Eucalyptus morrisbyi Conservation Action Plan

2018-2038

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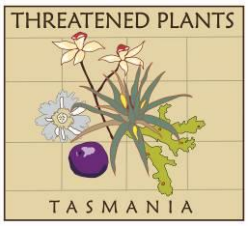

Citation: *Eucalyptus morrisbyi* recovery working group (2018) *Eucalyptus morrisbyi* conservation action plan 2018-2038.

Contents

1 Executive Summary

Eucalyptus morrisbyi is one of Australia's most endangered eucalypts and one of the Australian Government's priority threatened plant species for recovery under the Australian Threatened Species Recovery Strategy. The species is only known from two locations 21 km apart: in the East Risdon Conservation Area, and the fragmented Cremorne subpopulation which now consists of a main stand at Calverts Hill Nature Reserve and several small remnants surrounded by residential and agricultural land. This species is facing extreme risk of extinction in the short-term without further emergency interventions. Its extreme extinction risk is characterised by:

* Severe and rapid population declines across its range
* Extremely small number of reproductively mature individuals
* Extremely small extent of occurrence
* Extremely small area of occupancy

To conserve this species, continued threat abatement at Calverts Hill Nature Reserve is required to increase the number of mature plants and reverse the population decline at the only remnant stand capable of significant regeneration. However, threat abatement of this stand alone will not be adequate to ensure the long-term survival of the species. New conservation plantings are needed to increase its extent of occurrence, area of occupancy and assist its migration under future climate predictions. While it is important to maintain *E. morrisbyi* within its current range for as long as possible, assisted migration is considered as part of a long-term conservation planning strategy for this species due to severe declines and lower planting success rates within the known species range.

This *Eucalyptus morrisbyi* conservation action plan uses the IUCN Red List criteria as a framework to set management objectives (Table 3, pages 11-12). To achieve these objectives, realistic 5 and 20-year key performance indicators (KPIs) have been developed for each objective. The goal of the objectives is the down-listing of the species over a 20-year time period. Management actions have been developed to meet these KPIs. The management actions (Table 4, pages 19-26) are clearly described and include prioritisation of actions, recommended timeframes, organisational responsibilities and budgets for required actions.

The highest priority management actions (very high) outlined in Table 4 are:

- Threat abatement at Calverts Hill Nature Reserve:
    - Maintaining wildlife proof fences (including fence upgrade and repair when required);
    - Maintaining tree bands and investigating regeneration options for mature trees with declining health; and
    - Undertaking wildfire protection works (fire breaks and fuel reduction).
- Threat abatement at Delphis Drive:
    - Fencing of recruits.
- Reintroductions
    - Reintroductions in wildlife proof fenced areas at Calverts Hill Nature Reserve and maintenance of these plantings.
- Translocations
    - Finalising translocation guidelines and translocation plans; and
    - Undertaking at least 4 translocations within future climate envelope and maintenance of these plantings.
- Seed conservation
    - Assessing the impact of wildfire on the Geeveston seed orchard.
- Monitoring, evaluation and program coordination
    - Program coordination;
    - Plant health monitoring at Calverts Hill Nature Reserve; and
    - Undertaking 5-yearly census of remnant subpopulations.

2 Introduction

This plan has been developed to ensure that conservation actions for the endangered *Eucalyptus morrisbyi* are coordinated and able to realistically meet the long-term conservation objective for the species. *Eucalyptus morrisbyi* is under extreme risk of extinction in the short term. It is nearly functionally extinct due to the extremely small number of reproductively mature trees and there is a very real possibility that habitat protection and threat abatement will not prevent the continued loss of mature trees in the short-term. New conservation plantings are urgently needed to reduce the risk of extinction by increasing the number of locations and by assisted migration of the species to suitable locations in a future climatic range. This conservation action plan is based on a two-factor longer-term approach that relies on: 1. The next generation of plants derived from conservation plantings; and 2. Survival of recruits and threat abatement measures at Calverts Hill Nature Reserve.

The IUCN Red List criteria have been used as a framework to set management objectives toward an overarching conservation objective of down-listing the conservation status of the species within the next 20 years. This plan was jointly developed by Enviro-dynamics, the Tasmanian Parks and Wildlife Service (PWS), DPIPWE's Threatened Species Section (TSS), the Royal Tasmanian Botanical Gardens (RTBG), the Tasmanian Seed Conservation Centre (TSCC), the University of Tasmania (UTAS), Greening Australia (GA), Conservation Volunteers Australia (CVA), the Understorey Network (USN), Threatened Plants Tasmania (TPT), NRM South and pakana Services. These organisations are currently working together on a recovery project for the species funded by the Australian Government's Threatened Species Recovery Fund, and it is this fund that has supported the development of this plan to coordinate on-going community collaboration for the recovery of the species.

This conservation action plan is a living document which will be adapted with new data and information; however, any changes or amendments to management actions will be limited to those that contribute to achieving the overarching conservation objective (Section 3) and management objectives (Section 4).

2.1 Eucalyptus morrisbyi

Eucalyptus morrisbyi (Morrisby's gum) is a small tree endemic to Tasmania's southeast. It is only known from two locations 21 km apart: in the East Risdon Conservation Area, and the fragmented Cremorne subpopulation which now consists of a main stand at Calverts Hill Nature Reserve and several small remnants surrounded by residential and agricultural land. The East Risdon and Calverts Hill stands have suffered dramatic declines in recent decades with the loss of all but a few

established trees, leaving fewer than 30 reproductively mature trees in the wild. While it is thought that the species has been contracting to wetter gullies since glaciation, more recent changes in climate are exposing remnant subpopulations to extreme conditions. The species is highly palatable and once stressed, recovery is hampered by vertebrate and insect browsing which can lead to death of trees within years. The smaller remnants in the Cremorne area cannot expand due to existing roads and urban development.

Considerable recovery activity has been undertaken for the species over the last 25 years, including in the active regeneration at Calverts Hill Nature Reserve through planting of tube stock and protection of supressed juveniles and the establishment of multiple seed orchards representing pre-decline diversity of the two subpopulations (Appendix 1). Despite this, *Eucalyptus morrisbyi* now qualifies as Critically Endangered under the IUCN Red List criteria (see Section 2.1.3). While at imminent risk of extinction in the wild, ornamental and *ex situ* plantings will prevent complete loss of the species in the short to medium term.

