BLACKWOOD ECOLOGICAL SERVICES

Killen Falls Vegetation Management Plan

Killen Falls Public Reserve Tintenbar, NSW

A Report to Ballina Shire Council
April 2023

NOTE

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1 INTRODUCTION

1.1 Background

Ballina Shire Council (BSC) has engaged Blackwood Ecological Services to prepare a Vegetation Management Plan (VMP) for the Council Reserve located at Killen Falls in Tintenbar, NSW. The VMP is required to upgrade the previous Killen Falls VMP[3] prepared in 2004 to reflect current site conditions and incorporate key infrastructure improvements which have been implemented in recent years prompted by increased visitation by the public. A Plan of Management[4] (PoM) was prepared in 2017 which outlines a number of strategies and actions in relation to infrastructure and other management issues at the site, many of which have since been implemented.

The VMP will be used to guide the ongoing management and restoration of the site by Council, Landcare groups, industry professionals and the local community into the future.

1.2 The Subject site

The Subject site includes the Council Reserve located at Killen Falls, approximately 3km north of the Tintenbar Village in northern NSW. The Council Reserve is located on the southern side of Emigrant Creek and includes riparian land that runs from the base of the Emigrant Creek dam wall downstream to approximately 150m past the Killen Falls. The site is identified as Lot 1 DP 251994 and is approximately 1.3 hectares in area. Within the site the riparian corridor ranges in width from 75m to 50m, tapering to a narrow point towards the eastern end. The location and extent of the Subject site is illustrated in **FIGURE 1**. Access to the site is from Killen Falls Drive, off Friday Hut Road, west of the Pacific Highway.

1.3 Aims and objectives

The aim of this VMP is to provide a description and assessment of current site conditions and an outline of restoration actions to guide both contractors and volunteers as well as the management of all areas with respect to their ecological and cultural values.

The objectives of the VMP and its recommended works are to:

- assess the current condition of site vegetation;
- determine VMP zonings and restoration actions to guide both contractors and volunteers;
- determine aims and objectives to achieve the established target condition;
- address fauna habitat considerations for ongoing restoration efforts;
- address all weed species and control measures;
- address vegetation management and related issues;
- address all current and related legislation;
- address Aboriginal cultural heritage management;
- address infrastructure management and visitor facilities;
- address track management;
- address monitoring and record keeping;
- consider all existing master plans etc; and
- consider all public events and other anthropological uses of the land.

1.4 Consultation

As part of the preparation of this VMP the following groups were invited to provide comment on

[3] Bower Bush Works (2004)
[4] MikeSvikisPlanning (2017)

the draft report:

- Ballina Shire Council (BSC)
- Jali Aboriginal Land Council

1.5 Structure of this report

This report provides information on the following aspects of the Killen Falls Subject site:

Chapter 2: Site Background

- Background information on the Killen Falls Subject Site including zoning, geology and soils, site history, previous VMPs, active landcare groups and bush regeneration contracts.

Chapter 3: Site Values

- Details on native flora, fauna and vegetation communities as well as threatened species/communities known or which may potentially occur. Discussion on cultural heritage, recreational values and landscape setting/connectivity.

Chapter 4: Weed Species and Legislation

- Relevant weed legislation including known Priority weeds which occur in the Killen Falls Subject site.

Chapter 5: Restoration Strategy

- Delineation of works areas and recommendations on various work activities to be undertaken.

Chapter 6: Vegetation Management Issues and Guidelines

- Discussion of various vegetation management issues often encountered when undertaking bush regeneration works as well as recommended guidelines for best practice.

Chapter 7: Infrastructure Management and Visitor Facilities

- Brief overview of relevant infrastructure and visitor services and discussion on the management and maintenance of such facilities.

Chapter 8:

- Monitoring and record keeping requirements.

Chapter 9:

- Summary of recommended actions

Chapter 10

- References.

FIGURE 1: EXTENT OF THE SUBJECT SITE (Adapted from Mike Svikis Planning 2017)

2 SITE BACKGROUND

2.1 Introduction

This section provides background information about the Killen Falls VMP area including climate, zoning, geomorphology, previous management plans, active volunteer landcare groups and current bush regeneration contracts.

This section includes material and extracts taken from the previous VMP (Bower 2004) where appropriate.

2.2 Geology and soils

The Killen Falls Subject Site occurs on red ferrosol soils derived from the Lismore Basalts of the Mount Warning shield volcano Tertiary volcanics (NSW DPI 2008). The soils are free draining and well-structured, generally with a clay loam topsoil with potential high fertility in the organic layer decreasing with a shallower profile. They are also highly acid and are prone to aluminium toxicity with fertility rapidly declining after clearing and ongoing exposure (Morand 1994). Red ferrosols mainly occur in areas that have high rainfall (>1300mm) and warm temperatures and grow lush, subtropical rainforests in the Big Scrub region (Floyd 1990, Lott & Duggin 1993).

The project site comprises two erosional soil landscapes typified as Bangalow and Rosebank (Morand 1994). Erosional landscapes exhibit shallow soil profiles (with occasional depth), benches, undulating hillslopes and rock outcrops. The falls are located at the boundary between the two soil landscapes.

2.3 Topography

The elevation of the Subject Site ranges from 40m *asl* at creek level below the falls to 60m *asl* on the southern boundary approximately halfway between the carpark and the falls. The western half of the site is relatively flat with some sections sloping gently northwards towards the creek. The slope increases towards the waterfall which runs off an overhanging cliff line (about 20m in height) into a shallow basin. This cliff line runs in an easterly direction from the falls through part of the site with vegetation above and below the cliff line. East of the creek access track the riparian corridor is steep and rocky. The site has a fairly exposed north facing position with extensive areas of surface rock.

2.4 Climate

North eastern NSW has a warm temperate to subtropical climate with a pronounced summer/autumn "wet" season, "dry" mild winters and a warm dry spring. The annual average rainfall is 1817mm with March traditionally the wettest month (232mm) and September the driest (64mm). The warmest month is January with an average maximum temperature of 28.4˚C and July the coldest with average maximum temperatures around 20˚C (Bureau of Meteorology 2022).

2.5 Land tenure and zoning

The subject land is zoned *Deferred Matter* under Ballina LEP 2012, which means that it remains subject to Ballina LEP 1987 (**FIGURE 2**). The site is included within the current Ballina Shire Council Conservation Zone review project. It is proposed to be rezoned from 1(b) Rural (Secondary Agriculture) to C2 Environmental Conservation. The project has recently finished public exhibition and is being reviewed by Council staff. The Plan of Management (PoM) prepared by Mike Svikis Planning (2017) notes that the site has been mooted in the past for inclusion in an environment protection zone but the timeframe and likelihood of this outcome are unknown. The site was dedicated to Council as a Public Reserve at the subdivision of the parent lot in 1975. Killen Falls Drive was also dedicated to Council as a public road. Further information on the site in

relation to zoning objectives and permitted development can be found in the PoM (Mike Svikis Planning 2017).

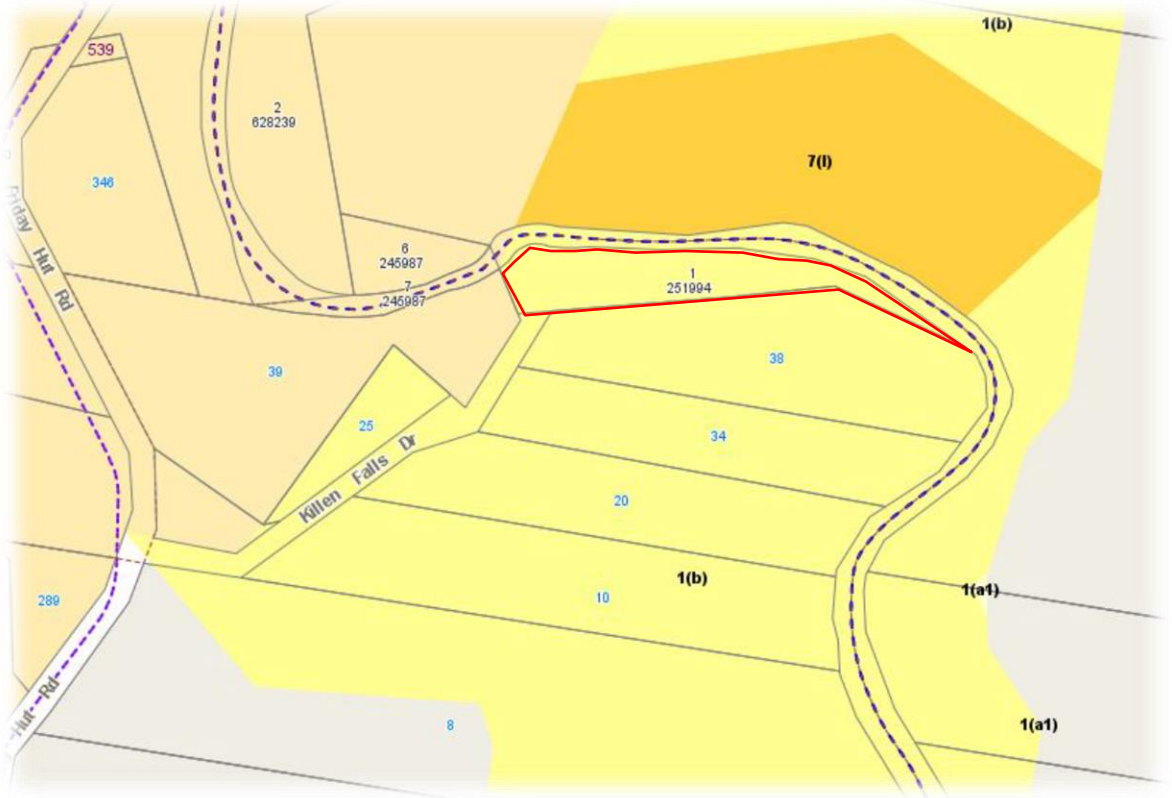


FIGURE 2: ZONING OF THE SUBJECT SITE AND SURROUNDING AREA
(Adapted from Mike Svikis Planning 2017)

2.6 Site history

The site is named after the Killen family who owned the neighbouring property to the north of the falls around 1885. The Subject Site has a history of clearing and cattle grazing. Photographs from the 1970s show open areas of paddock with some scattered trees along the upper sections of Emigrant Creek, downstream of the dam wall. The existing track was formerly used for vehicle access to the falls.

The Emigrant Creek Dam was constructed between 1967 and 1968 with subsequent strengthening works completed in 2002. Rehabilitation works were then undertaken by Rous Water in 2003 and included formalisation of the car park and landscaping of disturbed areas.

2.7 Surrounding land use

The surrounding land use includes stock grazing, macadamia plantations and rural residential properties. Emigrant Creek Dam is located directly upstream of the project area. The dam is managed by Rous Water and surrounding land owned by Rous Water has been rehabilitated and regenerated with native rainforest species. This area forms part of a drinking water catchment.

2.8 Previous management plans

The following reports/documents were reviewed as part of the preparation of this VMP. Descriptions of site vegetation at the time of these previous reports allow for a comparison to be made with current site conditions.

2.8.1 Killen Falls Vegetation Restoration Management Plan (Bower Bush

Works 2004)

This report was prepared for the Big Scrub Rainforest Landcare Group in 2004 and addressed the Subject site as well as two surrounding properties including a Big Scrub lowland rainforest remnant located on the northern side of Emigrant Creek. The current Subject site is identified as 'Area 3' in the plan and in 2004 comprised 20 years of regrowth vegetation including a mosaic of woody weeds (camphor laurel, privet, senna) and early successional rainforest species. Exotic pasture grasses and shrubland dominated by lantana and woody weed regeneration also were present. Area 3 was noted to be in poor to moderate condition with a low to moderate level of regeneration capacity and resilience due to past disturbance, exposure degraded soils and weed infestation.

Native diversity was fairly limited with a total of 45 trees and shrubs, 18 vines, 12 ferns, 9 herbs and groundcovers and 6 native grass species recorded. At least 13 native water plants were also recorded within the immediate riparian zone. A list of the native species recorded is provided in **APPENDIX A**. A total of 33 exotic plant species were recorded in Area 3, the main weeds being Camphor laurel, Privet spp., Senna spp. and Slash Pine as well as exotic grasses.

Restoration guidelines were divided into two zones, upper slope and riparian zone. Weed control and planting actions were outlined with the aim of expanding and linking areas of existing rainforest regrowth. The riparian zone includes a 5-10m wide corridor along the lower and upper creek banks. Restoration works in this zone aim to establish a dense cover of shrubs and trees along the upper riparian zone to assist shading of the creek edge. The VMP recommended planting and direct seeding of native herbs, sedges, grasses and water plants along the creek edge.

2.8.2 Vegetation Restoration Plan: Killen Falls (EnviTE 2010)

This plan was prepared as part of a funding grant through NSW Environmental Trust and provides updated information on native vegetation and weed species as well as weed control and restoration strategies for the Subject Site (identified in the plan as Zones 1 and 2). The funding allowed for preparation of the plan as well as the employment of professional bush regenerators to work with BSC and the Emigrant Creek/Tintenbar Landcare group to rehabilitate vegetation in Zone 1 and 2 over three years.

The plan outlines works undertaken since the 2004 VMP and includes control and removal of mature camphor laurel, lantana and slash pine. Rainforest plantings have been undertaken resulting in a native canopy which has reduced exotic seedling germination and growth. Weeds still occur around the planting edges and along the riparian edge. Planting of Lomandra and other riparian species has been undertaken by the landcare group to stabilise creek banks and prevent scouring and erosion. Weed species still dominate Zone 2 which includes the area east of the access track and the riparian area below Killen Falls. Mature Camphor laurel, Privet spp., Lantana and a dense groundcover of mist flower and molasses grass are present.

Detailed restoration works including follow-up bush regeneration in Zone 1 and primary and follow-up bush regeneration in Zone 2 are tabulated in the plan along with monitoring requirements. An updated list of native species and weed species is also included in this plan although the lists are not divided into zones and presumably covers all 5 zones (areas outside the Subject site covered in this VMP).

Year 1, Year 2 and Final Progress Reports were completed as part of the grant requirements. The final report concludes "*Primary and follow up bush regeneration work has been completed and followed up throughout the Council area at Killen Falls with systematic control of Camphor Laurel, Large and Small -leaved Privet and Mistflower undertaken. Regeneration of native plants is now evident in areas once dominated by weed*

species. Only low level, on-going maintenance is required in this area to ensure outcomes are maintained and enhanced".

