



## Landmark Ecological Services Pty Ltd

(ABN 29 064 548 876, ACN 064 548 876)

PO Box 100, Suffolk Park 2481

Phone 02 6684 0378

Email [landmark@landmarkonline.com.au](mailto:landmark@landmarkonline.com.au)

# Unicorn Falls Flora Survey and Assessment Report

Barbara Stewart, January 2020

## Table of Contents

1	Background .....	1
2	Location.....	1
3	Physical characteristics .....	1
4	Survey methods .....	2
4.1	Database searches .....	2
4.2	Day use area and 20m buffer zone.....	2
4.3	Campground and 20m buffer zone.....	2
4.4	Limitations.....	2
5	Results.....	3
5.1	Vegetation.....	3
	DUA carpark/pathway/toilet .....	3
	DUA disturbed edge.....	3
	DUA and surrounds.....	3
	Walking track from DUA to creek crossing.....	4
	Walking track from creek crossing to steps accessing pool below waterfall .....	4
	Campground .....	5
5.2	Threatened Ecological Communities .....	5
5.3	Conservation values.....	6
5.4	Flora species.....	6

Database search.....	6
Flora species diversity.....	8
Flora species of conservation significance.....	8
Exotic flora species.....	8
6 Impacts of proposal .....	9
6.1 Overview .....	9
6.2 Day use area.....	10
6.3 Campground .....	10
6.4 Flora species of conservation significance.....	10
7 Management recommendations .....	11
7.1 Day use area.....	11
Protection and management for native vegetation .....	11
Walking track to pool.....	11
7.2 Campground .....	11
Protection and management for species of conservation significance.....	11
7.3 Additional recommendations .....	12
Protection and management for species of conservation significance.....	12
List of suitable local native species for landscaping .....	12
Rehabilitation of motorcycle track .....	12
Rehabilitation of existing access to waterfall .....	12
Rehabilitation of northern access road to campground.....	12
Machinery use.....	13
Compensatory actions (extent and location) .....	13
Acknowledgements.....	15
References .....	15
APPENDIX 1 Flora species list.....	17
APPENDIX 2 Flora species for campground landscaping.....	23
APPENDIX 3 Calculation of areas of vegetation to be removed .....	24

DISCLAIMER This report was prepared by Landmark Ecological Services Pty Ltd in good faith exercising all due care and attention, but no representation or warranty, express or implied, is made as to the relevance, accuracy, completeness or fitness for purpose of this document in respect of any particular user's circumstances. Users of this document should satisfy themselves concerning its application to, and where necessary seek expert advice in respect of, their situation. The views expressed within are not necessarily the views of the Department of Planning, Industry and Environment and may not represent Department policy.

## 1 Background

Landmark Ecological Services Pty Ltd was engaged by NPWS to undertake flora surveys and assessments for new work around the Unicorn Falls precinct at South Chowan Road, Mt Jerusalem NP. The surveys and assessments were to support a Review of Environmental Factors (REF) for the works.

The works at Unicorn Falls precinct (the study sites) consist of:

- upgrade to existing Day Use Area (DUA). The upgrade will include 10 car parks, a sealed vault pit toilet, two table seats, interpretative sign, formalised stone steps to water hole, walking track from DUA to steps to water hole, bollards and minor landscaping.
- A new campground for three drive-in campsites and four walk-in campsites (on platforms) on Manns Rd. The campground will include toilet, interpretive signage, bollards and landscaping.

The assessments were based on plans (by Newscape) indicating the layout of the campground and DUA and the location of surveyed trees marked in the field and mapped on plans.

## 2 Location

The campground is located on Manns Road and the DUA is located on South Chowan Road, in the Upper Main Arm area of Mount Jerusalem National Park approximately 15 km northwest of Mullumbimby (REF - Regional Location of Proposed Visitor Hub Map).

## 3 Physical characteristics

The DUA incorporates a flat roadside strip, adjacent to South Chowan Road, on which carparking, toilet and walkway is proposed. The existing DUA is flat to gently sloping above the creek and waterhole. An existing steep to moderately sloping track provides access to the creek and waterfall viewing point and is proposed for upgrade with some refinements to the route.

The campground is proposed for a generally flat, previously disturbed area, close to Manns Road. It has been used for storing spoil from roads in the park and mounded soil and rocks occur on part of the site. At the edges of the campground, the land drops off gently to moderately in all directions excepting the road edge.

The creek level at the DUA is about 120m asl in altitude while the campground is 200m asl.

The soil at the locations of the campground and DUA has been mapped by Morand (1996) as Frogs Hollow Soil Landscape (Erosional Landscape Group). These soils are developed on steep hills of the Chillingham volcanics. Soils are moderately deep to deep, moderately well-drained Brown Podzolic Soils and and Brown Earths on ridges and upper slopes, and deep moderately well-drained Red Podzolic Soils and Red Clays elsewhere.

## 4 Survey methods

Field inspections were undertaken in conjunction with Dianne Mackey between April 2019 and January 2020.

### 4.1 Database searches

A list of threatened and protected flora species (NSW Biodiversity Conservation Act 2016) of possible occurrence at the site and therefore to be targeted for survey was compiled. Species recorded within Mount Jerusalem National Park were listed, based on an extract from the NSW Bionet Wildlife Atlas (8 April 2019). The NPWS REF guidelines also required particular consideration of Rare and Threatened Australian Plants (ROTAP); hence species so listed were also considered.

### 4.2 Day use area and 20m buffer zone

A general description of the vegetation at the DUA was prepared, with particular searches for flora species of conservation significance. The area of affected vegetation was estimated.

To account for possible indirect impacts, a buffer zone of 20m surrounding the DUA was inspected, the vegetation was searched for flora species of conservation significance and the area of affected vegetation estimated. Flora species additional to those recorded for the campground were listed. 5m buffers were applied to the tracks. The buffer was truncated at the South Chowan Road verge.

Details of trees proposed for removal or management, as set out by Northern Tree Care (2019) were compiled.

### 4.3 Campground and 20m buffer zone

In the area to be directly impacted by the proposal (Plan L-202 Issue C), surveyed trees (Plan L-203 Issue A), were located and marked with numbered tags and identified to species level. Trunk diameter at breast height (dbh) was measured and height was estimated in size classes for some trees (REF Appendices 1 & 2; Appendix 6 -Tree Removal & Protection Plan).

Smaller trees and shrubs which were not marked on survey plans were identified, quantified and dbh measured. The lower and ground storey vegetation was described and a species list compiled.

Flora species of conservation significance were targeted during searches in the campground and surrounding buffer zone.