2.1.1 Population Parameters

In total, the number of naturally occurring mature trees of *Eucalyptus morrisbyi* is now estimated to be fewer than 30, representing a 98.5% decline across its range from 1991 census results with the majority of this decline occurring over the last 10 years (Table 1, Figure 1). The East Risdon subpopulation has been in decline since the 1970s, and has been functionally extinct since 2002, consisting mostly of clones and few unique genotypes (Table 1). This subpopulation is in very poor health, with coppiced shoots subject to insect damage. There are no reproductively mature individuals at this site, and it is unlikely to be capable of regeneration under current conditions with significant competition from other native species including more drought tolerant eucalypts.

There has been a more recent decline at Calverts Hill Nature Reserve, with the loss of > 99% of reproductively mature plants since the previous census in 1991 (Table 1). This decline has been rapid with satellite imagery showing almost complete loss of *E. morrisbyi* canopy cover between 2005 to 2016 (Figures 1 A to D). A census in 2012-13 revealed a remarkable incidence of canopy death (71%), with an estimated 15% of crown death occurring in the preceding year (RJE Wiltshire unpublished data). The census was repeated in 2014 finding that crown death had increased over the 13 months to over 80%. Comparison of crown death data and classification of lignotuber coppicing and epicormic growth suggested that individuals in the poorest state had succumbed, and that epicormic or lignotuber recovery was not successful (RJE Wiltshire unpublished data). As of November 2018, there are only 6 mature trees remaining at this site (Table 1), with the recent death of a single tree in poor health (only lignotuber and epicormic growth evident in 2017). There are an estimated 2,400

juvenile plants occurring across the site, which until recently had been supressed by heavy browsing pressure (Appendix 1), but it is unclear whether these juveniles are the offspring of the few surviving trees or represent the larger, genetically diversity, pre-decline subpopulation. Seed bearing mature individuals can still be found in four small roadside remnants near Cremorne, although some trees in these remnants have died since the last census in 1991 (Table 1). Some recruitment has been observed in the paddock adjacent to the remnant at Delphis Drive.

Table 1. Population summary for *Eucalyptus morrisbyi* in Tasmania

Subpopulation	Tenure	NRM region	Year census	Number of mature plants	Number of juvenile plants	Area of occupancy of reproductive mature individuals (ha)
East Risdon	East Risdon State Reserve	South	2014	0	219 stems, 110 genotypes	0
			2002	0	81	0
			1996	<20	69	0.7
Cremorne subpopulation						
Calverts Hill	Calverts Hill Nature Reserve	South	2018	6	Estimated 2,400	0.3
			2017	7	-	0.5
			2014	604 (368 with some living canopy)	-	na
			2013	833 (529 with some living canopy)	-	na
			1991	1915	-	11.5
Lumeah Point	Coastal Reserve	South	1991	16	-	0.15
Honeywood Drive	road reserve, private land	South	1991	12	-	0.15
South Arm Road/ Delphis Drive					-	
Cremorne Avenue					-	

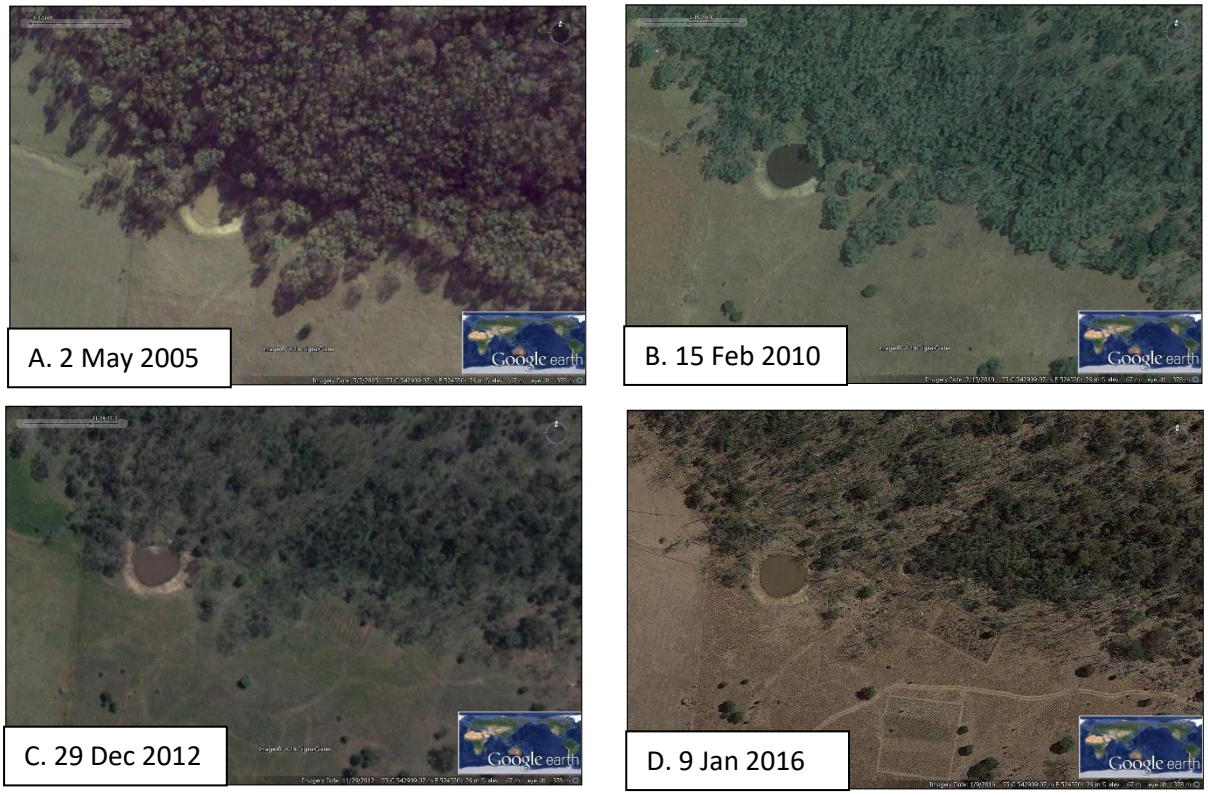

Figure 1 A to D. Series of satellite imagery of the main of the *Eucalypts morrisbyi* stand at Calvert Hill Nature Reserve showing the decline in canopy health over a 10-year period (2005 to 2016). Prepared by Richard Schahinger.

2.1.2 Threats

Threats to the species have been discussed in full in the revised species TSS listing statement (in press) and are summarised as:

- **Clearing and fragmentation** - Past records indicate a decline from clearing for agriculture and urban development of at least 50% in the area occupied by *Eucalyptus morrisbyi* on South Arm since European settlement (Wiltshire 1992).
- **Climate change** - *Eucalyptus morrisbyi* is relatively susceptible to drought, with the range of the species apparently retracting to wetter gullies since the last glaciation (Wiltshire et al. 1991), making the species particularly sensitive to the changing climate.
- **Vertebrate browsing** - Genotypes from the Calverts Hill stand are particularly palatable to vertebrate browsing (Mann *et al.* 2012) and this has been observed to be the most immediate threat to this site.