2.8.3 Killen Falls Plan of Management Part A (Mike Svikis Planning 2017)

This Plan of Management (PoM) covers the council reserve and outlines a number of recommendations in relation to infrastructure, public safety, parking, dogs, tracks etc. The plan provides a detailed history of the site as well as quantitative data on the visitation rates and traffic count for the site.

The PoM notes that social media has played a large part in the increase in popularity of the site over the last 5-10 years. A visitor count on Sunday 22 January (school holidays) between 10am to 2pm recorded a total of 279 people including 3 tour groups. A survey undertaken in relation to changes at Killen Falls concluded most visitors wanted a toilet, upgrade of the tracks, more parking and vehicle speed controls.

A number of the recommendations outlined in the report have since been implemented including:

- installation of a toilet;
- upgrade of the track to the viewing platform;
- installation of a handrail on the track down to the creek;
- replacement of the timber bench seat;
- signage in relation to hazards and track distance/rating;
- installation of fencing along the viewing platform track;
- exclusion of dogs from the site;

The report also recommended Water Quality Monitoring.

2.8.4 Killen Falls Plan of Management Part B (Mike Svikis Planning 2017)

Part B of the PoM covers the results of consultation which was undertaken as part of the plan preparation as well as costs and funding associated with the recommendations. Key issues raised include trespass and privacy, traffic and parking on Killen Falls Drive, tracks and other infrastructure, environmental restoration, water quality, toilets, rubbish, safety and risk.

2.9 Volunteer landcare groups and bush regeneration contracts

The Big Scrub Landcare group and Emigrant Creek/Tintenbar Landcare group have been actively involved with the restoration of the site since the VMP was prepared in 2004. Their commitment and hard work is evident in the success of the rehabilitation works including both weed control and revegetation. No Landcare group is currently working at the site.

A number of bush regeneration contractors have worked on the Subject site in the past including EnviTE. Contractors also worked with volunteer groups to provide training and participate in tree planting days. A small 5 year grant for a bush regeneration contractor commenced two years ago at the site and is primarily utilised for ongoing maintenance of the site. More recently bush regeneration has been funded by compensatory requirements from filming opportunities.

3 SITE VALUES

3.1 Introduction

This section provides details on the ecological attributes and values of the Subject site including: vegetation communities; EECs; flora and fauna; threatened species and threatened fauna habitats. Information in this section was obtained during site surveys undertaken in July 2022. Additional information has been collated from previous management plans applicable to the Subject site and other sources including the NSW Wildlife Atlas threatened flora/fauna records.

3.2 Vegetation

The Subject site comprises a mix of planted and regrowth rainforest and wet sclerophyll species with a closed native canopy. Vegetation west of the lookout consists primarily of mature planted species and well developed regrowth such as Blue quandong, Pencil cedar, Sweet pittosporum, Guioa, Foambark, Red ash, Brown kurrajong, Native frangipani and Macaranga. The majority of this area now has a closed canopy which has reduced the amount of light penetration and limited the occurrence of groundcover weeds.

View of closed native canopy in revegetation area

Plantings of Lomandra along the path edge, within the small drainage channel and along the creek bank have grown well and are also reducing groundcover weeds.

Dense plantings of Lomandra have reduced groundcover weeds and discouraged pedestrian access

Several mature eucalypts are established within this community type including Tallowwood, Forest red gum and Pink bloodwood. The groundcover does not include any regenerating eucalypts and they are unlikely to germinate now that the canopy has largely closed.

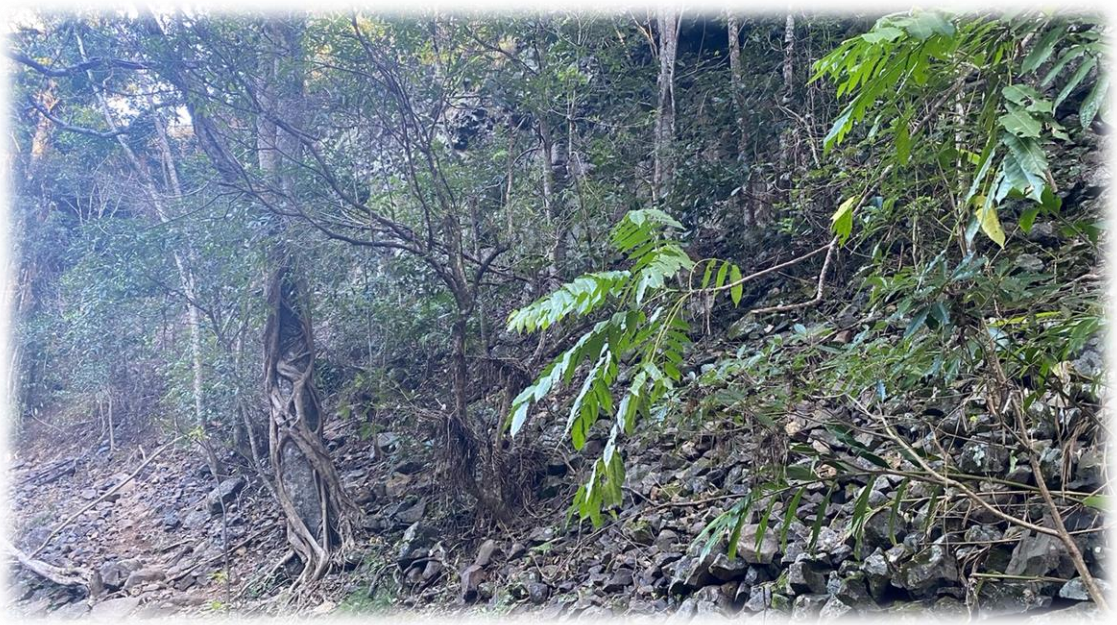
Grassy section along lower creekbank

More recent plantings have been undertaken along lower sections of the creek bank and within a small area just west of the lookout where there is a gap in the canopy. Exotic grasses such as Molasses and Paspalum dominate the groundlayer in this area. The exposed northern aspect and shallow dry soils with exposed rock are likely hampering regeneration efforts in this area.

Open area west of the lookout with Molasses grass and more recent plantings

To the east of the lookout above the cliff line a number of mature Brushbox occur amongst regrowth rainforest species. Bower Bush Works (2004) notes that this area is likely to have supported a drier formation of less complex rainforest with sclerophyll attributes. Significant works have been undertaken east of the lookout since 2010 to remove mature Camphor laurel, Privet spp., and Lantana which were noted as dominant in this area by EnviTE (2010). Natural regeneration of rainforest species has since developed although continued follow-up is required, particularly along the drier cliff top section where groundcover and woody weeds still occur.

Creekside areas below the cliff line and east of the creek access track comprise mature rainforest species with an abundance of native vines on a steep rocky slope. These areas are in good condition thanks to past restoration works which have removed the dense groundlayer of mistflower which once occurred in these areas.



Rainforest along the creek edge below the falls

Mature slash pines which occurred on the Subject site and along the southern edge on the adjacent private property in 2004 have since been treated and removed. Private land adjoining the southern boundary (west of the residence) has recently been planted with native rainforest species and was well maintained at the time of the site visit. These plantings will assist long-term with buffering the rainforest vegetation on site and reducing weed seed encroachment.

Recent rainforest plantings on adjoining private property to the south

A remnant of the Big Scrub (known as the Killen Falls remnant) remains on the northern side of Emigrant Creek near the falls. While not included in the VMP area, this remnant can be viewed from the lookout and from the falls and serves as an important native seed source for the site as well as providing significant fauna habitat. Bower Bush Works (2004) notes that prior to clearing the Subject site is likely to have supported complex forest similar to the Killen Falls remnant on the deeper soil profiles and the alluvial flats along the eastern edge of the reserve.

3.3 Endangered ecological communities

3.3.1 State listed EECs

Vegetation occurring within the Killen Falls remnant is recognised as Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions which is listed as an EEC under the NSW Biodiversity Conservation Act 2016 (BC Act 2016). Lower sections of the remnant are classified as Lowland Rainforest on Floodplain in the NSW North Coast Bioregion which is also listed as an EEC under the Act. Vegetation within the Subject Site is in an advanced stage of development toward a Lowland Rainforest community.

3.3.2 Commonwealth listed TECs

Lowland Rainforest of Subtropical Australia is listed as a critically endangered Threatened Ecological Community (TEC) under the Environment Protection and Biodiversity Conservation Act 1999. The listing advice for this TEC outlines a number of key diagnostic characteristics and condition thresholds that must be met for determination of the TEC. The Killen Falls remnant is likely to meet the highest quality (Patch Type A) of the TEC condition thresholds. The condition thresholds allow for non-remnant patches of a certain size where natural regeneration and/or active management (weed control/supplementary plantings) occur. Sections of the Subject site which comprise a closed canopy (≥70%), contain ≥30 native woody species and where ≥50% of vegetation is native are likely to meet the condition thresholds of the TEC.

3.4 Flora

The VMP prepared in 2004 by Bower Bush Works recorded a limited diversity of native plant species in the Subject site (relative to the Killen Falls remanant) including 45 species of trees and shrubs, 18 vines, 12 ferns, 9 herbs and groundcovers and 6 native grass species. Extensive plantings of rainforest species undertaken since then have increased the diversity, particularly in the canopy and upper stratum. The 2004 native flora list has been updated to include common native species noted during the site survey and is included in **APPENDIX A.**

The EnviTE restoration plan prepared in 2010 also includes a native flora list however the list is not segregated into zones and includes surrounding areas (including the remnant) which were included in the plan at that time.

3.5 Threatened flora species

3.5.1 Recorded within the Killen Falls Public Reserve

At the time of the 2004 VMP, Bower Bush Works recorded two flora species of conservation significance within the Subject site:

- *Tinospora tinosporoides* (Arrow-head vine) listed as Vulnerable under the BC Act.
- *Quassia* sp. 'Mt Nardi' listed as a ROTAP species

Two additional species, *Rhodomyrtus psidioides* (Native guava) and *Rhodamnia rubescens* (Scrub turpentine) were also recorded by Bower on the Subject site. These species have recently been listed as Critically Endangered under the BC Act and EPBC Act and are both still present on the site.

In 2010, EnviTE also recorded *Syzygium moorei* (Coolamon) within the Subject site, this species being listed as Vulnerable under the BC Act. This species, apparently planted, occurs quite widely within the restoration area.

Additional threatened flora species recorded during the current site assessment include:

- *Davidsonia jerseyana* (Davidson's plum) listed as Endangered under the BC Act and EPBC Act. Species is likely to have been planted at the site as part of restoration activities, natural habitat includes lowland subtropical rainforest and wet eucalypts forest at low altitudes.
- *Desmodium acanthocladum* (Thorny pea) listed as Vulnerable under the BC Act and EPBC Act. Species is likely to have been planted at the site as part of restoration activities, natural habitat includes dry rainforests and fringes of riverine subtropical rainforest.

3.5.2 Threatened flora known to occur in surrounding area

TABLE 1 lists additional threatened flora species which were recorded within the immediate surrounding area as part of the 2004 VMP.

TABLE 1
THREATENED FLORA PREVIOUSLY RECORDED IN THE SURROUNDING AREA

Common Name	Botanical Name	NSW Status	Commonwealth Status	Area recorded by Bower (2004)*
Isoglossa (herb)	*Isoglossa eranthemoides*	E	E	Area 1
Arrow-head vine	*Tinospora tinosporoides*	V	-	Areas 1, 2a, 3, 4
Ball nut	*Floydia praealta*	V	V	Area 1
Red lilly pilly	*Syzygium hodgkinsoniae*	V	V	Area 1
Scrub turpentine	*Rhodamnia rubescens*	CE	CE	Areas 1 and 3
Rough-shelled bush nut	*Macadamia tetraphylla*	V	V	Area 1
Smooth scrub turpentine	*Rhodamnia maideniana*	CE	-	Areas 1, 2a and 2b
Coolamon	*Syzygium moorei*	V	V	Area 2a
Acalypha	*Acalypha ?eremorum*	E	-	Area 1
Native guava	*Rhodomyrtus psidioides*	CE	CE	Areas 1, 3 and 4

* Area 1 is the Killen Falls remnant
Area 2a is the rainforest patch on the northern side of Emigrant Ck, upstream of the falls
Area 2b is a patch of Camphor laurel on the northern side of Emigrant Ck, downstream of the dam wall
Area 3 is the Killen Falls Public Reserve (subject site)
Area 4 is a patch of Camphor laurel south of the Subject site, on private land

Additional threatened flora species which have been recorded within a 5km radius and which may occur in future or be suitable for planting at the site as part of any future revegetation works include:

- Southern ochrosia (*Ochrosia moorei*)
- Nicker nut (*Caesalpinia bonduc*)
- Rainforest cassia (*Senna acclinis*)
- White laceflower (*Archidendron hendersonii*)
- Rusty rose walnut (*Endiandra hayesii*)
- Green-leaved rose walnut (*Endiandra muelleri* subsp. *bracteata*)
- Onion cedar (*Owenia cepiodora*)
- Sweet myrtle (*Gossia fragrantissima*)
- Red boppel nut (*Hicksbeachia pinnatifolia*)

- Coast Euodia (*Melicope vitiflora*)
- Small-leaved tamarind (*Diploglottis campbellii*)

Protocols for working around Threatened flora species are detailed in Section 6.5. Any new sightings of listed Threatened flora species or identification of a new Threatened flora species is to be reported to the BSC Natural Resource Officer. A sample may need to be sent to the NSW Herbarium for identification.

3.6 Fauna

No formal fauna surveys have been undertaken within the Subject site or the Killen Falls remnant to date. Bower (2004) notes that faunal data from similarly sized Big Scrub remnants indicate they provide important habitat for a diversity of reptile, bird and mammals species (particularly mobile species such as bats) and invertebrates. The diversity of habitat types - including closed forest, grassland, rocky outcrops and caves, wetlands and waterways as well as mature old-growth trees provide habitat niches for a relatively wide variety of species that occur within the broader study area.

The diversity of fauna species using the site will be limited by landscape scale processes including habitat fragmentation, localised extinction and feral animals. The site is not well connected with any substantial areas of intact native vegetation and is not readily re-colonised by native fauna that are not capable of traversing open habitat types.

3.7 Threatened fauna and habitats

3.7.1 Threatened fauna

A large number of Threatened fauna species have been previously recorded within 5km of the Subject site according to the NSW Wildlife Atlas database (refer to **TABLE 2** below). Additional species listed by Bower (2004) as having a high likelihood of occurrence have also been included.

