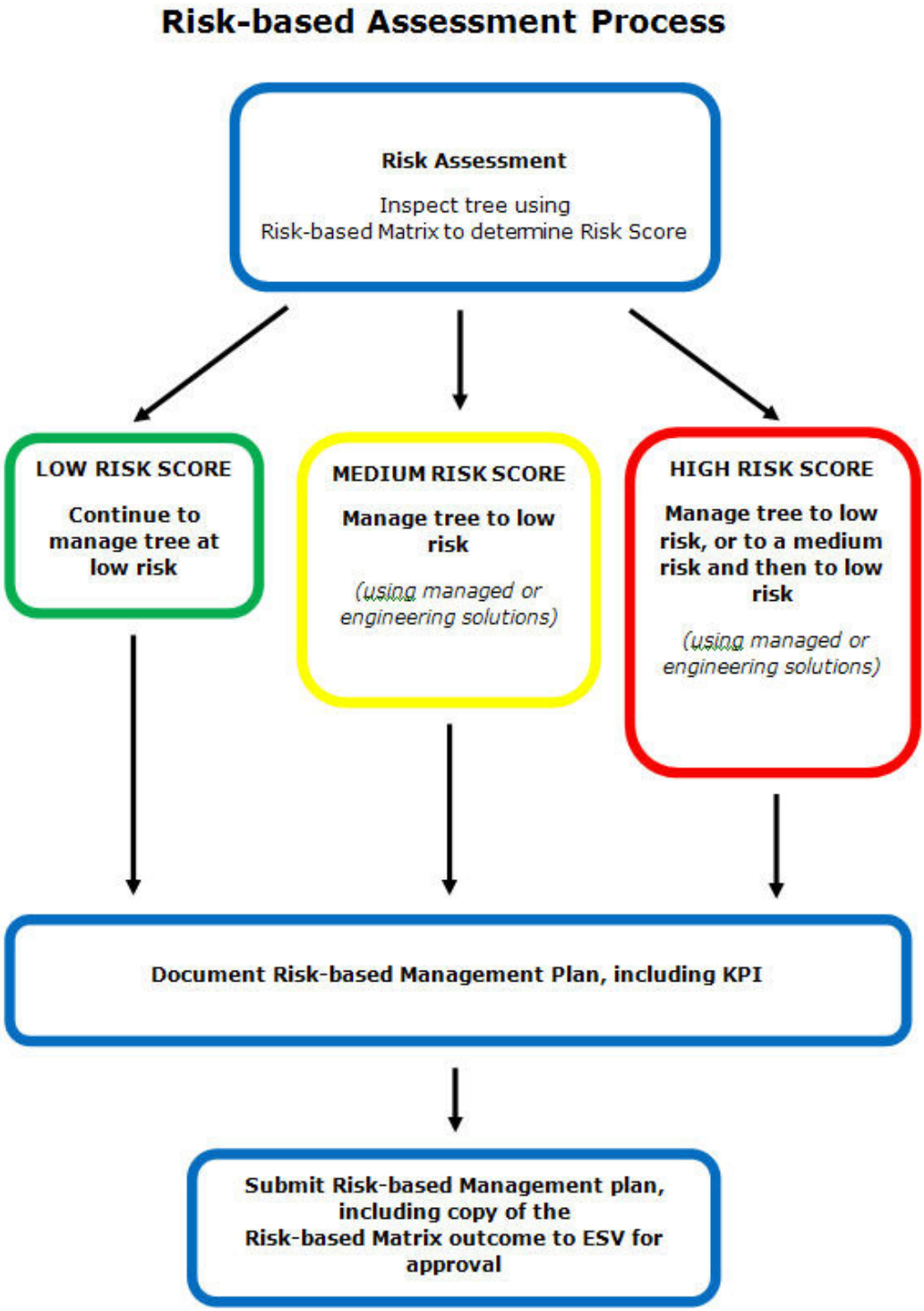


Figure 2. Risk-based assessment process flow chart for vegetation management (Declared Areas)

9. USING THE RISK-BASED MATRIX

The risk-based matrix at Appendix 1 is an abridged version designed specifically for use by arborists in the field. A copy of the full risk matrix is provided in the "Developing a Risk-Based Management Framework for Electric Line Clearance in Declared Areas: Project Report", available from the MAV.

The risk matrix at Appendix 1 enables arborists to immediately obtain the risk score (high, medium or low) for each of the three categories (climbability, foliage regrowth and branch failure or movement) once the Likelihood for each category has been assessed.

Step One: Identify the voltage of the powerlines

In general, powerlines in Declared Areas have a cruciform construction design and may have both High Voltage (6.6kV and/or 22kV) and Low Voltage conductors. In some designs a third voltage (66kV sub-transmission) is also included. 66kV sub-transmission powerlines are not to be assessed using the risk-based matrix.

High Voltage powerlines are potentially very dangerous and require special attention when assessing risk. Vegetation is allowed above High Voltage wires but must not enter the clearance space as described in Figure 4, page 28 of the 2010 Regulations.

