

24.0 VEGETATION MANAGEMENT PLAN, PRECINCTS 1 AND 5 – JAMES WARREN & ASSOCIATES

Implementation and Summary Table

Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
Protection of ecologically significant site values during Construction phase								
VMP-1	Erection of temporary high visibility fencing in accordance with Australian Standard 4970-2009 Protection of Trees	Between Precinct 1 & 5 and vegetation to be retained (EPZs)	To protect retained vegetation (including threatened flora, EECs and SEPP 14 wetlands) from all construction activities	Prior to construction in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 2)	Project 28 Pty Ltd – Site Manager	Temporary fencing installed and maintained where required	Daily checks on fencing condition	In accordance with the Precinct 1 & 5 BMP (JWA 2012)
VMP-2	Erection of temporary signage stating "Environmental Protection Zone – No Unauthorised Entry"	Along all temporary fencing	To notify construction personnel to keep out of Environmental Protection Zones	Prior to construction in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 2)	Project 28 Pty Ltd – Site Manager	Temporary signage installed and maintained where required	Daily checks on signage condition	N/A
VMP-3	Installation of erosion and sediment control devices	Between Precinct 1 & 5 and vegetation to be retained (EPZs)	To prevent the movement of sediment into ecologically sensitive areas and prevent the dispersal of weed seeds and vegetative material	Prior to construction in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 2)	Project 28 Pty Ltd – Site Manager	Erosion and sediment control devices installed where required	Regular inspections to ensure erosion and sediment is controlled and contained within Precinct 1 & 5	In accordance with the Erosion & Sediment Control Plan (Gilbert & Sutherland, July 2012)
Protection of ecologically significant site values during Operational phase								
VMP-4	Erection of permanent signage	Along the margins of Environmental Protection Zones and Roadways	Notification of EPZs / Koala habitat and the possibility of encountering Koalas	Immediately after bulk earthworks have been completed	Project 28 Pty Ltd – Site Manager	Signage has been erected at intervals no greater than 100m	Signage condition monitored and maintained	In accordance with the KPOM (JWA 2012) and Precinct 1 & 5 BMP (JWA 2012)
VMP-5	Water quality monitoring	Appropriate locations adjacent to	To ensure significant impacts to SEPP 14 wetlands are avoided	Prior to and during construction phase and during	Qualified environmental consultant	Regular water quality monitoring completed	Report raw data and results to TSC	In accordance with the Overall Water

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Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
		Precinct 1 & 5		operational phase				Management Plan (Gilbert & Sutherland, July 2012)
Restoration, enhancement and management of retained vegetation								
VMP-6	Stockpiling and re-use of topsoil	Native vegetation rehabilitation areas (i.e. Ecological buffers and EPZs)	To promote the natural regeneration of native vegetation	At commencement of Stage 1 earthworks in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 2)	Project 28 Pty Ltd – Site Manager	Top soil stockpiled and used ASAP after stripping to prevent loss of seed viability	N/A	Stripping topsoil immediately after summer seed drop may improve the germinable seed load (Berg 1975)
VMP-7	Weed Control	In the vicinity of Precinct 1 & 5	To permanently remove weeds and enable the protection of EPZs	During and after construction in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 2)	Project 28 Pty Ltd – Site Manager	All weeds removed / controlled in the vicinity of Precinct 1 & 5	Regular inspections to ensure weeds are under control	In accordance with the Precinct 1 & 5 WMP (JWA 2012)
VMP-8	Regeneration and revegetation (as detailed in Section 24.3.4 of this VMP)	Ecological buffers and EPZs	To assist natural regeneration, plant Koala food trees, provide core Acid frog habitat and revegetate heathland communities	On completion of bulk earthworks. Planting in wetter months (i.e. late summer/autumn) in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 2)	Bush Regeneration Company / Site manager	All designated regeneration / revegetation areas rehabilitated	Regular inspections to ensure plants are healthy and becoming established	In accordance with the KPOM (JWA 2012) and Precinct 1 & 5 TSMP (JWA 2012)
VMP-9	Rehabilitation monitoring (as detailed in Section 24.4.2 of this VMP)	Rehabilitation zones	To assess the health of rehabilitated areas and help to prioritise management actions	- Six (6) weeks after primary weeding - Six (6) weeks after initial plant-out - Every six (6) months thereafter until groundcovers are	Qualified Ecologist	Monitoring has been completed at specified intervals and Performance Criteria met (refer Section 24.4.6 of this VMP)	Report prepared following each inspection by the qualified ecologist. At the end of each year a detailed report will be prepared	N/A

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Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
				sufficiently established (i.e. 2-3 years) Annually after establishment until completion criteria are met (refer Section 24.4.6)		Performance criteria: Foliage Projective Cover (%) assessed using eye estimates or photo points (i.e. FPC of native vegetation increasing after each monitoring visit); species composition targets will be based on accepted benchmarks for the specific vegetation communities on the Kings Forest site (NEH 2012); noxious and environmental weeds are to be eradicated; infrastructure functional and well-maintained in a state suitable for hand over to Tweed Shire Council; natural recruitment of native seedlings throughout planting areas; and plantings providing variable habitats for native fauna species. Completion criteria: When performance criteria have been met, completion will have occurred.	for DECCW (refer Section 24.4.7 of this VMP)	

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24.1 Introduction

24.1.1 Executive Summary

The Kings Forest Stage 1 Project Application No. MP 08_0194 was lodged in November 2011. The Application and Environmental Assessment Report was advertised from December 2011 to January 2012 following which 302 public submissions and 10 agency submissions were received.

As a result of the submissions, amendments to the project have been made. The amended project contains the following key elements (NB: these elements will be revised and updated as the amended project is finalised).

- ♦ Subdivision to create new lots for future development;
 - Bulk earthworks across the site;
 - Road works comprising:
 - construction of the entrance road into the site and associated intersection works on Tweed Coast Road;
 - alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- ♦ Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- ♦ Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- ♦ The Plan of Development for Precinct 5.

This revised Vegetation Management Plan (VMP) addresses the amendments to the project and the key issues raised in the submissions.

24.1.2 Aims & Objectives

The aim of the Precinct 1 & 5 Vegetation Management Plan (VMP) is to protect and enhance the available habitat for fauna and flora (including threatened species) within the vicinity of Precincts 1 & 5. **FIGURE 1 (APPENDIX 2)** shows the final Precinct Plan for the Kings Forest site. **FIGURE 2 (APPENDIX 2)** shows the final Scope of Works Plan.

Specific objectives of this VMP are to:

- ♦ Protect the environmentally significant site values from bulk earthworks and construction activities;
- ♦ Provide permanent protection for the environmentally significant values within the vicinity of Precincts 1 & 5 (i.e. threatened flora and fauna species, SEPP 14 Wetlands and Endangered Ecological Communities);
- ♦ Assisted natural regeneration is to be utilised where appropriate; and
- ♦ Restore, enhance and manage the retained and protected vegetation including providing guidelines for:
 - The revegetation of ecological buffers to Environmental Protection Zones, SEPP 14 Wetlands and the Cudgen Nature Reserve; and
 - The management and rehabilitation of significant areas of Koala habitat (as recommended in the Kings Forest Stage 1 Koala Plan of Management [JWA 2012]).

24.1.3 Plan Requirements

This VMP has been prepared in accordance with DGR 9.4 which states:

“Updates are to be provided, where relevant, for the various management plans for koalas, vegetation, threatened species, feral animals weeds, the buffers, and the golf course providing where relevant details on timelines for implementation of recommended works including maintenance periods and measurable performance and completion criteria. Each plan is to consider all other plans for the site to ensure that management strategies do not conflict and that each plan can be implemented without negatively impacting on the objectives of another.”

This VMP has also been prepared to comply with Clause C2 of the modified Concept Approval as follows:

Vegetation Management Plan

“Each Vegetation Management Plan update is to provide details on:

- 1. the short, medium and long term measures to be implemented to rehabilitate degraded areas, and manage remnant vegetation and habitat within the buffers and Environmental Protection zoned land within the site.*
- 2. revegetation and regeneration including establishment of appropriate canopy (including koala feed trees), sub-canopy, understorey and ground strata.*
- 3. rehabilitation of creeks and drainage lines.*
- 4. conserving and re-using, where appropriate, the soil seed bank where good quality native vegetation is being removed.*
- 5. collection and propagation of endemic native seed for revegetation on the site.*
- 6. monitoring of water quality and vegetation health within buffers and environmental protection zoned areas.*
- 7. the design, regeneration/revegetation and management of the east-west wildlife corridor/s.*
- 8. measurable performance criteria are to be based on appropriate reference sites within the adjacent Cudgen Nature Reserve.”*

24.1.4 Relationship to other Management Plans

Additional to this VMP, the following Management Plans relevant to Precincts 1 & 5 have been prepared for the Stage 1 Project Application, and should be read in conjunction with this VMP:

- Kings Forest Stage 1 Project Application: Precinct 1 & 5 Threatened Species Management Plan (Precinct 1 & 5 TSMP) (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 1 & 5 Buffer Management Plan (Precinct 1 & 5 BMP) (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 1 & 5 Weed Management Plan (Precinct 1 & 5 WMP) (JWA 2012); and
- Kings Forest Stage 1 Project Application: Flora and Fauna Monitoring Report (FFMP) (JWA 2012).

24.2 Management Strategies

24.2.1 Introduction

The following sections outline proposed management strategies to protect and enhance the available habitat for fauna and flora (including threatened species) within the vicinity of Precincts 1 & 5. The following strategies are addressed:

- Protection of ecologically significant site values during Construction phase;
- Protection of ecologically significant site values during Operational phase; and
- Restoration, enhancement and management of retained vegetation

24.2.2 Protection of Ecologically Significant Site Values During Construction Phase

Vegetation Protection

During construction activities, temporary high visibility fencing will be erected to assist in the protection of the retained vegetation from all construction activities by restricting access from machinery and contractors. This fencing will be erected in accordance with Australian Standard 4970-2009 Protection of Trees and with the requirements of the Precinct 1 & 5 BMP (JWA 2012). Temporary signage will be provided along all temporary fencing during the construction phase stating "Environmental Protection Zone – No Unauthorised Entry".

No machinery, rubbish or spoil will be stored within retained vegetation during the construction phase of the development. Vehicle wash-down areas or access tracks will not be located in or immediately adjacent to retained vegetation.

Protection of Threatened Flora

A detailed Precinct 1 & 5 TSMP (JWA 2012) has been prepared outlining specific and detailed management procedures for the protection of Threatened flora species, which occur within the vicinity of Precincts 1 & 5.

Protection of EECs

Temporary high visibility fencing in accordance with Australian Standard 4970-2009 Protection of Trees will be erected to protect retained vegetation (as described above in Vegetation Protection) and will guard against damage to EEC's during the construction phase of the development. Signage will be provided along all temporary fencing during the construction phase stating "Environmental Protection Zone – No Unauthorised Entry".

No machinery, rubbish or spoil will be stored within EEC's during the construction phase of the development. Vehicle wash-down areas or access tracks will not be located in or immediately adjacent to EEC's.

Protection of SEPP 14 Wetlands

The SEPP 14 Wetlands adjacent to Precincts 1 & 5 are well within the vegetated areas that will be retained. Temporary high visibility fencing in accordance with Australian Standard 4970-2009 Protection of Trees, will be erected to protect retained vegetation (as described above in Vegetation Protection). The fencing will guard against damage to SEPP 14 Wetlands during the construction phase of the development.

Furthermore, erosion and sediment control devices shall be installed prior to commencement of earth works within Precincts 1 & 5 in accordance with the Erosion & Sediment Control Plan (Gilbert & Sutherland, July 2012). This will prevent the movement of sediment into ecologically sensitive areas as well prevent the dispersal of weed seeds and vegetative material.

No machinery, rubbish or spoil will be stored within SEPP 14 Wetlands during the construction phase of the development. Vehicle wash-down areas or access tracks will not be located in or immediately adjacent to SEPP 14 Wetlands.

24.2.3 Protection of Ecologically Significant Values During Operational Phase

Vegetation Protection

A Koala-proof fence will be constructed in accordance with the Stage 1 KPOM with the primary aim of preventing Koala access to residential areas (JWA 2012). This fence will also provide permanent protection to the vegetation by preventing pedestrian and vehicular access during the operational phase. Locked gates will be located where necessary to allow for maintenance.

Permanent signage will be provided along the edges of ecological buffers in accordance with the Precinct 1 & 5 BMP (JWA 2012).

Protection of Threatened Flora

The threatened flora species recorded within the vicinity of Precincts 1 & 5 will generally not require individual permanent fencing protection. Permanent Koala-proof fencing to be erected (as described above in Vegetation Protection) will provide permanent protection to the majority of threatened flora species by preventing pedestrian and vehicular access during the operational phase.

A detailed Precinct 1 & 5 TSMP (JWA 2012) has been prepared outlining specific and detailed management procedures for the protection of threatened flora species, which occur within the vicinity of Precincts 1 & 5.

Permanent signage will be provided along the edges of ecological buffers in accordance with the Precinct 1 & 5 BMP (JWA 2012).

Protection of EECs

The EEC's recorded within the vicinity of Precincts 1 & 5 will not require individual permanent fencing protection. Permanent Koala-proof fencing to be erected (as described above in Vegetation Protection) will provide permanent protection to EEC's by preventing pedestrian and vehicular access during the operational phase.

Protection of SEPP 14 Wetlands

The SEPP 14 Wetlands recorded within the vicinity of Precincts 1 & 5 will not require individual permanent fencing protection. Permanent Koala-proof fencing to be erected (as described above in Vegetation Protection) will provide permanent protection to SEPP 14 wetlands by preventing pedestrian and vehicular access during the operational phase.

A detailed water quality monitoring program is included in the Overall Water Management Plan (Gilbert & Sutherland, July 2012) and will ensure that significant impacts on adjacent SEPP 14 Wetlands are avoided.

24.2.4 Restoration, enhancement and management of retained vegetation

Strategies for the restoration, enhancement and maintenance of significant areas of vegetation, including SEPP 14 wetlands, Environmental Protection Zones and EEC's, are detailed in the Action Plan (i.e. Section 24.3). Restoration, enhancement and management techniques include:

- Weed control;
- Regeneration/revegetation;
- Pest management; and
- Adaptive management

The implementation of these management actions will increase both the quantity and quality of native habitat available to indigenous flora and fauna on the Kings Forest site. All areas of proposed heath retention/restoration will be located within either Environmental Protection Zones or ecological buffers and will be dedicated to either the Office of Environment and Heritage (OEH) or Tweed Shire Council (TSC). This will ensure their long-term protection.

It is recommended that no machinery, rubbish or spoil be stored, nor any vehicle wash-down areas or access tracks be located within retained vegetation.

24.3 Action Plan

24.3.1 Introduction

The following sections detail the actions required to ensure the aims and objectives of the VMP are met. The action plan includes the following measures:

- Re-use of topsoil;
- Weed control;
- Regeneration/revegetation measures; and
- Adaptive management

24.3.2 Re-use of topsoil to promote natural regeneration

Topsoil is an important source of seeds and propagules and has been effectively used in rehabilitation of native vegetation communities (e.g. [Bellairs & Bell 1993](#); [Koch & Ward 1994](#); [Ward et al. 1996](#)). Therefore, handled correctly, the topsoil seedbank can be used to successfully revegetate after disturbances like bulk earthworks.

As much of the Kings Forest site has been cleared of native vegetation for some time, due to historical land uses, not all of the land to be developed will contain a topsoil seedbank. Therefore, as a condition of consent, areas to be developed where a topsoil seedbank is likely to occur will be mapped and topsoil conserved in these areas for re-use in revegetation areas where appropriate. At the commencement of the Stage 1 earthworks at Kings Forest, stockpiles of topsoil will be created. This soil will then be used in the regeneration of the heath communities within buffer zones and EPZs.

To optimise the recovery of native vegetation rehabilitation areas it is important to consider the manner in which the top soil is handled. The following should be considered:

- It is important to consider the timing of topsoil recovery. Stripping topsoil immediately after summer seed drop may improve the germinable seed load ([Berg 1975](#));
- The seed bank is usually concentrated in the upper soil layer (i.e. 40–50mm) so it is important to only remove this depth of soil. A greater depth will dilute the seed bank and reduce the effectiveness of the soil as a potential mechanism for natural regeneration (Putwain & Gillham 1990);
- Topsoil should be used as soon as possible after stripping to prevent loss of seed viability ([Koch et al. 1996](#); [Mahesh et al. 1996](#)); and
- Top soil should be replaced at maximum depths of 100mm ([Rokich et al. 2000](#))

Refer to APPENDIX 1 for a specific seedbank translocation methodology for the Kings Forest site.

24.3.3 Weed control

Due to the significant disturbance history, Kings Forest supports a variety of weed species. Slash Pine (*Pinus elliottii*) is the most common. Plantations have resulted in the species being naturalised on the site. Progeny range in size from small seedlings to trees 15-20 metres. In some areas of the site, there is significant invasion into native vegetation communities, while in other areas there may be only one or two plants.

The aim of weed control within the vicinity of Precinct 1 & 5 is the permanent removal of weeds to enable the protection of Environmental Protection Zones and the Cudgen Nature Reserve. Harvesting of Slash Pine is to be completed as soon as possible to remove the continuing input of wilding propagates.

Disturbance during the construction phase will create an opportunity for weeds to colonise and establish, therefore weeds should be diligently controlled during and after construction in accordance with the Precinct 1 & 5 WMP (JWA 2012).

24.3.4 Regeneration and Revegetation Measures

Background

Rehabilitation/regeneration works to be completed within Precinct 1 & 5 Environmental Protection Zones and ecological buffers will generally include a combination of:

- Assisted natural regeneration where appropriate;
- Planting of preferred Koala food trees in accordance with the KPOM (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** and **APPENDIX 1** in the Precinct 1 & 5 Buffer Management Plan (BMP) (JWA 2012));
- Creation of core acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** and **APPENDIX 1** in the Precinct 1 & 5 BMP (JWA 2012)); and
- Regeneration/revegetation of heath communities (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** and **APPENDIX 1** in the Precinct 1 & 5 BMP (JWA 2012))

It should be noted that there is some overlap in the characteristics and objectives of proposed regeneration/revegetation areas at the Kings Forest site. For example, Koala food tree planting areas will also provide opportunities for revegetation with heath species (i.e. Koala food tree species will form the canopy with heath species forming the sub-canopy and understorey). Similarly, the creation of Wallum sedge

frog compensatory habitat (TSMP [JWA 2012]) provides an opportunity for further planting of scattered Koala food trees and wet heath species. The resulting revegetation areas will be structurally diverse and more closely mimic intact native vegetation communities (Refer to **APPENDIX 4** KPOM).

A suitably qualified bush regeneration company will be engaged to complete necessary rehabilitation works. The bush regeneration company will employ qualified bush regenerators, including a regeneration site manager who will be responsible for all project management and staff supervision.

Techniques to be employed to facilitate natural regeneration will be in accordance with those promoted by the Australian Association of Bush Regenerators (AABR).

24.3.5 Work Areas

The Revised Vegetation Management Plan (Landpartners 2009) identifies sixteen (16) work areas across the Kings Forest site. Work Areas 2, 13 and 15 are relevant to Precinct 1 & 5 Environmental Protection Zones (**FIGURE 3, APPENDIX 2**).

Furthermore, portions of the Precinct 1 & 5 ecological buffers have been identified as requiring regeneration and/or revegetation works during recent site assessments and occur outside of the LandPartners work areas. These are included in the following works schedule as 'Additional Work Areas' and are also detailed in the Precinct 1 & 5 Buffer Management Plan (JWA 2012).

24.3.6 Works schedule

The land will be revegetated/remediated and dedicated on a staged basis as soon as practical after adjacent subdivision works have been approved, or earlier subject to agreement between the parties. The staging of works will generally be based on the sequence of bulk earthworks (**FIGURE 2, APPENDIX 2**) as shown in **TABLE 1**. The following works schedule summarises the works relevant to the Environmental Protection Zones and associated ecological buffers within the area subject to this VMP.

TABLE 1
VMP STAGING OF WORKS

Earthworks sequencing	Work areas
Stage 1	2 & 13
Stage 1/2	15

Work Area & Location	Proposed Measures	Comments
2 Southern side of Depot Rd, North Eastern corner of site	➤ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping should also be considered where appropriate to promote natural heath regeneration. ➤ Koala food trees also to be planted in accordance with FIGURE 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012). ➤ Management of native vines within canopy on eastern margins. Vines to be cut at head height and at the base, but not poisoned. Particular attention to be paid to management of vines smothering the Threatened White-lace flower (refer Precinct 1 & 5 TSMP (JWA 2012)).	➤ A number of specimens of the threatened species Southern swamp orchid (<i>Phaius australis</i>) occur within the paperbark community. Any weed species within the vicinity of these plants should be hand removed. Further protection measures are discussed in the Precinct 1 & 5 TSMP (JWA 2012). ➤ Works to be completed in wetland areas (particularly SEPP 14 wetlands) will be completed during the drier months (June to September). ➤ Property boundaries must be clearly marked so that no works encroach into the adjacent Cudgen Nature Reserve.
13 Mid-Eastern portion of site	➤ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) and are to be revegetated with heath species (FIGURE 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Areas currently comprised of regrowth heath communities to be rehabilitated through assisted regeneration techniques (FIGURE 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping should be considered where appropriate to promote natural heath regeneration. ➤ Koala food trees also to be planted in accordance with the KPOM (FIGURE 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)).	➤ A number of specimens of the threatened species Southern swamp orchid (<i>Phaius australis</i>) occur within the paperbark community. Any weed species within the vicinity of these plants should be hand removed. Further protection measures are discussed in the Precinct 1 & 5 TSMP (JWA 2012). ➤ A single specimen of the threatened species Stinking cryptocarya (<i>Cryptocarya foetida</i>) occurs adjacent to the access track. Weed species within the vicinity of this tree should be hand removed. Further protection measures are discussed in the Precinct 1 & 5 TSMP (JWA 2012). ➤ Works to be completed in wetland areas (particularly SEPP 14 wetlands) will be completed during the drier months (June to September). ➤ Property boundaries must be clearly marked so that no works encroach into the adjacent Cudgen Nature Reserve.
15 Central SEPP14 Wetlands	➤ Inner 30m buffer is to be established to the EPZ. This buffer will be the focus for the creation of core acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) and are to be revegetated with heath species (FIGURE 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping should be considered where appropriate to promote natural heath regeneration. ➤ Koala food trees also to be planted in accordance with the KPOM (FIGURE 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)).	➤ Works to be completed in wetland areas (particularly SEPP 14 wetlands) will be completed during the drier months (June to September).

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Work Area & Location	Proposed Measures	Comments
Additional work areas	➤ Inner 30m buffer is to be established to Cudgen Nature Reserve between Work areas 2 & 13, and also the EPZ between Work areas 13 & 15 and along the northern boundary of work area 13. These buffer areas will be the focus for the creation of core acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) and are to be revegetated with heath species (FIGURE 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping should be considered where appropriate to promote natural heath regeneration.	

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24.3.7 Methodology

Planting methods

A general methodology for the planting of any trees/shrubs or groundcovers is as follows:

- Stockpiled topsoil is to be spread within revegetation areas where required.
- Where exotic grasses occur within planting areas they are to be sprayed with Glyphosate at least 2 weeks prior to planting.
- Plant holes to be dug to at least twice the root ball height and width.
- Soil is to be loosened, wetted and then the plant hole to be back filled with excavated soil.
- Weed free mulch should be applied to a minimum 75mm depth around the base of the plants but not adjacent to the stem.
- Plantings are to be protected with bags (e.g. gro-bags) held in position with bamboo stakes.
- Appropriate wallaby protection measures must be implemented to optimise survival of plantings (refer 'Wallaby Protection' section below).
- Plantings are to be watered for the first 3 months. Heavy mulching will reduce the need for regular watering, provided it is replaced at between 6-12 month intervals.
- When planting seedlings, slow release fertilisers and water crystals should be used to manufacturers recommendations to maximise survival rates.
- Ongoing monitoring of native species recruitment maintenance of enhancement planting works and control of environmental weeds are to be undertaken throughout the proposed five year plan and beyond.
- Native species from locally sourced seed stock only are to be planted. Consideration should be given to setting up an on-site nursery to assist in the collection and propagation of endemic native seed for revegetation on the site. Alternatively, plants should only be sourced from local nurseries that can provide proof of local provenance (i.e. within 20kms of the site).
- Revegetation is to include canopy as well as sub-canopy and understorey species (Section 24.3.5). Canopy species will generally be comprised of Koala food tree species. Sub-canopy and understorey species will generally be comprised of heath species. A species list is also provided for revegetation in areas not suitable for Koala feed trees and/or heath species.
- Plant spacing is flexible, for instance in areas which act as Asset Protection Zones, spacing of canopy trees will be greater (e.g. 10m). Generally, plants are spaced according to the following prescriptions:
 - 3m spacing for trees (upper canopy plants),
 - 1.5m spacing for shrubs and small trees (midstorey plants), and
 - 1m spacing for groundcover (ground storey plants up to 1.5m in height).
- Plantings should occur during wetter months (January to May).

Wallaby protection

The site is inhabited by a large population of Swamp wallabies which are likely to browse any newly planted trees, causing potential death of plants. A combination of the following measures should be considered for the protection of plants on a site by site basis:

- protective bags;
- wallaby repellents (e.g. Sen-Tree®); and
- wallaby-proof fencing using star pickets and pig mesh.

Koala-proof fencing (JWA 2012) may also exclude wallabies from some planting areas.

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Koala Feed Trees

Planting of Koala feed and shelter trees is recommended within numerous work zones to establish linkages between areas of Koala habitat and to increase foraging resources for the species at the site in the long term (in accordance with the Stage 1 KPoM [JWA 2012]) (**FIGURE 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012)). Faecal cuticle analysis undertaken by James Warren & Associates (Warren 2000) showed that the main species consumed by Koalas at the time of the SIS were Swamp mahogany (*Eucalyptus robusta*) and Swamp box (*Lophostemon suaveolens*) with smaller amounts of Brushbox (*L. confertus*), Blackbutt (*E. pilularis*) and Broad-leaved paperbark (*Melaleuca quinquenervia*).