- **Insect attack** - Both subpopulations of *Eucalyptus morrisbyi* are highly susceptible to insect browsing. The mortality rate, particularly of seedlings and saplings, is high following drought stress and the trees appear to become more susceptible to defoliation caused mainly by the autumn gum moth (*Mnesampela privata*). There is a possibility that Noisy miners (*Manorina melanocephala*) could be contributing to dieback by preventing the predation of the autumn gum moth at Calverts Hill as they have been observed at the Reserve.
- **Competition –** Other native plant species pose an issue at the East Risdon subpopulation, in particular competition from a native parasitic vine, *Cassytha pubescens.*
- **Fire –** The extremely small number of mature and seed-bearing *E. morrisbyi* are at significant risk of death following wildfire. This is especially the case at Calverts Hill, as it is unclear if juvenile plants have the lignotuber reserves to resprout after fire.
- **Weeds -** Drought conditions, removal of grazing and discontinuous control measures have allowed serrated tussock (*Nassella trichotoma*) to significantly increase in numbers at Calverts Hill. Without active control, serrated tussock infestations will likely pose a threat by invading *E. morrisbyi* recruitment niches and increasing fire risk through contribution to fuel load.

There are considerable genetic differences between the Calverts Hill and Risdon Hill stands (Mann *et al.* 2012, Jones *et al.* 2005). As well as being strongly differentiated at the molecular level (Jones *et al*. 2005), plants from the East Risdon subpopulation are less palatable to vertebrate browsing than Calverts Hill plants when grown in a common environment (*Mann et al.* 2012) and more susceptible to myrtle rust (newly introduced and found in cultivated settings in Tasmania), than Calverts Hill plants (Potts *et al.* 2016). Some molecular differences are also evident between plants from Calverts Hill and the smaller Cremorne remnants, however there is evidence the main population at Calverts Hill and the nearby remnant populations have been connected by gene flow more recently than East Risdon and Calverts Hill (Jones *et al.* 2005). Genetic variation and outcrossing rates in the two main populations (prior to the Calverts Hill decline) were high (Jones *et al.* 2005) perhaps due to the high levels of self-incompatibility of this species relative to other Tasmanian eucalypts (Potts & Savva 1988) and the longevity of genotypes at the East Risdon site due to lignotuber growth (Jones *et al.* 2005). Although *Eucalyptus morrisbyi* hybridises with *Eucalyptus viminalis* in the wild, studies have not revealed significant contamination of its gene pool.

2.1.3 Conservation Status

Eucalyptus morrisbyi is currently listed as Endangered under the EPBC Act but a recent review by TSS (in press) found that the species now qualifies as Critically Endangered according to the IUCN Red List criteria. The extreme extinction risk for this species is highlighted by the fact that it meets the thresholds for Critically Endangered under multiple IUCN criteria - **A1 + A2a +B1 +B2ab(ii,v) + C1+ C2a(i) + D** (Table 2).

Table 2. Application of the IUCN Criteria to *Eucalyptus morrisbyi*

IUCN Criteria	**Threshold for Critically Endangered**	***Eucalyptus morrisbyi***
A. Population decline		
A1. Population reduction in 10 years or 3 generations	≥90%	98.5% in 10 years (one generation approx. 10-15 years)
A2. Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.	≥80%	Direct observation of decline of over 80% through census data (Table 1, Figure 1)
B. Geographic range restricted		
B1. Extent of Occurrence (EOO)	<100 km^2	45 km^2
B2. Area of Occupancy (AOO)	<10 km^2	4 km^2
a. Number of locations	1	1
b. Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	*Any of (i)-(iv).*	b. Continuing decline observed in: (ii) area of occupancy; (v) number of mature individuals
C. Small population and decline		
Number of individuals	>250	<30

IUCN Criteria	**Threshold for Critically Endangered**	***Eucalyptus morrisbyi***
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	25% in 3 years or 1 generation	>27% in 4 years (decline at Calverts Hill between 2013-2017 see Table 1)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:		Continuing decline observed
(i) Number of mature individuals in each subpopulation	≤50	<30 (Table 1)
D. Very small or restricted population		
Number of mature individuals	<50	<30

3 Overarching Conservation Objective

The overarching conservation objective is to down-list *Eucalyptus morrisbyi* from Critically Endangered to Endangered by 2038.

4 Management Objectives and Key Performance Indicators

The IUCN Red List criteria have been used as a framework to set management objectives to achieve down-listing as categorised by each criterion (Table 3). To achieve each objective within the 20-year time frame of this plan, realistic 5 and 20-year key performance indicators (KPIs) have been set for each objective. Management actions designed to meet these KPIs are described in Section 5, and timeframes, prioritisation, responsibilities and budgets are outlined for each in Section 6.

Table 3. Management objectives for *Eucalyptus morrisbyi,* with 5 and 20-year KPI, to address IUCN Red List criteria and down list species from Critically Endangered to Endangered by 2038.

IUCN Criteria	Management Objective	5-year KPI	20-year KPI
A1 and A2 a: Population size reduction	*Objective 1: Halt and reverse population decline over the next 20 years*	• >5 mature trees in 2023	• >250 reproductively mature trees in 2038
B1: Extent of occurrence, fragmentation and decline	*Objective 2: Maintain and increase extent of occurrence (EOO) and number of populations over the next 20 years*	• EOO is maintained at 45 ha in 2023 • At least 4 additional populations are established within the future climatic range of the species by 2023	• At least 4 additional planted subpopulations with reproductively mature plants and recruitment occurring and have increased EOO >100 km^2
	Objective 3: Improve connectivity between populations to alleviate effects of fragmentation	• Plantings established in Cremorne area to increase gene transfer between Calverts Hill and Lumeah Point by 2023	
B2: Area of occupancy	*Objective 4: Maintain and increase area of occupancy over (AOO) the next 20 years*	• AOO is maintained at 4 ha in 2023 • At least 4 additional subpopulations are established within the future climatic range of	• Reintroduced plants at Calverts Hill are reproductively mature and contribute to AOO >10 km^2 • At least 4 additional planted subpopulations

