Sunshine Coast Airport Expansion Project: Offset Delivery Plan

Reference: B21223-ODP-
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Document Control Sheet

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Synopsis: Offset Delivery Plan prepared under *Environmental Offsets Act 2014* for Sunshine Coast Airport Expansion Project, amended from previous revisions prepared by Arup

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
1	17th April 2019	SKH		JDV	
2	8th August 2019				
3	15th January 2020				

DISTRIBUTION

Destination	Revision									
	1	2	3	4	5	6	7	8	9	10
Sunshine Coast Council	PDF	PDF	PDF							
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Note on Previous Versions

This document is Version 3.1 of the Sunshine Coast Airport Expansion Project. Version 3.0 is the latest plan approved under an Agreed Delivery Arrangement (ADA) and Notice of Agreement (NOA) between Sunshine Coast Council and the Department (No. AR098426). Version 3.1 has been prepared as a restructuring of Version 3.0 but does not introduce any changes to the offset strategy agreed between Council and the Department.

Versions 1.0 to 3.0 were prepared by Arup, as noted in the register below. This current plan has been prepared by BMT.

Rev	Date	Filename	Description	Author
1.0	3 Mar 2017	252448-ODP-REP-01	First draft	Arup
2.0	30 May 2017	252448-ODP-REP-02	Updated based on Department comments	Arup
3.0	29 Sep 2017	252448-ODP-REP-03	Updated with revised corridor boundary, provisions for confirming offset areas post-design and additional backup offset areas ***Latest plan approved under AR098426***	Arup
3.1	15 Jan 2020	B21223-ODP-REP-3.1	Updated structure based on Department comments	BMT

NOTE: Council and Arup has previously prepared and/or released Revisions 4.0 and 5.0 of the ODP, proposing an alternative offset strategy associated with the potential development of a new air traffic control (ATC) tower. However, this strategy is no longer considered and, therefore, the agreed approach of Version 3.0 will be applied.

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1 Prescribed Activity

1.1 Background

This Offset Delivery Plan (ODP) has been developed to guide the delivery of environmental offsets as part of the Sunshine Coast Airport Expansion Project (SCAEP). Offsets are required for the project under Controlled Activity Permit EPBC 2011/5823 and Environmental Authority (EA) BRID0035.

These approvals were provided as part of an environmental impact assessment (EIA) for the SCAEP, conducted under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and State *State Development and Public Works Organisation Act 1971* (SDPWO Act). Significant (residual) impacts were identified from the project for four species listed as threatened under the EPBC Act and/or *Nature Conservation (Wildlife) Regulation 2006* (Wildlife Regulation), leading to the need to provide offsets against these impacts. The four species were:

Common name	Scientific name	Status
Wallum sedgefrog	*Litoria olongburensis*	Vulnerable (EPBC Act and Wildlife Regulation)
Wallum froglet	*Crinia tinnula*	Vulnerable (Wildlife Regulation)
Wallum rocketfrog	*Litoria freycineti*	Vulnerable (Wildlife Regulation)
Ground parrot	*Pezoporus wallicus wallicus*	Vulnerable (Wildlife Regulation)

As part of the EIA, a biodiversity offset strategy (BOS) was prepared for the project, identifying the extent of impacts to be offset for these species and the proposed offset approach. This BOS was approved in-principle as part of the EIA process and forms the basis of this ODP.

Of these four species, the following form the matters assessed in the ODP:

(1) Wallum froglet

(2) Wallum rocketfrog

(3) Ground parrot.

The wallum sedgefrog is not considered further as it is subject to an Offset Management Plan, developed under EPBC 2011/5823. However, the offsets set out in the Offset Management Plan overlap with those proposed in the ODP for the other two acid frog species due to their similar habitat requirements.

Additionally, the BOS considered impacts to the Mount Emu she-oak (*Allocasuarina emunia*), listed as Endangered under EPBC Act, and connectivity between the northern and southern Marcoola blocks of the Mount Coolum National Park (MCNP). Actions proposed for these impacts, including translocation of she-oaks and development of a new connectivity corridor, were presented in the BOS but do not represent offsets. Therefore, these are not discussed further in this ODP except where proposed offsets are co-located with these action areas.

1.2 Offset Conditions

The offset conditions underpinning this ODP are set out below.

BRID0035 – Environmental Authority for Environmentally Relevant Activity 16(1)(d)

B1. Significant residual impacts to prescribed environmental matters are not authorised under this environmental authority or the *Environmental Offsets Act 2014* unless the impact is specified in Table 7.10—Significant Residual Impacts to Prescribed Environmental Matters.

B2. An environmental offset must be provided for the maximum extent for each of the prescribed environmental matters identified in Table 7.10—Significant Residual Impacts to Prescribed Environmental Matters in accordance with the *Environmental Offsets Act 2014* and the *Environmental Offsets Policy*, as amended from time to time.

Note: the deemed conditions listed in the *Environmental Offsets Act 2014* apply.

Table 7.10—Significant Residual Impacts to Prescribed Environmental Matters

Prescribed environmental matter	Location of impact	Maximum extent of impact (ha)
Protected wildlife habitat		
Habitat for an animal that is vulnerable wildlife – wallum froglet (*Crinia tinnula*)*	As shown in Figure 10 – Wallum Froglet Habitat Impacted	60.63
Habitat for an animal that is vulnerable wildlife – wallum rocketfrog (*Litoria freycineti*)	As shown in Figure 11 – Wallum Rocketfrog Habitat Impacted	21.85
Habitat for an animal that is vulnerable wildlife – ground parrot (*Pezoporus wallicus wallicus*)	As shown in Figure 12 – Ground Parrot Habitat Impacted	7.88

*Impacts on the wallum froglet were assessed as a matter under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Offsets would be delivered as required by the Commonwealth and the Coordinator General's evaluation report.

B3. Significant residual impacts on prescribed environmental matters are not authorised unless:

(i) the holder (in consultation with the administering authority) prepares a notice of election and an offset deliver plan to address significant residual impacts on the prescribed environmental matters listed in Table 7.10—Significant Residual Impacts to Prescribed Environmental Matters.

(ii) the notice of election must be prepared in accordance with Division 2 (s18(2-5) and s19) of the *Environmental Offsets Act 2014* and given to the entity with jurisdiction for this condition in a form approved under s92 of the *Environmental Offsets Act 2014*.

B4. The authority holder may start to deliver a proponent-driven offset before the authority is granted; but must not pay any amount under a financial settlement offsets until after the authority is granted.

B5. The authority holder must have entered into an agreed delivery arrangement with the administering authority, before starting any works that impact on the prescribed environmental matters listed in Table 7.10—Significant Residual Impacts to Prescribed Environmental Matters.

B6. If, after the agreed delivery arrangement is made, the authority holder proposes to change the way a prescribed environmental matter listed in Table 7.10—Significant Residual Impacts to Prescribed Environmental Matters is to be impacted, the authority holder must notify the administering authority of the changes and request an amended agreed delivery arrangement.

B7. Prior to the commencement of the activity, submit a georeferenced plan showing the final location and extent of any proponent-driven offset areas for prescribed environmental matters listed in Table 7.10—Significant Residual Impacts to Prescribed Environmental Matters to palm@des.qld.gov.au or mail to:

Department of Environment and Science
Permit and Licence Management
Implementation and Support Unit GPO Box 2454
Brisbane Qld 4001

B8. Submit final 'as constructed plans' showing the georeferenced location and extent of the proponent-driven offsets to palm@des.qld.gov.au or mail to:

Department of Environment and Science
Permit and Licence Management
Implementation and Support Unit GPO Box 2454
Brisbane Qld 4001

Within two (2) weeks of the completion of the on-ground works for the proponent-driven offsets.

1.3 Offset Approach

The offsets approach agreed between SCC and the Department of Environment and Science (DES) consists of a combination of proponent-driven offsets and financial offset settlement. The proponent driven offsets will be delivered across both the SCAEP site and at the Lower Mooloolah River Environmental Reserve (LMRER).

2 Impact Matters and Areas

2.1 Impact Matters

As noted above, the offset triggers for the SCAEP project are:

(1) EPBC Act – the project is a Controlled Action with a significant impact on a listed threatened species (wallum sedgefrog).

(2) *Environmental Offsets Act 2014* (Qld) (EO Act) – the project is a prescribed activity under the *Environmental Protection Act 1994* (Qld) (an environmentally relevant activity) with a significant residual impact on matters of national environmental significance (MNES – wallum sedgefrog) and protected wildlife habitat (wallum sedgefrog, wallum froglet, wallum rocketfrog, ground parrot).

Impacts to the wallum sedgefrog (under EPBC Act and EO Act) is covered through the Wallum Sedgefrog Offset Management Plan (Appendix C) while the remaining three EO Act species are the subject of this ODP.

The impact areas relevant to these triggers are shown in Figure 2-1 to Figure 2-3. Table 2-1 summarises the total area impacted for each matter. These areas consist of both breeding and non-breeding habitat.

Table 2-1 Impact matter areas

Matter	Matter group	Bioregion	Subregion	Impact area (ha)
Matters of State Environmental Significance				
Wallum froglet (*Crinia tinnula*)	Threatened animals	Southeast Queensland	Sunshine Coast – Gold Coast Lowlands	60.63
Wallum rocketfrog (*Litoria freycineti*)	Threatened animals	Southeast Queensland	Sunshine Coast – Gold Coast Lowlands	21.85
Ground parrot (*Pezoporus wallicus wallicus*)	Threatened animals	Southeast Queensland	Sunshine Coast – Gold Coast Lowlands	7.88

NOTE: This is the total impacted area approved for each species. Actual habitat loss may be less than this total, depending on final construction methodology and design.

These areas represent the impact matter areas for the purpose of the *Guide to determining terrestrial habitat quality* v1.2. Using the rapid assessment method in this guide, each matter has a habitat quality score (HQS) of 7.

2.2 Impact Sites

Impacts for all four species occur within lots 898 on CG4782 and 101 on CP883235. Additionally, impacts to the wallum froglet also occur on lot 53 on SP298053. All three lots are freehold and owned by Sunshine Coast Council (SCC).

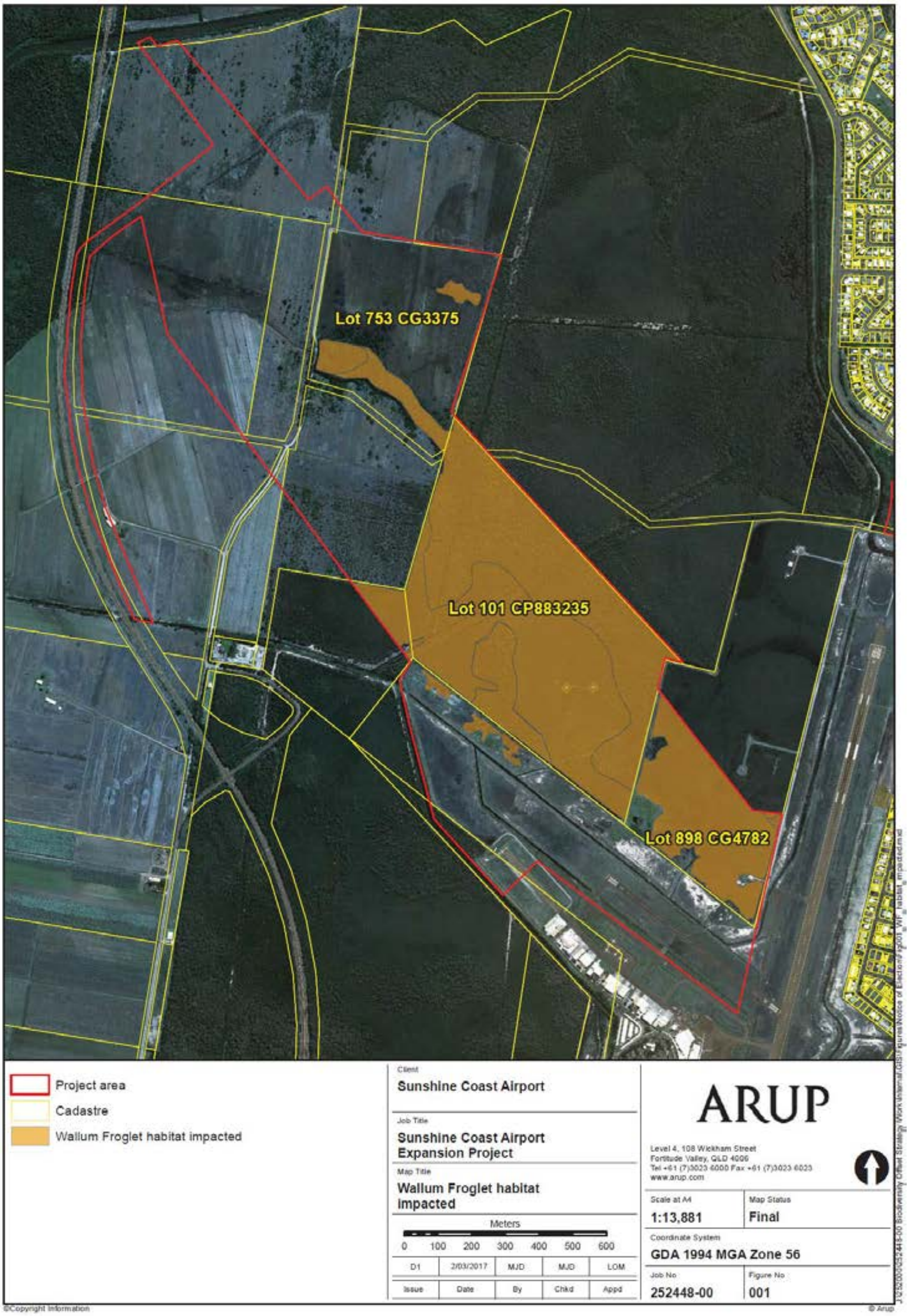


Figure 2-1 Wallum froglet habitat impacted

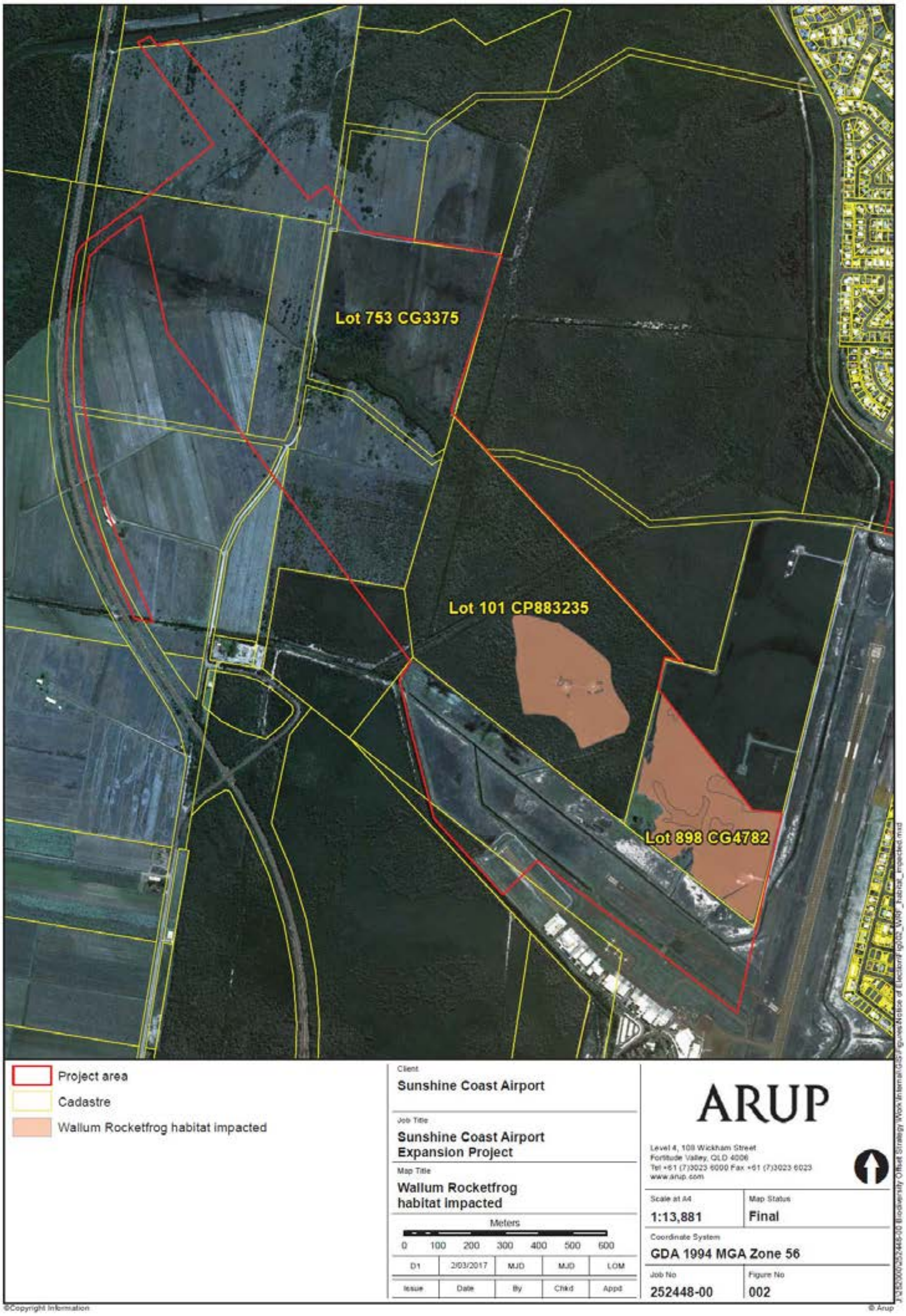


Figure 2-2 Wallum rocketfrog habitat impacted

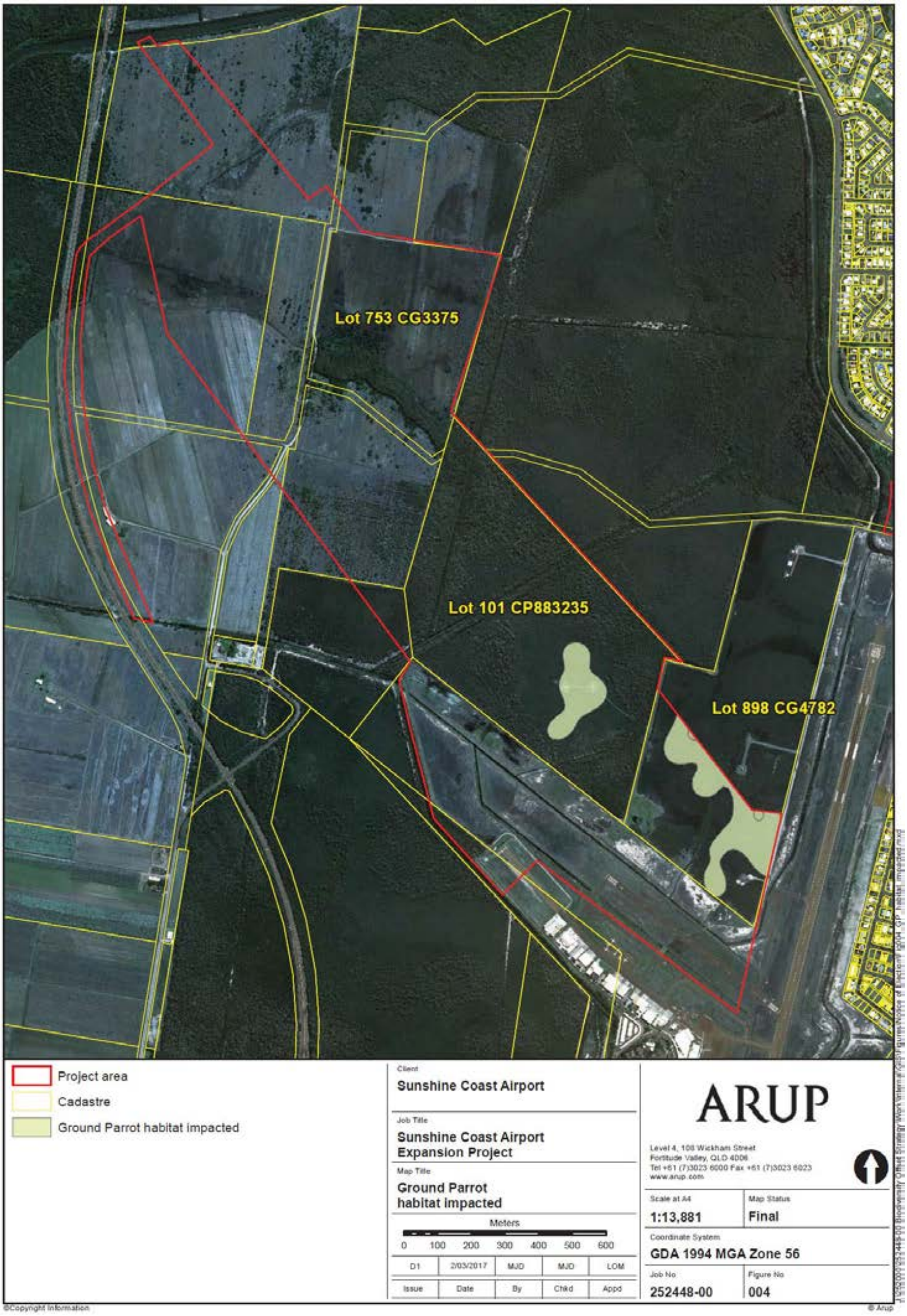


Figure 2-3 Ground parrot habitat impacted

2.3 Species Description and Threats

2.3.1 Wallum Froglet and Wallum Rocketfrog

Acid frog species, including the wallum froglet and wallum rocketfrog, are a group of frogs restricted to nutrient-poor, low pH wallum (coastal sandy lowland) environs. These species are unusual because of their tolerance to acidic, tannin-stained waters which are toxic to embryos and larvae of other, more common, widespread species (Ingram and Corben, 1975; Meyer *et al.* 2006).

Distribution

Acid frog species are found in sandy lowland areas of coastal southeast Queensland and eastern New South Wales. In Queensland, acid frog species occur on offshore dune islands and adjacent coastal dunes and sand plains from around Bundaberg south to the New South Wales border (Meyer *et al.* 2006). In New South Wales the wallum froglet occurs as far south as Kurnell and the wallum rocketfrog to Jervis Bay (Hines *et al.* 1999).

Within the Sunshine Coast region, the Noosa and Maroochy rivers (two large tidal river systems) extend well inland forming significant barriers to dispersal of acid frogs. Populations separated by these large river systems are likely to have been isolated from one another for significant periods (i.e. thousands of years) and they may have diverged genetically from each other. Genetic research undertaken on the wallum froglet supports this theory, with substantial sequence divergence (above 3.5%) between populations north and south of the Noosa River (Renwick, 2006). Therefore, in the interests of preserving genetic diversity, populations separated by these rivers should be treated as distinct management units (sensu Moritz, 1994) or, in the case of wallum froglet populations north and south of the Noosa River, evolutionary significant units (sensu Moritz, 1994). In summary, the mainland distribution of acid frog species in Queensland (north of the Caboolture River) comprises at least three management units: Cooloola, Peregian and Caloundra (EcoSmart Ecology, 2012).

The Peregian unit, which lies between the Noosa River south to the Maroochy River, includes populations near Lake Weyba and Peregian, north of Yandina Coolum Road (M. Sanders and E. Meyer unpub. data) as well as the SCAEP site. Clearing and urban development south of Coolum Beach, has resulted in habitat fragmentation, reducing connectivity between areas of suitable habitat for wallum froglet and wallum rocketfrog, north and south of Mount Coolum and the Marcoola area.

Habitat and Ecology

Acid frog species inhabit areas of low nutrient sandy soils characterised by tannin-stained acidic (pH < 6.0) waters (Ehmann, 1997).

The wallum froglet is the most abundant and widespread of these and is found in a wide range of habitats, including swamps, coastal lakes, drainage ditches, seepage areas in wet heath, areas of sedgeland, and melaleuca woodlands/swamps (Hines and Meyer, 2011). It also inhabits areas of disturbed habitat including pine plantations and areas of grazing land subject to slashing (EcoSmart Ecology, 2014).

Similar to the wallum froglet, the wallum rocketfrog inhabits a variety of habitat types but is usually less abundant on heavily-disturbed land. It is most often located in areas of wet heat with sparse to mid-dense ground cover (Hines and Meyer, 2011) and, as such, can be located in burnt and regrowth vegetation as well as slashed sedgeland/heath along fire trials (Ecosmart Ecology, 2014; E. Meyer pers. obs.). The wallum rocketfrog is perhaps the least abundant of all three acid frogs on the Sunshine Coast.

Both species breed after heavy spring and summer rain, though the wallum froglet may also breed in autumn and winter as well (Straughan and Main, 1966; Ingram and Corben, 1975; Ehmann, 1997; Anstis, 2013; Hines and Meyer, 2011). In these species, larval development is completed within five to 12 weeks depending on the time of year, with the larval period longer during autumn and winter (Anstis, 2013; E. Meyer, pers. obs.).

Knowledge of non-breeding habitat use by these acid frog species is poor. However anecdotal information suggests that both species can disperse some distance (hundreds of metres) from areas of breeding habitat into areas of surrounding forest and heath (Meyer *et al.* 2006).

Documented Threats

Several threats have been identified as potentially affecting the acid frogs described above, including:

- Habitat removal, fragmentation and degradation for agriculture, pine plantations, housing and infrastructure such as canal development, drainage projects and transport corridors (Ingram and McDonald, 1993; Hines *et al.* 1999)
- Changes in hydrological regimes or water quality due to landscape modification (including changes in salinity, acidity, nutrient levels, dissolved oxygen, temperature and turbidity) (Meyer *et al.* 2006)
- Use of biocides for weed and mosquito control programs (Meyer *et al.* 2006)
- Construction of physical barriers which limit movement between water bodies
- Mortality on roads adjacent to populations (Goldingay and Taylor, 2006)
- Exotic species, including:
  - Introduce fish (i.e. *Gambusia holbrooki*) resulting in increased predation of tadpoles (Hines *et al.* 1999)
  - Weed spread, leading to a modification of habitat structure
  - Feral pigs, leading to degradation of habitats (Meyer *et al.* 2006)
  - Introduced pathogens (i.e. *Batrachochytrium dendrobatidis*
- Competition from other native frog species such as *Litoria fallax* following habitat disturbance (Meyer *et al.* 2006)
- Inappropriate fire management (Meyer *et al.* 2006).

2.3.2 Ground Parrot

Distribution and Habitat

Within Australia, ground parrots occur in scattered, disjunct locations within 25 km of the coast from the Cooloola/Fraser Island region south to Tasmania. There is also an isolated genetically distinct population in Western Australia which has recently been recognised as a distinct species (Joseph *et al.* 2011; Murphy *et al.*, 2011). Within Queensland, ground parrots occur south from Maryborough to the Sunshine Coast, including Fraser Island. Historically, Ground Parrots were recorded as far south as the northern suburbs of Brisbane (Chisholm, 1924; McFarland,1991c).

Within the Sunshine Coast region (i.e. Caloundra north to Noosa), the species has been recorded south to Caloundra, although there are no records of this species south of Mooloolah River after 1975. For conservation management purposes, the Sunshine Coast ground parrot population may be divided up into three distinct subpopulations, each separated by expanses of urban development:

- *Peregian*: extends approximately 14 km from the Yandina-Coolum Road north to David Low Way (Noosa). This area includes the bulk of ground parrot habitat within the Sunshine Coast. Areas of habitats are predominately separated only by native vegetation and narrow roads (Havana Rd East, Emu Mountain Road, Eenie Creek Rd, and numerous National Park management trails), which are unlikely to hinder movement.
- *Marcoola*: between Sunshine Coast Drive and David Low Way, including Mount Coolum National Park (north and south) as well as the Sunshine Coast Airport. Suitable habitats are connected by remnant vegetation, however, only a narrow section of remnant vegetation exists to the west of the Sunshine Coast Airport.
- *Mooloolah*: habitat within Mooloolah River National Park.

Within Mooloolah River National Park birds were known to occur until circa 1980, after which fire is believed to have caused the localised extinction of ground parrots (McFarland, 1991c). While there are occasional unconfirmed records, no birds have been detected in Mooloolah River National Park despite repeated surveys. It remains unknown why the species has not repopulated Mooloolah National Park, despite apparent recovery of vegetation. Thus, the Queensland range of the species has contracted, and it is now only regularly recorded south to Mount Coolum National Park between the Sunshine Coast Airport and David Low Way (i.e. from suitable habitat supporting the Marcoola population centre).

Habitat and Ecology

Ground parrots occur in low-closed heathland, sedgeland and button grass communities, but on mainland Australia favour graminoid heaths (Meredith *et al.* 1984; McFarland, 1988; McFarland, 1989; Bryant, 1994). In Queensland, birds seem to prefer drier areas of graminoid heath but may also occur in wet heath, particularly in summer (McFarland, 1988; 1991a). They usually avoid extremely wet or flooded areas, or heath with shrub or tree canopy (McFarland, 1991a). Records of individuals from pastures, grasslands and estuarine flats (McFarland, 1989; Forshaw, 2002) probably represent dispersing juvenile birds, or birds displaced by fire or flood.

Ground parrots are highly cryptic in nature and difficult to observe. While they remain active during the day, birds are most detectable when calling at dusk and dawn (McFarland, 1991a). Call bouts appear to be regulated by ambient light levels, and as such may be influenced by moonlight (McFarland, 1991b). Dawn call bouts appear to last longer than dusk bouts, though call frequency is higher around dusk.

Radio-tracking studies in Cooloola National Park have found that adult birds have an average home range of 9.2 ha (McFarland, 1991a). Males have smaller home ranges than females and, despite having overlapping territories, birds tend to be solitary (McFarland 1991b). Within their territories birds forage for seeds, herbaceous plants and small fruits (Barker and Vestjens, 1980). It is thought that diet selection is based on the seasonal availability, accessibility and size of seeds and fruit (McFarland, 1991a).

Ground parrots breed between August and December, although data suggests they may breed earlier in Queensland, particularly August and September (McFarland, 1989). Nests are positioned on dry ground within heath that has not been burnt for at least three to four years (McFarland, 1991b). Clutch size ranges from three to four eggs. Two months after fledging young birds begin to disperse (Meredith *et al.* 1984).

Numerous studies throughout Australia have found that habitat suitability, and therefore ground parrot density, is influenced by fire. The observed impact of fire on ground parrot habitat suitability, however, differs between studies (Baker and Whelan, 1994) suggesting the response of ground parrots to fire may follow one of two possible scenarios. The first is that long-unburnt heath will become unsuitable and ground parrot numbers will gradually decline to zero (Meredith *et al.* 1984; McFarland, 1989; references in Baker and Whelan, 1994). The second suggests birds will remain in heath left unburnt (Baker and Whelan, 1994 and references therein, Spearritt and Krieger, 2007; Baker *et al.* 2010). These conflicting results may suggest that vegetation characteristics, rather than age since fire, are important in determining ground parrot density (Meredith *et al.* 1984; McFarland, 1991b, Baker and Whelan, 1994) and therefore appropriate management must be population or location specific. All areas of habitat become unsuitable immediately following fire (McFarland, 1991a, Meredith *et al.* 1984), and may remain so for up to four years after fire (Baker and Whelan, 1994; Garnett *et al.* 2010).

Adult birds are considered to be sedentary, although juvenile dispersal is often assumed in literature (e.g. McFarland 1991a, Higgins 1999). The presence of vagrant birds as much as 200 km from the nearest known population suggests that long-distance movements might be possible (Meredith *et al.* 1984; Garnett *et al.* 2010). However, the frequency of movements over 100 km is unknown and dispersal of juveniles over shorter distances (tens of kilometres) is more likely (Joseph *et al.* 2011).

Documented Threats

The distribution of ground parrots has contracted significantly since European settlement, and the species is now extinct in South Australia (Higgins 1999). Historic declines are probably linked to habitat clearance and destruction, particularly for urban development. Ongoing habitat loss is less severe, as most remaining populations now reside within protected estate (Garnett *et al.* 2010). However, within protected areas, factors such as altered water hydrology and inappropriate fire regimes may compromise ground parrot habitat values (Meredith *et al.* 1984; McFarland, 1989;

McFarland, 1991c, Forshaw and Cooper, 2002). Historical aerial photography of the Marcoola region, for example, shows extensive thickening of heath and the incremental spread of taller trees (most likely *Melaleuca* spp.).

In more developed coastal areas, birds may also be killed by foxes and cats, and on rare occasions fly into wire fences, windows or motor vehicles (Higgins, 1999 and references therein).

High rates of hatching failure have been recorded in southeast Queensland (McFarland, 1991b) and this may prevent population recovery. Genetic diversity within, and between Queensland subpopulations are low, suggesting increased susceptibility to inbreeding depression and further loss of genetic diversity (Chan *et al.* 2008).

3 Offsets Approach and Assessments

3.1 Land-Based Offsets

This section describes the land-based offsets adopted for the SCAEP together with a description of the offset liability and acquittal. Further details on the delivery of the different offset approaches are provided in subsequent sections.

3.1.1 Offset Sites

Land-based offsets will be delivered at the SCAEP site utilising retained and rehabilitated habitat as well as at SCC's LMRER. The following sections provide a description of the relevant Assessment Units (AUs) at each site, broken down by offset matter (i.e. species).

The lots and AUs making up the offset sites are listed in Table 3-1. The AUs are shown in Figure 3-1 and Figure 3-2.

Table 3-1 Sites and assessment units making up offset matter areas

Lot	Plan	AU		Applicable matter
SCAEP site (Marcoola Esplanade/David Low Way/Finland Road, Marcoola Qld 4564				
898	CG4782	6	Wallum Heath Management Area (WHMA)	Wallum froglet Wallum rocketfrog
51	SP298053	7	Connectivity Corridor	Wallum froglet Wallum rocketfrog
54	SP298053			
1106	SP206556			
1105	SP206553			
1	SP269581	8	Mount Emu She-Oak Translocation Area	Wallum froglet Wallum rocketfrog
101	CP883235	9	Vegetation Management Area A (VMA)	Wallum froglet Wallum rocketfrog Ground parrot
LMRER (Laxton Road, Palmview Qld 4553)				
2	RP27760	1	Paperbark regrowth with heathland shrubs	Wallum froglet Wallum rocketfrog
		2	Paperbark regrowth with eucalypt paddock trees	
		3	Exotic pasture	
		4	Advanced paperbark regrowth open forest	
		5	Advanced paperbark regrowth with sedgeland	
1	SP300404*	1	Paperbark regrowth with heathland shrubs	Wallum froglet Wallum rocketfrog
		3	Exotic pasture	
37	C3147	1	Paperbark regrowth with heathland shrubs	Wallum froglet Wallum rocketfrog

*Formerly RP27759

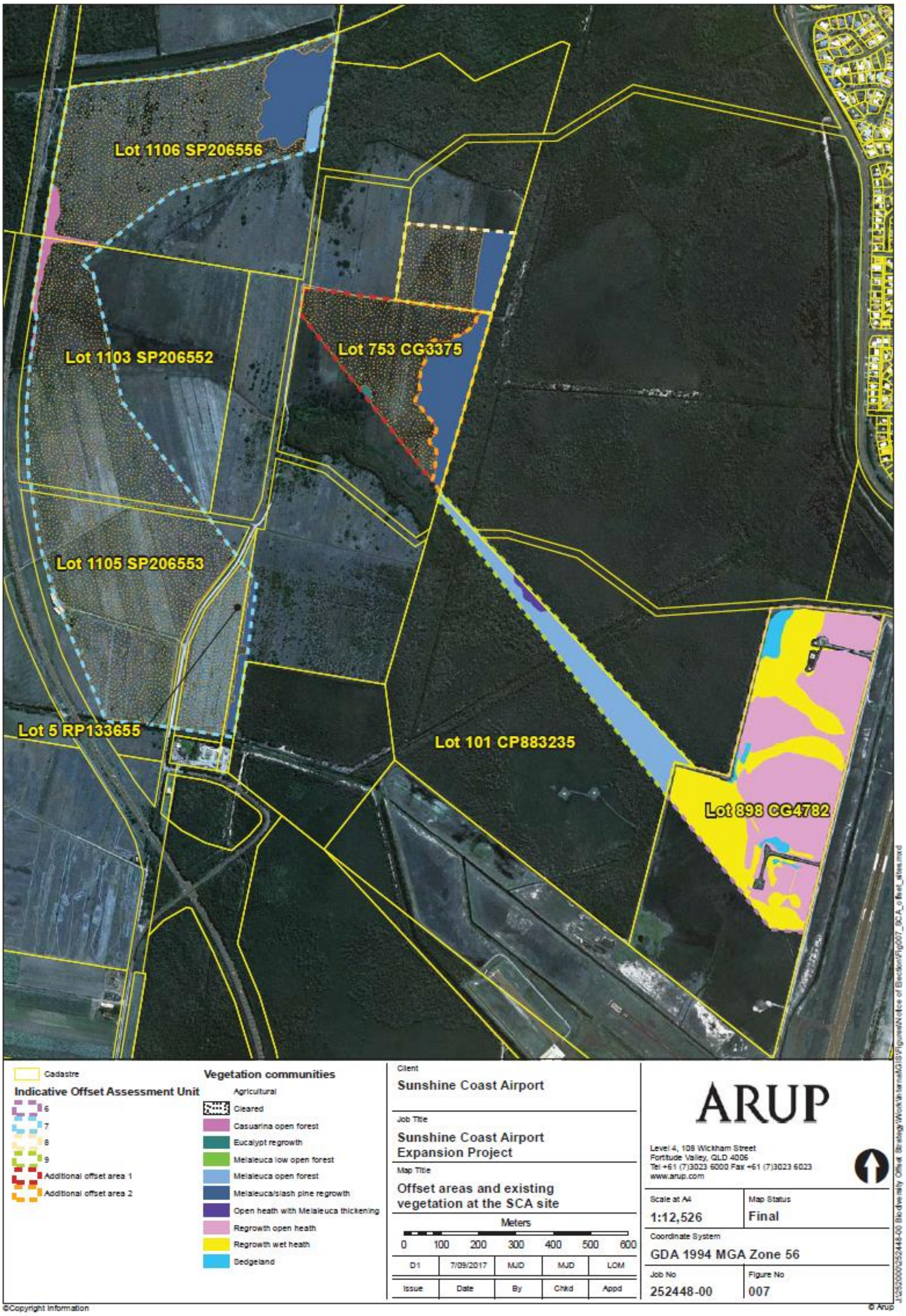


Figure 3-1 Offset matter sites and assessment units at SCAEP site

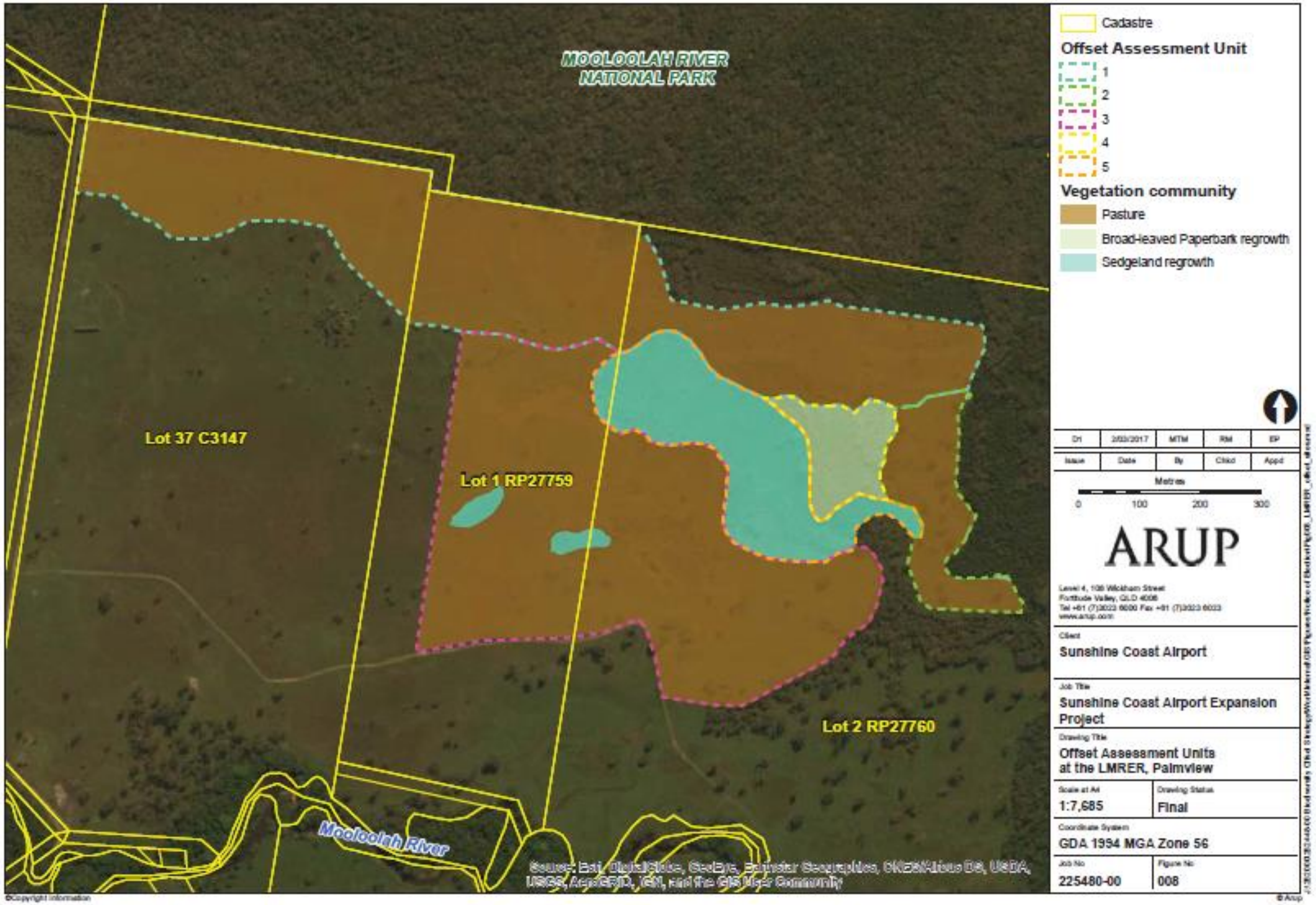


Figure 3-2 Offset matter sites and assessment units at LMRER

All the lots are freehold and owned by SCC. Landowner details are provided below. However, there is also a series of easements along lots 1106, 51 and 1105, which provide access to underground services. These easements are described in Table 3-2.