To account for possible indirect impacts, a buffer zone of 20m surrounding the campground was inspected, the vegetation was searched for flora species of conservation significance and the area of affected vegetation estimated. Flora species additional to those recorded for the campground were listed.

### 4.4 Limitations

The field inspections reported were brief. Vegetation present in the vicinity of the proposed campground and DUA was examined in detail; however, additional native flora species may

be present undetected. Seasonal surveys are necessary to detect species that are dormant or inconspicuous for part of the year (e.g. some terrestrial orchids). In addition, some of the inspections took place during extreme drought conditions, and changes to vegetation can be anticipated when the drought breaks.

## 5 Results

### 5.1 Vegetation

#### DUA carpark/pathway/toilet

This area was disturbed and highly variable. Typical structure and floristics are summarized as follows:

Stratum	Height (m)	Cover (%)	Dominant species
Emergent	15m	5	<i>Eucalyptus grandis</i>
Upper	to 6m	10	<i>Lophostemon confertus</i> , <i>Ceratopetalum apetalum</i> , <i>Flagellaria indica</i>
Mid-lower	1-5	60-70	<i>Callicoma serratifolia</i> , <i>Acacia melanoxylon</i> , <i>Elaeocarpus reticulatus</i>

Additional species are listed in Appendix 1.

#### DUA disturbed edge

This is a low, disturbed roadside strip adjacent to the DUA.

Stratum	Height (m)	Cover (%)	Dominant species
Upper	absent		
Mid	5	5	Isolated saplings, early regrowth rainforest
Lower	<1	60-70	<i>Paspalum mandiocanum</i> , <i>Setaria sphacelata</i> , <i>Lantana camara</i>

Additional species are listed in Appendix 1.

#### DUA and surrounds

The forest surrounding the day use area and adjacent creek was described for an area surrounding point location MGA 537300 6850435 (top of creek bank) as follows:

Stratum	Height (m)	Cover (%)	Dominant species
Upper	20	10	<i>Lophostemon confertus</i> , <i>Corymbia gummifera</i> , <i>Backhousia myrtifolia</i> , <i>Ceratopetalum apetalum</i>
Mid	5-10	60-70	<i>Callicoma serratifolia</i> , <i>Acacia melanoxylon</i> , <i>Elaeocarpus reticulatus</i>
Ground	0-2	60-70	<i>Exocarya sclerioides</i> , <i>Wilkiea huegeliana</i> , <i>Cordyline rubra</i> , <i>Lomandra longifolia</i>

Additional species are listed in Appendix 1.

Over a broader area and throughout a 20m buffer area, the canopy was frequently closed with occasional *Lophostemon confertus* but otherwise little sclerophyll component.

Additional canopy species included *Canarium australasicum*, *Sloanea woolsii*, *Schizomeria ovata* and *Endiandra discolor*.

#### Walking track from DUA to creek crossing

The forest in the vicinity of the proposed walking track from the DUA to the creek was described for an area surrounding point location MGA 537312 6850438 as follows:

Stratum	Height (m)	Cover (%)	Dominant species
Upper	20	70	<i>Ceratopetalum apetalum</i>
Mid	5-10	40	<i>Argophyllum nullumense</i> , <i>Ceratopetalum apetalum</i> , <i>Randia benthamiana</i>
Ground	0-2	30	<i>Backhousia myrtifolia</i> , <i>Triunia youngiana</i> , <i>Pittosporum revolutum</i> , additional rainforest seedlings

Additional species are listed in Appendix 1.

#### Walking track from creek crossing to steps accessing pool below waterfall

The vegetation in the general area of the proposed steps is described as follows:

Stratum	Height (m)	Cover (%)	Dominant species
Upper	20	70	<i>Ceratopetalum apetalum</i> , <i>Syncarpia glomulifera</i> , <i>Lophostemon confertus</i> , <i>Eucalyptus microcorys</i>
Mid	4-8	20	<i>Ceratopetalum apetalum</i> , <i>Trochocarpa laurina</i> , <i>Endiandra globosa</i>
Ground	0-2	25	<i>Linospadix monostachyos</i> , <i>Adiantum hispidulum</i> , <i>Blechnum cartilagineum</i> , <i>Exocarya sclerioides</i> .

Additional species are listed in Appendix 1.

Where sclerophyll components emerge above the rainforest, making up 10% cover or more, the vegetation is classed as Wet Sclerophyll Forest. Rainforest species, dominated by Coachwood, are otherwise the main canopy species. The disturbance history of the site (logging history and existing recreational use) combined with the topographically dissected landform of the creek gully have produced a fine scale mosaic of rainforest and wet sclerophyll vegetation types. The rainforest, where not disturbed, is layered dense vegetation classed as Warm Temperate rainforest formation, with floristic composition consistent with Floyd's (1990) Suballiance No 33, *Ceratopetalum/Schizomeria-Argyrodendron/Sloanea* within the *Ceratopetalum apetalum* Alliance. Floyd identifies four threads of floristic gradation representing the various combinations of the four major species. Of these, (3) *Ceratopetalum apetalum-Sloanea woolsii* is the best fit for the rainforest at the DUA and surrounds.

Similar vegetation extends beyond the area to be directly impacted by the DUA and associated works, though rainforest layers may be overtopped by sclerophyll species forming the canopy or as emergents.

## Campground

The vegetation in the campground is described as follows:

Stratum	Height (m)	Cover (%)	Dominant species
Upper	12	20-30	<i>Eucalyptus siderophloia</i> , <i>E. propinqua</i> , <i>E. microcorys</i> , <i>E. acmenoides</i>
Mid	3-6	20	<i>Polyscias elegans</i> , <i>Acacia irrorata</i> , <i>Eucalyptus spp.</i> , <i>Lantana camara</i> (sparse)
Ground	0-2	20	<i>Alpinia caerulea</i> , <i>Geitonoplesium cymosum</i> , <i>Exocarya sclerioides</i> , rainforest seedlings, <i>Paspalum mandiocanum</i>

In the surrounding buffer area, the vegetation is similar but with greater cover in all strata, especially in more sheltered downslope locations.

Additional species for the campground and the buffer area are listed in Appendix 1.

## 5.2 Threatened Ecological Communities

Though the rainforest vegetation at the DUA and vicinity has the characteristics of Warm Temperate Rainforest (Section 5.1), the vegetation at and around the DUA may be considered to fit the description NSW Scientific Committee's determination for the Endangered Ecological Community Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion (Lowland Rainforest).