IUCN Criteria	Management Objective	5-year KPI	20-year KPI
		the species by 2023	with reproductively mature plants and recruitment occurring have increased AOO >10 km^2
B ab (ii,v). number of locations	*See Objectives 2 and 3.*	*See Objectives 2 and 3, 5-year KPIs*	*See objectives 2 and 3, 5-year KPIs*
C1 and C2 a(i). Small population and decline	*Objective 5: Increase the number of mature individuals over the next 20 years*	• >250 recruits are surviving in 2023 • >250 planted seedlings surviving in 2023	• >250 reproductively mature plants within remnant subpopulations (including recruits and reintroduction plantings) by 2038 • >500 reproductively mature plants across entire population (including translocated subpopulations) by 2038 • > 50 reproductively mature individuals in each location by 2038
D: Number of individuals	*See Objective 5*	*See Objective 5, 5-year KPIs*	*See Objective 5, 20-year KPIs*

5 Management Actions

The management actions that have been considered to achieve the management objectives for *Eucalyptus morrisbyi* are summarised below:

- *Threat abatement* - Prevent further decline in natural remnants by continuing to protect existing plants (mature and juvenile) from browsers, wildfire and weeds
- *Translocation* - Establish additional 'conservation' plantings within an accepted range for the species to increase AOO, EOO, number of locations and number of mature plants
- *Seed conservation* - Bank representative seed from all remnants and manage seed orchards to preserve as much of pre-decline genetic diversity as possible
- *Re-introductions* - Bolster remnant populations through plantings where there is room for expansion
- *Monitoring and evaluation* - Monitor all remnants to assess condition, emerging threats and trends
- *Research* - Undertake research to inform and assist the conservation program by enabling adaptive management, and where feasible include research into the causes of population decline to help address any unidentified threats.

The majority of high priority threat abatement and reintroduction actions required to achieve management objectives for *Eucalyptus morrisbyi* have already been initiated (Appendix 1) and require on-going maintenance to achieve 5 and 20-year KPIs. The translocation actions required to achieve management objectives 2-5 are yet to be initiated and are an immediate priority due to the long timeframes required for planted seedlings to reach maturity.

Maintenance of high priority threat abatement (browser and wildfire protection) at Calverts Hill Nature Reserve and initiation of translocation actions are considered the highest priority management actions under this plan and should be undertaken immediately and concurrently. Discussion of these and other management actions are detailed in the following Sections 5.1 to 5.6 and their recommended prioritisation, timing, responsibilities and costs are outlined in the Management Action Table (see Section 6). Responsibilities are based on current partner roles and could be subject to change depending on funding and other resourcing changes.

5.1 Threat Abatement Actions

5.1.1 Calverts Hill Nature Reserve

Continued browsing and wildfire protection at Calverts Hill Nature Reserve are very high priority actions for this species. Calverts Hill is the only subpopulation capable of significant regeneration, and protection against mammal browsing is required for juvenile plants to reach maturity at this site. There has been significant investment in the installation and maintenance of two wildlife proof fences around at Calverts Hill Nature Reserve by the Tasmanian Parks and Wildlife Service, which has resulted in significant regeneration of juvenile plants at this site (Appendix 1). Juvenile plants found outside of these fenced areas are individually caged and the remaining adult trees have been banded to prevent possum browsing (Appendix 1). Fences, cages and tree bands require on-going maintenance, and the health of the plants that they protect should be monitored to detect wildlife breaches and detrimental levels of insect attack.

Current plant health monitoring methods used at Calverts Hill Nature Reserve are based on the impact of mammal browsing and insect attack on production forestry systems (Appendix 1) and current data collection and analysis are time consuming. A review of these monitoring methods is recommended to increase efficiency and check that control thresholds are relevant and effective to the context of the conservation of *E. morrsibyi*.

Wildfire is a particular risk to the Calverts Hill stand as most of the plants are juvenile and are unlikely to resprout after fire. To protect from wildfire, the maintenance of a firebreak and fuel management in the adjacent pasture by periodic grazing should be continued and the establishment of a new fire break on private land downslope from the Reserve should be investigated.

There are significant serrated tussock infestations at Calverts Hill Nature Reserve which have had discontinuous control efforts since grazing was removed. As this weed also occurs on neighbouring properties, the eradication of this weed from the local area is unlikely to be feasible without coordinated control efforts. The densest infestations of serrated tussock occur outside of the wildlife proof fences, which pose a threat through increased fuel load. These infestations are likely to be spread through firebreak maintenance and fuel management works without appropriate hygiene measures. A vehicle washdown facility has been installed by PWS for this purpose (Appendix 1). Control of serrated tussock within the wildlife proof fences is prioritised to prevent suppression of *E. morrisbyi* regeneration that is likely to occur if these infestations increase in density in the absence of control efforts. An updated serrated tussock management plan is required for the site and surrounding properties to ensure coordinated control efforts and formalise hygiene requirements.

Noisy miners have also been identified as a potential threat at the site and may influence numbers of pest insects. An assessment for the presence and impact of noisy miners is recommended (Table 3. 6.c) and if they are an issue at this site consideration of increasing patch size through revegetation of pasture area within the reserve is recommended.

5.1.2 East Risdon

It is very unlikely that *E. morrisbyi* plants at this site will ever reach reproductive maturity due to the high level of competition of more drought tolerant Eucalypt species. It is recommended that methods to stimulate growth and reproduction at this site are investigated e.g. regeneration burn, manual removal of competition, manual pruning, treatment with plant hormones or plant reintroductions.

5.1.3 Cremorne Remnants

Completion of a health assessment and census of these remnants is required before finalising recommendations for threat abatement activities at these sites. Below is a discussion of preliminary recommendations based on current knowledge of the remnants.

Delphis Drive

Band mature trees if their health is impacted by possum browsing and protect natural recruitment in the road reserve and in the adjacent paddock from both stock and wildlife browsing ensuring room for future recruitment.

Honeywood Drive and Lumeah Point

There is an active neighbourhood group, the majority living on Honeywood Drive, who are working with Clarence City Council and planting *E. morrisbyi* at Lumeah Point. It is recommended that both Clarence City Council and this group are approached to provide input into this conservation plan and discuss their objectives for these remnants. There are also *E. morrisbyi -E. viminalis* hybrids occurring at this site that have conservation significance.

5.2 Translocations

Translocation is a very high priority action in this plan due to the extreme extinction risk facing this species. Due to the rapid decline of wild subpopulations and the higher survival of plantings outside of the known range of the species, assisted migration has been considered in long-term conservation planning.

To achieve the overall conservation objective by 2038 and address the majority of management objectives for this species (Objective 2, 3, 4 and 5) conservation plantings at four additional locations are required.

These plantings will be undertaken outside of the known distribution of the species with the aim of increasing the extent of occurrence of the species while also improving the chances of survival under climate change predictions. The 'acceptable range' for planting this species is based on climate modelling undertaken by the University of Tasmania (Harrison 2017, PA Harrison unpublished data).