TABLE 2
NSW WILDLIFE ATLAS DATABASE RECORDS OF THREATENED FAUNA RECORDED WITHIN 5KM OF THE SUBJECT SITE

Common Name	Scientific Name	NSW Status	EPBC Status	Likelihood of occurrence
Amphibians				
Wallum Froglet	*Crinia tinnula*	V		Suitable habitat not present
Olongburra Frog	*Litoria olongburensis*	V	V	Suitable habitat not present
Birds				
Wompoo Fruit-Dove	*Ptilinopus magnificus*	V		Possible
Rose-crowned Fruit-Dove	*Ptilinopus regina*	V		Likely
Superb Fruit-Dove	*Ptilinopus superbus*	V		Possible
Black-necked Stork	*Ephippiorhynchus asiaticus*	E		Suitable habitat not present
Black Bittern	*Ixobrychus flavicollis*	V		Possible
Spotted Harrier	*Circus assimilis*	V		Suitable habitat not present
Little Eagle	*Hieraaetus morphnoides*	V		Possible

Common Name	Scientific Name	NSW Status	EPBC Status	Likelihood of occurrence
Eastern Osprey	*Pandion cristatus*	V		Suitable habitat not present
White-bellied sea-eagle	*Haliaeetus leucogaster*	V		Possible
Brolga	*Grus rubicunda*	V		Suitable habitat not present
Bush hen	*Amaurornis moluccana*	V		Possible
Bush Stone-curlew	*Burhinus grallarius*	E		Suitable habitat not present
Pied Oystercatcher	*Haematopus longirostris*	E		Suitable habitat not present
Eastern Grass Owl	*Tyto longimembris*	V		Suitable habitat not present
Masked Owl	*Tyto novaehollandiae*	V		Possible
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V		Suitable habitat not present
Dusky woodswallow	*Artamus cyanopterus cyanopterus*	V		Suitable habitat not present
White-eared Monarch	*Carterornis leucotis*	V		Possible
Mammals				
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	Suitable habitat present but unlikely due to isolation
Common Planigale	*Planigale maculata*	V		Possible
Koala	*Phascolarctos cinereus*	V	V	Suitable habitat not present
Squirrel Glider	*Petaurus norfolcensis*	V		Suitable habitat not present
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	Likely
Eastern Coastal Free-tailed Bat	*Micronomus norfolkensis*	V		Possible
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V		Likely
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V		Possible
Little Bentwing-bat	*Miniopterus australis*	V		Likely
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V		Likely
Southern Myotis	*Myotis macropus*	V		Likely
Eastern Long-eared Bat	*Nyctophilus bifax*	V		Likely
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V		Possible

3.7.2 Discussion of fauna habitat within the study area

3.7.2.1 Introduction

The VMP project area provides high value rainforest, aquatic and riparian community types that together support a range of habitat types for native fauna, including threatened (NSW BC Act 2016 & Commonwealth EPBC Act 1999) and locally significant species.

Although rainforest community types are typically associated with high fauna diversity, historical clearing of the surrounding native vegetation cover and fragmentation of habitats will have resulted

in the local extinction of many fauna populations and substantially reduced fauna biodiversity. The action of other threatening processes such as feral species and weed flora will have exacerbated these impacts on fauna. The Killen Falls remnant has been retained intact within this cleared landscape but the relatively small size and isolation of this remnant will not have been sufficient to enable many fauna groups to persist.

Revegetation works and natural regeneration have been carried out in recent decades and there has been a substantial increase in native vegetation cover. **APPENDIX G** shows historical aerial photography of the surrounding area in 1958, 1972 (following construction of the dam in 1968) and 1991. Over time fauna biodiversity can be expected to increase as plantings and regenerated areas develop. Highly mobile species such as birds and bats will be able to recolonise these areas relatively easily. Many mammal and reptile species that formerly occurred throughout Big Scrub rainforest areas, such as the Spotted-tailed quoll, Red-legged pademelon and Stephen's banded snake, are unlikely to be able to recolonise areas such as this without active translocation programs.

3.7.2.2 Amphibians

Habitats along Emigrant Creek and its minor tributaries provide good quality habitat for many frogs. A number of amphibian species are considered likely occurrences within or around the Killen Falls and Emigrant Creek area. Species considered likely occurrences include the Dwarf green tree frog (*Litoria fallax*), Bleating tree frog (*Litoria dentata*), Striped marsh frog (*Limnodynastes peronii*) and Tusked frog (*Adelotus brevis*), all of which occur in similar environments in the locality.

Closed forest habitats along drainage lines represent suitable habitat for tree frogs including the Dainty tree frog (*Litoria gracilent*a), Peron's tree frog (*Litoria peronii*) and Green tree frog (*Litoria caerulea*).

3.7.2.3 Reptiles

Distribution and abundance of reptiles is generally a function of habitat structure and availability of shelter and prey. The site provides a variety of microhabitats for reptiles, including closed and open forest types, grasslands, creeklines and artificial structures. The site represents good habitat for reptiles due to the presence of: the combination of shelter and basking sites; the juxtaposition of varying mesic forest types; rocky and cave areas for shelter; rainforest areas with good canopy and leaf litter development; availability of water in drainage lines; presence of artificial shelter sites (dam wall and infrastructure etc.) and reliable sources of prey.

Species considered likely to occur include: Green tree snake; Brown tree snake; Carpet python; Red-bellied black snake; Brown snake; Yellow-faced whip snake; Eastern water dragon; Blue-tongued lizard and a number of smaller skinks.

3.7.2.4 Birds

The diversity of ecosystems on and around the site provide habitat for a wide range of bird groups although the site is of most value for rainforest avifauna. Many insectivorous birds from higher latitudes spend winter in the locality and are likely to visit the site seasonally or periodically. These include species such as the Fantail cuckoo, Rainbow bee-eater, Noisy pitta, Tree martin, Black-faced cuckoo-shrike, Cicada bird, Golden and Rufous whistler, Rose robin, White-throated gerygone, Silvereye, Olive-backed oriole and Spangled drongo.

Birds such as honeyeaters and lorikeets move locally in response to changes in the availability of nectar and or pollen. Although not common on the site itself, the surrounding locality does contain a number of nectar bearing plants in the genera Eucalyptus, Banksia, Melaleuca and Callistemon.

These plants provide a continuity of food for nectarivorous birds.

Studies of bird usage in rainforest remnants indicate that the diversity and abundance of birds is related to the size of the rainforest patches and their degree of isolation from major areas of native forest (Holmes 1987; Connelly and Specht 1988). Locally nomadic and migratory rainforest species such as the Wompoo, Rose-crowned and Superb fruit-doves, Common koel and Black-faced cuckoo-shrike are known to use scattered areas of habitat as stepping stones between more intact areas of forest (Date *et al* 1992).

Rainforest areas along Emigrant Creek are likely to play host to a relatively high diversity of resident and nomadic birds over the year. The site provides a high diversity and abundance of fruiting species in remnant and regrowth rainforest areas. Rainforest patches on the site and adjacent properties represent important habitat for frugivorous birds in the context of the highly denuded nature of the surrounding landscape.

There is a general lack of trees with hollows necessary for hollow-nesting birds, however, the site may represent important forage habitat for hollow-dependent avifauna breeding in forests in the wider locality.

3.7.2.5 Mammals

Despite historical disturbance to the site and widespread vegetation clearance in the surrounding area, the site is likely to play host to a number of mammal species. The Mountain brushtail possum, Common brushtail and Ringtail possum are all likely to be found on the site.

Koalas would generally not have occurred within the Big Scrub area historically, but the widespread planting of eucalypts in windbreaks and farm plantings (including the preferred feed trees Tallowwood, Swamp mahogany and Flooded gum) has encouraged Koalas to move into areas around Tintenbar. The site itself provides some foraging habitat for Koalas with planted eucalypts.

The Swamp wallaby, Echidna, Water rat and Platypus are all likely to occur around Killen Falls. Smaller terrestrial mammals likely to occur on or near the site include the Northern brown bandicoot and the Bush rat as well as the introduced Black rat, House mouse and European fox.

The site provides good quality forage habitat for megachiropteran and microchiropteran bats. The Grey-headed and Black flying-fox are likely to forage on the site during peak flowering and fruiting of site vegetation.

Microchiropteran bats may also roost on the site, including within caves and underhangs around the falls themselves. Disturbance from visitors to the falls may discourage bat roosting although some suitable roosting niches are likely to remain relatively undisturbed.

3.7.2.6 Aquatic species

Emigrant Creek provides good quality aquatic habitat for fish and invertebrate species with rocky areas, deeper pools, overhanging riparian vegetation and in stream vegetation. The dam wall represents a barrier to movement upstream for most aquatic species.

3.8 Aboriginal heritage

The municipality of Ballina, including the Tintenbar area, was previously occupied by the Bundjalung people. It is likely that all streams and waterholes were used by the Bundjalung people prior to white settlement. Killen Falls is not registered as a site on the AHIMS register.

Consultation with the JALI Local Aboriginal Land Council has been undertaken as part of the preparation of this VMP.

Any interpretive educational material, sign, pamphlets etc. produced for the Killen Falls area or to be installed within the site are to be approved by the Ballina Shire Council and Jali Local Aboriginal Land Council prior to publication/installation. In the event that any Aboriginal artefacts, skeletal remains or shell midden materials are encountered during restoration works on the site, works are to stop and Council, Jali Local Aboriginal Land Council and the NSW Government Office of Environment and Heritage (OEH) are to be notified immediately. Works are not to commence until approval from such authorities exist.

3.9 Recreational values

Killen Falls has been used by locals for many decades for swimming and camping. Visitation of the site has increased substantially in recent years due to increased awareness of the site on social media. The site offers an easy short walk to a viewing platform from where the falls can be viewed. The walking track then descends down to the creek and offers access to the swimming hole at the base of the falls. Visitors are required to do some rock hopping to access the shallow swimming area.

Surveys undertaken in 2017 as part of the PoM recorded a total of 279 visitors on a sunny Sunday in the school holidays. Discussions with neighbours at the time noted they had observed 72 cars parked on Killen Falls Drive and more than 50 people swimming in the waterhole on one day in December.

The site also offers an opportunity to view a remnant of the Big Scrub (Killen Falls remnant) which can be viewed from the lookout platform or the base of the falls.

View from the viewing platform

3.10 Landscape setting and connectivity

The Killen Falls site is located toward the eastern periphery of the former Big Scrub. The Subject

site is situated within the Emigrant Creek catchment which runs in a north south direction from Newrybar and drains into the Richmond River near Ballina. The dominant land use in the catchment and surrounds comprises large scale plantations (macadamia, coffee and stone fruit) pasture and residential. Vegetated areas are generally restricted to riparian corridors and previously cleared steep land with some patches of restoration plantings. Vegetated areas are generally dominated by a mix of camphor laurel, privet and lantana as well as more common rainforest regrowth species. The Killen Falls Remnant is isolated from other Big Scrub remnants, the closest being Emery's Scrub located approximately 5km northwest of the site.

Extensive restoration works within the Council Reserve and adjoining private properties as well as around the Emigrant Creek dam have helped to improve ecological connectivity in the vicinity as well as the long-term viability of the remnant. Restoration of the Emigrant Creek Dam site by Rous Water has advanced considerably in the time since the 2004 Bower VMP.

4 WEED SPECIES AND LEGISLATION

4.1 Introduction

This section provides information on weed legislation relevant to this VMP and details the weed species recorded in the Subject site.

4.2 Weed Species Categories

Weeds are often classed in broad groups depending on their characteristics and types of threats they pose. Several different categories of weeds (priority weeds, environmental weeds, WONS, National Environmental Alert List Weeds) are recognised at a national, state, regional (catchment) and local level as described below.

4.2.1 Priority weeds

The NSW Biosecurity Strategy 2013-2021, Flood Safety Strategy 2022-2030 and NSW Biosecurity Act (2015) provide a framework for safeguarding primary industries, natural environments and communities from a range of pests, diseases and weeds. The NSW Biosecurity Act (2015) repeals the Noxious Weeds Act (1993). The North Coast Regional Strategic Weed Management Plan has been developed in response to these reforms and lists priority weeds for the North Coast area. A list of all weed species recorded in the Subject site is provided in Section 4.3 below. Priority weeds and their relevant management category are outlined in **TABLE 3.**

4.2.2 Environmental Weeds

Environmental weeds are defined as non-indigenous plant species that have invaded (or have the potential to invade) natural ecosystems and threaten (or have potential to threaten) environmental and/or conservation assets. Invasions of environmental weeds often reduce plant diversity and result in a loss of habitat for native animals (Muyt, 2001). Environmental weeds can be declared priority weeds however a number of serious environmental weeds are not included in the classifications of the NSW Biosecurity Act (2015). Environmental weeds can also be Australian native species that are not local (indigenous) to an area but have the potential to damage the local plant community.

4.2.3 Weeds of National Significance (WONS)

An effort to gain control of weeds in Australia has led to the development of a National Weeds Strategy. The strategy was first developed in 1997 and further refined in 2007 by the Commonwealth of Australia and issued under the authority of the National Resource Management Ministerial Council. Under the WONS Strategies detailed management procedures have been outlined and published for the control of the 20 recognised WONS. WONS are recognised as having potential to significantly impact upon natural values including: threats to human health and safety; threats to pastoral and agricultural industries; threats to water quality and supply; threats to indigenous flora; and threats to biodiversity and cultural values.

4.2.4 National Environmental Alert List Weeds

Under the National Weeds Strategy, 28 environmental weeds were identified National Environmental Alert Weeds. Alert Weeds are non-native plant species that are in the early stages of establishment and have the potential to become a significant threat to biodiversity if they are not managed.

4.3 Weed Species recorded

A total of 23 weed species were recorded during the site survey in July 2022, refer to **TABLE 3** below. In general, weed abundance across the site is low, particularly in areas with an established canopy of native rainforest species. Weeds are generally concentrated along the creek bank edge, where gaps in the canopy occur and along the cliff top, east of the lookout platform. A depositional

point bar which occurs in the creek at the western end of the site has been included in this VMP and contains a number of weeds.