Lowland Rainforest primarily encompasses Subtropical Rainforest. The determination notes, however, that, along with subtropical suballiances, Lowland Rainforest encompasses stands that display characteristics of some other suballiances. These stands occur in environments that are around the transitional limits of Lowland Rainforest with increasing altitude or maritime influence, or declining moisture status or soil nutrient status (Floyd 1990). As soil nutrient status declines, Lowland Rainforest may be replaced by warm temperate forms of rainforest. Lowland Rainforest typically occurs on relatively nutrient-rich, such as basic volcanic or fine-grained sedimentary substrates, but may also occur on substrates of intermediate fertility, including acid volcanics (Floyd 1990).

Warm temperate rainforests commonly occur at elevated sites on acid volcanic substrates, such as those present at the study sites. These stands of warm temperate rainforest are generally excluded from Lowland Rainforest. However, suballiances 33. *Ceratopetalum apetalum* - *Schizomeria* - *Argyrodendron spp.* - *Sloanea* suballiance (sensu Floyd 1990) within the *Ceratopetalum apetalum* alliance is one of the suballiances that may occur on soils of intermediate fertility throughout the bioregion, and is stated by the determination to be included within Lowland Rainforest where they occur in conjunction with stands of subtropical suballiances listed in paragraph 4 of the determination. While subtropical suballiances were not recognised at the study sites, rainforest vegetation richer in subtropical component species were recognised during brief inspections of vegetation lying between the campground and the DUA.

Accordingly, taking a precautionary approach, the rainforest is recognised as a possible EEC and considered in a Section 7.3 assessment (NSW *Biodiversity Conservation Act 2016*) conducted in the REF.

### 5.3 Conservation values

The warm temperate rainforest of the study sites has high biodiversity values, including flora species diversity, and provides habitat for numerous threatened species. Warm temperate rainforests are of particular importance being close to their northern distribution in Australia (NPWS 2004).

The wet sclerophyll forests intergrade with rainforest, including mature rainforest canopy trees and diverse rainforest understoreys. Sclerophyll canopy trees include Koala food trees *Eucalyptus microcorys* and *E. propinqua*.

### 5.4 Flora species

#### Database search

A Bionet extract (Section 4.1) showed that eighteen species of threatened and 50 protected flora species (BCA Act) have been recorded in Mount Jerusalem National Park (**Table 1**).

One species listed as Critically Endangered is included. Eleven of the species listed on **Table 1** are also listed as threatened on schedules of the EPBC Act (1999).

Table 1 Flora species of Conservation Significance

Scientific Name	Common Name	NSW status	Comm. status
<i>Actinotus gibbonsii</i>		P	
<i>Davidsonia johnsonii</i>	Smooth Davidson's Plum	E1	E
<i>Cyathea australis</i>	Rough Treefern	P	
<i>Cyathea cooperi</i>	Straw Treefern	P	
<i>Cyathea leichhardtiana</i>	Prickly Treefern	P	
<i>Caustis flexuosa</i>	Curly Wig	P	
<i>Caustis pentandra</i>	Thick Twist Rush	P	
<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge	P	
<i>Dicksonia youngiae</i>	Bristly Treefern	P	
<i>Doryanthes palmeri</i>	Giant Spear Lily	V,P	
<sup>^^</sup> <i>Elaeocarpus sedentarius</i>	Minyon Quandong	E1,3	E
<i>Rhynchosia acuminatissima</i>	Pointed Trefoil	V	
<i>Acacia bakeri</i>	Marblewood	V	
<i>Sticherus flabellatus</i> var. <i>flabellatus</i>	Umbrella Fern	P	
<sup>^^</sup> <i>Grammitis stenophylla</i>	Narrow-leaf Finger Fern	E1,3	
<i>Plectranthus nitidus</i>	Nightcap Plectranthus	E1	E



<i>Endiandra hayesii</i>	Rusty Rose Walnut	V	V
<i>Endiandra muelleri</i> subsp. <i>bracteata</i>	Green-leaved Rose Walnut	E1	
<i>Tinospora tinosporoides</i>	Arrow-head Vine	V	
<i>Baeckea linifolia</i>	Weeping Baeckea	P	
<i>Rhodamnia rubescens</i>	Scrub Turpentine	E4A	
<i>Syzygium hodgkinsoniae</i>	Red Lilly Pilly	V	V
<i>Uromyrtus australis</i>	Peach Myrtle	E1	E
<i>Acianthella amplexicaulis</i>		P	
<i>Acianthus caudatus</i>	Mayfly Orchid	P	
<i>Acianthus</i> spp.	Mosquito Orchid	P	
<i>Bulbophyllum argyropus</i>		P	
<i>Calanthe triplicata</i>	Christmas Orchid	P	
<i>Cestichis swenssonii</i>		P	
<i>Chiloglottis</i> spp.		P	
<i>Corybas aconitiflorus</i>	Spurred Helmet Orchid	P	
<i>Cryptostylis</i> spp.		P	
<i>Cymbidium madidum</i>		P	
<i>Cymbidium suave</i>	Snake Orchid	P	
<i>Dendrobium aemulum</i>	Ironbark Orchid	P	
<i>Dendrobium kingianum</i>	Pink Rock Orchid	P	
<i>Dendrobium pugioniforme</i>	Dagger Orchid	P	
<i>Dendrobium schoeninum</i>	Pencil Orchid	P	
<i>Eriochilus cucullatus</i>	Parson's Bands	P	
<i>Erythrorchis cassythoides</i>	Climbing Orchid	P	
<i>Pterostylis baptistii</i>	King Greenhood	P	
<i>Pterostylis daintreana</i>		P	
<i>Pterostylis ophioglossa</i>	Snake Tongue Greenhood	P	
<i>Pterostylis parviflora</i>	Tiny Greenhood	P	
<i>Sarcochilus ceciliae</i>	Fairy Bells	P	
<sup>^</sup> <i>Sarcochilus fitzgeraldii</i>	Ravine Orchid	V,P,2	V
<i>Belvisia mucronata</i>	Needle-leaf Fern	E1	
<i>Platycterium bifurcatum</i>	Elkhorn Fern	P	
<i>Platycterium superbum</i>	Staghorn	P	
<i>Banksia spinulosa</i> var. <i>collina</i>		P	
<i>Hicksbeachia pinnatifolia</i>	Red Boppel Nut	V	V
<i>Lomatia silaifolia</i>	Crinkle Bush	P	
<i>Macadamia tetraphylla</i>	Rough-shelled Bush Nut	V	V
<i>Persoonia adenantha</i>		P	
<i>Persoonia media</i>		P	
<i>Petrophile canescens</i>	Conesticks	P	
<i>Tmesipteris ovata</i>		P	
<i>Niemeyera whitei</i>	Rusty Plum, Plum Boxwood	V	

<i>Symplocos baeuerlenii</i>	Small-leaved Hazelwood	V	V
<i>Xanthorrhoea australis</i>		P	
<i>Xanthorrhoea johnsonii</i>	Johnson's Grass Tree	P	
<i>Xanthorrhoea latifolia</i>		P	
<i>Xanthorrhoea latifolia subsp. latifolia</i>		P	
<i>Xanthorrhoea latifolia subsp. maxima</i>		P	
<i>Xanthorrhoea macronema</i>		P	
<i>Xanthorrhoea spp.</i>		P	
<i>Lepidozamia peroffskyana</i>		P	
<i>Corokia whiteana</i>	Corokia	V	V

#### Flora species diversity

A diversity of flora species was recorded during the field inspection (Appendix 1). 104 native species and 6 exotic species (including invasive non-local natives) are included in the species list. Additional grass species are present as sparse and dry specimens. Grasses with no fertile material and in poor condition are difficult to identify.