Therefore, tree species nominated for planting include known feed tree species identified at the site (Swamp mahogany and Swamp box) in addition to other species such as Brushbox and Blackbutt (as per JWA), Red mahogany, Tallowwood and Forest red gum (Approved Koala Recovery Plan, DECC 2008). Koala feed trees should only be planted where conditions are appropriate for each particular species (i.e. soils, topography, vegetation) so that plantings are compatible with any existing natural vegetation. For example, species such as Tallowwood should be planted in higher elevation parts of the site, while planting in Precincts 1 & 5, which occurs in proximity to large areas of naturally occurring vegetation should be more conservative in its species selection and utilise species which commonly occur in surrounding vegetation (e.g. Swamp mahogany, Swamp box, Forest red gum). Areas identified within the KPoM (JWA 2012) for planting preferred Koala food trees are shown in **FIGURE 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012).

Acid Frog Compensatory Habitat

It is proposed to create core acid frog habitat within Environmental Protection Zones (EPZs) and ecological buffers on the Kings Forest site in accordance with the Precinct 1 & 5 TSMP (JWA 2012). Areas requiring rehabilitation works within EPZs and buffers will be targeted for the creation of core acid frog habitat.

The compensatory habitat areas will be planted with a combination of Swamp sclerophyll (i.e. Swamp mahogany & Broad-leaved paperbark) and wet heath species.

Heath regeneration/revegetation

FIGURE 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012) identifies proposed rehabilitation areas on the subject site, which are currently comprised of regenerating heath communities, or are suitable for revegetation with heath species. The basis for revegetation with wet vs. dry heath vegetation will be determined by the topography of each revegetation area. Species lists are provided in **Section 24.3.9**.

Enhancement Plantings

In areas where extensive weed infestations have been removed, or where Slash pine has been harvested (i.e. leaving large cleared areas), that are not suitable for revegetation with Koala food trees or heath regeneration/restoration, enhancement plantings with other locally endemic species will be completed. Additional species lists for each work area are provided in **Section 24.3.9**.

24.3.8 Species Schedule

Heath species

Where heath revegetation is necessary (**FIGURE 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012)), the following sub-canopy and understorey species are to be utilised:

Common name	Botanical name
Dry heath species*	
Sweet wattle	<i>Acacia suaveolens</i>
Prickly moses	<i>Acacia ulicifolia</i>
Heath aotus	<i>Aotus ericoides</i>
Wooly aotus	<i>Aotus lanigera</i>
Starhair bush	<i>Astrotricha longifolia</i>
Midgenberry	<i>Austromyrtus dulcis</i>
Wallum banksia	<i>Banksia aemula</i>
Heath-leaved banksia	<i>Banksia ericifolia</i>
Hairpin banksia	<i>Banksia spinulosa</i> var. <i>collina</i>
Leafless bossiaea	<i>Bossiaea ensata</i>
Variable bossiaea	<i>Bossiaea heterophylla</i>
Showy bossiaea	<i>Bossiaea rhombifolia</i>
Milkmaids	<i>Burchardia umbellata</i>
Curly wigs	<i>Caustis recurvata</i>
Christmas bush	<i>Ceratopetalum gummiferum</i>
Pink matchheads	<i>Comesperma ericinum</i>
Blue dampiera	<i>Dampiera stricta</i>
Blue flax-lilly	<i>Dianella caerulea</i>
Rolled flax-lilly	<i>Dianella revoluta</i>
Eggs & bacon pea	<i>Dillwynia retorta</i>
Hopbush	<i>Dodonaea triquetra</i>
Wiry panic	<i>Entolasia stricta</i>
Wallum heath	<i>Epacris pulchella</i>
Pinnate wedge pea	<i>Gompholobium pinnatum</i>
Slender bloodroot	<i>Haemodorum tenuifolium</i>
Narrow-leaved guinea flower	<i>Hibbertia linearis</i>
Hoary guinea flower	<i>Hibbertia obtusifolia</i>
Hairy guinea flower	<i>Hibbertia vestita</i>
Dogwood	<i>Jacksonia scoparia</i>
Wire lilly	<i>Laxmannia gracilis</i>
Sword sedge	<i>Lepidosperma laterale</i>
Knotted scale-rush	<i>Lepyrodia interrupta</i>
Erica heath	<i>Leucopogon ericoides</i>
Lance beard heath	<i>Leucopogon lanceolatus</i>
Wire beard-heath	<i>Leucopogon microphyllus</i>
Coast beard heath	<i>Leucopogon parviflorus</i>
Common beard-heath	<i>Leucopogon virgatus</i>
Screw fern	<i>Lindsaea linearis</i>

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Common name	Botanical name
Long-leaved matrush	<i>Lomandra longifolia</i>
Many-flowered matrush	<i>Lomandra multiflora</i>
Crinkle bush	<i>Lomatia silaifolia</i>
Large nectar heath	<i>Melichrus adpressus</i>
Jam tarts	<i>Melichrus procumbens</i>
Broom heath	<i>Monotoca elliptica</i>
Prickly-leaved monotoca	<i>Monotoca scoparia</i>
White dogwood	<i>Ozothamnus diosmifolius</i>
Small-leaved geebung	<i>Persoonia virgata</i>
Candlesticks	<i>Petrophile canescens</i>
Heath phyllota	<i>Phyllota phyllicoides</i>
Slender riceflower	<i>Pimelea linifolia</i>
Heathy platysace	<i>Platysace ericoides</i>
Shrubby platysace	<i>Platysace lanceolata</i>
Pomax	<i>Pomax umbellata</i>
Bracken	<i>Pteridium esculentum</i>
Green styphelia	<i>Styphelia viridis</i>
Black-eyed susan	<i>Tetradlea thymifolia</i>
Kangaroo grass	<i>Themeda australis</i>
Yellow rush-lilly	<i>Tricoryne elatior</i>
Austral bluebell	<i>Wahlenbergia gracilis</i>
Woolisia	<i>Woolisia pungens</i>
Wooly xanthosia	<i>Xanthosia pilosa</i>
Twiggy zieria	<i>Zieria minutiflora</i>
Sandfly zieria	<i>Zieria smithii</i>
Wet heath species*	
Swamp wattle	<i>Acacia elongata</i>
Heath aotus	<i>Aotus ericoides</i>
Wooly aotus	<i>Aotus lanigera</i>
Heath myrtle	<i>Baeckea imbricata</i>
Feather plant	<i>Balioskion pallens</i>
Feathertop	<i>Balioskion tetraphyllum</i>
Heath banksia	<i>Banksia ericifolia</i>
Swamp banksia	<i>Banksia robur</i>
Jointed twig-rush	<i>Baumea articulata</i>
Wallum boronia	<i>Boronia falcifolia</i>
Swamp boronia	<i>Boronia parvifolia</i>
Milkmaids	<i>Burchardia umbellata</i>
Wallum bottlebrush	<i>Callistemon pachyphyllus</i>
Curly wigs	<i>Caustis recurvata</i>
Swamp parrot pea	<i>Dillwynia floribunda</i>
Tall sundew	<i>Drosera auriculata</i>
Rosette sundew	<i>Drosera spathulata</i>
Spreading rope-rush	<i>Empodisma minus</i>
Coral heath	<i>Epacris microphylla</i>

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Common name	Botanical name
Blunt-leaf heath	<i>Epacris obtusifolia</i>
Swamp mahogany	<i>Eucalyptus robusta</i>
Tall saw-sedge	<i>Gahnia clarkei</i>
Red-fruited saw-sedge	<i>Gahnia sieberana</i>
Coral fern	<i>Gleichenia dicarpa</i>
Rocket goodenia	<i>Goodenia bellidifolia</i>
Slender bloodroot	<i>Haemodorum tenuifolium</i>
Sword sedge	<i>Lepidosperma laterale</i>
Prickly tea-tree	<i>Leptospermum juniperinum</i>
Lemon-scented tea-tree	<i>Leptospermum liversidgei</i>
Slender clubmoss	<i>Lycopodium laterale</i>
Thyme honeymyrtle	<i>Melaleuca thymifolia</i>
Heath phyllota	<i>Phyllota phyllicoides</i>
Slender rice-flower	<i>Pimelea linifolia</i>
Common bog rush	<i>Schoenus apogon</i>
	<i>Schoenus paludosus</i>
Swamp clubmoss	<i>Selaginella uliginosa</i>
Swamp heath	<i>Sprengelia sprengelioides</i>
Spoon-leaf goodenia	<i>Velleia spathulata</i>
Swamp grass-tree	<i>Xanthorrhoea fulva</i>

*The basis for revegetation with wet vs. dry heath species will be determined by the topography of the revegetation area.

Koala food tree species

Where revegetation with preferred Koala food trees is necessary (**FIGURE 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012)), the following canopy species are to be utilised:

Koala food trees	
Tallowwood	<i>Eucalyptus microcorys</i>
Blackbutt	<i>Eucalyptus pilularis</i>
Red mahogany	<i>Eucalyptus resinifera</i>
Swamp mahogany	<i>Eucalyptus robusta</i>
Forest red gum	<i>Eucalyptus tereticornis</i>
Brushbox	<i>Lophostemon confertus</i>
Swamp box	<i>Lophostemon suaveolens</i>
Broad-leaved paperbark	<i>Melaleuca quinquenervia</i>

Additional plant species

Additional canopy, sub-canopy and understorey plant species lists (i.e. for areas not suitable for Koala feed trees and/or heath species) for each work area are as follows:

Work Area 2

All revegetation works in this work unit will utilise Koala food trees and/or heath species.

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Work Area 13

Common name	Botanical name
Black wattle	<i>Acacia melanoxylon</i>
Lilly pilly	<i>Acmena smithii</i>
Black she- oak	<i>Allocasuarina littoralis</i>
Fern-leaved banksia	<i>Banksia oblongifolia</i>
Crimson bottlebrush	<i>Callistemon salignus</i>
Swamp oak	<i>Casuarina glauca</i>
Corkwood	<i>Duboisia myoporoides</i>
Blueberry ash	<i>Elaeocarpus reticulatus</i>
Scribbly gum	<i>Eucalyptus racemosa</i>
Sandpaper fig	<i>Ficus coronata</i>
Cheese tree	<i>Glochidion ferdinandi</i>
Bleeding Heart	<i>Homalanthus populifolius</i>
Cabbage tree palm	<i>Livistona australis</i>
Broad-leaved paperbark	<i>Melaleuca quinquenervia</i>
Elderberry ash	<i>Polyscias sambucifolia</i>

Work Area 15

Common name	Botanical name
Black wattle	<i>Acacia melanoxylon</i>
Lilly pilly	<i>Acmena smithii</i>
Black she- oak	<i>Allocasuarina littoralis</i>
Fern-leaved banksia	<i>Banksia oblongifolia</i>
Crimson bottlebrush	<i>Callistemon salignus</i>
Swamp oak	<i>Casuarina glauca</i>
Corkwood	<i>Duboisia myoporoides</i>
Blueberry ash	<i>Elaeocarpus reticulatus</i>
Scribbly gum	<i>Eucalyptus racemosa</i>
Sandpaper fig	<i>Ficus coronata</i>
Cheese tree	<i>Glochidion ferdinandi</i>
Bleeding Heart	<i>Homalanthus populifolius</i>
Cabbage tree palm	<i>Livistona australis</i>
Broad-leaved paperbark	<i>Melaleuca quinquenervia</i>
Elderberry ash	<i>Polyscias sambucifolia</i>
Macrophytes*	
Baumea	<i>Baumea rubiginosa</i>
Giant sedge	<i>Cyperus exaltatus</i>
Common spikerush	<i>Eleocharis acuta</i>
Rusty sedge	<i>Fimbristylis ferruginea</i>
Giant sedge	<i>Lepironia articulata</i>
Common reed	<i>Phragmites australis</i>
Club rush	<i>Schoenoplectus validus</i>

* Macrophytes to be planted in areas of shallow water and surrounds.

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24.3.9 Adaptive Management

Adaptive management is an approach that involves learning from management actions, and using those lessons to improve upon the overall plan. The principles of adaptive management have been incorporated into the administration of restoration projects within a variety of governmental authorities and programs (Thom 1997). Comprehensive, long-term monitoring is a component of adaptive management as adaptive management strategies rely on the accumulation of evidence supporting decisions that demand changes in action.

An adaptive management approach involves an integrated process of firstly monitoring, then reviewing and responding to the health and conditions of the plantings, natural regeneration and the status of the weed infestation. Alteration to the design and maintenance of works required, to ensure the objectives of the BMP are achieved, are then made.

Adaptive management strategies will be determined by the information provided in monitoring reports. Adaptive management strategies that may be required within this VMP are as follows:

- Amendment of species list for revegetation works;
- Replacement of enhancement plantings that do not survive; and
- Alteration of weed control methods or timing.

Before the implementation of any adaptive management strategy a brief report is be provided to Project 28 Pty Ltd and other relevant agencies detailing the proposed management actions and the predicted outcomes. The implementation must be approved by the relevant authority prior to implementation.

24.4 Monitoring and Reporting

24.4.1 Introduction

Monitoring is an essential component of this VMP and its associated rehabilitation works. Ongoing monitoring of the results of vegetation protection and rehabilitation works is essential throughout the proposed five (5) year plan or until the vegetation is self-sustaining (whichever is the earliest) (also refer FFMR (JWA 2012)). Monitoring and reporting will ensure the continuing success of the vegetation protection and rehabilitation programme by ensuring that activities are meeting set aims and objectives. The results obtained through monitoring will help managers to prioritise management actions and keep track of the health of rehabilitated areas.

Monitoring and reporting can be divided into the following distinct phases:

1. Baseline monitoring (prior to commencement of vegetation protection and rehabilitation works in each Work area);
2. Monitoring by an Ecologist will occur at strategic times; and
3. An annual report will be compiled by the Ecologist that combines the result of the above monitoring.
4. Long-term monitoring of the health and composition of vegetation communities is also proposed, including specific monitoring for impacts on the adjacent Cudgen Nature Reserve.

24.4.2 Rehabilitation Monitoring

Monitoring requirements

The vegetation monitoring will include regular visits by a qualified ecologist who is to complete the following:

- **Transects**
 - Ten (10) transects are to be placed within the retained vegetation areas;
 - Transect locations are to include a combination of retained vegetation, revegetation areas and ecological buffers, and are to be permanently marked;
 - Transects are to be 30 metres in length;
 - During monitoring visits tape measures are to be placed on the ground and the specific measurable features recorded along the transects;
 - Specific measurable features include:
 - Areas of vegetation cover (native species);
 - Areas of weed cover;
 - Areas of bare ground/mud;
 - Number, percentage and species of planted stems surviving;
 - Results are to be shown in a table which is to be presented in the monitoring reports.
- **Quadrats**
 - Three (3) Quadrats (1m²) are to be placed along each of the transects;
 - Quadrats must be placed a minimum of 5m apart along the length of the transect;
 - Quadrats are to be placed randomly within five (5) metres of the transect line;
 - The boundary of the quadrat with respect to the tape measure (e.g. between 3.5 – 4.5 metres on tape measure) will be recorded;
 - For each quadrat the following specific measurable features will be recorded:
 - Plant species occurring
 - Percentage cover
 - Height
 - Relative abundance of native species
 - Weed cover
 - Number, percentage and species of planted stems surviving
 - Results are to be shown in a table which is to be presented in the monitoring reports.
- **Fixed Photo points**
 - A central transect marker on each established monitoring transect is to be used as permanent photo station for photographic monitoring;
 - Four (4) photos are to be taken from each central transect marker. Photos are to be taken to the north, south, east and west;
 - Photos should be labelled with the:
 - Transect code
 - Direction of view
 - The date & time
 - Photos must be supplied in the monitoring reports in a form of prints no smaller than 4" x 6" and must be colour.

24.4.3 Baseline monitoring

Baseline data is to be gathered at each work area prior to the commencement of protection or regeneration works to allow the preparation of more detailed site specific assessments and more relevant performance criteria specific to the vegetation community that is being rehabilitated. Baseline monitoring will include the above assessments (Section 24.4.3), re-mapping of the site vegetation mapping and an assessment of restoration potential of each proposed rehabilitation area. This will assist in documenting vegetation recovery in the long term (refer to the Flora and Fauna Monitoring Report [JWA 2012]).

24.4.4 Timing of monitoring visits

The monitoring is to be completed by a suitably qualified ecologist. Site visits should occur:

- ♦ Six (6) weeks after primary weeding;
- ♦ Six (6) weeks after initial plant-out;
- ♦ Every six (6) months thereafter until groundcovers are sufficiently established (i.e. between two (2) - three (3) years)
- ♦ Annually after establishment until completion criteria are met (refer Section 24.4.7).

24.4.5 Long term Monitoring / Monitoring of impacts on the Cudgen Nature Reserve

Along with the regular monitoring within the EPZs and ecological buffers, the overall vegetation composition is to be regularly assessed and recorded. This long term monitoring should particularly focus on the interface between the Kings Forest site and the Cudgen Nature Reserve to identify any potential impacts (i.e. weed infestations, etc.). Long term monitoring will use both aerial photos and yearly assessments (ground truthing) of the composition and health of the vegetation communities using a hand held GPS.

The long term monitoring of the composition and health of the vegetation communities within the EPZs, ecological buffers and along the interface of the Kings Forest site and the Cudgen Nature Reserve will include:

- ♦ A detailed vegetation map at a scale of 1:5000 is to be completed within the EPZs and ecological buffers every twelve (12) months;
- ♦ A map of any significant weed infestations;
- ♦ Each year, after completion of vegetation mapping, a report is to be completed showing the changes in the composition of the vegetation communities. The results are to be shown in a table that shows the vegetation community and the area of the vegetation community as a percentage of the total area. Monitoring will continue until completion criteria are met (refer Section 24.4.7).

24.4.6 Performance Criteria

The success of the VMP will be regularly evaluated. Performance criteria will be guided by comparisons to baseline data collected in each work area, however a number of criteria will indicate successful rehabilitation of the EPZs and ecological buffers, including:

- ♦ *Foliage Projective Cover (%) assessed using eye estimates or photo points (i.e. FPC of native vegetation increasing after each monitoring visit);*
- ♦ *Species composition targets will be based on accepted benchmarks for the specific vegetation communities on the Kings Forest site;*
- ♦ *Noxious and environmental weeds are to be eradicated;*

- ♦ *Infrastructure functional and well-maintained in a state suitable for hand over to Tweed Shire Council;*
- ♦ *Natural recruitment of native seedlings throughout planting areas; and*
- ♦ *Plantings providing variable habitats for native fauna species.*

Performance criteria will be assessed as follows:

- ♦ *The photos taken during monitoring visits, in combination with the annual monitoring and mapping of native vegetation composition and the results of the annual fauna survey, will be used to determine the extent of native plant species and the levels of biodiversity the area is supporting.*
- ♦ *When it is determined that all performance criteria have been met, completion will have occurred.*

24.4.7 Reporting

Following each inspection by the qualified ecologist, a report will be prepared that will include tables and photographs from the monitoring visits. At the end of each year a detailed report will be prepared for the Department of Environment, Climate Change & Water (DECCW) and Tweed Shire Council. The report will discuss the following:

- ♦ Works undertaken;
- ♦ Progress of regeneration/revegetation areas against completion criteria using photos and tables showing the results of the monitoring visits;
- ♦ Significant problems encountered (death of seedlings, broken fences, vandalism, etc.) and the effect of these on the plantings and aims of the revegetation or regeneration strategy;
- ♦ Success or failures of measures implemented to rectify previously identified problems;
- ♦ Measures to be taken to rectify new problems; and
- ♦ Performance against performance criteria (Section 24.4.7).

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APPENDIX 1 – SOIL SEEDBANK TRANSLOCATION

Methodology

Prior to construction

Prior to the commencement of Stage 1 Bulk Earthworks, vegetation mapping will be updated following baseline data collection (refer Flora and Fauna Monitoring Report [JWA 2012]). Areas that are appropriate for soil translocation (both donor and recipient sites) will be mapped at this time.

Excavation

At the commencement of Stage 1 Bulk Earthworks, soil will be stripped from donor sites to a depth of 40-50mm. Material collected from donor sites will include leaf litter, ground plants and top soil. Excavation work must be carried out as quickly as possible to minimise the amount of time seed-bearing soil is stockpiled and prevent loss of seed viability. It is recommended that the excavation of the donor site only be commenced once the recipient site has been prepared. Stockpiles should be built as long and as low as possible (no more than 1 metre thick), protected by silt fences and covered with weed matting.

Translocation

Recipient areas should be ripped to increase regeneration potential. All translocated soil spread into nominated recipient sites will remain at its original excavated profile (maximum depth of 100mm). Following translocation, machinery must be kept from entering the recipient site due to the risk of further compaction. Logs and large branches collected from the donor site will be hand rolled in to place to provide habitat.

The regeneration will be monitored at the recipient areas for five years post translocation; monitoring floristic diversity and abundance based on accepted benchmarks for the specific vegetation communities on the Kings Forest site will assess the success of the translocation. A suitably qualified bush regeneration company will be engaged to control any weed invasion or erosion problems.

Soil disturbance and exposure of the soil is considered sufficient to stimulate regeneration, however, an ecological burn on the recipient site may be required to stimulate regeneration. Research indicates that burning after soil translocation results in very good initial germination, which produces thick regrowth and limits weed recruitment. However, there are several negative effects attributed to burning:

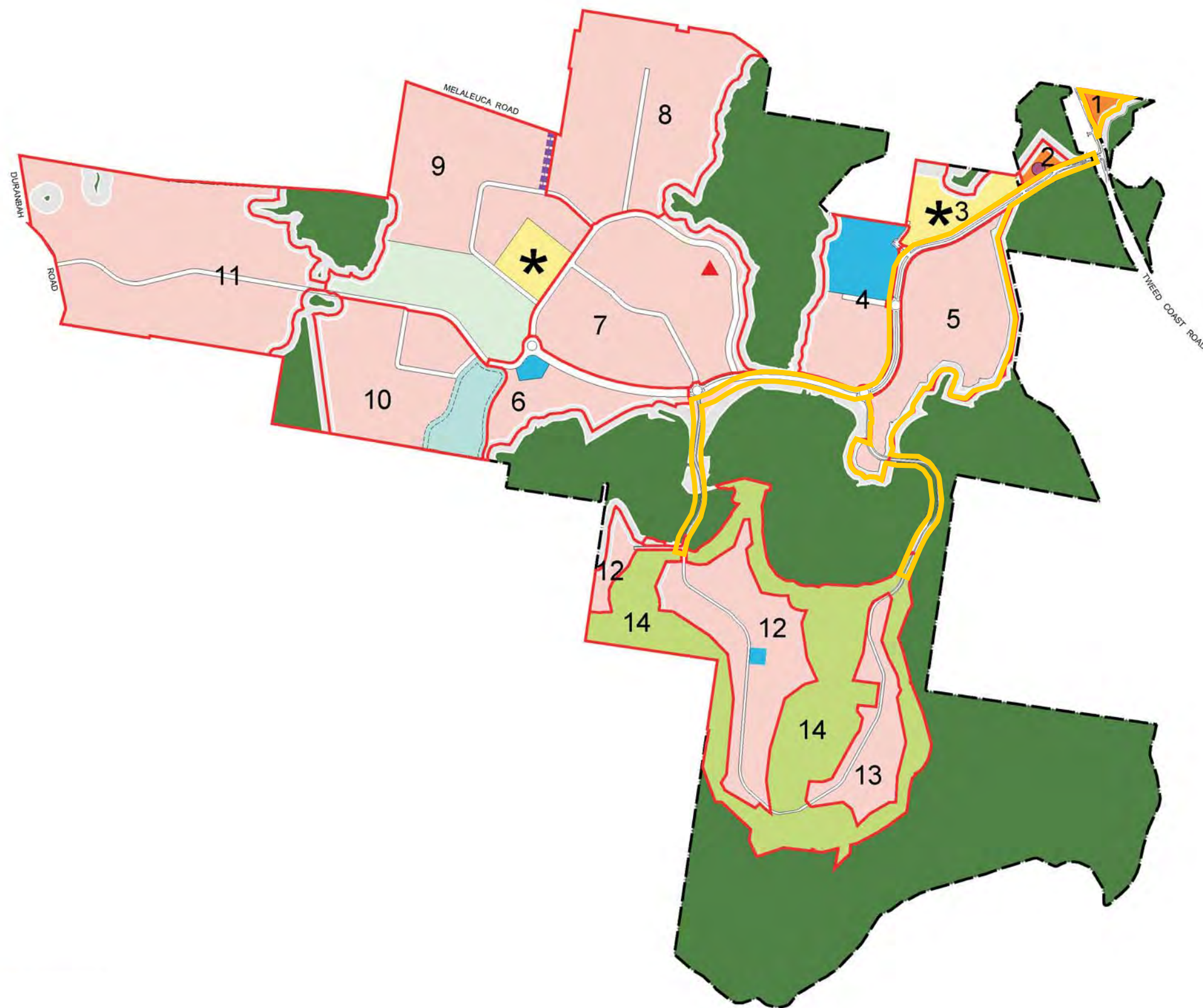
- ♦ the seed bank germinates all at once completely depleting the seed bank;
- ♦ regeneration is of the same age; and
- ♦ due to fast and thick growth, less competitive species may be lost, resulting in a lower-diversity assemblage dominated by second stage pioneers.

For this reason, an ecological burn is only deemed necessary if regeneration fails.