There are three categories of powerlines (refer Glossary for definitions) to be considered in the risk assessment:

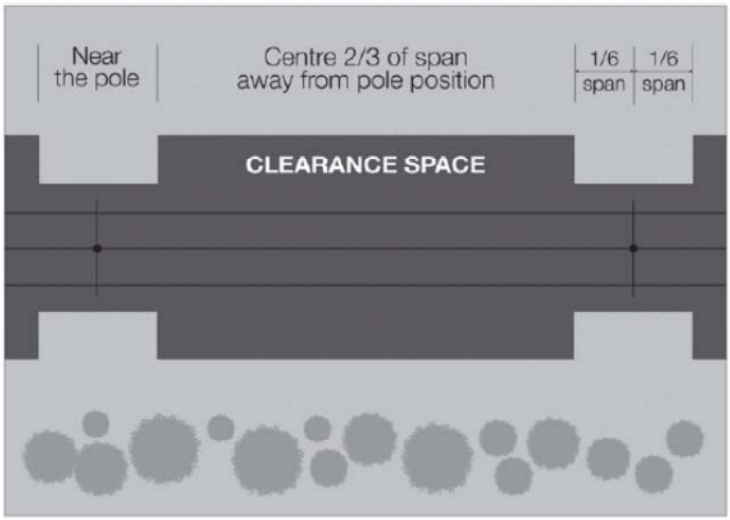
- LV Coated Service Wire (CSW), Insulated Cable, and Aerial Bundled Cable
- Uninsulated Low Voltage and High Voltage Aerial Bundled Cable
- High Voltage <66,000 volts

Step Two: Determine the tree's location with regards to pole and/or span

Vegetation clearance spaces take into consideration the powerline span length, which affects sag and sway. A tree's risk score will vary according to the span length and the location of the tree within the span.

An arborist using the risk-based management approach must allow for sag and sway for spans greater than 45 metres in length. In such spans no allowance for sag and sway is required in the 1/6 of the span closest to the power pole as minimal movement of the conductor occurs in this area due to the fixture point on the power pole. Allowances must be made for sag and sway in the centre 2/3 area of the span. The risk-based matrix can only be used on spans up to 100 metres in length.

No allowance for sag and sway is required for spans less than 45 metres in length.



Step Three: Assess if foliage or structural branch is inside or outside the clearance space

If the vegetation is outside the clearance space and not likely to grow into the clearance space in the next inspection period, the vegetation would be assessed as being compliant to the 2010 Regulations.

Examples of this situation include small trees that are well below the height of the powerlines, or a mature tree that will not grow into the defined clearance space (2010 Regulations) within the re-inspection period.

Step Four: Assess the Likelihood of the tree being climbed (code C1-C5 on matrix)

If a tree in close proximity to powerlines is climbable, there is a possibility that a child may climb the tree and be electrocuted. For this assessment, no differentiation between the different types of powerlines and voltages is necessary as all are capable of causing electrocution and fatality.

In the absence of an agreed industry standard about how to assess a tree's climbability, the following methodology is to be used:

- A tree is assessed as able to be climbed by a child, based on a child's physical attributes and ability. For the current assessment process, the general physical attributes and ability (including height) for a white 11 year old boy are taken as a reference point. Statistical information[1] on boys' height gives the 90% percentile (upper height range) for an 11 year old as 1600mm.
  ([1] Ref: Boys Height Growth Chart http://www.halls.md/on/boys-height-w.htm).

- A tree cannot be climbed, or is very difficult to climb, if the lowest branch is out of reach of the person trying to climb it. If the height of the tallest 11 year old boy (90% percentile) is taken as 1600mm, and additional height is allowed for reach, jumping and risk-taking, the following maximum reachable height can be calculated:

  Maximum reachable height = 1600mm + (1/3 of 1600mm) = 2150mm.

  For the assessment of climbability:

- The lowest allowable branch should be approximately 2150mm from the ground to the uppermost side of the branch. If a branch is at or below this height and provides some level of purchase/grip, it is assumed that a child could reach it and climb up the tree; and

- The availability of other secure hand and foot holds must be considered. If secure hand and foot holds are not available to support the child, the risk of touching the powerlines is reduced; and

- The likelihood of a child who has climbed a tree being able to get close enough to the powerlines to touch them must be considered. Specifically, the strength of the branch to which the child may be attached must be assessed; if it is not strong enough to support the child's weight the risk of his touching the powerline is reduced.

Risk score: Once the Likelihood of a child being able to climb a tree AND touch a powerline has been assessed, the risk-based matrix is used to obtain a risk score of high, medium or low.

Step Five: Assess the Likelihood of foliage impacting on powerlines (code F1-F13 on matrix)

The potential consequences of foliage entering the clearance space and impacting on the powerlines are power outage for High Voltage systems, and electrocution for Low Voltage systems.

Within each of the voltage and span ranges there are four categories of foliage and clearance space from which Likelihood of contact is to be assessed.