#### Flora species of conservation significance

One species listed as threatened (BC Act) was located within the proposed campground. Scrub Turpentine *Rhodamnia rubescens* is listed as Critically Endangered and is present as two stems of heights 40 and 16cm and is located in the 'Endangered plant species area' shown on the Campground Demolition Plan ( L-201 Issue C).

10 species of protected plants (BC Act) were recorded, including orchids, ferns and palms. Three species listed as rare (ROTAP) were recorded – Black Walnut *Endiandra globosa*, Silver-leaf *Argophyllum nullumense* and Pink Cherry *Austrobuxus swainii*.

#### Exotic flora species

The six exotic species listed in Appendix 1 pose threats of varying degree to native vegetation and may be of concern for the health of stock and humans. Some may have fauna habitat values.

Weed management is classified according to categories set out in the following plans:

#### *North Coast Regional Strategic Weed Management Plan 2017-2022.*

Responsibilities for management of serious weeds are set out in schedules of the North Coast Regional Strategic Weed Management Plan 2017-2022. The objectives for management are listed at both State level and Regional (North Coast) level.

The following list includes all species addressed in Management Categories in the Plan, and documented as occurring at the study sites. Species are listed in order of common name, including the management category under which the species is listed. "State" in the management category, indicates the species is a state listed species (A1.1 of the Weed Management Plan). This demonstrates where species may have both State and Regional

listings. Note that Asset Protection species occur in both Appendix 1.1 and 2.2 of the Weed Management Plan. Watch species occur in Appendix 2.1 of the Weed Management Plan.

Common Name	Management Category				
	PREVENT	ERADICATE	CONTAIN	ASSET PROTECTION	WATCH
Camphor laurel - <i>Cinnamomum camphora</i>					
Giant Parramatta grass - <i>Sporobolus fertilis</i>					
Lantana - <i>Lantana camara</i>				State	
Umbrella tree - <i>Schefflera actinophylla</i>					

The Weed Management Plan also lists Additional Species of Concern in North Coast Local Land Services Region at its Appendix 2.2.

These species are a high priority for asset protection. Many are actively managed under a number of current programs or are commercial species with a manageable biosecurity risk. It is not feasible to contain or eradicate these species, however minimising their impacts is reasonably practicable.

Additional Species of Concern in North Coast Local Land Services Region Species and known from the study sites are listed as follows:

Common name	Scientific name
Lantana	<i>Lantana camara</i>
Umbrella tree	<i>Schefflera actinophylla</i>

### Weeds of National Significance

WoNS have been selected as they require coordination of weed management responsibilities among all levels of government, organisations and individuals. The development of a strategic plan for each WoNS helps define responsibilities and identify strategies and actions to control the species.

One species of WoNS was present at the study sites:

Lantana *Lantana* species

## 6 Impacts of proposal

### 6.1 Overview

The proposal will have direct impacts, including removal of vegetation and possible damage during construction, indirect impacts resulting from ongoing human activity in the precinct, and further, though less likely, indirect impacts in a buffer zone around the Campground, DUA and associated infrastructure. The impacts are summarized in Table 2 and detail of calculation of areas of vegetation is included as Appendix 3.

The impacts stated assume recommended management measures and impact minimalization will be applied.

Table 2 Summary of impacts on vegetation

Location	Trees proposed for removal	Area m <sup>2</sup>
DUA including carpark/path/toilet	1 x Sally Wattle, 3 x Flooded Gums, several young rainforest trees and Brush Box	730 (including 47 of rainforest regrowth and 120 of highly disturbed edge)
Track from DUA to creek crossing*		41
Track from creek to steps to pool	2 x Coachwood (12m and 15m), 1 x Laurel sp.	56
Campground	70 trees (see REF Appendix 1)	1076 (940 plus 136 of understorey clearing in walk in camp area)
<b>TOTAL</b>	<b>77+ trees</b>	<b>1903</b>

\* It is recommended that a table seat is relocated to permit retention of the rainforest tree identified for removal on drawing L-101 Issue C.

Additional management measures are proposed for trees retained at the campground which are likely to be adversely affected by construction impacts.

## 6.2 Day use area

Northern Tree Care (2019) has identified one living tree for removal i.e. Leaning tree with damage to the base. This is a Sally Wattle *Acacia melanoxylon* with a leader leaning over the planned car park. In addition, a dead tree is proposed for partial removal, to a height of 2 m.

Two Coachwoods and one laurel sp. are proposed for removal on the walking track to the steps. However, most vegetation impacts associated with the development of the day use area are for the ancillary infrastructure: carpark/toilet/pathway, walking track/stairs, table seats.

## 6.3 Campground

Seventy trees are proposed for removal. The trees are listed in the Tree Removal Inventory (REF Appendix 1). Others for which small potential risks have been identified are recommended for retention by Northern Tree Care, subject to management (minor pruning and bracing of a dead tree) or precautions in high winds. Additional trees are identified as requiring adequate protection during construction, as shown on the Tree Removal and Protection Plan (REF Appendix 6) and their details are listed in REF Appendix 2 (Tree Protection Inventory – Manns Road Campground).

## 6.4 Flora species of conservation significance

The two stems of the Critically Endangered Scrub Turpentine are located on the edge of the campground in a position where they are vulnerable to accidental damage during construction and ongoing human activity.

None of the three ROTAP species recorded will be directly impacted by the proposal, though may be affected indirectly as a result of increased human activity. The three species are

considered Rare but are locally fairly common and do not require additional protections beyond those afforded other native species.

Protected species generally include those targeted for collection for horticulture, including orchids, ferns and palms. Increased human visitation resulting from the proposal may exacerbate the risk of picking and harvesting of ornamental species.