Registered owner	Sunshine Coast Regional Council
ABN/ACN	37 876 973 913
Phone number	07 5475 7272
Facsimile number	07 5475 7277
Email address	mail@sunsinecoast.qld.gov.au
Postal address	Locked Bag 72, Sunshine Coast Mail Centre

Table 3-2 Persons with registered interests

Parent lot	Type of registered interest	Interest identifier	Interest holder's name
51/SP298503	Easement	F/SP282575	Northern SEQ Distributor-Retailer Authority
	Easement	J/SP298055	Northern SEQ Distributor-Retailer Authority
	Easement	L/SP305084	Energex Ltd
54SP298053	Easement	H/SP298054	Northern SEQ Distributor-Retailer Authority
1106/SP206556	Easement	G/SP282576	Northern SEQ Distributor-Retailer Authority
	Easement	K/SP305084	Energex Ltd
1105/SP206553	Easement	E/SP282574	Northern SWQ Distributor-Retailer Authority
3/C3147	Easement	A/RP173627	South East Queensland Electricity Board

3.1.2 Offset Matter Areas

3.1.2.1 Overview of Approaches

The AUs can be grouped based on offset approach. These groupings are:

- LMRER Habitat Reconstruction and Assisted Regeneration
- WHMA Management and Breeding Ponds
- Connectivity Corridor Heathland and Paperbark Habitat
- Mount Emu She-Oak Heath Tiles
- VMA Habitat Conversion.

These groupings, their location, associated AUs, matters and treatment approaches are described in Table 3-3.

Table 3-3 Groupings of land-based offset approaches

Offset grouping	Description	Site	AUs	Habitat created (ha)			Total area (ha)
				Wallum froglet	Wallum rocketfrog	Ground parrot	
LMRER Habitat Reconstruction & Assisted Regeneration	*Treatment A: Assisted regeneration* This treatment consists of facilitating natural regeneration through minor human intervention (e.g. cattle exclusion, weed removal, appropriate fire regimes) together with some infill planting.	LMRER	4	2.30	2.30	-	40.22*
			5	7.50	7.50		
	Treatment B: Habitat reconstruction This treatment consists of installation of native species through planting and/or direct seeding with active and ongoing restoration to assist recovery. This also involves construction of acid frog breeding ponds to supplement existing breeding habitats.		1	24.05	9.62		
			2	3.82	1.53		
			3	2.55	2.55		
WHMA Management & Breeding Ponds	Augmentation and improvement of heath within the WHMA to create a wet/dry heath matrix, including creation of acid frog breeding ponds in northern WHMA.	SCAEP	6	25.46	25.46	-	25.46
Connectivity Corridor Heathland and Paperbark Habitat	Reconstruction and assisted regeneration of paperbark forest together with reconstruction of heath.	SCAEP	7	16.80	16.80	-	16.80*
Mount Emu She-Oak Heath Tiles	Translocation of heath tiles from Mount Emu she-oak clearing area to a reestablishment site, creating a new area of wet/dry heath matrix.	SCAEP	8	4.41	4.41	-	4.41
VMA Habitat Conversion	Augmentation of remnant vegetation in WMA to create a wet/dry heath matrix, and creation of acid frog breeding ponds.	SCAEP	9	5.84	5.84	5.84	5.84*

*Minimum area to be achieved; it is likely that final habitat creation will exceed these totals.

3.1.2.2 Wallum Froglet

Offsets for the wallum froglet will be established at both the SCAEP site and LMRER, considered together as a single offset matter area. The AUs making up the offset area together with the matter area HQS are provided in Table 3-4 and shown in Figure 3-1 and Figure 3-2.

Based on the habitat quality assessment, the offset matter area has an existing HQS of 5. As the HQS for the impact matter area was 7 (based on a rapid assessment) offsets are required to be delivered to achieve a minimum offset matter area HQS of 8 within 20 years.

Utilising the DES Land-based Offset Multiplier Calculator for regrowth offsets and assuming the minimum required gain of 3 in 20 years, the required multiplier for the offset matter is 2.76. Thus, the total offset required for the wallum froglet is 167.34 ha (60.63 ha x 2.76). However, a higher multiplier of 3.30 was adopted in the BOS approved through the EIS process, allowing for a HQS gain of only 2 in 20 years. This gives a total offset liability of 200.08 ha (60.63 ha x 3.30). This higher multiplier is adopted in this ODP for precautionary purposes and consistency with the BOS.

Details of the HQS and multiplier calculations are provided in Appendix A.

The total offset matter area for the wallum froglet is 92.73 ha. This accounts for 28.1 ha of impact matter area (based on the 3.30 multiplier), leaving 32.53 ha of residual impact to be offset. However, as outlined in the BOS, agreement was reached between the Office of the Coordinator-General (OCG), DES and SCC that as the financial cost of the land-based offsets would exceed the costs that would be required for a financial offset, the additional offset liability could be waived.

3.1.2.3 Wallum Rocketfrog

The wallum rocketfrog utilises primarily the same habitat as the wallum froglet. Therefore, the offset matter areas for both species utilise the same AUs. Table 3-5 and Figure 3-1 and Figure 3-2 summarises these AUs.

Based on the habitat quality assessment, the offset matter area has an existing HQS of 5. As the HQS for the impact matter area was 7 (based on a rapid assessment) offsets are required to be delivered to achieve a minimum offset matter area HQS of 8 within 20 years.

Utilising the DES Land-based Offset Multiplier Calculator for regrowth offsets and assuming the minimum required gain of 3 in 20 years, the required multiplier for the offset matter is 2.76. Thus, the total offset required for the wallum froglet is 167.34 ha (60.63 ha x 2.76). However, as with the wallum froglet, a higher multiplier of 3.30 was adopted in the BOS approved through the EIS process, allowing for an HQS gain of only 2 in 20 years. This gives a total offset liability of 200.08 ha (60.63 ha x 3.30). This higher multiplier is adopted in this ODP for precautionary purposes and consistency with the BOS.

Details of the HQS and multiplier calculations are provided in Appendix A.

Table 3-4 Offset matter area assessment units and habitat quality score: wallum froglet

AU		Treatment	Area (ha)	Size weighting	HQS	
					AU*	Weighted
LMRER	1	Habitat reconstruction in heavily disturbed areas, including construction of breeding ponds and installation of native species	24.05	0.26	6.36	1.65
	2		3.82	0.04	5.72	0.24
	3		2.55	0.03	4.11	0.11
	4	Assisted regeneration of advanced regrowth areas through minor intervention (e.g. cattle exclusion, weed management)	2.30	0.02	5.96	0.15
	5		7.50	0.08	6.09	0.49
SCAEP site	6	Management of retained airside land as wallum heath, including construction of breeding ponds	25.46	0.27	5.85	1.60
	7	Construction of suitable habitat in parts of Connectivity Corridor through installation of native heath and paperbark species	16.80	0.18	3.75	0.68
	8	Construction of suitable habitat through heath tile placement in Mount Emu She-Oak Translocation Area	4.41	0.05	3.78	0.18
	9	Conversion of paperbark forest to more suitable habitat through slashing and construction of breeding ponds	5.84	0.06	3.91	0.25
Total offset matter area (ha):			**76.01**			
Total offset matter HQS:			**5**			
Impact multiplier (based on minimum gain required)			**2.76**			
Impact multiplier (adopted from BOS)			**3.30**			

*The HQS per AU was determined based on a single transect per AU (except AU9). This approach is consistent with the DES *Guide to determining terrestrial habitat quality* v1.2 (2017) which provides ‘it may be possible to reduce the number of [sampling transects less than 2] if it can be demonstrated that different assessment units containing the same RE are in the same condition’. This is the case for the relevant AUs.

No transect was undertaken for AU9 as this area will be converted to a different vegetation community. Rather, the transect results for an adjoining area (AU8) were adopted as this reflects the expected starting position of AU9 once converted.

Despite this, all subsequent habitat quality assessments will utilise two transects, one of which will be at the same site as the original transect.

Table 3-5 Offset matter areas assessment units and habitat quality score: wallum rocketfrog

AU		Treatment	Area (ha)	Size weighting	HQS	
					AU*	Weighted
LMRER	1	Habitat reconstruction in heavily disturbed areas, including construction of breeding ponds and installation of native species	9.62	0.13	6.36	0.80
	2		1.53	0.02	5.72	0.12
	3		2.55	0.03	4.11	0.14
	4	Assisted regeneration of advanced regrowth areas through minor intervention (e.g. cattle exclusion, weed management)	2.30	0.03	5.96	0.18
	5		7.50	0.10	6.09	0.60
SCAEP site	6	Management of retained airside land as wallum heath, including construction of breeding ponds	25.46	0.33	5.85	1.96
	7	Construction of suitable habitat in parts of Connectivity Corridor through installation of native heath and paperbark species	16.80	0.22	3.62	0.80
	8	Construction of suitable habitat through heath tile placement in Mount Emu She-Oak Translocation Area	4.41	0.06	3.78	0.22
	9	Conversion of paperbark forest to more suitable habitat through slashing and construction of breeding ponds	5.84	0.08	3.91	0.30
		Total offset matter area (ha):				**76.01**
		Total offset matter HQS:				**5**
		Impact multiplier (based on minimum gain required)				**2.76**
		Impact multiplier (adopted from BOS)				**3.30**

*The HQS per AU was determined based on a single transect per AU (except AU9). This approach is consistent with the DES *Guide to determining terrestrial habitat quality* v1.2 (2017) which provides 'it may be possible to reduce the number of [sampling transects less than 2] if it can be demonstrated that different assessment units containing the same RE are in the same condition'. This is the case for the relevant AUs.

No transect was undertaken for AU9 as this area will be converted to a different vegetation community. Rather, the transect results for an adjoining area (AU8) were adopted as this reflects the expected starting position of AU9 once converted.

Despite this, all subsequent habitat quality assessments will utilise two transects, one of which will be at the same site as the original transect.

3.1.2.4 Ground Parrot

Offsets for the ground parrot will be offered at the SCAEP site only and consists only of a single AU, that is, the AU9 (the VMA). Table 3-6 and Figure 3-1 summarises this AU. The BOS also included delivery of an additional 2.28 ha of improved ground parrot habitat within AU6 (the WHMA). This was not accepted, however, during the assessment and approval of the BOS.

Based on the habitat quality assessment, the offset matter area has an existing HQS of 4. As the HQS for the impact matter area was 7 (based on a rapid assessment) offsets are required to be delivered to achieve a minimum offset matter area HQS of 8 within 20 years.

The ground parrot offset matter area HQS was determined based on using AU8 as a surrogate rather than through direct transects at AU9. This approach was required as AU9 will be substantially converted to deliver offsets. Therefore, the existing habitat quality will not be reflective of the actual 'starting point' for this area before offset treatment is applied. The existing habitat at AU8 provides a suitable representation of what a post-clearing environment at AU9 will be like and therefore is considered an appropriate equivalent. However, in consideration of this, new transects will be undertaken once initial clearing in AU9 has occurred and will be utilised to develop a new 'baseline' HQS.

NOTE: The HQS presented in the BOS was 5 as this was based on a combination of offset matter areas for the ground parrot and two acid frog species. A lower score is achieved through separating these matters due to the lower existing habitat quality for AU9 (based on the surrogate at AU8).

Utilising the DES Land-based Offset Multiplier Calculator for regrowth offsets and assuming the minimum required gain of 4 in 20 years, the required multiplier for the offset matter is 2.57. Thus, the total offset required for the ground parrot is 20.25 ha (7.88 ha x 2.57). However, a multiplier of 3.30 was used in the BOS as the ground parrot offset matter area was combined with offset matter areas for acid frogs. This gives a total offset liability of 26.00 ha (7.88 ha x 3.30). This higher multiplier is adopted in this ODP for consistency with the BOS.

Details of the HQS and multiplier calculations are provided in Appendix A.

The total offset matter area for the ground parrot is 5.84. This accounts for 1.77 ha of impact matter area (based on the 3.30 multiplier), leaving 6.11 ha of residual impact to be offset. This is addressed in Section 3.2 (Financial Offsets).

3.1.2.5 Summary

Table 3-7 summarises the land-based offset liability and acquittal for the three relevant matters.

Table 3-6 Offset matter area assessment units and habitat quality score: ground parrot

AU		Treatment	Area (ha)	Size weighting	HQS	
					AU*	Weighted
SCAEP site	9	Conversion of paperbark forest to more suitable habitat through slashing and construction of breeding ponds	5.84	1.0	3.91	3.91
		Total offset matter HQS:				**4**
		Impact multiplier (based on minimum gain required)				**2.57**
		Impact multiplier (adopted from BOS)				**3.30**

Table 3-7 Combined summary of offset requirements and delivery for relevant matters

Matter	Impact matter area (ha)	Adopted multiplier	Total offset liability (ha)	Offset matter area (ha)	Offset met (%)	Residual impact area (ha)	Approach to residual offset
Wallum froglet	60.63	3.30	200.08	92.73	46.35	32.53	Waived by agreement between OCG, DES and SCC
Wallum rocketfrog	21.85	3.30	72.11	76.01	105.42	(1.18)	n/a
Ground parrot	7.88	3.30	26.00	5.84	22.46	6.11	Financial offset

3.2 Financial Offsets

As noted above, there is a residual 6.11 ha of impact to ground parrot habitat requiring financial offsets. When this area is applied through the financial calculator, a payment of $1,078,806.04 is obtained. This was confirmed in discussions with the OCG and DES. See further Appendix B for calculation results.

The financial payment was made 2 March 2018 by SCC.

4 Offset Details – Lower Mooloolah River Environmental Reserve

4.1 Offset Site Description

The LMRER is located at Palmview, approximately 15 km south of the SCAEP, on freehold land. The site is bordered by the Mooloolah River to the south and east with the Mooloolah River National Park to the north. To the west are large tracts of grazing land and the whole area is currently used for cattle grazing.

A review of historical aerial photography shows that the eastern portion of the LMRER was cleared prior to 1958. The northern and western portions of the site remained well vegetated until sometime between 1997 and 2003 when the clearing was extended to current conditions. Historical photography also shows that prior to clearing the site was covered with an open forest vegetation community. This corresponds with the pre-clearing regional ecosystem mapping (DSITI, 2017), which has most of the site mapped as regional ecosystem (RE) 12.3.5 *Broad-leaved Paperbark open forest to woodland*. This RE is included in Broad Vegetation Group (BVG) 22a *Open forest and woodlands dominated by Broad-leaved Paperbark in seasonally inundated lowland coastal areas and swamps*.

Surveys of the current site condition have indicated the presence of six vegetation communities, described in Table 4-1 and shown in Figure 4-1. The site is largely dominated by cleared exotic pastures with scattered remnant and regrowth vegetation representative of REs 12.3.5 and, to a lesser extent, 12.3.8 and 12.3.1. Existing cleared areas support scattered remnant trees including broad-leaved paperbark (*Melaleuca quinquenervia*), forest red gum (*Eucalyptus tereticornis*), pink bloodwood (*Corymbia intermedia*), swamp box (*Lophostemon suaveolens*) and cabbage-tree palm (*Livistona australis*). Elements of native sedgeland are also present, typically associated with drainage lines and site depressions.

Good quality habitat for acid frogs was identified on site during preliminary investigations and all three species have been recorded within the LMRER property. There is further potential for acid frog habitat creation along the northern boundary of the site, as well as in several other small low-lying areas.

Based on the existing site condition, areas for focusing the restoration works for offset delivery are in the north-eastern corner of the LMRER adjacent to the national park and Mooloolah River.

Table 4-1 Description of existing vegetation communities at LMRER

Vegetation community	Description	Area (ha)
Non-native or non-remnant		
Pasture with regrowth and retained paperbark and eucalypts	Cleared, open grassland dominated by exotic grasses and sedges. There are scattered regrowth and remnant trees throughout including broad-leaved paperbark (*Melaleuca quinquenervia*), forest red gum (*Eucalyptus tereticornis*), pink bloodwood (*Corymbia intermedia*), swamp box (*Lophostemon suaveolens*) and cabbage-tree palm (*Livistona australis*). The northeast corner of the site contains a higher density of broad-leaved paperbark regrowth.	145.8
Broad-leaved paperbark regrowth (RE 12.3.5)	These areas contain advanced regrowth of broad-leaved paperbark trees, likely to be greater than 10-15 years old. Clearing and grazing appears to be excluded from these areas.	11.6
Sedgeland regrowth (RE 12.3.8)	There is a lower drainage depression in this location, with pooling surface water, native sedges and emergent broad-leaved paperbark trees. Dominant groundcovers observed were grey sedge (*Lepironia articulata*), jointed twigrush (*Baumea articulata*) and bungwall (*Blechnum indicum*).	8.1
	Subtotal	**165.5**
Remnant		
Riparian vine forest regrowth (RE 12.3.1)	This vegetation community is at the ecotone between pasture and/or paperbark forest and the Mooloolah River. Tree species present include weeping lillypilly (*Waterhousea floribunda*) and flooded gum (*Eucalyptus grandis*).	2.8
Remnant paperbark/eucalypt forest (RE 12.3.5)	Intact open forest dominated by broad-leaved paperbark. Vegetation community is consistent with the RE description. The occurrence of these patches of remnant vegetation on the site is associated with low-lying wet areas and the Mooloolah River riparian zone.	22.8
Remnant riparian vine forest (RE 12.3.1)	Riparian vine forest associated with Mooloolah River. Floristic composition is consistent with RE description.	2.4
	Subtotal	**28.0**
	Total	**193.5**

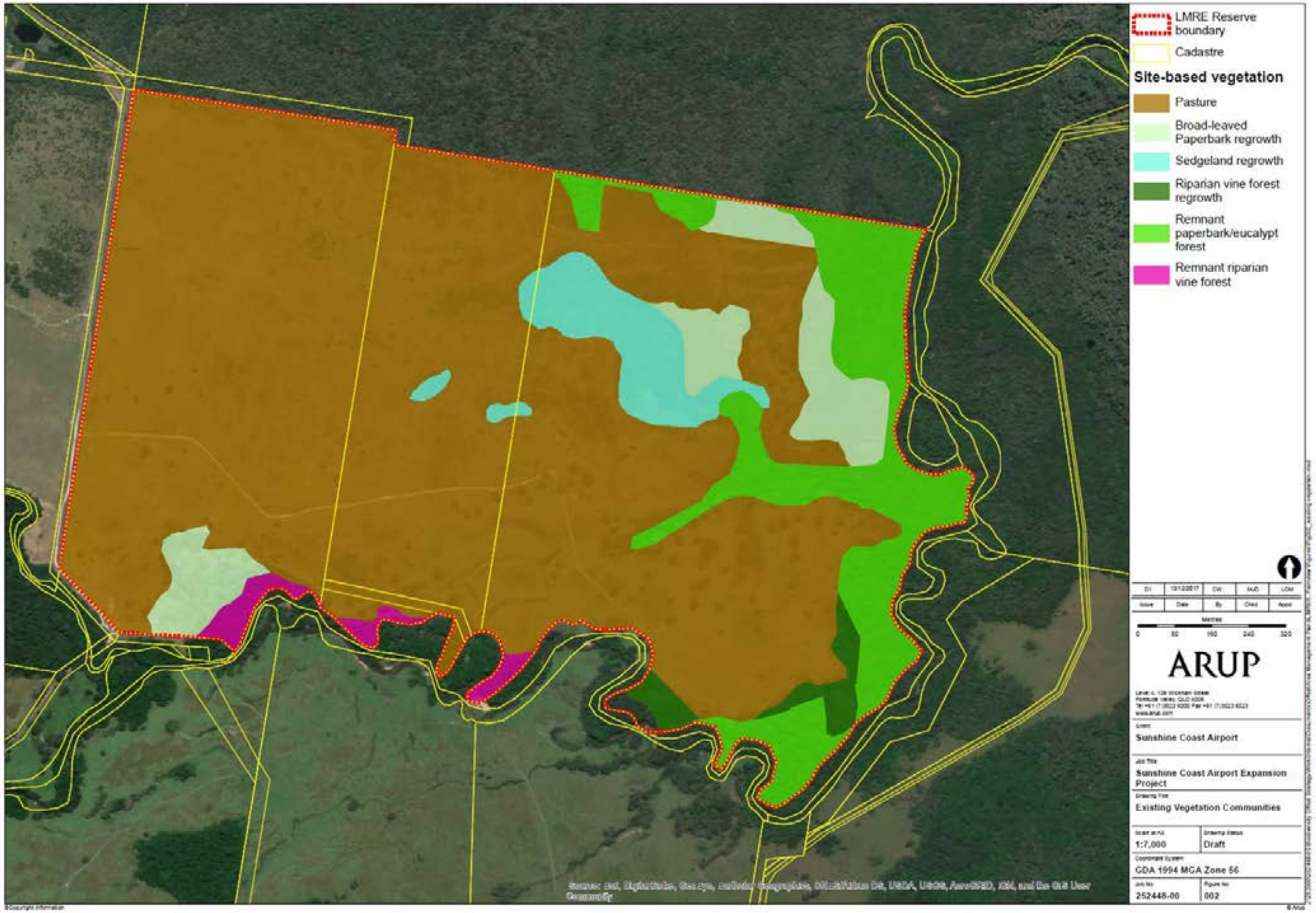


Figure 4-1 LMRER existing vegetation communities

Existing information on soil and groundwater conditions within the LMRER property is limited. However, wet heathland and swamp forest communities are commonly associated with shallow water tables (particularly after rain) which perch (or semi-perch) on a hardpan layer such as coffee rock (Griffith *et al.* 2003, Bryan, 1973). Vegetation dynamics within these areas are strongly influenced by the depth of groundwater and thickness of coffee rock, which can also inhibit the growth of large trees, such as broad-leaved paperbark by limiting root development.

Soil structure, including the presence of an indurated sand layer (coffee rock) and groundwater hydrology (specifically the behaviour of shallow,[1] perched aquifers) are likely to influence the successful recruitment and breeding of acid frogs to reconstructed breeding habitats at the LMRER. This includes influencing pond hydroperiod, which should be long enough to allow tadpoles to metamorphose without allowing predatory fish to persist and breed (as is likely if water persists year-round). Typically, this would mean a pond hydroperiod of around six to eight weeks. Groundwater and soil properties also influence pond water pH, turbidity, tannin-straining, salinity and aluminium levels, all of which can affect the suitability of constructed ponds for acid frogs.

4.2 Offset Design

The LMRER will be used to provide suitable breeding and non-breeding habitat for wallum froglet and wallum rocketfrog. This will be achieved through restoration works to establish an ultimate vegetation community that closely resembles pre-clearing condition (i.e. broad-leaved paperbark open forest to woodland – RE 12.3.5), with provision for areas of sedgeland (RE 12.3.8) and constructed frog ponds to improve habitat for acid frog species.

The offsets will be delivered through two broad treatment areas, according to the existing vegetation condition classes and restoration opportunities available at the site, shown in Table 4-2 and Figure 4-2. These areas form the basis of restoration and ongoing management approaches to be implemented at the site. Of the total area to be rehabilitated, at least 23.50 ha will provide an offset for wallum rocketfrog and at least 40.22 ha for the wallum froglet.

Additionally, a 3 m wide access track, comprising of sand or maintained understorey vegetation, will be maintained along the northern, western and southern boundary of the LMRER offset area. The track is to permit maintenance and fire service vehicle access to the site during the maintenance period or in the event of a bushfire on adjacent lands. These tracks may be decommissioned upon completion of the maintenance period.

[1] <2 m in deph

Table 4-2 Description of broad restoration treatment areas for LMRER

Treatment	Description	Existing conditions	Area (ha)	AU
A	Assisted regeneration	Advanced regrowth of broad-leaved paperbark open forest. Retains native canopy, sub-canopy and ground layers. Ponding surface water and areas of open sedgeland. Good coverage of breeding ponds.	2.30	4
		Advanced regrowth of broad-leaved paperbark and sedgeland. Low canopy cover, very dense native sedge and fern cover. Good coverage of breeding ponds.	7.50	5
B	Habitat reconstruction	Broad-leaved paperbark regrowth, with elements of heathland shrubs. Elements of native sedgeland in drainage depressions.	24.05	1
		Broad-leaved paperbark regrowth, with retained eucalypt paddock trees.	3.82	2
		Exotic pasture with very few native species and low habitat structure. Some areas of broad-leaved paperbark regrowth and native sedges.	25.50	3
		Total	**62.64**	

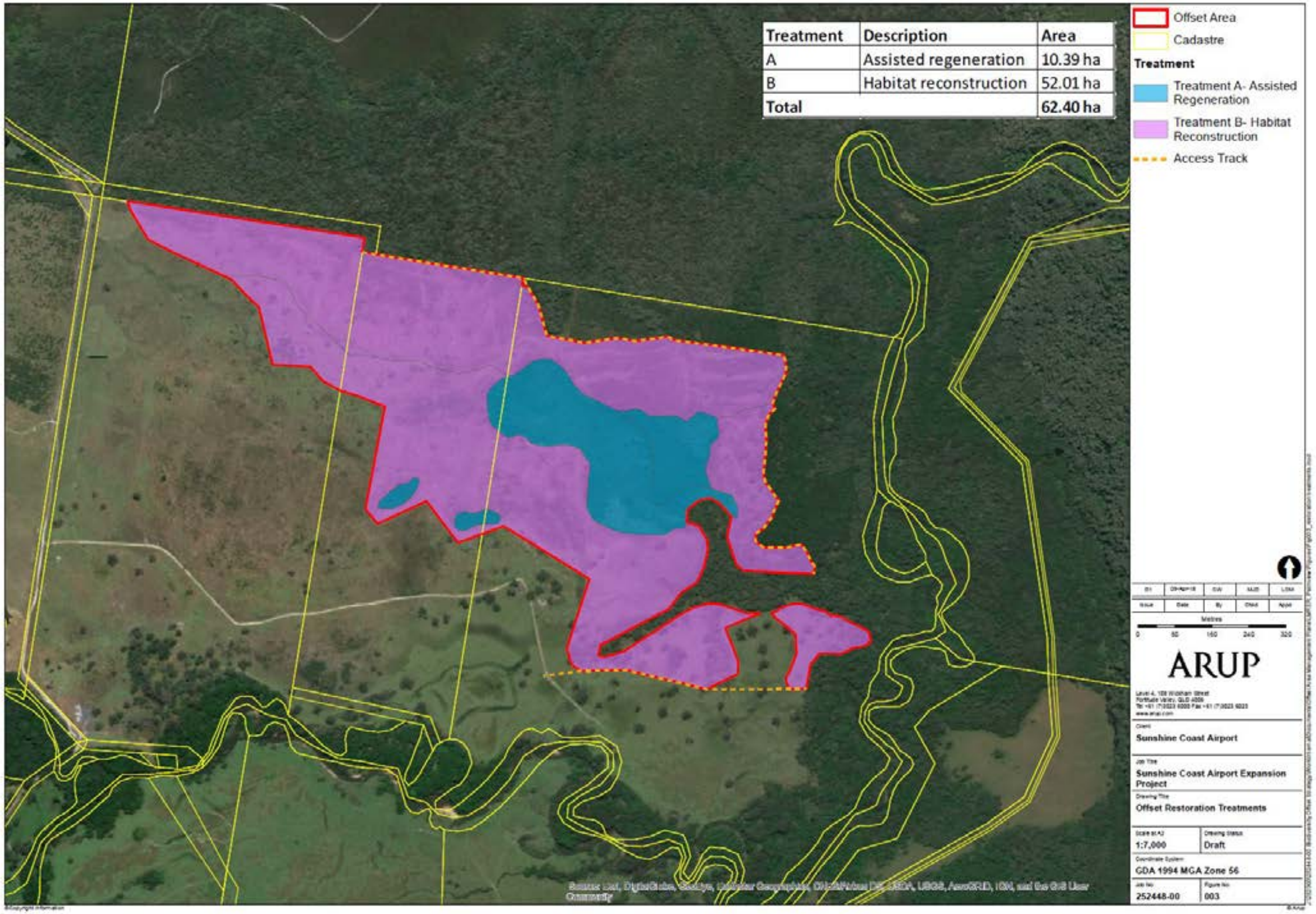


Figure 4-2 LMRER broad treatment areas

The two types of treatment to be used are described as follows:

Assisted Regeneration

- This treatment applies to areas where the native plant community is largely healthy and functioning, and when native plant seed is still stored in the soil and/or will be able to reach the site from nearby natural areas by birds or other animals, wind or water. In the existing state, natural regeneration processes (seedling germination, root suckering etc.) are being inhibited by biotic factors, such as weed invasion, soil compaction, cattle grazing and mechanical slashing.
- Due to the existing nature of these sites, relatively minor human intervention (e.g. cattle exclusion, weed and exotic grass removal, implementation of appropriate fire regimes) is sufficient to trigger the recovery process through natural regeneration; installation of new plants is not generally considered appropriate in these areas.
- Infill plantings may be of benefit in some areas to speed up successional processes and/or to improve the structure and complexity of habitats for acid frogs.

Habitat Reconstruction

- This treatment applies to areas that have been subject to increased degradation or alteration, when the degree of disturbance has been so great and longstanding that the pre-existing native plant community cannot recover by natural means. In these areas, a greater degree of human intervention is required, such as integrated weed management, grazing management and/or slashing, amelioration of soil conditions (e.g. importation of soils), drainage works and landscape reshaping.
- Acid frog breeding ponds will be constructed in this area to supplement available acid frog breeding habitats at the LMRER.
- Some native species will also be installed through direct planting or seeding as natural regeneration and recruitment is insufficient to initially re-establish the original vegetation. Depending on the prevailing circumstances, the planting of a broad diversity of species from the target ecosystem may be unnecessary and the use of pioneers may be sufficient to re-establish ecological processes.

4.3 Offset Delivery Actions and Procedures

4.3.1 Qualifications and Experience of Project Team

Offset delivery must be carried out under the direct supervision of a suitably qualified ecologist or bushland restoration specialist. This person must have a university degree in ecology, botany, environmental science or a similar and relevant field. All phases of the planning, implementation, completion and monitoring of the project must be reviewed by the supervising ecologist or bushland restoration specialists.

The on-ground works must be coordinated and supervised by qualified and experienced personnel within minimum qualifications in Certificate III in Horticulture, Conservation and Land Management (CaLM) or equivalent experience. The project shall be undertaken by bush regeneration specialists with minimum qualifications in Certificate III CaLM or equivalent and at least 5 years of practical ecological rehabilitation experience.

Monitoring and associated reports shall be prepared by a suitably qualified ecologist in preparing ecological monitoring reports.

4.3.2 Pre-Construction Investigations and Plans

Prior to commencement of any works, the following pre-construction activities will be undertaken:

- Site survey to identify restricted invasive plants and environmental weeds and, where necessary, development of a Weed Management Plan for the site. The Weed Management Plan must be developed in consultation with the acid frog specialist and aim for the removal/control of all environmental and noxious weeds[2] from the offset area, including any invasive native species that may reduce acid frog habitat amenity. Specifically, the plan should include:
  - Methodology, conditions and timing of the site survey
  - A list of all weed species located during the survey (including exotic or natural species which might adversely affect environmental values)
  - Weed survey results including a detailed geo-referenced map of existing weed infestations
  - Any weed control actions that may be required in addition to measures outlined in this ODP
  - Weeds of concern that should be the subject of immediate control and appropriate control methods for these weeds.[3]
- Updated habitat quality assessment transects, as per the DES guideline, to give a pre-construction HQS for the site.
- Investigations to identify the properties of groundwater and soils that would influence acid frog breeding ponds (e.g. pH, turbidity, tannin-staining, salinity, aluminium levels) and planting hole fertilisation or soil amelioration required. The soil testing is to consist of a minimum of one sample per hectare with physical and chemical analysis by a NATA accredited soil analysis laboratory.
- Development of detailed construction and maintenance plans, with details on nature, timing, duration and location of works. This will include detailed design of the acid frog breeding ponds, as informed from the above investigations.
- Development of a list of species for planting and a planting management strategy with measures to reduce the risk of unintended failure of planted areas.

This material will form the basis of the actual works delivery. Plans will be reviewed and approved by Council before commencement of works.

[2] Weeds to be considered include those listed under *Biosecurity Act 2016*, Restricted Invasive Plants of Queensland (DAF, 2016), Weeds of National Significance in the National Weed Strategy, Invasive Naturalised Plants in Southeast Queensland (Queensland Herbarium, 2002), and Draft Sunshine Coast Council Local Government Area Biosecurity Plan. Additionally, the plan should include other exotic plants known to exhibit weed characteristics (i.e. invasive, competitive characteristics).

[3] Weed control methods must be reviewed by the acid frog specialist to ensure they do not inadvertently place existing conservation values at risk.

NOTE: To the extent any of these plans differ from more general detail as provided in this ODP, the subsequent plans will have precedence.

4.3.3 Surveying and Pegging

Each treatment area will be surveyed and pegged to allow for the on-ground identification of areas to receive specific restoration treatments. The final location and dimensions of reconstructed acid frog habitats will be dependent on the results of soil and groundwater investigations and the recommendations of the ecologist or rehabilitation specialist.

4.3.4 Assisted Regeneration (Treatment A Area)

Little human intervention is required for the regeneration of the Treatment A area. The major intention for these areas is to support the regeneration of broad-leaved paperbark open forest by means of cattle exclusion, weed and exotic grass removal and the implementation of appropriate fire regimes. Further detail on specific activities will be included in detailed construction and maintenance plans.

4.3.5 Habitat Reconstruction (Treatment B Area)

Works for the Treatment B area will consist of active revegetation works and construction acid frog breeding ponds, as described below.

4.3.5.1 Planting

Revegetation works will be based on planting using the species listed in Table 4-3. Species are to be selected which are suitable for the in-situ soil and drainage conditions (i.e. some areas will experience periodic to near-permanent inundation). All tubestock are to be healthy, locally-sourced and acclimatised prior to planting. Any proposed stock substitutions must be approved by the supervising ecologist.

Prior to planting, all weeds and exotic plants are to be treated in accordance with the weed management plan, allowing time for any necessary follow-up treatments where required. Soils are to be cultivated to a depth of 150 mm. No ripping is to occur within the dripline of mature trees to avoid damage to root systems. Where plants are to be installed within the dripline of existing trees, holes are to be manually dug by hand or mechanical auger.

Plants are to be set out in accordance with the positions and quantities outlined in this document. Planting holes should be twice the width and depth of the pot size and prepared not more than 24 hours in advance of planting. Plants and planting holes should be watered immediately prior to planting to ensure adequate soil moisture content. To discourage any likely herbivory, plants are to receive a treatment of ‘Deter’ prior to planting. The outside roots of each plant shall be lightly teased apart prior to planting. Planting holes are to be backfilled and progressively firmed as needed.

Table 4-3 Active revegetation species palette

Stratum	Species	Common name	Planting density
Canopy	*Melaleuca quinquenervia*	Broad-leaved paperbark	1 plant/25 m^2
	Lophostemon suaveolens	Swamp box	
	Eucalyptus tereticornis	Forest red gun	
	Melicope elleryana	Pink flowered doughwood	
	Glochidion sumatranum	Umbrella cheese tree	
	Melaleuca linariifolia	Flax-leaved paperbark	
Shrub	*Hakea actites*	Mulloway needle bush	1 plant/9 m^2
	Acacia leiocalyx	Black wattle	
	Banksia robur	Swamp banksia	
	Glochidion ferdinandi	Cheese tree	
	Acacia disparrima subsp. disparrima	Hickory wattle	
	Alphitonia excelsa	Red ash	
	Melaleuca pachyphylla	Wallum bottlebrush	
	Leptospermum polygalifolium	Tantoon	
	Persoonia virgata	Geebung	
	Xanthorrhoea fulva	Swamp grasstree	
	Leptospermum liversidgei	Lemon-scented tea-tree	
	Hibiscus diversifolius	Swamp hibiscus	
	Baeckea frutescens	Weeping baeckea	
	Banksia aemula	Wallum banksia	
Ground	*Leersia hexandra*	Swamp ricegrass	3 plants/m^2
	Imperata cylindrica	Blady grass	
	Baumea rubiginosa	Flat leaf twig rush	
	Baumea articulata	Jointed rush	
	Gahnia clarkei	Tall sawsedge	
	Gahnia siberiana	Red-fruited sawsedge	
	Cyperus trinervis	Flat sedge	
	Chorizandra cymbaria	Heron bristle bush	
	Fimbristylis nutans		
	Baloskion pallens	Native rush	
	Lepironia articulata	Grey sedge	

4.3.5.2 Acid Frog Breeding Pond Construction

Acid frog breeding ponds are to be constructed in the habitat reconstruction treatment area (refer Figure 4-2) where suitable soil and groundwater conditions exist. Actions associated with breeding pond construction that should be implemented within this area are outlined below. These are to address performance objectives and criteria outlined in Table 4-5.

Pre-Construction Investigations

Detailed information on soil and groundwater conditions within relevant treatment areas is needed to maximise the success of acid frog habitat restoration works and to inform the precise location and design of breeding ponds. Additional investigative actions to be implemented prior to the commencement of restoration works will include:

- Installation of groundwater wells and loggers for monitoring groundwater in constructed acid frog breeding ponds (i.e. Treatment B Area)
- Installation of at least one groundwater well and logger within existing acid frog habitat at the LMRER to allow for comparison
- Investigation of soil profile (depth to indurated layer) and soil and groundwater properties (pH and salinity) with establishment of monitoring wells
- Downloading groundwater logger data quarterly.

Pond Design

Pond construction at LMRER will be guided by a detailed construction plan. This plan will need to be completed before construction of ponds can begin. The pond construction plan should show the location, extent and bathymetry of individual ponds. Pond design (especially pond depth) will be guided by data from groundwater loggers as well as expert advice (from the acid frog specialist). Existing acid frog habitat should be clearly indicated on the designs as exclusion areas.

The design and layout of constructed ponds should allow for:

- Approximately 38 ponds with a minimum combined area of 5 ha, scattered throughout the entire Treatment B area
- Ponds no smaller than approximately 10 m^2
- An approximate 1:5-6 fall from existing ground level to the pond floor
- Individual pond depth, as informed by soil and groundwater investigations
- Planting, establishment and ongoing recruitment of emergent sedges, including:
  - \- *Baumea rubiginosa*, *B. articulata* and/or *Lepironia articulata* for areas where deeper water is expected
  - \- *Baumea rubiginosa*, *Baloskion pallens*, and *Fimbristylis nutans* for shallower areas
- Areas of dense sedge and sparse-to-moderate sedge cover in and around ponds.

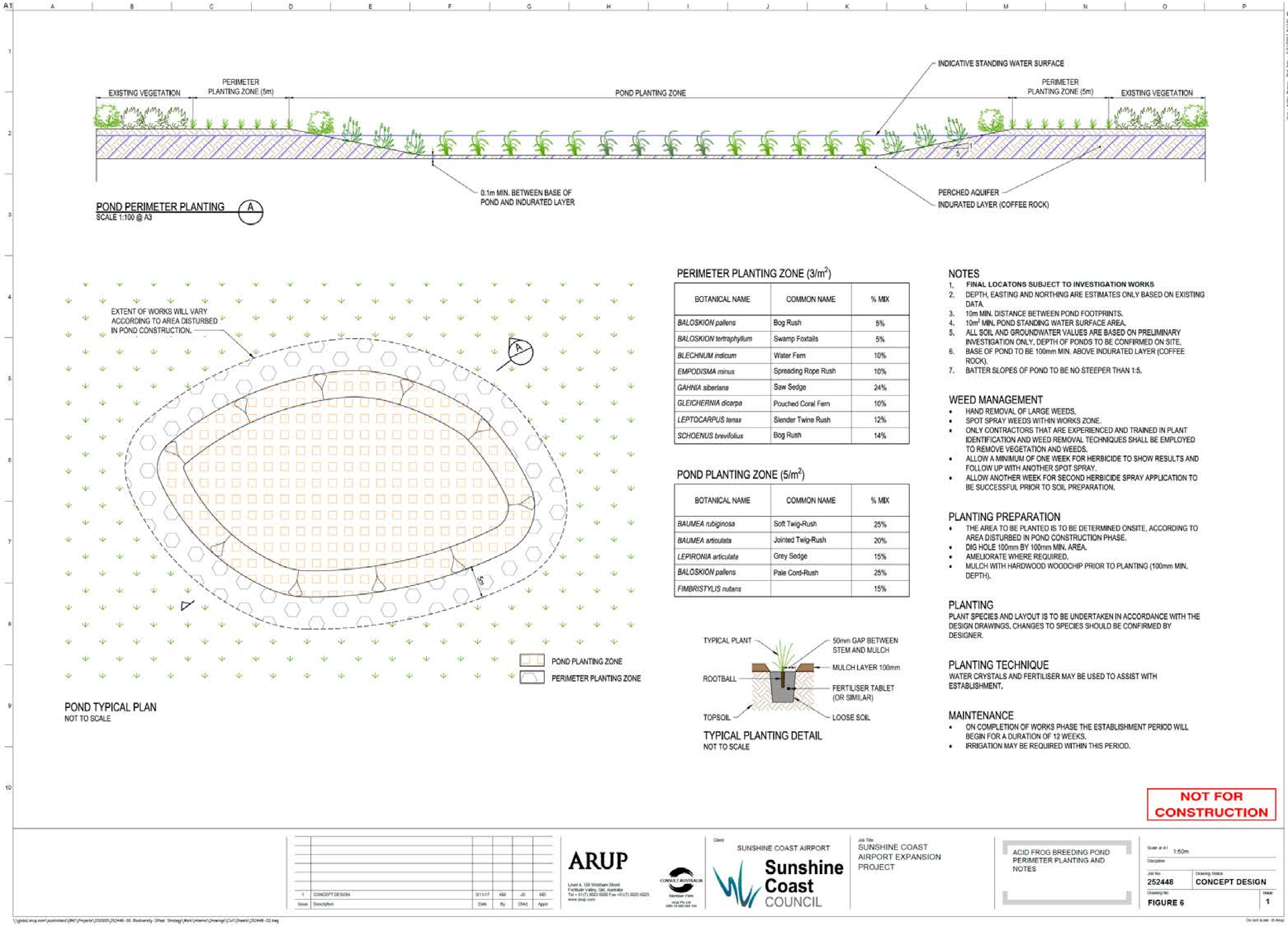
Figure 4-3 provides detailed specifications for acid frog breeding pond planting works.