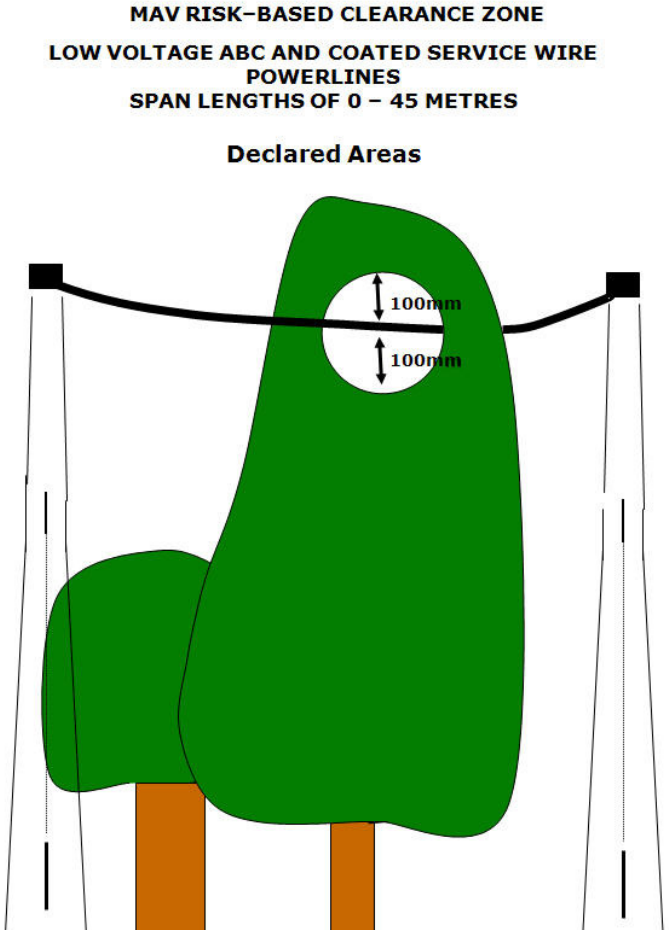
1. Foliage outside clearance space but likely to grow into clearance space, but not closer than 100mm to conductor.

2. Foliage inside clearance space but not closer than 100mm to conductor, on a mature (or over-mature) tree, and very unlikely to grow further into clearance space.

3. Foliage inside clearance space and likely to grow further into clearance space, but not closer than 100mm to conductor.

4. Foliage within 100mm of conductor.

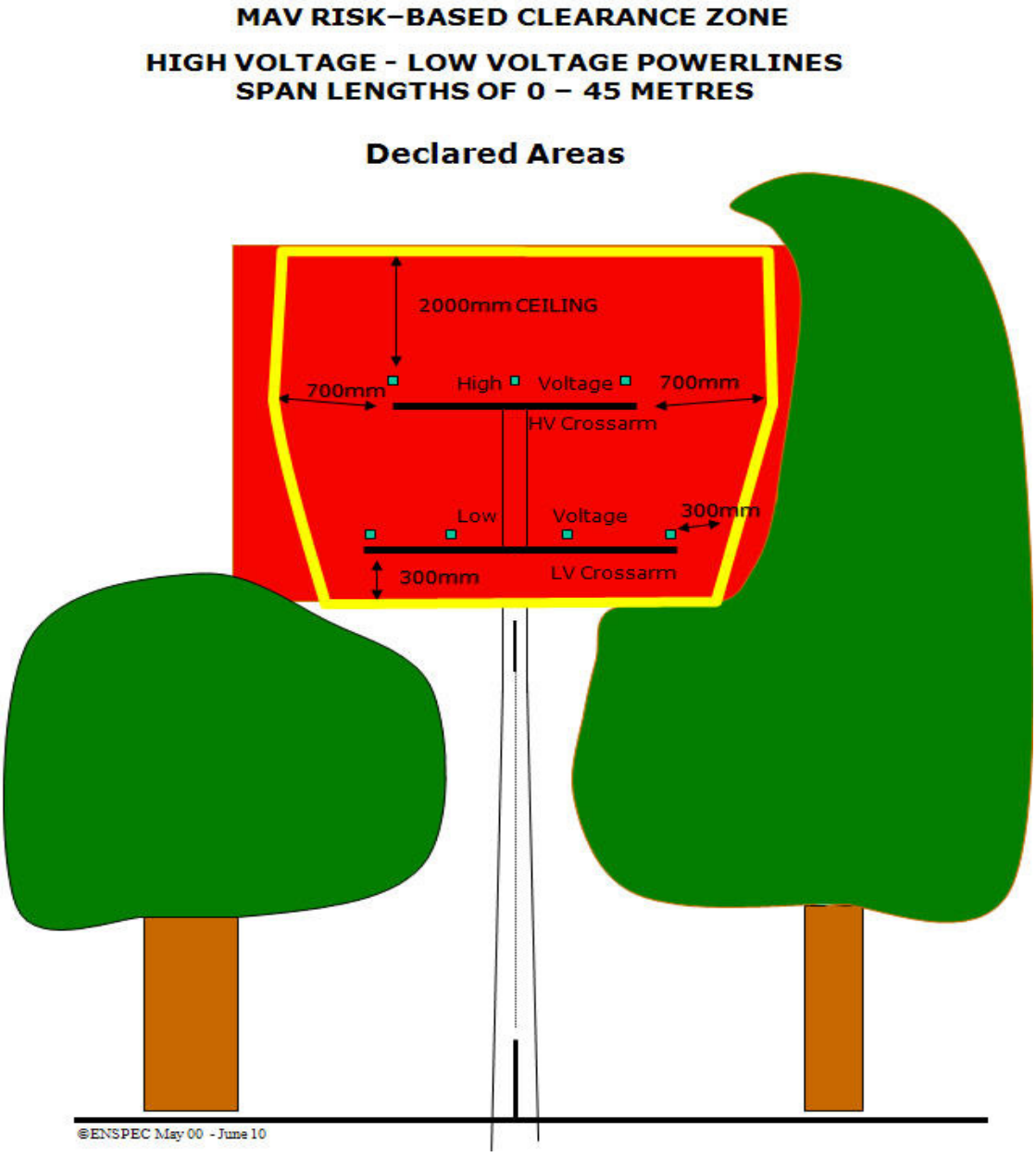
The minimum clearance space for foliage around LV Coated Service Wires (CSW), Insulated Cable and LV ABC using the risk-based management approach is 100mm (see diagram below). Councils should note this is a reduction from the 600mm clearance requirement under the 2010 Regulations for Coated Service Wires. Foliage within 100mm of LV CSW, Insulated Cable and LV ABC or likely to grow within 100mm within the next inspection period will have a high risk score.