## 7 Management recommendations

### 7.1 Day use area

Protection and management for native vegetation

Application of the Australian Standard *AS 4970-2009 Protection of trees on development sites* is recommended. The standard provides guidance for the protection of trees during construction and for the calculation of tree protection zones (TPZs) and structural root zones (SRZs) when required. TPZ radiuses have been calculated, as examples, for some trees identified for protection on the Tree Removal and Protection Plan (REF Appendix 6) and TPZ radius calculations are provided in Appendix 2 to the REF. Some basal diameters are also provided should SRZs calculations be required.

A Rose Walnut *Endiandra discolor* with exposed roots at rear of a spoil pile at the proposed entrance requires management to avoid damage and future instability when removal of the pile is required. The following is recommended:

- Retain tree.
- Remove spoil pile without damaging the tree roots and manage existing root damage and elevation of tree on rear of pile. Implement arborist advice regarding buffer distances.
- Install information shelter and any concrete plinth required well clear of existing vegetation to avoid impacts.
- It is recommended that the two table seats are located such that no trees will be removed.

Walking track to pool

To avoid impacts on native vegetation of conservation significance it is recommended that:

- An arborist inspects trees adjacent to the proposed stone wall on the walking track to the pool and provide tree protection advice, prior to construction commencing on the walking track and wall.
- Any excess soil from walking track construction is remove from the site.
- Battering is minimise as much as possible around the walking track to the steps to the pool and upslope of the steps to the pool.

### 7.2 Campground

Protection and management for species of conservation significance

The two stems of the Critically Endangered Scrub Turpentine *Rhodamnia rubescens* located on the edge of the campground will be protected within an 8 x 8m enclosure and the enclosure weeded as part of ongoing management of the campground.

### 7.3 Additional recommendations

#### Protection and management for species of conservation significance

General advice about the protection afforded all native species within the National Park to be included in signage. This will provide some protection for horticulturally sought after species.

#### List of suitable local native species for landscaping

Appendix 2 provides suggested species for landscaping at the campground. Some, such as sedges and *Lomandra*, will transplant well and could be salvaged from vegetation that is removed from work areas. Some may be difficult to source from local nurseries, and lead time for seed collection and production will be necessary.

#### Rehabilitation of motorcycle track

An area damaged by motorbikes requires rehabilitation. Bikes have created a track from the DUA, across the creek and up a steep adjacent slope. The following treatment is recommended:

- Pin coir logs (manufactured coconut fibre logs) in place across the track at intervals of 3m commencing upslope on the steep slope on the South Chowan Road side of the creek, where a small gully is forming at the track's centre. Continue this treatment on the DUA side of the creek.
- Include other measures to prevent motorbike access, e.g. placement of logs, boulders.
- Plant Spiny-headed Mat-rush *Lomandra longifolia* and the sedge *Exocarya sclerioides* above the coir logs.

There is an option to transplant the above species where they are proposed for removal from the walking track between the DUA and the creek crossing, or from another section of the walking track to the waterfall. For this approach to work, co-ordination by NPWS will be required for the rehabilitation works to be scheduled concurrently.

Note: It is recommended that NPWS investigates whether water flows from South Chowan Road down the steep track formed by motorbikes and, if so, arrange to divert this flow, otherwise rehabilitation of this area will be compromised.

#### Rehabilitation of existing access to waterfall

Drawings L-102 & L-103 (Issue C) show the existing pedestrian access to the waterfall as a 'Native Planting Bed (Bush Regeneration Works)'. The approach recommended in the preceding section could also be used to rehabilitate this area.

#### Rehabilitation of northern access road to campground

Plans for the campground (L-202 Issue C) show the former northern access road as a rehabilitation area. Soil compaction will be a major constraint to establishing trees on this site. Instead of attempting to establish trees, it is recommended that forest litter (leaves, sticks, bark etc. on the forest floor), which is removed from forested areas during site preparation for the campground, is stockpiled and then spread over the former road. Spreading of topsoil (collected up to a depth of 5cm) from those cleared area which are

relatively free of weeds will include soil stored seed of native vegetation. This should be stored separately to the leaf litter. Applying topsoil on the former access and finishing this with leaf litter will assist the establishment of natural regeneration when coupled with adequate erosion controls e.g. water bars and weeding and vehicle exclusion measures e.g. bollards.

#### Machinery use

Washdown of machinery to avoid spread of weeds such as Giant Paramatta Grass. Spoil from weed-infested locations taken off site.

#### Compensatory actions (extent and location)

Compensatory actions are proposed to offset the impacts of the proposal, including tree removal and management, understorey vegetation removal, impacts during construction and indirect impacts of increased human visitation.

Multipliers for the calculation of impact:offset ratios are set out in the Byron Biodiversity Strategy 2004 i.e.

High Conservation Value vegetation 10:1

Medium Conservation Value vegetation 5:1

Low Conservation Value vegetation 1:1

Multipliers are often applied to vegetation quantified by plant counts. Alternatively, calculations may be based on area of vegetation. It is proposed that, for current purposes, impacts be quantified on the basis of area. A subjective assignment of the level of conservation value took into account the conservation status of the vegetation (e.g. possible EEC) and the maturity and condition of the vegetation.

In addition, the multiplier can be modified to incorporate differing impact intensities e.g. direct versus indirect impacts (Table 3).

**Table 3 Calculation of compensatory areas**

Impact location	Impact description	Impact Area m <sup>2</sup>	Conservation value/impact intensity	Multiplier	Compensation Area m <sup>2</sup>
<b>DUA</b>	Indirect impacts on native vegetation	400	High/indirect impacts	5	2,000
<b>20m buffer</b>	Includes possible EEC	1250 (excludes pool)	High/indirect impacts	5	6,250
<b>DUA carpark etc</b>	Highly to lightly disturbed vegetation with some rainforest regrowth. 3 x Flooded Gums,	330 (including 47 of rainforest regrowth)	Medium/direct impacts	5	1,650

Impact location	Impact description	Impact Area m <sup>2</sup>	Conservation value/impact intensity	Multiplier	Compensation Area m <sup>2</sup>
	several rainforest trees and Brush Box removed, understorey cleared				
<b>Buffer, 5m</b>	Includes possible EEC	150 (reduced by South Chowan Road's location adjacent and excludes 20m DUA buffer overlap)	Medium/indirect impacts.	5	450
<b>Track - DUA to creek crossing</b>	Possible EEC partly cleared understorey	41	High/direct impacts	10	410
<b>Buffer, 5 m</b>	Indirect impacts on possible EEC	N/A Included in DUA buffer	High/indirect impacts	-	-
<b>Track - creek crossing to steps to waterfall</b>	Three trees removed, understorey removed, possible EEC partly cleared	56	High/direct impacts	10	560
<b>Buffer, 5m</b>	Indirect	400 (excludes overlap with DUA buffer)	High/indirect impacts	5	2,000
<b>Campground</b>	77 trees removed, understorey removed, indirect impacts on remaining trees and threatened flora	1,076 (940 + 136 of understorey clearing in walk in camp area)	Medium/direct and indirect impacts	10	10,760
<b>20m buffer</b>	Indirect impacts	3,900	Medium/indirect impacts	5	19,500
<b>TOTAL</b>		1,903 / 7,603 including buffer			43,580

It is proposed that compensation is by way of weed management in the vicinity of the DUA and campground. An area of 4.4ha (43,580m<sup>2</sup>) (Table 3) to be treated using appropriate and locally trialled bush regeneration techniques.