APPENDIX 2 – FIGURES

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- LEGEND**
- Town Centre / Neighbourhood Centre
 - Residential
 - Community Facilities / Education
 - Employment Land
 - Structured Open Space (Active)
(Passive open space to council standards, location subject to urban design)
 - Environmental Protection Area to be Dedicated to Council or NPWS
 - 50m Ecological Buffer
(includes APZ's & roads where approved)
 - ✱ State School Site
 - Proposed Zone Substation
(subject to Country Energy final approval)
 - ▲ Potential Affordable Housing Location
 - Potential Road Connection to Melaleuca Road
 - Private Open Space
 - Golf Course Area
(encompassing ecological buffers where indicated)
 - Private Open Space including Lake
 - Precinct Boundaries
 - Precincts 1 & 5
 - Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: RPS (Ref: 113691-PSP-4a
(PRECINCT PLAN).jpeg)

SCALE: 1 : 20 000 @ A3

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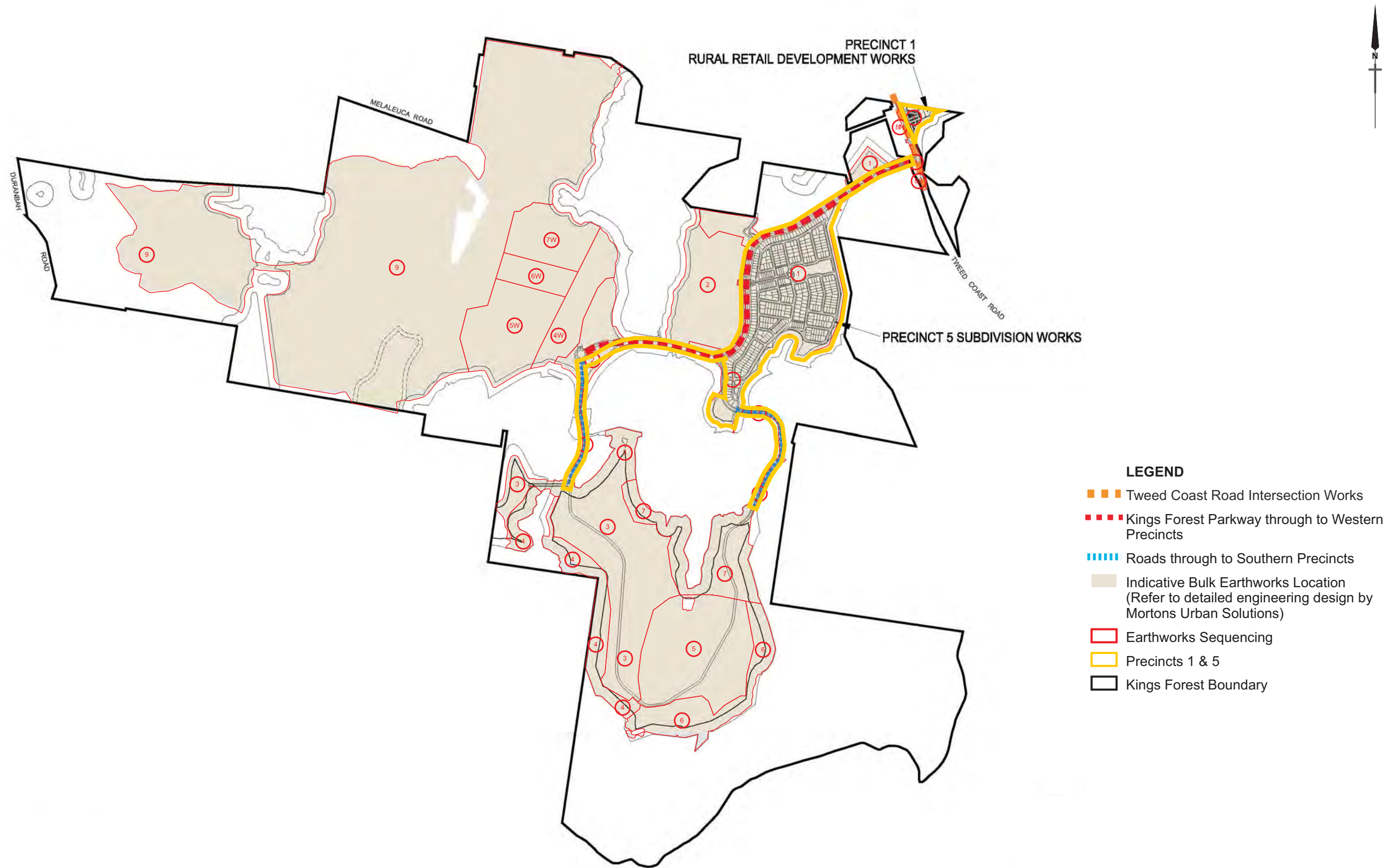
CLIENT
Project 28 Pty Ltd
PROJECT
Kings Forest Stage 1 Project Application
Precincts 1 & 5 - Vegetation Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 1

PREPARED: BW
DATE: 27 August 2012
FILE: N97017_VMP_Precincts.cdr

TITLE

**PRECINCTS
PLAN**



0 500m
1 : 20 000

SOURCE: RPS (Ref: 113691-PSP-4a (SCOPE OF WORKS).jpeg); Mortons Urban Solutions (Ref: sequencing COLOUR.pdf)
SCALE: 1 : 20 000 @ A3
JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

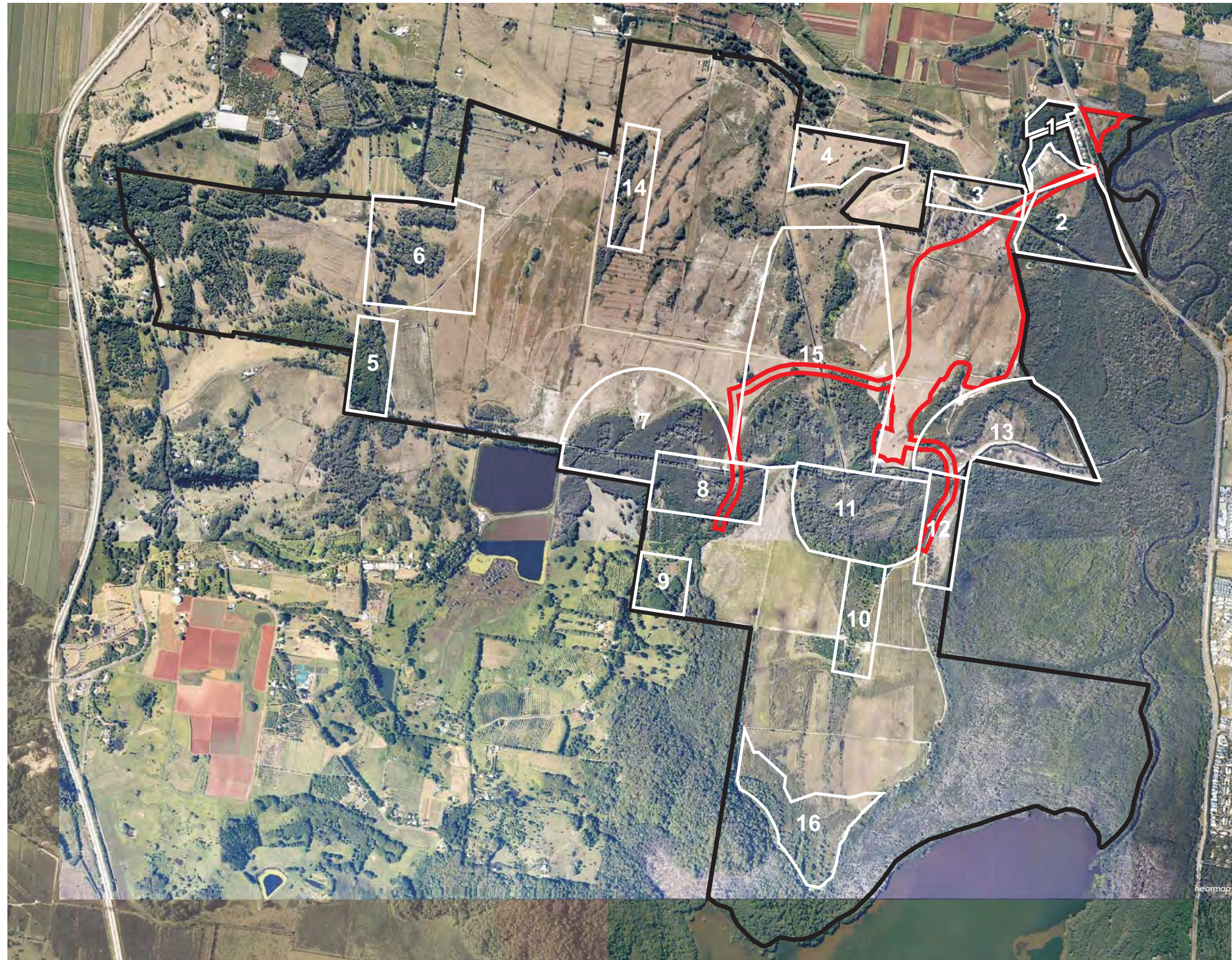
CLIENT
Project 28 Pty Ltd
PROJECT
Kings Forest Stage 1 Project Application
Precincts 1 & 5 - Vegetation Management Plan
Melaleuca Drive, Durambah, NSW
Shire of Tweed

FIGURE 2

PREPARED: BW
DATE: 28 August 2012
FILE: N97017_VMP_Scope.cdr

TITLE

SCOPE OF WORKS



- LEGEND**
- Vegetation Work Unit
 - Precincts 1 & 5
 - Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: Landpartners Revised Vegetation Management Plan (2009) Figure 9 & 2007 Aerial; Near Map June 2011 Aerial
SCALE: 1 : 20 000 @ A3
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CLIENT
Project 28 Pty Ltd
PROJECT
Kings Forest Stage 1 Project Application
Precincts 1 & 5 - Vegetation Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 3

PREPARED: BW
DATE: 20 August 2012
FILE: N97017_VMP_Veg Mgt.cdr

TITLE
**VEGETATION
MANAGEMENT
AREAS**

25.0 VEGETATION MANAGEMENT PLAN, PRECINCTS 2 TO 4 AND 6 TO 11– JAMES WARREN & ASSOCIATES, AUGUST 2012

Implementation and Summary Table

Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
Protection of ecologically significant site values during Construction phase								
VMP-1	Erection of temporary high visibility fencing	Between Precinct 2-4 & 6-11 and vegetation to be retained (EPZs)	To protect retained vegetation (including threatened flora, EECs and SEPP 14 wetlands) from all construction activities	Prior to construction in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 1)	Project 28 Pty Ltd – Site Manager	Temporary fencing installed and maintained where required	Daily checks on fencing condition	In accordance with the Precinct 2-4 & 6-14 BMP (JWA 2012)
VMP-2	Erection of temporary signage stating "Environmental Protection Zone – No Unauthorised Entry"	Along all temporary fencing	To notify construction personnel to keep out of Environmental Protection Zones	Prior to construction in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 1)	Project 28 Pty Ltd – Site Manager	Temporary signage installed and maintained where required	Daily checks on signage condition	N/A
VMP-3	Installation of erosion and sediment control devices	Between Precinct 2-4 & 6-11 and vegetation to be retained (EPZs)	To prevent the movement of sediment into ecologically sensitive areas and prevent the dispersal of weed seeds and vegetative material	Prior to construction in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 1)	Project 28 Pty Ltd – Site Manager	Erosion and sediment control devices installed where required	Regular inspections to ensure erosion and sediment is controlled and contained within Precinct 2-4 & 6-11	In accordance with the Erosion & Sediment Control Plan (Gilbert & Sutherland 2012)
Protection of ecologically significant site values during Operational phase								
VMP-4	Erection of permanent signage	Along the margins of Environmental Protection Zones and Roadways	Notification of EPZs / Koala habitat and the possibility of encountering Koalas	Immediately after bulk earthworks have been completed	Project 28 Pty Ltd – Site Manager	Signage has been erected at intervals no greater than 100m	Signage condition monitored and maintained	In accordance with the KPOM (JWA 2012) and Precinct 2-4 & 6-14 BMP (JWA 2012)
VMP-5	Water quality monitoring	Appropriate locations	To ensure significant impacts to SEPP 14	Prior to and during construction phase	Qualified environmental	Regular water quality monitoring	Report raw data and results to TSC	In accordance with the Overall

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Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
		adjacent to Precinct 2-4 & 6-11	wetlands are avoided	and during operational phase	consultant	completed		Water Management Plan (Gilbert & Sutherland 2012)
Restoration, enhancement and management of retained vegetation								
VMP-6	Stockpiling and re-use of topsoil	Native vegetation rehabilitation areas (i.e. Ecological buffers and EPZs)	To promote the natural regeneration of native vegetation	At commencement of Stage 1 earthworks in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 1)	Project 28 Pty Ltd – Site Manager	Top soil stockpiled and used ASAP after stripping to prevent loss of seed viability	N/A	Stripping topsoil immediately after summer seed drop may improve the germinable seed load (Berg 1975)
VMP-7	Weed Control	In the vicinity of Precinct 2-4 & 6-11	To permanently remove weeds and enable the protection of EPZs	During and after construction in accordance with the Scope of Works sequencing (FIGURE 2)	Project 28 Pty Ltd – Site Manager	All weeds removed / controlled in the vicinity of Precinct 2-4 & 6-11	Regular inspections to ensure weeds are under control	In accordance with the Precinct 2-4 & 6-11 WMP (JWA 2012)
VMP-8	Regeneration and revegetation (as detailed in Sections 25.3.4 of this VMP)	Ecological buffers and EPZs	To assist natural regeneration, plant Koala food trees, provide core Acid frog habitat and revegetate heathland communities	On completion of bulk earthworks. Planting in wetter months (i.e. late summer/autumn) in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 1)	Bush Regeneration Company / Site manager	All designated regeneration / revegetation areas rehabilitated	Regular inspections to ensure plants are healthy and becoming established	In accordance with the KPOM (JWA 2012) and Precinct 2-4 & 6-11 TSMP (JWA 2012)
VMP-9	Rehabilitation monitoring (as detailed in Section 25.4.2 of this VMP)	Rehabilitation zones	To assess the health of rehabilitated areas and help to prioritise management actions	• Six (6) weeks after primary weeding • Six (6) weeks after initial plant-out • Every six (6) months thereafter until groundcovers	Qualified Ecologist	Monitoring has been completed at specified intervals and Performance Criteria met (refer Section 25.4.6 of this VMP) Performance criteria:	Report prepared following each inspection by the qualified ecologist. At the end of each year a detailed report will be prepared	N/A

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Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
				are sufficiently established (i.e. 2-3 years) Annually after establishment until completion criteria are met (refer Section 25.4.6 of this VMP)		foliage Projective Cover (%) assessed using eye estimates or photo points (i.e. FPC of native vegetation increasing after each monitoring visit); species composition targets will be based on accepted benchmarks for the specific vegetation communities on the Kings Forest site (NEH 2012); noxious and environmental weeds are to be eradicated; infrastructure functional and well-maintained in a state suitable for hand over to Tweed Shire Council; natural recruitment of native seedlings throughout planting areas; and plantings providing variable habitats for native fauna species. Completion criteria: When performance criteria have been met, completion will have occurred.	for DECCW (refer Section 25.4.7 of this VMP)	

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25.1 Introduction

25.1.1 Executive Summary

The Kings Forest Stage 1 Project Application No. MP 08_0194 was lodged in November 2011. The Application and Environmental Assessment Report was advertised from December 2011 to January 2012 following which 302 public submissions and 10 agency submissions were received.

As a result of the submissions, amendments to the project have been made. The amended project contains the following key elements (NB: these elements will be revised and updated as the amended project is finalised).

- ♦ Subdivision to create new lots for future development;
 - Bulk earthworks across the site;
 - Road works comprising:
 - construction of the entrance road into the site and associated intersection works on Tweed Coast Road;
 - alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- ♦ Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- ♦ Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- ♦ The Plan of Development for Precinct 5.

This revised Vegetation Management Plan (VMP) addresses the amendments to the project and the key issues raised in the submissions.

25.1.2 Aim & Objectives

The aim of this VMP is to protect and enhance the available habitat for fauna and flora (including threatened species). **FIGURE 1 (APPENDIX 1)** shows the final Precinct Plan for the Kings Forest site. **FIGURE 2 (APPENDIX 1)** shows the final Scope of Works Plan.

Specific objectives of this VMP are to:

- ♦ Protect the environmentally significant site values from bulk earthworks activities;
- ♦ Assisted natural regeneration is to be utilised where appropriate; and
- ♦ Restore, enhance and manage the retained and protected vegetation including providing guidelines for the:
 - The revegetation of ecological buffers to Environmental Protection Zones and SEPP 14 Wetlands; and
 - Management and rehabilitation of significant areas of Koala habitat (as recommended in the Stage 1 KPOM [JWA 2012]).

25.1.3 Plan Requirements

As discussed above, this VMP has been prepared in accordance with DGR 9.4 which states:

“Updates are to be provided, where relevant, for the various management plans for koalas, vegetation, threatened species, feral animals weeds, the buffers, and the golf course providing where relevant details on timelines for implementation of recommended works

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including maintenance periods and measurable performance and completion criteria. Each plan is to consider all other plans for the site to ensure that management strategies do not conflict and that each plan can be implemented without negatively impacting on the objectives of another."

This VMP has also been prepared to comply with Clause C2 of the modified Concept Approval as follows:

Vegetation Management Plan

"Each Vegetation Management Plan update is to provide details on:

- 1. the short, medium and long term measures to be implemented to rehabilitate degraded areas, and manage remnant vegetation and habitat within the buffers and Environmental Protection zoned land within the site.*
- 2. revegetation and regeneration including establishment of appropriate canopy (including koala feed trees), sub-canopy, understorey and ground strata.*
- 3. rehabilitation of creeks and drainage lines.*
- 4. conserving and re-using, where appropriate, the soil seed bank where good quality native vegetation is being removed.*
- 5. collection and propagation of endemic native seed for revegetation on the site.*
- 6. monitoring of water quality and vegetation health within buffers and environmental protection zoned areas.*
- 7. the design, regeneration/revegetation and management of the east-west wildlife corridor/s.*
- 8. measurable performance criteria are to be based on appropriate reference sites within the adjacent Cudgen Nature Reserve."*

25.1.4 Relationship to other Management Plans

Additional to this VMP, the following Management Plans relevant to Precincts 2, 3, 4, 6, 7, 8, 9, 10 & 11 have been prepared for the Stage 1 Project Application, and should be read in conjunction with this VMP:

- Kings Forest Stage 1 Project Application: Precinct 2 – 4 & 6 – 11 Threatened Species Management Plan (Precinct 2-4 & 6-11 TSMP) (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 2 – 4 & 6 – 14 Buffer Management Plan (Precinct 2-4 & 6-14 BMP) (JWA 2012); and
- Kings Forest Stage 1 Project Application: Precinct 2 – 4 & 6 – 11 Weed Management Plan (Precinct 2-4 & 6-11 WMP) (JWA 2012).

A Kings Forest Stage 1 Project Application Koala Plan of Management (Stage 1 KPOM) (JWA 2012) has also been prepared for the entire Kings Forest site and is therefore relevant to Precincts 2 – 4 & 6 – 11.

Furthermore, a Kings Forest Stage 1 Project Application Flora and Fauna Monitoring Report (FFMR) (JWA 2012) has been prepared for the entire Kings Forest site and is therefore relevant to Precincts 2 – 4 & 6 – 11.

25.2 Management Strategies

25.2.1 Introduction

The following sections will outline the vegetation management strategies to be carried out within Precincts 2-4 & 6-11. The Stage 1 Project Application is for the completion of bulk earthworks only within Precincts 2, 3, 4, 6, 7, 8, 10 & 11. However, it is proposed to commence restoration and enhancement activities immediately upon the completion of bulk earthworks.

The following sections detail strategies for the:

- Protection of environmentally significant site values during bulk earthworks activities; and
- Restoration, enhancement and management of retained vegetation.

25.2.2 Protection of ecologically significant site values during bulk earthworks activities

Vegetation Protection

During bulk earthworks activities, temporary high visibility fencing will be erected to assist in the protection of the retained vegetation by restricting access from machinery and contractors. This fencing will be erected in accordance with Australian Standard 4970-2009 Protection of Trees and the requirements of the Precinct 2-4 & 6-11 BMP (JWA 2012). Temporary signage will be provided along all temporary fencing during bulk earthworks stating "Environmental Protection Zone – No Unauthorised Entry".

No machinery, rubbish or spoil will be stored within retained vegetation during the construction phase of the development. Vehicle wash-down areas or access tracks will not be located in or immediately adjacent to retained vegetation.

Protection of Threatened Flora

A detailed Precinct 2-4 & 6-11 TSMP (JWA 2012) has been prepared outlining specific and detailed management procedures for the protection of Threatened flora species which occur within the vicinity of Precincts 2-4 & 6-11.

Protection of EECs

Temporary high visibility fencing in accordance with Australian Standard 4970-2009 Protection of Trees will be erected to protect retained vegetation (as described above in Vegetation Protection) will guard against damage to EEC's during bulk earthworks activities. Temporary signage will be provided along all temporary fencing during bulk earthworks stating "Environmental Protection Zone – No Unauthorised Entry".

No machinery, rubbish or spoil will be stored within EEC's during the construction phase of the development. Vehicle wash-down areas or access tracks will not be located in or immediately adjacent to EEC's.

Protection of SEPP 14 Wetlands

The SEPP 14 Wetlands on the site are all well within the vegetated areas that will be retained. Temporary high visibility fencing in accordance with Australian Standard 4970-2009 Protection of Trees, will be erected to protect retained vegetation (as described

above in Vegetation Protection). The fencing will guard against damage to SEPP 14 Wetlands during the bulk earthworks activities.

Furthermore, Erosion and sediment control devices shall be installed prior to commencement of earth works within Precincts 1 & 5 in accordance with the Erosion & Sediment Control Plan (Gilbert & Sutherland 2012). This will prevent the movement of sediment into ecologically sensitive areas as well prevent the dispersal of weed seeds and vegetative material.

No machinery, rubbish or spoil will be stored within SEPP 14 Wetlands during the construction phase of the development. Vehicle wash-down areas or access tracks will not be located in or immediately adjacent to SEPP 14 Wetlands.

25.2.3 Restoration, enhancement and management of retained vegetation

Strategies for the restoration, enhancement and maintenance of significant areas of vegetation, including SEPP 14 wetlands, Environmental Protection Zones and EEC's, are detailed in the Action Plan (i.e. Section 25.3). Restoration, enhancement and management techniques include:

- ♦ Weed control;
- ♦ Regeneration/Revegetation;
- ♦ Pest Management; and
- ♦ Adaptive Management.

The implementation of these management actions will increase both the quantity and quality of native habitat available to the indigenous flora and fauna. All areas of proposed heath retention/restoration will be located within either Environmental Protection Zones or Ecological buffers and will be dedicated to either the Office of Environment and Heritage (OEH) or Tweed Shire Council (TSC). This will ensure their long-term protection.

It is recommended that no machinery, rubbish or spoil be stored, nor any vehicle wash down areas or access tracks be located within retained vegetation.

25.3 Action Plan

25.3.1 Introduction

The following sections detail the actions required to ensure the aims and objectives of the VMP are met. The action plan includes the following measures:

- ♦ Re-use of topsoil;
- ♦ Weed control;
- ♦ Regeneration/revegetation measures; and
- ♦ Adaptive management.

25.3.2 Re-use of topsoil to promote natural regeneration

Topsoil is an important source of seeds and propagules and has been effectively used in rehabilitation of native vegetation communities (e.g. [Bellairs & Bell 1993](#); [Koch & Ward 1994](#); [Ward et al. 1996](#)). Therefore, handled correctly, the topsoil seedbank can be used to successfully revegetate after disturbances like bulk earthworks.

As much of the Kings Forest site has been cleared of native vegetation for some time, due to historical land uses, not all of the land to be developed will contain a topsoil seedbank. Therefore, as a condition of consent, areas to be developed where a topsoil seedbank is likely to occur will be mapped and topsoil conserved in these areas for re-use in revegetation areas where appropriate. At the commencement of the Stage 1 earthworks at Kings Forest, stockpiles of topsoil will be created. This soil will then be used in the regeneration of the heath communities within buffer zones and EPZs.

To optimise the recovery of native vegetation rehabilitation areas it is important to consider the manner in which the top soil is handled. The following should be considered:

- It is important to consider the timing of topsoil recovery. Stripping topsoil immediately after summer seed drop may improve the germinable seed load ([Berg 1975](#));
-
- The seed bank is usually concentrated in the upper soil layer (i.e. 40–50 mm) so it is important to only remove this depth of soil. A greater depth will dilute the seed bank and reduce the effectiveness of the soil as a potential mechanism for natural regeneration (Putwain & Gillham 1990);
-
- Topsoil should be used as soon as possible after stripping to prevent loss of seed viability ([Koch et al. 1996](#); [Mahesh et al. 1996](#)); and
-
- Top soil should be replaced at maximum depths of 100mm ([Rokich et al. 2000](#)).

Refer to APPENDIX 1 (Precinct 1 & 5 BMP) for a specific seedbank translocation methodology for the Kings Forest site.

25.3.3 Weed control

Due to the significant disturbance history, Kings Forest supports a variety of weed species. Slash Pine (*Pinus elliottii*) is the most common. Plantations have resulted in the species being naturalised on the site. Progeny range in size from small seedlings to trees 15-20 metres in height. In some areas of the site there is significant invasion into native vegetation communities, while in other areas there may be only one or two plants.

The aim of weed control within the vicinity of Precinct 2-4 & 6-11 is the permanent removal of weeds to enable the protection of the Environmental Protection Zones. Harvesting of Slash Pine is to be completed as soon as possible to remove the continuing input of wilding propagates.

Disturbance during the bulk earthworks activities will create an opportunity for weeds to colonise and establish, therefore weeds should be diligently controlled both during and after completion of bulk earthworks in accordance with the Precinct 2-4 & 6-11 WMP (JWA 2012).

25.3.4 Regeneration and Revegetation measures

Background

Due to the large size of rehabilitation areas, rehabilitation will be completed with an emphasis on assisting natural regeneration rather than the labour intensive and costly approach of planting trees, although enhancement planting will still be completed in some areas (see below).

Natural regeneration is already occurring within some areas of the site and will be encouraged within retained vegetation communities. Rehabilitation/Regeneration works to be completed within Precinct 2, 3, 4, 6, 7, 8, 9, 10 & 11 Environmental Protection Zones and associated ecological buffers will generally include a combination of:

- Assisted natural regeneration where appropriate;
- Planting of preferred Koala food trees in accordance with the KPOM (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** and **APPENDIX 1** in the Precinct 1 & 5 Buffer Management Plan (BMP) (JWA 2012));
- Creation of core Acid frog compensatory habitat in accordance with the Precinct 2-4 & 6-11 TSMP (JWA 2012) (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** and **APPENDIX 1** in the Precinct 1 & 5 BMP (JWA 2012)); and
- Regeneration/revegetation of heath communities (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** and **APPENDIX 1** in the Precinct 1 & 5 BMP (JWA 2012)).

It should be noted that there is some overlap in the characteristics and objectives of proposed regeneration/revegetation areas at the Kings Forest site. For example, Koala food tree planting areas will also provide opportunities for revegetation with heath species (i.e. Koala food tree species will form the canopy with heath species forming the sub-canopy and understorey). Similarly, the creation of acid frog compensatory habitat (TSMP [JWA 2012]) provides an opportunity for further planting of scattered Koala food trees and wet heath species. The resulting revegetation areas will be structurally diverse and more closely mimic intact native vegetation communities (Refer to **APPENDIX 4 KPOM**).

A suitably qualified Bush Regeneration Company will be engaged via a tendering process to complete necessary rehabilitation works. The Bush Regeneration Company will employ qualified Bush Regenerators, including a Regeneration Site Manager, who will be responsible for all project management and staff supervision, and report directly to the site Ecologist.

Techniques to be employed to facilitate natural regeneration will be in accordance with those promoted by the Australian Association of Bush Regenerators (AABR).