The minimum clearance space for foliage around Uninsulated Low Voltage and High Voltage ABC cables using the risk-based management approach is 300mm.
Foliage within 300mm of Uninsulated LV and HV ABC or likely to grow within 300mm within the next inspection period will have a high risk score.

High Voltage powerlines must have a minimum clearance space of 700mm beside and below the conductor and 2000mm above the conductor (see diagram below). Foliage within 700mm of HV or likely to grow within 700mm within the next inspection period will have a high risk score.

Risk score: Once the Likelihood for each foliage clearance category has been assessed, the risk-based matrix is used to obtain a risk score of high, medium or low.



Step Six: Assess the Likelihood of branch failure or movement impacting on powerlines (code B1-B25 on matrix)

The consequences of a branch failing or moving in winds and contacting powerlines are electrocution, fire or power outage for both Low Voltage and High Voltage systems.

For the purposes of this risk-based management approach, branch diameter is to be measured at the height of the powerline conductor.

The risk-based matrix provides risk scores for two branch sizes:

- Branches greater than 130mm in diameter, measured at the powerline height
- Branches 50 to 130mm in diameter, measured at the powerline height*

** Please note, as the watermark on the matrix indicates, councils are not to use the 50 to 130mm diameter category on the matrix (rows B14-B25 inclusive) until further research regarding tree and branch dynamics in windy conditions has been conducted. Contact the MAV for further details.*

Within each of the voltage and span ranges there are four categories of branch failure and movement, together with the clearance spaces, from which Likelihood of contact is to be assessed.

- For the LV CSW, Insulated Cable and ABC the four categories for branch failure are:
    - Branch inside the clearance space but not closer than 100mm to powerlines, and unlikely to fail or move closer than 100mm to the powerlines
    - Branch inside the clearance space but not closer than 100mm to powerlines; branch has some defect but unlikely to fail or move closer than 100mm to the powerlines within the next inspection period
    - Branch inside the clearance space but not closer than 100mm to powerlines; likely to fail or move closer than 100mm to the powerlines
    - Branch inside the clearance space and closer than 100mm to the powerlines
- For the Uninsulated LV and HVABC powerlines the categories are the same as above but the clearances are increased to a minimum of 300mm for all four categories.
- For the HV lines the categories are the same but the clearances are increased to 700mm for all four categories.

  There are additional restrictions on branch locations for the HV powerlines because of the high voltages and serious consequences for this case. Only branches located below or beside powerlines, and 2 metres above powerlines are considered acceptable for the HV powerlines. Any branch above the HV powerlines and within 2 metres of the powerlines poses a serious risk if it was to fail and such branches should be removed.

Any branch that encroaches within the inner limit will need to be either removed or a managed or engineering solution sought.

Risk score: Once the Likelihood for each branch failure or movement category has been assessed, the risk-based matrix is used to obtain a risk score of either high, medium or low.

Step Seven: How to apply the risk score and determine the overall risk rating

As explained above, the assessing arborist will allocate a risk score (high, medium or low) for each of the three categories (climbability, foliage, and branch failure or movement) for each tree being assessed.

It is important to understand and remember that Likelihood is determined by the arborist assessing the tree in the field, whereas the Consequences are pre-determined by the electrical industry and cannot be modified by the arborist. This is the reason Consequences are not displayed in the risk matrix at Appendix 1.

In order to be able to determine a tree's priority in council's risk management plan, it is necessary to determine the overall risk score (high, medium or low) for each tree. A tree's overall risk score is taken to be the highest risk score that has been identified in the assessment of the three categories. For example, if a tree has a low risk score for climbability and high risk scores for foliage regrowth and branch failure or movement, then the tree is to be managed as a HIGH risk tree. KPIs should be determined and developed accordingly to reduce the high risk tree to a low risk over a period of years.

Example One:

A tree mid span in a span which is 70 to 100 metres in length and the powerline construction is of Low Voltage (uninsulated) with the tree affecting Low Voltage only.

The tree is assessed to have a Likelihood of being climbed of C2 which is a low risk.
The tree is assessed to have a Likelihood of foliage impacting on powerlines as F4 which is a medium risk.
The tree is assessed to have a Likelihood of branch failure or movement impacting on powerlines as B1 which is a low risk.

The tree will be allocated a risk rating of MEDIUM. Council would need to document within its risk management plan (attached to council's Electric Line Clearance Management Plan) how this tree will be managed to a LOW risk over a specified period of time. KPIs will need to be provided. To achieve this Council may consider pruning the tree on a more regular cycle, or perhaps look at engineering solutions to change the construction type.

Example Two:

A tree mid span in a span which is less than 45 metres in length and the powerline construction is of High and Low Voltage (uninsulated) with the tree affecting High and Low Voltage.

The tree is assessed to have a Likelihood of being climbed of C3 which is a low risk.
The tree is assessed to have a Likelihood of foliage impacting on powerlines as F12 which is a medium risk.
The tree is assessed to have a Likelihood of branch failure or movement impacting on powerlines as B6 which is a medium risk.