These plantings will be undertaken within the large-scale climate adapted *Eucalyptus* plantings undertaken with Greening Australia and the University of Tasmania, as this established program has high survival rates and existing and on-going landholder investment and associated management agreements. For conservation plantings to be considered as part of the conservation assessment for this species and contribute toward the objective of down-listing by 2038 they should follow finalised translocation guidelines for the species (draft in Appendix 3), and specific translocation plans are recommended for each translocation site.

5.3 Re-introductions

It is recommended that supplementary plantings are continued within existing wildlife proof fences at Calverts Hill Nature Reserve. This management action will not only help to maintain the Area of Occupancy (Objective 4), but also act to increase the genetic diversity at this site. The removal of non-local provenance plantings at Calverts Hill is not recommended in the short to medium term. These non-local provenance plantings (from East Risdon) have supplemented this declining stand with genotypes that show higher resistance to mammal browsing and could provide a benefit to longer term survival of the remnant stand at Calverts Hill. In highly modified landscapes, such as that which supports Calverts Hill Nature Reserve, the supplementation of non-local genotypes with local genotypes has been recommended to maximize the adaptive potential and increase resilience to climate change (Broadhurst *et al.* 2008, Prober *et al.* 2015). If a decision is made to prevent gene flow between the Calverts Hill and East Risdon genotypes, these non-local plants can be subsequently coppiced or removed prior to flowering. The planted seedlings from both provenances are unlikely to flower for at least 10 years, and gene flow is unlikely for 20 years as it would take this long for any intra-specific hybrids to mature and recruit.

5.4 Seed Conservation Actions

To achieve the management objectives for *E. morrisbyi* existing seed orchards and seed bank reserves, held at the Tasmanian Seed Conservation Centre at the Royal Tasmanian Botanic Gardens, need to be maintained for both:

* the long-term storage representative of the genetic diversity of the species; and
* the provision of seed for conservation plantings

5.4.1 Seed banking

To achieve a representative seed bank of the genetic diversity maintained within populations of *E. morrisbyi*, reserve collections from the Lumeah Point and Honeywood Drive remnants are required. To provide seed for conservation plantings, continued collection from seed orchards is required to maintain the Calverts Hill and Risdon Hill provenance seed bank. Seed collections from individual tree collections will be kept separate, but that a subsample of these will be bulked by provenance and these bulk seedlots can be used to monitor long-term seed viability and for non-experimental conservation plantings.

5.4.2 Seed orchards

It is recommended that existing seed orchards (Appendix 1, Table 1) are managed to protect mature plants and optimise seed production. There is a need to continue to engage with land managers to ensure emerging threats are addressed. An audit of plantings at South Arm is recommended to investigate if any of these plantings are useful as seed orchards for underrepresented provenances such as the Lumeah Point and Honeywood Drive remnants. Due to the conservation value of the existing successful seed orchards, reservation mechanisms should be considered for the seed orchards on private land (e.g. Brighton, Meadowbank; Appendix 1, Table 1). These could be in the form of a conservation covenant (*Nature Conservation Act*) or a 140-year agreement under the *Forestry Rights Act*.

To be considered as part of the conservation assessment for the species, conservation plantings need to produce viable offspring and be self-sustaining. As there is recruitment in some of the existing seed orchards (Appendix 1, Table 1), it is possible that these plantings could be considered as part of the conservation assessment if they also meet other characteristics that indicate long-term viability such as high genetic diversity, low levels of hybridisation (natural rate 1%), size, and room for expansion (see draft guidelines in Appendix 3).

5.5 Monitoring and Evaluation

This plan requires co-ordination of partner activity, data management, monitoring, evaluation and reporting to be effective. This role is currently undertaken by Enviro-dynamics and is funded until June 2019 under the Threatened Species Recovery Fund project. For co-ordination, monitoring and evaluation activities see Section 6, Table 1 (Actions 5a-f).

5.6 Research

For research activities that have been identified to inform and assist this conservation program see Section 6, Table 1 (Actions 6a-d). These research priorities have been designed to support adaptive management for the species. As a secondary research priority, an activity to investigate the causes of population decline have been identified.

6 Management Action Table

The prioritisation, timing, responsibilities and costs of the recommended management actions are outlined in Table 3. Responsibilities are based on current partner roles and could be subject to change depending on funding and other resourcing changes. Many of the action costs are in draft and responsible parties are currently costing these activities.

Table 4. Recommended management actions, their timeframes, prioritisation, current responsibilities and estimated costs.

Note: Partner abbreviations are as follows Enviro-dynamics (ED), the Tasmanian Parks and Wildlife Service (PWS), DPIPWE's Threatened Species Section (TSS), the Royal Tasmanian Botanical Gardens (RTBG), the Tasmanian Seed Conservation Centre (TSCC), the University of Tasmania (UTAS), Greening Australia (GA), Conservation Volunteers Australia (CVA), the Understorey Network (USN), Threatened Plants Tasmania (TPT) and pakana Services (pakana).

Action no.	Action	Description	Timeframe	Priority	Responsibilities	Estimated cost
1. Threat abatement at wild subpopulations						
1.1 Calverts Hill Nature Reserve						
1.1.a	Maintain wildlife proof fences	Monitor fences after windy weather, monitor mammal browsing, and trap and relocate possums when necessary	2018-2028	Very high	PWS	Costings dependant on need
1.1.b	Insect pest control	Monitor for insect pest thresholds to trigger control actions	2018-2028	High	PWS	
1.1.c	Upgrade and repair fences	The current wild-life proof fences will require repair and upgrade within 5-10 years.	2023-2028	Very High	PWS	$20,000-40,000
1.1.d	Caging plants	Caging plants found outside fenced area	2018-2038	Medium	PWS/CVA	$50-100 per cage
1.1.e	Maintain tree bands and	Maintain tree bands and investigate regeneration	2023-2038	Very High	PWS/ED	To be costed

Action no.	Action	Description	Timeframe	Priority	Responsibilities	Estimated cost
	investigate regeneration options for mature trees with declining health	options for unhealthy mature trees that are undergoing continuing decline e.g. watering, mulching, manual pruning, application of plant hormone etc				
1.1.f	Review pest monitoring methodology	Review pest monitoring methodology and provide technology to allow for efficient data collection, and include thresholds for management intervention and analysis of existing data	2019-2020	High	ED/UTAS	$10,000
1.1.g	Fire breaks and fuel reduction	Maintain existing firebreaks, and continue to reduce fuel load in pasture area adjacent to *E. morrisbyi* area	2018-2038	Very high	PWS	To be costed
1.1.h	New fire break on private land	Establish and maintain new fire break on private land downslope from the Reserve	Establish 2019-2020 Maintain 2019-2038	Very high	PWS	$20,000 for establishment, maintenance to be costed
1.1.i	Serrated tussock management plan	Develop a Serrated tussock management plan for Calverts Hill Nature Reserve and surrounding properties	2019	Medium	ED/PWS/Clarence City Council	$5,000
1.1.j	Weed control	Serrated tussock control within fenced areas, and other priorities identified by management plan	2019-2028	Medium	PWS/pakana	$10,000 per year within wildlife proof fenced areas, other priorities to be costed on development of