TABLE 3
EXOTIC SPECIES RECORDED IN SUBJECT SITE

Botanical Name	Common Name	Notes on abundance/location	Priority weed management category*
Commelina benghalensis	Hairy commelina	Recorded in low-lying areas along the creek bank, often amongst Swamp ricegrass	
Tradescantia fluminensis	Wandering jew	Recorded near the entrance of the site	
Myriophyllum aquaticum	Parrot's feather	Noted in amongst flood debris caught up in shrubs/trees along the creek edge.	Asset protection (R)
Andropogon virginicus	Whisky grass	One individual noted amongst rainforest veg on the southern side of the track.	
Melinis minutiflora	Molasses grass	Common on northern facing exposed rock and shallow soils where canopy is lacking. Predominately along the creek edge (upstream of the lookout platform and the cliff top area).	
Paspalum mandiocanum	Broadleaf paspalum	Common along the open edge of the creek bank.	
Setaria sp.	Pigeon grass	Low abundance on creek edge in low-lying area comprising Swamp ricegrass.	
Pinus radiata	Radiata pine	One dead sapling noted in area of open canopy.	Asset protection (R)
Archontophoenix alexandrae	Alexander palm	Cut individuals noted near the entrance to the site.	
Ageratina adenophora	Crofton weed	Sporadic, low abundance, in grassy areas along the creek edge and cliff top section. Also through the depositional point bar area.	Asset protection (R)
Ageratina riparia	Mistflower	Once dominant across the site, this species was recorded sporadically throughout the site in low numbers.	
Ageratum houstonianum	Blue billygoat weed	Sporadically noted in low abundance amongst exotic grasses and swamp ricegrass, predominately along exposed areas of the creek bank and cliff top.	
Bidens pilosa	Cobblers pegs	Low numbers on the cliff top area.	
Crassocephalum crepidioides	Thickhead	Uncommon, noted along the creek bank.	
Senna pendula var. *glabrata*	Senna	Sporadic observations throughout site, mostly seedlings although one mature individual noted amongst rainforest midstorey near entrance. Many saplings on the depositional point bar.	
Desmodium uncinatum	Silver-leaved desmodium	On cliff edge below the lookout platform.	
Cinnamomum camphora	Camphor laurel	Mostly seedlings noted across the site. Some larger saplings occur in areas, particularly along the creek bank and cliff top/edge.	Asset protection (R)

Botanical Name	Common Name	Notes on abundance/location	Priority weed management category*
Ligustrum lucidum	Large-leaved privet	A couple of mature individuals remain on the cliff edge, east of the lookout platform. Some seedlings also occur in this area and on the depositional point bar.	Asset protection (R)
Ligustrum sinense	Small-leaved privet	Seedlings noted sporadically across site, mostly on the cliff top area and the depositional point bar. Mature individuals also occur in the later.	Asset protection (R)
Passiflora edulis	Passionfruit	Small number of seedlings noted.	Asset protection (R)
Passiflora suberosa	Corky passionfruit	Moderate number of seedlings noted throughout site with recent control observed during the survey. Species was not recorded onsite in 2004 or 2010.	Asset protection (R)
Passiflora subpeltata	White passionflower	Low number of seedlings noted on the cliff top area.	Asset protection (R)
Lantana camara	Lantana	Small number of individuals noted, mostly amongst exotic grasses on the creek bank and on the cliff top.	Asset protection (S)

* (S) State level priority weeds
(R) Regional high risk priority weeds
Asset protection: For weeds listed as asset protection, the objective is to prevent the spread of weeds to key sites/assets of high economic, environmental and social value, or to reduce their impact on these sites if spread has already occurred. These weed species are widespread and unlikely to be eradicated or contained within the wider regional context. Effort is focussed on reducing weed threats to protect priority high value assets.

5 RESTORATION STRATEGY

5.1 Introduction

Since the preparation of the 2004 VMP by Bower Bush Works, the Subject site has undergone significant restoration works thanks to dedicated volunteers and bush regeneration contractors. The site represents an important example of a successful rainforest restoration program that has substantially improved biodiversity values over time. The majority of the site now has an established closed canopy of native rainforest species with limited weed presence beyond the occasional seedling.

The overall restoration strategy consists of maintaining the native vegetation cover on the site, controlling minor outbreaks of environmental weeds as they emerge, consolidating native vegetation cover on the lower banks and looking for opportunities to enhance flora species diversity and fauna habitat values.

Restoration works outlined below relate mostly to four specific areas where rehabilitation has been slower or less successful due to harsher conditions, access difficulties and erosion/flood damage. These areas are highlighted in **FIGURE 3** and include:

- Upper slope
- Riparian creek bank
- Depositional point bar

Specific restoration works required in these areas are outlined below as well as general ongoing maintenance tasks.

5.2 Upper slope

This area covers the majority of the site, upslope of the riparian creek bank to the southern boundary from the site entrance to the eastern edge. Thanks to past regeneration efforts the majority of this area is in good to excellent condition with an established closed canopy comprising native rainforest species and minimal weed presence. The exceptions to this include a small area approximately 10m by 10m where there is a gap in the canopy and the cliff top platform and edge, east of the lookout platform. These two areas are shown in **FIGURE 3**.

Restoration works proposed include:

- Weed control
    - continue ongoing weed maintenance by spot spraying exotic seedlings through areas of established rainforest plantings.
    - control mature woody weeds along the cliff top including Large-leaf privet and Lantana. Given the proximity of these plants to the cliff edge appropriate training and equipment may be required. Bush regeneration contractor to assess options in consultation with BSC.
    - spray exotic grasses around plantings and natural regeneration/native groundcovers.
- Planting
    - continue to maintain more recent plantings in the canopy gap. Consider supplementary plantings to replace failed plants and where the density of plantings is lacking. The exposed north facing nature of this area and likely shallow soils will limit the success of some species. In areas where previous plantings may have failed, plantings should use more hardy species such as Figs, Brush box, Macaranga,

Brown kurrajong, Hoop pine, Lilly pillys and Hard quandong. Water crystals and a suitable native fertiliser may also assist establishment of plants in this area.
    - Consider additional plantings of understorey and midstorey species to increase diversity in these stratums and consolidate any gaps.
    - Plant additional *Lomandra longifolia* where informal tracks occur to deter access. Strategic placement of fallen branches may also assist to prevent the formation of informal tracks.
- Maintenance/other
    - Trim overhanging branches along the access track as required.
    - Remove any rubbish from vegetated areas and dispose of in the bins provided.

Footpath through rainforest interior on upper slopes

5.3 Riparian creek bank

This zone includes the vegetation occurring along the margins of Emigrant Creek (lower and upper creek banks at about 5m to 10m width) both upstream and downstream of Killen Falls.

- Weed control
    - strategically control exotic grasses along creek edge, focus around native saplings/groundcovers and plantings, and slowly expand outwards to reduce erosion potential from overclearing of grasses. Avoid spray drift and hand weed where appropriate. Only use herbicides suitable for use near waterways.
    - Scrape back dead biomass of Molasses grass to promote seedling germination.
    - Treat camphor saplings and other woody weeds once plantings have established and the risk of erosion is reduced.
    - monitor for introduced weeds (including aquatic weeds) following flood events.
- Planting
    - plant additional creekline species such as Creek sandpaper fig (*Ficus coronata*), Water gum (*Tristaniopsis laurina*), Weeping lilly pilly (*Waterhousea floribunda*) and Creek lilly pilly (*Acmena smithii*) as well as *Lomandra longifolia* and other sedge/rushes in exposed

areas and where erosion is occurring to stabilise the creek bank. Plantings should be undertaken outside of the flood season.
    - Consider transplanting ferns such as Gristle fern and rasp fern from nearby areas to reduce exotic groundcovers once canopy is established and the right microclimate is present.
- Maintenance/other
    - assess any damage to plantings/vegetation following flood events, replace as required. Remove any larger branches and flood debris inhibiting native saplings.

Grassy section along the banks of Emigrant Creek

5.4 Depositional point bar

This is a low-lying area in Emigrant Creek at the western end of the reserve (refer to **FIGURE 3**). This area is highly flood prone and a low-lying channel between the point bar and the creek bank may be under water at some times. Previous plantings have been undertaken in this area and, although it is evident that flooding has resulted in the loss of planted seedlings and more established saplings, now include Figs, Hoop pine, Riberry, Brown tamarind, Creek lilly pilly, Red kamala, Sandpaper fig, Blackwood, Sweet pittosporum and Foambark. Native groundcovers occur in isolated patches and include Cunjevoi, Flax lily, ferns and *Lomandra longifolia*. Weeds are common throughout the area, particularly in the groundlayer including Paspalum, Blue billygoat weed, Trad, Crofton and Mistflower. Mature woody weeds are relatively sparse and include Small-leaf privet, Winter senna and Lantana. Numerous seedlings and larger saplings of Small-leaf privet and Winter senna occur, concentrated around mature individuals on the western edge.

Low-lying channel between the bar point and the creek bank.

- Weed Control
  - Treat mature woody weeds and spray extensive patches of privet and senna seedlings. Focus primarily around native plantings and where native regeneration is evident.
  - Spray exotic grass/herbs in a strategic manner, focusing around native ferns and areas of Swamp ricegrass and working outwards. Hand weed around native groundcovers where required.
  - monitor for introduced weeds (including aquatic weeds) following flood events
- Planting
  - maintain existing plantings as required
  - undertake supplementary plantings of suitable creekline species (refer to section above) in gaps and where natural regeneration is lacking.
- Maintenance/other
  - A large dead tree has fallen over in the area. It may be necessary to trim some of the branches to gain access for weed control and allow native regeneration to occur.
  - assess any damage to plantings/vegetation following flood events, replace as required. Remove any larger branches and flood debris inhibiting native saplings.

Vegetation on the bar point is a mix of native and exotic species

Fallen dead tree which may require cutting to allow access

5.5 Additional opportunities

Given the high-profile nature of the site and success of the restoration works to date, it may be appropriate to implement additional actions not directly related to vegetation restoration. Depending upon resources available the following options are suggested to further the natural values of the site and enhance community awareness and education:

- Installation of **fauna nest boxes** for bats and larger forest birds such as owls. Restoration efforts have greatly increased native vegetation cover but habitat resources such as tree hollows may take centuries to develop. Artificial nest boxes can provide a suitable interim substitute.

- Plantings of additional **koala feed trees** where appropriate. Provision of Koala habitat should be considered in the context of the overall Koala Management Strategy for the Ballina Shire.
- **Threatened flora transplanting**. The site provides a well protected and established rainforest habitat that would be suitable for the establishment of plantings of threatened and significant flora species known from the locality to increase genetic diversity and range for these species.
- Install **educational signage** relating to the Big Scrub and which highlights the success of restoration works undertaken. The site has become one of the regions most easily and commonly visited examples of a Big Scrub remnant and restoration area. This provides an opportunity to provide signage to educate visitors on the values of the Big Scrub and rainforest ecosystems as well as the principles of ecological restoration.
- **Educational field days** – for school groups, Landcare groups, TAFE students to demonstrate a successful rainforest restoration project.

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Project	Author & Date	Source	Figure 3
2211 Killen Falls Public Reserve VMP	MF April 2023	Nearmaps	Killen Falls VMP area

6 VEGETATION MANAGEMENT ISSUES & GUIDELINES

6.1 Introduction

This section provides details on specific management issues which are of relevance to the site or specific on-ground works and the success of such works.

6.2 Informal tracks

Visitor management including fencing, the planting of *Lomandra longifolia* along sections of the track edge and the installation of signs asking walkers to stay on the path, have helped reduce the formation of informal tracks. Signs of two informal tracks are still evident in the Subject site and their locations are shown in **FIGURE 4.** Additional planting of *Lomandra longifolia* in these areas may help deter people from climbing the fence and accessing these areas.

Fencing and signage installed at location of an informal track

6.3 Privacy screening

Planting of a privacy screen has been undertaken adjacent to the residential property at 20 Killen Falls Drive which is located near the shared zone access way (refer to **FIGURE 4**). This was recommended in the PoM (Mike Svikis Planning 2017). Plantings predominately consist of Lomandra with scattered trees such as Macaranga, Foambark, Bleeding heart, Lilly pilly, Ivory curl, Sandpaper fig and Pink-flowered doughwood. Plantings should be maintained by the bush regeneration contractor and any failed plantings should be replaced to maintain the developing visual screen.

Privacy screen plantings adjacent to shared access

FIGURE 4: LOCATION OF INFORMAL TRACKS (Adapted from Mike Svikis Planning 2017)

6.4 Erosion and flooding

The Subject site is located along Emigrant Creek which can be subject to flooding during peak rainfall events, particularly when the dam is full. Erosion of the creek edge is primarily occurring downstream of the depositional point bar, on the outer bank of the creek meander. Downstream of here and below the falls the creek edge is composed of rock and not subject to significant erosion issues. Planting of *Lomandra longifolia* and suitable riparian species as discussed in Section 5.3 will assist with reducing erosion in this area.

Flood debris was observed along some parts of the creek bank, up to 2m in height above the top of the bank. No significant damage to vegetation was noted despite the intensity of the flood event. Aquatic weeds from the Emigrant Creek dam, such as Parrots feather, were noted in the flood debris along the creek edge. Adaptive management actions may be required after flooding events to assess damage to the site and where necessary remove larger logs etc from plantings and ensure aquatic weeds do not establish.

Flood debris caught up on riparian vegetation along the creek edge

6.5 Guidelines for working around threatened species

Those undertaking works in areas where threatened species occur or within an EEC require a Section 132C licence (application for a scientific licence for the purpose of bush regeneration) under the National Parks and Wildlife Act 1974 (NPW Act). A checklist for bush regeneration activities in the habitat of threatened species, endangered populations and EECs has been prepared by the NPWS Northern Directorate and is provided in **APPENDIX B**. This checklist outlines specific methodology to be employed around threatened species such as buffer distances and the gradual removal of weeds which provide habitat for threatened fauna. It also stipulates that all workers carrying out bush regeneration works will be supervised by a trained and experienced co-ordinator with recognised certification or a minimum 2 years experience.

All volunteers are to be briefed on threatened flora species prior to undertaking any works across the Subject site. This is to be the responsibility of the Landcare supervisor.

The identification of any additional threatened species within the Subject site is to be reported to BSC's Environmental Scientist (Flora and Fauna). A sample may need to be sent to the NSW Herbarium for positive identification. Any new sightings are to be added to BSC's database.

6.6 Guidelines for chemical usage around waterways

Given the proximity of the site to Emigrant Creek and the use of the site for swimming the following is recommended:

- Procedures are to be in place to minimise potential for spillage of chemicals and any spills are to be dealt with immediately.
- All herbicides to be used should be registered for use in and around waterways. All herbicide use should be done in accordance with manufacturer's guidelines and should be undertaken by appropriately qualified personnel. Roundup Bioactive™ and Weedmaster 360™ are products with improved surfactants, making them safer to use near waterways.
- Spraying of herbicides should not be undertaken within 6 hours of rainfall and where there is likelihood of rain within 24 hours.