The tree will be allocated a risk rating of MEDIUM. Council would need to document within its risk management plan (attached to council's Electric Line Clearance Management Plan) how this tree will be managed to a LOW risk over a specified period of time. KPIs will need to be provided. To achieve this council may consider pruning the tree on a more regular cycle, or perhaps look at engineering solutions to change the construction type.

Example Three:

A tree mid span in a span which is less than 45 metres in length and the powerline construction is a Coated Service Wire with the tree affecting the Coated Service Wire.

The tree is assessed to have a Likelihood of being climbed of C4 which is a high risk.
The tree is assessed to have a Likelihood of Foliage impacting on powerlines as F5 which is a high risk.
The tree is assessed to have a Likelihood of Branch failure or movement impacting on powerlines as B1 which is a low risk.

The tree will be allocated a risk rating of HIGH. Council would need to document within its risk management plan (attached to council's Electric Line Clearance Management Plan) how this tree will be managed to a LOW risk over a specified period of time. KPIs will need to be provided. To achieve this council may consider pruning the tree on a more regular cycle, or perhaps look at engineering solutions to change the construction type.

10. HOW TO DOCUMENT THE RISK ASSESSMENT

In order for ESV to consider an exemption application, detailed information about each non-compliant tree (or group of trees) for which an exemption is being sought must be provided within the risk management plan.

When a suitably qualified arborist assesses a tree for which council is seeking an exemption, it is suggested that the following details be recorded:

- Assessing arborist
- Inspection date
- Tree location – Easting and Northing
- Adjoining property address (auto generated from council's cadastral information layer)
- The location of the tree in relation to the adjoining property
- Tree genus and species
- Health and condition of tree
- Date of next inspection or of proposed remedial works
- The powerline construction type, examples of which include:
    - Coated Service Wire construction
    - 2 and 3 bare wire service lines construction
    - Low Voltage bare wire and Coated Service Wire construction
    - Low Voltage bare wire construction
    - High Voltage (up to 22kV) and Low Voltage bare wire construction
    - High Voltage and Low Voltage bare wire and Coated Service construction
    - High Voltage bare wire construction type
    - High Voltage bare wire and Low Voltage ABC construction
    - Low Voltage ABC
    - High Voltage ABC
    - High and Low Voltage ABC construction
    - High Voltage bare wire and Coated Service Wire construction
    - 66,000 volt bare wire construction
    - 66,000 High (up to 22kV) and Low Voltage bare wire construction
    - 66,000 and Low Voltage bare wire construction
    - 66,000 and Low Voltage bare wire and Coated Service Wire construction
    - 66,000, High (up to 22kV) and Low Voltage bare wire and Coated Service Wire construction
    - Low Voltage AC and DC (tram) bare wire construction
    - High Voltage (up to 22kV), Direct Current (tram) bare wire construction
    - High (up to 22kV) and Low Voltage AC and Direct Current (tram) bare wire construction
    - Direct Current (tram) bare wire construction
- The voltage/s the tree is affecting (use powerline construction type)
- Why the tree is deemed to be a tree of value
- Is a Managed and/or Engineering solution required, and if so what type
- Likelihood Risk Level (refer to MAV risk-based matrix) for:
    - Climbability of tree
    - Likelihood of foliage impacting on powerlines
    - Likelihood of branch failure or movement on powerlines
- Overall Risk Level (High, Medium or Low)
- Other relevant information

11. KEY PERFORMANCE INDICATORS (KPI)

In order for councils to achieve and maintain an exemption from ESV under Clause 10 of the 2010 Regulations, council's risk management plan will need to set out clear key performance indicators (KPI) against which ESV can audit performance. Details of the non-compliant trees (see section 8 above) as well as records of the inspection and the corrective actions that are to be taken or proposed to be taken must be provided.

To manage vegetation to a low risk status, a transition plan is likely to be required by councils. Councils will need to document a step-by-step transition process in their management plan. This transition plan could include options such as setting priorities so that high risk cases are initially addressed and managed, first to a medium risk and then to a low risk. Once the high risk cases have been managed to a medium risk, the next phase would be to address medium risk trees and manage them to a low risk. Over time the desired outcomes of managing the tree population to a low risk will be achieved.

12. MANAGED AND ENGINEERING SOLUTIONS

Whilst pruning and vegetation clearance is common practice, there are other solutions that can reduce or even eliminate the need for cutting trees. Powerline engineering solutions may result in considerable long-term savings in annual pruning costs and should be investigated wherever possible. Councils should consult with electricity distribution companies to ascertain their planned up-grade schedules for Distribution Business assets as this may provide further opportunity for cost savings.

When managing powerline clearances the following solutions should be considered:

Managed Solutions

- Replanting with tree species more suitable to co-exist with powerlines
- Increase pruning frequency from traditional cycles

Engineering Solutions

- Aerial Bundled Cable
- Underground powerlines
- Power pole relocation
- Buck arm
- Pole raisers
- Point of powerline attachment

Implementing managed and engineering solutions to protect trees will require significant capital investment from a council and may require a long-term implementation timeframe. Where such options are being considered, councils should ensure the KPI are clearly defined well in advance of the actual anticipated implementation date.

13. CONCLUSION

The risk-based management approach explained on the previous pages was developed to enable councils to protect trees of value that would be adversely affected if pruned in accordance with the 2010 Regulations.