Site Preparation and Pond Construction

Pond construction should occur during the dry season (June to August) to minimise the risk of injuring acid frog adults and larvae. The footprint of any works associated with pond construction must be inspected by a registered fauna spotter/catcher prior to the commencement of works. The fauna spotter-catcher is to be present on-site whilst excavation works are undertaken if fauna are observed which require relocation or in case of fauna injury.

Prior to excavation works, tall woody vegetation (i.e. melaleuca regrowth and established eucalypts) will be removed from within the proposed pond footprint. Wherever possible this should be done manually using cut-stump methods to avoid significant ground and vegetation disturbance from heavy machinery. Remaining vegetation may require slashing to reduce density once the tall woody material has been removed.

To minimise damage to surrounding vegetation, ponds will be excavated using light machinery (<5 t) where practical. Damage to vegetation may be further reduced by minimising movement in and around constructed ponds and reusing previous access routes rather than moving across undisturbed areas of vegetation. Following construction, areas subject to soil disturbance around the perimeter of ponds should be planted with emergent sedges, in accordance with Figure 4-3. Access tracks are to be seeded with *Caustis recurvata* and *Fimbristylis nutans*.



PERIMETER PLANTING ZONE (3/m²)

BOTANICAL NAME	COMMON NAME	% MIX
BALOSKION pallens	Bog Rush	5%
BALOSKION tertraphyllum	Swamp Foxtails	5%
BLECHNUM indicum	Water Fern	10%
EMPODISMA minus	Spreading Rope Rush	10%
GAHNIA siberiana	Saw Sedge	24%
GLEICHERNIA dicarpa	Pouched Coral Fern	10%
LEPTOCARPUS tenax	Slender Twine Rush	12%
SCHOENUS brevifolius	Bog Rush	14%

POND PLANTING ZONE (5/m²)

BOTANICAL NAME	COMMON NAME	% MIX
BAUMEA rubiginosa	Soft Twig-Rush	25%
BAUMEA articulata	Jointed Twig-Rush	20%
LEPIRONIA articulata	Grey Sedge	15%
BALOSKION pallens	Pale Cord-Rush	25%
FIMBRISTYLIS nutans		15%

Figure 4-3 Acid frog breeding pond perimeter planting and notes

4.4 Practical Completion Performance Objectives and Criteria

Following the implementation of the habitat restoration works, the performance outcomes and criteria defined in Table 4-4 and Table 4-5 will need to be met to achieve practical completion and commence the maintenance works.

Table 4-4 Performance objectives and measurable criteria for assisted regeneration treatment areas (Treatment A)

Performance objective	Measurable criteria
Native regeneration of broad-leaved paperbark open forest vegetation community	• The following tree species are recorded as dominant or subdominant in the canopy and/or sub-canopy: broad-leaved paperbark, swamp box, forest red gum. • A minimum of 10 of the flora species listed in Table 4-3 are recorded. • Canopy or subcanopy layers are to be a minimum of 6 m in height, with a minimum foliage projective cover (FPC) of 30%. • Increased FPC of locally occurring native species in ground, shrub and canopy strata from the measured FPC at the time of the preparation of this specification. • Evidence of recruitment of locally occurring native flora species characteristic of the target community, through seeding and/or germination.
Reduction in the cover of exotic and weed species in all offset areas	• Exotic plant cover (other than declared pests, weeds of national significance and noxious/environmental weeds) is reduced to 10%. • Absence of any declared pest plants, weeds of national significance or SCC Declared Noxious/Environmental Weeds.

Table 4-5 Performance objectives and measurable criteria for habitat reconstruction treatment areas (Treatment B)

Performance objective	Measurable criteria
Creation of a minimum of 5 ha of acid frog breeding ponds	• Construction of ponds according to design specifications. • Native sedge density ~1/3 m^2 in and around ponds.
Delivery of active revegetation works	• A minimum of 4 canopy, 10 shrub and 10 understorey species listed in Table 4-3 are recorded. • Plant density in accordance with Table 4-3. • All failed plants replaced and reasons for failure recorded. • Adequate watering records provided to demonstrate active revegetation area was sufficiently watered. • Evidence of plant growth recorded.
Reduction in the cover of exotic and weed species in all offset areas	• Exotic plant cover (other than declared pests, weeds of national significance and noxious/environmental weeds) is reduced to 10%. • Absence of any declared pest plants, weeds of national significance or SCC Declared Noxious/Environmental Weeds.

4.5 Management and Maintenance

4.5.1 Short-term Management and Maintenance

LMRER offset site short-term management and maintenance requirements prescribed in this Section must be implemented within the first three years following practical completion of the restoration works. These prescribed measures are crucial to achieving offset habitat restoration objectives and are to be implemented until such a time as habitat restoration works have addressed the maintenance period performance outcomes identified above in Section 4.4.

Different approaches to the management of each AU at the LMRER will be required in the short-term and the contractor must be committed to adaptively managing each area. This includes adapting conservation and land management practices in response to results from the monitoring program and to unforeseen or unplanned management threats and issues, as well as to reflect advances in ecological research and land management technologies.

An indicative schedule of maintenance tasks is shown in Table 4-6. The broader program of all works is discussed in Section 4.7 (for LMRER) and Section 7 (for entire offset program).

Table 4-6 Indicative schedule of maintenance tasks

Performance criteria and management actions	Year 1	Year 2	Year 3
Weed control	Intensive mechanical and chemical weed control. Allow for 12 visits over the first year	Spot weed control in accordance with monitoring outcomes. Allow for 6 visits over the second year for weed control	Spot weed control in accordance with monitoring outcomes. Allow for 6 visits over the third year for weed control.
Erosion control and mulching	Erosion control and mulch to be installed where required following weed treatment and pond construction works.	Reapply mulch as needed to bare ground or new plantings	Reapply mulch as needed to bare ground or new plantings
Watering	As required	As required	As required
Replacement/Infill planting	Sourcing of seedlings or seeds from local provenance plant material. Identification and preparation of planting sites	Monitoring for success and replacement of failed plants.	Monitoring for success and replacement of failed plants.
Hygiene measures	As required for all site works	As required for all site works	As required for all site works
Ecological burns	No actions	No actions	Plan for ecological burn at end of maintenance period.

4.5.1.1 Weed Control

Weed control during assisted regeneration should be undertaken within the treatment areas according to the weed management plan. Specific weed treatments need to be undertaken in accordance with Biosecurity Queensland Information sheets:

https://www.daf.qld.gov.au/plants/weeds-pest-animals-ants/weeds/controlmethods.

Control methods are dependent upon the age, size, location and health of the weed specimen.

Follow up weed removal should be timed to treat weeds and exotic species prior to seed set. Chemical treatment of exotic grasses should be followed by slashing of dead vegetation which would be retained on the site to provide soil stabilisation and cover.

4.5.1.2 Watering

Any planting works undertaken within habitat reconstruction treatment areas, or to reinforce areas of assisted regeneration will require sufficient watering to encourage successful establishment. Watering should be carried out on an as-needs basis subject to the results of site inspections and monitoring. The water availability at the offset site and the need to import water installing systems to irrigate planting works is to be assessed by the appointed contractor.

A strict weed hygiene protocol should be implemented to prevent the spread of weeds. This would include a vehicle wash-down upon entry and exit to the site.

4.5.1.3 Replacement and Infill Planting

All plantings should be assessed regularly and replaced as required. Any failed or lost plantings are to be replaced with suitable stock in accordance with the species palette and planting specification outlined above in Section 4.3.5.1 and Figure 4-3.

It is expected that in instances where the contractor observes vacancies within assisted rehabilitation areas due to weed control, previously unobserved vacancies or canopy gaps, infill plantings will be provided to speed up the ecological succession process.

4.5.1.4 Exotic Disease Hygiene

Strict hygiene protocols, as per the Australian Government's Hygiene protocols for the control of exotic diseases in Australian frogs (Commonwealth of Australia 2011) are to be implemented at the LMRER for the duration of the three-year maintenance period so as to minimise the risk of disease spread to the site:

http://www.environment.gov.au/biodiversity/invasivespecies/publications/hygiene-protocols-control-diseases-australian-frogs

This is to include the cleaning of personnel, footwear, equipment and vehicles with a suitable disinfectant before entering and existing the site.

4.5.1.5 Fire Management

Fires must be controlled at the offset site to allow adequate time for juvenile plants to mature and set seed. A fire exclusion period of approximately three years is recommended. As such, a burn of the translocated area should be scheduled no sooner than 2021.

4.5.1.6 Corrective Actions

Corrective actions may be required if performance indicators outlined in Section 4.4 of this plan are not met. Triggers for corrective actions, potential causes and suggested corrective actions are identified in Table 4-7 below. It should be noted that the list of corrective actions provided is not exhaustive and additional actions may also be suitable/appropriate if deemed so by an acid frog expert. Corrective actions should therefore be implemented in consultation with an acid frog specialist.

Table 4-7 Corrective actions for LMRER acid frog offsets program

Indicator	Trigger	Possible cause	Potential corrective actions
Recruitment	Constructed ponds fail to support recruitment despite suitable (median or above median) rainfall, while reference sites support successful recruitment.	Pond design inadequate: ponds not holding water for long enough; water quality in ponds unsuitable; predator density within ponds too high; and/or vegetation cover unsuitable.	Modification of pond design (e.g., increased pond depth) Modification of vegetation within/surrounding ponds (e.g., increased density of emergent sedges)
Adult abundance	Constructed ponds consistently fail to attract breeding/calling animals, while reference sites support significant numbers of calling/breeding animals.	Pond design inadequate, such that: ponds not holding water for long enough; water quality in ponds unsuitable; density of competitor species too high; vegetation cover unsuitable; water persisting for too long allowing for the establishment and persistence of predatory fish. Predatory fish able to colonise constructed ponds.	Modification of pond design (e.g., increased or pond depth to increase pond hydroperiod, or decrease pond depth and hydroperiod to reduce densities of predator fish). Modification of vegetation within/surrounding ponds (e.g., increased density of emergent sedges). Construct barriers to prevent fish from colonising constructed ponds.
Ground and surface water quality	Surface water pH within created acid frog habitat exceeds 5.0.	Increased surface water runoff into habitat areas.	Reduce surface water runoff into habitat areas. Engage suitably qualified groundwater specialist or hydrogeologist to investigate sources of altered recharge levels.
Hydroperiod	Hydroperiod at created acid frog breeding ponds significantly shorter than existing habitat at reference sites, preventing successful recruitment. Permanent water within created acid	Reduced pond hydroperiod due to draining and/or reduced recharge of perched groundwater aquifer. Pond depth too great, allowing	Modification of pond design (e.g., increased pond depth in order to increase hydroperiod, or reduced pond depth to

Indicator	Trigger	Possible cause	Potential corrective actions
	frog breeding ponds allowing persistence of predatory fish (when water within retained ponds and at reference sites remains ephemeral).	surface water to persist for longer.	eliminate permanent water).
Vegetation structure	Significant die-off of vegetation and/or sedges without a marked reduction in rainfall (i.e., die-off not readily attributable to reduced rainfall/drought). Newly-identified incursions of weed species within offset areas. 5% increase or greater in the extent of existing infestations/incursions compared with initial weed survey.	Inappropriate planting regime (i.e. species may not be suited to local hydrology). Introduction/ spread of weed propagules by vehicles, machinery and/or personnel. Changes to abiotic factors such as disturbance regimes (e.g., slashing regimes).	Reassess soils and localised hydrology and replant with alternative species in accordance with the specifications outlined in Section 4.3.5. Carry out appropriate weed control activities consistent with actions in Section 4.5.1.1 Increase vigilance/monitoring of weeds.

4.5.2 Long-term Management Actions

This Section identifies measures that must be implemented for the long-term protection and management of acid frog habitat offsets at the LMRER offset site. These prescribed measures are crucial to achieving the objectives identified in Section 4.4.

Long term management of offsets at the LMRER is to occur indefinitely. However, a 20-year timeframe has been set for achieving the required 1-point condition gain in HQS, as compared with the impact site habitat quality score of 7, over 90% of the site. Note that this score is calculated together with an improvement in HQS for the SCAEP acid frog offset AUs.

The *National recovery plan for the Wallum Sedgefrog and other wallum-dependent frog species* ('Recovery Plan') (Meyer *et al* 2006) identifies several known and potential threats to acid frog species including wallum froglet and wallum rocketfrog. If not appropriately managed, these have the potential to impact the long-term success acid frog habitat offsets to be delivered at the LMRER. These are discussed further below.

4.5.2.1 Changed Hydrology, Poor Water Quality and Predation

As discussed in Section 4.1, hydrology and water quality are key factors that are likely to influence the success of acid frog recruitment to reconstructed habitat areas at the LMRER. To support the successful breeding/recruitment of acid frogs, constructed ponds must retain water long enough to allow tadpoles to metamorphose without allowing predatory fish (i.e. *Gambusia holbrooki*) to persist and breed (as is likely if water persists all year round). Typically, this would mean a pond hydroperiod of around six to eight weeks.

Following pond construction, surface and groundwater monitoring will be undertaken for a three-year period to assess the suitability of localised hydrology/ pond hydroperiod. Pond water pH, turbidity, tannin-staining, salinity and aluminium levels will also be monitored, all of which can affect the amenity of constructed ponds for acid frogs (with elevated pH, turbidity, salinity and aluminium likely reducing the suitability of ponds for acid frog species).

Where necessary, corrective actions will be implemented (as per Section 4.5.1.6) to address inappropriate hydrology and water quality with surface and groundwater monitoring extended until performance outcomes are achieved (refer to Section 4.6).

4.5.2.2 Inappropriate Fire Regimes

Inappropriate fire regimes may impact acid frog populations and the viability of associated broad-leaved paperbark open forest habitat areas. Short-term monitoring suggests acid frog numbers can significantly decline and may be slow to recover following fire events (Meyer *et al.* 2006). This can occur through direct mortality and a loss of vegetative cover, exposing frogs to increased predation and climate extremes (Meyer *et al.* 2006). Similarly, changes in the frequency and intensity of fires can prevent the regeneration of native vegetation and decrease plant species richness in acid frog habitats, ultimately impacting viability and carrying capacity over the long-term.

Long-term management of acid frog habitat offsets at the LMRER offset site is to incorporate the implementation of appropriate fire management practices. Table 4-8 provides fire management guidelines for target vegetation communities based on Queensland Herbarium (2016) Regional Ecosystem Fire Guidelines. An adaptive approach to fire management at the LMRER offset site is recommended based on the outcomes of offset monitoring.

Table 4-8 Fire regime requirements for the target vegetation community

Melaleuca Open Forest (RE 12.3.5)
Season: Late summer to mid-winter (after rain).
Intensity: Planned and occasional unplanned burns (typically of higher intensity) influence the ecology of melaleuca ecosystems.
Interval: Heath 8-12 years, Sedge 12-20 years, Mixed grass/shrub 6-20 years.
Strategy: Aim for a 25-70% burn mosaic (in association with surrounding ecosystems, as melaleuca ecosystems often just occur in patches or along natural drainage lines). Fires may, depending on the conditions and type of vegetation, burn areas larger than just the melaleuca ecosystem. Ensure secure boundaries from non-fire-regime adapted ecosystems, particularly foredune and beach ridge communities. Consider the needs of melaleuca ecosystems based on understorey (i.e., heath dominated, sedge dominated or mixed grass/shrub) when planning burns. High soil moisture (or presence of water on the ground) is required, as avoidance of peat-type fires must be maintained.
Issues: Fire regimes for melaleuca ecosystems require further fire research. Melaleuca forests are fire-adapted, but too high an intensity or frequent fire will slow or prevent regeneration and lead to lower species richness (since these communities contain numerous obligate seed regenerating species that require sufficient fire intervals to produce seed). High intensity fires may kill trees and lead to whipstick regeneration. Too frequent fire may result in a net loss of nutrients over time from an already nutrient poor system. Fire associations are significantly influenced by understorey composition. Melaleuca communities with a heath understorey should burn in a similar way to coastal heath (8-12 years). Sedge understorey communities will burn in association with the surrounding ecosystems (so will often burn with them but sometimes not, such that these communities have a slightly less fire frequency). Mixed understorey communities burn in a similar way to dry sclerophyll, in association with the surrounding dry sclerophyll, though somewhat less frequently due to the additional moisture present in melaleuca communities.

4.5.2.3 Exotic Disease

Chytridiomycosis is an exotic disease caused by the chytrid fungus *Batrachochytrium dendrobatidis* attributed to recent declines and extinctions in many Australian frog species (Meyer *et al.* 2006). Chytrid fungi typically live in water and soil and are spread among amphibian populations by means of human and animal transportation. Individual frogs can contract the disease by contact with infected animals or contaminated waters containing spores from infected animals (Commonwealth of Australia, 2016).

Strict hygiene protocols, as per the Australian Government's Hygiene protocols for the control of exotic diseases in Australian frogs (2011) are to be implemented at the LMRER so as to minimise the risk of disease spread to the site:

http://www.environment.gov.au/biodiversity/invasivespecies/publications/hygiene-protocols-control-diseases-australian-frogs

This is to include the cleaning of personnel, footwear, equipment and vehicles with a suitable disinfectant before entering and existing the site.

4.5.2.4 Weed Invasion

Although not addressed in the Recovery Plan, weeds may pose a threat to the viability of acid frog habitats, impacting vegetation structure and floristics through the competitive exclusion of native plant species. Weed control measures are to be implemented on site for the duration of the maintenance period to minimise the competitive impacts of exotic species on native habitats.

Weeds may establish within reconstructed acid frog breeding ponds and areas to be actively revegetated from propagules stored within the soil or deposited from machinery and vehicles undertaking the habitat restoration and maintenance works. These can also become established within naturally regenerating habitat areas due to historical disturbance and available resources.

Control and removal of invasive weeds at the LMRER offset site will assist the establishment, expansion and persistence of acid frog habitat. Implemented control measures must comply with Biosecurity Queensland guidelines (https://www.daf.qld.gov.au/plants/weeds-pest-animals-ants/weeds/controlmethods) and ensure any chemicals used are waterway safe. Inspections of the site should be carried out at least once every six (6) months to identify and control any weed species present.

4.6 Monitoring and Reporting

4.6.1 Habitat Quality

The overarching objective of the terrestrial habitat quality monitoring is to apply a standard metric to measure the success of the offset actions against the offset objectives identified in Section 4.4. The stated conservation outcome is to achieve a 1-point condition gain in HQS for the acid frog offset AUs within 20 years. While the AUs that make up this score cover both LMRER and SCAEP sites, the same gain will be sought for each individual HQS.

The habitat quality of each AU will be monitored by placing two monitoring transects within each assessment unit. The methodology for collecting data on the overall habitat quality of the offset sites will continue to apply the *Guide to Determining Terrestrial Habitat Quality* (DEHP 2014). The centre-point, start-point and bearing of each transect is to be recorded and the centre-point is to be permanently marked with a star picket.

One of these transects will be situated at the sites where data was collected to inform the existing habitat quality score derived to assess the size and scale of this offset package. The second transect will be located in an area of similar vegetation condition and habitat structure. All field data will be collected in accordance with the procedures described in 'Chapter 5 – Site Condition Assessment' of the *Guide to Determining Terrestrial Habitat Quality*.

The Site Context Assessment and Fauna Species Habitat Assessment components of the *Guide to Determining Terrestrial Habitat Quality* will also be completed.

All field data will be collected and entered into the relevant datasheets and compared with the benchmark values for the targeted Regional Ecosystems to obtain an overall habitat quality score. These monitoring events will be completed yearly.

A short report presenting the results of each year's monitoring activities will be prepared, including a brief commentary on how the works are contributing to the required conservation outcome of a demonstrated gain in habitat quality value. The reports are to include:

- The raw data collected in the Site Condition Assessment transects
- Completed Site Context Assessment data with any supporting GIS maps
- Completed Fauna Species Habitat Assessment
- Completed habitat quality score metric
- Photographs taken at the centre point facing north, south, east and west
- A description of any threats or disturbances observed
- Recommendations for any corrective actions to be applied
- An assessment or comment on the success of any corrective actions recommended during the previous year's monitoring.

4.6.2 Ground and Surface Water Level/Pond Hydroperiod

Monitoring of ground and surface water levels within created acid frog breeding habitats is necessary to evaluate the performance of constructed ponds and determine what, if any, corrective actions may be required should ponds fail to hold sufficient water after construction. Water level monitoring within created habitat should include:

- Continuous monitoring of ground water levels using capacitance water level loggers at sites established during the initial groundwater investigations (see Section 4.3.2).
- Continuous monitoring of pond hydroperiod using capacitance water level loggers at no less than 50% of constructed ponds (up to a maximum of 30 ponds).
- Continuous monitoring of pond hydroperiod using capacitance water level loggers in acid frog monitoring reference sites outside the LMRER offset area.

Water level loggers at monitoring sites should be serviced and downloaded quarterly with monitoring to continue until success criteria have been demonstrated. Data from ground water/pond hydroperiod loggers must be included within the annual monitoring reports.

4.6.3 Surface Water Quality

The amenity of artificial breeding habitat for acid frog species will depend on surface water quality within ponds, in particular pH and tannin-staining levels (with low pH and heavy tannin-staining limiting competition with ecologically-similar sibling species). Surface water quality (pH, tannin-staining, turbidity, and salinity) should therefore be monitored, both at constructed ponds and reference sites within and outside the SCA. Measurement and analysis of water chemistry should be undertaken during acid frog monitoring surveys and, providing surface water is present, quarterly while downloading of data from water loggers.

4.6.4 Weeds

The risk of weed infestation or expansion is most likely in the period following soil surface disturbance, and as such targeted weed monitoring will be undertaken in the 24 months following acid frog pond creation. In subsequent years weed monitoring need not be as rigorous and can be included as part of terrestrial habitat quality monitoring. Weed monitoring should include biannual surveys of the site to detect any new outbreaks or increases in existing infestations. In addition to exotic species, invasive native species should also be considered which may reduce the amenity of habitat for acid frog species. New weed outbreaks or increases of > 5% in the extent of existing infestations (based on the results of weed mapping prior to the commencement of site restoration) should trigger weed control.

Reporting from biannual weed monitoring, which is to continue for 24 months following the completion of all earthworks (runway and pond construction), need only be in the form of a short memo/report. It should include survey methods and results, and clearly document deviation from the pre-construction weed map/data. It should clearly indicate if further weed control actions are necessary.

Opportunistic weed survey results (commencing 24 months after all earthworks are completed) should be included annual reports, where relevant.

4.6.5 Acid Frogs

A monitoring program will be implemented to assess the success of offset measures for acid frog species (including the wallum sedgefrog). The objectives of this program are to:

- Monitor site ground and surface water conditions to ensure parameters suitable for acid frog habitat.
- Document breeding activity and recruitment success within constructed ponds at the LMRER to determine the success (or otherwise) of offsets for the wallum sedgefrog, wallum rocketfrog and wallum froglet.

Targeted surveys will be undertaken to assess both abundance and recruitment of acid frog species within areas of artificial habitat (constructed ponds) and reference sites outside of the LMRER (within

Mooloolah River National Park and/or Noosa National Park). Monitoring surveys must be conducted under conditions suitable for detection of target species, as outlined in Table 4-9.

Table 4-9 Suitable timing and conditions for surveys targeting acid frog species

Species	Suitable timing and conditions for nocturnal surveys targeting adult frogs	Suitable timing and conditions for surveys targeting tadpoles / metamorphosing frogs
Wallum sedgefrog	1-2 days after heavy rainfall resulting in inundation of breeding habitat in spring, summer or autumn.	5-8 weeks after heavy rain with breeding habitat at least partly inundated, in spring, summer or autumn.
Wallum froglet	1-2 days after heavy rainfall resulting in inundation of breeding habitat in spring, summer, autumn or winter.	5-8 weeks after heavy rain with breeding habitat at least partly inundated, in spring, summer or autumn.
Wallum rocketfrog	1-2 days after heavy rainfall resulting in inundation of breeding habitat in late spring or summer.	4-6 weeks after heavy rain with breeding habitat at least partly inundated, in late spring or summer

The abundance of adult and juvenile frogs at each constructed pond will be assessed by means of:

- Nocturnal counts of animals seen around the perimeter of ponds
- Nocturnal counts of animals seen along a 2 m-wide strip transect through the middle of each pond
- Five-minute counts of all frog species heard calling within a 5 m and 10 m radius of the centre of each pond.

The abundance of adult and juvenile frogs within reference sites outside of the LMRER will be assessed using:

- Nocturnal counts of animals seen along 2 m wide x 50 m long strip transects
- Five-minute point counts of all frog species heard calling within a 5 m and 10 m radius.

Point counts and strip transects within existing habitat will be situated in inundated sedgeland and wet heath.

Areas of surface water within constructed ponds and existing breeding habitat will be dip-netted for tadpoles and the identity and age (developmental stage) of tadpoles recorded. To allow comparison between sites, dipnet surveys will be timed (so that the abundance of tadpoles can be expressed as numbers captured/unit time). A maximum of 20 minutes will be spent surveying tadpoles at each pond/site surveyed.

The timing and number of surveys undertaken annually will depend on rainfall and detectability of target species during surveys. Under favourable conditions (i.e., with median or above-median wet season rainfall), nocturnal surveys targeting adult frogs would be carried out twice a year after heavy rain, with follow-up surveys targeting tadpoles/metamorphosing froglets 4-6 weeks later. Under drier conditions (i.e., with below-median wet season rainfall), survey opportunities may be limited and the number of monitoring surveys reduced.

Monitoring of artificial breeding habitat will continue until constructed ponds support successful recruitment of the wallum sedgefrog, wallum froglet and wallum rocketfrog. Monitoring of artificial breeding habitat may also be discontinued if, despite suitable rainfall, ponds fail to support recruitment of these species and corrective actions have been implemented without success.

Regular monitoring of retained habitat and reference sites will continue for a similar timeframe.

Results from the acid frog monitoring should be reported annually, at the end of each calendar year. The report should include:

- Survey methods, timing and conditions with comment on survey limitations
- Groundwater and surface water results (including depth to ground water, hydroperiod, and water quality data) in constructed habitats
- A summary of offset delivery actions completed during the monitoring year
- Acid frog abundance and breeding success at artificial habitats
- Recommendations to improve the amenity of constructed ponds for acid frog species
- Corrective actions, if required.

Following the success of artificial acid frog breeding ponds (i.e. no further acid frog monitoring required), groundwater monitoring (i.e. groundwater quality) will be included within the annual monitoring report.

4.7 Overall Program of Works

Table 4-10 shows the total program of works for the LMRER offsets, including initial set up through to maintenance and management.

Table 4-10 Indicative schedule of maintenance tasks

TASK	Year 0										Year 1				Year 2				Year 3			
	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10												
Implementation phase																						
Pre-start meeting																						
Site establishment and mobilisation																						
Survey and peg offset treatment areas																						
Carry out soil and groundwater investigations																						
Habitat (pond/wet heath) design																						
Weed survey and weed management plan																						
Prepare detailed ecological restoration plan																						
Carry out weed treatment in all offset areas																						
Commence and complete construction of ponds including planting works																						
Carry out planting works in active revegetation areas																						
On maintenance inspection																						
Three-year maintenance phase																						
Weed treatment																						
Watering																						
Infill planting (if required)																						
Ecological monitoring (vegetation)																						
Surface and groundwater monitoring																						
Weed monitoring																						
Ecological monitoring (acid frogs)																						

5 Offset Details – Wallum Heath Management Area and Vegetation Management Area A

5.1 Offset Site Description

The WHMA (AU6) and VMA (AU9) are contiguous areas to the north of the new runway. The WHMA is an area of unique wallum heath habitat created through the clearing of all overstorey trees for maintenance of existing runway and helicopter operations. Similarly, overstorey trees in the VMA will also need to be removed to provide for operational safety of the new runway. As the VMA habitat corresponds to the pre-disturbance status of the WHMA, these maintenance works will likely result in a similar heath habitat.

The WHMA currently supports regrowth dry open heath, corresponding to RE 12.2.12. This vegetation is dominated by a low-shrub layer (<0.5 m tall) of *Boronia falcifolia*, *Banksia robur*, *Sprengelia sprengelioides*, *Philotheca queenslandica*, *Strangea linearis*, *Dillwynia floribunda*, *Phyllota phylicoides*, and *Baeckea frutescens*. The ground layer includes *Xanthorrhoea fulva*, *Sporadanthus interruptus*, *Leptocarpus tenax*, *Empodisma minus* and *Gahnia sieberiana*. Recent investigations of the area indicate the presence of an organic hardpan (coffee rock) approximately 90-100 cm below ground level (BGL) as well as acidic ground water at depths of 65-80 cm BGL (see Table 5-1). The area is known to support breeding and non-breeding habitat for acid frogs as well as a population of 13-16 ground parrots.

The VMA adjoins the WHMA to the west and is currently dominated by open heath with melaleuca thickening, representing an expansion of RE 12.2.7 into RE 12.2.12. The understorey retains the characteristics of dry open heath but with a canopy of *Melaleuca quinquenervia*. This area is also known to support acid frogs, although is less likely to support breeding habitat.

Table 5-1 Preliminary groundwater bore hole results

Bore Label	Location	Depth to indurated layer (m)	Depth to water (m)	Water pH	Tannic acid equivalent (mg/L)
SCA1	WHMA – proposed offset area	0.92	0.72	4.3	62.42
SCA2	WHMA – proposed offset area	1.03	0.80	4.2	62.12
SCAREP1	WHMA –retained acid frog habitat	1.03	0.63	4.4	20.09
GW1	VMA	1.30	0.52-dry	4.82-7.05	-
GW3	VMA	1.0	0.82-1.79	4.92-6.95	-
GW9A/B	VMA	1	0.62-dry	6.83-6.7	-

5.2 Offset Design

As noted above, the WHMA already provides breeding and non-breeding habitat for acid frogs and habitat for ground parrots. However, ground parrots are currently absent from the northern portion of the WHMA, likely due to lower availability of seed producing plants, such as sedges. Acid frog habitat also occurs in the VMA, although this is primarily non-breeding habitat and does not support ground parrots. Following the maintenance clearing of the VMA, it is anticipated that the two areas will form a contiguous open heath community.

Recognising this, the offset design for these areas is focused on the improvement of existing habitat values through maintenance and provision of expanded breeding habitat. This will be undertaken through three primary types of activity, as shown in Table 5-2 and Figure 5-1.

Importantly, both the WHMA and VMA require ongoing management to maintain an open heath habitat suitable for ground parrot use. The regrowth of trees in this area (e.g. melaleuca) will decrease the suitability of the habitat for parrot use. Some of this maintenance will occur as part of airport operations, a more frequent level of maintenance is necessary to retain the environmental values of this habitat. Therefore, the long-term conversion of habitat to open heath forms an important offset outcome that would not otherwise be achieved in a 'business as usual' setting.

Table 5-2 Description of broad offset measures for WHMA (AU6) and VMA (AU9)

Description	Area WHMA (ha)	Area VMA (ha)
Augmentation of existing habitat in the VMA and northern WHMA to create a wet/dry heath matrix suitable for ground parrot habitat NOTE: This is linked in part to construction of breeding ponds as these will promote growth of sedges and other seed-bearing plants utilised by ground parrots	25.46*	5.84*
Construction of ponds within the VMA and northern WHMA to improve breeding habitat for acid frogs	1.7 (across both areas)**	
Management of VMA and WHMA (post above works) as open heath habitat	25.46*	5.84*

*The habitat conversion area and management area for both AUs consists of the entire AU area (inclusive of the ponds)
**Area of ponds determined based on minimum pond requirement under EPBC 2011/5823 (1.67 ha). Where monitoring of initial ponds indicates increased breeding habitat is required to sustain an appropriate population, more ponds can be installed.

Figure 5-1 WHMA and VMA offset areas

5.3 Offset Delivery Actions and Procedures

5.3.1 Qualifications and Experience of Project Team

Offset delivery must be carried out under the direct supervision of a suitably qualified ecologist or bushland restoration specialist. This person must have a university degree in ecology, botany, environmental science or a similar and relevant field. All phases of the planning, implementation, completion and monitoring of the project must be reviewed by the supervising ecologist or bushland restoration specialist.

Monitoring and associated reports shall be prepared by a suitably qualified ecologist in preparing ecological monitoring reports.

Additionally, the following specialists should be consulted prior to commencement of relevant elements of the works:

- Acid frog specialist and/or ground parrot specialist – prior to clearing works
- Groundwater specialist or hydrogeologist – prior to construction of ponds.

5.3.2 Pre-Construction Investigations and Plans

Prior to commencement of any works, the following pre-construction activities will be undertaken:

- Updated habitat quality assessment transects for the WHMA, as per the DES guideline, to give a pre-construction HQS for the site.

Investigations to identify the properties of groundwater and soils that would influence acid frog breeding ponds (e.g. pH, turbidity, tannin-staining, salinity, aluminium levels) and planting hole fertilisation or soil amelioration required. The soil testing is to consist of a minimum of one sample per hectare with physical and chemical analysis by a NATA accredited soil analysis laboratory. Note that existing data was already collected in 2016/17 at the sites shown in Figure 5-2.

- Where considered necessary by the relevant design consultant, updated data should be collected prior to completion of design.
- Development of detailed construction and maintenance plans, with details on nature, timing, duration and location of works. This will include detailed design of the acid frog breeding ponds, as informed from the above investigations.
- Development of list of species for planting and a planting management strategy with measures to reduce the risk of unintended failure of planted areas.

This material will form the basis of the actual works delivery. Plans will be reviewed and approved by Council before commencement of works.

NOTE: A habitat quality assessment transect will be conducted for the VMA following initial clearing of overstorey as conducting an assessment prior to this will not be reflective of the true 'starting position' of the offset area.

Figure 5-2 WHMA and VMA groundwater logger locations

5.3.3 Habitat Conversion

Clearing works will be undertaken within the VMA with the aim to remove tall woody vegetation (e.g. melaleuca regrowth and established eucalypts). Based on the volume of trees within the VMA for clearing, these works will be undertaken using mechanised clearing methods but in a manner that minimises the impact on the retained understorey. All cleared vegetation will be mulched and retained on site. Works will be undertaken under the supervision of a fauna spotter-catcher.

Following initial clearing, it may also be necessary to slash the remaining understorey to reduce density. Slashing will be undertaken to a height of 0.5 m.

Once all clearing is completed, signs highlighting the significance of offset areas will be placed at 50 m intervals around the perimeter. These signs will stipulate that access to offset areas is restricted and requires approval from airport management. Similar signs will also be placed around the WHMA.

A habitat quality transect assessment, as per the DES guideline, will be undertaken within the VMA following completion of the clearing works. This will provide a starting HQS for the purposes of measuring offset progress for this area. (see Section 5.6.1).

5.3.4 Pond Construction

Pond Design

Pond construction at the WHMA and VMA will be guided by a detailed construction plan. This plan will need to be completed before construction of ponds can begin. The pond construction plan should show the location, extent and bathymetry of individual ponds. Pond design (especially pond depth) will be guided by data from groundwater monitoring as well as expert advice (from the acid frog specialist). Existing acid frog habitat should be clearly indicated on the designs as exclusions areas.

The design and layout of construction ponds should allow for:

- Approximately 15-20 ponds with a minimum combined area of 1.7 ha scattered through the WHMA/VMA
- Ponds no smaller than 100 m^2
- An approximate 1:6 fall from existing ground level to the pond floor
- Individual pond depth, as informed by soil and groundwater investigations
- Planting, establishment and ongoing recruitment of emergent sedges including:
  - *Baumea rubiginosa*, *B. articulata* and/or *Lepironia articulata* for areas where deeper water is expected
  - *Baumea rubiginosa*, *Baloskion pallens*, and *Fimbristylis nutans* for shallower areas
  - *Caustis recurvata*, *Pseudanthus orientalis* and *Sprengelia sprengelioides* or other suitable food plants for ground parrots
- Areas of dense sedge and sparse-to-moderate sedge cover in and around ponds.

Site Preparation and Pond Construction

Pond construction should occur during the dry season (June to August) and outside ground parrot breeding season to minimise the risk of injuring acid frog adults and larvae and ground parrots. The footprint of any works associated with pond construction must be inspected by a registered fauna spotter/catcher prior to the commencement of works. The fauna spotter-catcher is to be present on-site whilst excavation works are undertaken if fauna are observed which require relocation or in case of fauna injury.

Prior to excavation works, tall woody vegetation (i.e. melaleuca regrowth and established eucalypts) will be removed from within the proposed pond footprint. Wherever possible this should be done manually using cut-stump methods to avoid significant ground and vegetation disturbance from heavy machinery. Remaining vegetation may require slashing to reduce density once the tall woody material has been removed.

To minimise damage to surrounding vegetation, ponds will be excavated using light machinery (<5 t) where practical. Damage to vegetation may be further reduced by minimising movement in and around constructed ponds and reusing previous access routes rather than moving across undisturbed areas of vegetation. Excavated soil will not be stockpiled in areas of retained heath habitat or ground parrot habitat.

Following construction, areas subject to soil disturbance around the perimeter of ponds should be planted with emergent sedges. Access tracks are to be seeded with *Caustis recurvata* and *Fimbristylis nutans*.

Planting

Once excavated, ponds will be planted out with sedge species favoured by acid frogs and ground parrot (including *B. rubiginosa*, *B. articulata*, *Lepironia articulata*, *Baloskion pallens*) at a density of no less than 1 plant/m^2. These sedge species already occur within areas of existing habitat in the north and centre of the WHMA and are likely to establish quickly under suitably wet conditions. Where necessary (i.e. under drier conditions), newly-planted stock will be watered to ensure sedges establish quickly.

Supplementary plant will be triggered if after 24 months from planting sedge cover is less than 50% compared to reference sites and shows little sign of improving, and/or a stochastic event (e.g. drought) causes sedge death reducing cover to less than 50% of retained habitats and reference sites.

5.4 Practical Completion Performance Objectives and Criteria

Following the implementation of the offset works, the performance outcomes and criteria defined in Table 5-3 and Table 5-4 will need to be met to achieve practical completion and commence the maintenance works.

Table 5-3 Performance objectives and measurable criteria for acid frog offset works

<table>
<tr><th>Performance objective</th><th>Measurable criteria</th></tr>
<tr><td>Creation of a minimum of 2.2 ha of acid frog breeding ponds</td><td rowspan="2">• Successful breeding within constructed ponds as indicated by the presence of juvenile acid frogs and/or late-stage tadpoles (while ponds continue to hold sufficient water to allow late stage tadpoles to complete their development)
• Recruitment of acid frogs within areas of retained habitat consistent with data from pre-construction surveys
• Acid frog abundance estimates within retained habitat are consistent with data from pre-construction surveys, with observed declines attributable to natural causes (e.g. reduced wet season rainfall, bushfire) as opposed to impacts arising from construction and operation of new runway
• Ground and surface water chemistry (pH, turbidity, tannin-staining, conductivity/salinity) within areas of retained breeding habitat remain consistent (± 10%) with pre-construction levels
• Ground and surface water chemistry (pH, turbidity, tannin-staining, conductivity/salinity) in constructed ponds are consistent (± 10%) with existing acid frog breeding habitat elsewhere
• Hydroperiod of constructed ponds is consistent with hydroperiod of retained habitats prior to construction and/or known breeding habitat at reference sites
• Constructed ponds and areas of retained habitat within the WHMA and VMA remain free of invasive weed species (native and/or exotic).</td></tr>
<tr><td>No net loss or reduction in amenity of retained breeding habitat due to runway construction or operation</td></tr>
</table>

Table 5-4 Performance objectives and measurable criteria for ground parrot offset works

Performance objective	Measurable criteria
No decline in ground parrot numbers >25% of that recorded during pre-construction surveys within the WHMA and VMA within 10 years of new runway being constructed OR Decline in ground parrot abundance >25% without a commensurate reduction in habitat quality*	• Ground parrot recorded in similar numbers to pre-construction surveys (with comparable survey effort and survey conditions) within areas of habitat within the WHMA and VMA • No evidence of exotic predators within the airport exclusion fence or, if detected, documentation of effective predator control • Vegetation surrounding construction ponds and within VMA includes ground parrot food plants similar to areas of core habitat** • No significant reduction (>10%) in the extent of retained ground parrot core habitat** • No new weed (exotic or natural) outbreaks and no increase in existing weed infestations • No significant changes to vegetation composition within areas of core habitat** • No change to existing surface or ground water quality within habitat in the WHMA and VMA.

*A decline of 20-25% in ground parrot numbers was anticipated as part of the EIS prepared for the SCAEP

**Core habitat includes all areas within 50% and 75% confidence lines based on kernel density data. This is less the area between the eastern boundary of the WHMA and the existing north/south runway drain within the 75% confidence contour which will be modified for construction of the sand delivery pipeline.

5.5 Management and Maintenance

NOTE: The following actions relate to maintenance of the habitat construction works discussed in Section 5.3 as well as general maintenance of the WHMA, as part of the offset design for this area.

5.5.1 Vegetation Control

Dense woody regrowth (particularly regrowth *Melaleuca quinquenervia*) can reduce the amenity of wet heath/sedgeland habitat for acid frogs and ground parrot. Typically ground parrots occupy habitats with vegetation less than 1 m in height, while acid frogs will occupy vegetation of varying heights provided a dense canopy is not present. Maintenance of vegetation within the WHMA and VMA should therefore ensure woody regrowth (e.g. *Melaleuca quinquenervia*) does not exceed a height of 1.5 m. Additional slashing may be required in areas of ground parrot habitat to ensure heath vegetation does not exceed a height of 1 m.

Vegetation control within the WHMA and VMA should not occur without approval from the acid frog and ground parrot specialist. Guidance for vegetation management will be provided to SCA by the acid frog and ground parrot specialist.