6.7 Best practice guidelines and other requirements

The following requirements are to be adhered to in all management zones:

- All weed control and planting works are to be undertaken by suitably qualified and/or experienced Bush regenerators and/or under the supervision of trained and experienced landcare personnel.
- Bush regenerators are to follow best practice guidelines as detailed in **APPENDIX C.**
- Bush regenerators are to complete Daily record sheets. The BSC Bush Regeneration and Herbicide Record Sheet is included in **APPENDIX D.**
- Any appointed nursery contractors for supply of plantings are to follow hygiene protocols in order to reduce the potential for pathogens, bacteria, pests and weeds being inadvertently introduced to the site. In particular, nurserys should ensure no plants showing signs of Myrtle rust are delivered to the site.
- All monitoring should be undertaken by a suitably qualified ecologist (refer to Section 8).
- Weed management is to be in accordance with the Weed Control Guidelines (**APPENDIX E**).
- Any planting is to be undertaken in accordance with the Guide to Planting (**APPENDIX F**).
- Any planting works to be undertaken within the VMP project area should utilise seedlings sourced from local provenance seed, cuttings or other propagation materials. For the purposes of this plan, local provenance is considered to be satisfied by the use of seedlings sourced from within the Emigrant Creek catchment area.

7 INFRASTRUCTURE MANAGEMENT AND VISITOR FACILITIES

7.1 Introduction

This section discusses and makes recommendations on the management and maintenance of council infrastructure within the VMP project area as well as existing visitor facilities and services. The location of infrastructure and visitor facilities discussed is provided in **FIGURE 5**.

7.2 Walking track and lookout platform

The walking track to the base of the falls consists of three main sections.

1. Carpark to lookout platform: Track has been upgraded since the PoM (Mike Svikis Planning 2017) with crushed sunset shale. Replenishment of material is required in some areas where pooling is occurring during rainfall events.

Replenishment of crushed shale is required along some sections of the track to prevent pooling during rainfall events

2. Lookout platform to creek: Beyond the lookout the track has not been upgraded with the exception of a steel handrail which has been installed in the steep section down to the creek edge. Several tree roots are exposed along the first section of track and represent a trip hazard. Installation of the handrail has assisted with concentrating human traffic and preventing encroachment into the adjacent vegetated areas. However, erosion is still an issue in this area which is quite steep, rocky and slippery when wet.

Steel handrail recently installed on steep section of path down to creek

3. Emigrant Creek to base of falls: no formal track occurs in this section and visitors are required to 'rock hop' and climb over large fallen timber along the creek edge to the base of the falls.
4. The lookout platform is in good condition having been installed in 2015. However, at the time of the site survey (during rain) extensive pooling of the platform surface was occurring. The gap between the boards on the platform are clogged from the crushed shale used on the walking track which is inhibiting the runoff of water. This should be remedied to prevent pooling in the future

Pooling on the lookout platform

7.3 Fencing

Post and wire fencing has been installed along the track edges from the carpark to the lookout as recommended in the PoM (Mike Svikis Planning 2017) to limit the formation of informal tracks to the creek. At the time of the site inspection, several sections of wire along the main track were

missing or loose. Replacement of the fencing wire and maintenance should be undertaken on a regular basis, particularly during peak visitor times over the warmer months.

7.4 Signage

Signage relating to visitor infrastructure and safety as recommended in the PoM (Mike Svikis Planning 2017) has been installed at the site and is considered adequate for these purposes. An opportunity exists to install educational signage to increase public awareness around the former Big Scrub and the importance of rainforest ecosystems. The site could be highlighted as a successful restoration project with before and after photos on display to emphasise the transformation. The high profile nature of the site, particularly with young people, as well as the unique natural values present and the history of the site make it an ideal location to showcase the rainforest restoration process.

7.5 Toilets, seating and rubbish

A permanent toilet was installed at the site in recent years due to increased visitor numbers and concerns over water quality. One bench seat is located near the carpark as well as three rubbish bins. Additional seating and/or picnic tables could be installed in the open grassy area near the carpark. Replacement of one landfill bin with a recycling bin should also be considered by BSC.

7.6 Parking

A nine-space landscaped car park as well as a car and bus turn-around area has been constructed at the site. In recent years, parking and traffic management have become major issues at the site due to the increased popularity and limited space for parking. Extensive information on parking issues and car numbers are outlined in the PoM (Mike Svikis Planning 2017). Formalisation of parking along Killen Falls Drive may be required to accommodate extra cars during the warmer months.

The placement of rocks along the edge of the shared zone has been undertaken to prevent cars from parking in this area which was creating a safety issue for pedestrians. The installation of speed cushions in the shared zone, as recommended in the PoM (Mike Svikis Planning 2017), has not been undertaken to date.

7.7 Dogs

In previous years dogs were allowed access to the site but were required to remain on a lead. The PoM (Mike Svikis Planning 2017) recommended that dogs should not be permitted on the subject land, particularly as some owners were allowing dogs to swim in the pool and wander off lead. Signs have now been installed at the Subject site to inform visitors that dogs are prohibited from the site.

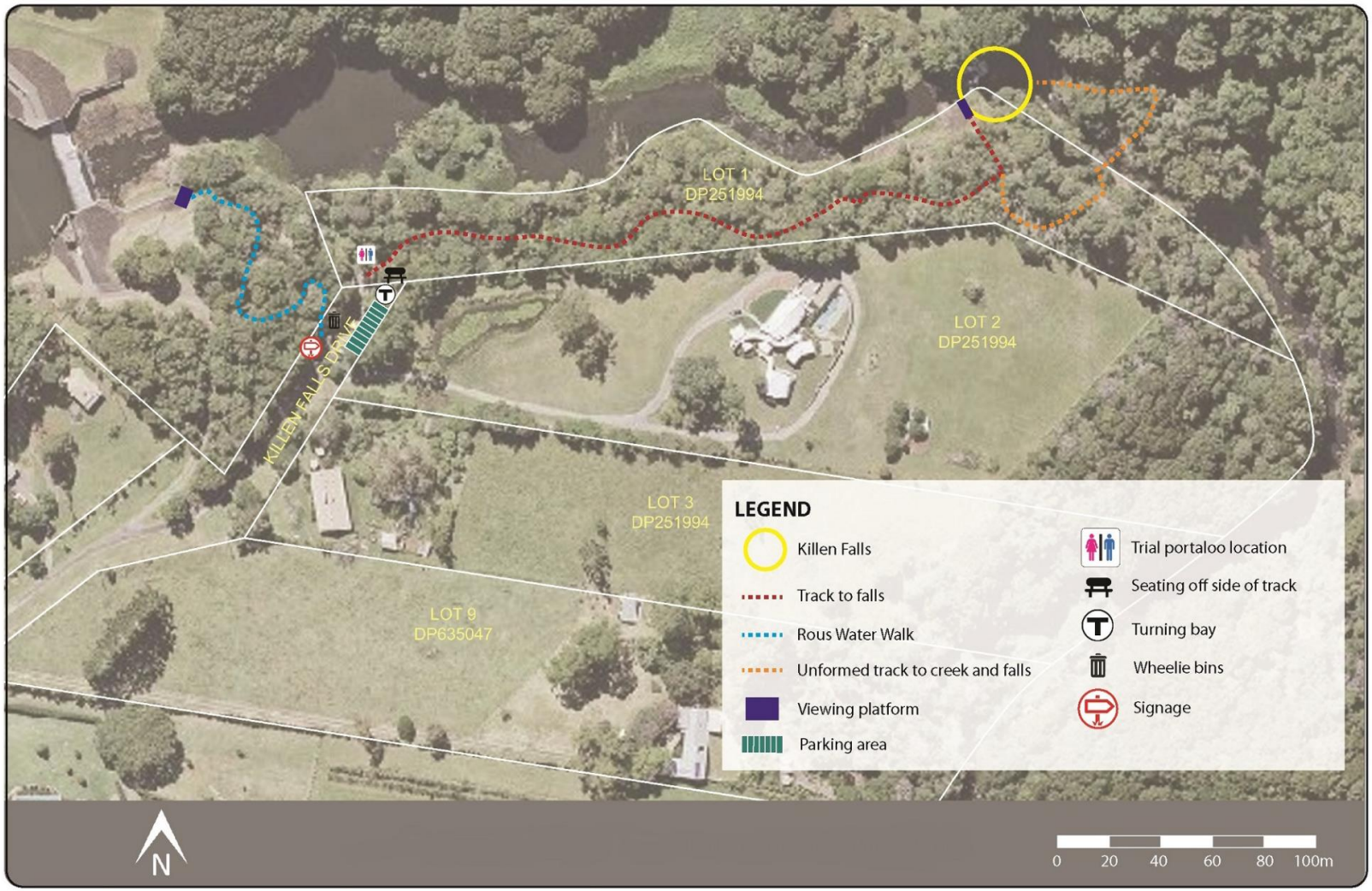

FIGURE 5: INFRASTRUCTURE ON THE SUBJECT SITE (Adapted from Mike Svikis Planning 2017)

8 MONITORING AND RECORD KEEPING

8.1 Introduction

Monitoring of weed control works as well as daily record taking of works and chemical use should be undertaken as part of any vegetation management works undertaken within the Subject site.

8.2 Monitoring

Monitoring/progress reports are often required as part of grant applications to ensure allocated funds are being spent as per the grant application and works are on schedule. All monitoring, should include preparation of a monitoring report which is to be submitted to BSC and should generally include the following:

- Photographs from establish photopoints and/or any quantitative data collected from established quadrats/transects;
- Description of works performed since last monitoring event and map showing areas worked;
- Assessment of weed presence in worked areas;
- Assessment of natural recruitment and identification of areas requiring planting where this is lacking;
- Assessment of health and growth of any planted specimens, including details on losses and possible reasons for losses greater than 10%;
- Discussion on the effective of weed control works and any possible areas for improvement;
- Discussion of any management problems or unforeseen issues which have arisen (eg. erosion/storm damage/dumping of green waste/vandalism/fire etc.);
- Identification of opportunities for improvement/additional works/volunteer involvement etc;

Monitoring is typically undertaken for a period of 5 years (or the length of the grant funding) with biannual monitoring events for new sites and then annual monitoring events for subsequent years.

8.3 Record keeping

Both volunteers and contractors are required to complete a Daily Record Sheet (DRS) for each day of works undertaken within the Subject site. A copy of the BSC approved DRS is provided in **APPENDIX D**. The form includes details on the following:

- Names of personnel and hours worked;
- Weather conditions;
- Activities undertaken;
- Areas worked (and illustrated on a map);
- Herbicide usage and methods of application;
- Precautions taken to protect threatened species;
- Note of any incidents/near misses/accidents; and
- General observations.

Completed forms should be submitted to BSC on a regular basis.

9 SUMMARY OF RECOMMENDED ACTIONS

Actions/Recommendations		Responsibility
Restoration Actions		
Upper Slope	• <u>Weed control</u> o continue ongoing weed maintenance by spot spraying exotic seedlings through areas of established rainforest plantings. o control mature exotics along the cliff top including Large-leaf privet and Lantana. Given the proximity of these plants to the cliff edge appropriate training and equipment may be required. Bush regeneration contractor to assess options in consultation with BSC. o spray exotic grasses around plantings and natural regeneration/native groundcovers. • <u>Planting</u> o continue to maintain more recent plantings in the canopy gap. Consider supplementary plantings to replace failed plants and where the density of plantings is lacking. The exposed north facing nature of this area and likely shallow soils will limit the success of some species. Utilise more hardy species such as Figs, Sally wattle, Brush box, Macaranga, Brown kurrajong, Hoop pine, Lilly pillys and Hard quandong. Water crystals and a suitable native fertiliser may also assist establishment of plants in this area. o Consider additional plantings of understorey and midstorey species to increase diversity in these stratums and consolidate any gaps. o Plant additional *Lomandra longifolia* where informal tracks occur to deter access. Strategic placement of fallen branches may also assist to prevent the formation of informal tracks. • <u>Maintenance/other</u> o Trim overhanging branches along the access track as required. o Remove any rubbish from vegetated areas and dispose of in the bins provided.	Bush regeneration contractor
Riparian creek bank	• <u>Weed control</u> o strategically control exotic grasses along creek edge, focus around native saplings/groundcovers and plantings, and slowly expand outwards to reduce erosion potential. Avoid spray drift and hand weed where appropriate. Only use herbicides suitable for use near waterways. o Scrape back dead biomass of Molasses grass to promote seedling germination. o Treat camphor saplings and other woody weeds once plantings have established and the risk of erosion is reduced. o monitor for introduced weeds (including aquatic weeds) following flood events • <u>Planting</u> o plant additional creekline species such as Creek sandpaper fig (*Ficus coronata*), Water gum (*Tristaniopsis laurina*), Weeping lilly pilly (*Waterhousea floribunda*) and Creek lilly pilly (*Acmena smithii*) as well as *Lomandra longifolia* and other sedge/rushes in exposed areas and where erosion is occurring to stabilise the creek bank. Plantings should be undertaken outside of the flood season. o Consider transplanting ferns such as Gristle fern and rasp fern from nearby areas to reduce exotic groundcovers once canopy is established and the right microclimate is present.	Bush regeneration contractor

Actions/Recommendations		Responsibility
	• Maintenance/other o assess any damage to plantings/vegetation following flood events, replace as required. Remove any larger branches and flood debris inhibiting native saplings.	
Depositional point bar	• Weed Control o Treat mature woody weeds and spray extensive patches of privet and senna seedlings. Focus primarily around native plantings and where native regeneration is evident. o Spray exotic grass/herbs in a strategic manner, focusing around native ferns and areas of Swamp ricegrass and working outwards. Hand weed around native groundcovers where required. o monitor for introduced weeds (including aquatic weeds) following flood events • Planting o maintain existing plantings as required o undertake supplementary plantings of suitable creekline species (refer to section above) in gaps and where natural regeneration is lacking. • Maintenance/other o A large dead tree has fallen over in the area. It may be necessary to trim some of the branches to gain access for weed control and allow native regeneration to occur. o assess any damage to plantings/vegetation following flood events, replace as required. Remove any larger branches and flood debris inhibiting native saplings.	Bush regeneration contractor
Additional opportunities	• Installation of fauna nest boxes, particularly bat boxes • Plantings of additional koala feed trees where appropriate • Threatened flora transplanting • Install educational signs - relating to the Big Scrub and which highlight the success of restoration works undertaken • Educational field days – for school groups, Landcare groups, TAFE students to demonstrate a successful rainforest restoration project	BSC/ Bush regeneration contractor/ Landcare
Vegetation Management Recommendations		
Informal tracks	• Maintain fencing • Additional planting of *Lomandra longifolia* in these areas may help deter people from climbing the fence and accessing these areas.	BSC and Bush regeneration contractor
Privacy screening	• Plantings should be maintained by the bush regeneration contractor and any failed plantings should be replaced.	Bush regeneration contractor
Erosion and flooding	• Planting of *Lomandra longifolia* and suitable riparian species as discussed in Section 5.3 will assist with reducing erosion in this area. • Adaptive management actions may be required after flooding events to assess damage to the site and where necessary remove larger logs etc from plantings and ensure aquatic weeds do not establish.	BSC and Bush regeneration contractor
Infrastructure Management Recommendations		
Walking track	• Additional crushed shale is required along some sections of the track to prevent pooling during rainfall events	BSC

Actions/Recommendations		Responsibility
and lookout platform	• Clearing of the gaps between the boards on the lookout platform is required to reduce pooling and allow run-off during rain events.	
Fencing	• Replacement of the fencing wire and maintenance should be undertaken on a regular basis, particularly during peak visitor times over the warmer months.	BSC
Signage	• An opportunity exists to install educational signage to increase public awareness around the former Big Scrub and the importance of rainforest ecosystems.	BSC
Toilet, seating and rubbish	• Additional seating and/or picnic tables could be installed in the open grassy area near the carpark. • Replacement of one landfill bin with a recycling bin should also be considered by BSC.	BSC
Parking	• Formalisation of parking along Killen Falls Drive is recommended to accommodate extra cars during the warmer months.	BSC
Dogs	• Dogs should continue to be excluded from the site.	BSC
Monitoring and record keeping	• Monitoring of weed control works as well as daily record taking of works and chemical use should be undertaken as part of any vegetation management works undertaken within the Subject site.	Bush regeneration contractor

10 REFERENCES

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APPENDIX A

NATIVE FLORA LIST

The following table lists the native flora species recorded within the Subject site (Killen Falls Public Reserve) in the 2004 survey undertaken by Bower Bush Works. Any additional species recorded during the recent survey in July 2022 by Blackwood Ecology have also been added to the list.