It is imperative that councils understand that ESV will be conducting more rigid assessments and audits both in the field and by desktop in the future. Councils must ensure they keep their Management Plans up to date and monitor KPIs accurately for when ESV conducts audits.

The application of a risk-based management approach by council to electric line clearance in Declared Areas depends on ESV approval of an exemption under Clause 10 of the 2010 Regulations. In order to maintain an exemption, councils will need to be able to demonstrate progress against the KPI set out within their risk management plan.

This methodology has been developed for use in conjunction with the *Electricity Safety (Electric Line Clearance) Regulations 2010*. The 2010 Regulations expire on 29 June 2015 at which time this manual will also expire.

Any amendments to the *Code of Practice of Electrical Safety for Work on or Near High Voltage Electrical Apparatus (The Blue Book) Victoria 2005*, or to the *Electricity Safety (Electric Line Clearance) Regulations 2010* will require this document to be updated accordingly.

This manual has been designed for use in the field by assessing arborists. A more detailed explanation of the methodology and risk matrix is provided in the "Developing a Risk-Based Management Framework for Electric Line Clearance in Declared Areas: Project Report", available from the MAV.

14. GLOSSARY

Term	Description
Aerial bundled cable (ABC)	Insulated cable manufactured to Australian Standard AS/NZS 3560.1, AS/NZS 3560.2 or AS 3599 Part 1 or AS 3599 Part 2. ABC use several insulated phase conductors bundled tightly together. Used for voltages up to 1.2 kV. (Ref 2010 Regulations p.35/36).
Arborist (Qualified)	National Certificate Level IV in Horticulture and Arboriculture, including the 'Assess Trees' module or an equivalent qualification, and at least three years of field experience in assessing trees.
AS 4373 2007 Pruning Amenity Trees	Australian Standard for correct tree pruning techniques
Bare Service Cable	Uninsulated connection to Point of Supply
Blue Book (The)	Code of Practice of Electrical Safety for Work on or Near High Voltage Electrical Apparatus (The Blue Book) Victoria 2005
Clearance Zone	Space around a powerline to be clear of foliage or branches.
Climbability of a tree	Whether a tree in the vicinity of powerlines is able to be climbed by a child (assessed using the physical attributes and ability of a Caucasian 11 y.o. boy as a reference point). Minimum height for lowest branch will be approximately 2150mm to the uppermost side of the branch.
Conductor	Wire, cable or form of metal designed for carrying electric current
Declared Area	An area of land in an urban area declared for the purposes of the Electricity Safety Act 1998.
Easement	An Easement is a right that a person or entity (such as a council) has over property owned by someone else. Public utilities such as electricity have easements over land to locate their powerlines in order to supply electricity.
Exemptions	Energy Safe Victoria may exempt a responsible person from the Electricity Safety (Electric Line Clearance) Regulations 2010.
Foliage	Leaves, twigs and branches less than 20mm in diameter
Habitat tree	• Habitat for fauna (Ref 2010 Regulations p.12). • Listed as threatened, Section 10 of the Flora and Fauna Guarantee Act 1988 • "endangered" or "vulnerable" or "critically endangered" in the Threatened Fauna List
Hazard tree	A tree likely to fall onto or otherwise come into contact with an electric line (Ref 2010 Regulations p.11)
Heritage tree	Within the Heritage Act 1995
High Voltage (HV)	Nominal voltage exceeding 1000 volts a.c. or exceeding 1500 volts d.c. (up to and including 22kV and excluding 66kV)
Insulated cable	Low voltage cable, single or multi-core, insulated by a medium other than air.
Insulated service cable	A low voltage cable used to convey electricity to a property. Ref AS 3000-1991 – SAA Wiring Rules
Low Voltage (LV)	Nominal voltage exceeding 50 V a.c./120 V d.c. but not exceeding 1000 V a.c./1500 V d.c.
Management Plan	Under Clause 9 of the 2010 Regulations, council must prepare before 31 March each year a Management Plan relating to compliance with the Code of Practice for Electric Line Clearance
Point of supply	Point at which electrical supply is connected to the private building or pole.
Powerline	Electrical line with voltage of 66000 V or less (not including transmission lines)
Prescribed voltage	Section 3 of the Act, definition of Low Voltage 1000 Volts AC 1500 Volts DC
Pruning	Pruning of trees according to Australian Standard AS 4373 – 2007 "Pruning of Amenity Trees"

Risk-based Management Plan	A plan that documents how a council will manage the vegetation clearance spaces of trees of value that are not compliant with the 2010 Regulations. The plan will ensure these trees are protected whilst being managed to a low risk outcome. A risk-based management plan forms part of council's Electric Lince Clearance Management Plan.
Sag	The vertical displacement of the conductor below the point at which the conductor is attached to the supporting structure and includes any extra displacement caused by hot weather or high load current.
Service Line	A low voltage line connecting the power supply to a customer's premises.
Structural Branch	A branch that is 130mm in diameter (or larger), measured at the conductor height. This is separate from foliage because a structural branch will not move in the wind in the same way as foliage.
Sway	The horizontal displacement of the conductor caused by wind.
Threatened Flora list	Rare or threatened plants in Victoria (Ref DSE).
Tree	Includes whole or part of a tree.
Tree of cultural or environmental significance	• Within the meaning of the Heritage Act 1995 • Section 144 of the Aboriginal Heritage Act 2006 • Listed as threatened, Section 10 of the Flora and Fauna Guarantee Act 1988 • 'endangered' or 'vulnerable' in the Threatened Flora List
Tree of Value	The character of trees of value may include their: • Heritage value • Cultural significance • Historical significance • Environmental significance • Habitat value • Landscape Value • Aesthetic value • Status as rare or endangered species or specimens • Special Significance
Vegetation	The whole or any part of a tree or plant.