5.5.2 Weed Management

The establishment and spread of weed species may also reduce the amenity of habitat for acid frog species and ground parrot. Weeds should therefore be subject ongoing monitoring and management within areas of existing and newly-created habitat (as outlined in Section 5.6.7). Weed introduction and spread is most likely during the construction of the SCAEP and following ground disturbance for the creation of artificial ponds. However, as open dry and wet heath communities show some resilience to weed infestation a detailed weed management strategy is considered unnecessary unless an outbreak is detected. Measures to constrain/limit the spread of weeds will therefore focus on preventing the establishment and expansion of weeds. The following measures are proposed to reduce the risk posed by weeds within acid frog and ground parrot habitat:

- All vehicles and machinery entering the WHMA and VMA must be free of plant material, course debris and soil.
- All vehicles will be inspected prior to work commencing to ensure they comply with the above standards.
- Prior to pond construction, the weed map included in the Acid Frog Construction Management Plan (Sanders *et al.* 2016) will be updated to show weed infestations within and adjacent to the WHMA and VMA. The map is to include environmental weeds (i.e. native species) that could affect acid frog values.
- Weeds will be monitored to detect new outbreaks or increases in existing infestations (see Section 5.6.7).
- New outbreaks, or increases >5% in the extent of existing infestations (based on preconstruction weed mapping), should trigger weed control.
- Prior to undertaking weed control, the airport project manager must commission a weed management plan. The plan must be either developed in cooperation with, or reviewed by, the

acid frog specialist and include post-weed control monitoring to ensure weed control has been effective.

- Weed control strategies must be undertaken according to the weed management plan and should occur within six months from weed outbreak detection (unless otherwise stipulated within the plan).

5.5.3 Corrective Actions

Corrective actions may be required if performance indicators outlined in Section 5.4 of this management plan are not met. Triggers for corrective actions, potential causes and suggested corrective actions are identified in Table 5-5. It should be noted that the list of corrective actions provided is not exhaustive and additional actions may also be suitable/appropriate if deemed so by an acid frog and ground parrot expert. Corrective actions should therefore be implemented in consultation with an acid frog and ground parrot specialist.

Table 5-5 Corrective actions for WHMA and VMA acid frogs and ground parrot offsets program

Indicator	Trigger	Plausible cause(s)	Potential corrective actions
Acid frogs			
Recruitment	• Substantive reduction in larval and/or juvenile recruitment at retained habitats compared to preconstruction baseline/ control levels (where reduction in recruitment is not attributable to reduced rainfall)	• Reduced pond hydroperiod due to draining and/or reduced recharge of perched groundwater aquifer • Reduced water quality within retained habitat due to saltwater intrusion from runway platform • Insufficient area of ponds	• Engage suitably qualified groundwater specialist or hydrogeologist to investigate sources of altered recharge levels and advice on measures to restore groundwater aquifer and halt saltwater intrusion, if possible • Modification of pond design (e.g., increased pond depth, construction of new ponds
	• Constructed ponds fail to support recruitment despite suitable (median or above-median) rainfall, while retained habitat and/or at reference sites support successful recruitment	• Pond design inadequate: ponds not holding water for long enough; water quality in ponds unsuitable; predator density within ponds too high; and/or vegetation cover unsuitable • Insufficient area of ponds	• Modification of pond design (e.g., increased pond depth, construction of new ponds) • Modification of vegetation within/surrounding ponds (e.g., increased density of emergent sedges)
Adult abundance	• A decrease in acid frog numbers in retained habitats compared to baseline/control data (where reduction in	• Reduced pond hydroperiod due to draining and/or reduced recharge of perched groundwater aquifer	• Engage suitably qualified groundwater specialist or hydrogeologist to

Indicator	Trigger	Plausible cause(s)	Potential corrective actions
	numbers is not attributable to reduced rainfall)	• Reduced water quality within retained habitat due to saltwater intrusion from runway platform • Increased surface water runoff into habitat areas	investigate sources of altered recharge levels and advice on measures to restore groundwater aquifer and halt saltwater intrusion, if possible • Reduce or divert surface water runoff into habitat areas
Pond effectiveness	• Constructed ponds consistently fail to attract breeding/calling animals, while retained habitat and/or reference sites support significant numbers of calling/breeding animals	• Pond design inadequate, such that: ponds not holding water for long enough; water quality in ponds unsuitable; density of competitor species too high; vegetation cover unsuitable; water persisting for too long allowing for the establishment and persistence of predatory fish • Predatory fish able to colonise constructed ponds	• Modification of pond design (e.g., increased or pond depth to increase pond hydroperiod, or decrease pond depth and hydroperiod to reduce densities of predator fish) • Modification of vegetation within/surrounding ponds (e.g. increased density of emergent sedges). • Construct barriers to prevent fish from colonising constructed ponds
Ground and surface water quality	• Surface water pH within areas of retained or created artificial acid frog habitat exceeds 5.0* • Increased salinity of surface water and ground water within perched aquifers, such that salinity levels within areas of retained or created artificial acid frog breeding habitat exceed 1 ppt, preconstruction/baseline levels or levels at reference sites (whichever is greater)*	• Increased surface water runoff into habitat areas • Reduced water quality within retained habitat due to saltwater intrusion from runway platform	• Reduce surface water runoff into habitat areas • Engage suitably qualified groundwater specialist or hydrogeologist to investigate sources of altered recharge levels and advice on measures to restore groundwater aquifer and halt saltwater intrusion, if possible
Hydroperiod	• Hydroperiod within retained habitats much reduced, such that recruitment success significantly lower compared with baseline levels (despite comparable rainfall)**	• Reduced pond hydroperiod due to draining and/or reduced recharge of perched groundwater aquifer	• Engage suitably qualified groundwater specialist or hydrogeologist to investigate sources of altered recharge levels and advice on measures to restore groundwater aquifer

Indicator	Trigger	Plausible cause(s)	Potential corrective actions
			and halt saltwater intrusion, if possible
	• Hydroperiod at created acid frog breeding ponds significantly shorter than retained habitats and/or existing habitat at reference sites, preventing successful recruitment • Permanent water within created acid frog breeding ponds allowing persistence of predatory fish (when water within retained ponds and at reference sites remains ephemeral)	• Reduced pond hydroperiod due to draining and/or reduced recharge of perched groundwater aquifer • Pond depth too great, allowing surface water to persist for longer	• Modification of pond design (e.g. increased pond depth to increase hydroperiod, or reduced pond depth to eliminate permanent water)
Vegetation structure	• Significant die-off of vegetation and/or sedges without a marked reduction in rainfall (i.e., die-off not readily attributable to reduced rainfall/drought) • Newly-identified incursions of weed species within the WHMA or VMA • 5% increase or greater in the extent of existing infestations/incursions compared with preconstruction/baseline surveys	• Change in surface water and/or groundwater hydrology/salinity due to failure of mitigation measures • Introduction/ spread of weed propagules by vehicles, machinery and/or personnel • Changes to biotic factors such as ground and surface water quality and hydrology • Changes to abiotic factors such as disturbance regimes (e.g., slashing regimes)	• Carry out appropriate weed control activities consistent with actions in Section 5.3 • Modify slashing regimes • Increase vigilance/monitoring of weeds. • Engage suitably qualified groundwater specialist or hydrogeologist to investigate sources of altered recharge levels and advice on measures to restore groundwater aquifer and halt saltwater intrusion, if possible
Ground parrots			
Predators	• Evidence (observation, scat or track) of exotic predators within the airport perimeter fence	• Exclusion fence damage	• Predator control, • Fence repair • Increased monitoring to demonstrate successful control
Vegetation composition/ structure	• ≥5% reduction in the abundance of graminoid sedges and other Ground Parrot food plant species within Ground Parrot habitats# • Newly-identified incursions of weed	• Inappropriate conditions to promote food plant growth. Factors may include: unsuitable soil moisture (groundwater and surface water changes); competition; altered soil chemistry	• Control weeds, • Evaluate possible causal factors and develop strategies to favour known food plants

Indicator	Trigger	Plausible cause(s)	Potential corrective actions
	species within the WHMA or VMA • 5% increase or greater in the extent of existing infestations/incursions compared with preconstruction/baseline surveys • Vegetation density and height not consistent with areas of core habitat	(e.g. salinity); weed infestation • Inappropriate slashing regime	• Supplementary planting/seeding of food plants • Modify slashing regime
Extent of core habitat	• >10% reduction in core habitat	• Predators • Changes to vegetation condition and structure • Edge effects (unavoidable)	• As relevant above
Ground Parrot abundance	• A decline >25% in Ground Parrot abundance (as estimated using call frequency, flush counts, and triangulation estimates) within 10 years of construction or • A decline in ground parrot abundance and a commensurate reduction in habitat quality	• Loss of seed producing plant species (see vegetation impacts above) • Increased predation (see above) • Inappropriate vegetation structure • Edge effects (unavoidable)	• See aforementioned actions • Undertake appropriate vegetation control to modify habitat structure

Acid Frogs

*Baseline data on water quality at acid frog breeding sites within the airport are currently limited. Thresholds for water quality parameters are therefore based largely on information from published and unpublished field studies conducted elsewhere. Thresholds for corrective actions may be subject to modification pending the results of water monitoring component of this management plan.

**Changes in pond hydroperiod may occur from increased or decreased rainfall (i.e., independent of development impacts on ground/surface water hydrology). Ground and surface water level monitoring of pond hydrology in this monitoring plan can be used to refine thresholds for corrective actions relating to pond hydroperiod.

Ground Parrots

*Occupied areas calculated using kernel density and includes 50%, 75% and 100% confidence intervals. Suitable vegetation composition informed from monitoring results included in this plan.

**Where core habitat is within 50% and 75% kernel density intervals.

5.6 Monitoring and Reporting

A schedule of monitoring actions relating to acid frog species and the ground parrot at the WHMA and VMA is provided in Table 5-6 and more detailed monitoring in Sections 5.6.1 and 5.6.3.

Table 5-6 Monitoring actions and schedule

Monitoring action	Responsibility	Commencement/completion	Frequency
Habitat quality	Ecologist	Immediately after completion of clearing for VMA	Annually (or as per DES guideline)
Pond hydroperiod	Acid frog and ground parrot specialist	2017 wet season/subject to results (see Section 5.6.1 for details)	Quarterly
Groundwater monitoring	Acid frog and ground parrot specialist	2017 wet season/ongoing	Quarterly while acid frog monitoring ongoing; biannual thereafter
Surface water quality monitoring	Acid frog and ground parrot specialist	2017 wet season/subject to results (see Section 5.6.1 for details)	During frog monitoring work
Weed monitoring (targeted)	Airport appointed contractor	No less than 1 month prior to earthworks (runway or pond construction)/ 24 months after completion of all earthworks	Biannual
Weed monitoring (opportunistic)	Acid frog and ground parrot specialist	24 months after completion of all earthworks /ongoing	Quarterly
Predatory pest monitoring	Acid frog and ground parrot specialist	June 2017/ongoing	During all monitoring actions
Adult acid frog monitoring	Acid frog and ground parrot specialist	2017 wet season/subject to results (see Section 5.6.1 for details)	Twice annually (subject to suitable rainfall [see Section 5.6.1]).
Acid Frog recruitment monitoring	Acid frog and ground parrot specialist	2017 wet season/subject to results (see Section 6.1.3 for details)	Twice annually (subject to suitable rainfall [see Section 5.6.1]).
Ground Parrot monitoring	Acid frog and ground parrot specialist	February 2017/ongoing	6 times each year; at least once in breeding season

5.6.1 Habitat Quality

The overarching objective of the terrestrial habitat quality monitoring is to apply a standard metric to measure the success of the offset actions against the offset objectives identified in Section 4.4. The stated conservation outcome is to achieve a 1-point condition gain in HQS for the acid frog offset AUs within 20 years. While the AUs that make up this score cover both LMRER and SCAEP sites, the same gain will be sought for each individual HQS.

The habitat quality of each AU will be monitored by placing two monitoring transects within each assessment unit. The methodology for collecting data on the overall habitat quality of the offset sites will continue to apply the *Guide to Determining Terrestrial Habitat Quality* (DEHP, 2014). The centre-point, start-point and bearing of each transect is to be recorded and the centre-point is to be permanently marked with a star picket.

One of these transects will be situated at the sites where data was collected to inform the existing habitat quality score derived to assess the size and scale of this offset package. The second transect will be located in an area of similar vegetation condition and habitat structure. All field data will be collected in accordance with the procedures described in 'Chapter 5 – Site Condition Assessment' of the *Guide to Determining Terrestrial Habitat Quality*.

The Site Context Assessment and Fauna Species Habitat Assessment components of the *Guide to Determining Terrestrial Habitat Quality* will also be completed.

All field data will be collected and entered into the relevant datasheets and compared with the benchmark values for the targeted Regional Ecosystems to obtain an overall habitat quality score. These monitoring events will be completed yearly.

A short report presenting the results of each year's monitoring activities will be prepared, including a brief commentary on how the works are contributing to the required conservation outcome of a demonstrated gain in habitat quality value. The reports are to include:

- The raw data collected in the Site Condition Assessment transects
- Completed Site Context Assessment data with any supporting GIS maps
- Completed Fauna Species Habitat Assessment
- Completed habitat quality score metric
- Photographs taken at the centre point facing north, south, east and west
- A description of any threats or disturbances observed
- Recommendations for any corrective actions to be applied
- An assessment or comment on the success of any corrective actions recommended during the previous year's monitoring.

5.6.2 Acid Frogs

A monitoring program will be implemented to assess the success of mitigation and offset measures for acid frog species. The objectives of this program are to:

- Evaluate changes in acid frog numbers and recruitment within retained habitat (to assess the efficacy of mitigation measures during operation of the new runway).
- Document breeding activity and recruitment success within constructed ponds at the WHMA and VMA (to determine the success (or otherwise) of offsets for acid frogs.

The first of these objectives will be met using a BACI (Before-After, Control-Impact) sampling framework (Stewart-Oaten 1986, Underwood 1992, Stewart-Oaten 2003). The BACI design examines the Before (pre-construction) and After (post-construction) conditions at both Control (i.e., reference sites4) and Impact sites. Currently, the only pre-construction data regarding acid frog habitat values is that provided in the EIS. While useful for assessing existing habitat values and potential impacts of the project on acid frogs, this data is inadequate for assessing future impacts of development on acid frog species/habitat values. Baseline data from reference/control sites (outside the airport) are also currently lacking. The current shortage of baseline data from impact and control sites makes it difficult to determine whether observed changes in abundance and/or habitat values during monitoring are the result of development impacts or other factors (such as reduced rainfall), increasing the risk of a type I error (i.e. incorrectly attributing a reduction in abundance and/or habitat value for acid frogs to development impacts). It is therefore important that additional information on acid frog abundance/recruitment and habitat values be collected at control and impact sites before construction of the new runway begins. To ensure data is collected before impacts occur, acid frog monitoring must include the 2017 wet season.

Targeted surveys will be undertaken to assess both abundance and recruitment of acid frog species within areas of artificial habitat (constructed ponds), retained habitat within airport, and reference sites outside of the SCA (within Mooloolah River National Park and/or Noosa National Park). Monitoring surveys must be conducted under conditions suitable for detection of target species, as outlined in Table 5-7.

Table 5-7 Suitable timing and conditions for surveys targeting acid frog species

Species	Suitable timing and conditions for nocturnal surveys targeting adult frogs	Suitable timing and conditions for surveys targeting tadpoles/ metamorphosing frogs
Wallum froglet	1-2 days after heavy rainfall resulting in inundation of breeding habitat in spring, summer, autumn or winter.	5-8 weeks after heavy rain with breeding habitat at least partly inundated, in spring, summer or autumn.
Wallum rocketfrog	1-2 days after heavy rainfall resulting in inundation of breeding habitat in late spring or summer.	4-6 weeks after heavy rain with breeding habitat at least partly inundated, in late spring or summer

The abundance of adult and juvenile frogs at each constructed pond will be assessed by means of:

- Nocturnal counts of animals seen around the perimeter of ponds
- Nocturnal counts of animals seen along a 2 m-wide strip transect through the middle of each pond
- Five-minute counts of all frog species heard calling within a 5 m and 10 m radius of the centre of each pond.

The abundance of adult and juvenile frogs within retained habitat and reference sites outside of the SCA will be assessed using:

- Nocturnal counts of animals seen along 2 m-wide x 50 m-long strip transects; and
- Five-minute point counts of all frog species heard calling within a 5 m and 10 m radius.

Point counts and strip transects within existing habitat will be situated in inundated sedgeland and wet heath.

Areas of surface water within constructed ponds and existing breeding habitat will be dip-netted for tadpoles and the identity and age (developmental stage) of tadpoles recorded. To allow comparison between sites, dipnet surveys will be timed (so that the abundance of tadpoles can be expressed as numbers captured/unit time). A maximum of 20 minutes will be spent surveying tadpoles at each pond/site surveyed.

The timing and number of surveys undertaken annually will depend on rainfall and detectability of target species during surveys. Under favourable conditions (i.e., with median or above median wet season rainfall), nocturnal surveys targeting adult frogs would be carried out twice a year after heavy rain, with follow-up surveys targeting tadpoles/metamorphosing froglets 4-6 weeks later (see Table 5-7). Under drier conditions (i.e., with below-median wet season rainfall), survey opportunities may be limited and the number of monitoring surveys reduced.

Monitoring of artificial breeding habitat will continue until constructed ponds support successful recruitment of the wallum sedgefrog, wallum froglet and wallum rocketfrog. Monitoring of artificial breeding habitat may also be discontinued if, despite suitable rainfall, ponds fail to support recruitment of these species and corrective actions have been implemented without success.

Regular monitoring of retained habitat and reference sites will continue for a minimum of 5 years after the new runway is completed in order to determine what, if any, impacts construction/operation of the runway might have on retained habitat in the short-to-medium term. Regular monitoring of retained habitat and reference sites may continue beyond 5 years if, during this period:

- Abundance and recruitment of acid frogs within retained habitat and at control/reference sites is heavily impacted by drought;
- Impacts on retained acid frog habitat are detected (in which case monitoring will continue until impacts have been ameliorated, or corrective actions to address impacts fail); or
- Constructed ponds fail to support recruitment (in which case monitoring will continue until corrective actions have been implemented successfully and constructed ponds support successful recruitment of acid frog species, or corrective actions fail to improve recruitment success within constructed ponds).

Monitoring of retained habitat and reference sites may again be required if longer-term, incipient impacts on ground water (i.e., saltwater intrusion and/or increased drawdown within perched aquifers) are detected within groundwater monitoring wells located in proximity to retained habitat within the WHMA.

Results from the acid frog monitoring should be reported annually, at the end of each calendar year. The report should include:

- Survey methods, timing and conditions with comment on survey limitations
- Groundwater and surface water results (including depth to ground water, hydroperiod, and water quality data) in retained and constructed habitats*
- A summary of offset delivery actions completed during the monitoring year
- Acid frog abundance and breeding success at both retained and artificial habitats
- Recommendations to improve the amenity of constructed ponds for acid frog species
- Corrective actions, if required.

*Following the success of artificial acid frog breeding ponds (i.e., no further acid frog monitoring required) groundwater monitoring (i.e., groundwater quality) will be included within the Eastern Ground Parrot Monitoring report.

A design and construction plan will be developed to guide the construction of acid frog breeding ponds at the SCA. This plan will need to be completed before construction of ponds can begin. The pond construction plan should show the location, extent and bathymetry of individual ponds. Pond design (in particular pond depth) will be guided by data from ground water loggers currently deployed at SCA as well as expert advice (from the acid frog and ground parrot specialist). This plan will include:

- Results and analysis of pre-construction investigations (e.g. groundwater monitoring data from capacitance water loggers)
- Design drawings showing the size, bathymetry and location of individual ponds
- Preferred access tracks to the ponds which minimise vegetation disturbance
- Construction and environmental exclusion zones which should not be entered
- Pond construction methods
- Revegetation actions (including sedge planting or seeding as required).

5.6.3 Ground Parrots

Ground parrot monitoring should commence as soon as possible and continue throughout construction and airport operation life. Monitoring surveys should be undertaken six times a year (roughly every two months), with at least one survey during peak breeding (August/September). ground parrot monitoring must occur during fine weather (i.e., not in the rain and not while conditions are windy).

A monitoring program will be implemented to assess the success of mitigation and offset measures for the ground parrot. The objectives of this program are:

- To document and evaluate changes in the ground parrot population in areas of retained habitat within the WHMA and VMA following construction of the new runway
- To monitor changes in habitat use within retained habitat (specifically primary area of use, compared to pre-disturbance) following construction of the new runway
- To evaluate the use of created and augmented ground parrot habitat to the north of the WHMA and within the VMA.

Ideally, these objectives would be achieved using the BACI method. In this case, the BACI method is difficult to apply as a comparable control site/population cannot be found. In Queensland, the SCA ground parrot population is unusual, because of its small size (probably <15 individuals) and likely isolation. All other ground parrot populations within Queensland are much larger, more connected, and unlikely to be subject to the same inherent threats as the SCA population, at least in the short-term. Small isolated populations, like the SCA ground parrot population, have greater vulnerability to stochastic demographic and genetic processes increasing their susceptibility to decline and extinction. Small isolated populations are also less resilient and therefore more susceptible to natural environmental impacts (e.g., drought, fire). Comparison with a larger, more robust control population could therefore lead to erroneous conclusions regarding development impacts on the SCA ground parrot populations. To determine if observed declines are likely attributable to development impacts or not, impact pathways identified in the SCA EIS will need to be monitored and evaluated more closely (where possible5).

To allow comparison with pre-construction (EIS) data, data on ground parrot abundance and habitat usage should be collected using the same techniques used during surveys for the SCAEP EIS. This includes call triangulation (to estimate areas of use), flush transects (to estimate abundance and area of use), and call counts (to estimate abundance). Details of these methods are provided in Table 5-8.

In addition, the following should be included within the monitoring:

- A flush transect along the length of the VMA
- Call triangulation sampling in the VMA, to commence once a bird has been detected from the area during flush counts.

Vegetation structure and composition should be assessed using the same variables collected during the SCAEP EIS within a 1x1 m quadrat. Data on vegetation should be collected from flush locations, within core ground parrot habitat (where core habitat occurs within the 50% and 75% kernel density contours), and from the proposed offset areas.

Table 5-8 Ground parrot survey techniques used in each monitoring event

Method	Timing	Notes
Call triangulation	Twice: one morning and one evening call bout	Alternate start point from the middle to the end of transect. Transect added to the VMA once birds have been recorded from the area in flush counts.
Flush count	At least two observers once along each transect	Three transects within the WHMA and a fourth with the VMA.
Call count	Twice: one morning and one evening call bout	
Vegetation assessment	As possible throughout survey when not engaged in other techniques	

Results from the ground parrot monitoring program should be reported annually, at the end of each calendar year. The report should include:

- Survey methods, timing and conditions (with comment on any conditions that may have affected survey results)
- A summary of offset delivery actions completed during the monitoring year
- Analysis of trends in ground parrot call frequency, flush counts, or triangulation data (including comparisons with data collected during pre-construction surveys)
- Analysis of changes in vegetation composition or structure over time (including comparisons with data collected during pre-construction surveys)
- Analysis and discussion of seasonal or temporal influences on ground parrot abundance, detectability and/or area of use (reported only as required)
- Discussion of weed infestations and/or expansion of existing infestations requiring management*
- Evidence of predatory pest species, or lack thereof
- Additional recommendations to improve ground parrot habitat

- Corrective actions, if required
- A review of the ground parrot monitoring program ensure it remains suitable for detecting impacts and/or demonstrating offset success/failure.

*Formal weed monitoring and independent weed reporting to occur during and in the 24 months immediately following completion of all earthworks.

The report should also include groundwater quality results once the acid frog monitoring is no longer required.

Recommendations regarding management of vegetation will be included within the annual Ground Parrot Monitoring Report and, if required, include:

- A map showing areas requiring slashing and/or removal of woody regrowth;
- The type of control necessary (manual removal of emergent regrowth/slashing); and
- Specific direction regarding control methods, including the timing and height of slashing. The acid frog and ground parrot specialist may also recommend additional control measures, if for example, more frequent control may be beneficial (e.g., thinning of dense ground cover). To minimise impacts on the ground parrot and acid frog species, vegetation control should take place under dry conditions, preferably outside the ground parrot breeding season (i.e. before 15th July and after 31st October).

5.6.4 Ground and Surface Water Levels/Pond Hydroperiod

Monitoring of ground and surface water levels within created acid frog breeding habitats is necessary to evaluate the performance of constructed ponds and determine what, if any, corrective actions may be required should ponds fail to hold sufficient water after construction. Monitoring of water level/hydroperiod within retained habitat at the WHMA and VMA and existing habitat elsewhere (outside the SCA) is also important in this regard. Water level monitoring within created habitat should include:

- Continuous monitoring of ground water levels using capacitance water level loggers at sites previously established within the WHMA
- Continuous monitoring of pond hydroperiod using capacitance water level loggers at no less than 50% of constructed ponds (up to a maximum of ten ponds)
- Continuous monitoring of pond hydroperiod using capacitance water level loggers at acid frog monitoring sites within retained habitat at the WHMA and VMA
- Continuous monitoring of pond hydroperiod using capacitance water level loggers in acid frog monitoring reference sites outside the WHMA and VMA.

Water level loggers at monitoring sites should be serviced and downloaded quarterly with monitoring to continue until success criteria have been demonstrated. Data from ground water/pond hydroperiod loggers must be included within the annual acid frog monitoring report.

5.6.5 Groundwater Quality

During the SCAEP EIS it was recognised that saline intrusion from marine sediments (used as fill for the new runway) could move laterally into adjacent habitats leading to increased soil and water salinity within areas of acid frog and ground parrot habitat. To address this, several mitigation measures were included within the airport design to restrict saline intrusion north and east of the new runway. The effectiveness of these measures will be assessed by monitoring groundwater salinity levels within the WHMA and VMA. Monitoring of groundwater levels will also allow for early detection of saline intrusion so that corrective actions cane be undertaken before severe impacts occur. Currently, three groundwater loggers are in proximity to the proposed northern perimeter drain within the VMA. An additional two loggers within 150 m of the proposed drain should be included within the WHMA to allow early detection of impacts on groundwater levels and/or water quality in areas of retained acid frog and ground parrot habitat. Groundwater samples should be collected from monitoring wells for measurement of salinity and pH on a quarterly basis. Initially groundwater monitoring results are to be included within the Acid Frog Monitoring Report but may be reported within the Ground Parrot Monitoring Report once acid frog monitoring is no longer required. Detection of impacts to groundwater, particularly saline intrusion from the runway platform, may be slow and prolonged. Groundwater quality monitoring should therefore continue throughout the life of the airport.

5.6.6 Surface Water Quality

The amenity of artificial breeding habitat for acid frog species will depend on surface water quality within ponds, particularly pH and tannin-staining levels (with low pH and heavy tannin-staining limiting competition with ecologically-similar sibling species). Surface water quality (pH, tannin-staining, turbidity, and salinity) should therefore be monitored, both at constructed ponds and reference sites within and outside the WHMA and VMA. Measurement and analysis of water chemistry should be undertaken during acid frog monitoring surveys and, providing surface water is present, quarterly while downloading of data from water loggers.

5.6.7 Weeds and Predatory Pests

The risk of weed infestation or expansion is most likely in the period following soil surface disturbance, and as such targeted weed monitoring will be undertaken in the 24 months following acid frog pond creation. In subsequent years weed monitoring need not be as rigorous and can be included as part of Ground Parrot monitoring surveys.

Weed monitoring should include:

- Targeted surveys to be undertaken twice (biannually) in the 24 months following runway and/or pond earthworks. Survey results will be compared with pre-construction mapping showing the location and extent of weed infestation within the WHMA and the VMA (see Section 5.3).
- Low-level weed surveillance during ground parrot surveys in subsequent years.

Weed monitoring should consider not only exotic species, but also invasive native species which may reduce the amenity of habitat for acid frog species and/or ground parrots.

Incursions by feral cats, foxes and dogs are likely to be limited by the high chain-wire fence surrounding the WHMA. This fence is frequently checked for structural integrity, and as such, intensive monitoring of large mammalian predators is considered unnecessary. Rather, the presence of feral cats, foxes and dogs (including scats and tracks), will be determined by:

- Establishing six baited infra-red remote triggered cameras positioned around the WHMA and the VMA for the duration of each ground parrot monitoring event;
- Opportunistic observations during all other monitoring activities; and
- The maintenance of a pest register to document sightings of cats, foxes or dogs by airport ground staff. The register will be reviewed while undertaking ground parrot monitoring surveys.

Evidence of mammalian predators will be reported in the annual ground parrot monitoring report, with recommendations for pest control included as necessary.

A Weed Survey Report will be completed prior to construction of the runway. The report will include:

- Survey methodology, conditions and timing
- A list of all weed species located during the survey (including exotic or natural species which might adversely affect environmental values)
- Weed survey results including a detailed geo-referenced map of existing weed infestations
- Additional weed control actions that may be required during construction not outlined in this document
- Weeds of concern that should be the subject of immediate control and appropriate control methods for these weeds.

Reporting from biannual weed monitoring, which is to continue for 24 months following the completion of all earthworks (runway and pond construction), need only be in the form of a short memo/report. It should include survey methods and results, and clearly document deviation from the pre-construction weed map/data. It should clearly indicate if further weed control actions are necessary.

Opportunistic weed survey results (commencing 24 months after all earthworks are completed) should be included within the Ground Parrot Monitoring Report.

6 Offset Details – Connectivity Corridor and Translocation Area

The connectivity corridor and translocation sites both formerly supported an area of melaleuca open forest (RE 12.2.7) together with some assemblages of casuarina open forest (RE 12.1.1) and closed heath (RE 12.2.12) within the corridor. Both sites were cleared in the mid-20th century to support the expansion of sugar cane cropping, and now consist of degraded grassland although with some native regrowth elements (e.g. *Acacia* spp., *Melaleuca quinquenervia*).

The only areas of retained vegetation are *Casuarina glauca* open forest on saline-influenced soils, adjacent to the Sunshine Motorway, and paperbark forest adjoining the north Marcoola block of the Mount Coolum National Park. The *C. glauca* forest was part of a broader community that extends to the Maroochy River but has been fragmented by the motorway construction and changes in local hydrology.

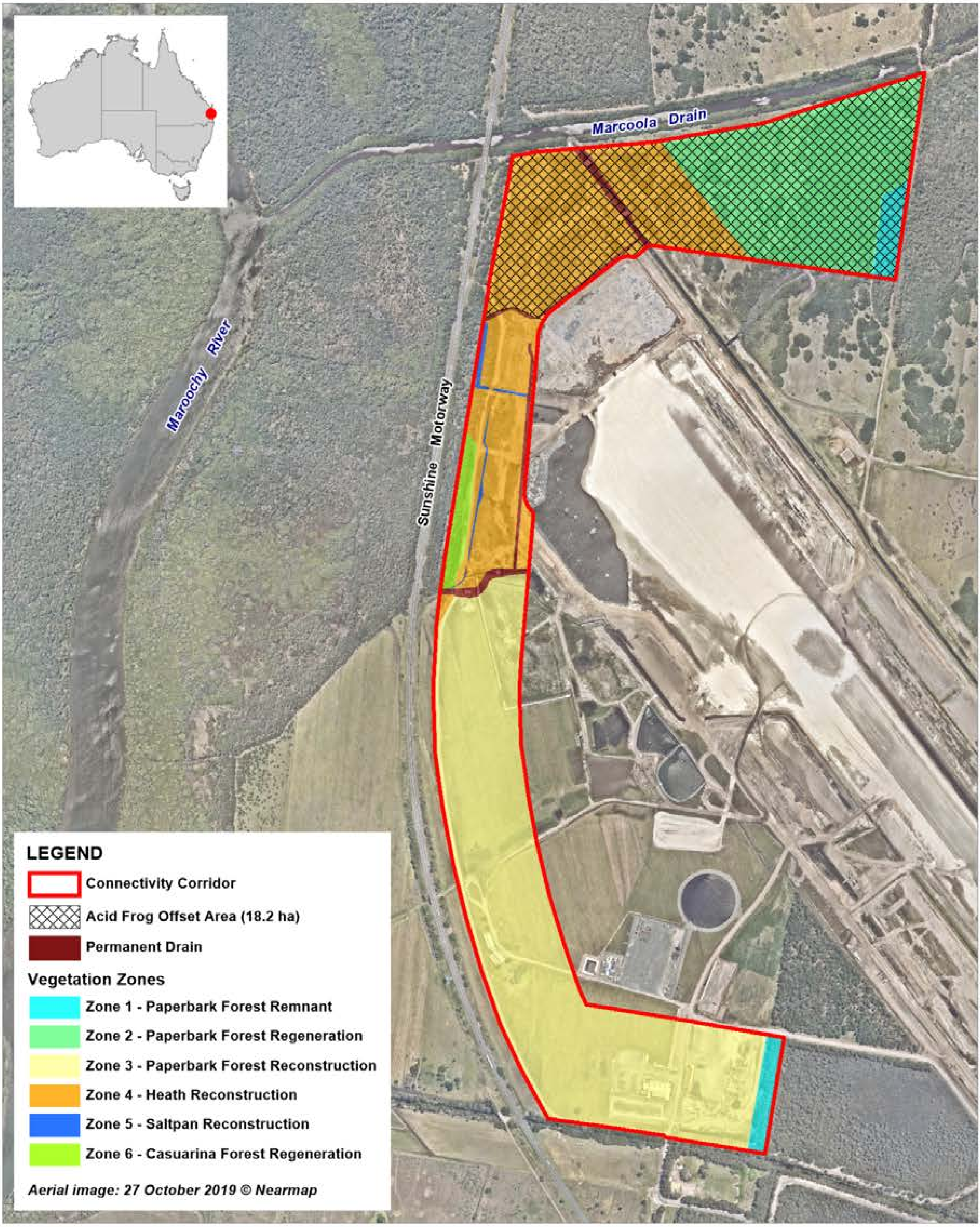
The northwest portion of the corridor includes saline soils and groundwater, influenced by tidal flows from the Maroochy River/Marcoola Drain. The remainder of the site is fresh, with a shallow-perched ground-water layer, overtopping a (discontinuous) layer of coffee rock.

For these areas, the following offset actions will be undertaken:

- Translocation Area – translocation of *Allocasuarina emuina* species from an impacted area south of the new SCAEP runway, together with areas of heath-tile. This translocation will create new wallum heath habitat that can be utilised as habitat by acid frog species.
- Connectivity Corridor – creation of new habitat through assisted regeneration and reconstruction, linking the north and south Marcoola blocks of the Mount Coolum National Park. The corridor will contain six treatment zones, based on the operational needs of the new runway:
  - Zone 1: Paperbark Forest Remnant
  - Zone 2: Paperbark Forest Regeneration
  - Zone 3: Paperbark Forest Reconstruction
  - Zone 4: Heath Reconstruction
  - Zone 5: Saltpan Reconstruction
  - Zone 6: Casuarina Forest Regeneration.

In total, these offsets will provide at least 21.21 ha of habitat for acid frogs. This includes 16.80 ha within the connectivity corridor, made up by paperbark forest (Zones 2 and 3) and heath (Zone 4), as shown in Figure 6-1. The actual extent of these areas exceeds 16.80 ha, thus likely leading to a larger area of offset created for this site. The remaining 4.41 ha is provided within the Translocation Area.

Further detail on the delivery of these offsets is provided in the Mount Emu She-oak Translocation and Management Plan (Arup, 2017) and Connectivity Corridor Offset Area Management Plan (Arup, 2018) in Appendix C.



Title:

Acid Frog Offsets Within the Connectivity Corridor

Figure: 6-1

Rev: B

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Approx. Scale

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7 Legal Security

Council will provide legal security for the land-based offset areas through Environmental Offset Protection Area (EOPA) declarations. It is intended that the request for declarations will be made in the following stages:

- EOPA for AUs 1 to 5 (LMRER), 6 (WHMA), 8 (translocation area) and 9 (VMA) – made within 6 months of clearing works at VMA (as this will represent the new ‘baseline’ from which offset activities are measured.
- EOPA for 16.80 ha of heathland and paperbark habitat within connectivity corridor (AU7) – made within 6 months of finalisation of corridor design and designated of relevant portion for offset purposes.

8 Overall Program and Costing

8.1.1 Program and Timing

Council and the Sunshine Coast Airport will implement the activities set out in this ODP and supporting plans. An indicative program for the planning, delivery, implementation and management of the offset tasks is provided in Table 8-1. This staging proposes that the delivery of the offsets will commence prior to clearing and construction works for the Project.

Table 8-1 Offset actions delivery program

Phase and Offset Delivery	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Construction period										
Detailed plan preparation (all sites)										
Secure conservation tenure										
LMRER										
Prepare detailed ecological restoration plans										
Soil/groundwater investigations and habitat (pond wet heath) design										
Stage restoration works (assisted regeneration and habitat creation)										
Maintenance and monitoring (vegetation)										
Maintenance and monitoring (acid frogs)										
WHMA and VMA										
Soil/groundwater investigations and pond design										
Preparation of ground parrot habitats north of northern perimeter drain (selective clearing area)										
Pond creation										
Maintenance and monitoring (acid frogs)										
Maintenance and monitoring (ground parrot)										
Mount Emu she-oak translocation area										
Pre-clearing surveys of clearing and receiving sites										
Seed collection and storage										
Heath-tile translocation										
Maintenance and monitoring										
Connectivity corridor										

8.1.2 Cost Estimate

A preliminary cost estimate has been compiled for delivering the direct, land-based offsets and the priority indirect actions for the Project (Table 8-2). The total cost of the priority actions is **$11,050,070**. This also includes 10 years of management and monitoring of the offset sites.

Table 8-2 Preliminary costing of priority actions to deliver the offset package

Priority action outlined in EIS		
Matter	**Action summary**	**Estimate**
Loss of 1.67 ha of wallum sedgefrog habitat during construction	Design and construction of vegetated ponds *on site* (across 2.28 ha area in the far north of the Offset Assessment Unit 6 and a 5.8 ha strip along north-eastern boundary of proposed runway [total = 8.08 ha]) Includes 5 years monitoring and maintenance	$161,600.00
Loss of 60.63 ha of wallum froglet, wallum rocketfrog, broad-leaved paperbark, sedgeland and heathland communities	Revegetation works across 63 ha at Palmview providing a mixture of wet heath, sedgeland Melaleuca wetland (includes 10 years monitoring and maintenance)	$5,800,000.00
Loss of 7.79 ha of ground parrot habitat	Slashing of woody vegetation to create 5.84 ha linear stretch of habitat alongside northern perimeter drain through the slashing of woody growth > 1.5 m in height	$32,120.00
Loss of connectivity between southern and northern sections of Mount Coolum National Park	48 ha revegetation works with 10 years maintenance and monitoring	$3,500,000.00
	Installation of culverts along vegetated corridor over northern and western perimeter drains	$25,000.00
Direct impact to 4.41 ha (*N* = 550 plants) of Mount Emu she-oak habitat and population	Heath-tile translocation to receiving site to the north, adjacent to existing Mount Emu she-oak population	$1,532,000.00
TOTAL		**$11,050,070.00**

9 Risks to Offset Delivery

An assessment of the risks to the offset delivery has been completed using a qualitative risk analysis matrix, as recommended in the ODP template. The definitions for the consequences, likelihood and risk levels are summarised in Table 9-1 and Table 9-2, with the risk assessment provided in Table 9-3.