Species highlighted in **bold** are listed as threatened under the BC Act and/or the EPBC Act

Family	Botanical Name	Common Name	2004	2022
Ferns and Fern Allies				
Adiantaceae	*Adiantum diaphanum*	Filmy Maidenhair	X	
	Adiantum hispidulum var. *hispidulum*	Rough Maidenhair	X	
Aspleniaceae	*Asplenium australasicum*	Bird's nest fern	X	
Blechnaceae	*Blechnum cartilagineum*	Gristle fern	X	
	Doodia caudata		X	
Cyatheaceae	*Cyathea cooperi*	Straw tree fern	X	
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh ground fern	X	
	Pteridium esculentum	Bracken fern	X	
Dicksoniaceae	*Calochlaena dubia*	Soft bracken	X	
Dryopteridaceae	*Lastreopsis marginans*	Bordered shield fern	X	
Polypodiaceae	*Platycerium bifurcatum*	Elkhorn fern	X	
	Pyrrosia rupestris	Rock felt fern	X	
Thelypteridaceae	*Christella dentata*	Binung	X	
Gymnosperms				
Araucariaceae	*Araucaria cunninghamii*	Hoop pine		X
Monocotyledons				
Araceae	*Alocasia brisbanensis*	Cunjevoi		X
	Pothos longipes	Pothos vine	X	
Arecaceae	*Archontophoenix cunninghamiana*	Bangalow palm		X
Asteliaceae	*Cordyline rubra*	Red fruited palm lily	X	
Commelinaceae	*Commelina cyanea*	Native commelina	X	
Cyperaceae	*Carex appressa*	Sedge	X	
	Carex polyantha	Tassie sedge	X	
	Cyperus enervis	Soft sedge	X	
	Schoenoplectus validus	Club rush	X	
Dioscoraceae	*Dioscorea transversa*	Native yam	X	
Juncaceae	*Juncus usitatus*	Common rush	X	
Lomandraceae	*Lomandra longifolia*	Spiny-headed matrush		X
Phormiaceae	*Dianella caerulea*	Blue flax lily		X
Poaceae	*Cynodon dactylon*	Couch grass	X	
	Imperata cylindrica	Blady grass	X	
	Leersia hexandra	Swamp ricegrass	X	
	Oplismenus aemulus	Basket grass	X	
	Oplismenus imbecillis	Basket grass	X	
	Ottochloa gracillima	Pademelon grass		X
Ripogonaceae	*Ripogonum album*	White supplejack	X	
	Ripogonum elseyanum	Hairy supplejack	X	
Zingiberaceae	*Alpinia caerulea*	Native ginger	X	
Dicotyledons				
Acanthaceae	*Pseuderanthemum variabile*	Pastel flower	X	
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed	X	
Apiaceae	*Centella asiatica*	Centella	X	

Family	Botanical Name	Common Name	2004	2022
Apocynaceae	*Melodinus australis*	Southern melodinus	X	
	Tabernaemontana pandacaqui	Banana bush	X	
Araliaceae	*Polyscias murrayi*	Pencil cedar		X
Asclepiadaceae	*Marsdenia rostrata*	Milk vine	X	
Asteraceae	*Eclipta prostrata*	White eclipta	X	
Bignoniaceae	*Pandorea jasminoides*	Bower vine	X	
Caesalpinioideae	*Caesalpinia scortechinii*	Large prickle vine	X	
Caryophyllaceae	*Drymaria* subsp. *diandra*	Tropical chickweed	X	
Celastraceae	*Elaeodendron australe var. australe*	Red-fruited olive plum	X	
	Hippocratea barbata	Knot vine	X	
Davidsoniaceae	***Davidsonia jerseyana***	**Davidson's plum**		**X**
Dilleniaceae	*Hibbertia scandens*	Climbing guinea flower	X	
Elaeocarpaceae	*Elaeocarpus grandis*	Blue quandong		X
	Elaeocarpus obovatus	Hard quandong	X	
	Sloanea australis	Maiden's blush	X	
	Sloanea woollsii	Yellow carabeen	X	
Euphorbiaceae	*Breynia oblongifolia*	Coffee bush	X	
	Glochidion ferdinandi var. *ferdinandi*	Cheese tree	X	
	Homalanthus populifolius	Native bleeding heart	X	
	Macaranga tanarius	Macaranga		X
	Mallotus philippensis	Red kamala	X	
Eupomatiaceae	*Eupomatia laurina*	Bolwarra	X	
Fabaceae	*Austrosteenisia glabristyla*	Giant blood vine	X	
	Caesalpinia scortechnii	Large prickle-vine		X
	Callerya megasperma	Native wistaria	X	
	Desmodium acanthocladum	**Thorny pea**		**X**
Lamiaceae	*Plectranthus* sp.		X	
Lauraceae	*Cryptocarya laevigata*	Red-fruited laurel		X
	Cryptocarya obovata	Pepperberry	X	
	Cryptocarya triplinervis var *triplinervis*	Three-veined Cryptocarya		X
	Litsea australis	Brown bolly gum	X	
	Neolitsea australiensis	Green bolly gum	X	
	Neolitsea dealbata	White bolly gum	X	
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling lily	X	
Meliaceae	*Dysoxylum mollissimum*	Red bean	X	
	Synoum glandulosum subsp. *glandulosum*	Scentless rosewood	X	
Menispermaceae	*Carronia multisepala*	Carronia	X	
	Tinospora tinosporoides	**Arrow-head vine**	**X**	
Menyanthaceae	*Nymphoides indica*	Water snowflake	X	
Mimosaceae	*Acacia fimbriata*	Fimbriate wattle		X
	Acacia melanoxylon	Blackwood wattle	X	
Monimiaceae	*Wilkiea huegeliana*	Veiny wilkiea	X	
	Wilkiea macrophylla	Large-leaved wilkiea	X	
Moraceae	*Ficus coronata*	Creek sandpaper fig	X	
	Maclura cochinchinensis	Cockspur	X	
	Trophis scandens	Burny vine	X	
Myrsinaceae	*Myrsine variabilis*	Muttonwood		X

Family	Botanical Name	Common Name	2004	2022
Myrtaceae	*Acmena smithii*	Creek lilly pilly	X	
	Corymbia intermedia	Pink bloodwood		X
	Eucalyptus microcorys	Tallowwood		X
	Eucalyptus tereticornis	Forest red gum		X
	Lophostemon confertus	Brushbox	X	
	Rhodamnia rubescens	**Scrub turpentine**	X	
	Rhodomyrtus psidiodes	**Native guava**	X	
	Syzygium australe	Brush cherry	X	
	Syzygium luehmannii	Riberry	X	
	Syzygium moorei	**Durobby**		**X**
	Syzygium oleosum	Blue lilly pilly	X	
	Tristaniopsis laurina	Water gum	X	
Oleaceae	*Notelaea johnsonii*	Veinless Mock-olive	X	
Onagraceae	*Ludwigia peploides*	Water primrose	X	
	Ludwigia octovalvis	Willow primrose	X	
Peperomiaceae	*Peperomia blanda* var. *floribunda*		X	
Pittosporaceae	*Hymenosporum flavum*	Native frangipani		X
	Pittosporum revolutum	Hairy pittosporum	X	
	Pittosporum undulatum	Sweet pittosporum	X	
Polygonaceae	*Persicaria decipiens*	Slender knotweed	X	
	Persicaria strigosa	Smartweed	X	
Potamogetonaceae	*Potamogeton octandrus*	Pondweed	X	
Proteaceae	*Buckinghamia celsissima**	Ivory curl tree		X
Rhamnaceae	*Alphitonia excelsa*	Red ash	X	
Rosaceae	*Rubus rosifolius*	Native raspberry, rose leaf bramble	X	
Rubiaceae	*Morinda jasminoides*	Morinda	X	
Rutaceae	*Flindersia australis*	Teak	X	
	Flindersia bennettiana	Bennett's ash	X	
	Flindersia schottiana	Cudgerie	X	
	Melicope elleryana	Pink-flowered doughwood		X
Sapindaceae	*Arytera divaricata*	Coogera	X	
	Castanospora alphandii	Brown tamarind		X
	Cupaniopsis anacardioides	Tuckeroo		X
	Guioa semiglauca	Guioa	X	
	Jagera pseudorhus	Foambark	X	
	Mischocarpus pyriformis	Yellow pear fruit	X	
	Sarcopteryx stipitata	Steelwood	X	
Sapotaceae	*Planchonella australis*	Black apple	X	
Simaroubaceae	Quassia sp. 'Mt Nardi'	Quassia	X	
Sterculiaceae	*Commersonia bartramia*	Brown kurrajong	X	
	Sterculia quadrifida	Red-fruited kurrajong		X
Thymelaeaceae	*Wikstroemia indica*	Wikstromeia	X	
Ulmaceae	*Trema tomentosa* var. *aspera*	Native peach	X	
Urticaceae	*Elatostema reticulatum*	Rainforest spinach	X	
Verbenaceae	*Clerodendrum floribundum*	Smooth clerodendrum		X
Vitaceae	*Cissus antarctica*	Water vine	X	

APPENDIX B

CHECKLIST FOR BUSH REGENERATION ACTIVITIES IN THE HABITAT OF THREATENED SPECIES, ENDANGERED POPULATIONS AND EECS

Northern Directorate

Checklist For Bush Regeneration Activities In The Habitat Of Threatened Species, Endangered Populations And Endangered Ecological Communities

Background

Threatened species, endangered populations and endangered ecological communities are protected in NSW under the *Threatened Species Conservation Act* 1995 (TSC Act).

It is an offence to "harm" or "pick" threatened species, populations or ecological communities, or cause "damage" to critical habitat or the habitat of threatened species, populations or ecological communities[1].

"Harm" refers to native fauna, and is defined as to:
hunt, shoot, poison, net, snare, spear, pursue, capture, trap, injure, or kill.
"Pick" refers to native flora, and is defined as to:
gather, pluck, cut, pull up, destroy, poison, take, dig up, remove or injure the plant or any part of the plant.
"Damage" is not defined but the common dictionary definition would apply.

It is a defence to a prosecution if the action was:

- authorised in accordance with a Section 120 licence or a Section 132C licence under the *National Parks and Wildlife Act* or a licence granted under Section 91 of the TSC Act (flora and ecological communities);
- authorised in accordance with a development consent under the *Environmental Planning & Assessment Act 1979;* or
- authorised by or under the Rural Fires Act 1997, or the State Emergency and Rescue Management Act 1989.

Bush regeneration activities

Areas where bush regeneration is undertaken are often the habitat of threatened species or may be an endangered ecological community (e.g. Lowland Rainforest on Floodplain). It is understood that the intention of bush regeneration activities is to have a positive impact, however, there is a chance that these activities may adversely impact on threatened species, populations or ecological communities. This may occur where:

- a species (flora or fauna) is not known to exist on the site (e.g. cryptic species such as orchids);
- a species may be accidentally harmed or picked (e.g. by spray drift or accidental cutting).
- a species may be misidentified and is thought to be either an exotic or common native species and therefore may be removed or damaged;
- the requirements of the species, including habitat structure and components, may be temporarily adversely impacted (e.g. maintaining microclimatic conditions, connecting or sheltering habitat for fauna);

Licensing

Those undertaking bush regeneration activities may consider applying for a Section 132C licence under the NPW Act.

A Section 132C licence is issued where the NPWS considers that the proposed work is for conservation purposes.

Licence Conditions

Generally, licences are issued on an annual basis; however, shorter or longer term licences are also issued where appropriate.

The NPWS may prohibit, condition, or limit bush regeneration works in some areas where it may affect research plots. Other licence conditions may be applied after consideration of population estimates, age structure, viability and health of the population or individuals.

The Bush Regeneration Checklist

The intention of the checklist is to ensure that bush regeneration activities will **not** have a significant impact on threatened species, populations or ecological communities and their habitats. Applicants should consider attaching this standard checklist to any Section 132C licence application to assist the NPWS in assessing the significance of the proposed activity. The NPWS will assume the applicant is prepared to adhere to the guidelines in the checklist where they form part of the licence application. Detail of any proposed work additional or contrary to that described in the checklist must be provided. The NPWS then assesses the likely significance of the impact of the proposal[2] using the information provided in the licence application.

For the purposes of the checklist, bush regeneration is considered as all types of habitat restoration and may include such activities as manual weed removal, herbicide use, temporary damage to, or removal of native plants, planting, track work or maintenance and habitat removal or modification.

1. Threatened Species are listed under two schedules on the *Threatened Species Conservation Act*: Schedule 1 includes Endangered Species, Endangered Populations and Endangered Ecological Communities and Schedule 2 includes Vulnerable species. The *Threatened Species Conservation Act* Schedules are maintained by the NSW Scientific Committee. The most recent versions of these schedules may be obtained on the NPWS Web Site: www.nationalparks.nsw.gov.au.

2. A Species Impact Statement must be prepared where a proposed activity is assessed as likely to have a significant impact on threatened species, populations or ecological communities.