Action no.	Action	Description	Timeframe	Priority	Responsibilities	Estimated cost
						management plan
1.2 East Risdon						
1.2.a	Investigate regeneration options	Investigate regeneration options such as regeneration burn, manual pruning and treatment with plant hormones	Opportunistic - resources and seasonal conditions	Low	All	To be costed
1.3 Cremorne remnants						
1.3.a	Health assessment	Health assessment of Cremorne remnants	2019	High	UTAS	Scheduled for 2019
1.3.b	Finalise threat abatement recommendations	Determine threat abatement recommendations based on findings of threat assessment	2019	High	All	To be costed
1.3.c	Engage with local stakeholders	Engage with land managers and local community groups with an interest or responsibility for these remnants (e.g. Department of State Growth, Clarence City Council)	2019-2023	High	ED/TSS/UTAS	$5,000 per year
1.3.1 Delphis Drive						
1.3.1.a	Band mature trees	Band trees impacted by possum browsing with clear polycarbonate bands	2019	High	State Growth	$600-1,000
1.3.1.b	Fencing of recruits	Protect natural recruitment on roadside and in adjacent paddock, with room for future recruitment.	2019	Very High	State Growth	To be costed
2. Seed conservation						
2.a	Collect and process seed from all remnants	Collect seed, including from Lumeah Point and Honeywood Drive, process and bank at TSCC	2019-2020	Medium	TSSC/pakana	ca. $5,000 per collection with

Action no.	Action	Description	Timeframe	Priority	Responsibilities	Estimated cost
						processing
2.b	Collections from seed orchards	Continue to make collections seed orchards for reintroductions and translocations	2019-2023	High	TSCC/pakana	Brighton scheduled and funded for 2019 Others ca. $5,000 per collection with processing
2.c	Assess the impact wildfires on Geeveston seed orchard	Assess the impact of 2019 wildfires on Geeveston seed orchard and identify management requirements to promote recovery	2019	Very High	ED/UTAS	To be costed
2.d.	Manage seed orchards	Seed orchards require management to maximise seed set and to address emerging threats (to be determined by Action 2.c and 2.d.)	2019-2038	Medium	Contractors	To be costed
2.e.	Continue to engage with land managers	Continue to engage with land managers with seed orchards to identify emerging threats	2018-2038	High	ED/TSS	To be costed
2.f.	Reservation of seed orchards on private land	Consider conservation covenant or other reservation instrument for seed orchards on private land	2018-2038	Medium	TSS	To be costed
2.g.	Audit of plantings at South Arm	Audit of plantings at South Arm to determine value as seed orchards	2019	High	UTAS	Scheduled and funded for 2019
	3. Reintroductions					
3.a	Reintroductions in wildlife proof fenced areas at Calverts Hill	Complete reintroductions in wildlife proof fenced areas	2019	Very High	CVA	Scheduled and funded for 2019

Action no.	Action	Description	Timeframe	Priority	Responsibilities	Estimated cost
3.b.	Maintain reintroduced plants	Water in first summer, hand weed around plants and remove cages	2018-2023	Very High	CVA	Scheduled and funded until June 2019 Approximately $10,000 per year for 5 years
3.c.	Re-assess management of non-local provenance plantings at Calverts Hill	Review current literature on benefits of co-provenance selection to increase viability of threatened Eucalypt populations. If the evidence in 10 year suggests that there could be a negative impact of this strategy on the long-term viability of *E. morrisbyi* at Calverts Hill, prevent flowering of all plants that are East Risdon in origin (i.e. coppice or remove plants).	2028	Medium	All	Cost of coppicing or removal of 223 saplings in 10 years' time.
4. Translocations						
4.a	Undertake initial off-site planting	Undertake initial off-site planting of 300 plants at Marchweil	2019	Very High	GA/CVA/UTAS	Scheduled and funded for 2019
4.b	Finalise translocation guidelines	Review draft guidelines in Appendix 4 in relation to literature on *Eucalyptus* translocations and ANPC translocation guidelines (2018)	2019	Very High	ED with review from group	Scheduled for 2019
4.c	Prepare a translocation plan for translocation sites	Site specific translocation plan for each translocation site	2019-2022	Very High	ED	$2,000
4.d	Undertake 4 additional translocations within future climate envelope	Plantings within future climate range for the species, with site selection to allow for establishment under current climate as determined by UTAS climate	2019-2023	Very High	GA	$60,000 per planting

Action no.	Action	Description	Timeframe	Priority	Responsibilities	Estimated cost
	(1,000 plants per site, each site approximately 8-10ha).	modelling e.g. Marchweil, Swansea and 2 additional sites with landholder negotiations underway.				
4.e	Undertake translocation plantings in Cremorne area	Plantings established in Cremorne area to increase gene transfer between Calverts Hill and Cremorne remnants	2019-2028	High	Clarence City Council and local community groups	To be costed
4.f	Maintain translocated plants	Watering, weeding and removal of browsing protection when required	2019-2023	Very High	GA/landholder	To be costed
5. Monitoring, evaluation and program coordination						
5.a	Program coordination	Co-ordination of partner activity, data management, monitoring and evaluation. Annual visits to assess condition of remnants and seed orchards to determine management requirements and emerging threats.	2018-2038	Very High	ED	Schedule and funded until June 2019 $5,000-20,000 per year depending on activity level
5.b	Plant health monitoring at Calverts Hill	Using the revised monitoring methodology with monthly monitoring of mammal browsing, monitoring fences after high wind events and monthly monitoring of insect impacts (during 9-month insect growth season).	2018-2038	Very High	PWS	Estimated at $15,000 per year of staff time with current methods
5.c	Engagement with other stakeholders	Contact coast care groups at Lumeah Point, Calverts Hill foreshore and Clarence City Council to support community planting efforts	2019	High	ED	Schedule and funded until June 2019