Table 9-1 Qualitative risk analysis matrix

CONSEQUENCES	LIKELIHOOD				
	Rare	Unlikely	Possible	Likely	Almost certain
Severe – Permanent and/or very long-term damage to areas of significant value	H	H	E	E	E
Major – significant and/or long-term damage to areas of high value	M	M	H	H	E
Moderate – Moderate or medium-term damage to areas of value	M	M	M	H	H
Minor – Minor and/or short-term damage to areas of low value	L	M	M	M	H
Insignificant – Insignificant or very short-term damage to areas of very low or negligible value	L	L	L	M	M

Low Risk (L)	Moderate Risk (M)	High Risk (H)	Extreme Risk (E)
Requires routine action	Requires moderate action <1 month	Requires priority action <2 weeks	Requires immediate action <1 week

Table 9-2 Likelihood of risk occurring

Likelihood	Qualitative description	Quantitative description
Almost Certain	The event is expected to occur in most circumstances	May occur once a month or more frequently
Likely	The event will probably occur in many circumstances	May occur once every year
Possible	Identified factors indicate the event could occur at some time	May occur once every 2 or 3 years
Unlikely	The event could occur at some time but is not expected	May occur once every 5 years
Rare	The event may occur only in exceptional circumstances	May occur once every 10 years

Table 9-3 Offset delivery risk assessment

Element	Consequences	Likelihood	Initial risk	Justification	Possible corrective actions	Residual risk
Soils incompatible with the creation of wallum sedgefrog breeding habitat	**Major** Constructed ponds are rendered unsuitable for breeding due to elevated pH, turbidity and/or aluminium levels	Possible	**High**	Soil investigations at SCA show the structure and composition of soils in offset areas is similar to that in areas of existing wallum sedgefrog habitat, comprising low-nutrient siliceous sand with low levels of clay/silt. Water within ponds is therefore unlikely to contain high levels of aluminium or clay fines. Soils within offset areas are also acidic and therefore unlikely to result in elevated pH.	Investigate alternate sites within the AU for areas that have suitable groundwater conditions for the construction of breeding ponds	**Moderate**
Groundwater levels incompatible with the creation of wallum sedgefrog breeding habitat	**Major** Ponds fail to hold water long enough to support successful recruitment of wallum sedgefrog	Possible	**High**	Preliminary soil and groundwater investigations within offset areas indicate the presence of a shallow, groundwater aquifer less than 1 m BGL. Constructed ponds should therefore hold enough water to support successful breeding (provided ponds are deep enough to intercept and hold ground water). Ongoing monitoring of groundwater levels will help ensure ponds are built deep enough to do this.	Fitting ponds with a liner to increase pond hydroperiod.	**Moderate**
Groundwater quality incompatible with the creation of wallum sedgefrog breeding habitat	**Major** Water quality is unsuitable for wallum sedgefrog Water quality favours competitor species reducing amenity of constructed ponds for wallum sedgefrog	Possible	**High**	Groundwater investigations within offset areas indicate the presence of a shallow, groundwater aquifer containing acidic, tannin-stained water perched above an organic hardpan less than 1 m BGL. Soil and groundwater conditions are therefore similar to those found in areas of wallum sedgefrog breeding habitat elsewhere within the SCA.	Investigate alternate sites within the AU for areas that have suitable groundwater conditions for the construction of breeding ponds	**Moderate**
Establishment and spread of weeds within offset areas	**Moderate** Amenity of breeding habitat reduced where weeds occur at high abundance	Possible	**Moderate**	Weeds occur at low abundance within offset areas and are unlikely to pose a threat provided weed monitoring and management actions are implemented during and after construction.	Increased monitoring and control of weeds	**Low**

Element	Consequences	Likelihood	Initial risk	Justification	Possible corrective actions	Residual risk
Failure to establish sedge cover in offset areas	**Moderate** Amenity of breeding habitat reduced in areas with sparse or low sedge cover	Possible	**Moderate**	Successful establishment of sedges is likely except under drought conditions. Hydrological conditions within ponds should allow for the persistence of sedges once established.	Watering of sedges to ensure establishment of sedges in the event of drought. Modification of pond design to improve hydrological conditions within ponds, so as to ensure the growth and persistence of sedges.	**Low**
Incursion or establishment of exotic predators	**Severe**	Possible	**Extreme**	Both acid frog and ground parrot populations will be susceptible to predation from cats and foxes.	Review exotic predator management strategies and consider increasing baiting or other methods of eradication. Increase frequency of inspections on fencing and review the effectiveness of the current fencing. Consider requirements to upgrade or improve fencing.	**Moderate**
Failure or decline in health of tubestock	**Moderate**	Possible	**Moderate**	Some areas of the offset works, particularly the corridor planting works will require the importation of plants to achieve the required native vegetation cover.	Review planting and maintenance methodology, including source of plants, water regime, topsoil and mulch ameliorants.	**Low**
Erosion and topsoil loss	**Major**	Possible	**High**	Erosion and sediment transport can result in the movement of sediments into areas of created acid frog habitat, altering the water chemistry so that it is unsuitable for breeding. Loss of topsoil can also affect the ability for new plants to establish.	Reapply mulch to effected areas and review depth of mulch. Review need for more permanent measures such as jute matting. Review species selection for groundcovers and increase density installed to provide greater coverage. Investigate potential alterations to surface water flows to avoid areas	**Low**

Element	Consequences	Likelihood	Initial risk	Justification	Possible corrective actions	Residual risk
Decline in native vegetation cover	**Major**	Possible	**High**	Causes of declining native vegetation cover may be broad and related to weed incursions, surface/ground water changes, drought, fire or flooding. Regular monitoring in established transects and points within the offset areas will be carried out to detect these impacts.	Corrective actions will be dependent on the mechanism of decline in vegetation cover. They may include additional or different weed treatments	**Low**
Inappropriate fire regime	**Major**	Possible	**High**	The diversity of open forest, heathland, wallum and sedgeland communities across the offset sites will require different fire regimes to maintain ecological health. Too frequent or too few fires can result in a decline in the health of a specific vegetation community. Absence of prescribed ecological burns can also result in vegetation conditions with an increased fuel load, leading to uncontrolled fires.	As part of the ongoing management plan and OAMP for the sites, a fire regime will need to be planned and implemented.	**Low**
Absence of native fauna using the corridor	**Major**	Possible	**High**	The intent of the corridor offset is to mitigate the loss of connectivity between the two sections of Mount Coolum National Park. Monitoring will be required to assess the success of this corridor.	Review the habitat condition of the corridor and investigate measures to improve the value through structures, such as logs and nest boxes. Carry out infill planting or revegetation works to improve the habitat complexity of the corridor.	**Low**
Population of Mount Emu she-oak does not establish or increase	**Major**	Possible	**High**	The EPBC Act approval requires the population of Mount Emu she-oak in the translocated area to increase.	Carry out planting of nursery-raised plants that will be sourced from the impact population. Review the fire regime of the translocated heath community.	**Low**

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11 Signatories and Declaration

11.1 Signatories

11.1.1 Landowners

I/We:

- Agree to the offset being undertaken over my/our land identified in Section 1, Part B, of this offset delivery plan in the manner outlined in this offset delivery plan;
- Request the approval of this offset delivery plan under the *Environmental Offsets Act 2014*;
- Consent to the collection and use of the personal information in this form for the purposes of assessing this offset delivery plan made under the *Environmental Offsets Act 2014*;
- Solemnly and sincerely declare that the information provided is true and correct to the best of my knowledge and I make this solemn declaration conscientiously believing the same to be true; and
- Understand that all information supplied on or with this application form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.

Lot and Plan	Lot 898 CG4782 (SCA – Airservices)		
Owner	Airservices Australian		
Signature of owner		Date signed	09.10.17

Lot and Plan	Lot 1106 SP206556		
Owner	Sunshine Coast Regional Council		
Signature of owner		Date signed	10/10/17

Lot and Plan	Lot 1103 SP206552		
Owner	Sunshine Coast Regional Council		
Signature of owner		Date signed	10/10/17

Lot and Plan	Lot 1105 SP206553		
Owner	Sunshine Coast Regional Council		
Signature of owner		Date signed	10/10/17

Lot and Plan	Lot 5 RP133655		
Owner	Sunshine Coast Regional Council		
Signature of owner		Date signed	10/10/17

Lot and Plan	Lot 1 SP269581		
Owner	Sunshine Coast Regional Council		
Signature of owner		Date signed	10/10/17

Lot and Plan	Lot 101 CP883235		
Owner	Sunshine Coast Regional Council		
Signature of owner		Date signed	10/10/17

Lot and Plan	Lot 37 C3147 (Lower Mooloolah River Environmental Reserve)		
Owner	Sunshine Coast Regional Council		
Signature of owner		Date signed	10/10/17

Lot and Plan	Lot 1 RP27759 (Lower Mooloolah River Environmental Reserve)		
Owner	Sunshine Coast Regional Council		
Signature of owner	G Haverty	**Date signed**	10/10/17

Lot and Plan	Lot 2 RP27760 (Lower Mooloolah River Environmental Reserve)		
Owner	Sunshine Coast Regional Council		
Signature of owner	G Haverty	**Date signed**	10/10/17

11.1.2 Proponent

I/We:

- Request the approval of this offset delivery plan under the *Environmental Offsets Act 2014*;
- Consent to the collection and use of the personal information in this form for the purposes of assessing this offset delivery plan made under the *Environmental Offsets Act 2014*;
- Solemnly and sincerely declare that the information provided is true and correct to the best of my knowledge and I make this solemn declaration conscientiously believing the same to be true; and
- Understand that all information supplied on or with this application form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.

Full Name	Greg Laverty		
Address	Locked Bag 72, Nambour QLD 4560		
Phone	07 5475 7272		
Email	mail@sunshinecoast.qld.gov.au.		
Signature of Proponent		**Date signed**	10/10/17

11.2 Declaration

Note: If you deliberately provide false information in this application you may be liable for prosecution under the relevant Acts or Regulations.

- I do solemnly and sincerely declare that the information provided is true and correct to the best of my knowledge and I make this solemn declaration conscientiously believing the same to be true.
- I understand that all information supplied on or with this application form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.
- I confirm that the offset delivery plan provides benefits in relation to the prescribed environmental matters located on the offset site that are additional to any other benefit provided under a requirement of an Act or agreed to under other schemes or programs and are also additional to the conditions of the approval associated with the prescribed activity held by the authority holder.

Full Name	Greg Laverty		
Address	Locked Bag 72, Nambour QLD 4560		
Phone	(07) 5475 7272		
Email	mail@sunshinecoast.qld.gov.au		
Signature of Applicant		Date signed	11/10/17

Appendix A Queensland Offset Assessment Calculator Output

A.1 Habitat Quality Score Assessments

Habitat Quality Site Assessment Template……………………………………………………………………………………..

For all environmental offset applications you must:

- Complete form (Environmental Offsets Delivery Form 1– Notice of Election and Advanced Offsets Details)
- Complete any other forms relevant to your application
- Provide the mandatory supporting information identified on the forms as being required to accompany your application

This form is useful for undertaking a **habitat quality analysis** of an impact and/or offset/advanced offset site.
Please note that this form should be completed individually for each assessment unit under consideration.

Is this Assessment for: **An Impact Site** ☐ **An Offset Site** ☑ **an Advanced Offset Site** ☐

Habitat Quality Assessment Unit Score Sheet

Part C - Site Data

Property	Palmview	Date	

Assessment Unit:	Assessment Unit Area (ha)	RE	Bioregion Number
1	24.05	12.3.5	Southeast Queensland

Landscape Photo- Please attach or insert north, south, east and west photos in the spaces provided from row 231-355 below and include details such as Time and Mapping Coordinates in the following row.

Datum		Zone	Easting	Northing
WGS 84 ☐	0m Mark	56	153.09271	-26.73232
GDA 94 ☑	50m Mark	Zone	Easting	Northing
		56	153.09323	-26.73251
Plot bearing		90	Recorders	MJD / FSR

Site description and Location (including details of discrete polygons within the assessment unit)

Palmview grazing property (Lot 1 RP27759 and Lot 2 RP27760), currently owned in freehold by Sunshine Coast Council. Extensive grazing once covered the property, now used by small number of cattle.

Assessment unit can be described as a contiguous areas of Broad-leaved Paperbark *Melaleuca quinquenervia* regrowth, with a canopy height of 3-4m. Ground layer dominated by exotic grasses, with some native and exotic sedges in lower areas where pooling surface water is common. Isolated retained eucalypt trees and Cabbage Palms throughout, spaced very sparcely.

Part D - Native Species Richness: (*list species below)

Tree species richness:			
Total number of species	1		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Shrub species richness:			
Total number of species	3		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name	*Eucalypt spp.*	Common Name	Eucalypt sapling
Scientific Name	*Melastoma malabathricum* subsp. *malabathricum*	Common Name	Native Blue Tongue
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Grass species richness:			
Total number of species	1		
Scientific Name	*Themeda triandra*	Common Name	Kangaroo Grass
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Forbs and others (non grass ground) species richness:			
Total number of species	9		
Scientific Name	*Gahnia sieberiana*	Common Name	Red-fruited Saw-sedge
Scientific Name	*Cyperus sp.*	Common Name	Sedge
Scientific Name	*Cyperus sp.*	Common Name	Sedge
Scientific Name	*Drosera spathulata*	Common Name	Sundew
Scientific Name	*Baumea teretifolia*	Common Name	
Scientific Name	*Schoenoplectus mucronatus*	Common Name	
Scientific Name	*Velleia spathulata*	Common Name	
Scientific Name	*Lomandra longifolia*	Common Name	Mat Rush
Scientific Name	*Fimbristylis nutans*	Common Name	

Part E - Non-Native Plant Cover: (*list species below)

Total percentage cover within plot	90.00%		
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part F - Coarse Woody Debris: (*list lengths of individual logs in meters)

Total Length of Course Woody Debris (Meters):			
1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

Part G - Native perennial grass cover, organic litter: (*provide percentage cover within each quadrat, and provide average cover)

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Native perennial grass cover	5.00%	10.00%	5.00%	0.00%	10.00%	6.00%

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Organic Litter	0.00%	0.00%	0.00%	0.00%	0.00%	

Part H- Number of large trees , tree canopy height, recruitment of woody perennial species:

Eucalypt Large tree DBH benchmark used :	0	Non- Eucalypt Large tree DBH benchmark used:	33
Number of large eucalypt trees:	0	Number of large non eucalypt trees:	0
Total Number Large Trees:			

Median Tree Canopy Height Measurements	Canopy:	4.00	Sub-canopy:		Emergent:	18.00

Number of ecologically dominant layer species regenerating:	1

Part I - Tree canopy cover, Shrub canopy cover

Tree canopy cover %	Canopy:	18.40%	Sub-canopy:		Emergent:	
Shrub canopy cover %	15.00%					

Note: Only assess Emergent (E) or Subcanopy (S) layers if the benchmark document stipulates that layers are present *If trees are in the same layer and continuous along the transect you can group them

Part J - Site Context Score

ATTRIBUTE	Size of Patch	Connectedness	Context	Distance to Permanent Water	Ecological Corridors
DESCRIPTION	3 - 26 - 100ha	3 - 50%-75% connection	1 - <10% remnant	1 - 0-500m	2 - Sharing a common boundary
SCORE	5	4	0	0	4

DOES THIS ASSESSMENT UNIT ALSO CONTAIN A SPECIES HABITAT REQUIREMENT.

YES ☑ **PLEASE COMPLETE SPECIES HABITAT INDEX DETAILS BELOW AND THEN ATTACH LANDSCAPE PHOTOS AND SUBMIT AS DIRECTED**

NO ☐ **PLEASE ATTACH LANDSCAPE PHOTOS BELOW AND SUBMIT AS DIRECTED**

Part K - Species Habitat Attributes

Species Habitat Attributes

No	Species Name	CommonName	NCA Status	Attributes	Threats to species	Quality and availability of food and foraging habitat	Quality and availability of shelter	Species mobility capacity	Role of site location to overall population in the State
1	*Crinia tinnula*	wallum froglet	V	Description	*3 - Low threat level*	*3 - High*	*3 - High*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	15	10	10	10	1
2	*Litoria freycineti*	wallum rocketfrog	V	Description	*3 - Low threat level*	*2 - Moderate*	*2 - Moderate*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	15	5	5	10	1
3	*Litoria olongburensis*	wallum sedgefrog	V	Description	*3 - Low threat level*	*1 - Poor*	*1 - Poor*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	15	1	1	10	1
4				Description					
				Score					
5				Description					
				Score					
6				Description					
				Score					
7				Description					
				Score					
8				Description					
				Score					
9				Description					
				Score					
10				Description					
				Score					
				Maximum Score	15.00	10.00	10.00	10.00	1.00

Attach Landscape Photos Here

North

South

East

West

(FORM COMPLETE) Please save and forward completed form/s together with Offsets Delivery Form 5 that can be accessed here: [QLD Environmental Offsets]

Habitat Quality Site Assessment Template………………………………………………………………………………………

For all environmental offset applications you must:

- Complete form (Environmental Offsets Delivery Form 1– Notice of Election and Advanced Offsets Details)
- Complete any other forms relevant to your application
- Provide the mandatory supporting information identified on the forms as being required to accompany your application

This form is useful for undertaking a **habitat quality analysis** of an impact and/or offset/advanced offset site.
Please note that this form should be completed individually for each assessment unit under consideration.

Is this Assessment for: **An Impact Site** ☐ **An Offset Site** ☑ **an Advanced Offset Site** ☐

Habitat Quality Assessment Unit Score Sheet

Part C - Site Data

Property	Palmview	Date	

Assessment Unit:	Assessment Unit Area (ha)	RE	Bioregion Number
2	3.82	12.3.5	Southeast Queensland

Landscape Photo- Please attach or insert north, south, east and west photos in the spaces provided from row 231-355 below and include details such as Time and Mapping Coordinates in the following row.

Datum WGS 84 GDA 94		Zone	Easting	Northing
	0m Mark	56	153.10098	-26.73591
		Zone	Easting	Northing
	50m Mark	56	153.10104	-26.73544
Plot bearing		0	Recorders	MJD / FSR

Site description and Location (including details of discrete polygons within the assessment unit)

Palmview grazing property (Lot 2 RP27760), currently owned in freehold by Sunshine Coast Council. Extensive grazing once covered the property, now used by small number of cattle. Very dense groundcover with exotic grasses indicates that grazing has been largely excluded from this AU. Higher abundance of retained paddock trees of the genus *Eucalyptus* and *Angophora* within this AU. Mapped and floristically remnant RE 12.3.5 located to the north, east and south of this AU. Also shares a boundary with floristically remnant sedgeland/fernland/paperbark complex in the centre of the offet area.

AU described as regrowth Broad-leaved Paperbark forest, with scattered *Acacia spp.* and eucalypt saplings. EDL approximately 3m in height, composed almost completely of Broad-leaved Paperbark trees. Emergent layer of eucalypts up to 22m in height. No defined shrub layer, this strata dominated largely by paperbark saplings. Very dense ground cover dominated by exotic grasses, with some native grasses. Exotic and native sedges common in drainage depressions and low lying areas.

Topography is generally flat, with a very gradual fall towards the central sedgeland/fernland/paperbark complex and the southern drainage line.

Part D - Native Species Richness: (*list species below)

Tree species richness:			
Total number of species	4		
Scientific Name	*Eucalyptus tereticornis*	Common Name	Forest Red Gum
Scientific Name	*Corymbia intermedia*	Common Name	Pink Bloodwood
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name	*Angophora subvelutina*	Common Name	Rough-barked Apple
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Shrub species richness:			
Total number of species	2		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name	*Pultenea robusta*	Common Name	Tall Swamp Pea
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Grass species richness:			
Total number of species	3		
Scientific Name	*Imperata cylindrica*	Common Name	Blady Grass
Scientific Name	*Themeda triandra*	Common Name	Kangaroo Grass
Scientific Name	*Cymbopogon refractus*	Common Name	Barbwire Grass
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Forbs and others (non grass ground) species richness:			
Total number of species	5		
Scientific Name	*Dianella caerulea*	Common Name	Blue Flax-lilly
Scientific Name	*Lomandra longifolia*	Common Name	Mat Rush
Scientific Name	*Cyperus sp*	Common Name	A sedge
Scientific Name	*Centella asiatica*	Common Name	Pennywort
Scientific Name	*Patersonia sericea*	Common Name	Native Iris
Scientific Name		Common Name	
Scientific Name		Common Name	

Part E - Non-Native Plant Cover: (*list species below)

Total percentage cover within plot	80.00%		
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part F - Coarse Woody Debris: (*list lengths of individual logs in meters)

Total Length of Course Woody Debris (Meters):			
1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

Part G - Native perennial grass cover, organic litter: (*provide percentage cover within each quadrat, and provide average cover)

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Native perennial grass cover	40.00%	25.00%	10.00%	10.00%	5.00%	18.00%

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Organic Litter	0.00%	0.00%	0.00%	0.00%	0.00%	

Part H- Number of large trees , tree canopy height, recruitment of woody perennial species:

Eucalypt Large tree DBH benchmark used :	0	Non- Eucalypt Large tree DBH benchmark used:	33
Number of large eucalypt trees:	0	Number of large non eucalypt trees:	3
Total Number Large Trees:	3		

Median Tree Canopy Height Measurements	Canopy:	3.00	Sub-canopy:		Emergent:	22.00

Number of ecologically dominant layer species regenerating:	1

Part I - Tree canopy cover, Shrub canopy cover

Tree canopy cover %	Canopy:	20.40%	Sub-canopy:		Emergent:	4.90%
Shrub canopy cover %	8.50%					

Note: Only assess Emergent (E) or Subcanopy (S) layers if the benchmark document stipulates that layers are present *If trees are in the same layer and continuous along the transect you can group them

Part J - Site Context Score

ATTRIBUTE	Size of Patch	Connectedness	Context	Distance to Permanent Water	Ecological Corridors
DESCRIPTION	1 - <5ha	3 - 50%-75% connection	1 - <10% remnant	1 - 0-500m	2 - Sharing a common boundary
SCORE	0	4	0	0	4

DOES THIS ASSESSMENT UNIT ALSO CONTAIN A SPECIES HABITAT REQUIREMENT.

YES ☑ PLEASE COMPLETE SPECIES HABITAT INDEX DETAILS BELOW AND THEN ATTACH LANDSCAPE PHOTOS AND SUBMIT AS DIRECTED

NO ☐ PLEASE ATTACH LANDSCAPE PHOTOS BELOW AND SUBMIT AS DIRECTED

Part K - Species Habitat Attributes

Species Habitat Attributes

No	Species Name	CommonName	NCA Status	Attributes	Threats to species	Quality and availability of food and foraging habitat	Quality and availability of shelter	Species mobility capacity	Role of site location to overall population in the
1	*Crinia tinnula*	wallum froglet	V	Description	*3 - Low threat level*	*3 - High*	*3 - High*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	15	10	10	10	1
2	*Litoria freycineti*	wallum rocketfrog	V	Description	*3 - Low threat level*	*3 - High*	*3 - High*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	15	10	10	10	1
3	*Litoria olongburensis*	wallum sedgefrog	V	Description	*3 - Low threat level*	*2 - Moderate*	*2 - Moderate*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	15	5	5	10	1
4				Description					
				Score					
5				Description					
				Score					
6				Description					
				Score					
7				Description					
				Score					
8				Description					
				Score					
9				Description					
				Score					
10				Description					
				Score					
				Maximum Score	15.00	10.00	10.00	10.00	1.00

Attach Landscape Photos Here

North

South

East

West

Habitat Quality Site Assessment Template...

For all environmental offset applications you must:

- Complete form (Environmental Offsets Delivery Form 1– Notice of Election and Advanced Offsets Details)
- Complete any other forms relevant to your application
- Provide the mandatory supporting information identified on the forms as being required to accompany your application

This form is useful for undertaking a **habitat quality analysis** of an impact and/or offset/advanced offset site.
Please note that this form should be completed individually for each assessment unit under consideration.

Is this Assessment for: **An Impact Site** ☐ **An Offset Site** ☑ **an Advanced Offset Site** ☐

Habitat Quality Assessment Unit Score Sheet

Part C - Site Data

Property	Palmview	Date	

Assessment Unit:	Assessment Unit Area (ha)	RE	Bioregion Number
3	25.48	12.3.5	Southeast Queensland

Landscape Photo- Please attach or insert north, south, east and west photos in the spaces provided from row 231-355 below and include details such as Time and Mapping Coordinates in the following row.

Datum				
WGS 84 GDA 94	0m Mark	Zone	Easting	Northing
		56	153.09683	-26.73614
	50m Mark	Zone	Easting	Northing
		56	153.09629	-26.73597
Plot bearing		285	Recorders	MJD / FSR

Site description and Location (including details of discrete polygons within the assessment unit)
Palmview grazing property (Lot 2 RP27760), currently owned in freehold by Sunshine Coast Council. Highly degraded exotic pasture, with very low levels of native shrub and tree regrowth. Very low strutural complexity and high levels of exotic ground cover. Ecologically dominant layer can be described as the ground cover of exotic grasses. Areas of native vegetation groundcover are concentrated in depressions where pooling surface water has allowed the growth of native sedges.

Part D - Native Species Richness: (*list species below)

Tree species richness:			
Total number of species	1		
Scientific Name	*Melaleuca quinquenervia*	**Common Name**	Broad-leaved Paperbark
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	

Shrub species richness:			
Total number of species	2		
Scientific Name	*Melaleuca quinquenervia*	**Common Name**	Broad-leaved Paperbark
Scientific Name	*Melastoma malabathricum* subsp. *malabathricum*	**Common Name**	Native Blue Tongue
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	

Grass species richness:			
Total number of species	1		
Scientific Name	*Themeda triandra*	**Common Name**	Kangaroo Grass
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	

Forbs and others (non grass ground) species richness:			
Total number of species	7		
Scientific Name	*Cyperus sp*	**Common Name**	A sedge
Scientific Name	*Philydrum lanuginosum*	**Common Name**	Wooly Frogsmouth
Scientific Name	*Gahnia sieberiana*	**Common Name**	Red-fruited Saw-sedge
Scientific Name	*Commelina diffusa*	**Common Name**	Native Wandering Jew
Scientific Name	*Centella asiatica*	**Common Name**	Pennywort
Scientific Name	*Xyris complanata*	**Common Name**	
Scientific Name	*Persicaria sp.*	**Common Name**	A smartweed

Part E - Non-Native Plant Cover: (*list species below)

Total percentage cover within plot	90.00%		
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	
Scientific Name		**Common Name**	

Part F - Coarse Woody Debris: (*list lengths of individual logs in meters)

Total Length of Course Woody Debris (Meters):			
1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

Part G - Native perennial grass cover, organic litter: (*provide percentage cover within each quadrat, and provide average cover)

Native perennial grass cover	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
	0.00%	0.00%	0.00%	0.00%	0.00%	

Organic Litter	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
	0.00%	0.00%	0.00%	0.00%	0.00%	

Part H- Number of large trees , tree canopy height, recruitment of woody perennial species:

Eucalypt Large tree DBH benchmark used :	0	Non- Eucalypt Large tree DBH benchmark used:	33
Number of large eucalypt trees:	0	Number of large non eucalypt trees:	0
Total Number Large Trees:			

Median Tree Canopy Height Measurements	Canopy:	3.00	Sub-canopy:		Emergent:	

Number of ecologically dominant layer species regenerating:	1

Part I - Tree canopy cover, Shrub canopy cover

Tree canopy cover %	Canopy:	2.40%	Sub-canopy:		Emergent:	
Shrub canopy cover %	4.90%					

Note: Only assess Emergent (E) or Subcanopy (S) layers if the benchmark document stipulates that layers are present *If trees are in the same layer and continuous along the transect you can group them

Part J - Site Context Score

ATTRIBUTE	Size of Patch	Connectedness	Context	Distance to Permanent Water	Ecological Corridors
DESCRIPTION	3 - 26 - 100ha	1 - 0% - 10% connection	1 - <10% remnant	1 - 0-500m	1- Not within
SCORE	5	0	0	0	0

DOES THIS ASSESSMENT UNIT ALSO CONTAIN A SPECIES HABITAT REQUIREMENT.

YES ☐ **PLEASE COMPLETE SPECIES HABITAT INDEX DETAILS BELOW AND THEN ATTACH LANDSCAPE PHOTOS AND SUBMIT AS DIRECTED**

NO ☐ **PLEASE ATTACH LANDSCAPE PHOTOS BELOW AND SUBMIT AS DIRECTED**

Part K - Species Habitat Attributes

Species Habitat Attributes

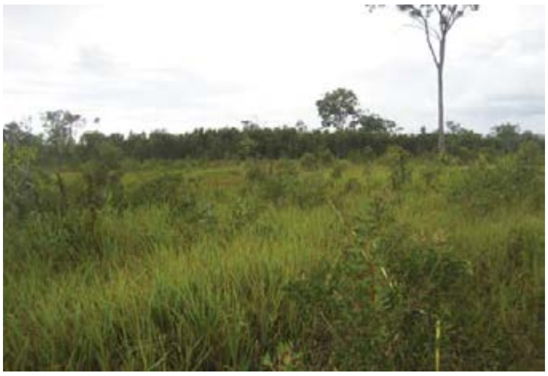
No	Species Name	CommonName	NCA Status	Attributes	Threats to species	Quality and availability of food and foraging habitat	Quality and availability of shelter	Species mobility capacity	Role of site location to overall population in the State
1	*Crinia tinnula*	wallum froglet	V	Description	*2 - Moderate threat level*	*2 - Moderate*	*2 - Moderate*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	7	5	5	10	1
2	*Litoria freycineti*	wallum rocketfrog	V	Description	*2 - Moderate threat level*	*1 - Poor*	*1 - Poor*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	7	1	1	10	1
3	*Litoria olongburensis*	wallum sedgefrog	V	Description	*2 - Moderate threat level*	*1 - Poor*	*1 - Poor*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	7	1	1	10	1
4				Description					
				Score					
5				Description					
				Score					
6				Description					
				Score					
7				Description					
				Score					
8				Description					
				Score					
9				Description					
				Score					
10				Description					
				Score					
				Maximum Score	7.00	5.00	5.00	10.00	1.00

Attach Landscape Photos Here

North

South

East



West

(FORM COMPLETE) Please save and forward completed form/s together with Offsets Delivery Form 5 that can be accessed here: QLD Environmental Offsets

Habitat Quality Site Assessment Template……………………………………………………………………………………………..

For all environmental offset applications you must:

- Complete form (Environmental Offsets Delivery Form 1– Notice of Election and Advanced Offsets Details)
- Complete any other forms relevant to your application
- Provide the mandatory supporting information identified on the forms as being required to accompany your application

This form is useful for undertaking a **habitat quality analysis** of an impact and/or offset/advanced offset site.
Please note that this form should be completed individually for each assessment unit under consideration.

Is this Assessment for: **An Impact Site** ☐ **An Offset Site** ☑ **an Advanced Offset Site** ☐

Habitat Quality Assessment Unit Score Sheet

Part C - Site Data

Property	Palmview	Date	

Assessment Unit:	Assessment Unit Area (ha)	RE	Bioregion Number
4	2.3	12.3.5	Southeast Queensland

Landscape Photo- Please attach or insert north, south, east and west photos in the spaces provided from row 231-355 below and include details such as Time and Mapping Coordinates in the following row.

Datum WGS 84 GDA 94		Zone	Easting	Northing
	0m Mark	56	153.1	-26.736
	50m Mark	Zone	Easting	Northing
		56	153.099	-26.7358
Plot bearing		315	Recorders	MJD / FSR

Site description and Location (including details of discrete polygons within the assessment unit)
Palmview grazing property (Lot 2 RP27760), currently owned in freehold by Sunshine Coast Council. Assessment Unit is located in an area that has had grazing excluded for some time and native regrowth is in a moderate to excellent condition. Some areas appear to have retained Broad-leaved Paperbark trees . Grazing likley excluded due to hydrology. Very high quality regrowth and floristically remnant Broad-leaved Paperbark forest. Some areas have good canopy cover of Broad-leaved Paperbark trees. In centre of patch, no weed/exotic cover, however some exotic grass cover on edge.

Part D - Native Species Richness: (*list species below)

Tree species richness:			
Total number of species	1		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Shrub species richness:			
Total number of species	1		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Grass species richness:			
Total number of species	2		
Scientific Name	*Leersia hexandra*	Common Name	Swamp Rice Grass
Scientific Name	*Imperata cylindrica*	Common Name	Blady Grass
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Forbs and others (non grass ground) species richness:			
Total number of species	7		
Scientific Name	*Blechnum indicum*	Common Name	Bungwall
Scientific Name	*Baumea rubiginosa*	Common Name	Twigrush
Scientific Name	*Baumea articulata*	Common Name	Jointed Twigrush
Scientific Name	*Persicaria sp.*	Common Name	Smartweed
Scientific Name	*Lygodium microphyllum*	Common Name	Climbing Maidenhair Fern
Scientific Name	*Pteridium esculentum*	Common Name	Bracken Fern
Scientific Name	*Schoenus brevifolius*	Common Name	Spiky Sedge
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part E - Non-Native Plant Cover: (*list species below)

Total percentage cover within plot			
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part F - Coarse Woody Debris: (*list lengths of individual logs in meters)

Total Length of Course Woody Debris (Meters):	385.50		
1	7.30	26	
2	8.60	27	
3	0.65	28	
4	6.50	29	
5	1.20	30	
6	3.50	31	
7	5.60	32	
8	2.10	33	
9	0.80	34	
10	0.60	35	
11	1.20	36	
12	0.50	37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

Part G - Native perennial grass cover, organic litter: (*provide percentage cover within each quadrat, and provide average cover)

Native perennial grass cover	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
	0.00%	0.00%	0.00%	0.00%	0.00%	

Organic Litter	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
	0.00%	0.00%	0.00%	0.00%	0.00%	

Part H- Number of large trees , tree canopy height, recruitment of woody perennial species:

Eucalypt Large tree DBH benchmark used :	0	Non- Eucalypt Large tree DBH benchmark used:	33
Number of large eucalypt trees:	0	Number of large non eucalypt trees:	13
Total Number Large Trees:	13		

Median Tree Canopy Height Measurements	Canopy:	18.00	Sub-canopy:	5.50	Emergent:	

Number of ecologically dominant layer species regenerating:	1

Part I - Tree canopy cover, Shrub canopy cover

Tree canopy cover %	Canopy:	68.20%	Sub-canopy:	12.50%	Emergent:	
Shrub canopy cover %	0.54%					

Note: Only assess Emergent (E) or Subcanopy (S) layers if the benchmark document stipulates that layers are present *If trees are in the same layer and continuous along the transect you can group them

Part J - Site Context Score

ATTRIBUTE	Size of Patch	Connectedness	Context	Distance to Permanent Water	Ecological Corridors
DESCRIPTION	1 - <5ha	1 - 0% - 10% connection	2 - >10% to 30% remnan	1 - 0-500m	2 - Sharing a common boundary
SCORE	0	0	2	0	4

DOES THIS ASSESSMENT UNIT ALSO CONTAIN A SPECIES HABITAT REQUIREMENT.

YES ☑ **PLEASE COMPLETE SPECIES HABITAT INDEX DETAILS BELOW AND THEN ATTACH LANDSCAPE PHOTOS AND SUBMIT AS DIRECTED**

NO ☐ **PLEASE ATTACH LANDSCAPE PHOTOS BELOW AND SUBMIT AS DIRECTED**

Part K - Species Habitat Attributes

Species Habitat Attributes

No	Species Name	CommonName	NCA Status	Attributes	Threats to species	Quality and availability of food and foraging habitat	Quality and availability of shelter	Species mobility capacity	Role of site location to overall population in the State
1	*Crinia tinnula*	wallum froglet	V	**Description**	*3 - Low threat level*	*3 - High*	*3 - High*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	15	10	10	10	1
2	*Litoria freycineti*	wallum rocketfrog	V	**Description**	*3 - Low threat level*	*3 - High*	*3 - High*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	15	10	10	10	1
3	*Litoria olongburensis*	wallum sedgefrog	V	**Description**	*3 - Low threat level*	*3 - High*	*3 - High*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	15	10	10	10	1
4				**Description**					
				Score					
5				**Description**					
				Score					
6				**Description**					
				Score					
7				**Description**					
				Score					
8				**Description**					
				Score					
9				**Description**					
				Score					
10				**Description**					
				Score					
				Maximum Score	15.00	10.00	10.00	10.00	1.00

Attach Landscape Photos Here

North

South

East

West

(FORM COMPLETE)

Please save and forward completed form/s together with Offsets Delivery Form 5 that can be accessed here: QLD Environmental Offsets

Habitat Quality Site Assessment Template.. **PLEASE NOTE - YELLOW INDICATES AN AUTO POPULATED FIELD**

For all environmental offset applications you must:

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- Complete any other forms relevant to your application
- Provide the mandatory supporting information identified on the forms as being required to accompany your application

This form is useful for undertaking a **habitat quality analysis** of an impact and/or offset/advanced offset site.
Please note that this form should be completed individually for each assessment unit under consideration.

Is this Assessment for: **An Impact Site** ☐ **An Offset Site** ☑ **an Advanced Offset Site** ☐

Habitat Quality Assessment Unit Score Sheet

Part C - Site Data

Property	Sunshine Coast Airport - corridor offset	Date	

Assessment Unit:	Assessment Unit Area (ha)	RE	Bioregion Number
5	7.5	12.3.5	Southeast Queensland

Landscape Photo- Please attach or insert north, south, east and west photos in the spaces provided from row 231-355 below and include details such as Time and Mapping Coordinates in the following row.

Datum WGS 84 GDA 94		Zone	Easting	Northing
	0m Mark	56	153.096	-26.735
	50m Mark	Zone	Easting	Northing
		56	153.097	-26.7348
Plot bearing		135	Recorders	MJD / FSR

Site description and Location (including details of discrete polygons within the assessment unit)

Palmview grazing property (Lot 2 RP27760), currently owned in freehold by Sunshine Coast Council. Assessment Unit is located in an area that has had grazing excluded for some time and native regrowth is in a moderate to excellent condition. Grazing likley excluded due to hydrology

Regrowth Broad-leaved Paperbark forest, sedgeland and fernland complex. Some areas lack a canopy/shrub layer. Very low weed and exotic plant coverage.

Pooling surface water present during site investigations on 10th April. Low turbidity and pH < 5

Part D - Native Species Richness: (*list species below)

Tree species richness:			
Total number of species	2		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name	*Lophostemon suaveolens*	Common Name	Swamp Box
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Shrub species richness:			
Total number of species	4		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name	*Glochidion sumatranum*	Common Name	Cheese Tree
Scientific Name	*Melastoma malabathricum* subsp. *malabathricum*	Common Name	Native Blue Tongue
Scientific Name	*Meleleuca pachyphylla*	Common Name	Swamp Bottlebrush
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Grass species richness:			
Total number of species	1		
Scientific Name	*Imperata cylindrica*	Common Name	Blady Grass
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Forbs and others (non grass ground) species richness:			
Total number of species	6		
Scientific Name	*Blechnum indicum*	Common Name	Bungwall
Scientific Name	*Baumea rubinosa*	Common Name	Twigrush
Scientific Name	*Baumea articulata*	Common Name	Jointed Twigrush
Scientific Name	*Schoenus brevifolius*	Common Name	Spiky Sedge
Scientific Name	*Gahnia sieberiana*	Common Name	Red-fruited Saw Sedge
Scientific Name	*Lygodium microphyllum*	Common Name	Climbing Maidenhair Fern
Scientific Name		Common Name	

Part E - Non-Native Plant Cover: (*list species below)

Total percentage cover within plot	0.00%		
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part F - Coarse Woody Debris: (*list lengths of individual logs in meters)

Total Length of Course Woody Debris (Meters):	86.10		
1	2.80	26	
2	3.40	27	
3	1.20	28	
4	0.55	29	
5	0.66	30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

Part G - Native perennial grass cover, organic litter: (*provide percentage cover within each quadrat, and provide average cover)

Native perennial grass cover	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
	0.00%	0.00%	0.00%	0.00%	0.00%	

Organic Litter	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
	25.00%	15.00%	5.00%	18.00%	25.00%	17.60%

Part H- Number of large trees , tree canopy height, recruitment of woody perennial species:

Eucalypt Large tree DBH benchmark used :		Non- Eucalypt Large tree DBH benchmark used:	30
Number of large eucalypt trees:		Number of large non eucalypt trees:	
Total Number Large Trees:			

Median Tree Canopy Height Measurements	Canopy:	12.00	Sub-canopy:	3.00	Emergent:	

Number of ecologically dominant layer species regenerating:	1

Part I - Tree canopy cover, Shrub canopy cover

Tree canopy cover %	Canopy:	46.50%	Sub-canopy:	7.20%	Emergent:	
Shrub canopy cover %	2.30%					

Note: Only assess Emergent (E) or Subcanopy (S) layers if the benchmark document stipulates that layers are present *If trees are in the same layer and continuous along the transect you can group them

Part J - Site Context Score

ATTRIBUTE	Size of Patch	Connectedness	Context	Distance to Permanent Water	Ecological Corridors
DESCRIPTION	2 - 5 - 25ha	1 - 0% - 10% connection	1 - <10% remnant	1 - 0-500m	2 - Sharing a common boundary
SCORE	2	0	0	0	4

DOES THIS ASSESSMENT UNIT ALSO CONTAIN A SPECIES HABITAT REQUIREMENT.

YES ☑ PLEASE COMPLETE SPECIES HABITAT INDEX DETAILS BELOW AND THEN ATTACH LANDSCAPE PHOTOS AND SUBMIT AS DIRECTED

NO ☐ PLEASE ATTACH LANDSCAPE PHOTOS BELOW AND SUBMIT AS DIRECTED

Part K - Species Habitat Attributes

Species Habitat Attributes

No	Species Name	CommonName	NCA Status	Attributes	Threats to species	Quality and availability of food and foraging habitat	Quality and availability of shelter	Species mobility capacity	Role of site location to overall population in the...
1	Crinia tinnula	wallum froglet	V	Description	3 - Low threat level	3 - High	3 - High	4 - Minor restriction (0 – 25% reduction)	1 - Not or unlikely to be critical to species' survival"
				Score	15	10	10	10	1
2	Litoria freycineti	wallum rocketfrog	V	Description	3 - Low threat level	3 - High	3 - High	4 - Minor restriction (0 – 25% reduction)	1 - Not or unlikely to be critical to species' survival"
				Score	15	10	10	10	1
3	Litoria olongburensis	wallum sedgefrog	V	Description	3 - Low threat level	3 - High	3 - High	4 - Minor restriction (0 – 25% reduction)	1 - Not or unlikely to be critical to species' survival"
				Score	15	10	10	10	1
4				Description					
				Score					
5				Description					
				Score					
6				Description					
				Score					
7				Description					
				Score					
8				Description					
				Score					
9				Description					
				Score					
10				Description					
				Score					
				Maximum Score	15.00	10.00	10.00	10.00	1.00

Attach Landscape Photos Here

North

South

East

West

(FORM COMPLETE)

Please save and forward completed form/s together with Offsets Delivery Form 5 that can be accessed here: [QLD Environmental Offsets]

Habitat Quality Site Assessment Template……………………………………………………………………………………………

For all environmental offset applications you must:

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- Provide the mandatory supporting information identified on the forms as being required to accompany your application

This form is useful for undertaking a **habitat quality analysis** of an impact and/or offset/advanced offset site.
Please note that this form should be completed individually for each assessment unit under consideration.

Is this Assessment for: **An Impact Site** ☐ **An Offset Site** ☑ **an Advanced Offset Site** ☐

Habitat Quality Assessment Unit Score Sheet

Part C - Site Data

Property	Sunshine Coast Airport - Wallum Heath Management Area	Date	

Assessment Unit:	Assessment Unit Area (ha)	RE	Bioregion Number
6	25.46	12.2.12	Southeast Queensland

Landscape Photo- Please attach or insert north, south, east and west photos in the spaces provided from row 231-355 below and include details such as Time and Mapping Coordinates in the following row.

Datum		Zone	Easting	Northing
WGS 84	0m Mark	56	153.09188	-26.59393
GDA 94	50m Mark	Zone	Easting	Northing
		56	153.09234	-26.59393
Plot bearing		0	Recorders	MJD / FSR

Site description and Location (including details of discrete polygons within the assessment unit)

Wallum Heath Management Area within airside sections of the Sunshine Coast Airport. Area undergoes periodic slashing and management to maintain a low vegetation cover to meet airport safety and operational requirements. This section of the airport contains radar and meteorological equipment.

Regrowth wallum heathland, with patches of wetter sedgeland/fernland. Very sparse Broad-leaved Paperbark regrowth within sampling sites, but density of regrowth varies across AU. Area is subject to inundation during rainfall events. Known habitat for acid frogs and Ground Parrot.