APPENDIX 1 – RISK-BASED MATRIX (ABRIDGED VERSION) FOR ELECTRIC LINE CLEARANCE IN DECLARED AREAS

Category 1: Likelihood of climbing and touching powerlines

Code	Likelihood of tree being climbed and powerlines touched	Risk Score		
		At pole or span <55m	Mid span Span 55 to 70m	Mid span Span 70m-100m
C1	Cannot climb AND cannot touch powerlines eg. short tree, outside clearance space	LOW	LOW	LOW
C2	Able to climb but cannot touch powerlines	LOW	LOW	LOW
C3	Difficult to climb AND/OR difficult to touch powerlines	LOW	MED	MED
C4	Difficult to climb AND could touch powerlines	HIGH	HIGH	HIGH
C5	Able to be climbed AND could touch powerlines	HIGH	HIGH	HIGH

For the above table there is no distinction between powerline voltages or construction.

Category 2: Likelihood of foliage impacting on powerlines within the next inspection period

Code	Likelihood of foliage impacting on powerlines within the next inspection period	Risk Score		
		At pole or span <55m	Mid span Span 55 to 70m	Mid span Span 70m-100m
F1	Foliage outside clearance space and not likely to grow into the clearance space in the next inspection period. eg. small or mature tree that will not grow to sufficient height in the re-inspection period.	LOW	LOW	LOW
F2	Foliage outside clearance space but likely to grow into clearance space but not closer than 100mm to powerline. **(LV, CSW, Insulated Cable and ABC)**	LOW	LOW	LOW
F3	Foliage inside clearance space but not closer than 100mm to powerline, on a mature (or over-mature) tree, and very unlikely to grow further into clearance space. **(LV, CSW, Insulated Cable and ABC)**	LOW	LOW	LOW
F4	Foliage inside clearance space and likely to grow further into clearance space but not closer than 100 mm to powerline. **(LV, CSW, Insulated Cable and ABC)**	LOW	LOW	MED
F5	Foliage within 100 mm of powerline or likely to grow within 100 mm of powerline. **(LV, CSW, Insulated Cable and ABC)**	HIGH	HIGH	HIGH
F6	Foliage outside clearance space but likely to grow into clearance space but not closer than 300 mm to powerline. **(Uninsulated LV and HVABC)**	LOW	LOW	LOW
F7	Foliage inside clearance space but not closer than 300mm to powerline, on a mature (or over-mature) tree, and very unlikely to grow further into clearance space. **(Uninsulated LV and HVABC)**	LOW	LOW	LOW
F8	Foliage inside clearance space and likely to grow further into clearance space but not closer than 300 mm to powerline. **(Uninsulated LV and HV ABC)**	LOW	MED	MED
F9	Foliage within 300 mm of powerline or likely to grow within 300 mm of powerline. **(Uninsulated LV and HVABC)**	HIGH	HIGH	HIGH
F10	Foliage outside clearance space but likely to grow into clearance space but not closer than 700 mm to powerline. Below or beside powerline only. **(Uninsulated HV)**	LOW	LOW	MED
F11	Foliage inside clearance space but not closer than 700mm to powerline, on a mature (or over-mature) tree, and very unlikely to grow further into clearance space. Below or beside powerline only. **(Uninsulated HV)**	LOW	LOW	MED
F12	Foliage inside clearance space and likely to grow further into clearance space but not closer than 700 mm to powerline. **(Uninsulated HV)**	LOW	MED	MED
F13	Foliage within 700 mm of powerline or likely to grow within 700 mm of powerline. **(Uninsulated HV)**	HIGH	HIGH	HIGH

Category 3: Likelihood of branch failure or movement impacting on powerlines

Code	Likelihood of branch failure or movement impacting on powerlines	Risk Score		
		At pole or Span <55m	Mid span Span 55 to 70m	Mid span Span 70m-100m
B1	Branch outside the clearance space. Tree structurally sound and branch unlikely to fail inside clearance space.	LOW	LOW	LOW
B2	Branch (>130mm Dia.), inside clearance space but not closer than 100 mm to powerline, unlikely to fail or move closer than 100 mm to the powerline. **(LV, CSW, Insulated Cable and ABC)**	LOW	LOW	LOW
B3	Branch (>130mm Dia.), inside clearance space but not closer than 100 mm to powerline; branch has some defect but unlikely to fail or move closer than 100 mm to the powerline within the next inspection period. **(LV, CSW, Insulated Cable and ABC)**	LOW	LOW	LOW
B4	Branch (>130mm Dia.), inside clearance space but not closer than 100 mm to powerline, likely to fail or move closer than 100 mm to the powerline within inspection cycle. **(LV, CSW, Insulated Cable and ABC)**	MED	MED	MED
B5	Branch (>130mm Dia.), inside clearance space and closer than 100 mm to powerline. **(LV, CSW, Insulated Cable and ABC)**	MED	HIGH	HIGH
B6	Branch (>130mm Dia.), inside clearance space but not closer than 300 mm to powerline, unlikely to fail or move closer than 300 mm to the powerline. **(Uninsulated LV and HVABC)**	LOW	LOW	LOW
B7	Branch (>130mm Dia.), inside clearance space but not closer than 300 mm to powerline; branch has some defect but unlikely to fail or move closer than 300 mm to the powerline within the next inspection period. **(Uninsulated LV and HV ABC)**	LOW	LOW	LOW
B8	Branch (>130mm Dia.), inside clearance space but not closer than 300 mm to powerline, likely to fail or move closer than 300 mm to the powerline. **(Uninsulated LV and HVABC)**	MED	MED	MED
B9	Branch (>130mm Dia.), inside clearance space and closer than 300 mm to powerline. **(Uninsulated LV and HVABC)**	HIGH	HIGH	HIGH