Action no.	Action	Description	Timeframe	Priority	Responsibilities	Estimated cost
5.d	Undertake census of all remnant subpopulations every 5 years	Using a consistent method to ensure comparable data i.e. plant numbers to consider mature and immature individuals separately.	2019-2038	Very High	TSS/TPT/ED/UTAS	To be costed
5.e	Monitoring and scoring of plantings	Monitoring re-introduced plants at Calverts Hill Nature Reserve, and translocated plants in conservation plantings and comparing the growth and survival of the Calverts and Risdon provenances	2019-2023	High	UTAS	Scheduled and funded for 2018 Calverts Hill plantings 4 additional translocation plantings monitoring $2,000 per year
5.f	Extension surveys around South Arm/Cremorne area	Extension surveys around South Arm/Cremorne area	2019-2038	Medium	TSS/TPT/ED	To be costed
5.g.	Develop adaptive management framework	Develop adaptive management framework for the species including thresholds for management interventions associated with census, genetic surveys and plant health monitoring data and any changes required for this plan in response to new information.	2019	High	ED/UTAS	To be costed
6. Research						
6.a	Genetic analysis of seed orchards and community plantings	Genetic analysis to determine the provenance of community plantings on South Arm, and other conservation plantings.	2019	High	UTAS	Scheduled and funded for 2019

Action no.	Action	Description	Timeframe	Priority	Responsibilities	Estimated cost
6.b	Genetic analysis of diversity of Calverts Hill recruits	Investigate the genetic diversity of the naturally occurring juvenile plants, and how this relates spatially across the site	2019-2020	High	UTAS	$20,000
6.c	Investigate additional causes of decline at Calvert Hill Nature Reserve	Investigate if additional site conditions influencing the health of *E. morrisbyi* at Calverts Hill Nature Reserve, for example: - presence and impact on noisy miners; - mycorrhizal associations and soil health; and - original understorey diversity.	2019	Low	TSS/UTAS	To be costed

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8 Appendices

Appendix 1 History of conservation activities

Protection of wild subpopulations

In the late 1970s there were attempts to reverse the decline at the East Risdon subpopulation through removal of competition from a native parasitic vine, *Cassytha pubescens* (Brown & Bayley-Stark 1979). The understorey was thinned in October 2001 in order to further reduce competition stress on the trees. Supplementary watering and reintroductions were also initiated. None of these activities reversed declines or increased plant numbers at this site.

In 2017 the seven remaining adult trees at Calverts Hill were banded to prevent possum browsing and as of November 2018 six of these trees are still surviving. Two of these trees, directly beneath the dam in the southern fenced area flowered in 2018 and have shown some improvement in canopy health. Also in 2017, two wildlife proof fences were installed around the majority of juvenile plants. These fenced areas were confirmed wildlife browser free through a trapping and relocation program. Juvenile plants found outside of the wildlife proof fences are individually caged. Fencing has resulted in significant regeneration of juvenile plants. Surveys give an estimate of over 2,400 juvenile plants across the two fenced areas and plant health monitoring of 50 of these plants has revealed a 57% increase in average height in 12 months.

Established plant health monitoring methods for Calverts Hill Nature Reserve have threshold set that indicate when trapping and relocation of possums is required. When browsing levels increase and a trapping program is initiated, camera monitoring is used to help identify where animals are breaching the fences. Plant health monitoring is also used to inform when insect pests are likely to impact on plant growth, and thresholds that inform when insect control methods should be considered. These monitoring methods have been adapted from methods used by Sustainable Timber Tasmania for monitoring pest loads within coupes.

To protect the Calverts Hill stand from wildfire a firebreak has been established between the *E. morrisbyi* stand and the pasture area in the Reserve. This fuel is managed in this pasture area by periodic grazing. Due to the proximity of juvenile *E. morrisbyi* to the downslope boundary with the neighbouring land owners, no fire break has been established on the western side of the stand. The current landuse, (e.g. grazing and cropping), of this property maintains low biomass during the fire season.

Control of serrated tussock infestation has been prioritised within the core *E. morrisbyi* area. Due to the risk of spreading this invasive species through threat abatement works at the site, a vehicle washdown facility has been installed by PWS to prevent spread to other reserves.

Seed collection and banking

Although *E. morrisbyi* has undergone dramatic population decline, seed banked collections and seed orchards were established prior to the decline and capture high levels of diversity. In 2016, the Calverts Hill stand was thought to be poorly represented in seed orchards and seed banked collections, due to the susceptibility of this provenance to browsing, which impacted seed production in the orchards (Jones *et al.* 2016). Since then, there has been a significant and successful seed orchard re-discovered on private land near Brighton which has been genetically confirmed to be Calverts Hill in origin and contain similar levels of diversity to the pre-decline stand (Jones *et al.* unpubl.). Seed collections have been undertaken from this orchard in 2017 and 2018, significantly increasing the diversity and quality of seed banked from the Calverts Hill provenance.

The Tasmanian Seed Conservation Centre (TSCC at the Royal Tasmanian Botanical Gardens) now has representative collections of the genetic diversity maintained within the two core subpopulations, only lacking seed from one of the Cremorne remnants (Delphis Drive). This banked collection includes pedigreed seed lots from a diverse representation from both Calverts Hill and East Risdon, although there are small seed numbers among some of the East Risdon seed lots (<100 seeds). Back-up of bulked provenance collections are stored at the Millennium Seed Bank at the Royal Botanic Gardens, Kew.

There are seven known seed orchards, two comprising mixed East Risdon and Calverts Hill provenance (Geeveston and Lutana) and one confirmed as purely Calverts Hill provenance (Brighton; Table 1). Inter- and intraspecific hybridisation has been recorded in seed collected from the two mixed provenance seed orchards, with interspecific hybrids mainly found in seed collected from trees along the edge rows in the Geeveston seed orchard where both provenances flowered well (Table 1). Interspecific hybrids can be easily screened based on morphological characters assessed at the seedling stage, however, intraspecific hybrids cannot be determined morphologically and require molecular genetic approaches. Seed collected from the Brighton orchard has no intraspecific hybridisation due to the absence of the East Risdon provenance, though interspecific hybrids have been recorded at the site.

There is recruitment at some of the existing plantings (Table 1), and once these recruits are seedbearing (i.e. producing viable offspring) it may be possible to consider them as part of the

conservation assessment if they also meet other characteristics that indicate long-term viability (see draft guidelines in Appendix 3).