25.3.5 Work Areas

The Revised Vegetation Management Plan (Landpartners 2009b) identifies sixteen (16) work areas across the Kings Forest site. Work Areas 1, 2, 3, 4, 5, 6, 7, 14 and 15 are relevant to this VMP (**FIGURE 3, APPENDIX 1**).

Furthermore, portions of the Precinct 2, 3, 4, 6, 7, 8, 9, 10 & 11 ecological buffers have been identified as requiring regeneration and/or revegetation works during recent site assessments and occur outside of the LandPartners work areas. These are included in the following works schedule as 'Additional Work Areas'.

25.3.6 Works schedule

The land will be revegetated/remediated and dedicated on a staged basis as soon as practical after adjacent subdivision works have been approved, or earlier subject to agreement between the parties. The staging of works will generally be based on the sequence of bulk earthworks (**FIGURE 2, APPENDIX 1**) as shown in **TABLE 1**. The following works schedule summarises the works relevant to the Environmental Protection Zones and associated ecological buffers within the area subject to this VMP.

TABLE 1
VMP STAGING OF WORKS

Earthworks sequencing	Work areas
Stage 1	1, 2 & 3
Stage 2	15
Stage 5 & 9	7
Stage 9	4, 5, 6 & 14

Work Area	Proposed Measures
1	➤ Removal of any pine wildings (completed as part of Weed Management Plan). ➤ Harvesting of mature Slash Pine (responsibility of client). ➤ Opportunities for establishment of Koala feed and shelter trees where appropriate.
2	➤ Ripping within grassland/heath community to promote regeneration. ➤ Management of native vines within canopy on Eastern margins. Vines to be cut at head height and at the base, but not poisoned. Particular attention to be paid to threatened White Laceflower. ➤ Removal of any pine wildings (completed as part of Weed Management Plan). ➤ Harvesting of mature Slash Pine (responsibility of client). ➤ Opportunities for establishment of Koala feed and shelter trees where appropriate. ➤ Koala food trees will also be planted in road reserve.
3	➤ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Maintenance of existing restoration plantings North of Depot Road. ➤ Ripping (where appropriate) within heath/grassland communities to promote regeneration.
4	➤ This entire area will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) and is to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Burning windrows of previously cleared vegetation to promote regeneration. ➤ Ripping of entire area to promote regeneration.
5	➤ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Burning or ripping pine plantation after harvesting to promote regeneration.
6	➤ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping sandy disturbed area along Northern boundary to promote regeneration.

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Work Area	Proposed Measures
7	➤ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Koala food trees also to be planted in accordance with the KPOM (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)).
14	➤ Pockets of vegetation to be retained ➤ Possible treatments include landscape plantings or removal of stock in combination with weed control to allow natural regeneration.
15	➤ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Koala food trees also to be planted in accordance with the KPOM (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Harvesting of mature Slash Pine.
Additional work areas	➤ Inner 30m buffer areas will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping should be considered where appropriate to promote natural heath regeneration.

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25.3.7 Methodology

Planting methods

A general methodology for the planting of any trees/shrubs or groundcovers is as follows:

- Stockpiled topsoil is to be spread within revegetation areas where required.
- Where exotic grasses occur within planting areas they are to be sprayed with Glyphosate at least 2 weeks prior to planting.
- Plant holes to be dug to at least twice the root ball height and width.
- Soil is to be loosened, wetted and then the plant hole to be back filled with excavated soil.
- Weed free mulch should be applied to a minimum 75mm depth around the base of the plants but not adjacent to the stem.
- Plantings are to be protected with bags (e.g. gro-bags) held in position with bamboo stakes.
- Appropriate wallaby protection measures must be implemented to optimise survival of plantings (refer 'Wallaby Protection' section below).
- Plantings are to be watered for the first 3 months. Heavy mulching will reduce the need for regular watering, provided it is replaced at between 6-12 month intervals.
- Ongoing monitoring of native species recruitment maintenance of enhancement planting works and control of environmental weeds are to be undertaken throughout the proposed five year plan and beyond.
- Native species from locally sourced seed stock only are to be planted wherever possible. Consideration should be given to setting up an on-site nursery to assist in the collection and propagation of endemic native seed for revegetation on the site. Alternatively, plants should only be sourced from local nurseries that can provide proof of local provenance (i.e. within 20km of the site).
- Revegetation is to include canopy as well as sub-canopy and understorey species (Section 25.3.5). Canopy species will generally be comprised of Koala food tree species. Sub-canopy and understorey species will generally be comprised of heath species. A species list is also provided for revegetation in areas not suitable for Koala feed trees and/or heath species.
- Plant spacing is flexible, for instance in areas which act as Asset Protection Zones, spacing of canopy trees will be greater (e.g. 10 m). Generally, plants are spaced according to the following prescriptions:
 - 3m spacing for trees (upper canopy plants);
 - 1.5m spacing for shrubs and small trees (midstorey plants); and
 - 1m spacing for groundcover (ground storey plants up to 1.5m in height).
- Plantings should occur during wetter months (January to May).

Wallaby protection

The site is inhabited by a large population of Swamp wallabies which are likely to browse any newly planted trees, causing potential death of plants. A combination of the following measures should be considered for the protection of plants on a site by site basis:

- protective bags;
- wallaby repellents (eg. Sen-Tree®); and
- wallaby-proof fencing using star pickets and pig mesh.

Koala proof fencing (JWA 2012) may also exclude wallabies from some planting areas.

Koala Feed Trees

Planting of Koala feed and shelter trees is recommended within numerous work zones to establish linkages between areas of Koala habitat and to increase foraging resources for the species at the site in the long term (in accordance with the Stage 1 KPOM (JWA 2012)) (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012)). Faecal cuticle analysis undertaken by James Warren & Associates (Warren 2000) showed that the main species consumed by Koalas at the time of the SIS were Swamp mahogany (*Eucalyptus robusta*) and Swamp box (*Lophostemon suaveolens*) with smaller amounts of Brushbox (*L. confertus*), Blackbutt (*E. pilularis*) and Broad-leaved paperbark (*Melaleuca quinquenervia*).

Therefore tree species nominated for planting include known feed tree species identified at the site (Swamp mahogany and Swamp box) in addition to other species such as Brushbox and Blackbutt (as per JWA), Red mahogany, Tallowwood and Forest red gum (Approved Koala Recovery Plan, DECC 2008). Koala feed trees should only be planted where conditions are appropriate (i.e. soils, topography, vegetation) so that plantings are compatible with any existing natural vegetation. For example species such as Tallowwood should be planted in higher elevation parts of the site, while planting which occurs in proximity to large areas of naturally occurring vegetation should be more conservative in its species selection and utilise species which commonly occur in surrounding vegetation (e.g. Swamp mahogany, Swamp box, Blackbutt, Forest red gum). Areas identified within the KPOM (JWA 2012) for planting preferred Koala food trees are shown in **FIGURES 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012).

Acid Frog Compensatory Habitat

It is proposed to create Core Acid frog habitat within Environmental Protection Zones (EPZ's) and ecological buffers on the Kings Forest site in accordance with the Precinct 2-4 & 6-11 TSMP (JWA 2012). Areas requiring rehabilitation works within EPZ's and buffers will be targeted for the creation of Core Acid Frog habitat.

The compensatory habitat areas will be planted with a combination of Swamp sclerophyll (i.e. Swamp mahogany & Broad-leaved paperbark) and Wet heath species.

Heath regeneration/revegetation

FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012) identifies proposed rehabilitation areas on the subject site which are currently comprised of regenerating heath communities, or are suitable for revegetation with heath species. The basis for revegetation with wet vs. dry heath vegetation will be determined by the topography of each revegetation area. Species lists are provided in **Section 25.3.9**.

Constructed Wetlands

Freshwater wetlands covering approximately 8.2 ha will be constructed within the golf course buffer zone (refer to Precinct 2-4 & 6-14 BMP, JWA 2012), forming bio-retention basins to trap sediment, nutrients and act as chemical renovators for the entire urban development adjacent to the golf course. These wetlands will contribute to the golf course's buffering attributes (i.e. environmental protection for the surrounding SEPP 14 Wetlands and Environmental Protection Zones) and provide habitat for native flora and fauna. They will also augment the existing wetlands and adjacent ecosystems.

Enhancement Plantings

In areas where extensive weed infestations have been removed or where Slash pine has been harvested (i.e. leaving large cleared areas) that are not suitable for revegetation with Koala food trees or heath regeneration/restoration, enhancement plantings with other locally endemic species will be completed. Additional species lists for each Work area are provided in **Section 25.3.9**.

25.3.8 Species Schedule

Heath species

Where heath revegetation is necessary (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012)), the following sub-canopy and understorey species are to be utilised:

Common name	Botanical name
Dry heath species*	
Sweet wattle	<i>Acacia suaveolens</i>
Prickly moses	<i>Acacia ulicifolia</i>
Heath aotus	<i>Aotus ericoides</i>
Wooly aotus	<i>Aotus lanigera</i>
Starhair bush	<i>Astrotricha longifolia</i>
Midgenberry	<i>Austromyrtus dulcis</i>
Wallum banksia	<i>Banksia aemula</i>
Heath-leaved banksia	<i>Banksia ericifolia</i>
Hairpin banksia	<i>Banksia spinulosa</i> var. <i>collina</i>
Leafless bossiaea	<i>Bossiaea ensata</i>
Variable bossiaea	<i>Bossiaea heterophylla</i>
Showy bossiaea	<i>Bossiaea rhombifolia</i>
Milkmaids	<i>Burchardia umbellata</i>
Curly wigs	<i>Caustis recurvata</i>
Christmas bush	<i>Ceratopetalum gummiferum</i>
Pink matchheads	<i>Comesperma ericinum</i>
Blue dampiera	<i>Dampiera stricta</i>
Blue flax-lilly	<i>Dianella caerulea</i>
Rolled flax-lilly	<i>Dianella revoluta</i>
Eggs & bacon pea	<i>Dillwynia retorta</i>
Hopbush	<i>Dodonaea triquetra</i>
Wiry panic	<i>Entolasia stricta</i>
Wallum heath	<i>Epacris pulchella</i>
Pinnate wedge pea	<i>Gompholobium pinnatum</i>
Slender bloodroot	<i>Haemodorum tenuifolium</i>
Finger hakea	<i>Hakea dactyloides</i>
Narrow-leaved guinea flower	<i>Hibbertia linearis</i>
Hoary guinea flower	<i>Hibbertia obtusifolia</i>
Hairy guinea flower	<i>Hibbertia vestita</i>

Common name	Botanical name
Dogwood	<i>Jacksonia scoparia</i>
Wire lilly	<i>Laxmannia gracilis</i>
Sword sedge	<i>Lepidosperma laterale</i>
Knotted scale-rush	<i>Lepyrodia interrupta</i>
Erica heath	<i>Leucopogon ericoides</i>
Lance beard heath	<i>Leucopogon lanceolatus</i>
Wire beard-heath	<i>Leucopogon microphyllus</i>
Coast beard heath	<i>Leucopogon parviflorus</i>
Common beard-heath	<i>Leucopogon virgatus</i>
Screw fern	<i>Lindsaea linearis</i>
Long-leaved matrush	<i>Lomandra longifolia</i>
Many-flowered matrush	<i>Lomandra multiflora</i>
Crinkle bush	<i>Lomatia silaifolia</i>
Large nectar heath	<i>Melichrus adpressus</i>
Jam tarts	<i>Melichrus procumbens</i>
Broom heath	<i>Monotoca elliptica</i>
Prickly-leaved monotoca	<i>Monotoca scoparia</i>
White dogwood	<i>Ozothamnus diosmifolius</i>
Broad-leaved geebung	<i>Persoonia cornifolia</i>
Small-leaved geebung	<i>Persoonia virgata</i>
Candlesticks	<i>Petrophile canescens</i>
Conesticks	<i>Petrophile pulchella</i>
Heath phyllota	<i>Phyllota phyllicoides</i>
Slender riceflower	<i>Pimelea linifolia</i>
Heathy platysace	<i>Platysace ericoides</i>
Shrubby platysace	<i>Platysace lanceolata</i>
Pomax	<i>Pomax umbellata</i>
Bracken	<i>Pteridium esculentum</i>
Green styphelia	<i>Styphelia viridis</i>
Black-eyed susan	<i>Tetratheca thymifolia</i>
Kangaroo grass	<i>Themeda australis</i>
Yellow rush-lilly	<i>Tricoryne elatior</i>
Austral bluebell	<i>Wahlenbergia gracilis</i>
Woolisia	<i>Woolisia pungens</i>
Wooly xanthosia	<i>Xanthosia pilosa</i>
Twiggy zieria	<i>Zieria minutiflora</i>
Sandfly zieria	<i>Zieria smithii</i>
Wet heath species*	
Swamp wattle	<i>Acacia elongata</i>
Heath aotus	<i>Aotus ericoides</i>
Wooly aotus	<i>Aotus lanigera</i>
Heath myrtle	<i>Baeckea imbricata</i>
Feather plant	<i>Baloskion pallens</i>
Feathertop	<i>Baloskion tetraphyllum</i>
Heath banksia	<i>Banksia ericifolia</i>

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Common name	Botanical name
Swamp banksia	<i>Banksia robur</i>
Jointed twig-rush	<i>Baumea articulata</i>
Wallum boronia	<i>Boronia falcifolia</i>
Swamp boronia	<i>Boronia parvifolia</i>
Milkmaids	<i>Burchardia umbellata</i>
Pale grass-lilly	<i>Caesia parviflora</i>
Wallum bottlebrush	<i>Callistemon pachyphyllus</i>
Curly wigs	<i>Caustis recurvata</i>
Swamp parrot pea	<i>Dillwynia floribunda</i>
Tall sundew	<i>Drosera auriculata</i>
Rosette sundew	<i>Drosera spathulata</i>
Spreading rope-rush	<i>Empodisma minus</i>
Coral heath	<i>Epacris microphylla</i>
Blunt-leaf heath	<i>Epacris obtusifolia</i>
Swamp mahogany	<i>Eucalyptus robusta</i>
Tall saw-sedge	<i>Gahnia clarkei</i>
Red-fruited saw-sedge	<i>Gahnia sieberana</i>
Coral fern	<i>Gleichenia dicarpa</i>
Rocket goodenia	<i>Goodenia bellidifolia</i>
Slender bloodroot	<i>Haemodorum tenuifolium</i>
Sword sedge	<i>Lepidosperma laterale</i>
Prickly tea-tree	<i>Leptospermum juniperinum</i>
Lemon-scented tea-tree	<i>Leptospermum liversidgei</i>
Knotted scale-rush	<i>Lepyrodia interrupta</i>
Slender clubmoss	<i>Lycopodium laterale</i>
Thyme honeymyrtle	<i>Melaleuca thymifolia</i>
Heath phyllota	<i>Phyllota phyllicoides</i>
Slender rice-flower	<i>Pimelea linifolia</i>
Common bog rush	<i>Schoenus apogon</i>
	<i>Schoenus paludosus</i>
Swamp clubmoss	<i>Selaginella uliginosa</i>
Swamp heath	<i>Sprengelia sprengelioides</i>
Spoon-leaf goodenia	<i>Velleia spathulata</i>
Swamp grasstree	<i>Xanthorrhoea fulva</i>

* The basis for revegetation with wet vs. dry heath species will be determined by the topography of the revegetation area.

Koala food tree species

Where revegetation with preferred Koala food trees is necessary (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012)), the following canopy species are to be utilised:

Koala food trees	
Tallowwood	<i>Eucalyptus microcorys</i>
Blackbutt	<i>Eucalyptus pilularis</i>

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Red mahogany	<i>Eucalyptus resinifera</i>
Swamp mahogany	<i>Eucalyptus robusta</i>
Forest red gum	<i>Eucalyptus tereticornis</i>
Brushbox	<i>Lophostemon confertus</i>
Swamp box	<i>Lophostemon suaveolens</i>
Broad-leaved paperbark	<i>Melaleuca quinquenervia</i>

Additional plant species

Additional canopy, sub-canopy and understorey plant species (i.e. for areas not suitable for Koala feed trees and/or heath species) are as follows:

Common name	Botanical name
Black wattle	<i>Acacia melanoxylon</i>
Lilly pilly	<i>Acmena smithii</i>
Black she- oak	<i>Allocasuarina littoralis</i>
Fern-leaved banksia	<i>Banksia oblongifolia</i>
Crimson bottlebrush	<i>Callistemon salignus</i>
Swamp oak	<i>Casuarina glauca</i>
Corkwood	<i>Duboisia myoporoides</i>
Blueberry ash	<i>Elaeocarpus reticulatus</i>
Scribbly gum	<i>Eucalyptus racemosa</i>
Sandpaper fig	<i>Ficus coronata</i>
Cheese tree	<i>Glochidion ferdinandi</i>
Bleeding Heart	<i>Homalanthus populifolius</i>
Cabbage tree palm	<i>Livistona australis</i>
Broad-leaved paperbark	<i>Melaleuca quinquenervia</i>
Elderberry ash	<i>Polyscias sambucifolia</i>
Macrophytes*	
Baumea	<i>Baumea rubiginosa</i>
Giant sedge	<i>Cyperus exaltatus</i>
Common spikerush	<i>Eleocharis acuta</i>
Rusty sedge	<i>Fimbristylis ferruginea</i>
Giant sedge	<i>Lepironia articulata</i>
Common reed	<i>Phragmites australis</i>
Club rush	<i>Schoenoplectus validus</i>

* Macrophytes to be planted in areas of shallow water and surrounds.

25.3.9 Adaptive Management

Adaptive management is an approach that involves learning from management actions, and using those lessons to improve upon the overall plan. The principles of adaptive management have been incorporated into the administration of restoration projects within a variety of governmental authorities and programs (Thom 1997). Comprehensive, long-term monitoring is a component of adaptive management as adaptive management strategies rely on the accumulation of evidence supporting decisions that demand changes in action.

An adaptive management approach involves an integrated process of firstly monitoring, then reviewing and responding to the health and conditions of the plantings, natural regeneration and the status of the weed infestation. Alteration to the design and maintenance of works required, to ensure the objectives of the BMP are achieved, are then made.

Adaptive management strategies will be determined by the information provided in monitoring reports. Adaptive management strategies that may be required within this VMP are as follows:

- ♦ Amendment of species list for revegetation works;
- ♦ Replacement of enhancement plantings that do not survive;
- ♦ Alteration of weed control methods or timing.

Before the implementation of any adaptive management strategy a brief report is be provided to Project 28 Pty Ltd and other relevant agencies detailing the proposed management actions and the predicted outcomes. The implementation must be approved by the relevant authority prior to implementation.

25.4 Monitoring and Reporting

25.4.1 Introduction

Monitoring is an essential component of this VMP and its associated rehabilitation works. Ongoing monitoring of the results of vegetation protection and rehabilitation works is essential throughout the proposed five (5) year plan or until the vegetation is self-sustaining (whichever is the earliest) (also refer FFMR (JWA 2012)). Monitoring and reporting will ensure the continuing success of the vegetation protection and rehabilitation programme by ensuring that activities are meeting set aims and objectives. The results obtained through monitoring will help managers to prioritise management actions and keep track of the health of rehabilitated areas.

Monitoring and reporting can be divided into the following distinct phases:

1. Baseline monitoring (prior to commencement of vegetation protection and rehabilitation works in each Work area);
2. Monitoring by an Ecologist will occur at strategic times; and
3. An annual report will be compiled by the Ecologist that combines the result of the above monitoring.
4. Long-term monitoring of the health and composition of vegetation communities is also proposed, including specific monitoring for impacts on the adjacent Cudgen Nature Reserve.

25.4.2 Rehabilitation Monitoring

Monitoring requirements

The vegetation monitoring will include regular visits by a qualified ecologist who is to complete the following:

- ♦ Transects
 - Ten (10) transects are to be placed within the retained vegetation areas;
 - Transect locations are to be permanently marked;
 - Transects are to be thirty (30) metres in length;

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- During monitoring visits tape measures are to be placed on the ground and the specific measureable features recorded along the transects;
 - Specific measurable features include:
 - Areas of vegetation cover (native species);
 - Areas of weed cover;
 - Areas of bare ground/mud;
 - Number, percentage and species of planted stems surviving;
 - Results are to be shown in a table which is to be presented in the monitoring reports.
- ♦ Quadrats
- Three (3) quadrats (1m²) are to be placed along each of the transects;
 - Quadrats must be placed a minimum of 5m apart along the length of the transect;
 - Quadrats are to be placed randomly within five (5) meters of the transect line;
 - The boundary of the quadrat with respect to the tape measure (e.g. between 3.5 – 4.5 metres on tape measure) will be recorded;
 - For each quadrat the following specific measurable features will be recorded:
 - Plant species occurring;
 - Percentage cover;
 - Height;
 - Relative abundance of native species;
 - Weed cover; and
 - Number, percentage and species of planted stems surviving.
 - Results are to be shown in a table which is to be presented in the monitoring reports.
- ♦ Fixed Photo points
- A central transect marker on each established monitoring transect is to be used as permanent photo station for photographic monitoring;
 - Four (4) photos are to be taken from each central transect marker. Photos are to be taken to the north, south, east and west;
 - Photos should be labelled with the:
 - Transect code;
 - Direction of view; and
 - The date & time.
 - Photos must be supplied in the monitoring reports in a form of prints no smaller than 4" x 6" and must be colour.

25.4.3 Baseline monitoring

Baseline data is to be gathered at each work area prior to the commencement of protection or regeneration works to allow the preparation of more detailed site specific assessments and more relevant performance criteria specific to the vegetation community that is being rehabilitated. Baseline monitoring will include the above assessments (Section 25.4.2), re-mapping of the site vegetation mapping and an assessment of restoration potential of each proposed rehabilitation area. This will assist in documenting vegetation recovery in the long term (refer to the Flora and Fauna Monitoring Report [JWA 2012]).

25.4.4 Timing of monitoring visits

The monitoring is to be completed by a suitably qualified ecologist. Site visits should occur:

- ♦ Six (6) weeks after primary weeding;

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- Six (6) weeks after initial plant-out;
- Every six (6) months thereafter until groundcovers are sufficiently established (i.e. between two (2) - three (3) years)
- Annually after establishment until completion criteria are met (refer Section 25.4.6).

25.4.5 Long Term Monitoring

Along with the regular monitoring within the EPZ's, the overall vegetation composition is to be regularly assessed and recorded. Long term monitoring will use both aerial photos and yearly assessments (ground truthing) of the vegetation communities using a hand held GPS.

The Long term monitoring of the vegetation composition within the EPZ's will include:

- A detailed vegetation map at a scale of 1:5,000 is to be completed within the EPZ's every twelve (12) months;
- Each year, after completion of vegetation mapping, a report is to be completed showing the changes in the composition of the vegetation communities. The results are to be shown in a table that shows the vegetation community and the area of the vegetation community as a percentage of the EPZ's. Monitoring will continue until completion criteria are met (refer Section 25.4.6).

25.4.6 Performance Criteria

The success of the VMP will be regularly evaluated. Performance criteria will be guided by comparisons to baseline data collected in each work area, however a number of criteria will indicate successful rehabilitation of the EPZs and ecological buffers, including:

- Foliage Projective Cover (%) assessed using eye estimates or photo points (i.e. FPC of native vegetation increasing after each monitoring visit);
- Species composition targets will be based on accepted benchmarks for the specific vegetation communities on the Kings Forest site;
- Noxious and environmental weeds are to be eradicated;
- Infrastructure functional and well-maintained in a state suitable for hand over to Tweed Shire Council;
- Natural recruitment of native seedlings throughout planting areas; and
- Plantings providing variable habitats for native fauna species.

Performance criteria will be assessed as follows:

- The photos taken during monitoring visits, in combination with the annual monitoring and mapping of native vegetation composition and the results of the annual flora survey, will be used to determine the extent of native plant species and the levels of biodiversity the area is supporting.
- When it is determined that all performance criteria have been met, completion will have occurred.

25.4.7 Reporting

Following each inspection by the qualified ecologist, a report will be prepared that will include tables and photographs from the monitoring visits. At the end of each year a detailed report will be prepared for the Department of Environment and Climate Change (DECC) and Tweed Shire Council. The report will discuss the following:

- Works undertaken;

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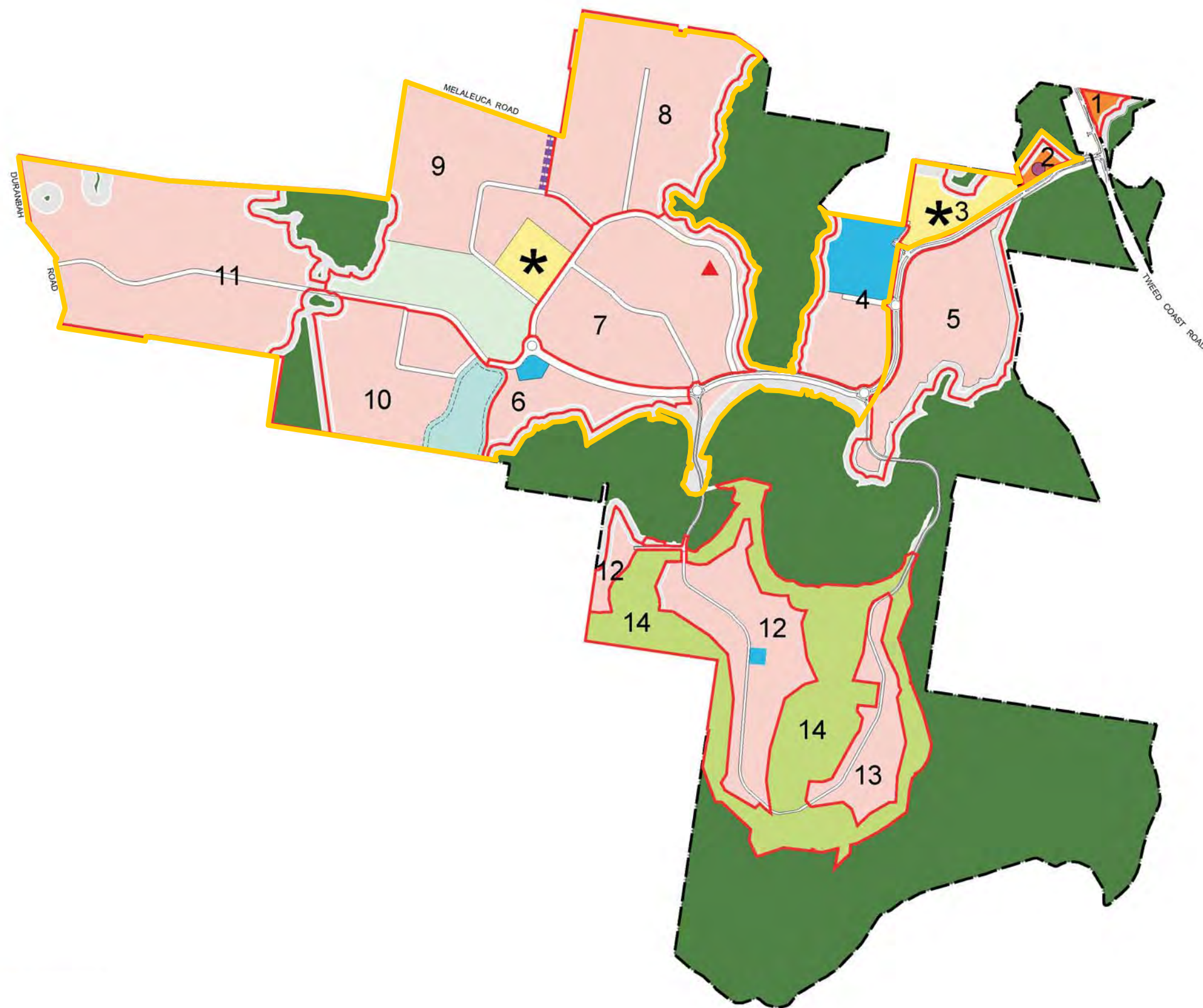
25-21

- ♦ Progress of regeneration/revegetation areas against completion criteria using photos and tables showing the results of the monitoring visits;
- ♦ Significant problems encountered (death of seedlings, broken fences, vandalism etc.) and the effect of these on the plantings and aims of the revegetation or regeneration strategy;
- ♦ Success or failures of measures implemented to rectify previously identified problems;
- ♦ Measures to be taken to rectify new problems; and
- ♦ Performance against performance criteria (Section 25.4.6).