Code	Likelihood of branch failure or movement impacting on powerlines	Risk Score		
		At pole or Span <55m	Mid span Span 55 to 70m	Mid span Span 70m-100m
B10	Branch (>130mm Dia.), horizontal or vertical and inside clearance space but not closer than 700 mm to powerline, unlikely to fail or move closer than 700 mm to the powerline . (Branch is to be below or beside powerline, and/or 2 metres above powerline). **(HV)**	LOW	LOW	MED
B11	Branch (>130mm Dia.), horizontal or vertical and inside clearance space but not closer than 700 mm to powerline; branch has some defect but unlikely to fail or move closer than 700 mm to the powerline within the next inspection period. (Branch is to be below or beside powerline, and/or 2 metres above powerline). **(HV)**	LOW	MED	MED
B12	Branch (>130mm Dia.), horizontal or vertical and inside clearance space but not closer than 700 mm to powerline, likely to fail or move closer than 700 mm to the powerline (Branch is to be below or beside powerline, and/or 2 metres above powerline). **(HV)**	HIGH	HIGH	HIGH
B13	Branch (>130mm Dia.), horizontal or vertical and inside clearance space and closer than 700 mm to powerline, or above powerline (Branch is below or beside powerline) Or Branch is above powerline and within 2 m of the powerline. **(HV)**	HIGH	HIGH	HIGH
B14	Branch (50-130 mm Dia.), inside clearance space but not closer than 100 mm to powerline, unlikely to fail or move closer than 100 mm to the powerline. **(LV, CSW, Insulated Cable and ABC)** [REF #2]	LOW	LOW	LOW
B15	Branch (50-130 mm Dia.), inside clearance space but not closer than 100 mm to powerline; branch has some defect but unlikely to fail or move closer than 100 mm to the powerline. **(LV, CSW, Insulated Cable and ABC)** [REF #2]			
B16	Branch (50-130 mm Dia.), inside clearance space but not closer than 100 mm to powerline, likely to fail or move closer than 100 mm to the powerline. **(LV, CSW, Insulated Cable and ABC)** [REF #2]			
B17	Branch (50-130 mm Dia.), inside clearance space and closer than 100 mm to powerline. **(LV, CSW, Insulated Cable and ABC)** [REF #2]			

Not to be used until further verification

Code	Likelihood of branch failure or movement impacting on powerlines	Risk Score		
		At pole or Span <55m	Mid span Span 55 to 70m	Mid span Span 70m-100m
B18	Branch (50-130 mm Dia.), inside clearance space but not closer than 300 mm to powerline, unlikely to fail or move closer than 300 mm to the powerline. **(Uninsulated LV and HVABC)**	**Not to be used until further verification**		
B19	Branch (50-130 mm Dia.), inside clearance space but not closer than 300 mm to powerline; branch has some defect but unlikely to fail or move closer than 300 mm to the powerline. **(Uninsulated LV and HVABC)**	**Not to be used until further verification** LOW	LOW	MED
B20	Branch (50-130 mm Dia.), inside clearance space but not closer than 300 mm to powerline, likely to fail or move closer than 300 mm to the powerline. **(Uninsulated LV and HVABC)**	**Not to be used until further verification**		
B21	Branch (50-130 mm Dia.), inside clearance space and closer than 300 mm to powerline. **(Uninsulated LV and HVABC)**	**Not to be used until further verification**		
B22	Branch (50-130mm Dia.), Horizontal or Vertical and inside clearance space but not closer than 700 mm to powerline, unlikely to fail or move closer than 700 mm to the powerline. (Branch is to be below or beside powerline or 3 m above the powerline). **(HV)**	**Not to be used until further verification**		
B23	Branch (50-130mm Dia.), horizontal or vertical and inside clearance space but not closer than 700 mm to powerline, unlikely to fail or move closer than 700 mm to the powerline. (Branch is to be below or beside powerline and/or 3 metres above powerline). **(HV)**	**Not to be used until further verification** MED	MED	MED
B24	Branch (50-130mm Dia.), horizontal or vertical and inside clearance space but not closer than 700 mm to powerline, likely to fail or move closer than 700 mm to the powerline (Branch is to be below or beside powerline and/or 3 metres above powerline). **(HV)**	**Not to be used until further verification**		
B25	Branch (50-130mm Dia.), horizontal or vertical and inside clearance space and closer than 700 mm to powerline. (Branch is to be below or beside powerline and/or 3 metres above powerline). **(HV)**	**Not to be used until further verification** HIGH	HIGH	HIGH

#1 All branch diameters expressed as diameter at height of powerline

#2 Structural branches. For branches 50-130mm, dynamic measurements under wind conditions to verify sway movement need to be conducted.

#3 Refer Sag and Sway Energy Australia Publication