Conservation Plantings

Plant reintroductions have been occurring at Calverts Hill since 2010, with two small fenced areas planted in 2010 and 2014 adjacent to the core *E. morrisbyi* woodland. Protection from browsing has been essential with declines in health of mature trees observed when fenced areas are breached. Most recently, 446 *E. morrisbyi* plants (representing both East Risdon and Calverts Hill provenances) have been reintroduced into the core *E. morrisbyi* population at Calverts Hill to supplement the genetic diversity of natural occurring juvenile plants, since the naturally occurring plants could be offspring of the few surviving trees at the site rather than the pre-decline subpopulation. This reintroduction has involved paired plantings of *E. morrisbyi* from the Calverts Hill and East Risdon provenances, and the comparative survival of these provenances will be monitored by the University of Tasmania. A further reintroduction of 150 *E. morrisbyi* into the remaining empty niches within wildlife proof fences has been scheduled for Autumn 2019.

There have been a number of translocation plantings of the species for either seed orchards or to improve connectivity of the fragmented Cremorne population (Table 1). These translocation plantings have varied in their success, with the plantings outside of the known range of the species generally being more successful (Geeveston, Meadowbank, Penna and Brighton) than those in closer proximity to wild populations (South Arm and Lutana). While planting success is likely to be climate related it is also influenced by browser pressure. The seed orchards at relatively high rainfall site of Franklin had high survival rates initially, though failed within 10 years of planting due to mammal browsing pressure (B. Potts pers. comm. 2019).

For translocation plantings to be considered as part of the conservation assessment for the species they need to produce viable offspring and be self-sustaining. There is recruitment at some of the existing plantings (Table 1), and when these recruits are seedbearing it may be possible to consider them as part of the conservation assessment. Due to the rapid decline of wild subpopulations and the higher survival of plantings outside of the known range of the species, assisted migration has been considered in long-term conservation planning. Based on climate modelling undertaken by the University of Tasmania, a planting in the future climate range of the species, with site selection suitable for establishment under current climatic conditions, has been scheduled for 2019.

Table 1. Known translocation plantings of *Eucalyptus morrisbyi*.

Location (and distance from closest wild stand)	Purpose	Year	Number of plants planted	Provenance	Status
Brighton (15 km)	Seed orchard	1994	1,000	Confirmed diverse representation of Calverts Hill	Relatively high survival, recruitment observed, seed collected from 60 mature plants
Meadowbank (48 km)	Seed orchard	1992-3	>1,000	Potentially diverse representation of Calverts Hill; genetic analysis scheduled for 2019	Trees had reached 5-8m, though were burnt in the 2013 fires and now re-sprouting from lignotubers
Lutana (1.2 km)	Seed orchard	1999	588	Mixed Risdon and Calverts Hill (original planting diverse)	Dry site with poor survival and patchy flowering
Geeveston (>50 km)	Seed orchard	1990s	569	Mixed Risdon and Calvert Hill (original planting diverse)	Wetter site with higher survival but heavy possum browsing on Calverts Hill genotypes. This site has recently been impacted by the 2019 wildfires in the Huon Valley.
Penna (17 km)	unknown	unknown	>200	Unknown, genetic analysis schedule for 2019	Relatively high survival, recruitment observed including *E. viminalis* hybrids
South Arm community plantings (34 known) (closest 500m)	Connectivity	1987	average 40 (largest 150)	Calverts Hill and Cremorne remnants, genetic analysis schedule for	Average survival rate 61% two years after planting, a health assessment schedule for 2019

Location (and distance from closest wild stand)	**Purpose**	**Year**	**Number of plants planted**	**Provenance**	**Status**
				2019	
Boyer (20 km)	Seed orchard	1990	613	Calverts Hill	Initial high survival rate, followed by high mortality after 10 years (1995: 93% survival; 2012: high mortality noted)
Meunna (250 km)	Seed orchard	1990	768	Calverts Hill	Wetter site with no survival (2007: 40-50% survival; 2015: none surviving). Possibly due to frost damage.
Franklin (40 km)	Seed orchard	1990	768	Calverts Hill	Wetter site with no survival. Impacted by browsing pressure within 12 months of planting.

Appendix 2 Summary of IUCN Red List Criteria

SUMMARY OF THE FIVE CRITERIA (A-E) USED TO EVALUATE IF A TAXON BELONGS IN AN IUCN RED LIST THREATENED CATEGORY (CRITICALLY ENDANGERED, ENDANGERED OR VULNERABLE).[1]

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) *[(a) cannot be used for A3]*.

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

- **(a)** direct observation *[except A3]*
- **(b)** an index of abundance appropriate to the taxon
- **(c)** a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality
- **(d)** actual or potential levels of exploitation
- **(e)** effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)

	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented **OR** Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals			
(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals			

C. Small population size and decline

	Critically Endangered	Endangered	Vulnerable
Number of mature individuals	< 250	< 2,500	< 10,000
AND at least one of C1 or C2			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:			
(a) **(i)** Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(ii) % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals			

D. Very small or restricted population

	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	**D1.** < 1,000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	**D2.** typically: AOO < 20 km² or number of locations ≤ 5

E. Quantitative Analysis

	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

1 Use of this summary sheet requires full understanding of the *IUCN Red List Categories and Criteria* and *Guidelines for Using the IUCN Red List Categories and Criteria*. Please refer to both documents for explanations of terms and concepts used here.

Appendix 3 Draft translocation guidelines for *Eucalyptus morrisbyi*

The guidelines for translocation of *Eucalyptus morrisbyi* should be developed with reference to the Australian Network for Plant Conservation (ANPC) translocation guidelines (2018) and a review of the literature on threatened eucalypt translocation programs. At a minimum these guidelines will consider:

- Creating viable self-sustaining populations (rather than seed orchards, shelter belts or ornamental plantings) which can be considered as part of the species population structure
- Planting size and shape – minimum size to be developed. Plantings in discrete areas rather than mixed plantings with other eucalypt species.
- Plant spacing – at least 5 m apart in a random, natural arrangement (not rows and blocks).
- Plant diversity and vegetation structure – planted with naturally co-occurring species (except eucalypts), representing the structural elements found at Calverts Hill Nature Reserve e.g. ground cover and shrub layer.
- Genetic diversity and consideration of mixed provenance plantings to maximise adaptation potential (Prober *et al.* 2015)
- All inter-specific hybrids should be screened out in the nursery before planting.
- Location - future climatic range for the species, with site selection to allow for establishment under current climate. Natural values assessment will be undertaken to ensure there are no threatened eucalypts able to hybridise with *E. morrisbyi* within 500m (vegetated) and 5 km (open areas).
- Select sites and planting design based on predetermined characteristics to improve chances of success and limit interspecific hybridisation. Health assessment of previous plantings and climate modelling to be used to help select locations.
- Consider permanency through conservation covenant or agreement through Forestry Rights Act. At a minimum in the short term, make sure that the landholder is aware that if the Commonwealth endorsed approach of consideration of the planting in the conservation assessment that planting will be covered by the EPBC Act.