Around the campground, Lantana, in particular, is suppressing development of the formerly logged forests. All environmental weeds, including *Schefflera actinophylla* in the buffer zone of the campground, to be removed. Around the DUA, weeds predominantly occur along the road edge and are being removed for infrastructure development, however, any weeds with the buffer area (20m) should be targeted.

Primary bush regeneration work will require adequate follow-up in subsequent seasons/years for it to be successful. The compensation bush regeneration program should be integrated with other NPWS Tweed Byron Area bush regeneration programs to ensure regular, scheduled works occur.

The proposed locations for compensatory works are:

- around the Manns Road campground and opposite the campground, across Manns Road;
- the dense lantana infestation at the end of the track running east and downslope from the campground and the adjoining riparian area (Grid Reference 536867 6850986). Note: 2 x Critically Endangered Scrub Turpentine *Rhodamnia rubescens* occur at this grid reference. The two plants (1x1m height, 1x2m height) have been prostrated by a tree fall and are surrounded by the dense lantana infestation. This location is adjacent to rainforest and rainforest occurs in isolated patches within the lantana infestation and in a thin strip along the riparian area. Work here will greatly assist rainforest establishing.
- Around the DUA – locally, weeds are mainly located along the road edge and are being removed for infrastructure development, however, if other weeds occur with the buffer area to the DUA and associated infrastructure(20m) these should be targeted.

A range of vegetation from dry sclerophyll to wet sclerophyll and rainforest types will benefit from works at the recommended locations.

### Multipliers

The compensation area is based on dense Lantana infestation. An additional x2 multiplier to be applied if medium to low density lantana is identified for removal.

### Acknowledgements

Dianne Mackey managed field work, assisted with field survey, calculated areas of vegetation proposed for removal, undertook data entry and collaborated to develop recommendations.

### References

- Floyd, A. 1990. *Australian Rainforests in N.S.W.* Vol. 2. Surrey Beatty, Chipping Norton.
- Morand, D.T., 1994 *Soil Landscapes of the Murwillumbah-Tweed Heads 1:100,000 Sheet*.  
Department of Conservation and Land Management, Sydney.
- Northern Tree Care, 2019. Arboricultural Report: Unicorn Falls and Day Campground.  
Northern Tree Care, Burringbar.
- NSW NPWS, 2004. Parks and Reserves of the Tweed Caldera. Plan of Management.



## APPENDIX 1 Flora species list

Indicative flora species list from survey results. CE = Critically Endangered, R = rare, p = protected, e = exotic

SPECIES		STATUS					LOCATION							
Scientific name	Common name	Threat-ened BCT Act	Threat-ened EPBC Act	ROTAP	Prot-ected BCT Act	Native /exotic	DUA car park etc	DUA Road- side Dist- urbed edge	DUA	DUA to creek cross- ing	Creek cross- ing to steps	DUA addi- tional	Camp area	Camp area addi- tional
<i>Argophyllum nullumense</i>	Silver Leaf			R						x				
<i>Acacia melanoxylon</i>	Sally Wattle						x	x						x
<i>Acacia irrorata</i>	Green Wattle												x	
<i>Adiantum formosum</i>	Giant Maidenhair				p					x				
<i>Adiantum hispidulum</i>	Rough Maidenhair Fern				p						x			
<i>Adiantum</i> sp.	a maidenhair fern				p				x					
<i>Ageratina riparia</i>	Mistflower					e		x						
<i>Ageratum conyzoides</i>	Goatweed					e		x						
<i>Allocasuarina torulosa</i>	Forest Oak													x
<i>Alpinia caerulea</i>	Native Ginger												x	
<i>Anopterus macleayanus</i>	Macleay Laurel								x					
<i>Archontophoenix cunninghamiana</i>	Bangalow Palm				p		x		x	x				x
<i>Asplenium australasicum</i>	Bird's Nest Fern				p				x					
<i>Atractocarpus benthamianus</i>	Native Gardenia								x	x				
<i>Austrobuxus swainii</i>	Pink Cherry			x								x		
<i>Backhousia myrtifolia</i>	Grey Myrtle								x	x				
<i>Blechnum cartilagineum</i>	Gristle Fern								x	x	x			

SPECIES		STATUS					LOCATION							
Scientific name	Common name	Threatened BCT Act	Threatened EPBC Act	ROTAP	Protected BCT Act	Native /exotic	DUA car park etc	DUA Roadside Disturbed edge	DUA	DUA to creek crossing	Creek crossing to steps	DUA additional	Camp area	Camp area additional
<i>Breynia oblongifolia</i>	Coffee Bush													x
<i>Bursaria spinosa</i>	Boxthorn												x	
<i>Calamus muelleri.</i>	Wait-A-While				p				x					
<i>Callicoma serratifolia</i>	Black Wattle						x	x				x		
<i>Canarium australasicum.</i>	Mango Bark									x				
<i>Capparis arborea</i>	Native Caper												x	
<i>Cayratia clematoidea</i>	Native Grape													x
<i>Cephalalaria cephalobotryus</i>	Climbing Panax						x							
<i>Ceratopetalum apetalum</i>	Coachwood						x		x	x	x			
<i>Cissus antarctica</i>	Water Vine												x	
<i>Cissus hypoglauca</i>	Water Vine						x							
<i>Cissus sp.</i>	a water vine									x				
<i>Clematis sp</i>	Old Man's Beard												x	
<i>Commersonia bartramia</i>	Brown Kurrajong							x						
<i>Cordyline rubra</i>	Palm-lily								x	x			x	
<i>Corymbia gummifera</i>	Red Bloodwood								x					
<i>Cryptocarya glaucescens</i>	Jackwood								x					
<i>Cuttsia viburnea</i>	Native Hydrangea									x				
<i>Cyathea leichhardtiana</i>	Prickly Tree Fern				p		x		x	x				
<i>Cymbidium suave</i>	Snake Orchid												x	
<i>Daviesia arborea</i>	Golden Pea Tree												x	