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APPENDIX 1 – FIGURES



- LEGEND**
- Town Centre / Neighbourhood Centre
 - Residential
 - Community Facilities / Education
 - Employment Land
 - Structured Open Space (Active)
(Passive open space to council standards, location subject to urban design)
 - Environmental Protection Area to be Dedicated to Council or NPWS
 - 50m Ecological Buffer
(includes APZ's & roads where approved)
 - * State School Site
 - Proposed Zone Substation
(subject to Country Energy final approval)
 - Potential Affordable Housing Location
 - Potential Road Connection to Melaleuca Road
 - Private Open Space
 - Golf Course Area
(encompassing ecological buffers where indicated)
 - Private Open Space including Lake
 - Precinct Boundaries
 - Precincts 2-4 & 6-11
 - Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: RPS (Ref: 113691-PSP-4a
(PRECINCT PLAN).jpeg)

SCALE: 1 : 20 000 @ A3

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CLIENT
Project 28 Pty Ltd

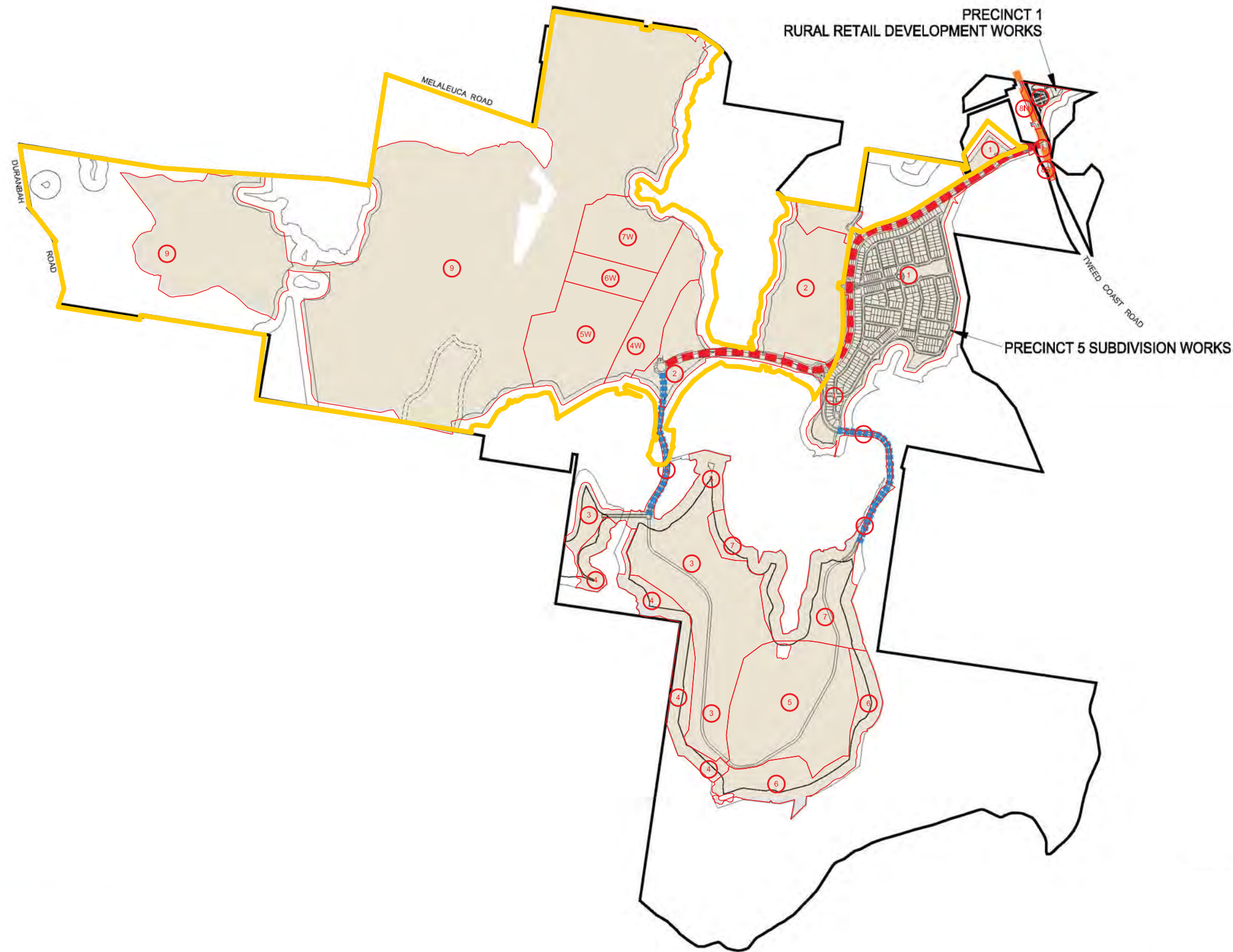
PROJECT
Kings Forest Stage 1 Project Application
Precincts 2-4 & 6-11 - Vegetation Mgt Plan
Melaleuca Drive, Durambah, NSW
Shire of Tweed

FIGURE 1

PREPARED: BW
DATE: 27 August 2012
FILE: N97017_VMP_Precincts.cdr

TITLE

**PRECINCTS
PLAN**



SOURCE: RPS (Ref: 113691-PSP-4a (SCOPE OF WORKS).jpeg); Mortons Urban Solutions (Ref: sequencing COLOUR.pdf)
SCALE: 1 : 20 000 @ A3
JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

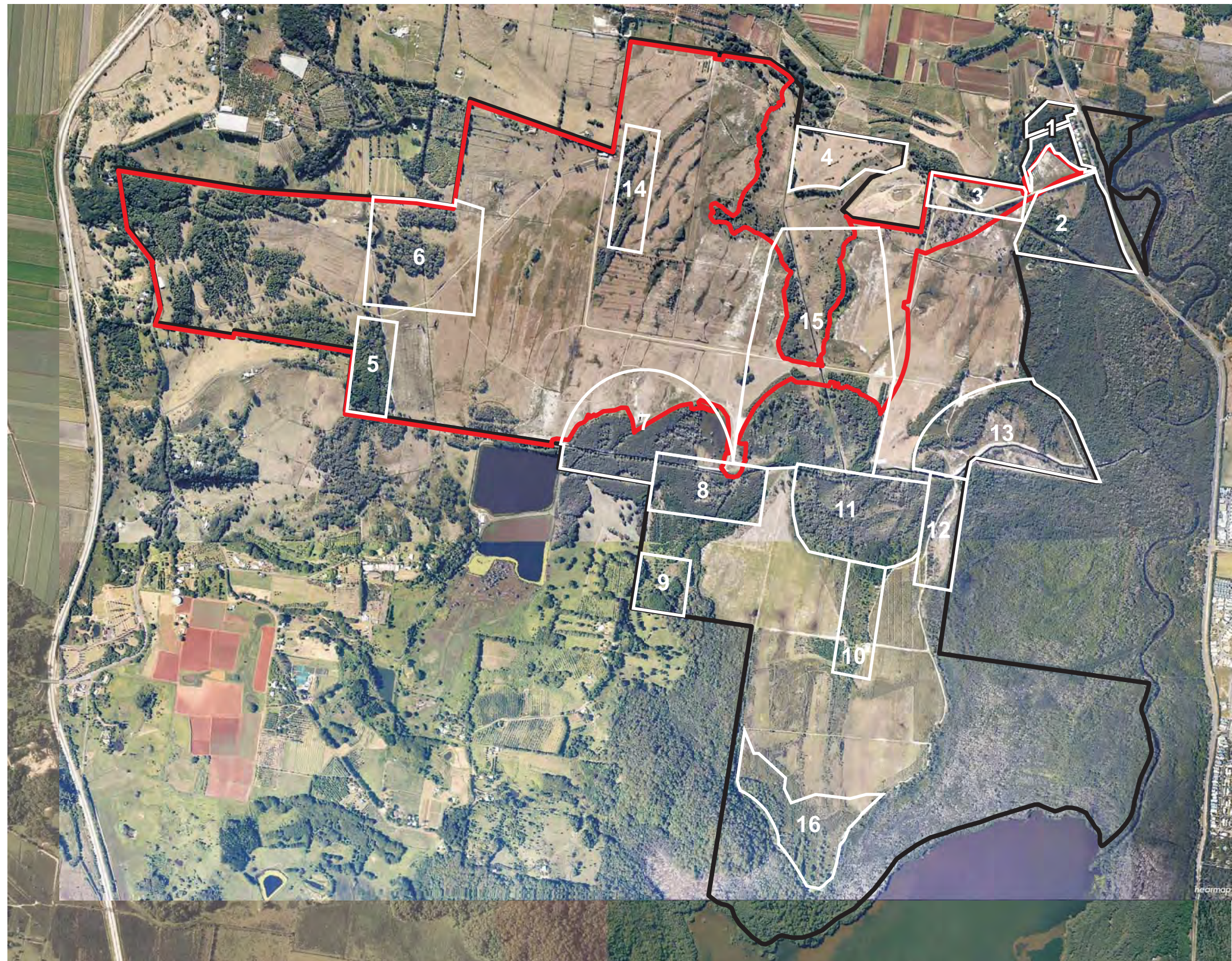
CLIENT
Project 28 Pty Ltd
PROJECT
Kings Forest Stage 1 Project Application
Precincts 2-4 & 6-11 - Vegetation Mgt Plan
Melaleuca Drive, Durambah, NSW
Shire of Tweed

FIGURE 2

PREPARED: BW
DATE: 28 August 2012
FILE: N97017_VMP_Scope.cdr

TITLE

**SCOPE
OF WORKS**



- LEGEND**
- Vegetation Work Unit
 - Precincts 2-4 & 6-11
 - Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: Landpartners Revised Vegetation Management Plan (2009) Figure 9 & 2007 Aerial; Near Map June 2011 Aerial
SCALE: 1 : 20 000 @ A3
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CLIENT
Project 28 Pty Ltd
PROJECT
Kings Forest Stage 1 Project Application
Precincts 2-4 & 6-11 - Vegetation Mgt Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 3

PREPARED: BW
DATE: 20 August 2012
FILE: N97017_VMP_Veg Mgt.cdr

TITLE
**VEGETATION
MANAGEMENT
AREAS**

26.0 VEGETATION MANAGEMENT PLANS, PRECINCTS 12, 13 AND 14 – JAMES WARREN & ASSOCIATES, AUGUST 2012

Implementation and Summary Table

Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
Protection of ecologically significant site values during Construction phase								
VMP-1	Erection of temporary high visibility fencing	Between Precinct 12, 13 & 14 and vegetation to be retained (EPZs)	To protect retained vegetation (including threatened flora, EECs and SEPP 14 wetlands) from all construction activities	Prior to construction in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 1)	Project 28 Pty Ltd – Site Manager	Temporary fencing installed and maintained where required	Daily checks on fencing condition	In accordance with the Precinct 2-4 & 6-14 BMP (JWA 2011)
VMP-2	Erection of temporary signage stating "Environmental Protection Zone – No Unauthorised Entry"	Along all temporary fencing	To notify construction personnel to keep out of Environmental Protection Zones	Prior to construction in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 1)	Project 28 Pty Ltd – Site Manager	Temporary signage installed and maintained where required	Daily checks on signage condition	N/A
VMP-3	Installation of erosion and sediment control devices	Between Precinct 12, 13 & 14 and vegetation to be retained (EPZs)	To prevent the movement of sediment into ecologically sensitive areas and prevent the dispersal of weed seeds and vegetative material	Prior to construction in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 1)	Project 28 Pty Ltd – Site Manager	Erosion and sediment control devices installed where required	Regular inspections to ensure erosion and sediment is controlled and contained within Precinct 12, 13 & 14	In accordance with the Erosion & Sediment Control Plan (Gilbert & Sutherland July 2012)
Protection of ecologically significant site values during Operational phase								
VMP-4	Erection of permanent signage	Along the margins of Environmental Protection Zones and Roadways	Notification of EPZs / Koala habitat and the possibility of encountering Koalas	Immediately after bulk earthworks have been completed	Project 28 Pty Ltd – Site Manager	Signage has been erected at intervals no greater than 100m	Signage condition monitored and maintained	In accordance with the KPOM (JWA 2012) and Precinct 2-4 & 6-14 BMP (JWA 2011)
VMP-5	Water quality monitoring	Appropriate locations adjacent to	To ensure significant impacts to SEPP 14 wetlands are avoided	Prior to and during construction phase and during	Qualified environmental consultant	Regular water quality monitoring completed	Report raw data and results to TSC	In accordance with the Overall Water

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Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
		Precinct 12, 13 & 14		operational phase				Management Plan (Gilbert & Sutherland July 2012)
Restoration, enhancement and management of retained vegetation								
VMP-6	Stockpiling and re-use of topsoil	Native vegetation rehabilitation areas (i.e. Ecological buffers and EPZs)	To promote the natural regeneration of native vegetation	At commencement of Stage 1 earthworks in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 1)	Project 28 Pty Ltd – Site Manager	Top soil stockpiled and used ASAP after stripping to prevent loss of seed viability	N/A	Stripping topsoil immediately after summer seed drop may improve the germinable seed load (Berg 1975)
VMP-7	Weed Control	In the vicinity of Precinct 12, 13 & 14	To permanently remove weeds and enable the protection of EPZs	During and after construction in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 1)	Project 28 Pty Ltd – Site Manager	All weeds removed / controlled in the vicinity of Precinct 12, 13 & 14	Regular inspections to ensure weeds are under control	In accordance with the Precinct 12, 13 & 14 WMP (JWA 2011)
VMP-8	Regeneration and revegetation (as detailed in Section 26.3.3 of this VMP)	Ecological buffers and EPZs	To assist natural regeneration, plant Koala food trees, provide core Acid frog habitat and revegetate heathland communities	On completion of bulk earthworks. Planting in wetter months (i.e. late summer/autumn) in accordance with the Scope of Works sequencing (FIGURE 2, APPENDIX 1)	Bush Regeneration Company / Site manager	All designated regeneration / revegetation areas rehabilitated	Regular inspections to ensure plants are healthy and becoming established	In accordance with the KPOM (JWA 2012) and Precinct 12, 13 & 14 TSMP (JWA 2011)
VMP-9	Rehabilitation monitoring (as detailed in Section 26.4.2 of this VMP)	Rehabilitation zones	To assess the health of rehabilitated areas and help to prioritise management actions	• Six (6) weeks after primary weeding • Six (6) weeks after initial plant- out • Every six (6) months thereafter until groundcovers	Qualified Ecologist	Monitoring has been completed at specified intervals and Performance Criteria met (refer Section 26.4.6 of this VMP)	Report prepared following each inspection by the qualified ecologist. At the end of each year a detailed report will be prepared	N/A

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Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
				are sufficiently established (i.e. 2-3 years) Annually after establishment until completion criteria are met (refer Section 26.4.6 of this VMP)		Performance criteria: foliage Projective Cover (%) assessed using eye estimates or photo points (i.e. FPC of native vegetation increasing after each monitoring visit); species composition targets will be based on accepted benchmarks for the specific vegetation communities on the Kings Forest site (NEH 2012); noxious and environmental weeds are to be eradicated; infrastructure functional and well-maintained in a state suitable for hand over to Tweed Shire Council; natural recruitment of native seedlings throughout planting areas; and plantings providing variable habitats for native fauna species. Completion criteria: When performance criteria have been met, completion will have occurred.	for DECCW (refer Section 26.4.7 of this VMP)	

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26.1 INTRODUCTION

26.1.1 Executive Summary

The Kings Forest Stage 1 Project Application No. MP 08_0194 was lodged in November 2011. The Application and Environmental Assessment Report was advertised from December 2011 to January 2012 following which 302 public submissions and 10 agency submissions were received.

As a result of the submissions, amendments to the project have been made. The amended project contains the following key elements (NB: these elements will be revised and updated as the amended project is finalised).

- Subdivision to create new lots for future development;
 - Bulk earthworks across the site;
 - Road works comprising:
 - construction of the entrance road into the site and associated intersection works on Tweed Coast Road;
 - alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- The Plan of Development for Precinct 5.

This revised Vegetation Management Plan (VMP) addresses the amendments to the project and the key issues raised in the submissions.

26.1.2 Aim & Objectives

The aim of the Precinct 12, 13 & 14 VMP is to protect and enhance the available habitat for flora and fauna (including threatened species) within the vicinity of Precincts 12, 13 & 14.

FIGURE 1 (APPENDIX 1) shows the final Precinct Plan for the Kings Forest site. **FIGURE 2 (APPENDIX 1)** shows the final Scope of Works Plan.

Specific objectives of this VMP are to:

- Protect the environmentally significant site values from bulk earthworks and/or construction activities;
- Assisted natural regeneration is to be utilised where appropriate; and
- Restore, enhance and manage the retained and protected vegetation including providing guidelines for the:
 - Restoration/revegetation of heath communities within the Golf Course (i.e. Precinct 14);
 - Restoration/revegetation of the Scribbly gum community south of Precincts 12, 13 & 14;
 - Management and rehabilitation of significant areas of Koala habitat (as recommended in the Stage 1 KPOM [JWA 2012]).

26.1.3 Plan Requirements

As discussed above, this VMP has been prepared in accordance with DGR 9.4 which states:

“Updates are to be provided, where relevant, for the various management plans for koalas, vegetation, threatened species, feral animals weeds, the buffers, and the golf course providing where relevant details on timelines for implementation of recommended works including maintenance periods and measurable performance and completion criteria. Each plan is to consider all other plans for the site to ensure that management strategies do not conflict and that each plan can be implemented without negatively impacting on the objectives of another.”

This VMP has also been prepared to comply with Clause C2 of the modified Concept Approval as follows:

Vegetation Management Plan

“Each Vegetation Management Plan update is to provide details on:

- 1. the short, medium and long term measures to be implemented to rehabilitate degraded areas, and manage remnant vegetation and habitat within the buffers and Environmental Protection zoned land within the site.*
- 2. revegetation and regeneration including establishment of appropriate canopy (including koala feed trees), sub-canopy, understorey and ground strata.*
- 3. rehabilitation of creeks and drainage lines.*
- 4. conserving and re-using, where appropriate, the soil seed bank where good quality native vegetation is being removed.*
- 5. collection and propagation of endemic native seed for revegetation on the site.*
- 6. monitoring of water quality and vegetation health within buffers and environmental protection zoned areas.*
- 7. the design, regeneration/revegetation and management of the east-west wildlife corridor/s.*
- 8. measurable performance criteria are to be based on appropriate reference sites within the adjacent Cudgen Nature Reserve.”*

26.1.4 Relationship to other Management Plans

Additional to this VMP, the following Management Plans relevant to Precincts 12, 13 & 14 have been prepared for the Stage 1 Project Application, and should be read in conjunction with this VMP:

- Kings Forest Stage 1 Project Application: Precinct 12, 13 & 14 Threatened Species Management Plan (Precinct 12, 13 & 14 TSMP) (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 12, 13 & 14 Weed Management Plan (Precinct 12, 13 & 14 WMP) (JWA 2012).
- Kings Forest Stage 1 Project Application: Precinct 2 – 4 6 – 14 Buffer Management Plan (Precinct 2-4 & 6-11 BMP) (JWA 2012);

A Kings Forest Stage 1 Project Application Koala Plan of Management (Stage 1 KPOM) (JWA 2012) has also been prepared for the entire Kings Forest site and is therefore relevant to Precincts 12, 13 & 14.

Furthermore, a Kings Forest Stage 1 Project Application Flora and Fauna Monitoring Report (FFMR) (JWA 2012) has been prepared for the entire Kings Forest site and is therefore relevant to Precincts 12, 13 & 14.

26.2 Management Strategies

26.2.1 Introduction

The following sections will outline the vegetation management strategies to be carried out within Precincts 12, 13 & 14. The Stage 1 Project Application is for the completion of bulk earthworks only within Precincts 12, 13 & 14. However, it is proposed to commence restoration and enhancement activities immediately upon the completion of bulk earthworks.

The following sections detail strategies for the:

- ♦ Protection of environmentally significant site values during bulk earthworks activities; and
- ♦ Restoration, enhancement and management of retained vegetation.

Permanent protection measures for environmentally significant site values (i.e. permanent fencing, signage, etc.) will be required at the operational phase.

26.2.2 Protection of ecologically significant site values during bulk earthworks activities

Vegetation Protection

During bulk earthworks activities, temporary high visibility fencing will be erected around the edges of all vegetation to be retained in accordance with Australian Standard 4970-2009 Protection of Trees to assist in the protection of the retained vegetation by restricting access from machinery and contractors. Signage will be provided along all temporary fencing during the construction phase stating "Environmental Protection Zone – No Unauthorised Entry".

No machinery, rubbish or spoil will be stored within retained vegetation during the construction phase of the development. Vehicle wash-down areas or access tracks will not be located in or immediately adjacent to retained vegetation.

Protection of Threatened Flora

A detailed Precinct 12, 13 & 14 TSMP (JWA 2012) has been prepared outlining specific and detailed management procedures for the protection of Threatened flora species which occur within the vicinity of Precincts 12, 13 & 14.

Protection of EECs

Temporary high visibility fencing in accordance with Australian Standard 4970-2009 Protection of Trees erected to protect retained vegetation (as described above in Vegetation Protection) will guard against damage to EEC's during bulk earthworks activities. Temporary signage will be provided along all temporary fencing during bulk earthworks activities stating "Environmental Protection Zone – No Unauthorised Entry".

No machinery, rubbish or spoil will be stored within EEC's during the construction phase of the development. Vehicle wash-down areas or access tracks will not be located in or immediately adjacent to EEC's.

Protection of SEPP 14 Wetlands

The SEPP 14 Wetlands adjacent to Precincts 12, 13 & 14 occur within vegetated areas that will be retained. Temporary high visibility fencing in accordance with Australian Standard 4970-2009 Protection of Trees, will be erected to protect retained vegetation (as described above in Vegetation Protection). The fencing will guard against damage to SEPP 14 Wetlands during the bulk earthworks activities.

Furthermore, erosion and sediment control devices shall be installed prior to commencement of earth works within Precincts 1 & 5 in accordance with the Erosion & Sediment Control Plan (Gilbert & Sutherland, July 2012). This will prevent the movement of sediment into ecologically sensitive areas as well prevent the dispersal of weed seeds and vegetative material.

No machinery, rubbish or spoil will be stored within SEPP 14 Wetlands during the construction phase of the development. Vehicle wash-down areas or access tracks will not be located in or immediately adjacent to SEPP 14 Wetlands.

26.2.3 Restoration, enhancement and management of retained vegetation

Strategies for the restoration, enhancement and maintenance of significant areas of vegetation, including SEPP 14 wetlands, Environmental Protection Zones and EEC's, are detailed in the Action Plan (i.e. Section 26.3). Restoration, enhancement and management techniques include:

- ♦ Weed control;
- ♦ Regeneration/Revegetation;
- ♦ Pest management; and
- ♦ Adaptive management.

The implementation of these management actions will increase both the quantity and quality of native habitat available to the indigenous flora and fauna. All areas of proposed heath retention/restoration will be located within either Environmental Protection Zones or Ecological buffers and will be dedicated to either the Office of Environment and Heritage (OEH) or Tweed Shire Council (TSC). This will ensure their long-term protection. It is recommended that no machinery, rubbish or spoil be stored, nor any vehicle wash-down areas or access tracks are be located within retained vegetation.

26.3 Action Plan

The following sections detail the actions required to ensure the aims and objectives of the VMP are met. The action plan includes the following measures:

Re-use of topsoil;
Weed control;
Regeneration/revegetation measures; and
Adaptive management.

26.3.1 Re-use of topsoil to promote natural regeneration

Topsoil is an important source of seeds and propagules and has been effectively used in rehabilitation of native vegetation communities (e.g. [Bellairs & Bell 1993](#); [Koch & Ward 1994](#); [Ward et al. 1996](#)). Therefore, handled correctly, the topsoil seedbank can be used to successfully revegetate after disturbances like bulk earthworks.

As much of the Kings Forest site has been cleared of native vegetation for some time, due to historical land uses, not all of the land to be developed will contain a topsoil seedbank. Therefore, as a condition of consent, areas to be developed where a topsoil seedbank is likely to occur will be mapped and topsoil conserved in these areas for re-use in revegetation areas where appropriate. At the commencement of the Stage 1 earthworks at Kings Forest, stockpiles of topsoil will be created. This soil will then be used in the regeneration of the heath communities within buffer zones and EPZs.

To optimise the recovery of native vegetation rehabilitation areas it is important to consider the manner in which the top soil is handled. The following should be considered:

- It is important to consider the timing of topsoil recovery. Stripping topsoil immediately after summer seed drop may improve the germinable seed load ([Berg 1975](#));
- The seed bank is usually concentrated in the upper soil layer (i.e. 40–50 mm) so it is important to only remove this depth of soil. A greater depth will dilute the seed bank and reduce the effectiveness of the soil as a potential mechanism for natural regeneration (Putwain & Gillham 1990);
- Topsoil should be used as soon as possible after stripping to prevent loss of seed viability ([Koch et al. 1996](#); [Mahesh et al. 1996](#)); and
- Top soil should be replaced at maximum depths of 100mm ([Rokich et al. 2000](#)).