Part D - Native Species Richness: (*list species below)

Tree species richness:			
Total number of species	1		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Shrub species richness:			
Total number of species	11		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name	*Philotheca queenslandica*	Common Name	Queensland Wax Flower
Scientific Name	*Woollsia pungens*	Common Name	
Scientific Name	*Banksia robur*	Common Name	Wallum Banksia
Scientific Name	*Pultenea paleacea*	Common Name	Chaffy Swamp Pea
Scientific Name	*Leptospermum liversidgei*	Common Name	Swamp May
Scientific Name	*Baeckea frutescens*	Common Name	Weeping Baeckea
Scientific Name	*Leucopogon leptospermoides*	Common Name	Bushy Whitebeard
Scientific Name	*Hibbertia vestita*	Common Name	Guinea Flower
Scientific Name	*Boronia falcifolia*	Common Name	Wallum Boronia
Scientific Name	*Epacris pulchella*	Common Name	Coral Heath

Grass species richness:			
Total number of species	0		
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Forbs and others (non grass ground) species richness:			
Total number of species	12		
Scientific Name	*Schoenoplectus mucronatus*	Common Name	
Scientific Name	*Empodisma minus*	Common Name	Spreading Rope Rush
Scientific Name	*Balloskion pallens*	Common Name	Pale Cordrush
Scientific Name	*Xyris complanata*	Common Name	Hatpins
Scientific Name	*Baumea teretifolia*	Common Name	
Scientific Name	*Baumea articulata*	Common Name	Jointed Twigrush
Scientific Name	*Cassytha pubescens*	Common Name	Dodder Laurel
Scientific Name	*Xanthorrhoea fulva*	Common Name	Wallum Grasstree
Scientific Name	*Gleichenia dicarpa*	Common Name	Pouched Coral Fern
Scientific Name	*Persicaria sp.*	Common Name	Smartweed
Scientific Name	*Blechnum indicum*	Common Name	Bungwall
Scientific Name	*Gonocarpus micranthus*	Common Name	Creeping Raspwort

Part E - Non-Native Plant Cover: (*list species below)

Total percentage cover within plot			
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part F - Coarse Woody Debris: (*list lengths of individual logs in meters)

Total Length of Course Woody Debris (Meters):			
1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

Part G - Native perennial grass cover, organic litter: (*provide percentage cover within each quadrat, and provide average cover)

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Native perennial grass cover	0.00%	0.00%	0.00%	0.00%	0.00%	

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Organic Litter						

Part H- Number of large trees , tree canopy height, recruitment of woody perennial species:

Eucalypt Large tree DBH benchmark used :		Non- Eucalypt Large tree DBH benchmark used:	
Number of large eucalypt trees:		Number of large non eucalypt trees:	
Total Number Large Trees:			

Median Tree Canopy Height Measurements	Canopy:	2.50	Sub-canopy:		Emergent:	

Number of ecologically dominant layer species regenerating:	5

Part I - Tree canopy cover, Shrub canopy cover

Tree canopy cover %	Canopy:	3.90%	Sub-canopy:		Emergent:	
Shrub canopy cover %	35.30%					

Note: Only assess Emergent (E) or Subcanopy (S) layers if the benchmark document stipulates that layers are present *If trees are in the same layer and continuous along the transect you can group them

Part J - Site Context Score

ATTRIBUTE	Size of Patch	Connectedness	Context	Distance to Permanent Water	Ecological Corridors
DESCRIPTION	2 - 5 - 25ha	2 - >10% - <50%	1 - <10% remnant	1 - 0-500m	2 - Sharing a common boundary
SCORE	2	2	0	0	4

DOES THIS ASSESSMENT UNIT ALSO CONTAIN A SPECIES HABITAT REQUIREMENT.

YES ☐ **PLEASE COMPLETE SPECIES HABITAT INDEX DETAILS BELOW AND THEN ATTACH LANDSCAPE PHOTOS AND SUBMIT AS DIRECTED**

NO ☐ **PLEASE ATTACH LANDSCAPE PHOTOS BELOW AND SUBMIT AS DIRECTED**

Part K - Species Habitat Attributes

Species Habitat Attributes

No	Species Name	CommonName	NCA Status	Attributes	Threats to species	Quality and availability of food and foraging habitat	Quality and availability of shelter	Species mobility capacity	Role of site location to overall population in the
1	*Crinia tinnula*	wallum froglet	V	Description	*3 - Low threat level*	*2 - Moderate*	*3 - High*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	15	5	10	10	1
2	*Litoria freycineti*	wallum rocketfrog	V	Description	*3 - Low threat level*	*2 - Moderate*	*3 - High*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	15	5	10	10	1
3	*Litoria olongburensis*	wallum sedgefrog	V	Description	*2 - Moderate threat level*	*2 - Moderate*	*3 - High*	*4 - Minor restriction (0 – 25% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	7	5	10	10	1
4	Pezoporus wallicus wallicus	ground parrot	V	Description	*2 - Moderate threat level*	*3 - High*	*3 - High*	*4 - Minor restriction (0 – 25% reduction)*	2 - Likely to be critical to species' survival
				Score	7	10	10	10	4
5				Description					
				Score					
6				Description					
				Score					
7				Description					
				Score					
8				Description					
				Score					
9				Description					
				Score					
10				Description					
				Score					
				Maximum Score	15.00	10.00	10.00	10.00	4.00

Attach Landscape Photos Here

North

South

East

West

(FORM COMPLETE) Please save and forward completed form/s together with Offsets Delivery Form 5 that can be accessed here: QLD Environmental Offsets

Habitat Quality Site Assessment Template…………………………………………………………………………………………. **PLEASE NOTE - YELLOW INDICATES AN AUTO POPULATED FIELD**

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This form is useful for undertaking a **habitat quality analysis** of an impact and/or offset/advanced offset site.
Please note that this form should be completed individually for each assessment unit under consideration.

Is this Assessment for: **An Impact Site** ☐ **An Offset Site** ☑ **an Advanced Offset Site** ☐

Habitat Quality Assessment Unit Score Sheet

Part C - Site Data

Property	Sunshine Coast Airport - corridor offset	Date	

Assessment Unit:	Assessment Unit Area (ha)	RE	Bioregion Number
7	38.22	12.2.7	Southeast Queensland

Landscape Photo- Please attach or insert north, south, east and west photos in the spaces provided from row 231-355 below and include details such as Time and Mapping Coordinates in the following row.

Datum		Zone	Easting	Northing
WGS 84	0m Mark	56	153.078	-26.579
GDA 94	50m Mark	Zone	Easting	Northing
		56	153.078	-26.5783
Plot bearing		0	Recorders	MJD / FSR

Site description and Location (including details of discrete polygons within the assessment unit)

North-east corner of the proposed corridor offset located on Sunshine Coast Airport land (Lot 1106 on SP206556).

The vegetation composition of the Assessment Unit is predominantly degraded grassland, due to the historic and current use as cane lands. The northern section has been removed from cultivation earlier and has some native regrowth elements. Further to the south, there are still areas under cane cultivation which contain no native canopy cover. Much of the Assessment Unit has exotic grasses, forbs and sedges as the dominant group of species. Declared pest plants, particularly Groundsel Bush *Baccharis halimifolia,* are common across the AU.

The sampling site is located within an area of the most advanced native regrowth, dominated by Wattle *Acacia spp.* and Broad-leaved Paperbark *Melaleuca quinquenervia.*

AU also includes the 4.41ha of land reserved for the Mount Emu She-oak offset, as the current floristic condition of the AU is similar.

Part D - Native Species Richness: (*list species below)

Tree species richness:			
Total number of species	5		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name	*Acacia cincinnata*	Common Name	Coil-pod Wattle
Scientific Name	*Acacia disparrima* subsp. *disparrima*	Common Name	Hickory Wattle
Scientific Name	*Commersonia bartramia*	Common Name	Brown Kurrajong
Scientific Name	*Glochidion sumatranum*	Common Name	Cheese Tree
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Shrub species richness:			
Total number of species	1		
Scientific Name	*Acacia cincinnata*	Common Name	Coil-pod Wattle
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Grass species richness:			
Total number of species	1		
Scientific Name	*Imperata cylindrica*	Common Name	Blady Grass
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Forbs and others (non grass ground) species richness:			
Total number of species	0		
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part E - Non-Native Plant Cover: (*list species below)

Total percentage cover within plot	90.00%		
Scientific Name	*Setaria sp.*	Common Name	Setaria
Scientific Name	*Baccharis halimifolia*	Common Name	Groundsel Bush
Scientific Name		Common Name	Exotic Grasses
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part F - Coarse Woody Debris: (*list lengths of individual logs in meters)

Total Length of Course Woody Debris (Meters):			
1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

Part G - Native perennial grass cover, organic litter: (*provide percentage cover within each quadrat, and provide average cover)

Native perennial grass cover	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
	0.00%	3.00%	4.00%	0.00%	15.00%	4.40%

Organic Litter	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
	90.00%	94.00%	95.00%	20.00%	3.00%	60.40%

Part H- Number of large trees , tree canopy height, recruitment of woody perennial species:

Eucalypt Large tree DBH benchmark used :	50	Non- Eucalypt Large tree DBH benchmark used:	30
Number of large eucalypt trees:	0	Number of large non eucalypt trees:	0
Total Number Large Trees:			

Median Tree Canopy Height Measurements	Canopy:	7.00	Sub-canopy:	4.00	Emergent:	

Number of ecologically dominant layer species regenerating:	3

Part I - Tree canopy cover, Shrub canopy cover

Tree canopy cover %	Canopy:	51.10%	Sub-canopy:	22.90%	Emergent:	
Shrub canopy cover %	1.00%					

Note: Only assess Emergent (E) or Subcanopy (S) layers if the benchmark document stipulates that layers are present *If trees are in the same layer and continuous along the transect you can group them

Part J - Site Context Score

ATTRIBUTE	Size of Patch	Connectedness	Context	Distance to Permanent Water	Ecological Corridors
DESCRIPTION	3 - 26 - 100ha	1 - 0% - 10% connection	1 - <10% remnant	1 - 0-500m	2 - Sharing a common boundary
SCORE	5	0	0	0	4

DOES THIS ASSESSMENT UNIT ALSO CONTAIN A SPECIES HABITAT REQUIREMENT.

YES ☑ PLEASE COMPLETE SPECIES HABITAT INDEX DETAILS BELOW AND THEN ATTACH LANDSCAPE PHOTOS AND SUBMIT AS DIRECTED

NO ☐ PLEASE ATTACH LANDSCAPE PHOTOS BELOW AND SUBMIT AS DIRECTED

Part K - Species Habitat Attributes

Species Habitat Attributes

No	Species Name	CommonName	NCA Status	Attributes	Threats to species	Quality and availability of food and foraging habitat	Quality and availability of shelter	Species mobility capacity	Role of site location to overall population in the
1	Crinia tinnula	wallum froglet	V	Description	*2 - Moderate threat level*	*1 - Poor*	*1 - Poor*	*2 - Highly restricted (51% - 75% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	7	1	1	4	1
2	Litoria freycineti	wallum rocketfrog	V	Description	*2 - Moderate threat level*	*1 - Poor*	*1 - Poor*	*2 - Highly restricted (51% - 75% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	7	1	1	4	1
3	Litoria olongburensis	wallum sedgefrog	V	Description	*2 - Moderate threat level*	*1 - Poor*	*1 - Poor*	*2 - Highly restricted (51% - 75% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	7	1	1	4	1
4				Description					
				Score					
5				Description					
				Score					
6				Description					
				Score					
7				Description					
				Score					
8				Description					
				Score					
9				Description					
				Score					
10				Description					
				Score					
				Maximum Score	7.00	1.00	1.00	4.00	1.00

Attach Landscape Photos Here

North

South

East

West

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Is this Assessment for: **An Impact Site** ☐ **An Offset Site** ☑ **an Advanced Offset Site** ☐

Habitat Quality Assessment Unit Score Sheet

Part C - Site Data

Property	Sunshine Coast Airport	Date	

Assessment Unit:	Assessment Unit Area (ha)	RE	Bioregion Number
8	4.41	12.2.12	Southeast Queensland

Landscape Photo- Please attach or insert north, south, east and west photos in the spaces provided from row 231-355 below and include details such as Time and Mapping Coordinates in the following row.

Datum		Zone	Easting	Northing
WGS 84	0m Mark	56	153.082	.26.582
GDA 94	50m Mark	Zone	Easting	Northing
		56	153.082	-26.583
Plot bearing			Recorders	

Site description and Location (including details of discrete polygons within the assessment unit)
Proposed Mount Emu She-oak offset area. No formal Bioconditon transect was completed within this AU, however the current vegetation characteristics are functionally similar to AU7. The information in this form has been collated from AU7.

Part D - Native Species Richness: (*list species below)

Tree species richness:			
Total number of species	5		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name	*Acacia cincinnata*	Common Name	Coil-pod Wattle
Scientific Name	*Acacia disparrima* subsp. *disparrima*	Common Name	Hickory Wattle
Scientific Name	*Commersonia bartramia*	Common Name	Brown Kurrajong
Scientific Name	*Glochidion sumatranum*	Common Name	Cheese Tree
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Shrub species richness:			
Total number of species	1		
Scientific Name	*Acacia cincinnata*	Common Name	Coil-pod Wattle
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Grass species richness:			
Total number of species	1		
Scientific Name	*Imperata cylindrica*	Common Name	Blady Grass
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Forbs and others (non grass ground) species richness:			
Total number of species	0		
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part E - Non-Native Plant Cover: (*list species below)

Total percentage cover within plot	90.00%		
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part F - Coarse Woody Debris: (*list lengths of individual logs in meters)

Total Length of Course Woody Debris (Meters):			
1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

Part G - Native perennial grass cover, organic litter: (*provide percentage cover within each quadrat, and provide average cover)

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Native perennial grass cover	0.00%	3.00%	4.00%	0.00%	15.00%	4.40%

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Organic Litter	90.00%	94.00%	95.00%	20.00%	3.00%	60.40%

Part H- Number of large trees , tree canopy height, recruitment of woody perennial species:

Eucalypt Large tree DBH benchmark used :	50	Non- Eucalypt Large tree DBH benchmark used:	30
Number of large eucalypt trees:	0	Number of large non eucalypt trees:	0
Total Number Large Trees:			

Median Tree Canopy Height Measurements	Canopy:	7.00	Sub-canopy:	4.00	Emergent:	

Number of ecologically dominant layer species regenerating:	3

Part I - Tree canopy cover, Shrub canopy cover

Tree canopy cover %	Canopy:	51.10%	Sub-canopy:	22.90%	Emergent:	
Shrub canopy cover %	1.00%					

Note: Only assess Emergent (E) or Subcanopy (S) layers if the benchmark document stipulates that layers are present *If trees are in the same layer and continuous along the transect you can group them

Part J - Site Context Score

ATTRIBUTE	Size of Patch	Connectedness	Context	Distance to Permanent Water	Ecological Corridors
DESCRIPTION	1 - <5ha	3 - 50%-75% connection	1 - <10% remnant	1 - 0-500m	2 - Sharing a common boundary
SCORE	0	4	0	0	4

DOES THIS ASSESSMENT UNIT ALSO CONTAIN A SPECIES HABITAT REQUIREMENT.

YES ☑ PLEASE COMPLETE SPECIES HABITAT INDEX DETAILS BELOW AND THEN ATTACH LANDSCAPE PHOTOS AND SUBMIT AS DIRECTED

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Part K - Species Habitat Attributes

Species Habitat Attributes

No	Species Name	CommonName	NCA Status	Attributes	Threats to species	Quality and availability of food and foraging habitat	Quality and availability of shelter	Species mobility capacity	Role of site location to overall population in the
1	Crinia tinnula	wallum froglet	V	Description	2 - Moderate threat level	1 - Poor	1 - Poor	2 - Highly restricted (51% - 75% reduction)	1 - Not or unlikely to be critical to species' survival"
				Score	7	1	1	4	1
2	Litoria freycineti	wallum rocketfrog	V	Description	2 - Moderate threat level	1 - Poor	1 - Poor	2 - Highly restricted (51% - 75% reduction)	1 - Not or unlikely to be critical to species' survival"
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				Score					
6				Description					
				Score					
7				Description					
				Score					
8				Description					
				Score					
9				Description					
				Score					
10				Description					
				Score					
				Maximum Score	7.00	1.00	1.00	4.00	1.00

Attach Landscape Photos Here

North

South

East

West

(FORM COMPLETE)

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Habitat Quality Site Assessment Template……………………………………………………………………………………………..

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Habitat Quality Assessment Unit Score Sheet

Part C - Site Data

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Assessment Unit:	Assessment Unit Area (ha)	RE	Bioregion Number
8	4.41	12.2.12	Southeast Queensland

Landscape Photo- Please attach or insert north, south, east and west photos in the spaces provided from row 231-355 below and include details such as Time and Mapping Coordinates in the following row.

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	0m Mark	56	153.082	.26.582
	50m Mark	Zone	Easting	Northing
		56	153.082	-26.583
Plot bearing			Recorders	

Site description and Location (including details of discrete polygons within the assessment unit)
Proposed Mount Emu She-oak offset area. No formal Bioconditon transect was completed within this AU, however the current vegetation characteristics are functionally similar to AU7. The information in this form has been collated from AU7.

Part D - Native Species Richness: (*list species below)

Tree species richness:			
Total number of species	5		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name	*Acacia cincinnata*	Common Name	Coil-pod Wattle
Scientific Name	*Acacia disparrima* subsp. *disparrima*	Common Name	Hickory Wattle
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Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Shrub species richness:			
Total number of species	1		
Scientific Name	*Acacia cincinnata*	Common Name	Coil-pod Wattle
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Grass species richness:			
Total number of species	1		
Scientific Name	*Imperata cylindrica*	Common Name	Blady Grass
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Forbs and others (non grass ground) species richness:			
Total number of species	0		
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part E - Non-Native Plant Cover: (*list species below)

Total percentage cover within plot	90.00%		
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part F - Coarse Woody Debris: (*list lengths of individual logs in meters)

Total Length of Course Woody Debris (Meters):			
1		26	
2		27	
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6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

Part G - Native perennial grass cover, organic litter: (*provide percentage cover within each quadrat, and provide average cover)

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Native perennial grass cover	0.00%	3.00%	4.00%	0.00%	15.00%	4.40%

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Organic Litter	90.00%	94.00%	95.00%	20.00%	3.00%	60.40%

Part H- Number of large trees , tree canopy height, recruitment of woody perennial species:

Eucalypt Large tree DBH benchmark used :	50	Non- Eucalypt Large tree DBH benchmark used:	30
Number of large eucalypt trees:	0	Number of large non eucalypt trees:	0
Total Number Large Trees:			

Median Tree Canopy Height Measurements	Canopy:	7.00	Sub-canopy:	4.00	Emergent:	

Number of ecologically dominant layer species regenerating:	3

Part I - Tree canopy cover, Shrub canopy cover

Tree canopy cover %	Canopy:	51.10%	Sub-canopy:	22.90%	Emergent:	
Shrub canopy cover %	1.00%					

Note: Only assess Emergent (E) or Subcanopy (S) layers if the benchmark document stipulates that layers are present *If trees are in the same layer and continuous along the transect you can group them

Part J - Site Context Score

ATTRIBUTE	Size of Patch	Connectedness	Context	Distance to Permanent Water	Ecological Corridors
DESCRIPTION	1 - <5ha	3 - 50%-75% connection	1 - <10% remnant	1 - 0-500m	2 - Sharing a common boundary
SCORE	0	4	0	0	4

DOES THIS ASSESSMENT UNIT ALSO CONTAIN A SPECIES HABITAT REQUIREMENT.

YES ☑ PLEASE COMPLETE SPECIES HABITAT INDEX DETAILS BELOW AND THEN ATTACH LANDSCAPE PHOTOS AND SUBMIT AS DIRECTED

NO ☐ PLEASE ATTACH LANDSCAPE PHOTOS BELOW AND SUBMIT AS DIRECTED

Part K - Species Habitat Attributes

Species Habitat Attributes

No	Species Name	CommonName	NCA Status	Attributes	Threats to species	Quality and availability of food and foraging habitat	Quality and availability of shelter	Species mobility capacity	Role of site location to overall population in the
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				Score	7	1	1	4	1
4				Description					
				Score					
5				Description					
				Score					
6				Description					
				Score					
7				Description					
				Score					
8				Description					
				Score					
9				Description					
				Score					
10				Description					
				Score					
				Maximum Score	7.00	1.00	1.00	4.00	1.00

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East

West

(FORM COMPLETE) Please save and forward completed form/s together with Offsets Delivery Form 5 that can be accessed here: QLD Environmental Offsets

A.2 Habitat Quality Score Multipliers

Habitat Quality Final Summary

For all environmental offset applications you must:
- Complete form (Environmental Offsets Delivery Form 1–Notice of Election and Advanced Offsets Details)
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- Provide the mandatory supporting information identified on the forms as being required to accompany your application

Note: This document/tool may be used in relation to undertaking a habitat quality analysis of an impact site/offset site and/or advanced offset site and is designed to be attached to Envrionmental Offsets Delivery Form 5 - Habitat Quality

Habitat Quality Final Summary Template - *Crinia tinnula*

Case Reference	
Project Name	
Total Area	92.73

PART		Habitat Quality Attributes	Requirement	Assessment Unit Number 1	2	3	4	5	6	7	8	9
		Assessment Unit Area (ha)	Area (ha)	24.05	3.82	2.55	2.3	7.5	25.46	16.8	4.41	5.84
		Regional Ecosystems	RE	12.3.5	12.3.5	12.3.5	12.3.5	12.3.5	12.2.12	12.2.7	12.2.12	12.2.12
		Bioregion	Bioregion	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland
1	Site Condition Attributes	1. Recruitment of woody perennial species	Score	5	5	5	5	5	3	5	3	3
		2. Native plant species richness										
		- Trees	Score	3	5	3	3	3	3	5	5	5
		- Shrubs	Score	5	5	5	5	5	3	3	2.5	2.5
		- Grasses	Score	3	3	3	3	3	2.5	3	3	3
		- Forbs	Score	3	3	3	3	3	3	2.5	2.5	2.5
		3. Tree canopy height										
		- Canopy layer	Score	3	0	0	5	5	3	3	5	5
		- Sub-Canopy Layer	Score					3		3		
		- Emergent Layer	Score									
		Average Score	Average Score	3	0	0	5	4	3	3	5	5
		4. Tree canopy cover										
		- Canopy layer	Score	2	2	0	5	2	2	5	3	3
		- Sub-Canopy Layer	Score							5		
		- Emergent Layer	Score									
		Average Score	Average Score	2	2	0	5	2	2	5	3	3
		5. Shrub canopy cover	Score	3	3	3	5	3	3	0	0	0
		6. Native perennial grass cover	Score	5	5					1	5	5
		7. Organic litter	Score					5		3	3	3
		8. Large trees	Score		5		5					
		9. Coarse woody debris	Score				2	0				
		10. Weed cover	Score	5	5	5		10		5	5	5
2	Site Context	11. Size of patch (fragmented)	Score	5	0	5	0	2	2	5	0	2
		12. Connectedness (fragmented)	Score	4	4	0	0	0	2	0	4	4
		13. Context (fragmented)	Score	0	0	0	2	0	0	0	0	0
		14. Distance from water (intact)	Score	0	0	0	0	0	0	0	0	0
		15. Ecological corridors	Score	4	4	0	4	4	4	4	4	4
3	Species Habitat In	16. Threats to species	Score	15	15	7	15	15	15	7	7	7
		17. Quality and availability of food and foraging habitat	Score	10	10	5	10	10	10	1	1	1
		18, Quality and availability of shelter	Score	10	10	5	10	10	10	1	1	1
		19. Species mobility capacity	Score	10	10	10	10	10	10	4	4	4
		20. Role of site location to overall population in the State.	Score	1	1	1	1	1	4	1	1	1

Habitat Quality Score (measured)	96.00	95.00	60.00	93.00	95.00	79.50	58.50	59.00	61.00
Habitat Quality Score (max)	151.00	166.00	146.00	156.00	156.00	136.00	156.00	156.00	156.00
Assessment Unit Area (ha)	24.05	3.82	2.55	2.30	7.50	25.46	16.80	4.41	5.84
Assessment Unit Habitat Quality Score	6.36	5.72	4.11	5.96	6.09	5.85	3.75	3.78	3.91
Size weighting	0.26	0.04	0.03	0.02	0.08	0.27	0.18	0.05	0.06
Weighted Assessment Unit Habitat Quality Score	1.65	0.24	0.11	0.15	0.49	1.60	0.68	0.18	0.25
FINAL TOTAL HABITAT QUALITY SCORE	**5.35**								

Administrative Information

Name of Assessment Officer	Jeremy Visser	Date	*11-Mar-19*	
Organisation/Company Name	BMT			
Project Name	Sunshine Coast Airport Expansion Project			
Phone Number	3831 6744	Email	*Jeremy.Visser@bmtglobal.com*	

Habitat Quality Final Summary

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- Provide the mandatory supporting information identified on the forms as being required to accompany your application

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Habitat Quality Final Summary Template - *Litoria freycineti*

Case Reference	
Project Name	
Total Area	76.01

PART	Habitat Quality Attributes	Requirement	Assessment Unit Number								
			1	2	3	4	5	6	7	8	9
	Assessment Unit Area (ha)	Area (ha)	9.62	1.53	2.55	2.3	7.5	25.46	16.8	4.41	5.84
	Regional Ecosystems	RE	12.3.5	12.3.5	12.3.5	12.3.5	12.3.5	12.2.12	12.2.7	12.2.12	12.2.12
	Bioregion	Bioregion	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland
1 Site Condition Attributes	1. Recruitment of woody perennial species	Score	5	5	5	5	5	3	5	3	3
	2. Native plant species richness										
	- Trees	Score	3	5	3	3	3	3	5	5	5
	- Shrubs	Score	5	5	5	5	5	3	3	2.5	2.5
	- Grasses	Score	3	3	3	3	3	2.5	3	3	3
	- Forbs	Score	3	3	3	3	3	3	2.5	2.5	2.5
	3. Tree canopy height										
	- Canopy layer	Score	3	0	0	5	5	3	3	5	5
	- Sub-Canopy Layer	Score					3		3		
	- Emergent Layer	Score									
	Average Score	Average Score	3	0	0	5	4	3	3	5	5
	4. Tree canopy cover										
	- Canopy layer	Score	2	2	0	5	2	2	5	3	3
	- Sub-Canopy Layer	Score							5		
	- Emergent Layer	Score									
	Average Score	Average Score	2	2	0	5	2	2	5	3	3
	5. Shrub canopy cover	Score	3	3	3	5	3	3	0	0	0
	6. Native perennial grass cover	Score	5	5					1	5	5
	7. Organic litter	Score					5		3	3	3
	8. Large trees	Score		5		5					
	9. Coarse woody debris	Score				2	0				
	10. Weed cover	Score	5	5	5		10		5	5	5
2 Site Context	11. Size of patch (fragmented)	Score	5	0	5	0	2	2	5	0	2
	12. Connectedness (fragmented)	Score	4	4	0	0	0	2	0	4	4
	13. Context (fragmented)	Score	0	0	0	2	0	0	0	0	0
	14. Distance from water (intact)	Score	0	0	0	0	0	0	0	0	0
	15. Ecological corridors	Score	4	4	0	4	4	4	4	4	4
3 Species Habitat In	16. Threats to species	Score	15	15	7	15	15	15	7	7	7
	17. Quality and availability of food and foraging habitat	Score	10	10	5	10	10	10	1	1	1
	18, Quality and availability of shelter	Score	10	10	5	10	10	10	1	1	1
	19. Species mobility capacity	Score	10	10	10	10	10	10	4	4	4
	20. Role of site location to overall population in the State.	Score	1	1	1	1	1	4	1	1	1

Habitat Quality Score (measured)	96.00	95.00	60.00	93.00	95.00	79.50	58.50	59.00	61.00
Habitat Quality Score (max)	151.00	166.00	146.00	156.00	156.00	136.00	156.00	156.00	156.00
Assessment Unit Area (ha)	9.62	1.53	2.55	2.30	7.50	25.46	16.80	4.41	5.84
Assessment Unit Habitat Quality Score	6.36	5.72	4.11	5.96	6.09	5.85	3.75	3.78	3.91
Size weighting	0.13	0.02	0.03	0.03	0.10	0.33	0.22	0.06	0.08
Weighted Assessment Unit Habitat Quality Score	0.80	0.12	0.14	0.18	0.60	1.96	0.80	0.22	0.30
FINAL TOTAL HABITAT QUALITY SCORE	**5.12**								

Administrative Information

Name of Assessment Officer	**Jeremy Visser**	**Date**	*11-Mar-19*	
Organisation/Company Name	**BMT**			
Project Name	**Sunshine Coast Airport Expansion Project**			
Phone Number	**3831 6744**	**Email**	*Jeremy.Visser@bmtgloblal.com*	

Habitat Quality Final Summary

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- Provide the mandatory supporting information identified on the forms as being required to accompany your application

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Habitat Quality Final Summary Template - *Pezoporus wallicus wallicus*

Case Reference	
Project Name	
Total Area	5.84

PART		Habitat Quality Attributes	Requirement	Assessment Unit Number								
				1	2	3	4	5	6	7	8	9
		Assessment Unit Area (ha)	Area (ha)	0	0	0	0	0	0	0	0	5.84
		Regional Ecosystems	RE	12.3.5	12.3.5	12.3.5	12.3.5	12.3.5	12.2.12	12.2.7	12.2.12	12.2.12
		Bioregion	Bioregion	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland	Southeast Queensland
1	Site Condition Attributes	1. Recruitment of woody perennial species	Score	5	5	5	5	5	3	5	3	3
		2. Native plant species richness										
		- Trees	Score	3	5	3	3	3	3	5	5	5
		- Shrubs	Score	5	5	5	5	5	3	3	2.5	2.5
		- Grasses	Score	3	3	3	3	3	2.5	3	3	3
		- Forbs	Score	3	3	3	3	3	3	2.5	2.5	2.5
		3. Tree canopy height										
		- Canopy layer	Score	3	0	0	5	5	3	3	5	5
		- Sub-Canopy Layer	Score					3		3		
		- Emergent Layer	Score									
		Average Score	Average Score	3	0	0	5	4	3	3	5	5
		4. Tree canopy cover										
		- Canopy layer	Score	2	2	0	5	2	2	5	3	3
		- Sub-Canopy Layer	Score							5		
		- Emergent Layer	Score									
		Average Score	Average Score	2	2	0	5	2	2	5	3	3
		5. Shrub canopy cover	Score	3	3	3	5	3	3	0	0	0
		6. Native perennial grass cover	Score	5	5					1	5	5
		7. Organic litter	Score					5		3	3	3
		8. Large trees	Score		5		5					
		9. Coarse woody debris	Score				2	0				
		10. Weed cover	Score	5	5	5		10		5	5	5
2	Site Context	11. Size of patch (fragmented)	Score	5	0	5	0	2	2	5	0	2
		12. Connectedness (fragmented)	Score	4	4	0	0	0	2	0	4	4
		13. Context (fragmented)	Score	0	0	0	2	0	0	0	0	0
		14. Distance from water (intact)	Score	0	0	0	0	0	0	0	0	0
		15. Ecological corridors	Score	4	4	0	4	4	4	4	4	4
3	Species Habitat In	16. Threats to species	Score	15	15	7	15	15	15	7	7	7
		17. Quality and availability of food and foraging habitat	Score	10	10	5	10	10	10	1	1	1
		18, Quality and availability of shelter	Score	10	10	5	10	10	10	1	1	1
		19. Species mobility capacity	Score	10	10	10	10	10	10	4	4	4
		20. Role of site location to overall population in the State.	Score	1	1	1	1	1	4	1	1	1

Habitat Quality Score (measured)	96.00	95.00	60.00	93.00	95.00	79.50	58.50	59.00	61.00
Habitat Quality Score (max)	151.00	166.00	146.00	156.00	156.00	136.00	156.00	156.00	156.00
Assessment Unit Area (ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.84
Assessment Unit Habitat Quality Score	6.36	5.72	4.11	5.96	6.09	5.85	3.75	3.78	3.91
Size weighting	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
Weighted Assessment Unit Habitat Quality Score	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.91
FINAL TOTAL HABITAT QUALITY SCORE	**3.91**								

Administrative Information

Name of Assessment Officer	**Jeremy Visser**	**Date**	*11-Mar-19*	
Organisation/Company Name	**BMT**			
Project Name	**Sunshine Coast Airport Expansion Project**			
Phone Number	**3831 6744**	**Email**	*Jeremy.Visser@bmtglobal.com*	

Appendix B Financial Offset Calculator for Ground Parrot

From:	Matt Davis
To:	Matt Davis
Subject:	Fwd: Environmental offsets calculator results - Financial settlement offset calculator
Date:	Wednesday, 21 December 2016 9:36:24 PM
Attachments:	data.csv

---------- Forwarded message ----------
From: <no-reply@ehp.qld.gov.au>
Date: Wed, Dec 21, 2016 at 4:18 PM
Subject: Environmental offsets calculator results - Financial settlement offset calculator
To: davis.james.matt@gmail.com

Environmental offsets calculator results - Financial settlement offset calculator

Payment details

Non-protected area cost	
On ground cost	$488,800.00
Landholder incentive payment	$467,806.04
Administrative cost	$122,200.00
Total non-protected area cost	$1,078,806.04

Protected area cost	
Total protected area cost	$0.00

Total cost	
Grand total	$1,078,806.04

Total offset area: 24.44 ha

Section 1

LGA
Sunshine Coast Regional Council
Bioregion
Southeast Queensland
Subregion
Sunshine Coast - Gold Coast Lowlands
Impact area
6.11 ha
Notional offset area
24.44 ha
Distinct matter area 1.1

Impact area: 6.11 ha
Notional offset area: 24.44 ha

Matter groups:

- 1.1.1: Threatened animals - Pezoporus wallicus wallicus (ground parrot)

Sections, areas and matter groups used in calculations

Section	Bioregion / Marine (and waterways) zone	Subregion / Marine bioregion	Local government area (LGA)	Distinct matter area (DMA)	DMA impact area (ha)	DMA notional offset area (ha)	Matter group
1	Southeast Queensland	Sunshine Coast - Gold Coast Lowlands	Sunshine Coast Regional Council	1.1	6.11	24.44	1.1.1 Threatened animals - Pezoporus wallicus wallicus (ground parrot)

Appendix C Supporting Offset and Management Plans

Sunshine Coast Airport Expansion Project

Wallum Sedgefrog Offset Management Plan

March 2018

ECOSMART ECOLOGY
48 Streeton Parade
Everton Park QLD 4053 Australia

Tel: +61 7 31621161

Name of Project:	Sunshine Coast Airport Expansion Project
Document Author(s):	Mark Sanders, Dr Ed Meyer and Matt Davis
Name of Document:	Wallum Sedgefrog Offset Management Plan
Version:	Version 6.0

DECLARATION OF ACCURACY

I declare that:

1. To the best of my knowledge, all the information contained in, or accompanying this Offset Management Plan is complete, current and correct.
2. I am duly authorised to sign this declaration on behalf of the approval holder.
3. I am aware that:
   a. Section 490 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence for an approval holder to provide information in response to an approval condition where the person is reckless as to whether the information is false or misleading.
   b. Section 491 of the EPBC Act makes it an offence for a person to provide information or documents to specified persons who are known by the person to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) where the person knows the information or document is false or misleading.
   c. The above offences are punishable on conviction by imprisonment, a fine or both.

Signed

____

Full name (please print)

____

Organisation (please print)

____

Date ____/___/

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EXECUTIVE SUMMARY

The Sunshine Coast Airport Expansion Project (SCAEP) will see the construction of a new runway and associated infrastructure at Sunshine Coast Airport (SCA), near Marcoola, south-east Queensland. Construction of this runway will result in the loss of 1.67 ha of non-remnant breeding habitat for the Wallum Sedgefrog (*Litoria olongburensis*) – a species listed as 'Vulnerable' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Approval of the SCAEP under the EPBC Act has been conditioned with the preparation of an Offset Management Plan (OMP) to define how significance residual impact to Wallum Sedgefrog (WSF) breeding habitat will be offset. Offset obligations and measures for achieving the offsets required under the EPBC Act are outlined in this OMP.

Under this OMP, EPBC Act offset obligations will be met by the creation of 2.3ha of new Wallum Sedgefrog breeding habitat on SCA land. To achieve this, vegetated ponds will be constructed in areas of drier heath and Melaleuca woodland currently unsuitable for breeding/recruitment of Wallum Sedgefrogs, but in close proximity to existing breeding habitat, north-east of the proposed runway.

In order to offset the loss of Wallum Sedgefrog breeding habitat at SCA, newly created breeding habitat must meet the criteria in the below table.

No.	Performance Area	Completion Criteria (measurable and reportable targets)
1	Security and protection of offset areas	• The offset area is legally secured in perpetuity. • The air-side perimeter fence is completed and inspected daily for breaches. • Signs are placed every 50m around the perimeter of the WHMA and Vegetation Management Area A to prevent unauthorised access.
2	Water Chemistry	• Water pH values within constructed ponds are within the range recorded at reference sites*. • Turbidity values within constructed ponds are within the range recorded at reference sites*. • Conductivity/salinity levels within constructed ponds are within the range recorded at reference sites*. • Tannin staining (tannic acid equivalents mg/L) at created ponds are within the range recorded at reference sites*. • The salinity of perched groundwater does not consistently exceed levels recorded within the SCA prior to construction of the SCAEP by more than 20%.
3	Hydroperiod	• Hydroperiod of constructed ponds comparable with that of reference sites. • Constructed ponds hold water long enough to support recruitment of Wallum Sedgefrogs when conditions are wet enough to support recruitment of Wallum Sedgefrogs at reference sites.

No.	Performance Area	Completion Criteria (measurable and reportable targets)
4	Vegetation	Vegetation cover within and around constructed ponds suitable for Wallum Sedgefrog and comparable with reference sites, as indicated by: • A predominance of upright terete sedges (>50% of vegetation cover) and/or • % cover/density of upright sedges at constructed ponds within the range recorded at reference sites. • Vegetation in and around constructed ponds remains free of non-native and native weed species (including declared pest plants) until monitoring is completed.
5	Predatory Fish	Ponds remain free of fish predators (particularly *Gambusia holbrooki*) or do not support fish predators at densities higher than reference sites known to support successful recruitment of Wallum Sedgefrogs.
6	Wallum Sedgefrog abundance	Abundance of Wallum Sedgefrogs at constructed ponds within the range recorded at reference sites under suitably wet conditions (see Section 5.2).
7	Wallum Sedgefrog recruitment	Constructed ponds known or likely to support recruitment (as evidenced by the presence of metamorphs and/or late stage tadpoles with surface water still present) in direct proportion to the number/proportion of reference sites known or likely to support recruitment under suitably wet conditions (i.e., with sufficient rainfall to support breeding). Recruitment is key to self-sustaining Wallum Sedgefrog habitat, and if this criteria is demonstrated then it is assumed all other completion criteria have been met.
8	Need for ongoing intervention/management	Constructed ponds continue to provide breeding habitat for Wallum Sedgefrogs without any further intervention/management other than ongoing control of woody regrowth.
9	Area of offset habitat	The area of breeding habitat created within offset areas is 2.3 ha or greater.

*Reference sites include areas of retained habitat within the SCA and sites outside of the SCA known to support successful recruitment of Wallum Sedgefrogs.

In order to meet these criteria, breeding ponds will be constructed in areas of sandy, siliceous soil with shallow acidic ground water (<1 m BGL) close to existing breeding habitat on SCA land north-east of the proposed runway. Pond design and construction will be guided by data from soil and groundwater investigations undertaken at SCA, so excavated ponds hold water long enough to support juvenile recruitment under suitably wet conditions (i.e., where there is sufficient rainfall to support recruitment at reference sites).

A monitoring program will also be implemented to determine: (1) whether constructed ponds meet the above criteria and support successful breeding/recruitment of Wallum Sedgefrogs; and (2) what, if any, corrective actions are needed to achieve the required offsets. This program will include monitoring of pond water quality and hydroperiod, vegetation condition, Wallum Sedgefrog abundance, and recruitment success at offset sites and reference sites within and outside of SCA.

Details of the design, construction and monitoring of ponds at offset sites are provided in this document along with contingencies for meeting offset obligations should constructed ponds fail to meet the completion criteria outlined above.

Residual risks associated with offsetting the loss of Wallum Sedgefrog are low and, as such, the likelihood of successfully meeting offset obligations for the Wallum Sedgefrog is high.

1.0 BACKGROUND AND SCOPE

The proposed Sunshine Coast Airport Expansion Project (SCAEP) will necessitate the construction of a new east-west runway and associated infrastructure at the existing Sunshine Coast Airport (SCA), Marcoola. The construction and operation of the new runway will result in a residual impact to approximately 1.67ha of Wallum Sedgefrog (*Litoria olongburensis*) breeding habitat, and therefore environmental offsets under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are required. To demonstrate how the SCA will achieve its offset requirements, a Biodiversity Offset Strategy (BOS) (ARUP 2015) was prepared as part of the Environmental Impact Statement (EIS) for the SCAEP.

While approved by the Commonwealth, the SCAEP has been conditioned with preparing a stand-alone Wallum Sedgefrog Offset Management Plan (OMP) to further clarify how these offsets will be planned, delivered and monitored for success. As detailed in condition 15 of the EPBC Act approval decision (2011/5823), this OMP must be approved by the Department of Environment and Energy (DEE) and include:

a. *The proposed legal mechanism and timelines for securing the offset area/s*

b. *Details of the minimum offset area/s proposed to compensate for clearing breeding habitat for Litoria olongburensis*

c. *Evidence that the offset/s are in accordance with the EPBC Act Environmental Offsets Policy including a populated copy of the EPBC Act offsets assessment guide with detailed justification for each input*

d. *Information about how the offset area/s provide connectivity with other relevant habitats and biodiversity corridors*

e. *A textual description and a map to clearly define the location and boundaries of the offset area/s accompanied by the offset attributes*

f. *A description of the management measures (including timing, frequency and longevity) that will be implemented on the offset area/s for the protection and management of habitat for Litoria olongburensis, including details of how the management measures proposed take account of the Litoria olongburensis recovery plan and the Litoria olongburensis threat abatement plan*

g. *Performance and completion criteria for evaluating the management of the offset area/s and criteria for triggering remedial action (if necessary)*

h. *A program, including timelines to monitor and report on the effectiveness of the management measures, and progress against the performance and completion criteria*

i. *A description of potential risks to the successful implementation of the offset/s, a description of the contingency measures that would be implemented to mitigate against these risks and residual risk ratings.*

All of these matters are addressed in this OMP. An annotated checklist explaining where these matters are addressed is provided in Appendix A of this report.