3. The Wildlife Atlas is the NPWS statewide flora and fauna database.

NPWS Checklist For Bush Regeneration Activities:

Please Note:
1) The checklist is provided to facilitate licence applications and to draw attention to NPWS issues of concern.
2) There is no requirement to use the checklist when applying for a licence. You may alternatively choose to provide details of your project and an explanation of how you will ensure there will not be a significant impact on threatened species, their habitat or on endangered ecological communities.
3) If you provide a negative answer using the checklist this does not necessarily mean your application will be unsuccessful. You will however need to provide a satisfactory explanation as to why you do not wish to comply with the guideline and how you will ensure there is unlikely to be a significant impact on threatened species, their habitat or on endangered ecological communities.
4) You may wish your licence application to cover the collection of Voucher Herbarium Specimens and Plant Material for Identification.

Management Planning:	**yes**	**no**	**more info attached**
The proposed activities will be in accordance with a management plan or site plan (map). *Please attach the plan or relevant sections of the plan or strategy to the licence application.*			
The project has been discussed with the relevant Landcare coordinator. *If not, provide details of any other professional advice you have sought, e.g. from a qualified bush regenerator.*			
A NPWS Wildlife Atlas database search of a 5km radius of the site has been undertaken to identify threatened flora/fauna species known or likely to occur on the site. The Wildlife Atlas is accessible on the NPWS Web Site *www.nationalparks.nsw.gov.au* .			See Tables 1& 2
Prior to commencing any works on site, a permit or permission will be obtained from the relevant landowner(s) or land manager(s).			
Training and supervision:			
All workers carrying out bush regeneration and associated works will be supervised by a trained and experienced co-ordinator who has completed a recognised bush regeneration course (e.g. the Certificate of Bushland Regeneration) or a minimum of 2 years bush regeneration experience. *If 'yes', please provide below the name and qualifications of the co-ordinator.* Name: …… Qualifications/experience:…….			See attached s132c Licence applicatio n
Other members of the group that have bush regeneration training or experience. Name: …… Qualifications/experience: …… Name: …… Qualifications/experience:……. Name: ……		See	attached s132c Licence applicatio n

Qualifications/experience:…… Name: …… Qualifications/experience:…… Name: …… Qualifications/experience:……			
All activities by workers will be regularly checked and approved by the co-ordinator.			
All workers will be informed of any threatened species or endangered ecological communities in the area or which may occur in the area and the potential impacts of activities on these species/communities. *e.g. vines on the edge of a littoral rainforest remnant may protect the remnant from salt-bearing winds.*			
	yes	**no**	**more info attached**
All workers have adequate weed and native plant identification skills. *i.e. all workers can identify and differentiate between weeds and native plants that occur on the site.*			
Workers will be familiar with the identifying features of threatened flora that are known or likely to occur in the project area. Where threatened species known from the area are similar to weed species, the distinguishing features between these will be understood prior to commencing the work.			
Access to sites			
All vehicular access to sites will be restricted to formed roads.			
Unnecessary damage to sites will be avoided. *e.g. avoid working in wet weather to lessen soil compaction.*			
Impacts on flora:			
Prior to any works being undertaken, the presence or absence of threatened flora will be determined by a thorough walking search of the area.			
All threatened flora will be tagged with highly visible flagging tape before work commences. If a number of individuals occur in a clump, that area should be marked out with flagging tape.			
Cutting or damaging of threatened flora will be avoided.			
All plants will be positively identified before they are removed (pulled, cut, poisoned etc).			
Weed removal within 2m of a threatened species will be undertaken by hand.			
To reduce the possibility of introducing plant diseases and weeds the following measures will be applied: 1. Secateurs will be sharp and cleaned with methylated spirits. 2. Footwear will be cleaned of loose soil and preferably treated with bleach between sites.			

Impacts on fauna:			
All workers will be aware of any threatened fauna that are known or likely to occur on site, and the potential impacts of the proposed activities on those species.		See	attached lists for examples
The habitat and refuge potential of weeds and rubbish will be considered prior to removal. *e.g. Lantana can provide cover for threatened fauna such as the Bush-hen. Dead Lantana and poisoned Camphor Laurels should, where possible, be left in situ.*			
Weeds will be removed gradually in areas where an infestation is extensive. *Ideally, 50% of weeds that may provide habitat should be left until native plant species have re-established and provide alternative refuge.*			
Disturbance to, and removal of rocks, logs and other potential refuge sites will be avoided.			
A herbicide registered for use near waterways will be used within 5m of waterways.			
Herbicide spraying will be prohibited within 5 metres from watercourses where threatened frogs are known or likely to occur and within a 10m radius of records of threatened frogs.			
A buffer of 1m along other watercourses will be maintained in which no herbicide will be sprayed.			
Care will be taken to minimise disturbance to shy or cryptic species. *e.g. the Marbled Frogmouth roosts in vine 'curtains'.*			
Care will be taken to minimise disturbance to the leaf litter layer.			
Reconstruction through revegetation: *This section does **not** address propagation or planting of threatened species – this activity would need to be separately addressed.*			
Seed collection or cuttings will be from species, populations or ecological communities other than those listed as threatened (unless licensed by NPWS).			
Prior to collecting any seed or cuttings permission will be obtained from the relevant landholder or manager of the site. *e.g. a licence is required to collect native plants on National Parks estate.*			
	yes	**no**	**more info attached**
Seed collection from any one species will be limited to less than 10% of the available crop at that site.			
Seed collection from any individual plant will be limited to less than 10% of the available crop.			
If your seed source is used by other seed collectors, has consideration been			

given to minimising any cumulative impacts to the source plants? *Some individual plants are known as a reliable seed source and their seed is collected extensively. This may result in – (i) a reduction in genetic diversity); (ii) an impediment to the individual's natural ability to regenerate.*			
When collecting propagation material from a wild population, collection will be random from as many individuals as possible across the population to ensure a representative range of genetic material is collected. Collectors will avoid selection of propagation material on the basis of physical attributes. *e.g. tallest, most attractive, greatest amount of seed or flowers.*			
Plantings will be sourced from stock of local provenance.*			
Propagated plants will be used only at the subject site. *i.e. excess material will only be used at other sites if it meets the provenance criteria.*			
A buffer of 5 metres will be maintained around all threatened plant specimens. Planting will only be undertaken outside this buffer. *This requirement is intended to protect the roots of the threatened plant from damage, introduction of disease or impacts of herbicide.*			
Care will be taken to ensure that mulch does not introduce weeds or impede natural regeneration at the site.			
Care will be taken to ensure that weeds and/or phytopthora are not introduced to a site from any plantings.			
Consideration will be given to the possible impacts of plantings on the ecological requirements of threatened species at the site *e.g. reduced light, competition, etc.*			
Species will be planted within their natural habitat and range. Plantings will be guided by the plants' local habitat preferences. *e.g. the species used for plantings along watercourses should be those that naturally occur in that habitat in your local area.*			
Herbicide use: *A permit from the National Registration Authority for Agricultural and Veterinary Chemicals PO Box E240, Kingston ACT 2604 may be required for herbicide use that is not consistent with conditions specified on the label.*	**Yes**	**No**	
A buffer of 2m will be maintained around all threatened plant specimens. Herbicide use will only be undertaken outside this buffer.			
Herbicide use will cease where there are any signs of threatened species being affected by herbicide. *e.g. browning off, wilting, deformed growth.*			
All herbicide spray operators will be capable of undertaking precise and effective weed control.			
Spray will be directed away from threatened flora.			
Herbicide will only be sprayed in suitable weather conditions when the impact of spray drift (windy) or run-off (wet) on threatened flora is minimised.			
Marker dyes e.g. 'white field marker' will be mixed with herbicide before use. *Marker dye enables the worker to see where the spray is landing.*			

Reporting and data records:			
Any new records of threatened species will be provided within three months to NPWS. These records will be in a format appropriate for entry into the Wildlife Atlas, once identifi cation of a threatened species is confirmed by a recognised authority. *Wildlife Atlas cards available on request.*			

*Local provenance species should be regarded as those species propagated from material that has been collected from a natural wild population as close as possible to a site. For example, within the local catchment – which may be based on a local creek.

Please sign below, keep a copy for your records and attach all original pages of checklist, and any additional information, to your application form.

I, the undersigned, agree that the proposed bush regeneration activities are in accordance with all items checked above, additional information attached and the licence application form.

_____	_____	_____
Name (please print)	Signature	Date

Further reading:

Buchanan, R. (1989) *Bush Regeneration: Recovering Australian Landscapes*. TAFE Student Learning publication, Sydney.

Buchanan, R. (1992) "Site assessment – a vital part of bush regeneration" in *Urban Bushland in Western Sydney*. Seminar Proceedings, Nature Conservation Council of NSW, 1992.

FloraBank (1999) *Guidelines 5: Seed collection from woody plants for local revegetation*. FloraBank, ACT.

FloraBank (1999) *Guidelines 6: Native seed collection methods*. FloraBank, ACT.

FloraBank (2000) *Guideline 10: Seed Collection ranges for revegetation. FloraBank, ACT*

Greening Australia NSW (1999) *Management principles to guide the restoration and rehabilitation of indigenous vegetation*. Greening Australia NSW, Sydney.

Harden, G. (1990-1993; 2002) Flora of NSW, Vols 1-4. Un iversity of NSW Press, Kensington.

Joseph, R. (1999) An integrated, systematic approach to rainforest remnant restoration. In *Rainforest Remnants – A Decade of Growth*. Proceedings of a conference on rainforest regeneration., NSW National Parks and Wildlife Service, Alstonville.

McDonald, T. (1993) Strategic plans for bush regeneration. in *Bushland in Our Cities and Suburbs Part 1: Making Planning Work*. Seminar Proceedings, Nature Conservation Council of NSW, 1993.

McDonald, T. (1994) What are we doing with ecosystem resilience and the restoration of damaged plant communities. in *Bushland in Our Cities and Suburbs Part 2: Making Bush Regeneration Work*. Seminar Proceedings, Nature Conservation Council of NSW, 1994.

NSW National Parks and Wildlife Service. (2000) *Threatened species of the lower north coast of NSW*. NSW NPWS, Coffs Harbour

NSW National Parks and Wildlife Service. (2002*) Threatened species of the upper north coast of NSW*. Vol 1. Fauna. Vol 2. Flora. NSW NPWS, Coffs Harbour

NSW National Parks and Wildlife Service. (2003) *Threatened species of the New England Tablelands and North West Slopes of NSW* . NSW NPWS, Coffs Harbour

Acknowledgements
These guidelines have been developed by Dianne Brown, Annette McKinley and Maria Matthes of the Threatened Species Unit, Conservation Programs and Planning Division, National Parks and Wildlife Service, Northern Directorate, with assistance from the following people: Hank Bower (Byron Shire Council), Sue Bower, Conservation Ecologists Association, Mike Delaney (Envite), R. John Hunter (NPWS), Bob Jarman (Landcare), Rosemary Joseph (NPWS), Lisa King (Envite), Stephanie Lymburner (Australian Association of Bush Regenerators), Tein McDonald (Australian Association of Bush Regenerators), Kate McKenzie (Landcare), Julie Mousley (Landcare), John Ross, Maurizio Rossetto (Royal Botanic Gardens, Sydney), Barbara Stewart, Lisa Wellman (NPWS), Carolyn Woods (Landcare).

APPENDIX C

BEST PRACTICE GUIDELINES FOR BUSH REGENERATION PERSONNEL

- The regenerators are to ensure all tools, equipment and vehicles are to be cleaned free of weed propagules and potential pathogens, such as Phytophthora and Myrtle rust.
- If a tree on the adjacent lands is damaged, immediately assess the situation and apply appropriate level of treatment to facilitate recovery.
- Weeds are to be controlled in accordance with the Weed Control Strategy (Appendix E) or using alternative proven best practice species-specific methods.
- Procedures are to be in place to minimise potential for spillage of chemicals and any spills are to be dealt with immediately. Each vehicle should have a spill response kit.
- All herbicides use should be undertaken in accordance with the manufacturer's specifications and should be undertaken by appropriately qualified personnel. Spraying of herbicides should not be undertaken within 6 hours of rainfall and where there is likelihood of rain within 24 hours.
- Any herbicides to be used near waterways should be registered for use in and around waterways, including Roundup Bioactive™ and Weedmaster 360™. These products have improved surfactants, making them safer to use near waterways.
- Personnel undertaking bush regeneration activities should have completed a minimum Certificate II Conservation and Land Management course and also hold a current ChemCert Accreditation card for the safe application of chemicals.
- The regulatory body for herbicide use is the Australian Pesticides and Veterinary Medicines Authority which administers the registration of Agricultural and Veterinary Chemicals (AGVET) in Australia. Workers should regularly consult the AGVET Permits to check on the latest updates.

APPENDIX D

BALLINA SHIRE COUNCIL DAILY RECORD SHEET

Ballina Shire Council

BUSH REGENERATION RECORD SHEET

ZONE / LOCATION: _____ Date: _____/_____/_____

NAME OF PERSONNEL / VOLUNTEER (S)	time start	time finish	signature	total hrs worked
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
(More space provided on back of form for additional personnel/volunteers)			Daily total hours worked	

Weather Conditions: (temperature, wind speed / direction, prevailing rain, cloud cover etc.)

Work Complete: (area, distance, number of plants, comments on previous works, monitoring / follow up or reminders etc.)

Did any Accidents / Incidents / Near Misses occur etc? (please circle) YES / NO (if YES please attach incident statement or give brief report)

Other Comments or Observations:

HERBICIDE APPLICATION RECORD SHEET (for chemical use only) Permit No. Used: _____

The Pesticides Amendment Regulation as part of the Pesticides Act, 1999 requires responsible personal to complete this form within 24 hours of herbicide application, and then lodged with Ballina Shire Council to be filed for 3 years.

NAME OF CHEMICAL CERTIFICATED WORKER (S)	spray time start	spray time finish	signature
1.			
2.			
3.			