Refer to APPENDIX 1 (Precinct 1 & 5 BMP) for a specific seedbank translocation methodology for the Kings Forest site.

26.3.2 Weed control

Due to the significant disturbance history, Kings Forest supports a variety of weed species. Slash Pine (*Pinus elliottii*) is the most common. Plantations have resulted in the species being naturalised on the site. Progeny range in size from small seedlings to trees 15-20 metres in height. In some areas of the site there is significant invasion into native vegetation communities, while in other areas there may be only one or two plants.

The aim of weed control within the vicinity of Precincts 12, 13 & 14 is the permanent removal of weeds to enable the protection of the Environmental Protection Zones and the adjacent Cudgen Nature Reserve. Harvesting of Slash Pine is to be completed as soon as possible to remove the continuing input of wilding propagates.

Disturbance during the bulk earthworks activities will create an opportunity for weeds to colonise and establish, therefore weeds should be diligently controlled both during and after completion of bulk earthworks in accordance with the Precinct 12, 13 & 14 WMP (JWA 2012).

26.3.3 Regeneration and Revegetation Measures

Background

Due to the large size of rehabilitation areas, rehabilitation will be completed with an emphasis on assisting natural regeneration rather than the labour intensive and costly approach of planting trees, although enhancement planting will still be completed in some areas.

Natural regeneration is already occurring within some areas of the site and will be encouraged within retained vegetation communities. Rehabilitation/regeneration works to be completed within Precinct 12, 13 & 14 Environmental Protection Zones and the golf course will generally include a combination of:

- Assisted natural regeneration where appropriate;
- Planting of preferred Koala food trees in accordance with the KPOM (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** and **APPENDIX 1** in the Precinct 1 & 5 Buffer Management Plan (BMP) (JWA 2012));
- Creation of core acid frog compensatory habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2012) (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** and **APPENDIX 1** in the Precinct 1 & 5 BMP (JWA 2012)); and
- Regeneration/revegetation of heath communities (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** and **APPENDIX 1** in the Precinct 1 & 5 BMP (JWA 2012)).

It should be noted that there is some overlap in the characteristics and objectives of proposed regeneration/revegetation areas at the Kings Forest site. For example, Koala food tree planting areas will also provide opportunities for revegetation with heath species (i.e. Koala food tree species will form the canopy with heath species forming the sub-canopy and understorey). Similarly, the creation of acid frog compensatory habitat (TSMP [JWA 2012]) provides an opportunity for further planting of scattered Koala food trees and wet heath species. The resulting revegetation areas will be structurally diverse and more closely mimic intact native vegetation communities (Refer to **APPENDIX 4** of the KPOM).

A suitably qualified bush regeneration company will be engaged to complete necessary rehabilitation works. The bush regeneration company will employ qualified bush regenerators, including a regeneration site manager, who will be responsible for all project management and staff supervision, and report directly to the site Ecologist.

Techniques to be employed to facilitate natural regeneration will be in accordance with those promoted by the Australian Association of Bush Regenerators (AABR).

26.3.4 Work Areas

The Revised Vegetation Management Plan (LandPartners 2009) identifies sixteen (16) work areas across the Kings Forest site. Work Areas 8, 9, 10, 11, 12, and 16 are relevant to Precinct 12, 13 & 14 Environmental Protection Zones (**FIGURE 3, APPENDIX 1**).

Furthermore, portions of the Precinct 12, 13 & 14 EPZ's and the golf course have been identified as requiring regeneration and/or revegetation works during recent site assessments and occur outside of the LandPartners work areas. These are included in the following works schedule as 'Additional Work Areas'.

26.3.5 Works schedule

The land will be revegetated/remediated and dedicated on a staged basis as soon as practical after adjacent subdivision works have been approved, or earlier subject to agreement between the parties. The staging of works will generally be based on the sequence of bulk earthworks (**FIGURE 2, APPENDIX 1**) as shown in **TABLE 1**. The following works schedule summarises the works relevant to the Environmental Protection Zones and associated ecological buffers within the area subject to this VMP.

TABLE 1
VMP STAGING OF WORKS

Earthworks sequencing	Work areas
Stage 3	8
Stage 4	9
Stage 4 & 6	16
Stage 3 & 7	11
Stage 7	10 & 12

Work Area	Proposed Measures
8	➤ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Koala food trees also to be planted in accordance with the KPoM (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping within heath/grassland communities to promote regeneration.
9	➤ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Koala food trees also to be planted in accordance with the KPoM (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Buffer plantings (rainforest species) within ecological and agricultural buffer areas.
10	➤ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Koala food trees also to be planted in accordance with the KPoM (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping to promote heathland regeneration. ➤ Opportunity for extensive rehabilitation of dam with wetland plantings.
11	➤ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Koala food trees also to be planted in accordance with the KPoM (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping to promote heathland regeneration around edges.

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Work Area	Proposed Measures
12	➤ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Koala food trees also to be planted in accordance with the KPoM (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping to promote heathland regeneration.
16	➤ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Koala food trees also to be planted in accordance with the KPoM (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping of grasses to promote regeneration of heath.
Additional Work Areas	➤ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core aid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2012) and are to be revegetated with heath species (refer FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012)). ➤ Ripping should be considered where appropriate to promote natural heath regeneration.

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26.3.6 Methodology

Planting methods

A general methodology for the planting of any trees/shrubs or groundcovers is as follows:

- Stockpiled topsoil is to be spread within revegetation areas where required.
- Where exotic grasses occur within planting areas they are to be sprayed with Glyphosate at least 2 weeks prior to planting.
- Plant holes to be dug to at least twice the root ball height and width.
- Soil is to be loosened, wetted and then the plant hole to be back filled with excavated soil.
- Weed free mulch should be applied to a minimum 75mm depth around the base of the plants but not adjacent to the stem.
- Plantings are to be protected with bags (e.g. gro-bags) held in position with bamboo stakes.
- Appropriate wallaby protection measures must be implemented to optimise survival of plantings (refer 'Wallaby Protection' section below).
- Plantings are to be watered for the first 3 months. Heavy mulching will reduce the need for regular watering, provided it is replaced at between 6-12 month intervals.
- Ongoing monitoring of native species recruitment maintenance of enhancement planting works and control of environmental weeds are to be undertaken throughout the proposed five year plan and beyond.
- Native species from locally sourced seed stock only are to be planted wherever possible. Consideration should be given to setting up an on-site nursery to assist in the collection and propagation of endemic native seed for revegetation on site. Alternatively, plants should only be sourced from local nurseries that can provide proof of local provenance (i.e. within 20kms of the site).
- Revegetation is to include canopy as well as sub-canopy and understorey species (Section 26.3.5). Canopy species will generally be comprised of Koala food tree species. Sub-canopy and understorey species will generally be comprised of heath species. A species list is also provided for revegetation in areas not suitable for Koala feed trees and/or heath species.
- Plant spacing is flexible, for instance in areas which act as Asset Protection Zones, spacing of canopy trees will be greater (e.g. 10m). Generally, plants are spaced according to the following prescriptions:
 - 3m spacing for trees (upper canopy plants),
 - 1.5m spacing for shrubs and small trees (midstorey plants), and
 - 1m spacing for groundcover (ground storey plants up to 1.5m in height).
- Plantings should occur during wetter months (January to May).

Wallaby protection

The site is inhabited by a large population of Swamp wallabies which are likely to browse any newly planted trees, causing potential death of plants. A combination of the following measures should be considered for the protection of plants on a site by site basis:

- protective bags;
- wallaby repellents (e.g. Sen-Tree®); and
- Wallaby-proof fencing using star pickets and pig mesh.

Koala Feed Trees

Planting of Koala feed and shelter trees is recommended within numerous work zones to establish linkages between areas of Koala habitat and to increase foraging resources for the species at the site in the long term (in accordance with the Stage 1 KPoM [JWA 2012]) (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012)). Faecal cuticle analysis undertaken by James Warren & Associates (JWA 2000) showed that the main species consumed by Koalas at the time of the SIS were Swamp mahogany (*Eucalyptus robusta*) and Swamp box (*Lophostemon suaveolens*) with smaller amounts of Brushbox (*L. confertus*), Blackbutt (*E. pilularis*) and Broad-leaved paperbark (*Melaleuca quinquenervia*).

Therefore, tree species nominated for planting include known feed tree species identified at the site (Swamp mahogany and Swamp box) in addition to other species such as Brushbox and Blackbutt (as per JWA), Red mahogany, Tallowwood and Forest red gum (Approved Koala Recovery Plan, DECC 2008). Koala feed trees should only be planted where conditions are appropriate (i.e. soils, topography, vegetation) so that plantings are compatible with any existing natural vegetation. For example, species such as Tallowwood should be planted in higher elevation parts of the site, while planting which occurs in proximity to large areas of naturally occurring vegetation should be more conservative in its species selection and utilise species which commonly occur in surrounding vegetation (e.g. Swamp mahogany, Swamp box, Blackbutt, Forest red gum). Areas identified within the KPoM (JWA 2012) for planting preferred Koala food trees are shown in **FIGURES 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012).

Acid Frog Compensatory Habitat

It is proposed to create core acid frog habitat within Environmental Protection Zones (EPZ's), ecological buffers and the golf course on the Kings Forest site in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2012). Areas requiring rehabilitation works within EPZ's and buffers will be targeted for the creation of core acid frog habitat.

The compensatory habitat areas will be planted with a combination of Swamp sclerophyll (i.e. Swamp mahogany & Broad-leaved paperbark) and Wet heath species.

Heath regeneration/revegetation

FIGURES 10 & 10A – 10L (APPENDIX 2) in the Precinct 1 & 5 BMP (JWA 2012) identifies proposed rehabilitation areas on the subject site which are currently comprised of regenerating heath communities, or are suitable for revegetation with heath species. The basis for revegetation with wet vs. dry heath vegetation will be determined by the topography of each revegetation area. Species lists are provided in **Section 26.3.8**.

Enhancement Plantings

In areas where extensive weed infestations have been removed or where Slash pine has been harvested (i.e. leaving large cleared areas) that are not suitable for revegetation with Koala food trees or heath regeneration/restoration, enhancement plantings with other locally endemic species will be completed. Additional species lists for each Work area are provided in **Section 26.3.8**.

26.3.7 Species Schedule

Heath species

Where heath revegetation is necessary (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012)), the following sub-canopy and understorey species are to be utilised:

Common name	Botanical name
Dry heath species*	
Sweet wattle	<i>Acacia suaveolens</i>
Prickly moses	<i>Acacia ulicifolia</i>
Heath aotus	<i>Aotus ericoides</i>
Wooly aotus	<i>Aotus lanigera</i>
Starhair bush	<i>Astrotricha longifolia</i>
Midgenberry	<i>Austromyrtus dulcis</i>
Wallum banksia	<i>Banksia aemula</i>
Heath-leaved banksia	<i>Banksia ericifolia</i>
Hairpin banksia	<i>Banksia spinulosa</i> var. <i>collina</i>
Milkmaids	<i>Burchardia umbellata</i>
Curly wigs	<i>Caustis recurvata</i>
Christmas bush	<i>Ceratopetalum gummiferum</i>
Pink matchheads	<i>Comesperma ericinum</i>
Blue dampiera	<i>Dampiera stricta</i>
Blue flax-lilly	<i>Dianella caerulea</i>
Rolled flax-lilly	<i>Dianella revoluta</i>
Eggs & bacon pea	<i>Dillwynia retorta</i>
Hopbush	<i>Dodonaea triquetra</i>
Wiry panic	<i>Entolasia stricta</i>
Wallum heath	<i>Epacris pulchella</i>
Pinnate wedge pea	<i>Gompholobium pinnatum</i>
Slender bloodroot	<i>Haemodorum tenuifolium</i>
Finger hakea	<i>Hakea dactyloides</i>
Narrow-leaved guinea flower	<i>Hibbertia linearis</i>
Hoary guinea flower	<i>Hibbertia obtusifolia</i>
Hairy guinea flower	<i>Hibbertia vestita</i>
Dogwood	<i>Jacksonia scoparia</i>
Wire lilly	<i>Laxmannia gracilis</i>
Sword sedge	<i>Lepidosperma laterale</i>
Knotted scale-rush	<i>Lepyrodia interrupta</i>
Erica heath	<i>Leucopogon ericoides</i>
Lance beard heath	<i>Leucopogon lanceolatus</i>
Wire beard-heath	<i>Leucopogon microphyllus</i>
Coast beard heath	<i>Leucopogon parviflorus</i>
Common beard-heath	<i>Leucopogon virgatus</i>
Screw fern	<i>Lindsaea linearis</i>
Long-leaved matrush	<i>Lomandra longifolia</i>

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Common name	Botanical name
Many-flowered matrush	<i>Lomandra multiflora</i>
Crinkle bush	<i>Lomatia silaifolia</i>
Large nectar heath	<i>Melichrus adpressus</i>
Jam tarts	<i>Melichrus procumbens</i>
Broom heath	<i>Monotoca elliptica</i>
Prickly-leaved monotoca	<i>Monotoca scoparia</i>
White dogwood	<i>Ozothamnus diosmifolius</i>
Broad-leaved geebung	<i>Persoonia cornifolia</i>
Small-leaved geebung	<i>Persoonia virgata</i>
Candlesticks	<i>Petrophile canescens</i>
Conesticks	<i>Petrophile pulchella</i>
Heath phyllota	<i>Phyllota phyllicoides</i>
Slender riceflower	<i>Pimelea linifolia</i>
Heathy platysace	<i>Platysace ericoides</i>
Shrubby platysace	<i>Platysace lanceolata</i>
Pomax	<i>Pomax umbellata</i>
Bracken	<i>Pteridium esculentum</i>
Green styphelia	<i>Styphelia viridis</i>
Black-eyed susan	<i>Tetradlea thymifolia</i>
Kangaroo grass	<i>Themeda australis</i>
Yellow rush-lilly	<i>Tricoryne elatior</i>
Austral bluebell	<i>Wahlenbergia gracilis</i>
Woolisia	<i>Woolisia pungens</i>
Wooly xanthosia	<i>Xanthosia pilosa</i>
Twiggy zieria	<i>Zieria minutiflora</i>
Sandfly zieria	<i>Zieria smithii</i>
Wet heath species*	
Swamp wattle	<i>Acacia elongata</i>
Heath aotus	<i>Aotus ericoides</i>
Wooly aotus	<i>Aotus lanigera</i>
Necklace fern	<i>Asplenium flabellifolium</i>
Heath myrtle	<i>Baeckea imbricata</i>
Feather plant	<i>Baloskion pallens</i>
Feathertop	<i>Baloskion tetraphyllum</i>
Heath banksia	<i>Banksia ericifolia</i>
Swamp banksia	<i>Banksia robur</i>
Jointed twig-rush	<i>Baumea articulata</i>
Wallum boronia	<i>Boronia falcifolia</i>
Swamp boronia	<i>Boronia parvifolia</i>
Milkmaids	<i>Burchardia umbellata</i>
Pale grass-lilly	<i>Caesia parviflora</i>
Wallum bottlebrush	<i>Callistemon pachyphyllus</i>
Curly wigs	<i>Caustis recurvata</i>
Swamp parrot pea	<i>Dillwynia floribunda</i>
Tall sundew	<i>Drosera auriculata</i>

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Common name	Botanical name
Rosette sundew	<i>Drosera spathulata</i>
Spreading rope-rush	<i>Empodisma minus</i>
Coral heath	<i>Epacris microphylla</i>
Blunt-leaf heath	<i>Epacris obtusifolia</i>
Swamp mahogany	<i>Eucalyptus robusta</i>
Tall saw-sedge	<i>Gahnia clarkei</i>
Red-fruited saw-sedge	<i>Gahnia sieberana</i>
Coral fern	<i>Gleichenia dicarpa</i>
Rocket goodenia	<i>Goodenia bellidifolia</i>
Slender bloodroot	<i>Haemodorum tenuifolium</i>
Sword sedge	<i>Lepidosperma laterale</i>
Prickly tea-tree	<i>Leptospermum juniperinum</i>
Lemon-scented tea-tree	<i>Leptospermum liversidgei</i>
Knotted scale-rush	<i>Lepyrodia interrupta</i>
Slender clubmoss	<i>Lycopodium laterale</i>
Thyme honeymyrtle	<i>Melaleuca thymifolia</i>
Heath phyllota	<i>Phyllota phyllicoides</i>
Slender rice-flower	<i>Pimelea linifolia</i>
Common bog rush	<i>Schoenus apogon</i>
	<i>Schoenus paludosus</i>
Swamp clubmoss	<i>Selaginella uliginosa</i>
Swamp heath	<i>Sprengelia sprengelioides</i>
Spoon-leaf goodenia	<i>Velleia spathulata</i>
Swamp grasstree	<i>Xanthorrhoea fulva</i>

* The basis for revegetation with wet vs. dry heath species will be determined by the topography of the revegetation area.

Koala food tree species

Where revegetation with preferred Koala food trees is necessary (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** in the Precinct 1 & 5 BMP (JWA 2012)), the following canopy species are to be utilised:

Koala food trees	
Tallowwood	<i>Eucalyptus microcorys</i>
Blackbutt	<i>Eucalyptus pilularis</i>
Red mahogany	<i>Eucalyptus resinifera</i>
Swamp mahogany	<i>Eucalyptus robusta</i>
Forest red gum	<i>Eucalyptus tereticornis</i>
Brushbox	<i>Lophostemon confertus</i>
Swamp box	<i>Lophostemon suaveolens</i>
Broad-leaved paperbark	<i>Melaleuca quinquenervia</i>

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Additional plant species

Additional canopy, sub-canopy and understorey plant species (i.e. for areas not suitable for Koala feed trees and/or heath species) are listed below.

Common name	Botanical name
Black wattle	<i>Acacia melanoxylon</i>
Lilly pilly	<i>Acmena smithii</i>
Black she- oak	<i>Allocasuarina littoralis</i>
Fern-leaved banksia	<i>Banksia oblongifolia</i>
Crimson bottlebrush	<i>Callistemon salignus</i>
Swamp oak	<i>Casuarina glauca</i>
Corkwood	<i>Duboisia myoporoides</i>
Blueberry ash	<i>Elaeocarpus reticulatus</i>
Scribbly gum	<i>Eucalyptus racemosa</i>
Sandpaper fig	<i>Ficus coronata</i>
Cheese tree	<i>Glochidion ferdinandi</i>
Bleeding Heart	<i>Homalanthus populifolius</i>
Cabbage tree palm	<i>Livistona australis</i>
Broad-leaved paperbark	<i>Melaleuca quinquenervia</i>
Elderberry ash	<i>Polyscias sambucifolia</i>
Macrophytes*	
Baumea	<i>Baumea rubiginosa</i>
Giant sedge	<i>Cyperus exaltatus</i>
Common spikerush	<i>Eleocharis acuta</i>
Rusty sedge	<i>Fimbristylis ferruginea</i>
Giant sedge	<i>Lepironia articulata</i>
Common reed	<i>Phragmites australis</i>
Club rush	<i>Schoenoplectus validus</i>

* Macrophytes to be planted in areas of shallow water and surrounds.

26.3.8 Adaptive Management

Adaptive management is an approach that involves learning from management actions, and using those lessons to improve upon the overall plan. The principles of adaptive management have been incorporated into the administration of restoration projects within a variety of governmental authorities and programs (Thom 1997). Comprehensive, long-term monitoring is a component of adaptive management as adaptive management strategies rely on the accumulation of evidence supporting decisions that demand changes in action.

An adaptive management approach involves an integrated process of firstly monitoring, then reviewing and responding to the health and conditions of the plantings, natural regeneration and the status of the weed infestation. Alteration to the design and maintenance of works required, to ensure the objectives of the VMP are achieved, are then made.

Adaptive management strategies will be determined by the information provided in monitoring reports. Adaptive management strategies that may be required within this VMP are as follows:

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- ♦ Amendment of species list for revegetation works;
- ♦ Replacement of enhancement plantings that do not survive;
- ♦ Alteration of weed control methods or timing.

Before the implementation of any adaptive management strategy a brief report is be provided to Project 28 Pty Ltd and other relevant agencies detailing the proposed management actions and the predicted outcomes. The implementation must be approved by the relevant authority prior to implementation.

26.4 Monitoring and Reporting

26.4.1 Introduction

Monitoring is an essential component of this VMP and its associated rehabilitation works. Ongoing monitoring of the results of vegetation protection and rehabilitation works is essential throughout the proposed five (5) year plan or until the vegetation is self-sustaining (whichever is the earliest) (also refer FFMR (JWA 2012)). Monitoring and reporting will ensure the continuing success of the vegetation protection and rehabilitation programme by ensuring that activities are meeting set aims and objectives. The results obtained through monitoring will help managers to prioritise management actions and keep track of the health of rehabilitated areas.

Monitoring and reporting can be divided into the following distinct phases:

5. Baseline monitoring (prior to commencement of vegetation protection and rehabilitation works in each Work area);
6. Monitoring by an Ecologist will occur at strategic times; and
7. An annual report will be compiled by the Ecologist that combines the result of the above monitoring.
8. Long-term monitoring of the health and composition of vegetation communities is also proposed, including specific monitoring for impacts on the adjacent Cudgen Nature Reserve.

26.4.2 Rehabilitation Monitoring

Monitoring requirements

The vegetation monitoring will include regular visits by a qualified ecologist who is to complete the following:

- ♦ Transects
 - Ten (10) transects are to be placed within the retained vegetation areas;
 - Transect locations are to be permanently marked;
 - Transects are to be 30 metres in length;
 - During monitoring visits tape measures are to be placed on the ground and the specific measureable features recorded along the transects;
 - Specific measurable features include:
 - Areas of vegetation cover (native species);
 - Areas of weed cover;
 - Areas of bare ground/mud;
 - Number, percentage and species of planted stems surviving;
 - Results are to be shown in a table which is to be presented in the monitoring reports.

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- ♦ Quadrats
 - Three (3) quadrats (1m²) are to be placed along each of the transects;
 - Quadrats must be placed a minimum of 5m apart along the length of the transect;
 - Quadrats are to be placed randomly within five (5) metres of the transect line;
 - The boundary of the quadrat with respect to the tape measure (e.g. between 3.5 – 4.5 metres on tape measure) will be recorded;
 - For each quadrat the following specific measurable features will be recorded:
 - Plant species occurring
 - Percentage cover
 - Height
 - Relative abundance of native species
 - Weed cover
 - Number, percentage and species of planted stems surviving
 - Results are to be shown in a table which is to be presented in the monitoring reports.
- ♦ Fixed Photo points
 - A central transect marker on each established monitoring transect is to be used as permanent photo station for photographic monitoring;
 - Four (4) photos are to be taken from each central transect marker. Photos are to be taken to the north, south, east and west;
 - Photos should be labelled with the:
 - Transect code
 - Direction of view
 - The date & time
 - Photos must be supplied in the monitoring reports in a form of prints no smaller than 4" x 6" and must be colour.

26.4.3 Baseline monitoring

Baseline data is to be gathered at each work area prior to the commencement of protection or regeneration works to allow the preparation of more detailed site specific assessments and more relevant performance criteria specific to the vegetation community that is being rehabilitated. Baseline monitoring will include the above assessments (Section 26.4.2), re-mapping of the site vegetation mapping and an assessment of restoration potential of each proposed rehabilitation area. This will assist in documenting vegetation recovery in the long term (refer to the Flora and Fauna Monitoring Report [JWA 2012]).

26.4.4 Timing of monitoring visits

The monitoring is to be completed by a suitably qualified ecologist. Site visits should occur:

- ♦ Six (6) weeks after primary weeding;
- ♦ Six (6) weeks after initial plant-out;
- ♦ Every six (6) months thereafter until groundcovers are sufficiently established (i.e. between two (2) - three (3) years)
- ♦ Annually after establishment until completion criteria are met (refer Section 26.4.6).

26.4.5 Long term Monitoring

Along with the regular monitoring within the EPZ's, the overall vegetation composition is to be regularly assessed and recorded. Long term monitoring will use both aerial photos and yearly assessments (ground truthing) of the vegetation communities using a hand held GPS.

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The Long term monitoring of the vegetation composition within the EPZ's will include:

- A detailed vegetation map at a scale of 1:5000 is to be completed within the EPZ's every twelve (12) months;
- Each year, after completion of vegetation mapping, a report is to be completed showing the changes in the composition of the vegetation communities. The results are to be shown in a table that shows the vegetation community and the area of the vegetation community as a percentage of the EPZ's. Monitoring will continue until completion criteria are met.

26.4.6 Performance Criteria

The success of the VMP will be regularly evaluated. Performance criteria will be guided by comparisons to baseline data collected in each work area, however a number of criteria will indicate successful rehabilitation of the EPZs and ecological buffers, including:

- Foliage Projective Cover (%) assessed using eye estimates or photo points (i.e. FPC of native vegetation increasing after each monitoring visit);
- Species composition targets will be based on accepted benchmarks for the specific vegetation communities on the Kings Forest site;
- Noxious and environmental weeds are to be eradicated;
- Infrastructure functional and well-maintained in a state suitable for hand over to Tweed Shire Council;
- Natural recruitment of native seedlings throughout planting areas; and
- Plantings providing variable habitats for native fauna species.

Performance criteria will be assessed for the EPZ's as follows:

- The photos taken during monitoring visits, in combination with the annual monitoring and mapping of native vegetation composition and the results of the annual flora survey, will be used to determine the extent of native plant species and the levels of biodiversity the area is supporting.
- When it is determined that all performance criteria have been met, completion will have occurred.

26.4.7 Reporting

Following each inspection by the qualified ecologist, a report will be prepared that will include tables and photographs from the monitoring visits. At the end of each year a detailed report will be prepared for the Department of Environment, Climate Change & Water (DECCW) and Tweed Shire Council. The report will discuss the following:

- Works undertaken;
- Progress of regeneration/revegetation areas against completion criteria using photos and tables showing the results of the monitoring visits;
- Significant problems encountered (death of seedlings, broken fences, vandalism, etc.) and the effect of these on the plantings and aims of the revegetation or regeneration strategy;
- Success or failures of measures implemented to rectify previously identified problems;
- Measures to be taken to rectify new problems; and
- Performance against performance criteria (Section 26.4.6).