SPECIES		STATUS					LOCATION							
Scientific name	Common name	Threatened BCT Act	Threatened EPBC Act	ROTAP	Protected BCT Act	Native /exotic	DUA car park etc	DUA Roadside Disturbed edge	DUA	DUA to creek crossing	Creek crossing to steps	DUA additional	Camp area	Camp area additional
<i>Dawsonia sp.</i>	Giant Moss								x					
<i>Dendrobium aemulum</i>	Ironbark Orchid				p								x	
<i>Denhamia sivestris</i>	Narrow-leaved Orangebark												x	
<i>Desmodium rhytidophyllum</i>	Hairy Trefoil												x	
<i>Dianella caerulea</i>	Blue Flax-lily								x	x			x	
<i>Doodia aspera</i>	Prickly Rasp Fern									x				
<i>Elaeocarpus reticulatus</i>	Blueberry Ash						x							
<i>Endiandra discolor</i>	Rose Walnut											x		
<i>Endiandra globosa</i>	Black Walnut			R							x			
<i>Eucalyptus acmenoides</i>	White Mahogany												x	
<i>Eucalyptus grandis</i>	Flooded Gum						x						x	
<i>Eucalyptus microcorys</i>	Tallowwood												x	
<i>Eucalyptus propinqua</i>	Grey Gum												x	
<i>Eucalyptus siderophloia</i>	Ironbark												x	
<i>Eucalyptus spp.</i>	a eucalypt												x	
<i>Exocarya sclerioides</i>	a sedge								x		x		x	
<i>Flagellaria indica</i>	Whip Vine						x							
<i>Geitonoplesium cymosum</i>	Scrambling Lily									x			x	
<i>Glochidion ferdinandi</i>	Cheese Tree						x							x
<i>Glycine clandestina</i>	Twining Glycine												x	
<i>Guioa semiglauca</i>	Guioa													x

SPECIES		STATUS					LOCATION							
Scientific name	Common name	Threatened BCT Act	Threatened EPBC Act	ROTAP	Protected BCT Act	Native /exotic	DUA car park etc	DUA Roadside Disturbed edge	DUA	DUA to creek crossing	Creek crossing to steps	DUA additional	Camp area	Camp area additional
<i>Helicia ferruginea</i>	Rusty Helicia								x					
<i>Hovea sp</i>	a purple pea													x
<i>Imperata cylindrica</i>	Blady Grass												x	
<i>Jagera pseudorhus</i>	Foambark						x							x
<i>Lantana camara</i>	Lantana					e			x				x	
<i>Lastreopsis marginans</i>	Glossy Shield Fern												x	
<i>Linospadix monostachyos</i>	Walking Stick Palm				p				x	x	x			
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush								x	x	x			
<i>Lomandra spicata</i>	Orange Lomandra												x	
<i>Lophostemon confertus</i>	Brush Box						x		x		x		x	
<i>Maclura cochinchinensis</i>	Cockspur													x
<i>Mallotus discolor</i>	Yellow Kamala													x
<i>Mallotus philippensis</i>	Red kamala													x
<i>Myrsine variabilis</i>	Muttonwood												x	
<i>Neolitsea dealbata</i>	White Bolly Gum						x							
<i>Nephrolepis cordifolia</i>	Fishbone Fern													x
<i>Ozothamnus diosmifolius</i>	Rice Flower						x	x	x					
<i>Pandorea pandorana.</i>	Wonga Vine								x					
<i>Paspalum mandiocanum</i>	Broadleaf Paspalum					e			x				x	
<i>Pittosporum revolutum</i>	Rough fruit Pittorporum									x				
<i>Pittosporum rhombifolium</i>	Holly Wood								x					x
<i>Plectranthus sp</i>	a spur-flower													x

SPECIES		STATUS					LOCATION								
Scientific name	Common name	Threatened BCT Act	Threatened EPBC Act	ROTAP	Protected BCT Act	Native /exotic	DUA car park etc	DUA Roadside Disturbed edge	DUA	DUA to creek crossing	Creek crossing to steps	DUA additional	Camp area	Camp area additional	
<i>Polyscias elegans</i>	Celerywood												x		
<i>Polyscias murrayi</i>	Pencil Cedar						x	x							
<i>Pseuderanthamum variabilis</i>	Pastel Flower													x	
<i>Pseudovanilla foliata</i>	Great Climbing Orchid				x				x						
<i>Quintinia sieberi</i>	Grey Possumwood						x	x							
<i>Rhodamnia rubescens</i>	Scrub Turpentine	CE											x		
<i>Ripogonum elseyanum</i>	Hairy Supplejack								x	x					
<i>Rubus mollucanus</i>	Mollucca Bramble						x								
<i>Schefflera actinophylla</i>	Umbrella Tree												x		
<i>Schizomeria ovata</i>	Crab Apple											x			
<i>Setaria sphacelata</i>	Setaria					e		x							
<i>Sloanea australis</i>	Maiden's Blush								x			x			
<i>Sloanea woollsii</i>	Yellow Carabeen						x		x						
<i>Smilax australis</i>	Native Sarsparilla												x		
<i>Sporobolus fertilis</i>	Giant Parramatta Grass					e							x		
<i>Syncarpia glomulifera</i>	Turpentine										x		x		
<i>Synoum glandulosum</i>	Scentless Rosewood												x		
<i>Syzygium luehmannii</i>	Small-leaved Lilly Pilly								x						
<i>Tasmannia insipida</i>	Brush Pepperbush									x					
<i>Themdea australis</i>	Kangaroo Grass												x		
<i>Toechima dassyrache</i>	Steelwood											x			

SPECIES		STATUS					LOCATION							
Scientific name	Common name	Threatened BCT Act	Threatened EPBC Act	ROTAP	Protected BCT Act	Native /exotic	DUA car park etc	DUA Road-side Disturbed edge	DUA	DUA to creek crossing	Creek crossing to steps	DUA additional	Camp area	Camp area additional
<i>Toona australis</i>	Red Cedar												x	
<i>Trema tomentosa</i>	Poison Peach						x							
<i>Tripladenia cunninghamii</i>	Bush Lily								x		x			
<i>Triunia youngiana</i>	Spice Bush									x				
<i>Trochocarpa laurina</i>	Tree Heath						x			x	x			x
<i>Tylophora paniculata</i>	Thin-leaved Tylophora													x
<i>Wikstroemia indica</i>	Bootlace Bush												x	
<i>Wilkaea huegeliana</i>	Veiny Wilkiea								x					