The SCAEP EIS considered environmental impacts from the proposed activities on surrounding values, including Wallum Sedgefrog habitats within the immediately adjacent Mount Coolum

National Park and Wallum Heath Management Area (WHMA) (EcoSmart Ecology 2014). The EIS assessment considered all foreseeable impacts, including both site-specific impacts as well as general threats documented in the Species Profiles and Threats Database (SPRAT) and Wallum Sedgefrog Recovery Plan (Meyer *et al* 2006). Impacts such as light spill, feral predators, disease, inappropriate fire regimes, traffic etc., were considered minor within the context of the SCAEP, while other impacts such as altered water quality (nitrification/salination), habitat loss, noise pollution and groundwater draw-down were considered more serious. Measures addressing/mitigating these impacts are identified in the SCAEP EIS. This EIS and the impact assessment and mitigation measures for Wallum Sedgefrog contained therein have been accepted by the DEE.

The offsets outlined in this document occur within the EIS assessment area and help address residual impacts (i.e., the loss of breeding habitat) associated with the SCAEP. This document does not attempt to reassess impacts/threats associated with the SCAEP, but outlines measures and criteria for the successful delivery of offsets required under the EPBC Act to offset residual impacts of the SCAEP on Wallum Sedgefrog breeding habitat (i.e., the creation of new areas of Wallum Sedgefrog breeding habitat within the SCA).

1.1 DATA SOURCES

This OMP was prepared using data from a variety of published and unpublished sources. Key information/data sources used in the preparation of this plan are outlined in Table 1.1. Commentary on the reliability/limitations of data and associated risks to achieving the objectives of this plan are included in this table.

Table 1.1. Key data sources used to formulate the current OMP.

Source(s)	Relevant data/information	Reliability	Limitations	Associated risks
Federal recovery plan (Meyer *et al* 2006) and survey guidelines (DEWHA 2010) for the Wallum Sedgefrog	• Habitat usage and habitat requirements • Breeding requirements • Threats • Appropriate survey methods	Moderate - High	Elements of the national recovery plan require updating and may no longer be entirely accurate/correct.	Minimal, as more up-to-date/accurate information has been obtained from other sources (i.e., newly published scientific studies and wallum sedgefrog experts).
Published scientific literature	• Habitat usage and habitat requirements • Breeding requirements	High	None identified	Minimal
Expert advice/ opinion (provided by Dr Edward Meyer and Dr Katrin Lowe)	• Biology and habitat requirements • Threatening processes/response to disturbance • Survey methods	High	None identified	Minimal
SCAEP EIS	• Existing habitat values for Wallum Sedgefrog at SCA and adjoining lands • Abundance, distribution and recruitment of Wallum Sedgefrogs at SCA and adjoining lands • Impacts of proposed development on existing habitat values at SCA and adjoining lands	High	Evaluation of habitat values, abundance and recruitment are based on surveys under wetter-than-average conditions, EIS data may therefore overestimate the extent of breeding habitat, Wallum Sedgefrog abundance under normal/drier conditions. Mapping of habitat values does not differentiate between areas of higher and lower quality breeding habitat.	Minor, as offset calculations based on extent and condition of cleared habitat under unusually wet conditions. (i.e., estimated habitat loss represents a 'worst case' scenario).

Source(s)	Relevant data/information	Reliability	Limitations	Associated risks
	• Information on existing soil and groundwater conditions at SCA			
Pre-construction acid frog monitoring (2016/17)	• Existing habitat values for Wallum Sedgefrog at SCA and reference sites outside of SCA. • Abundance, distribution and recruitment of Wallum Sedgefrogs at SCA and reference sites outside of SCA	High	Pre-construction monitoring surveys undertaken during the 2016/17 wet season may underestimate Wallum Sedgefrog habitat values (abundance and recruitment) due to poor rainfall through 2016 and early 2017.	Minimal, as offset calculations are based on the assessment of habitat values and mapping under unusually wet conditions (i.e., surveys undertaken in 2012 for the EIS).
Pre-construction groundwater monitoring	Variation in groundwater levels at offset and reference sites. Ground water quality (pH, tannin-staining and salinity) at offset and reference sites.	High	The current dataset reflects conditions during a period of unusually low rainfall (i.e., late 2016/ 2017).	Moderate. Additional data on groundwater levels (under wetter conditions) will further inform pond design and help to ensure ponds constructed in offset areas retain water long enough to support successful recruitment of Wallum Sedgefrogs. Ongoing monitoring of groundwater level data is also important for detecting development impacts on offset site values (i.e., drawdown of groundwater tables), and for assessing the performance of constructed ponds. Data on groundwater quality are also important for assessing the suitability of offset sites for breeding and will be used to assess development impacts on water quality at offset sites. Frequent maintenance (see Section 5.1.1) will significantly reduce the risk of logger malfunction leading to data loss.

Source(s)	Relevant data/information	Reliability	Limitations	Associated risks
Pre-construction soil investigations	Soil conditions (including depth to indurated layers, sand and clay content) within proposed offset areas.	Moderate-high	None.	Minimal, as available data indicate soils in offset areas are suitable for the creation of breeding ponds for Wallum Sedgefrog.
Pre-construction surface hydroperiod monitoring	Data on pond hydroperiod in areas of existing Wallum Sedgefrog breeding habitat (used to assess the performance of constructed ponds).	High	Available pond hydroperiod data at reference sites are limited to 2017. However monitoring will continue until pond construction (2019)	Minimal. While pond hydroperiod provides a useful insight into the likelihood of successful breeding based on water depth/duration, successful breeding can be demonstrated directly through recruitment observation. As the completion criteria provided in this plan are *comparative* within any given year (i.e., offset pond hydroperiod compared to retained/reference sites) any data limitations will not affect outcomes. Frequent maintenance (see Section 5.1.1) will reduce the risk of logger malfunction leading to data loss.

2.0 OFFSET REQUIREMENTS AND LOCATION

2.1 LAND-BASED OFFSET REQUIREMENTS

Baseline surveys for the SCAEP located Wallum Sedgefrogs in both remnant and non-remnant areas of wet heath and sedgeland within the WHMA and nearby helicopter training area. Within the northern and central regions of the WHMA, frogs were associated with RE 12.2.15 (closed sedgeland), as well as isolated low-lying areas of RE 12.2.12 (closed heath on waterlogged soils). These habitats will not be directly impacted by the SCAEP. Within the southern portion of the WHMA and at the helicopter training area, frogs were predominantly located in non-remnant, regrowth wet heath (Figure 2.1).

The SCAEP will result in the loss of 1.67 ha of non-remnant Wallum Sedgefrog breeding habitat at the SCA, mostly from the south of the Wallum Heath Management Area (WHMA) (Figure 2.2). At the time of assessment (2012), vegetation in these southern habitats was comparable to other stable Wallum Sedgefrog populations within the region, despite being non-remnant. Based on this, stocking rates, and site context, a habitat quality score of 7 has applied in the EPBC offset calculator guide (see Appendix B).

Data from the SCAEP EIS shows Wallum Sedgefrog habitat which will be lost generally supports lower densities of Wallum Sedgefrogs and reduced breeding potential due to less extensive and persistent surface water compared with Wallum Sedgefrog habitat elsewhere within the SCA (due in large part to drainage channels previously constructed in the south of the WHMA) (EcoSmart Ecology 2014). Upright (terete) sedges favoured by Wallum Sedgefrogs (see Shuker and Hero 2012) are also less abundant in this area compared with habitat elsewhere within the SCA. Areas of Wallum Sedgefrog habitat lost to development therefore have lower long-term value than retained habitat at the SCA.

Observations during recent surveys in 2017 reveal a marked increase in tree cover in the south of the WHMA since the completion of EIS surveys in 2012, with the emergence of dense tall *Melaleuca quinquinervia* regrowth (EcoSmart Ecology 2018 *unpublished*) in and adjacent areas of mapped Wallum Sedgefrog breeding habitat. This increase in tree cover is likely to have increased evapotranspiration and drawdown of ground water, further reducing the amenity of habitat for Wallum Sedgefrog in the south of the WHMA. The habitat quality score currently assigned to areas of lost habitat, which was based on EIS survey data from 2012, may therefore overestimate the value of Wallum Sedgefrog breeding habitat requiring offsetting. Surveys in 2018 (subject to suitable rainfall) will collect additional data on habitat usage/values in the south of the WHMA and allow this score to be re-evaluated if necessary.

With a habitat quality score of 7 (based on EIS survey data from 2012), the loss of habitat from the south of the WHMA will be offset by creating 2.3 ha of new Wallum Sedgefrog breeding habitat within the SCA precinct. Wallum Sedgefrog breeding habitat will be created north-east of the new runway, in proximity to areas of retained heathland in the north of the WHMA (see Section 2.2.1 for details). It is anticipated that newly-created breeding habitat, which will be located in dry heathland currently unsuitable for breeding Wallum Sedgefrog, will be of higher quality than that being lost and, as such, will achieve 100% of the project's offset requirements for residual impacts on Wallum Sedgefrog.

The area required for offsetting (2.3 ha) is derived from calculations in the EPBC Act *Offsets Assessment Guide* which takes into account the quality, context and stocking rates of lost habitat and offset areas. A detailed justification of offset calculations is provided in Appendix B.

Figure 2.1
Wallum Sedgefrog breeding habitat and associated vegetation communities identified during the SCAEP EIS

Scale:
1:5,615
0 0.1 0.2
Kilometers

ecosmart ECOLOGY

2011/5823 Sunshine Coast Airport Extension - Wallum Sedgefrog Offset Management Plan

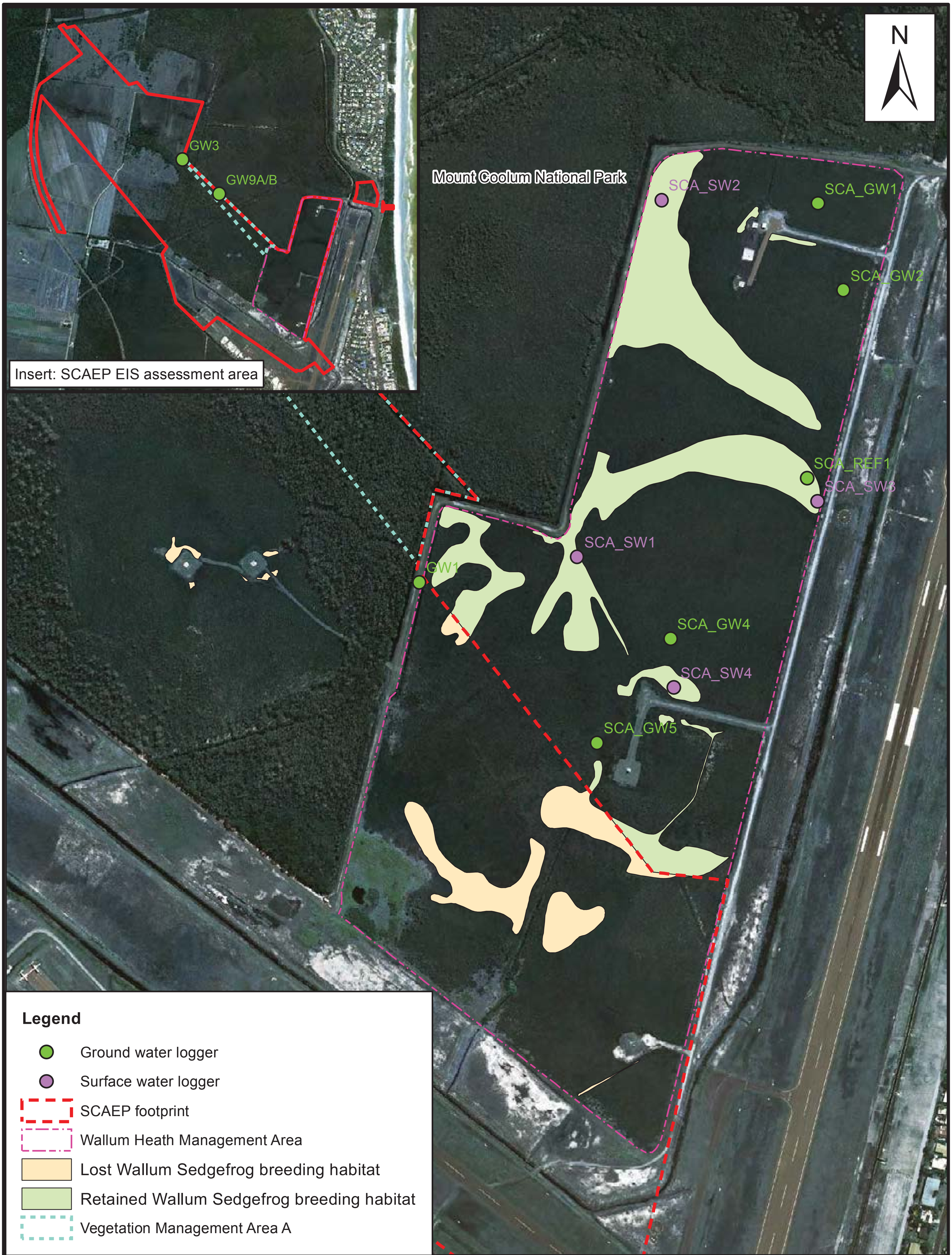


Figure 2.2.
Retained and lost Wallum Sedgefrog breeding habitat at the SCA

Scale:
1:5,571
0 0.1 0.2
Kilometers

ecosmart ECOLOGY

2.2 SCA Offset Location and Context

It is expected that EPBC Act offset obligations will be met through the creation of 2.3 ha of new Wallum Sedgefrog breeding habitat on SCA land at Marcoola. Habitat for Wallum Sedgefrogs will be created by constructing vegetated ponds in areas of sandy, siliceous soil with shallow acidic ground water (<1 m BGL) close to, and near contiguous with, existing breeding habitat on SCA land north-east of the proposed runway.

2.2.1 Offset location

Wallum Sedgefrog breeding habitat will be created within the WHMA and on SCA land north-east of the new runway, in areas of regrowth heath and melaleuca open forest currently unsuitable for breeding/recruitment of Wallum Sedgefrogs. Offset sites within the SCA, shown in Figure 2.3, include areas of regrowth coastal heath in the northern portion of the Wallum Heath Management Area (WHMA) and a wedge-shaped area of mixed heath/melaleuca woodland (RE 12.2.7) to the immediate north of the northern perimeter drain (hitherto referred to as Vegetation Management Area A).

Both these areas lie within the SCA precinct which will be secured by a 2m high chain-wire perimeter fence monitored by SCA staff on a daily basis. This fence will preclude members of the public and larger pest animals such as pigs, cats and foxes from accessing offset areas. Offset areas are also separated from existing and future airport operations by drains and land buffers (i.e., runway aprons typically >50m in width) ensuring the risk to created ponds from pollutants, transported by surface flow, is negligible.

Appropriate buffers to the offset areas have been included to manage impacts to created offset habitats. The minimum distance from the hardstand area of the runway and Vegetation Management Area A is 170m. A 3m wide perimeter track will be located a minimum of 30m from Vegetation Management Area A. The northern perimeter drain runs along the southern edge of Vegetation Management Area A and WHMA, effectively capturing and diverting surface water runoff from the runway strip and the perimeter track.

The offset delivery areas for pond creation in the WHMA are located over 500m from the edge of works for the new runway. To the east is the existing runway alignment. There is an existing drain that runs along the edge of the existing runway strip to capture and divert surface water runoff from entering the offset area.

Vegetation Management Area A and the WHMA will be slashed (as needed) and, where necessary, cleared to allow construction of at least 10 vegetated ponds covering a total area of no less than 2.3 ha to provide offset breeding habitat. This figure represents ~28% of the total combined area available within the two sites located in WHMA and Vegetation Management Area A (i.e., 0.52ha + 1.91ha + 5.4 = 8.27 ha; see Figure 2.3 for details). An indicative layout showing the approximate location of breeding ponds is provided in Appendix C. The entire 8.27ha will be managed for Wallum Sedgefrog and legally secured in perpetuity as discussed in Section 3.1.

Legend

- Existing Ground water logger
- Existing Surface water logger
- Existing Eastern Drain
- Proposed Northern Perimeter Drain
- Indicative Airside Fence
- Indicative Exclusion Fence (2m high,
- Augmentation of existing habitat through the creation of breeding ponds to form a mosaic of wet/dry heath
- Creation of wet/dry heath mosaic; breeding pond creation and ongoing management of tall woody species
- Lost Wallum Sedgefrog breeding habitat
- Retained Wallum Sedgefrog breeding habitat
- Sign Placement Zone (indicative)

Figure 2.3

Areas available (shown in blue and yellow) for receiving offset ponds within the SCA

Scale:

1:6,767

0 0.1 0.2
Kilometers

ecosmart ECOLOGY

As shown in Figure 2.3, proposed offset areas lie immediately adjacent Mount Coolum National Park and are situated close to and/or are contiguous with areas of retained Wallum Sedgefrog habitat within the SCA (in the north-west and centre of the WHMA). The ponds will be created in an area that does not currently provide breeding ponds. These ponds will be located between existing ponds located on SCA land and adjacent, remnant wallum habitats to the north and west associated with the Mount Coolum National Park.

2.2.2 Soils and Groundwater

Preliminary soil and groundwater investigations within proposed offset areas have confirmed the presence of low nutrient, sandy soil situated above an indurated, organic hardpan layer approximately 90-100 cm below ground level (BGL). Groundwater acidity and tannin-staining levels measured during these investigations are consistent with conditions favoured by acid frog species (Table 2.1). Offset ponds will be created with the intent to intersect with the groundwater, ensuring suitable water chemistry for Wallum Sedgefrog breeding.

Ongoing monitoring of groundwater levels within the SCA will document seasonal variation in depth-to-groundwater, improving the likelihood that final pond depth will be sufficient to support hydroperiods comparable with retained/reference habitats (see Section 3.2 for details of pre-construction investigations). These factors considered, the probability of offsets succeeding is high.

Table 2.1. Preliminary groundwater bore hole results within the SCA

Bore Label#	Location	Depth to indurated layer (m)	Depth to water (m)	Water pH	Tannic acid equivalent (mg/L)
SCA_GW1	WHMA – proposed offset area	0.92	0.72**	4.3	62.42
SCA_GW2	WHMA – proposed offset area	1.03	0.80**	4.2	62.12
SCA_REF1	WHMA –retained acid frog habitat	1.03	0.63**	4.4	20.09
GW1*	Vegetation Management Area A	1.30	0.52-dry	4.82-7.05	-
GW3*	Vegetation Management Area A	1.0	0.82-1.79	4.92-6.95	-
GW9A/B*	Vegetation Management Area A	1	0.62-dry	6.83-6.7	-

#Locations indicated in Figure 2.2

* Three sampling events since installation; tannic acid equivalence not sampled

** Depth to groundwater measurements at SCA 1, SCA 2 and SCAREF1 were made under unusually dry conditions in December 2016. Groundwater levels are likely much higher under wetter conditions.

2.2.3 Existing vegetation and acid frog habitat values within proposed offset areas

Vegetation within the WHMA offset area comprises regrowth dry closed heath (non-remnant RE 12.2.12) dominated by low shrubs (< 0.5m), including *Boronia falcifolia, Banksia robur, Sprengelia sprengelioides, Philotheca queenslandica, Strangea linearis, Dillwynia floribunda, Phyllota phylicoides,* and *Baeckea frutescens*. The ground layer within the WHMA offset area includes *Xanthorrhoea fulva, Sporadanthus interruptus, Leptocarpus tenax, Empodisma minus* and *Gahnia sieberiana.*

Vegetation within Management Area A is dominated by open heath with mid-dense to dense cover of *Melaleuca quinquenervia*, representing an expansion of RE 12.2.7 into RE 12.2.12. The area retains the characteristics of dry open heath, but with a more dominant tree layer of *Melaleuca quinquenervia* with some areas of *Eucalyptus robusta*.

Proposed offset areas within the SCA are currently unsuitable for breeding due to the scarcity of ponding water and upright sedges favoured by Wallum Sedgefrogs (including *Baumea* spp and *Baloskion pallens*). The amenity of these areas for Wallum Sedgefrog is therefore low and, other than the occasional animal dispersing from habitat elsewhere in the WHMA, these areas have little or no value as Wallum Sedgefrog habitat.

3.0 OFFSET DELIVERY

3.1 MECHANISM TO LEGALLY SECURE AND PROTECT OFFSETS

All biodiversity offsets required for the SCAEP, including those required for the Wallum Sedgefrog, will be secured in perpetuity in accordance with the Queensland *Environmental Offsets Act 2014* (Environmental Offsets Act). The offset areas have been legally secured and SCA has signed an agreed delivery arrangement with the Queensland Department of Environment and Science (DES) for delivering acid frog offsets on the land. The 2.3 ha of constructed Wallum Sedgefrog breeding habitat will be protected, along with an additional 5.97 ha surrounding the breeding habitat (as identified in Figure 2.2). This additional offset may provide foraging habitat and shelter for the Wallum Sedgefrog, as well as aid in connectivity between patches of breeding habitat.

Under Section 30 of the Environmental Offsets Act, SCA will enter into an environmental offset agreement, which requires an Offset Delivery Plan to be approved by the Queensland Department of Environment and Heritage Protection (DEHP). When approved by DEHP the environmental offset protection area will be recorded in the environmental offset register held by the department and recorded against the title for the land by the land registrar. This ensures that the offset protections are recorded in perpetuity and attached to the title of the land so that subsequent owners and managers are aware of the legal protection.

3.2 PRE-POND CONSTRUCTION INVESTIGATIVE ACTIONS

To support successful Wallum Sedgefrog breeding and recruitment, excavated ponds must retain water long enough to allow tadpoles to metamorphose without allowing predatory fish to persist and breed (as is likely if water persists all year round) (Meyer *et al* 2006). Typically, this would mean a pond hydroperiod of around 6-8 weeks. In wallum areas, pond hydroperiod is strongly influenced by soil structure (in particular the presence and depth of indurated material like coffee rock) as well as groundwater hydrology (in particular the behaviour of shallow [<2m in depth], 'perched' aquifers) (see SCA EIS for details). Groundwater and soil properties also influence pond water pH, turbidity, tannin-staining, salinity and aluminium levels, all of which can affect the amenity of constructed ponds and suitability for Wallum Sedgefrogs. Detailed information on groundwater is therefore needed to ensure the design and location of constructed ponds are suitable for Wallum Sedgefrogs. Groundwater investigations, which began in November 2016, will continue up until pond completion criteria have been achieved (see Section 3.6).

Information on groundwater hydrology is being provided by surface water and groundwater monitoring wells established within and adjacent offset areas (see Figure 2.3 for location of wells and monitoring points). Water monitoring points include:

- Two groundwater wells and loggers in the proposed Wallum Sedgefrog offset areas within the WHMA,
- One groundwater well and logger located in retained Wallum Sedgefrog habitat for comparison with the proposed offset area loggers,
- Three groundwater wells and loggers located within Vegetation Management Area A, and
- Three surface water loggers located in retained Wallum Sedgefrog habitat.

Groundwater and surface water monitoring wells were established in late 2016 (Nov/Dec) and early 2017 (March) respectively. Other relevant details informative for pond design including soil profile (depth to indurated layer), ground water pH, and ground water salinity were also collected while installing the wells (see Section 0). Groundwater data collected during the 2016/17 and 2017/18 wet seasons will be provided to the consultant(s) responsible for the design and construction of ponds.

Additional data on ground and surface water quality collected during baseline surveys in the 2016/17 wet season will also be used to identify changes in water quality (i.e., pH, salinity and nitrate levels) requiring corrective actions.

<u>Pond Design</u>

Indicative drawings showing the proposed design and location of ponds, based on existing soil and groundwater data, is provided in Appendix C. The construction of ponds in both the WHMA and Vegetation Management Area A will be guided by a detailed design and construction plan completed prior to pond construction. The pond design plans will show the location, extent and bathymetry of individual ponds. Pond design (in particular pond depth) will be guided by data from groundwater loggers already deployed at SCA as well as expert advice from the acid frog specialist. Existing habitat, both for Wallum Sedgefrog and other conservation significant species, will be clearly indicated within the plan as exclusion areas. The design and layout of constructed ponds must allow for:

- A minimum of 10 ponds with a combined area of 2.3 ha, scattered throughout the WHMA offset area and Vegetation Management Area A,
- Ponds no smaller than approximately 100m^2,
- A fall from existing ground level to the pond floor at a slope of no more than 1:3,
- The expression and persistence of groundwater within ponds, so as to allow successful recruitment of Wallum Sedgefrogs (but not leading to permanent inundation). Depth will be informed by the groundwater results collected prior to construction, and
- Areas of dense sedge and sparse-to-moderate sedge cover in and around ponds, including *Baumea rubiginosa*, *B. articulata* and/or *Lepironia articulata* for areas of deeper water, and *Baumea rubiginosa*, *Balloskion pallens*, and *Fimbristylis nutans* for shallower areas.

<u>Pond Construction Timing</u>

Some initial vegetation clearing to facilitate topographical and geotechnical surveys has occurred in 2018 with the bulk of clearing for runway construction (including the removal of woody vegetation in Vegetation Managemnet Area A) to occur in mid-late 2018 (see Section 3.3). No investigative clearing has occurred within the proposed pond offset areas. Once vegetation is cleared, construction works associated with the SCAEP are anticipated to continue for three years. Based on the current construction program, pond construction will occur after the decommission of the sand delivery pipeline and before August 2019, so as to avoid Eastern Ground Parrot breeding (a species protected under Queensland legislation). This timeframe will also allow the collection of additional groundwater data needed to inform pond design, including changes in groundwater levels following the removal of woody vegetation within an adjacent Vegetation Management Area A (scheduled for mid-late 2018).

3.3 Site Preparation and Pond Construction

<u>Site Preparation</u>

Prior to pond construction works, tall woody vegetation (i.e., melaleuca and eucalypt trees) will be selectively removed from Vegetation Management Area A. While selective clearing will avoid significant ground disturbance and loss of understorey vegetation, some damage is likely as machinery removes larger trees and grinds stumps. Selective clearing will:

- Where possible mulch woody vegetation outside of Vegetation Management Area A,
- Remove all bulk mulch from Vegetation Management Area A to avoid smothering retained vegetation,
- Re-contour areas of disturbance, as required, to allow ongoing slashing activities (necessary for the control of future regrowth),
- Include supplementary planting where >2 m^2 of soil has been exposed (if required),
- Undertake follow-up weed monitoring and control (see Section 5.4) to ensure weeds to not proliferate following disturbance, and
- Slash retained understory vegetation to a height of 0.5m.

At least one qualified fauna spotter catcher will oversee the removal of tall woody vegetation from Vegetation Management Area A. Damaged vegetation is expected to recover quickly negating the need for detailed revegetation, monitoring and prescriptive weed control. Selective clearing is scheduled for mid-2018.

Once Vegetation Management Area A has been prepared (i.e., all woody timber removed), signs highlighting the significance of offset areas will be placed at 50m intervals around the perimeter of this area. These signs will stipulate that access to offset areas is restricted and requires approval from SCA management. Similar signs will also be placed around the WHMA.

<u>Pond Construction</u>

In order to minimise damage to surrounding vegetation, ponds will be excavated using light machinery (< 5 tonnes in weight). Damage to vegetation will be further reduced by minimising movement in and around constructed ponds, and reusing previous access routes rather than moving across undisturbed areas of vegetation. Excavated soil will not be stockpiled within areas of retained heath habitat or Eastern Ground Parrot habitat.

3.4 VEGETATION ESTABLISHMENT

Once excavated, ponds will be planted out with sedge species favoured by the Wallum Sedgefrog (including *Baumea rubiginosa*, *B. articulata*, *Lepironia articulata* and *Baloskion pallens*) at a density of no less than 1 plant/m^2. These sedge species already occur within areas of existing Wallum Sedgefrog habitat in the north and centre of the WHMA and are likely to establish quickly under suitably wet conditions. Where necessary (i.e., under drier conditions), newly-planted stock will be watered to ensure sedges establish quickly.

Vegetation monitoring is discussed in Section 5.3 and will commence prior to pond construction (at retained habitats). Supplementary planting will be triggered if (1) after 24 months from planting sedge cover is less than 50% compared to reference sites, and shows little sign of improving, and/or (2) a stochastic event (e.g., drought) causes sedge death reducing cover to less than 50% of retained habitats and reference sites.

3.5 WEED CONTROL

Weed species within or adjacent the WHMA and Vegetation Management Area A are currently restricted to the perimeter and along a single access track to the VHF Omnidirectional Radio. Weeds are largely absent from the heath vegetation into which offset ponds will be created. Weed introduction and spread within the SCA is most likely during the construction of the SCAEP and following ground disturbance for the creation of artificial ponds. To reduce the risk of weed infestation at constructed ponds, or in areas of retained Wallum Sedgefrog habitat, the entire Vegetation management Area A and WHMA will be subject to weed control actions outlined below. Weed control actions and monitoring will commence prior to site preparation and continue until end of approval (30 June 2046).

Table 3.1. A summary of weed control measures, triggers and timing for application across the WHMA and Vegetation Management Area A.

Phase/period	Trigger	Method/approach	Timing
Site preparation/ Pre-pond construction	• High risk weed species, • Medium risk weed species infestation < 500m^2	• Hand removal • Possible preparation of weed management plan and implementation of controls therein.	• Weed infestations subject to hand removal to be eliminated prior to pond construction, • Weed management plan (if required) completed prior to pond construction
Pond construction	New outbreaks attributed to pond earthworks	• Hand removal	During pond planting, which will occur immediately following pond earthworks.
Post pond construction/ ongoing	• High risk weed species, • Medium risk weed species with infestations < 500m^2, and/or • Infestations whose extent has increased by >10% from baseline weed mapping	• Hand removal (if feasible) • Possible preparation of weed management plan and	• Hand removal or weed management plan completed within two months of outbreak/trigger detection

	(completed prior to SCAEP clearing)	implementation of controls therein.	• Timing included in weed management plan for weed control.

While the above triggers and controls apply to the broader WHMA and Vegetation Management Area A, weeds will be specifically controlled at created offset ponds. At these locations (i.e., the pond and a 2m buffer) any weed found to exceed 5% cover will be controlled as per measures in Section 3.5.4. The presence and density of weeds at constructed ponds will be detected during vegetation monitoring (see Section 5.3)

3.5.1 Weed control pre-pond construction

Prior to 30th July 2018 or clearing for the SCAEP (whichever occurs first), a weed assessment will be undertaken to identify and document existing weed infestations within and adjacent (100m buffer) to the WHMA and Vegetation Management Area A. This assessment will:

- Document the occurrence of declared exotic species, as well as native species and non-declared exotic weed species which may adversely affect Wallum Sedgefrog habitat (e.g., Singapore daisy, groundsel bush, whisky grass, signal grass and love grass),
- Document weed species density within affected areas, and
- Include a risk assessment of each weed species with regard to their potential to impact dry and wet heath habitats.

Data from this initial assessment will be used to generate mapping in ArcGIS showing the extent and location of weed infestations which will be used to identify priority areas for weed control and monitoring. This mapping will be updated annually to identify changes in the distribution of weed species and develop specific and measurable triggers for weed control. Mapping of weed distribution will also be used to assess the efficacy of weed control measures.

High risk weed species, and medium risk weed species with infestations <500m^2, will be subject to control measures within 60 days of the assessment or 30 days prior to pond construction (whichever occurs first). Weed monitoring to commence approximately six months after the completion of the weed map and continue until end of approval (see Section 5.4).

3.5.2 Weed control during pond construction

During pond construction the following measures will be implemented to reduce the risk posed by weeds:

- All vehicles and machinery entering the WHMA and Vegetation Management Area A must be free of plant material, coarse debris and soil as per Biosecurity Queensland's clean down procedures,
- All vehicles entering the WHMA and Vegetation Management Area A will be inspected prior to commencing work in these areas in order to ensure compliance with these procedures, and
- Machinery operating on site will not be allowed to move from weed-affected areas to areas of retained or newly created Wallum Sedgefrog habitat.

Pond earthworks are likely to be completed within a matter of days or weeks, and no direct weed control during this time is required. Planting of native sedges/heath will commence immediately following earthworks and any new infestations attributed to recent pond earthworks will be controlled at this time. Weed monitoring, which will commence prior to pond construction, will continue until end of approval to identify and control weed outbreaks before they become widespread.

3.5.3 Weed control following pond construction

High risk weed species, medium risk species which may be easily removed avoiding potential future spread (e.g, areas with an extent of <500m^2), or infestations which have grown by > 10% (compared with baseline and subsequent updated mapping) will be subject to control measures within two months of detection. Control of weed outbreaks/infestations will continue until they have been eliminated and/or no longer pose a threat in areas of Wallum Sedgefrog habitat.

3.5.4 Weed Control measures

Where feasible, small weed infestations will be removed using low-impact removal methods. Such methods include hand removal of weeds and wick-application of herbicides, and any other application methods that avoid direct or indirect contact with frogs or surface water. Where hand removal and wick-application of herbicides is impractical, spot spraying may be used to control weed infestations, but not while surface water is present in areas of known or potential Wallum Sedgefrog breeding habitat. Under wet conditions, spot spraying will not be allowed within 50 m of breeding areas (retained or created) or connecting floodways. To avoid any impact on Wallum Sedgefrogs and Matters of State Environmental Significance within the WHMA and Vegetation Management Area A (i.e., the Wallum Froglet, Wallum Rocketfrog and Eastern Ground Parrot), herbicide application will not occur without prior approval from acid frog specialist and a consultant ecologist with expertise in Eastern Ground Parrot.

In order to minimise impacts on acid frog and Eastern Ground Parrot habitat values, weed control within the WHMA and Vegetation Management Area A will be conducted on foot or, where necessary, using a quad-bike and trailer. Larger equipment may be used around the perimeter of these areas.

In some situations the risk of weed infestation or risk from weed control on Wallum Sedgefrog values may be unacceptably high, for example:

- A weed species has been recorded and continues to spread, or shows no evidence of reduction, despite control efforts, and
- Hand-removal methods are proving ineffective and other application methods may be required in close proximity to Wallum Sedgefrog habitats.

Under such circumstances, a specific weed control plan will need to be prepared in consultation with a weed specialist, the acid frog specialist, and a consultant ecologist with expertise in Eastern Ground Parrot.

<u>Weed Control Plans</u>

Within 60 business days of a weed management plan trigger (see above), a weed control plan will be developed for the SCA by a suitably qualified ecologist and include:

- Control measures for individual weed species/and or outbreak areas,
- An assessment of short and long-term risks of control measures for adult Wallum Sedgefrogs and their tadpoles,
- Measures to reduce or avoid the identified risks to Wallum Sedgefrog if unacceptably high including alternative control measures (if available),
- A schedule outlining the implementation of control measures which, where possible, should implemented within two months of a triggering event (unless otherwise justified within the plan),
- Factors which may limit weed control success or timing (e.g., rainfall, strong wind and/or presence surface water in frog breeding areas),
- Triggers for further control action and completion criteria, and
- Any additional monitoring (beyond that described in Section 5.4) to document success or trigger further control actions.

Weed control plans will be developed in conjunction with, or reviewed by, the acid frog specialist (see Section 7.1). Weed control will be implemented until monitoring has demonstrated the absence of weeds for a period of 24 months Where necessary, additional weed control plans may be developed, or existing plans updated.

3.6 Pollutants

With the exception of the sand delivery pipeline, all construction activities and airport operation will be separated from offset areas by (i) the installation of a low-permeability liner underneath the new runway, (ii) construction of the northern perimeter drain and associated cut-off wall south of proposed offset areas (see Section 8.15.3 in Chapter B8 of the SCAEP EIS for details), and iii) the existing drain along the western boundary of the WHMA (see Figure 2.3). Movement of pollutants/contaminants east- and northwards from the runway construction and operation will therefore be largely eliminated.

The construction and operation of the sand delivery pipeline will include monitoring and maintenance to reduce the risk of failure (outlined in the SCAEP EIS), and heavy machinery used to construct pipelines will be prohibited from operating/entering heath vegetation in the WHMA or Vegetation Management Area A. The risk of adverse impacts to the WHMA and Vegetation Management Area A is therefore small.

In the unlikely event of a significant spill/leakage event (> 400 L) within 100m of the WHMA or Vegetation Management Area A, targeted monitoring of contaminants/pollutants will be undertaken at existing ground water monitoring sites in and adjacent offset areas to assess possible impacts on ground water quality. Depending on monitoring results, construction of ponds may be delayed to allow remediation of affected areas. If remediation isn't possible or practical, offsets will be created elsewhere (see Section 6.2 for details of contingency measures).

3.7 Ongoing Management Actions

Dense regrowth of *Melaleuca quinquenervia* may reduce the amenity of wet heath/sedgeland habitat for Wallum Sedgefrogs, particularly when trees become taller (>2 m height).

Maintenance of vegetation surrounding the Wallum Sedgefrog breeding ponds within the WHMA and Vegetation Management Area A will therefore be required on an ongoing basis.

Woody regrowth within areas of Wallum Sedgefrog habitat will be managed using the same approach currently used to limit vegetation height within the WHMA for the purposes of aircraft safety (i.e., occasional cut-stump removal of *Melaleuca* and *Eucalyptus* regrowth and infrequent slashing of vegetation to a height of 0.4 m or higher). While likely to result in some mortality of frogs, existing practices for control of woody vegetation are unlikely to pose a significant threat to Wallum Sedgefrog numbers at SCA as cut-stump removal and slashing would occur during dry periods when Wallum Sedgefrogs are more likely to be sheltering at the base of sedges. This view is supported by the persistence and abundance of Wallum Sedgefrogs within the WHMA during EIS surveys as well as the presence of wallum sedgefrogs within areas of slashed heath elsewhere on the Sunshine Coast (see EcoSmart Ecology 2012). To ensure future impacts on Wallum Sedgefrog are avoided, vegetation control within the WHMA and Vegetation Management Area A will occur during dry periods when sedgefrogs are unlikely to be active and sitting out on vegetation, and only if approved by the acid frog specialist (see Section 7.1). Recommendations regarding management of vegetation will be provided in the annual Acid Frog Monitoring Report (see Section 8.0, below) which will include:

- A map showing areas requiring slashing and/or removal of woody regrowth,
- Specific recommendations regarding the type of control necessary (manual removal of emergent regrowth and/or slashing), and
- Specific direction regarding control methods, including the timing and height of slashing. If slashing is required, it will not occur during wet conditions.

Recommendations regarding vegetation management will be implemented within six months following the submission of the annual monitoring report (subject to suitable weather conditions or other constraints imposed by the acid frog specialist).

3.8 Schedule and timing

Breeding ponds will be constructed, after the completion of clearing works and the dredging/placement of sediment for the new runway. Delaying the establishment of the Wallum Sedgefrog breeding ponds until this time, has a number of advantages, including:

- Facilitating the collection of additional groundwater data to inform pond construction and design (under wetter conditions than the 2016/17 wet season, when there was no recruitment of Wallum Sedgefrogs at SCA due to poor rainfall [EcoSmart Ecology, 2017b]),
- Allowing sufficient time to develop/finalise a detailed pond construction plan including detailed design drawings (taking into account soil and groundwater data from dry and wet years),
- Allowing agreements with Air Services Australia regarding the tenure and future management of land at SCA to be finalized before ponds are constructed,
- Helping avoid/reduce disturbance of the Eastern Ground Parrot (a conservation significant species listed as Vulnerable under state legislation, which occurs within the WHMA) during this species' breeding season (see Ecomsart Ecology, 2017a for details), and

- Reducing interaction with ancillary pipeline dredging works, thereby avoiding/reducing short-term residual impacts of construction (specifically noise and light pollution) on offset habitat during construction of the runway.

Delaying the construction of ponds is unlikely to jeopardise the persistence/viability of Wallum Sedgefrog populations at or adjacent SCA either, as the 1.67 ha of habitat being lost is not considered critical to the survival of Wallum Sedgefrog populations at SCA or nearby Mt Coolum National Park (see Ecosmart Ecology, 2014).

It is expected that construction of ponds (including planting of sedges) will be completed within three months. Establishment works (watering and weed surveillance/control) will be undertaken to support the establishment of vegetation in and around ponds for 12 months or longer if required (to account for the influence of rainfall/drought on the establishment and persistence of vegetation).

The time to successful offsetting (following the construction of ponds) is likely to be 10 years, although a conservative 20 years has been applied in offset calculations (see Appendix B).

A summary of offset timing is provided in Table 3.2.

Table 3.2. Anticipated pond design and site preparation timing

<table>
<tr><th>Action</th><th>Timing Requirement</th><th>Timing according to current development schedule</th></tr>
<tr><td>Finalise agreement with Air Services Australia regarding tenure and future management of offset areas</td><td>Prior to clearing</td><td>Before June 2018 or SCAEP clearing (whichever occurs first)</td></tr>
<tr><td>Weed control: baseline weed mapping</td><td colspan="2">30th July 2018 or prior to SCAEP clearing (whichever occurs first).</td></tr>
<tr><td>Gather additional groundwater data to better inform pond design (i.e., pond depth/bathymetry)</td><td>Continuous until 1 week prior to commencing ground water analysis</td><td>Nov 20176 - June 2018</td></tr>
<tr><td>Analyse and evaluate groundwater data to determine appropriate pond depth for inclusion in detailed pond design.</td><td rowspan="2">To be completed 30 days prior to commencing pond construction</td><td>July 2018</td></tr>
<tr><td>Develop pond design and construction plan for the SCA</td><td>August/September 2018</td></tr>
<tr><td>Weed control: follow-up weed control (pre pond construction)</td><td>Completed no less than 30 days prior to pond construction</td><td>August/September 2018</td></tr>
<tr><td>Commence and complete construction of ponds (in accordance with the pond design and construction plan)</td><td>After sand delivery pipeline decommission and outside Ground Parrot breeding period (Aug – Nov).</td><td>After December 2018 and before August 2019</td></tr>
<tr><td>Plant/stock constructed ponds with sedges</td><td>Immediately following pond earthworks</td><td>Before August 2019</td></tr>
<tr><td>Weed control</td><td>Ongoing following pond construction</td><td>Ongoing, commencing six months after completion of baseline mapping</td></tr>
</table>

4.0 ENVIRONMENTAL OUTCOMES/COMPLETION CRITERIA

4.1 OBJECTIVE

The objective of this plan is to create 2.3ha of like-for-like (or better), self-sustaining Wallum Sedgefrog habitat to offset the loss of 1.67ha from the SCA. The proposed offset exceeds the minimum offset requirements based on the EPBC offset calculator guide.

4.2 COMPLETION CRITERIA

The success of offsets provided under this plan will be evaluated using measurable Completion criteria, as detailed in Table 4.1.