REFERENCES

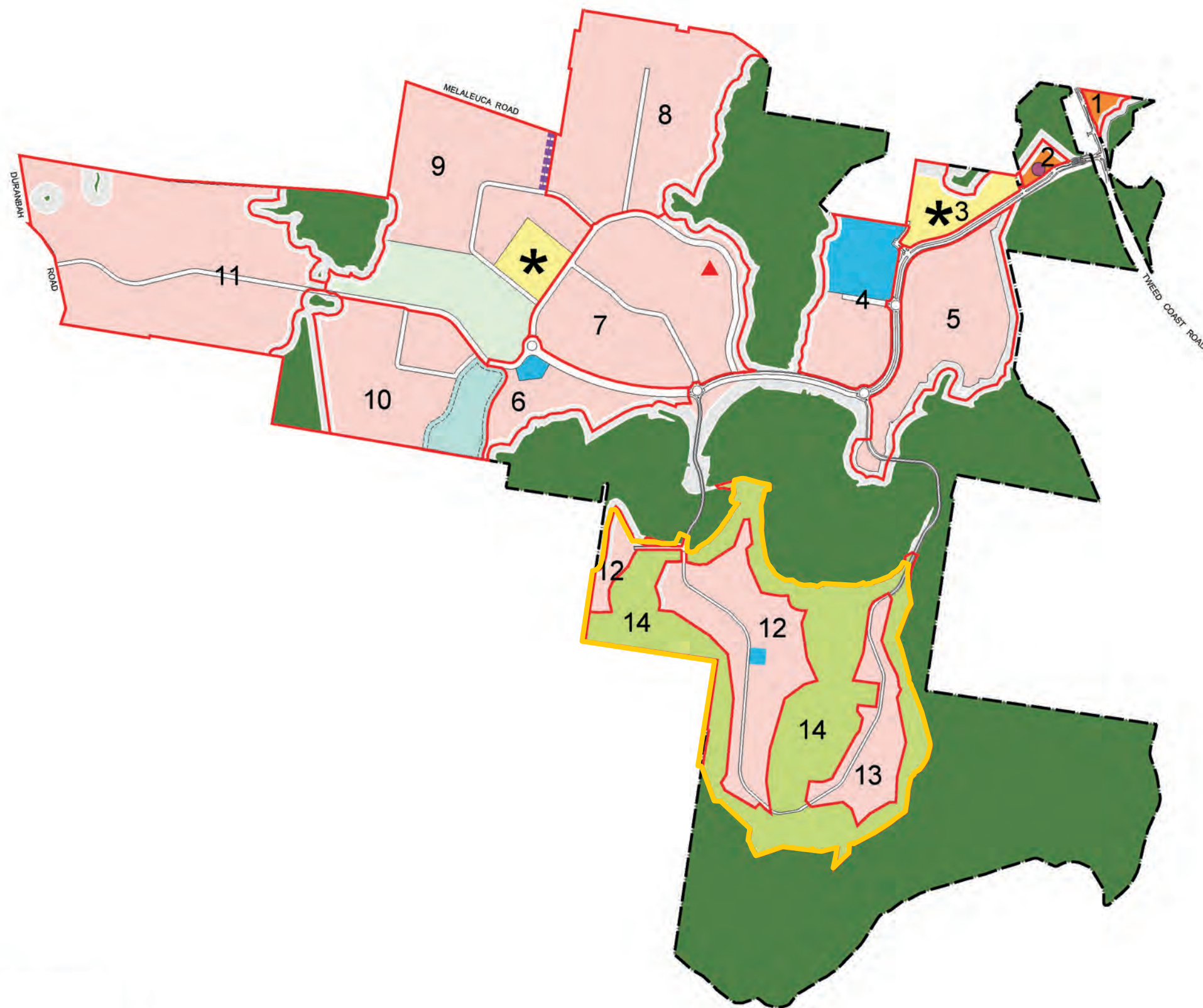
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APPENDIX 1 – FIGURES

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- LEGEND**
- Town Centre / Neighbourhood Centre
 - Residential
 - Community Facilities / Education
 - Employment Land
 - Structured Open Space (Active)
(Passive open space to council standards, location subject to urban design)
 - Environmental Protection Area to be Dedicated to Council or NPWS
 - 50m Ecological Buffer
(includes APZ's & roads where approved)
 - * State School Site
 - Proposed Zone Substation
(subject to Country Energy final approval)
 - Potential Affordable Housing Location
 - Potential Road Connection to Melaleuca Road
 - Private Open Space
 - Golf Course Area
(encompassing ecological buffers where indicated)
 - Private Open Space including Lake
 - Precinct Boundaries
 - Precincts 12-14
 - Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: RPS (Ref: 113691-PSP-4a
(PRECINCT PLAN).jpeg)

SCALE: 1 : 20 000 @ A3

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

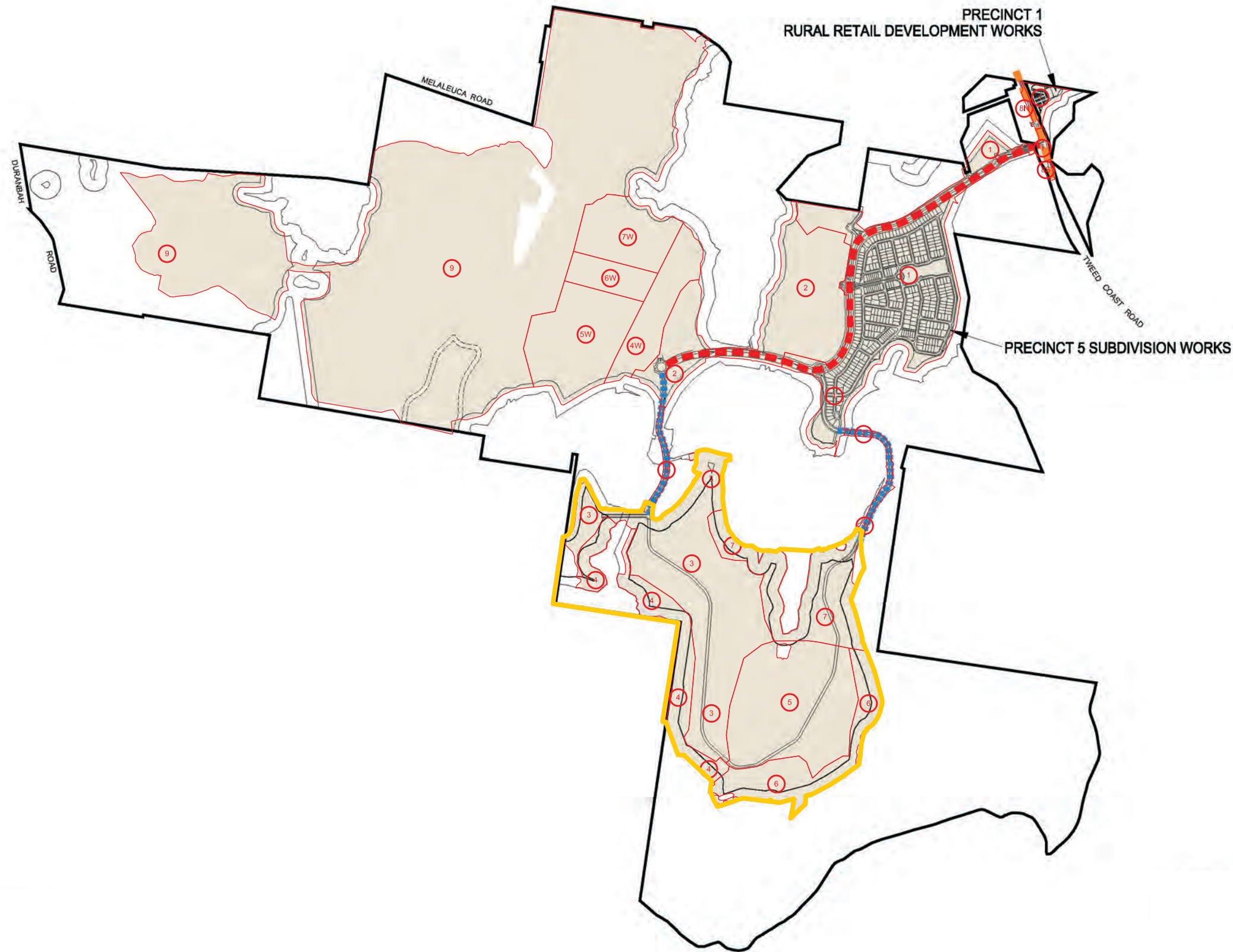
CLIENT
Project 28 Pty Ltd
PROJECT
Kings Forest Stage 1 Project Application
Precincts 12-14 - Vegetation Management Plan
Melaleuca Drive, Durambah, NSW
Shire of Tweed

FIGURE 1

PREPARED: BW
DATE: 27 August 2012
FILE: N97017_VMP_Precincts.cdr

TITLE

**PRECINCTS
PLAN**



- LEGEND**
- ■ ■ Tweed Coast Road Intersection Works
 - ■ ■ Kings Forest Parkway through to Western Precincts
 - ■ ■ Roads through to Southern Precincts
 - Indicative Bulk Earthworks Location (Refer to detailed engineering design by Mortons Urban Solutions)
 - Earthworks Sequencing
 - Precincts 12-14
 - Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: RPS (Ref: 113691-PSP-4a (SCOPE OF WORKS).jpeg); Mortons Urban Solutions (Ref: sequencing COLOUR.pdf)
SCALE: 1 : 20 000 @ A3
JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Project 28 Pty Ltd
PROJECT
Kings Forest Stage 1 Project Application
Precincts 12-14 - Vegetation Management Plan
Melaleuca Drive, Durambah, NSW
Shire of Tweed

FIGURE 2

PREPARED: BW
DATE: 28 August 2012
FILE: N97017_VMP_Scope.cdr

TITLE

SCOPE OF WORKS



- LEGEND**
- Vegetation Work Unit
 - Precincts 12-14
 - Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: Landpartners Revised Vegetation Management Plan (2009) Figure 9 & 2007 Aerial; Near Map June 2011 Aerial
SCALE: 1 : 20 000 @ A3
JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Project 28 Pty Ltd
PROJECT
Kings Forest Stage 1 Project Application
Precincts 12-14 - Vegetation Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 3
PREPARED: BW
DATE: 20 August 2012
FILE: N97017_VMP_Veg Mgt.cdr

TITLE
**VEGETATION
MANAGEMENT
AREAS**

27.0 ACID SULFATE SOILS MANAGEMENT PLAN – GILBERT & SUTHERLAND

Darryl Anderson Consulting Pty Ltd

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DOCUMENT CONTROL

DOCUMENT 10927 ASSMP TJR1F.docx

TITLE Acid Sulfate Soil Management Plan, Kings Forest Stage 1 Project Application, Kings Forest, New South Wales

PROJECT MANAGER N. Zurig

AUTHOR(S) T. Robinson/D. Smith

CLIENT Project 28 Pty Ltd

CLIENT CONTACT Reg van Rij

CLIENT REFERENCE –

SYNOPSIS This management plan establishes responsibilities and procedures for the management of acid sulfate soils and a range of related issues during Stage 1 of the development of the Kings Forest Development, New South Wales.

REVISION HISTORY

REVISION #	DATE	EDITION BY	APPROVED BY	FILE NAME
1	12/10	T. Robinson /D. Smith	G. Holland /L. Varcoe	10468 ASSMP TJR1F
2	4/11	M.Hancock	N. Zurig /L. Varcoe	10468 ASSMP TJR2F
3	7/12	M.Foster	N. Zurig /L. Varcoe	10927 ASSMP TJR1F

DISTRIBUTION

	REVISION NUMBER									
	1	2	3	4	5	6	7	8	9	10
Distribution										
Project 28 Pty Ltd	3	3	1							
JBA Planning	-	1	-							
Darryl Anderson Consulting Pty Ltd	-	-	1							
G&S file	1	1	1							

SUMMARY

Project 28 Pty Ltd commissioned Gilbert & Sutherland Pty Ltd (G&S) to prepare an Acid Sulfate Soil Management Plan (ASSMP) for Stage 1 earthworks proposed by the Kings Forest Stage 1 Project Application. The ASSMP incorporates the findings of investigations conducted by G&S and incorporated in the *Kings Forest Stage 1 Project Application Acid Sulfate Soil Assessment Report* (2012) produced for Project 28 Pty Ltd by G&S (the “ASSA report”).

The Kings Forest Stage 1 Project Application No. MP 08_0194 was lodged in November 2011. The Application and Environmental Assessment Report was advertised from December 2011 to January 2012 following which 302 public submissions and 10 agency submissions were received. As a result of the submissions, amendments to the project have been made. The amended project contains the following key elements (NB: these elements will be revised and updated as the amended project is finalised):

- Subdivision to create new lots for future development;
 - Bulk earthworks across the site;
 - Road works comprising:
 - construction of the entrance road into the site and associated intersection works on Tweed Coast Road;
 - alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- The Plan of Development for Precinct 5.

The ASSA report identified the presence of Potential Acid Sulfate Soil (PASS) and Actual Acid Sulfate Soil (AASS) materials at the site thereby triggering the need for an ASSMP in accordance with the NSW Acid Sulfate Soils Management Advisory Committee (ASSMAC) Guidelines.

This ASSMP is designed to ensure that ASS encountered at the Kings Forest development site during Stage 1 earthworks are appropriately identified and treated in accordance with proven management techniques. The ASSMP provides a clear management protocol based on operational policies, performance criteria, implementation strategies and corrective actions, should they be necessary. The ASSMP identifies who is responsible for each specific aspect of ASS management.

The ASSMP provides a working tabular format with provision for amendment if required.

Kings Forest, Stage 1 - Summary and Implementation Table, Acid Sulfate Soil Management Plan

Action No	ACTION	Location (reference to Map)	Purpose	TIMING and FREQUENCY	RESPONSIBILITY	PERFORMANCE MEASURE	MONITORING and reporting	Further Details
ASSMP 1	Phase 2 acid sulfate soil sampling and identification (dry and wet excavation)	Stage 1 earthworks	To identify any AASS, PASS or acidic soils during Stage 1 earthworks and determine their acid generating potential prior to treatment	SPOCAS (or Chromium Suite) analysis will be conducted at a frequency of 1 test/500m ³ of excavated in situ materials	Contractor's Site Manager; Environmental Consultant	All AASS, PASS and acidic soil material is appropriately identified prior to treatment	ASS analytical results including interpretation and liming rates shall be reported to the site supervisor and kept onsite	Table 27.3.3
ASSMP 2	Acid sulfate soil treatment (dry and wet excavation)	Stage 1 earthworks	No acidic or potentially acidic soils are to be disturbed or excavated without appropriate testing and/or treatment by neutralisation of the acid generating potential (AGP) of the material	All excavation works and stockpiling of untreated acid sulfate materials shall be conducted in such a manner that the length of time the untreated materials are exposed to air is minimised	Contractor's Site Manager; Environmental Consultant	All ASS material has been appropriately identified and will be neutralised and verified prior to final placement	Records including testing results and lime delivery dockets are to be kept on site during the construction phase and should be available for inspection at all times Records shall be made available to DECCW and TSC upon request	Table 27.3.4
ASSMP 3	Sediment and erosion control	Stage 1 earthworks	To prevent the displacement of sediment and soil from drains particularly during storm events Compliance with the NSW POEO Act (1997)	All erosion and sedimentation control devices shall be inspected: • weekly during construction • monthly, when no works are occurring on site • within 24 hours of expected rainfall • within 18 hours following a rainfall event • or in accordance with ESCP provisions Monthly audit inspections will be undertaken to ensure adequate erosion and sedimentation control	Consulting Engineer; Contractor's Site Manager	All excavated soil material shall be contained in such a manner so as to prevent the displacement of this material across the site. No erosion or sediment accumulation shall result from on-site activities. All waters shall be treated prior to release off-site to prevent the discharge of sediment-	The Environmental Consultant or the proponent's nominated representative will report the findings of the audit inspections to the proponent and make recommendations in regard to additional erosion and sedimentation control measures Records shall be made available to DECCW and TSC upon request	Table 27.3.5

Action No	ACTION	Location (reference to Map)	Purpose	TIMING and FREQUENCY	RESPONSIBILITY	PERFORMANCE MEASURE	MONITORING and reporting	Further Details
				devices are installed, particularly in acidic soil treatment areas.		laden waters into Cudgen Creek or the surrounding environs.		
ASSMP 4	Surface water quality management	Acid sulfate soil treatment areas	To prevent adverse impacts to surface and groundwater quality in the downstream receiving environment	Site works to be inspected weekly and following rainfall events for any evidence of oxidation of acidic soils or sediment accumulation Water quality monitoring to be conducted prior to discharge of waters ponding in ASS treatment areas	Contractor's Site Manager	Surface water quality will comply with the discharge criteria listed in Table 27.3.6 prior to release from the site	Results to be recorded and kept onsite for inspection by local or state government officers at all times Monthly water quality reports to be provided to the Proponent Water quality reports to be provided to TSC or DECCW upon request DECCW to be notified immediately of any environmental incident	Table 27.3.6
ASSMP 5	Groundwater (excavation works)	Groundwater monitoring locations to be specified	To ensure that construction activities do not impact onsite groundwater or groundwater in the receiving environment	Groundwater monitoring to be conducted prior to earthworks and during the Stage 1 construction works for the parameters listed in Table 13.2.1 of the <i>Kings Forest Stage 1 Erosion and Sediment Control Plan</i> (G&S 2012) – Section 13 of the <i>Kings Forest Stage 1 Management Plan</i> (DAC, 2012)	Contractor's Site Manager	No deterioration in groundwater quality below the range of natural variation	Groundwater monitoring results shall be kept onsite All results or incident reporting (including actions taken) to be forwarded to Environmental Representative and Supervising Engineer DECCW to be notified immediately of any environmental incident	Table 27.3.7

GLOSSARY

TERM	MEANING
ASS	Acid Sulfate Soils. This is the collective term for both Actual Acid Sulfate Soils and Potential Acid Sulfate Soils.
ASSMAC	Acid Sulfate Soil Management Advisory Committee
ASSMP	Acid Sulfate Soils Management Plan.
PASS	Potential Acid Sulfate Soils. These soils contain pyrite and are usually undisturbed. When these soils are exposed the pyrite oxidises to produce sulfuric acid.
AASS	Actual Acid Sulfate Soils. These soils are formed when the pyrite in Potential Acid Sulfate Soils oxidises to produce sulfuric acid.
CRS	Chromium Reducible Sulfur (CRS) is an analytical method, which quantifies sulfur in an inorganic (i.e. pyritic) form. This method is a suitable test to determine whether the oxidisable sulfur is from organic material or if it is from pyrite, and therefore formed under estuarine conditions.
TAA	Titrateable Actual Acidity. TAA is a measure of a soil's acidity prior to the complete oxidation of sulfidic material, including both pyritic and organic acidity.
TPA	Titrateable Potential Acidity. TPA is the titrateable oxidisable acidity, calculated from the complete oxidation of the soil.
TSA	Titrateable Sulfidic Acidity. TSA is a measure of the soil acidity resulting from sulfidic material. This is a general indicator of the acidity produced from pyritic material.

27.1 Introduction

27.1.1 Background

Project 28 Pty Ltd commissioned Gilbert & Sutherland to prepare an Acid Sulfate Soil Management Plan (ASSMP) for Stage 1 Project Application for the proposed Kings Forest development at Kings Forest, New South Wales.

The Director General of the Department of Planning issued amended Environmental Assessment Requirements (DGRs) for the project application on 23 December 2010. The DGRs require that specialist advice be provided to address the following Key Issues:

Key Issue 6.2: Identify the location and scale of any ASS impacts and provide a summary of the management likely to be required.

The *Kings Forest Stage 1 Project Application Acid Sulfate Soil Assessment* (G&S 2012) identified the presence of Potential Acid Sulfate Soil (PASS) and Actual Acid Sulfate Soil (AASS) materials throughout the site.

PASS and AASS materials were encountered at depths ranging from near surface level to greater than 13m below Natural Surface Level (NSL), indicating a widespread presence of these materials throughout the site. The presence of these materials necessitates the production of an ASSMP in accordance with the requirements under the Acid Sulfate Soils Management Advisory Committee Guidelines 1998 (the "ASSMAC guidelines").

27.1.2 The project application

The Kings Forest Development site covers approximately 870 hectares and is situated south-west of the town of Cudgen. The Kings Forest development will involve total cut volumes of approximately 1,731,012m³. Typically the depth of

excavation will be up to 3.0m with the exception of the proposed dam in the west of the site, which may involve excavations up to 8.0m below natural surface level (NSL). This will be subject to further detailed hydrological assessment.

The Project Application incorporates the following elements (NB: these elements will be revised and updated as the amended project is finalised):

- Subdivision to create new lots for future development;
 - Bulk earthworks across the site;
 - Road works comprising:
 - construction of the entrance road into the site and associated intersection works on Tweed Coast Road;
 - alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- The Plan of Development for Precinct 5.

The Stage 1 Project Application Revised Concept Plan is shown on the attached RPS Australia East Pty Ltd Drawing No. 113691-PSP-4a(CONCEPT PLAN) Plan No. 01.

27.1.3 Objectives

This report constitutes ASSMP for the Stage 1 Project Application for of the Kings Forest development, Kings Forest, NSW.

27.2 The proposal

The Kings Forest Stage 1 Project Application earthworks include the excavation of a total of approximately 1,731,012m³ of material. In order to facilitate construction at the site, both dry and wet excavation methods will be employed requiring appropriate management of ASS.

27.2.1 Construction sequence

The general construction sequence and associated environmental protection measures will be undertaken in accordance with the *Kings Forest Stage 1 Management Plan* (Darryl Anderson Consulting, 2012).

The following sections detail the management measures for the management of ASS and associated waters during the construction works.

27.3 ASSMP structure

This ASSMP acknowledges the potential environmental impacts associated with the future disturbance of ASS during Stage 1 earthworks at the Kings Forest site, and details strategies to mitigate them.

Each control strategy is based upon proven environmental management methods and is presented as a commitment. The commitments made within this document will form the basis of future assessments, which will be made available to the Tweed Shire Council (TSC) for review.

The ASSMP is based on a series of tables for use during the construction phase of the future development. The person responsible for the implementation of the measures detailed is written on the table itself. The tables then detail the issue, the performance criteria, the implementation strategy, monitoring, auditing, reporting, failure identification and the corrective action. The detachable pages within each section detail the provisions of the ASSMP. The format is presented below for reference purposes.

Title

Person responsible	This is the person who has accepted the responsibility of implementing the ASSMP provisions detailed on this page.
Issue	The issue with which the table deals.
Operational policy	The operational policy or management objective that applies to the element.
Performance criteria	Performance criteria (outcomes) for each element of the operation.
Implementation strategy	The strategies or tasks (to nominated operational design standards) that will be implemented to achieve the performance criteria.
Monitoring	The monitoring requirements, which will measure actual performance (i.e. specified limits to pre-selected indicators of change).
Auditing	The auditing requirements, which will verify implementation of, agreed construction and operation phase environmental management strategies and compliance with agreed performance criteria.
Reporting	Content, timing and responsibility for reporting and auditing of monitoring results.
Identification of incident or failure	The circumstances under which the agreed performance criteria are unlikely to be met and environmental harm is likely to result.
Corrective action	The action to be implemented in case a performance requirement is not reached and the company(s) responsible for action.

Commitment #

What the management has committed the company to.

An objective of the tabular format is to allow for change and allow the ASSMP to be a working document. If items need altering, changes may be made to the individual tables after appropriate consultation with the statutory authorities.

27.3.1 General commitments

Commitment 1

The Developer undertakes to comply with the environmental implementation strategy as contained within the approved Acid Sulfate Soil Management Plan (ASSMP).

Commitment 2

The Developer undertakes to fulfil all commitments made in this ASSMP and to carry out its activities on the project site in accordance with relevant current statutory requirements and approved amendments.

27.3.2 Definitions

In this ASSMP the terms have the following meanings;

- ASSMAC means the Acid Sulfate Soils Management Advisory Committee.
- ASSMP means the approved Acid Sulfate Soil Management Plan and includes any amendments that may be approved from time to time.
- Developer means the party undertaking the development of the land and includes the person nominated as having the responsibility for implementing the provisions of the ASSMP.
- Development means the development of the site as defined in this Project Application and future project applications.
- DECCW means the NSW Department of Environment, Climate Change and Water.
- POEO Act means the NSW Protection of the Environment Operations Act, 1997.
- Proponent means the person undertaking the development of the land and includes the person nominated as having the responsibility for implementing the provisions of the ASSMP.
- TSC means the Tweed Shire Council.

27.3.3 Phase 2 acid sulfate soil sampling and identification (dry and wet excavation)

Person responsible	Contractor's Site Manager, Environmental Consultant
Issue	Acid sulfate soil identification.
Operational policy	To identify any AASS, PASS or acidic soils during Stage 1 earthworks at the site and determine their acid generating potential prior to treatment.
Performance criteria	All AASS, PASS and acidic soil material is appropriately identified prior to treatment.
Implementation strategy	An initial (Phase 1) acid sulfate soil investigation was conducted by G&S, with the results relating to the material underlying the proposed development site outlined in the <i>Kings Forest Stage 1 Project Application Acid Sulfate Soil Assessment</i> Report (G&S, July 2012). Phase 2 sampling of dry and wet excavated materials will be undertaken according to the following protocol prior to placement within the designated bunded treatment area/zone. Frequency: SPOCAS (or Chromium Suite) analysis will be conducted at a frequency of 1 test/500m³ of excavated in situ materials. Sample size: Soil samples should be approximately 0.3 kg in size with a brief soil texture description accompanying each sample. Sampling: Soil samples to be tested onsite or collected in sealed containers that exclude air for temporary storage prior to testing onsite. Handling and storage: Samples destined for storage shall be frozen or dried within 24 hours of collection.
Monitoring	Laboratory analysis will employ the SPOCAS Method (Method 23) or Chromium Suite (Method 22B). Material (spatial) tracking of dry and wet excavated material will be undertaken by the environmental consultant and site supervisor. Records shall be kept of volumes excavated, location of excavated material and acid sulfate soil testing frequency.
Reporting	ASS analytical results including interpretation and liming rates shall be reported to the site supervisor and kept onsite.
Identification of incident or failure	Insufficient sampling or failure to sample as identified by material tracking records and/or test results and/or procedures.
Corrective action	Undertake additional sampling as required to completely characterise the nature of the material to be disturbed. Consultation with an Environmental Consultant to determine appropriate rates for additional sampling.

Commitment 3

The Developer will undertake all necessary investigations to identify the occurrence and severity of PASS, AASS and acidic soil during the construction phase.