## APPENDIX 2 Flora species for campground landscaping

Scientific Name	Common Name	Life form	Comments
<i>Pseuderanthemum variabile</i>	Pastel Flower	Herb	Ground cover, ornamental flowers
<i>Adiantum aethiopicum</i>	Common Maidenhair	Fern	Ground cover
<i>Adiantum hispidulum</i>	Rough Maidenhair	Fern	Ground cover
<i>Polyscias elegans</i>	Celery Wood	Tree	Ornamental spreading form
<i>Cordyline rubra</i>	Palm-Lily	Shrub	Ornamental leaves
<i>Ozothamnus diosmifolius</i>	White Dogwood	Shrub	Bushy, white flowers
<i>Denhamia silvestris</i>	Narrow-leaved Orangebark	Shrub	Small, spreading
<i>Exocarya sclerioides</i>	a sedge	Sedge	Tall ground cover
<i>Nephrolepis cordifolia</i>	Fishbone Fern	Fern	Spreading ground cover, be sure to source local native stock
<i>Trochocarpa laurina</i>	Tree Heath	Shrub	Bushy, white flowers
<i>Mallotus discolor</i>	White Kamala	Tree	Yellow fruit
<i>Hardenbergia violacea</i>	False Sarsaparilla	Vine	Ground cover, ornamental purple flowers
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	Herb	Large clump, ground cover
<i>Lomandra spicata</i>	a mat-rush	Herb	Sparse clump, ground cover
<i>Eucalyptus microcorys</i>	Tallowwood	Tall tree	Koala food tree
<i>Eucalyptus propinqua</i>	Small-fruited Grey Gum	Tall tree	Koala food tree
<i>Dianella caerulea</i>	Blue Flax-lily	Herb	Ground cover, ornamental blue fruit
<i>Pittosporum undulatum</i>	Sweet Pittosporum	Small tree	Bushy, white flowers, fruit ornamental
<i>Themeda triandra</i>	Kangaroo Grass	Grass	Ground cover
<i>Dodonaea triquetra</i>	Large-leaf Hop-bush	Shrub	Bushy
<i>Alpinia caerulea</i>	Native Ginger	Herb	Ground cover, clumping, blue fruit
<i>Viola hederacea</i>	Ivy-leaved Violet	Herb	Ground cover, pale lilac flowers

## APPENDIX 3 Calculation of areas of vegetation to be removed

<b>Unicorn Falls Day Use Area</b>
<b>Proposed carpark/pathway and toilet</b>
<b>Estimated Area of Vegetation Removal:</b> 330m <sup>2</sup> (measured on Plan L-102), includes an area of rainforest regrowth: 47m <sup>2</sup> , cover 60-70% . Includes 120m <sup>2</sup> of highly disturbed edge dominated by exotic grasses and herbs.
<b>Walking track from DUA to creek crossing</b>
<p><b>Calculations for vegetation removal in the above area</b></p> <p>Track to creek: 1.2m x 13m = 15.6m<sup>2</sup> (allows for Grade 4 track to 600mm wide and battering 300mm each side and stone steps 400mm wide as per plans L-302). Measured on L-103.</p> <p>Table seats: Minimum dimensions: 1.8m x 1.8m (PFM 7.2.5). Allow for rock walls and levelling. Circle with 2m radius (measured on Demolition Plan) 2 x 12.56m<sup>2</sup> = 25.12m<sup>2</sup></p> <p><b>Final Estimated Total:</b> 25.12 + 15.6 m<sup>2</sup> = <b>41m<sup>2</sup></b> (40.72).</p> <p>Assume understorey impacts only and recommend <b>no</b> tree removal.</p>
<b>Walking track from creek crossing to steps proposed to access pool below the waterfall</b>
<p><b>Calculations for vegetation removal in the above area</b></p> <p>Track to start of steps: 32m x 0.9m wide = 28.8m + 2.7 = 32 m<sup>2</sup> (31.5) (allows for Grade 4 track to 600mm wide with battering 300mm one side plus battering on both sides for 9m= 9 x 0.3 = 2.7m<sup>2</sup>)</p> <p>24m of stone wall: 24 x 1m = 24m<sup>2</sup> (includes 600mm wide footing and backfill/batter).</p> <p><b>Final Estimated Total: 32 + 24 = 56m<sup>2</sup></b></p>
<p><b>Notes:</b></p> <ul style="list-style-type: none"> <li>• Current alignment results in removal of 2 x Coachwood trees (12m &amp; 15m) and an unidentified laurel adjacent to the very large Brush Box, approaching the start of the steps. None of these trees are surveyed so do not appear on plans.</li> <li>• Extent of battering required around this track (and particularly upslope of the steps has not been calculated). Battering may impact unsurveyed vegetation in this (steep) area. See Levels and Grading Plan 02 OF 02.</li> <li>• Due to the high level of localised disturbance around the existing access down the steep slope to the pool below the waterfall, little if any vegetation is likely to be affected by installing steps at this location.</li> </ul>

- Arborist recommends minimising soil disturbance around tree roots (see Australian Standard for Tree Protection Zones). Particularly important for trees adjacent to the stone wall. Recommend that arborist assess prior to construction or implement TPZs.

### **Manns Road Campground**

#### **Calculations for understorey removal in the walk-in camp area (measured on L-202)**

Walk-in camp area: 20m x 20m = 400m<sup>2</sup>

Platforms Area (4) = 4.8m x 3.6m (See Tech Specs in Manual – smallest size platform) = 17.3 x 4 = 69.2m<sup>2</sup>

Note: Advised by Tweed Byron NPWS to assess platforms instead of 'cut' construction with retaining wall shown on plans.

Add 1m around platforms for construction disturbance = 5.8m x 4.6m = 26.7 x 4 = **106.7 m<sup>2</sup>**

Tracks to platforms: none shown on plans – assumed unconstructed footpads which are also used for construction = 2 x 1m (wide) x 10m = 20 m<sup>2</sup>

2 x 1m (wide) x 4m = 8 m<sup>2</sup>. Combined tracks = 20 m<sup>2</sup> + 8 m<sup>2</sup> = **28 m<sup>2</sup>**

**Estimate of direct disturbance (understorey removal) for tracks, platforms and construction = 106.7 m<sup>2</sup> + 28 m<sup>2</sup> = 136 m<sup>2</sup> (135.7)**

#### **Calculations for vegetation removal for campground, access road and carparks (measured on demolition plan)**

Campground and adjoining road: **884 m<sup>2</sup>**

Access road (from Manns Road) and adjoining carpark = **120 m<sup>2</sup>**

Walk in camp carpark = **60 m<sup>2</sup>**

Extension of track to join existing trail (east of campground) = **11 m<sup>2</sup>**

Total of above = **1075m<sup>2</sup>**

Less area of spoil pile and adjoining cleared access = **135 m<sup>2</sup>**

**Final Estimated Total = 1075 – 135 = 940 m<sup>2</sup>**

Note: *Estimated* area of existing northern access road available for revegetation = 90 m<sup>2</sup>