TARGET WEED SPECIES: (insert common or botanic names)

_____

_____

Date of Chemical Application: _____/_____/_____

_____

_____

HERBICIDE APPLIED: (insert trade or chemical name) _____

_____

CONCENTRATION USED: (enter as ratio e.g. 1:15) _____ OR _____gm/ml per _____litres

\+ _____gm/ml per _____litres (if cocktail)

VOLUME APPLIED (total amount for this session): _____litres

ADDITIONAL CHEMICAL AGENT(S) APPLIED (insert name and application rate): _____

_____

METHOD OF APPLICATION: _____

_____

Location of Work: (Describe area where chemical applied or mark on attached map. Incl. nearest watercourse or lake / pond)

PRECAUTIONS TAKEN TO PROTECT SUSCEPTABLE THREATENED / VULNERABLE SPECIES:

Species Name(s):	Precautions Taken:

Insert Bush Regeneration Site Map Here:

ADDITIONAL PERSONNEL / VOLUNTEER (S)	time start	time finish	signature	total hrs worked
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				

APPENDIX E

WEED CONTROL GUIDELINES

TABLE E1
CONTROL METHODS FOR WEED SPECIES RECORDED WITHIN THE SUBJECT SITE

Species	Control Methods
Camphor laurel	Seedlings: hand-pull or spray (G 1:75 + penetrant); Saplings: Cut, scrape and paint or basal bark (G 1:1.5); Trees: Drill (G 1:2.5)
Crofton weed	Hand-pull and hang to dry or spray G 1:50 + surfactant.
Hairy commelina Wandering jew (Trad)	Spray with (G 1:50 + MM + penetrant). 2-3 applications may be necessary. Rake and compost under black plastic.
Lantana *Lantana camara*	Stems: Cut, scrape & paint (G 1:1.5); bush-hook/slash and spray regrowth with glyphosate (G 1:100); over-spray (G 1:100 + penetrant) thoroughly soaking both foliage and stems or splatter gun (G 1:9 + penetrant)
Small-leaved privet Large-leaved privet	Saplings: cut, scrape and paint or cut and paint (1:1.5); Trees: frill/inject (1:1 or 1:1.5) or cut and paint (undiluted glyphosate) for stems up to 8cm diameter; Seedlings: hand-pull or spray (1.5g metsulfuron methyl per 10L water OR 20mL glyphosate + 1.5g metsulfuron methyl per 10L water + wetting agent if other weeds such as Lantana and Camphor laurel are present)
Mistflower	Hand-pull and hang to dry, or spray (1:100 + penetrant).
Passionfruit vines	Stems: Cut, scrape & paint (G 1:1.5); Regrowth: spray (G 1:75 + MM + penetrant).
Senna (Cassia)	Seedlings: handpull or spot spray (G 1:100 +MM + surfactant) Shrubs: cut, scrape & paint stump, or stem inject (G 1:1.5 + MM)
Silver-leaf desmodium	Hand pull or crown. Spray (G 1:50) + surfactant. Cut, scrape & paint tuberous roots (G 1:1.5). Collect and bag seeds.
Slash pine/Radiata pine/Norfolk pine	Seedlings: hand-pull; Saplings and trees: cut close to ground or trial Frill/Inject (G 1:1.5) ensuring thick bark is penetrated. Ringbark.
Soft herbs /grasses/annuals	Spray (G 1:100).

NOTES

G	Glyphosate
MM	Metsulfuron methyl
(G 1:χ)	Numbers in brackets are glyphosate dilution ratios
MM ratios	Spray application rate of 1.5g per 10L of water; Hand mix application rate 1g/L with glyphosate or 2g/L without glyphosate
penetrant	Pulse is the recommended penetrant
surfactant	Brushwet is the recommended surfactant

Marker dye, such as Envirodye, should always be used when spraying.

Sources

Big Scrub Rainforest Landcare Group (2000) Common Weeds of Northern NSW Rainforests. BSRLG.
Ensbey (2011) NSW Department of Primary Industries, Noxious and Environmental Weed Control Handbook 5th Edition.

Details of weed control methods
(Adapted from www.mullum.com.au/wilsonscreeklandcare/weeds/weeds_techniques.html)

Cut, Scrape and Paint
This is suitable for coppicing and suckering weeds such as Camphor, Bitou bush and Privet, or any weeds which are too large for hand-pulling or have long taproots such as Ochna. This method provides for no soil disturbance and weed eradication is successful.

1. Cut the stem/s 1-2 cm above ground level using either secateurs, loppers, a pruning saw or a chainsaw, depending on the thickness and toughness of the stem.
2. Immediately apply glyphosate™ (generally 1:1 or 1:1.5 or 100%) to the cut surface of the stem or, with medium and large trees, to the outside edges of the cut surface. (Herbicides need to be applied immediately after the cut is made because the ability of the plant to transport fluids ceases as soon as the tissues are severed.)
3. Search through the leaf litter to locate any exposed stem or root surface. Scrape the exposed stem or root surface slightly with a knife until a light green coloured layer is exposed (Do not scrape too deeply.) Apply the herbicide to the scraped sections, either with a brush, injector or spray bottle.
4. Follow up as required.

Scrape and Paint
This is a variation of the cut, scrape and paint technique described above, the difference being the plant is not cut but left intact and scraped. This technique ensures the translocation of the herbicide throughout the entire plant.
1. Scrape several sections of the stem along one side only, in lengths of at least 30 cm. The stem needs to be scraped firmly, exposing the fibres and/or light green coloured layer. Be careful not to sever the stem completely.
2. Each scraped section is immediately painted, prior to scraping the next section, with the recommended diluted glyphosate for the particular weed.

Frill/Inject
Use a small axe to cut into the sapwood at a downward angle. Three rows of cuts are made in a brick pattern around all multi-branches, low to the ground. 1 to 3 cuts are made before immediately injecting the cuts with a glyphosate mix dependent on tree type. The cuts need to be filled slowly to avoid chemical spills. Frilling is easy to use in readily accessible spots. Drilling may be more suitable for hard to get at multi-stems.

Penetrant denotes use of penetrant such as Pulse®. Penetrant facilitates the transfer of the herbicide through the surface tissue and is often used for plants with waxy leaves. Manufacturer's instructions should be followed when using any penetrant.

APPENDIX F
General Guide to Planting

1. STOCK

Only use fully sun hardened plant stock, and not stock direct from a shade house. Tube stock is the best as it is a cost effective plant container size, light in weight and easy to handle. Choose plants that are not root bound, do not have yellowing or discoloured leaves and that have a strong stem. Seedlings should be about 30cm in height.

Seedlings should be ordered from a local nursery 6 months in advance and the need for local provenance emphasised.

The nursery should ensure no plants showing signs of Myrtle rust are delivered to the site.

2. SPACING

Random spacing is the usual planting pattern to obtain a natural effect, rather than lines or grids. Trees are typically planted at 1 to 2m spacings. The positioning of plantings should take into account any existing trees and any natural regeneration occurring in the planting area.

3. PREPARATION OF THE SITE

Remove any grasses and weeds completely at each specific planting location in a 1m diameter circle, either manually or chemically. When the weeds/grass cover have died (after about 3 weeks if spraying) at each location planting can begin. Dig a hole in the centre of the circle 20 cm deeper than the plant container and twice as wide. Tools usually used for digging holes are augers, shovels or mattocks. The soil at the base and sides of the hole should be rough and loose to allow root penetration. Water the plants well before planting to ensure a moist root ball.

4. PLANTING

Place a generous amount of water into the hole before planting (2-4 litres if the soil is dry), as losses are reduced by planting into and providing a moist root zone. Tap the plant out of its container and loosen any pot bound or circular roots. Prune the roots if they are very bound up. Put the plant in the hole with the water and fill in with loose crumbly soil. Firm the plant in well with the feet or hands. This is very important for settling the plant roots in, and to provide a stress free start for each plant.

5. FERTILISING

For specific plant species apply approximately one handful of low-phosphorus or "native" fertiliser, preferably in the form of slow-release pellets. Place the fertiliser on the soil surface following planting, but not too close to the stem.

6. WATER CRYSTALS

The use of water crystals should be employed when necessary, ie: on rocky sites, west facing dry slopes or during periods of drought. Soak water crystals and place a generous handful in the base of the hole prior to planting.

7. MULCH

Individual trees should be mulched. Mulch is basically any material that can cover the bare earth and is essential for water retention and weed suppression.

The usual method of mulching is to lay the mulch material in a 0.5m to 1.0m diameter area around the plant. Take care to mulch right up to the stem, but not too heavily. If a gap is left between the stem and the mulch weeds will grow from the gap in direct competition with the plant. Straw mulch may be used, at a rate of about 8-10 plants per bale. Alternatively native chip mulch obtained from the tree clearing works may be used.

8. TREE GUARDS/FENCING

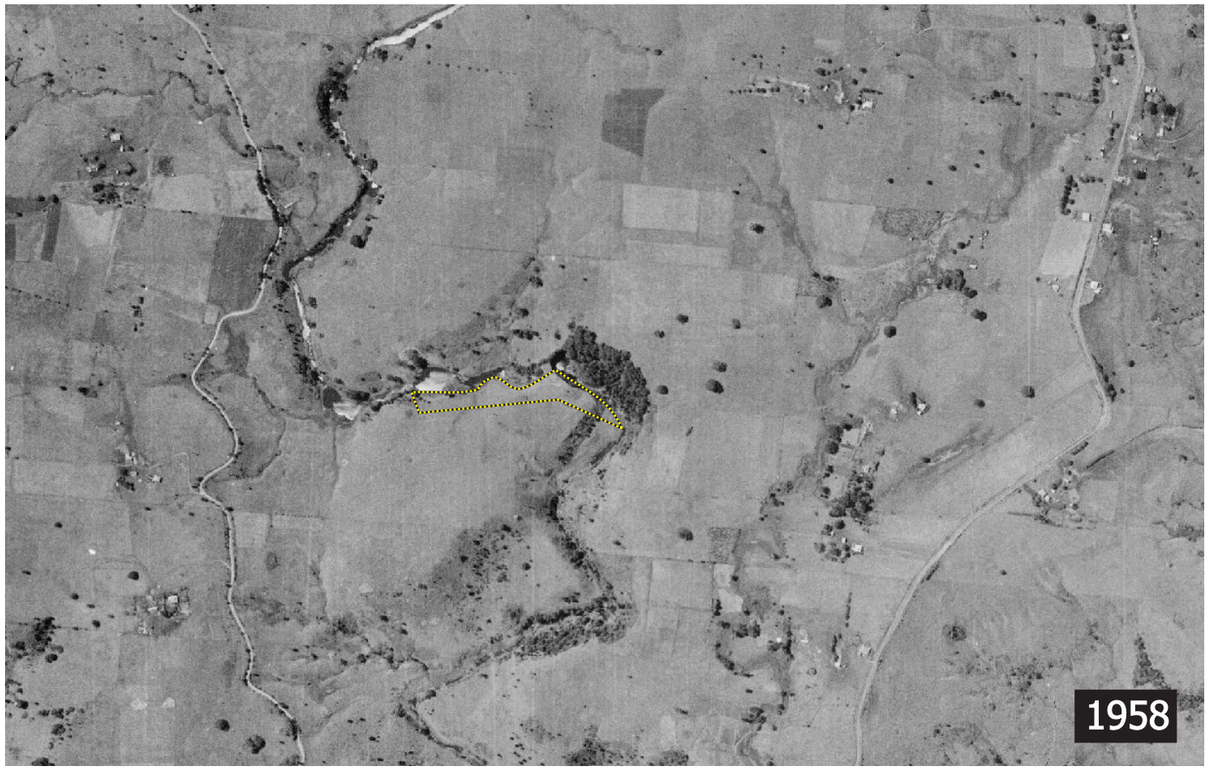
Tree guards or in some cases fencing should be employed where browsing fauna are considered a problem.

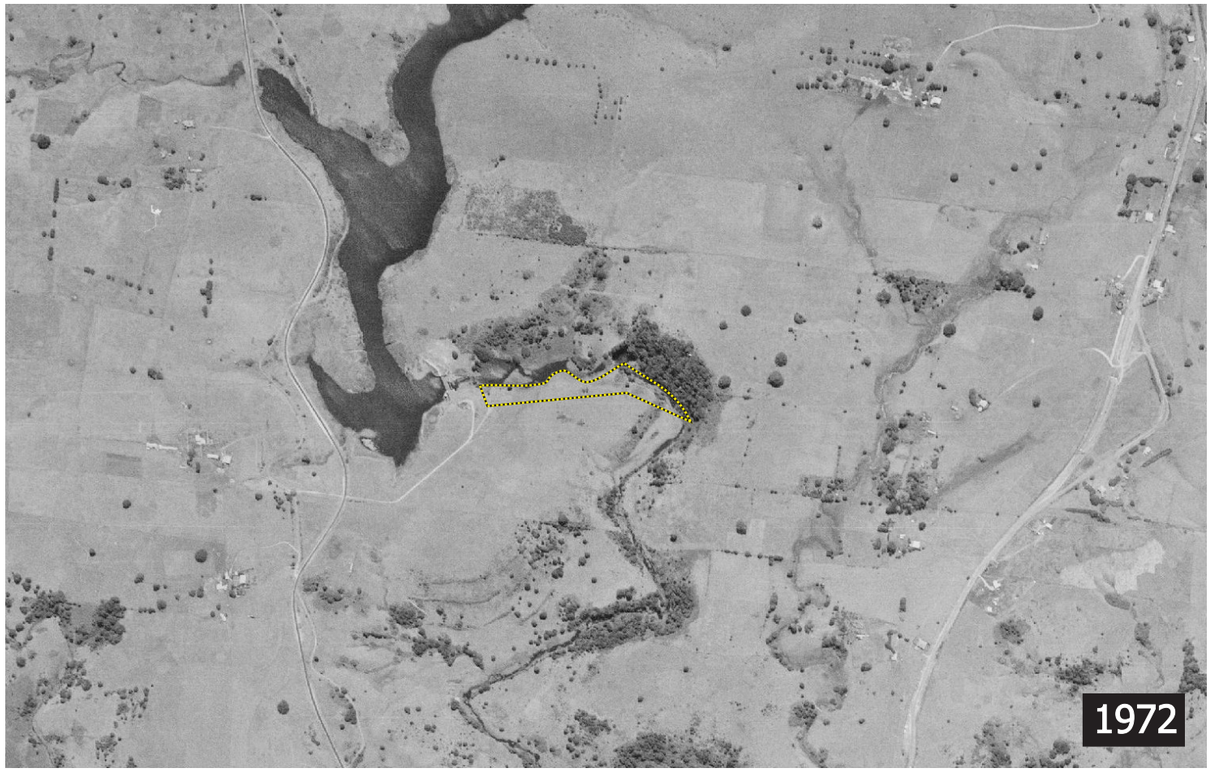
9. WATERING

Plants should be watered every few days for at least a fortnight following planting if there is not sufficient rain. Extra watering may be necessary if dry conditions prevail after planting.

Adapted from Greening Australia (NSW) Inc. North Coast Regional Office. (Undated) **Reforestation: Why and How.** http://www.nor.com.au/environment/greenwork/refinfo.htm.

APPENDIX G
Historical Aerial Photography of the locality





BLACKWOOD ECOLOGICAL SERVICES
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Project	Author & Date	Source	Figure G1
2211 Killen Falls Public Reserve VMP	MF April 2023	NSW Spatial Imagery	Historical Imagery of Killen Falls VMP area