27.3.4 Acid sulfate soil treatment (dry and wet excavation)

Person responsible	Contractor's Site Manager, Environmental Consultant
Issue	Treatment of AASS and acidic non-ASS identified onsite.
Operational policy	No acidic or potentially acidic soils are to be disturbed or excavated without appropriate testing and/or treatment by neutralisation of the acid generating potential (AGP) of the material.
Performance criteria	All ASS material has been appropriately identified and will be neutralised and verified prior to final placement.
Implementation strategy	ASS excavation to be conducted according to the following treatment measures. Lime treatment All excavated soils will be treated with lime or neutralising agent to neutralise their equivalent net acid generating potential (TPA or equivalent oxidisable sulfur concentrations). Lime treatment will be required where the following thresholds are exceeded: • Potential soil acidity (S_{POS} or S_{CR}): $>0.3\%$, • Actual soil acidity (TAA): $>18 \text{ mol H}^+/\text{t}$, • If $\text{pH}_{KCl} < 4.5$ and/or if jarosite is present, retained soil acidity analysis (S_{NAS} or S_{RAS}) will also be required. A mixing factor of safety of 1.5 shall be implemented. Material will be placed in spatially tracked lots within bunded areas. The bunded areas shall have a leachate collection system. Placed material will be spread to a depth of $<300\text{mm}$, limed at the determined rate and mixed with a rotary hoe or disc plough to a minimum depth of 300mm. Stockpiling prior to spreading will be kept to a minimum and in general accordance with the requirements for Short Term Stockpiling as per the ASSMAC guidelines. Materials used to construct the bunds will be free from ASS. The bunded area will be prepared with surface lime at the rate of $0.2 \times$ average net acid generating potential (NAGP) per metre depth of material to be placed or at the minimum rate of $5\text{kg}/\text{m}^2/\text{metre depth of material}$. A layer of lime slurry shall be applied to exposed cut faces immediately following the excavation to the maximum depth to neutralise the soils exposed to oxidation. Any dewatering of the excavation or treatment of leachate or groundwater within the excavation shall be undertaken as detailed in Section 27.3.7. Validation testing Following lime treatment, Phase 3 verification testing shall be performed by assessing oxidisable sulfur (or an equivalent method agreed with DECCW) sampled at the rate of one sample per $1,000\text{m}^3$ of treated material.

	Subsequent treatment layers (<300mm) will not be placed within the treatment pad until Validation (Phase 3) testing results are obtained, indicating the complete neutralisation of the treated material. Any material that exceeds TAA thresholds but does not exceed oxidisable sulfur concentrations (e.g. material that is high in organic matter or iron oxides) shall be treated with lime at the appropriate application rate, but will not require validation testing to be undertaken. Excavation works and timing of stockpiling/treatment All excavation works and stockpiling of untreated acid sulfate materials shall be carried out in such a manner that: • the surface area of materials exposed to oxidation is minimised, • the length of time the untreated materials are exposed to air is minimised, • provides for a system of suitable diversion drains or embankments to divert surface waters away from the stockpiles and the excavation area, • ensures that any unforeseen groundwater seepage and/or leachate and/or stormwater runoff within the excavation area is collected and not released from the site, untreated to any stormwater drain or waters (including groundwater), • ensures that any leachate and/or stormwater runoff which has been in contact with acid sulfate materials or contaminants is collected and not released from the site, untreated to any stormwater drain or waters (including groundwater). Supply of neutralising agent A supply of neutralising agent or agricultural lime shall be kept onsite at all times for treatment of ASS. The supply shall be stored in a covered and bunded area to prevent accidental release to the environment. A supply of hydrated lime shall be kept onsite at all times for treatment of acidic waters (if encountered). Storage requirements for hydrated lime shall be as specified for a neutralising agent or agricultural lime and in accordance with the manufacturer's MSDS.
Monitoring	Soil that has been treated by neutralisation shall meet the following performance criteria: • Acid base accounting shall be used to demonstrate that there is an excess amount of acid neutralising capacity of at least 0.5 times the potential plus existing acidity of the soil (i.e. the 1.5 safety factor). If the excess acid neutralising capacity (ANC) is less than 0.2 times the potential plus existing acidity, the soil shall be re-treated. ANC shall also be moderated by the use of a fineness factor of at least 1.5. • Post-neutralisation, the soil pH is to be greater than 6.5; and • Excess neutralising agent shall remain within the soil until all acid generation reactions are complete and the soil has no further capacity

	to generate acidity. Collect lime delivery dockets and compare with calculated amounts required. All validated materials shall be stored separately to non-validated materials.
Auditing	Auditing will be undertaken by the site manager and/or the proponent's nominated representative. Alternatively, auditing may be carried out by an independent consultant. The audit should include an inspection of site activities, complaints, corrective actions and reporting to assess compliance with the provisions outlined within the ASSMP.
Reporting	Records including testing results and lime delivery dockets are to be kept on site during the construction phase and should be available for inspection at all times. Records shall be made available to DECCW and TSC upon request.
Identification of incident or failure	Further investigation would only be required if: • verification (Phase 3) sampling tests fail, indicating the insufficient application of lime • the formation of jarosite in exposed or excavated soils was observed • areas of green-blue water or extremely clear water occurred • rust-coloured deposits on plants and on the banks of drains or water bodies were noted • a sulfurous odour was detected • the pH of related water bodies dropped substantially below background levels.
Corrective action	Retesting of materials in the vicinity of excavation using an ASSMAC approved laboratory method. Any need for additional lime in specific lots would be assessed and applied with thorough mixing.

Commitment 4

The Developer will appropriately treat acid sulfate soil excavated in the course of construction, in accordance with the recommended liming rate determined by Phase 2 testing.

27.3.5 Sediment and erosion control

Person Responsible	Consulting Engineer, Contractor's Site Manager
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Issue	Sediment and erosion control.
Operational policy	To prevent the displacement of sediment and acidic soil material across the site during Stage 1 earthworks, particularly during storm events. Compliance with the NSW POEO Act (1997).
Performance criteria	All excavated soil material shall be contained in such a manner so as to prevent the displacement of this material across the site. No erosion or sediment accumulation shall result from on-site activities. All waters shall be treated prior to release off-site to prevent the discharge of sediment-laden waters into Cudgen Creek or the surrounding environs.
Implementation strategy	Erosion and sediment control devices such as (but not limited to) silt fences, bunds and contour drains should be installed prior to commencement of site activities and should be maintained at operational capacity throughout the life of site operations in accordance with the <i>Kings Forest Stage 1 Project Application Erosion and Sediment Control Plan</i> prepared by G&S (2012) – Section 13 of the <i>Kings Forest Stage 1 Management Plan</i> (DAC, 2012). Upslope runoff shall be diverted around any cleared or disturbed regions of the site in a way that minimises erosion and diverts waters to a legal point of detention or discharge. Areas used for the treatment of ASS shall be contained within bunds and isolated from surface flow by the construction of diversion drains. Sediment control fences should be constructed at the downslope perimeter of any cleared or disturbed areas of the site. Sediment fences shall also be constructed around the perimeter of the site. Where possible, the excavation/construction program shall be scheduled to minimise the potential for soil loss to occur. Exposed areas of the site shall be minimised by staging works wherever practicable. Stripped topsoil shall be separated from subsoil materials and shall only be stripped from the areas designated on the appropriate plans. Any material treated for potential or actual acidity, after treatment, should be stockpiled taking into account the following considerations: • stockpiles are not to be located on public footpaths, nature strips, roads, road shoulders or any other public land • stockpiles are to be protected from upslope surface flows • sediment filters should be provided downslope of stockpiles • any permanent or long term (>3 months) stockpiles should be seeded within a fortnight of final forming with an appropriate seed mix. Site access locations shall have a rock or a cattle grid shakedown structure installed to prevent the transfer of sediment from the site.

Monitoring	All erosion and sedimentation control devices shall be inspected: • weekly during construction • monthly, when no works are occurring on site • within 24 hours of expected rainfall • within 18 hours following a rainfall event • or in accordance with ESCP provisions. Monthly audit inspections will be undertaken to ensure adequate erosion and sedimentation control devices are installed, particularly in acidic soil treatment areas.
Auditing	Auditing will be undertaken by the site manager and/or the proponent's nominated representative. Alternatively, auditing may be carried out by an independent consultant. The audit should include an inspection of site activities, complaints, corrective actions and reporting to assess compliance with the provisions outlined within the ASSMP.
Reporting	The Environmental Consultant or the proponent's nominated representative will report the findings of the audit inspections to the proponent and make recommendations in regard to additional erosion and sedimentation control measures. Records shall be made available to DECCW and TSC upon request.
Identification of incident or failure	Displacement of acid sulfate or exposed soil across the site. Inadequate bunding of acidic soil treatment areas. Damaged or failed erosion and sediment control devices. Other issues that may be identified by the Environmental Consultant or the proponent's nominated representative in the course of conducting the environmental audits.
Corrective action	Identify the source of any displaced material and take the necessary steps required to prevent a recurrence. This may include: • the installation of additional erosion and sediment control measures • maintenance of existing controls • a review of work practices to minimise exposed areas and the duration of exposure • additional controls or structures as directed by the Environmental Consultant or the proponent's nominated representative.

Commitment 5

The Developer will ensure that appropriate and adequate erosion and sediment control measures are installed and maintained for the duration of the construction works.

27.3.6 Surface water quality management

Person responsible	Contractor's Site Manager												
Issue	Surface water quality in the receiving environments, including Cudgen Creek, and groundwater quality at the site will not be adversely affected by the disturbance and treatment of ASS.												
Operational policy	To prevent adverse impacts to surface and groundwater quality in the downstream receiving environment.												
Performance criteria	Surface water quality in the Cudgen Creek and associated watercourses will not be adversely impacted by the development of the site. Where practicable, surface water quality in the receiving environment will comply with water quality criteria set by pre-construction background monitoring as referred to in Table 13.2.1 of the <i>Kings Forest Stage 1 Erosion and Sediment Control Plan</i> (G&S 2012) – Section 13 of the <i>Kings Forest Stage 1 Management Plan</i> (DAC, 2012). Interim performance criteria have been based on existing TSC water quality monitoring data. Any surface water ponding within the ASS treatment areas or any other water quality control structures will meet the following discharge criteria prior to release from the site. <table border="1"> <thead> <tr> <th>Parameter</th><th>Interim Criteria</th></tr> </thead> <tbody> <tr> <td>pH</td><td>6.5 – 7.5</td></tr> <tr> <td>Turbidity</td><td><10 NTU</td></tr> <tr> <td>Suspended solids</td><td><10mg/L</td></tr> <tr> <td>Dissolved oxygen (field measured)</td><td>>5mg/L</td></tr> <tr> <td>Oil and/or grease</td><td>No visible film, no detectable odour</td></tr> </tbody> </table> <u>Note:</u> If receiving environment is alkaline, pH will be 6.5-7.5. If receiving environment is acidic, pH will be 4.2-6.7 in accordance with the Threatened Species Management Plan (JWA 2012) for habitat requirements for Wallum Froglet (<i>Crinia signifera</i>) and Olongburra Frog (<i>Litoria olongburensis</i>).	Parameter	Interim Criteria	pH	6.5 – 7.5	Turbidity	<10 NTU	Suspended solids	<10mg/L	Dissolved oxygen (field measured)	>5mg/L	Oil and/or grease	No visible film, no detectable odour
Parameter	Interim Criteria												
pH	6.5 – 7.5												
Turbidity	<10 NTU												
Suspended solids	<10mg/L												
Dissolved oxygen (field measured)	>5mg/L												
Oil and/or grease	No visible film, no detectable odour												
Implementation strategy	Surface water (general) Surface water monitoring will be undertaken prior to discharge of waters ponding in ASS treated areas. Existing surface water conditions shall be maintained outside the construction area. When constructed, surface water flows will be directed (utilising a negative grade) towards the nearest temporary sediment basin. Sediment and erosion control measures will be implemented in accordance with the <i>Sediment and Erosion Control Plan</i> (G&S, July 2012) - Section 13 of the <i>Kings Forest Stage 1 Management Plan</i> (DAC, 2012). All monitoring equipment shall be maintained in a functional condition, calibrated and serviced at a frequency compliant with the manufacturers'												

specifications.

Further visual assessment shall be undertaken weekly and following rainfall events for evidence of:

- yellow efflorescence on soil surface
- iron staining of soils or water
- accumulation of sediment within stormwater drains or roadside gutters.

Dewatering

It is considered that excavation dewatering (if required) will involve:

- Testing and treatment of surface water, accumulated runoff and any groundwater seepage within the excavation pit.
- Dewatering of treated waters via external pump with discharge overland or to waterway.

All ponded surface and/or groundwater within excavations in estuarine soils below 5m AHD shall be tested within the excavation and treated if necessary prior to discharge.

Alternatively, water may be pumped to an external receptacle, such as a skip or turkey's nest, and treated prior to discharge.

Turbid waters may be treated in situ by the use of gypsum as a flocculant.

Low pH (i.e. pH<6.5 that need to be amended to be consistent with the receiving environment) waters may be ameliorated in situ by the use of hydrated lime or crushed ag-lime to achieve a pH>6.5 and <9.0 prior to release. In using hydrated lime, all care shall be undertaken to ensure pH is not above 9.0.

All discharges in general will need to comply with the discharge criteria listed above.

Before undertaking any earthworks in drains or watercourses, the drain or watercourse will be bunded and contained in a staged manner, with water tested and treated prior to discharge. Particular attention will be given to watercourses containing high levels of organic matter that may also have the potential to form monosulfidic black oozes (MBOs). Existing MBOs will be managed, with organic material within the drain kept to a minimum and dissolved oxygen concentrations within water-bodies monitored and increased if necessary (in accordance with the recommendations outlined in Tulau (2007)).¹ Titratable Actual Acidity contents and water pH levels of water-bodies will also be monitored and adjusted as necessary.

Supply of neutralising agent

A supply of hydrated lime shall be kept on site at all times for treatment of acidic waters (if encountered). Storage requirements for hydrated lime shall be as specified for a neutralising agent or agricultural lime and in accordance with the manufacturer's MSDS.

¹ Tulau, M.J. (2007), *Acid Sulfate Soils Remediation Guidelines for Coastal Floodplains in New South Wales*, NSW Department of Environment and Climate Change.

Monitoring	The contractor or site manager shall inspect site works weekly and following rainfall events for any evidence of oxidation of acidic soils or sediment accumulation as outlined above. Pre-discharge monitoring to ensure compliance with the release criteria will be undertaken and documented. All monitoring will be undertaken using equipment regularly calibrated. Daily rainfall to be recorded by the civil contractor.
Auditing	Auditing will be undertaken by the site manager and/or the proponent's nominated representative. Alternatively, auditing may be carried out by an independent consultant. The audit should include an inspection of site activities, complaints, corrective actions and reporting to assess compliance with the provisions outlined within the ASSMP.
Reporting of monitoring results	Water quality monitoring results will be recorded and reported to the Proponent on a monthly basis. Water quality monitoring reports will be provided to TSC or DECCW upon request. All results will be kept on-site for inspection by local or state government officers at all times. DECCW to be notified immediately of any environmental incident.
Identification of incident or failure	Controlled or uncontrolled discharge from the site, where the water quality fails to meet the discharge criteria. Discharge from the site without appropriate pre-discharge monitoring. Deterioration in surface water quality downstream of the development resulting from site works or the discharge of waters from the development site.
Corrective action	Take necessary steps to address the problem to prevent a recurrence. Addition of hydrated lime to contained waters to increase pH to within the recommended range (consistent with the receiving environment). Addition of gypsum to contained waters to reduce suspended solids as required. Review of contractor management if discharge has occurred without appropriate testing. Further discharge of contained waters to cease until appropriate monitoring has occurred and results verify that the release criteria have been met. If sediment has accumulated within stormwater drains or roadside gutters additional erosion and sediment control measures as required.

Commitment 6

Management will ensure, through inspection and in situ analysis, that no adverse impact on surface water quality results from development of the site.

27.3.7 Groundwater (excavation works)

Person Responsible	Contractor's Site Manager
Issue	Management of groundwater intercepted during the course of excavations.
Operational policy	To ensure that construction activities do not impact onsite groundwater or groundwater in the receiving environment.
Performance criteria	No deterioration in groundwater quality below the range of natural variation.
Implementation strategy	The detailed groundwater monitoring program taking into consideration the recommendations outlined in the ASSMP and including details relating to monitoring locations, analysis parameters and background groundwater monitoring is presented in the <i>Kings Forest Stage 1 Project Application Groundwater Management Plan</i> (G&S 2012) – Section 9 of the <i>Kings Forest Stage 1 Management Plan</i> (Darryl Anderson Consulting, 2012). Liming of excavations will be undertaken in accordance with the methods outlined in Section 27.3.4. No groundwater will be discharged from the site until the specified water quality criteria are reached. Sampling results for groundwater monitoring shall be submitted to the Environmental Representative and Supervising Engineer within the reporting period following the receipt of laboratory results. Reliable monitoring equipment will be used for all monitoring. This equipment will be regularly calibrated according to manufacturers' specifications. Groundwater management contingency plan If large volumes of groundwater are encountered during excavation of the water features (lakes) the possibility of groundwater drawdown in the vicinity of the site must be managed. This can be achieved through a staged approach to excavation as follows: • The surface area of any large excavation such as a water feature should be divided into cells with one cell excavated at a time. • Each cell should be excavated to final depth and allowed to fill with groundwater. • Bund walls would be provided between any completed cell and any cell being actively excavated in order to retain water in the completed sections as excavation continues. • Bund walls may be removed progressively as they become redundant.
Monitoring	Groundwater monitoring shall be undertaken for the parameters listed in Table 13.2.1 of the <i>Kings Forest Stage 1 Erosion and Sediment Control Plan</i> (G&S 2012) – Section 13 of the <i>Kings Forest Stage 1 Management Plan</i> (DAC, 2012) prior to earthworks and during the Stage 1 construction works.
Auditing	Auditing will be undertaken by the site manager and/or the proponent's nominated representative. Alternatively, auditing may be carried out by an independent consultant during the construction phase of the development. The audit should include

	an inspection of site activities, complaints, corrective actions and reporting to assess compliance with the ASSMP.
Reporting	Groundwater monitoring results shall be kept onsite. All results or incident reporting (including actions taken) to be forwarded to Environmental Representative and Supervising Engineer. DECCW to be notified immediately of an environmental incident.
Identification of incident or failure	Discharge of waters offsite without appropriate testing to ensure the water quality criteria outlined in the surface water performance criteria (Section 27.3.6) are met. Deterioration in surface water quality downstream of the development resulting from discharge of waters from the development site. Failure to implement the contingency plan if large volumes of groundwater are encountered during excavation.
Corrective Action	Take necessary steps to address the problem to prevent a recurrence. Addition of hydrated lime to contained waters as required to maintain the pH within the recommended range. Addition of gypsum to contained waters as required to reduce suspended solids concentrations. Discharge of any contained waters will not be permitted until the water quality criteria are reached. If any un-seasonal reduction in groundwater levels is detected, a groundwater recharge trench system is to be implemented, with groundwater levels monitored until such time as normal groundwater levels are detected within the groundwater boreholes. Implement groundwater contingency plan.

Commitment 7

Management will ensure, through inspection and in situ analysis, that no adverse impact on groundwater quality results from development of the site.

27.3.8 Contractor management

Person Responsible	Consulting Engineer/Site manager
Issue	Contractor management.
Operational policy	To ensure the Developer's Duty of Care is met by ensuring the Contractor is aware of their responsibilities under the terms of the ASSMP and the POEO Act.
Performance criteria	Each contractor shall be fully aware of its responsibilities under the terms of the ASSMP and to respond to environmental issues arising from construction activities.
Implementation strategy	Review of the ASSMP and the construction phase contracts by the Developer. Training for construction staff in implementation of ASSMP provisions. The contract must detail the relationship between the Contractor, the Environmental Auditor (if applicable), the Supervising Engineer and the Principal. In particular the following points will be explicit. The parties responsible for the excavation and construction sequencing. The parties who will hold possession of the site during the construction phase. The parties who will be the point of contact for the statutory authorities. The parties who will prepare and be responsible for the management plans for the site. The parties who will supply and pay for the neutralising agent.
Monitoring	Weekly site inspections to be carried out by the supervising engineer and/or the contractor's site supervisor.
Auditing	Auditing will be undertaken by the site manager and/or the proponent's nominated representative. Alternatively, auditing may be carried out by an independent consultant. The audit should include an inspection of site activities, complaints, corrective actions and reporting to assess compliance with the provisions outlined within the ASSMP.
Reporting	Full details to be available to the contractor together with suggested corrective actions if required.
Corrective action	To be detailed as required, with the proponent having the right to call a halt to any activity being undertaken which is deemed in conflict with the ASSMP.

Commitment 8

A proactive program of contractor management will be implemented.

27.4 Administration of the ASSMP

27.4.1 Amendment of the ASSMP

The Developer may make an application to TSC to amend the provisions of this ASSMP. The application shall:

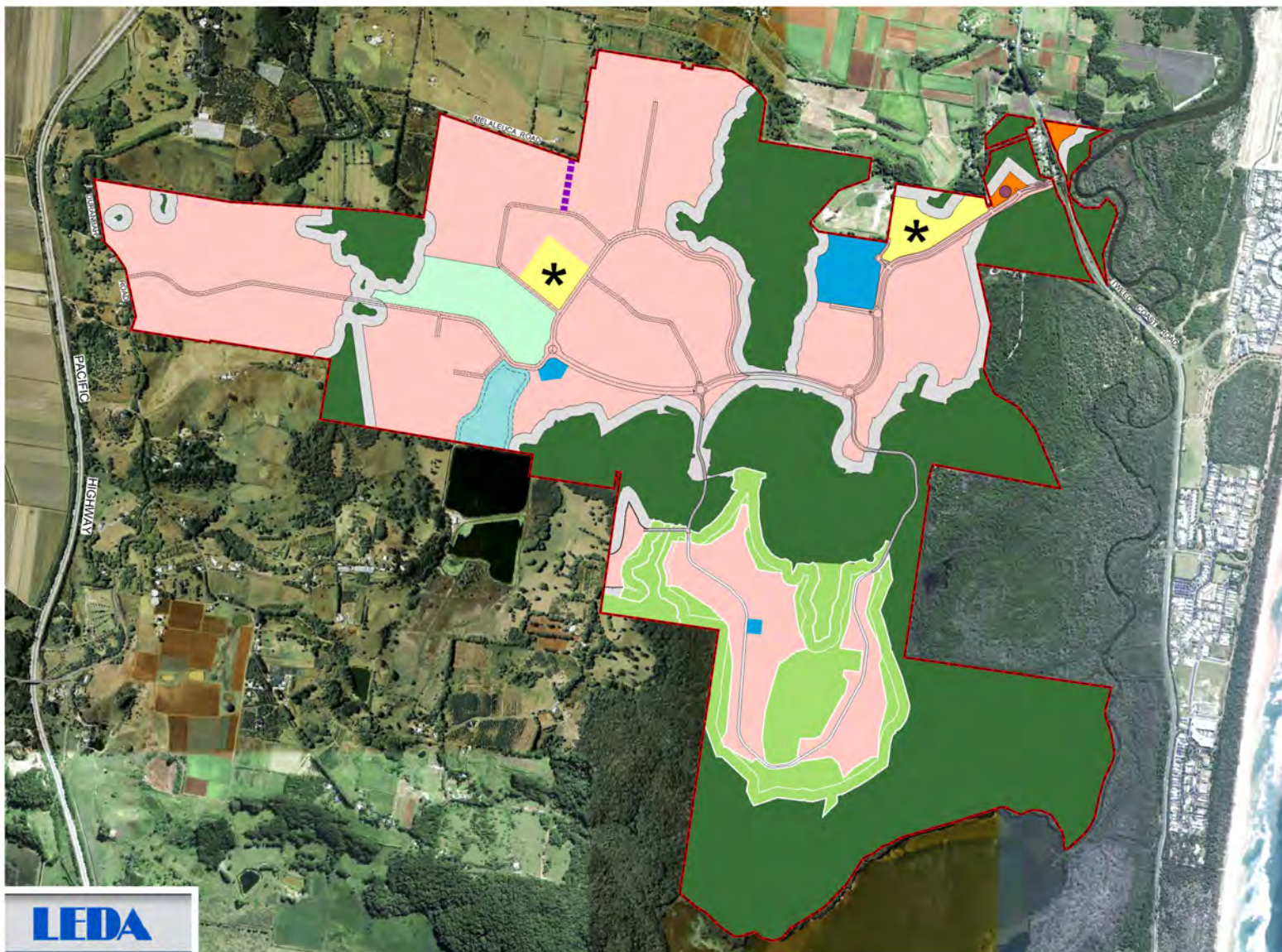
- be in writing; and
- specify the provisions of the ASSMP to which the application relates; and
- state how the proposed amendments achieve the objectives of the provisions to which the amendments relate.

TSC shall approve the amendment where TSC is satisfied acting reasonably that the proposed amendments achieve the objective of the provisions to which the amendment relates.

27.4.2 Incident management

The Developer and any person appointed by the Developer as having responsibility for a control strategy set out in this ASSMP have clearly defined responsibilities under the NSW *Protection of the Environment Operations Act* (1997) to report any incidents likely to cause material or serious environmental harm.

27.5 Attachment 1 - Stage 1 Project Application Revised Concept Plan



LEDA

IMPORTANT NOTE
This plan was prepared as a preliminary concept plan for planning purposes only. As such all particulars, including lot design, areas and densities, are subject to detailed survey, site investigations and to the requirements of council and any other authority which may have requirements under any relevant legislation.
This note is an integral part of this plan.

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	CLIENT PROJECT 28 Pty Ltd	PLAN KINGS FOREST STAGE 1 PROJECT APPLICATION REVISED CONCEPT PLAN	REVISIONS				 RPS Australia East Pty Ltd ACN 140 292 762 ABN 44 140 292 762 Suite 4, Robina East Quay Corporate Park (North Building) 34-36 Glenferrie Drive, Robina PO Box 1045 Robina DC, Qld 4226 T +61 7 555 36900 F +61 7 555 36999 W rpsgroup.com.au
	Date 21 AUGUST 2012		No.	DETAILS	DATE	Init.	
	Surveyed -		A	REVISION	21.8.12	BJB	
	Drafted BJB		B				
	Parish CUDGEN		C				
	County ROUS		D				
			E				
F							
	G						
	I						
SCALE: 1:20000 (A3)			Local Authority Tweed S.C.		DWG Ref 113691-PSP-4a(CONCEPT PLAN)		PLAN No. 01