Baseline data collected during EIS surveys reflect Wallum Sedgefrog habitat values under unusually wet conditions (Section 2.1) and do not account for variation in Wallum sedgefrog abundance and recruitment in response to climatic variation (e.g., lower recruitment and abundance in years with below-average rainfall). Reliance on EIS data for defining measurable performance targets is therefore problematic. To account for variation in Wallum Sedgefrog recruitment and abundance in response to variable rainfall, the performance of offset areas will be compared with reference sites both within and outside of the SCA (see Section 4.3). This approach will allow the performance of constructed ponds to be evaluated more fairly under a range of climatic conditions (i.e., in years with below-average, average and above-average rainfall).

Table 4.1. Offset Completion Criteria

No.	Performance Area	Completion Criteria (measurable and reportable targets)
1	Security and protection of offset areas	• The offset area is legally secured in perpetuity. • The air-side perimeter fence is completed and inspected daily for breaches. • Signs are placed every 50m around the perimeter of the WHMA and Vegetation Management Area A to prevent unauthorised access.
2	Water Chemistry	• Water pH values within constructed ponds are within the range recorded at reference sites*. • Turbidity values within constructed ponds are within the range recorded at reference sites*. • Conductivity/salinity levels within constructed ponds are within the range recorded at reference sites*. • Tannin staining (tannic acid equivalents mg/L) at created ponds are within the range recorded at reference sites*. • The salinity of perched groundwater does not consistently exceed levels recorded within the SCA prior to construction of the SCAEP by more than 20%.
3	Hydroperiod	• Hydroperiod of constructed ponds comparable with that of reference sites. • Constructed ponds hold water long enough to support recruitment of Wallum Sedgefrogs when conditions are wet enough to support recruitment of Wallum Sedgefrogs at reference sites.

No.	Performance Area	Completion Criteria (measurable and reportable targets)
4	Vegetation	Vegetation cover within and around constructed ponds suitable for Wallum Sedgefrog and comparable with reference sites, as indicated by: • A predominance of upright terete sedges (>50% of vegetation cover) and/or • % cover/density of upright sedges at constructed ponds within the range recorded at reference sites. • Vegetation in and around constructed ponds remains free of non-native and native weed species (including declared pest plants) until monitoring is completed.
5	Predatory Fish	Ponds remain free of fish predators (particularly *Gambusia holbrooki*) or do not support fish predators at densities higher than reference sites known to support successful recruitment of Wallum Sedgefrogs.
6	Wallum Sedgefrog abundance	Abundance of Wallum Sedgefrogs at constructed ponds within the range recorded at reference sites under suitably wet conditions (see Section 5.2).
7	Wallum Sedgefrog recruitment	Constructed ponds known or likely to support recruitment (as evidenced by the presence of metamorphs and/or late stage tadpoles with surface water still present) in direct proportion to the number/proportion of reference sites known or likely to support recruitment under suitably wet conditions (i.e., with sufficient rainfall to support breeding). Recruitment is key to self-sustaining Wallum Sedgefrog habitat, and if this criteria is demonstrated then it is assumed all other success criteria have been met.
8	Need for ongoing intervention/management	Constructed ponds continue to provide breeding habitat for Wallum Sedgefrogs without any further intervention/management other than ongoing control of woody regrowth.
9	Area of offset habitat	The area of breeding habitat created within offset areas is 2.3 ha or greater.

*Reference sites include areas of retained habitat within the SCA and sites outside of the SCA known to support successful recruitment of Wallum Sedgefrogs.

If monitoring indicates that the completion criteria cannot be met by the end of the life of the approval, the Department of Environment and Energy will be contacted promptly. In this instance, a new offset will be proposed to address the project's impact on Wallum Sedgefrog habitat.

4.3 Reference Sites

To help gauge the success of constructed ponds, six reference sites have been established within areas of Wallum Sedgefrog habitat inside and outside of the SCA. Four are located in retained habitat within the WHMA while two are located approximately 14km south at Mooloolah River National Park. Mooloolah River National Park has been selected for its access and proximity, known sizeable breeding populations of acid frog species, and has been used to monitor Wallum Sedgefrog numbers in the past (see Lowe, *et al* 2013, 2016). Data collected from reference sites will be compared with data from constructed ponds to determine the success (or otherwise) of constructed ponds in meeting the completion criteria identified in Table 4.1 above.

5.0 MONITORING

A detailed monitoring program will be implemented to determine whether the objectives of this OMP are met and assess if corrective actions are required. This program will include monitoring of ground water levels, surface water levels (pond hydroperiod), water quality, vegetation cover, weeds, and Wallum Sedgefrog abundance and recruitment success. Monitoring will occur within offset areas as well as reference sites identified in Section 4.3. The location of monitoring sites within the SCA is illustrated in Figure 5.1.

All monitoring actions will be carried out annually until the completion criteria have been met (hereafter referred to as the 'maintenance period'), with vegetation, weeds, groundwater quality, and Wallum Sedgefrog monitoring to occur once every five years thereafter until end of approval (June 2046), hitherto referred to as the 'off maintenance' period. If monitoring during the 'off-maintenance' period shows deviation from completion criteria, monitoring will become annual again until the completion criteria is met for a further five consecutive years. Table 5.1 provides a summary of monitoring actions, schedule and timing.

5.1 WATER MONITORING

5.1.1 Ground and surface water level monitoring

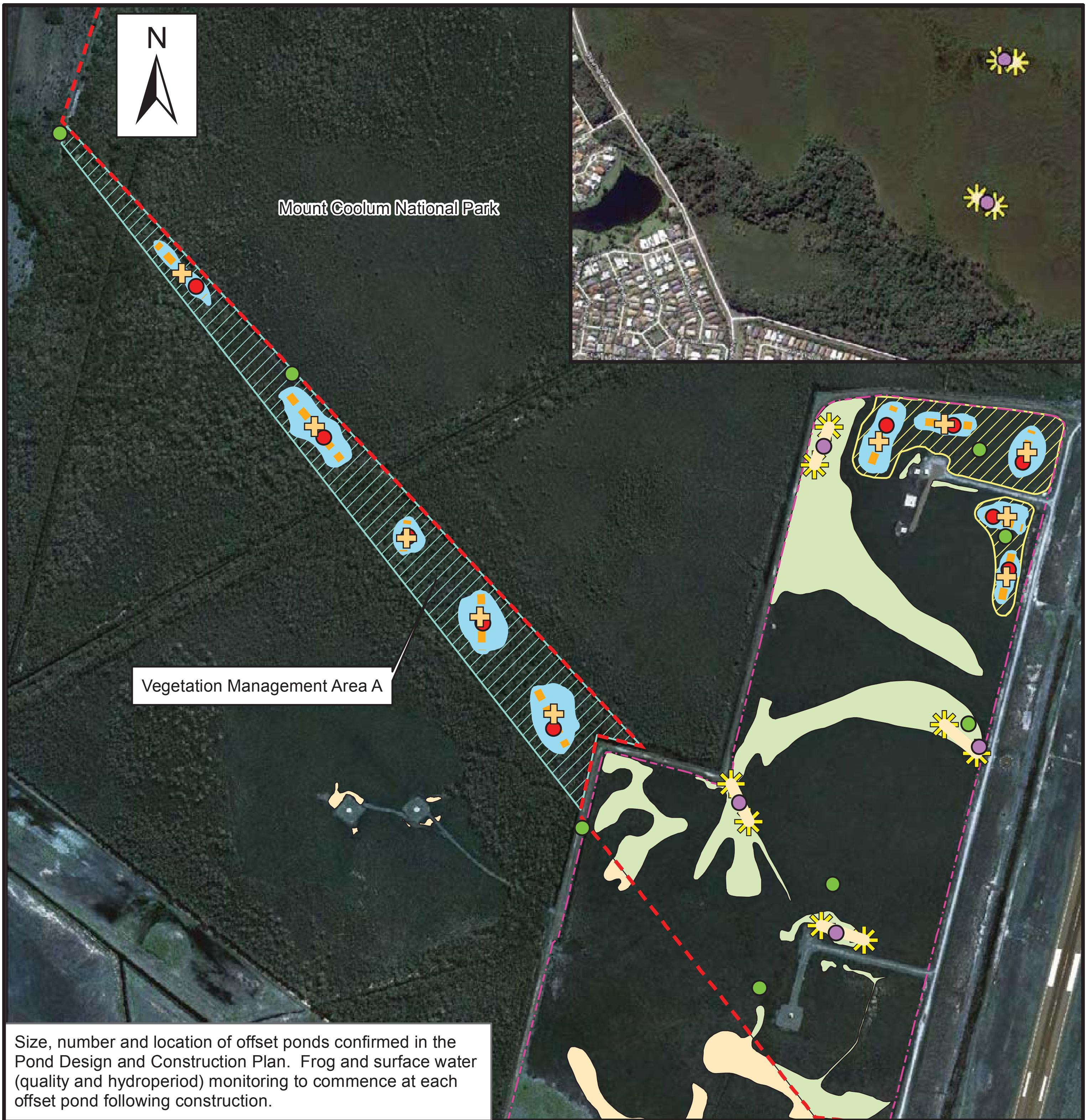
Monitoring Objective: (1) To determine whether the hydroperiod of constructed ponds is comparable with that with that of reference sites, and (2) to collect data on groundwater levels informing pond design (depth).

Performance Indicator: Groundwater levels and pond hydroperiod in offset areas is broadly consistent with that of reference sites in years with near-average or above average rainfall.

Ground and surface water levels will be monitored using capacitance water level loggers set to record water levels on hourly basis. Capacitance logger locations will include:

- Groundwater level monitoring wells at six sites previously established within the SCA (see Section 2.2 and Figure 5.1). These locations have been strategically selected to record data from retained habitat (for comparison with newly-created habitat), within proposed offset areas (to determine appropriate pond design/depth) and within proximity to the proposed runway (to detect possible draw-down or increased salinity impacts resulting from construction of the new runway),
- Six surface water loggers located in proximity to each reference site (i.e., four in the WHMA and two at Mooloolah River NP),
- Surface water loggers at no less than 50% of constructed ponds (once constructed) within the SCA (up to a maximum of ten ponds). Pond selection will consider spatial location and pond design (i.e., large and small ponds).

The depth of created ponds without loggers will be recorded manually during adult and recruitment Wallum Sedgefrog surveys. Data from groundwater/pond hydroperiod loggers will be included within the annual Acid Frog Monitoring Report.



Legend

- Future aural census point (indicative only)
- Future surface water logger (indicative only; 50% ponds - max 10)
- Existing Ground water logger
- Existing Surface water logger
- Existing acid frog monitoring transect
- Future frog monitoring (indicative only)
- Existing acid frog aural census point
- SCAEP footprint
- Wallum Heath Management Area
- Offset pond (indicative only)
- Augmentation of existing habitat through the creation of breeding ponds to form a mosaic of wet/dry heath
- Creation of wet/dry heath mosaic; breeding pond creation and ongoing management of tall woody species
- Lost Wallum Sedgefrog breeding habitat
- Retained Wallum Sedgefrog breeding habitat

Figure 5.1

Existing and future (indicative) monitoring locations at the SCA and Mooloolah River National Park

Scale:

1:6,376

0 0.1 0.2
Kilometers

ecosmart ECOLOGY

Table 5.1. Summary of monitoring actions and timing

Monitoring activity	Management needs/ questions addressed	Parameter/s measured	Where	Commencing	Schedule/Frequency#		Further details
					Maintenance	Off-maintenance	
Ground water level monitoring	• Acquire data on groundwater levels to inform pond design (depth) to ensure constructed ponds intersect groundwater. • Monitor changes in ground water levels affecting surface water expression and pond hydroperiod.	Depth to ground water	Six sites in/adjacent to offset areas and at (one) reference site (within WHMA).	Four groundwater loggers were installed in Nov/Dec 2016 or earlier, two installed in Jul 2017.	• Data recorded hourly. • Loggers checked and maintained on quarterly basis.	No longer needed, other monitoring actions (e.g., Wallum Sedgefrog and vegetation surveys) sufficient to maintain offset integrity.	Section 5.1.1

Monitoring activity	Management needs/ questions addressed	Parameter/s measured	Where	Commencing	Schedule/Frequency#		Further details
					Maintenance	Off-maintenance	
Surface water level monitoring (hydroperiod)	• Determine pond hydroperiod under varying conditions in offset areas and reference sites. • Acquire data on pond hydroperiod to ascertain the likelihood of successful reproduction in constructed ponds and reference sites.	Depth and persistence of surface water.	• Four reference sites within the WHMA. • Two reference sites within Mooloolah River NP. • At least 50% of pond constructed in offset areas (up to a maximum of 10 ponds).	• Surface water loggers were set up at each of the six reference sites late 2016. • Loggers will be installed at offset ponds upon completion of earthworks.	• Data recorded hourly. • Loggers checked and maintained on a quarterly basis.	Surface water depth measurements taken at frog monitoring locations (i.e., transects through retained/control habitats and constructed ponds) while engaged in adult/recruitment surveys. Detailed logger of water no longer needed as other monitoring actions are sufficient to demonstrate ongoing hydroperiod success.	Section 5.1.1
Ground water quality	Identify any long-term increases in groundwater salinity resulting from construction of the SCAEP.	Conductivity/ salinity	Six sites in/adjacent to offset areas and at (one) reference site (within WHMA).	Four groundwater loggers installed in Nov/Dec 2016 or earlier, two installed in Jul 2017.	Data recorded hourly, checked and maintained quarterly	Once every five years	Section 5.1.2.
Surface water quality	Ensure water quality within offset ponds is comparable with reference sites supporting breeding of Wallum sedgefrogs.	pH, tannin-staining, salinity, turbidity and nitrates.	• Six reference sites: four within the WHMA and two at Mooloolah River National Park. • All ponds constructed in offset areas.	• Monitoring of reference sites commenced late 2017. • Monitoring of water quality in offset ponds will commence once ponds are constructed.	• During each Wallum Sedgefrog survey. • During maintenance and download of water loggers (subject to surface water)	Once every five years	Section 5.1.2.

Monitoring activity	**Management needs/ questions addressed**	**Parameter/s measured**	**Where**	**Commencing**	**Schedule/Frequency#**		**Further details**
					Maintenance	**Off-maintenance**	
Wallum Sedgefrog adult abundance	Determine the relative abundance of Wallum Sedgefrogs offset ponds and reference sites.	Abundance of adult and juvenile/ recently-metamorphosed Wallum Sedgefrogs.	• Six reference sites, four in the WHMA, two at Mooloolah River NP. • Areas of habitat being lost (prior to construction). • All ponds constructed in offset areas.	• Monitoring of reference sites occurred in summer of 2016/17 but was not undertaken in 2017/18. Monitoring to recommence in 2018/19. • • Surveys of offset ponds will begin once construction of ponds is complete.	Adult surveys conducted twice each summer wet season (Oct-April) provided conditions are suitable for detection of Wallum Sedgefrogs.	Two adult surveys conducted during one summer wet season period once every five years	Section 5.2
Wallum Sedgefrog recruitment	If Wallum Sedgefrogs successfully breed/recruited	Presence of metamorphs and/or advanced tadpoles (with sufficient surface water to complete development)			Recruitment surveys to occur 4-6 weeks after *each* adult survey	Recruitment surveys to occur 4-6 weeks after *each* adult survey. (subject to maintenance of surface water)	
Vegetation Monitoring	Ensure establishment of suitable vegetation (terete sedges and other wet heath species) in and around constructed ponds.	Height, species composition and percentage cover of vegetation in and around ponds.	• At each of the six reference sites used for Wallum Sedgefrog monitoring. • At all offset ponds.	• Vegetation monitoring at reference sites will commence during summer 2018/19, • Vegetation monitoring will commence at offset ponds immediately after the completion of offset ponds.	• Once each summer following the wet season at reference sites. • Once each summer at offset ponds following the wet season (quarterly condition checks within 24 months after planting).	Once every five years, following the wet season.	Section 5.3

Monitoring activity	Management needs/ questions addressed	Parameter/s measured	Where	Commencing	Schedule/Frequency#		Further details
					Maintenance	Off-maintenance	
Weed Monitoring	Identify and control weed outbreaks in and around ponds constructed in offset areas.	• Existing/current weeds present and their extent, • New weed infestation. • Increases in existing weed infestations.	• Throughout the WHMA and Vegetation Management Area A	Baseline survey and weed map conducted prior to 30 July 2018 or SCAEP clearing (whichever occurs first).	Biannual in the 24 months following completion of pond earthworks; annual thereafter.	Once every five years.	Section 5.4

#Maintenance period = the period until completion criteria are achieved; off-maintenance period = the period from success until end of approval (30 June 2046)

Timing and Frequency: Groundwater and surface water monitoring at reference sites has already commenced. Groundwater monitoring has also commenced at offset sites, and surface water monitoring in offset ponds will begin once pond construction is complete. Water loggers, which operate continuously, will be checked and maintained quarterly until completion criteria have been achieved. Other monitoring actions (e.g., acid frog monitoring, vegetation monitoring) will be sufficient to ensure ongoing value of offset areas until end of approval (2046).

Risks: Accurate monitoring of water levels may be jeopardised if loggers are damaged or become inoperable.

Mitigation: Quarterly downloads will allow logger condition to be checked. Loggers damaged or no longer operational will be replaced/repaired within 20 working days, subject to logger availability and suitable conditions.

5.1.2 Surface and ground water quality monitoring

Monitoring Objective: (1) To demonstrate surface water chemistry in constructed ponds is consistent with Wallum Sedgefrog breeding habitat, and (2) to identify any adverse impacts on ground and/or surface water quality in retained and/or offset habitat from the SCAEP.

Performance Indicator: (1) Surface water chemistry parameters (pH, turbidity, tannin-staining, conductivity/salinity, nutrient levels) in constructed ponds is within the range recorded within existing Wallum Sedgefrog breeding habitat at reference sites (including areas of existing habitat within the SCA prior to construction of the new runway, and reference sites outside of the SCA), and (2) the salinity of perched groundwater does not consistently exceed levels recorded within the SCA prior to construction of the SCAEP by more than 20%.

The amenity of artificial breeding habitat for Wallum Sedgefrogs will depend on surface water quality within ponds, in particular pH and tannin-staining levels (with low pH and heavy tannin-staining limiting competition with ecologically-similar sibling species). Surface water quality (pH, tannin-staining, turbidity, nitrates and salinity) will therefore be monitored at each constructed pond as well as reference sites within and outside the SCA. Monitoring ground water for salinity will also help to ensure mitigation measures aimed at avoiding impacts on groundwater salinity north of the new runway (identified in the EIS) are effective.

Measurement and analysis of water chemistry will be undertaken during Wallum Sedgefrog monitoring surveys and, providing surface water is present, while downloading data from capacitance water loggers. Groundwater and surface quality water monitoring will continue until constructed ponds support successful recruitment of the Wallum Sedgefrog and all completion criteria have been achieved. Ongoing monitoring will occur at 5 year intervals following this until the end of the life of the approval.

Risks: None. Measurement of water quality requires the presence of ground and/or surface water. Prolonged dry spells may limit access to surface and/or ground water, therefore reducing the frequency of surface and groundwater sampling.

Mitigation: None possible, as the availability of surface and ground water is dependent on rainfall.

5.2 WALLUM SEDGEFROG MONITORING PROGRAM

Monitoring Objective: To (1) determine the presence and abundance of Wallum Sedgefrogs at offset ponds, and (2) document breeding and successful recruitment of Wallum Sedgefrogs within constructed ponds under suitably wet conditions, and (3) determine the presence, or otherwise, of predatory fish species within constructed ponds.

Performance Indicators: (1) Wallum Sedgefrog abundance comparable with or greater than that at reference sites, (2) successful breeding within constructed ponds as indicated by the presence of juvenile Wallum Sedgefrogs or late stage tadpoles (while ponds continue to hold sufficient water to allow late stage tadpoles to complete their development), and (3) exotic predatory fish (*Gambusia holbrooki*) absent or rarely present at very low densities (e.g., after extreme rainfall events, when predatory fish may temporarily colonise constructed ponds and areas of retained habitat in the WHMA) .

Adult and Metamorph Surveys

Targeted surveys will be undertaken to assess the abundance of Wallum Sedgefrogs at constructed ponds and reference sites within and outside the SCA (see Section 4.3 for location of monitoring sites). Surveys to determine the abundance of Wallum Sedgefrogs will be undertaken within 14 days after heavy rainfall resulting in inundation of breeding habitat in spring, summer or autumn.

Monitoring of Wallum Sedgefrog abundance in offset areas will commence in summer wet season (Oct-April) following the construction of ponds. Created ponds are likely to be smaller in extent than reference sites (particularly those within the National Park) and therefore sampling will use slightly different methods.

Monitoring of Wallum Sedgefrog abundance at reference sites, which was undertaken during the 2016/17 wet season and will recommence in 2018/19, will be assessed by means of:

- Nocturnal counts of animals seen along 2m-wide x 50 m long strip transects, and
- Five-minute point counts of individuals heard calling within a 30m radius of the start and end points of each transect.

Where 50m transects are not possible at constructed ponds due to size limitations, the abundance of adult, sub-adult and recently-metamorphosed Wallum Sedgefrogs at each pond will be assessed by means of:

- Nocturnal counts of animals seen around the perimeter of ponds,
- Nocturnal counts of animals seen along a 2m-wide strip through the middle of each pond, and
- Five-minute counts of calling individuals heard within a 30m radius of the centre of each pond.

Searches at both constructed ponds and reference sites will be timed to estimate frogs detected per minute and allow data comparison.

Recruitment Surveys

Provided surface water persists, surveys for recruitment (targeting tadpoles/metamorphosing frogs) will be undertaken 4-6 weeks after heavy rain (sufficient to inundate ponds and stimulate breeding) in spring, summer or autumn.

Areas of surface water within constructed ponds and control sites will be dip-netted for tadpoles and the identity and age (developmental stage) of tadpoles recorded. To allow comparison between sites, dipnet surveys will be timed (so that the abundance of tadpoles can be expressed as numbers captured/unit time). A maximum of 20 minutes will be spent surveying tadpoles at each pond/site surveyed. The presence and relative abundance of exotic predatory fish (e.g., *Gambusia holbrooki*) will also be recorded during this work.

Timing and Frequency: Monitoring of Wallum Sedgefrog abundance and recruitment success at reference sites has already commenced. Additional work is also planned in areas of lost Wallum Sedgefrog habitat (in the south of the WHMA) in order to gather additional baseline data on frog abundance and recruitment success in these areas prior to clearing (if possible).

The timing and number of surveys undertaken annually will depend on rainfall and detectability of target species during surveys. Under favourable conditions (i.e., with median or above-median wet season rainfall), nocturnal surveys targeting adult frogs would be carried out twice a year after heavy rain, with follow-up surveys targeting tadpoles/metamorphosing froglets 4-6 weeks later. Under drier conditions (i.e., with below-median wet season rainfall), survey opportunities may be limited and the number of monitoring surveys reduced however at least one Wallum Sedgefrog targeted survey event (including follow-up recruitment) will occur annually.

Annual monitoring to determine the success of artificial breeding habitat (as described above) will continue until constructed ponds support successful recruitment of the Wallum Sedgefrog.

Monitoring of artificial breeding habitat may also be discontinued if, despite suitable rainfall, ponds fail to support recruitment of these species <u>and</u> corrective actions have been implemented without success. If this occurs, the failed offset will be declared to the Department of Environment and Energy as mentioned in Section 4.2.

Once offset success has been achieved, acid frog surveys (adult abundance and recruitment) will occur every five years.

Risks: (1) A lack of rainfall may delay or inhibit Sedgefrog monitoring in years with below-average rainfall, (2) restrictions on air-side[1] access at SCA may on occasion prevent surveys from being conducted within 14 days of rainfall, and (3) delayed procurement of monitoring services may also limit opportunities for survey under suitably wet conditions, particularly in years with poor rainfall.

Mitigation: (1) Monitoring of other environmental parameters (e.g., vegetation growth and weed abundance) will ensure the offset area continues to improve toward future quality until suitable conditions for Wallum Sedgefrog survey are met, (2) the SCA will ensure protocols are developed and resources provided to facilitate access to monitoring sites within 24-48 hours of notice, and (3) procurement of monitoring services will be finalised *prior* to the 30th of

[1] Airside is a federally restricted space and, in addition to access notification, requires detailed background checks or supervision.

September each year and include all works/reporting over the forthcoming monitoring period (through to June the following year).

5.3 VEGETATION MONITORING

Monitoring Objectives: To ensure native vegetation suitable for Wallum Sedgefrog breeding habitat establishes at offset sites.

Performance Indicator: Dense to mid-dense cover of native sedges established in and around constructed ponds, with density of vegetation cover comparable with that at reference sites within retained habitat at SCA and/or reference sites outside the SCA.

Vegetation monitoring will be conducted to assess the establishment of native sedges, and other suitable wet heath vegetation at constructed ponds. For comparative purposes, and to document success, the monitoring will include sampling of vegetation cover within retained Wallum Sedgefrog habitat at the SCA and reference sites outside the SCA (see Section 5.2 for the location of monitoring sites). Vegetation monitoring will include the collection of data on:

- Vegetation density/cover and height at constructed ponds and reference sites,
- Plant species present at constructed ponds and reference sites, and
- The presence of weed species and their density.

Timing and Frequency: Monitoring of vegetation at reference sites will commence in 2018 and occur annually, at the end of the wet season (April-June). Monitoring of vegetation at offset ponds will commence following completion of pond construction and continue until completion criteria have been met. In the first 12 months following planting, vegetation at constructed ponds will be checked quarterly to ensure plantings establish successfully as well as identify the need for any corrective actions (e.g., increased watering, replacement of plants, and/or weed control). Thereafter vegetation monitoring at constructed ponds will occur annually at the end of the wets season (April-June). After completion criterion are met, vegetation monitoring will occur every 5 years until the end of the life of the approval. If this criterion is no longer met at some stage of the approval, appropriate corrective actions will be implemented and monitoring will become annual again until the completion criteria is met for a further two consecutive years.

Risks: There are no foreseeable risks associated with the successful completion of vegetation monitoring.

Mitigation: Supplementary planting/watering will be triggered if (1) after 24 months from planting sedge cover is less than 50% compared to retained habitats and reference sites, and shows little sign of improving, and/or (2) a stochastic event (e.g., drought) causes sedge death reducing cover to less than 50% of retained habitats and reference sites. If the establishment of native vegetation at constructed ponds is compromised by weeds, weed control measures will be implemented to address this.

5.4 WEED MONITORING

Monitoring Objective: To ensure weeds do not reduce the quality of Wallum Sedgefrog habitat or compromise the establishment of native vegetation within constructed ponds .

Performance Indicator: Constructed ponds, the WHMA and Vegetation management area A within the SCA remain free of weed species (both native and/or exotic).

Weed monitoring actions will include:

- Weed surveys and production of a baseline map showing the extent and density of existing weed infestations within and adjacent (100m buffer) to the WHMA and Vegetation Management Area A prior to the 30th July 2018 or commencement of SCAEP clearing (whichever occurs: see Section 3.5 for details).
- Targeted weed surveys undertaken twice each year, commencing approximately six months after baseline surveys, and continuing for 24 months after the completion of pond construction,
- Annual targeted weed surveys commencing 24 months after completion of pond construction and continuing through until pond completion criteria have been met,
- Once pond completion criteria have been met, targeted weed surveys will occur once every five years. The frequency of weed monitoring after completion criteria are met may be increased if weeds subsequently establish in offset areas or areas of retained habitat, and
- A risk assessment of the potential impact/spread into retained and created Wallum Sedgefrog habitats for any new weed species detected during the monitoring. These will be subject to control measures and triggers outlined in Section 3.5.

The risk posed by new weeds/weed infestations to Wallum Sedgefrog habitats will be evaluated by comparing monitoring data with mapping from baseline and previous monitoring surveys showing the location and extent of weed infestation within the WHMA and Vegetation Management Area A.

Weed monitoring will consider not only exotic species, but also invasive native species which may reduce the amenity of constructed ponds for Wallum Sedgefrogs (see Section 3.5.1 for further details). Detected weed species/infestations will be controlled according to the triggers and methods outlined in Section 3.5.

Timing and Frequency: The risk of weed infestation or expansion within the SCA is greatest in the period following soil surface disturbance, and as such targeted weed monitoring will be undertaken biannually in the 24 months following Wallum Sedgefrog pond creation, or in the unlikely event that fire affects vegetation. In subsequent years, weed monitoring will be undertaken annually. More frequent monitoring in high risk areas such as tracks are not necessary as offset ponds will be buffered from weeds by the surrounding native vegetation mosaic.

Risks: There are no foreseeable risks associated with weed monitoring, though the establishment of weeds within constructed ponds may compromise the establishment of native vegetation in offset areas for Wallum Sedgefrog.

Mitigation: Biannual monitoring when ponds are at most risk from weed invasion (i.e., after soil disturbance, before native vegetation has become established) will ensure outbreaks are quickly detected, even if initially underestimated. Stubborn weeds, or weeds that are spreading rapidly, will trigger the preparation and implementation of a weed control plan (see Section 3.5).

5.5 DATA MANAGEMENT

Data from monitoring actions (i.e., ground and surface water monitoring, vegetation monitoring, weed monitoring and Wallum Sedgefrog monitoring surveys) will be collated and stored in an electronic (Excel or Access) database maintained by the rehabilitation consultant (see Section 7.1). Databases will be updated regularly, after each monitoring event, and updated copies sent to the approval holder for safe-keeping and review. Copies of the database(s) will be provided to DEE upon request. Relevant data will be included in the annual Acid Frog Monitoring Report and provided to DEE (see Section 8.1.3).

6.0 Risk Assessment and Contingencies

6.1 Risk Assessment

6.1.1 Risk Assessment Framework

Residual risks associated with offsetting the loss Wallum Sedgefrog habitat at SCA were assessed using the risk assessment framework shown in Table 6.1. With this framework, risks are categorised by qualitative measures of likelihood and the severity of their consequences as described in Table 6.2.

Table 6.1. Risk framework

		Consequence				
		Minor	**Moderate**	**High**	**Major**	**Critical**
Likelihood	**Highly Likely**	Medium	High	High	Severe	Severe
	Likely	Low	Medium	High	High	Severe
	Possible	Low	Medium	Medium	High	Severe
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Low	Medium	High

Table 6.2. Likelihood and consequence

Qualitative measure of likelihood (how likely is it that this event/circumstances will occur after management actions have been put in place/are being implemented)	
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the project
Possible	Might occur during the life of the project
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances
Qualitative measure of consequences (what will be the consequence/result if the issue does occur)	
Minor	Minor risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing low cost, well characterised corrective actions.
Moderate	Moderate risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing well characterised, high cost/effort corrective actions.
High	High risk of failure to achieve the plan's objectives. Results in medium-long term delays to achieving plan objectives, implementing uncertain, high cost/effort corrective actions.
Major	The plan's objectives are unlikely to be achieved, with significant legislative, technical, ecological and/or administrative barriers to attainment that have no evidenced mitigation strategies.
Critical	The plan's objectives are unable to be achieved, with no evidenced mitigation strategies.

6.1.2 Risk Assessment

The offsets prescribed in this document are located within the area evaluated during the EIS. A variety of potential impacts to Wallum Sedgefrog values were considered during the EIS and deemed negligible or adequately mitigated (see Section 1.0). Negligible or appropriately mitigated impacts are not re-assessed here and this assessment considers only specific risks relevant to offset delivery. Residual risks take into consideration triggers and corrective actions for offsetting the loss of Wallum Sedgefrog habitat at SCA, as identified in Table 6.2 below.

Any reference to monitoring actions, investigations and devising corrective actions in Table 6.2 must be carried out be a suitably qualified expert in acid frog ecology.

Table 6.3. Risk Assessment to offset delivery (including triggers and corrective actions).

Threat event or circumstance	Relevant management measures	Residual risk			Trigger detection and monitoring activity/ies	Feasible/effective corrective actions[#]	Timing
		L	C	RL			
Failure to legally secure approved offset site(s).	Negotiate formal agreement with relevant parties to legally secure proposed offset sites.	Rare	High	Low	No agreement is reached or entered into with respect to the tenure of offset properties identified in the OMP, prior to the commencement of works.	• Delay clearing of Wallum Sedgefrog habitat until formal agreement is reached regarding the tenure of proposed offset sites. • Delay clearing if no agreement is reached until alternative offset site(s) have been secured and revise OMP to reflect changed circumstances. Submit revised OMP to DEE for approval.	Offset land to be secured prior to commencement of SCAEP clearing.
Legislative reform prejudices proposed tenure arrangements for offset properties.	Assess implications of impending legislative reform for legally securing tenure for conservation.	Rare	High	Low	Tenure for conservation of offset sites is jeopardised by impending legislative reform.	• Delay clearing until an exemption from legislative reforms is secured. • Delay clearing if an exemption cannot be secured, secure alternative offset site(s) and revise OMP to reflect changed circumstances. Submit revised OMP to DEE for approval.	Offset land to be secured prior to commencement of SCAEP clearing.
Existing soil and groundwater conditions in offset areas are unsuitable for the creation of Wallum Sedgefrog breeding habitat.	Confirm that soil and groundwater conditions in proposed offset areas are suitable for the creation of Wallum Sedgefrog breeding habitat, prior to clearing and construction works.	Rare	High	Low	Soils rich in clay (>5% clay content) Groundwater levels remain below 1 m (BGL) during wet season Groundwater pH >5, saline (> 1 ppt), and/or not heavily tannin-stained	N/A as preconstruction investigations indicate soil and ground water conditions suitable for the creation of Wallum Sedgefrog breeding habitat.	N/A. Actions already completed.
Accurate prediction of suitable pond depth compromised from logger failure	Loggers monitored quarterly and replaced/repaired as required	Rare	High	Low	Logger malfunction identified during quarterly downloaded and maintenance	Loggers replaced/repaired.	Loggers replaced within 20 working days (subject to logger availability).

Threat event or circumstance	Relevant management measures	Residual risk			Trigger detection and monitoring activity/ies	Feasible/effective corrective actions#	Timing
		L	C	RL			
Offset site values are compromised by development impacts on groundwater, surface water and/or pond hydroperiod.	Ensure the implementation of impact mitigation measures outlined in the SCAEP EIS, and successfully avoid adverse impacts on groundwater conditions, pond hydroperiod and surface water quality within offset areas and areas of retained habitat north-east of the new runway.	Rare	High	Low	Corrective actions will be implemented if monitoring data shows the following: • Surface water pH within areas of created artificial acid frog habitat exceeds 5.0*. • Salinity of surface water and ground water within perched aquifers at offset ponds exceed 1 ppt above pre-construction/baseline levels or levels at reference sites (whichever is greater)*. • Hydroperiod of constructed ponds comparable with that of reference sites. • Constructed ponds consistently fail to support recruitment despite recruitment at reference sites under similar conditions.	• Investigate why pond completion criteria have not been met and, if possible, address the factor(s) underlying pond failure. • If the factor(s) underlying pond failure cannot be determined or addressed, additional ponds will be constructed to offset the loss of Wallum Sedgefrog habitat. Where appropriate, additional ponds will be constructed within existing offset areas at SCA or, if necessary, an alternative offset site outside of the SCA (i.e., Lower Mooloola Environmental Reserve).	• Trigger detection and requirement for investigation identified in annual acid frog monitoring report. • Investigations into the cause(s) of water quality and hydroperiod triggers will commence within 15 days of triggers being exceeded. Corrective actions will be implemented within a month of the underlying cause(s) being identified. • Newly created ponds completed within 12 months of confirming failure. • Alternative offset site selected and secured within 24 months of confirming failure.
Failure of native terete sedges to establish in offset ponds	Monitor and manage impacts of drought and the establishment and growth of sedges in constructed ponds.	Rare	Mod	Low	If after 24 months from planting sedge cover is < 50% compared to reference habitats.	• Facilitate recovery of vegetation in constructed ponds through additional planting and watering of	Corrective actions undertaken within three months of recommended intervention (as

Threat event or circumstance	Relevant management measures	Residual risk			Trigger detection and monitoring activity/ies	Feasible/effective corrective actions#	Timing
		L	C	RL			
Creation of Wallum Sedgefrog breeding habitat in proposed offset areas prejudiced by stochastic events (i.e., drought).					Vegetation monitoring shows a significant decline (>50%) in the extent and/or condition of sedges.	newly-planted stock (see Section 3.4). • Investigate hydroperiod and undertake remedial actions (if required). • Acid frog specialist to revise timeline/ scheduling of works in OMP to reflect changed conditions.	determined by the acid frog specialist and reported in the annual monitoring report).
Amenity of offset areas for Wallum Sedgefrogs is compromised by the establishment and spread of 'weed' species and growth of woody vegetation (including Melaleuca trees).	Weed monitoring and control undertaken as per Section 3.5.	Rare	Minor	Low	Weed control triggers and monitoring details provided in Section 3.5. Regrowth of native woody vegetation will be controlled when average emergent height exceeds 2m, or as recommended in the Acid Frog Monitoring report (see Section 3.6). Measures for the control of woody regrowth will be determined on an 'as needed' basis and detailed in the Acif Frog Monitoring report (see Section 3.6)	Implement control measures to reduce the standing biomass of weed species and woody vegetation in accordance with the Acid Frog Management Plan (native woody regrowth) and/or Section 3.5 (weed infestations).	• Weed control required as per triggers in Section 3.5 to commence (1) within 60 days of the pre-construction survey or 30 days prior to pond construction, and/or (2) within 15 days of weed detection after pond earthworks. • Monitoring biannual until 24 months following construction, annual until pond success, and every five years thereafter.
Establishment of exotic predatory fish (*Gambusia holbrooki*)	Typically only an issue in permanent waters and unlikely if ponds meet hydroperiod criteria	Rare	Minor	Low	Monitor fish presence during acid frog recruitment surveys	Drain pond to remove fish and address hydroperiod (see above).	Prior to following wet season (i.e., October – Apr).

Threat event or circumstance	Relevant management measures	Residual risk			Trigger detection and monitoring activity/ies	Feasible/effective corrective actions#	Timing
		L	C	RL			
Fire	The offset areas will be separated from adjacent vegetation (i.e., Mount Coolum National Park) by a perimeter fence and access track. This break will prevent fire spread into the offset areas. There are no fire ignition sources within the WHMA or Vegetation Management Area A. Control burns will not be used within the WHMA or Vegetation Management Area A. In the unlikely event that a fire outbreak occurs within the WHMA/Vegetation Management Area A, it will be immediately controlled by on-site fire authorities.	Rare	Mod	Low	Any fire, or evidence of fire (e.g., smoke) within or adjacent the SCA will trigger an immediate response. Fire in and around the SCA is the subject to continual scrutiny to ensure safe operation of aircraft.	In the unlikely event that fire affects vegetation, natural recovery is expected. Weeds will be monitored following fire (see Section 5.4).	• Fire control actions to occur immediately if threatening the SCA.
Biocides affecting water quality	The use of herbicides controlled as documented in Section 3.5. No other biocides to be used within or adjacent (within 100m) of the WHMA or Vegetation Management Area A without review/management from the wallum sedgefrog expert. The offset areas will not be subject to mosquito control.	Rare	Mod	Low	No biocides used except 1) as detailed in Section 3.5.	Biocides removed from offset areas and prevented from future use.	• Immediately following incident

Threat event or circumstance	Relevant management measures	Residual risk			Trigger detection and monitoring activity/ies	Feasible/effective corrective actions#	Timing
		L	C	RL			
Eutrophication and pollution	(See Section 3.6) The WHMA and Vegetation Management Area A are separated from operation areas by a perimeter drains and cut-off wall. This prevents lateral movement of sub-surface and surface water. No nutrients or pollutants will be able to enter the WHMA or Vegetation Management Area A. Refuelling of vehicles (e.g., slashers, pond construction equipment and/or light vehicles) will not occur within 200m of the WHMA or Vegetation Management Area A. Heavy Machinery used for pipeline construction will be prohibited from entering heath vegetation in the WHMA or Vegetation Management Area A.	Rare	Mod	Low	Targeted monitoring of contaminants/pollutants will be undertaken following spills >400 L within 100m of offset areas at existing groundwater monitoring sites in and adjacent offset areas to assess possible impacts on groundwater quality.	Investigations commenced to identify possible sources of eutrophication/pollution. Subject to monitoring/investigation results, construction of ponds may be delayed to allow remediation, or if not possible, created as per Section 6.2.	• Investigations commenced within 14 days of event.

Threat event or circumstance	Relevant management measures	Residual risk			Trigger detection and monitoring activity/ies	Feasible/effective corrective actions#	Timing
		L	C	RL			
PFAS/PFOS contamination in	Current monitoring completed by SCA indicates that PFAS levels in groundwater are below threshold levels for human health and management actions. Monitoring across the airport site to detect PFAS/PFOS will be an ongoing requirement of management. PFAS/PFOS are not used in any fire fighting foams on the SCA, so risk of new contamination as a result of an emergency is zero. In accordance with approved management plan requirements, no groundwater encountered during construction will be discharged directly into wetlands or waterway, including offset areas.	Rare	High	Low	SCA requires monitoring for PFAS/PFOS across the entire airport site. If PFAS/PFOS are detected in groundwater or soils within or adjacent to the offset area, management actions will be implemented in accordance with the approved PFAS/PFOS management plan for the SCA site.	Carry out remediation of groundwater in accordance with PFAS/PFOS management plans.	• As required in the overarching PFAS/PFOS monitoring and management plan

All corrective actions will be implemented in consultation with a Wallum Sedgefrog expert.

6.2 CONTINGENCIES

In the unlikely event that constructed ponds do not meet completion criteria for at least the life of the approval, additional land-based offsets will be required, with the new offsets accommodating both the impacts to the project and the failed initial offset. New ponds may need to be created when monitoring in accordance with the actions in Table 6.3 indicates that the created ponds are not meeting the completion criteria in Section 4.2. During monitoring, a suitably qualified acid frog expert will make recommendations on corrective actions first, and then advise on the need to create new ponds.

The requirement for additional offsetting will be met by constructing additional breeding ponds within designated offset areas within SCA (i.e., within the remaining 5.97 ha secured for the conservation of Wallum Sedgefrogs) where site investigations indicate that suitable vegetation and hydrological conditions are present. If investigations do not identify any suitable sites for pond creation within the designated areas, additional properties and sites may need to be found. This new offset, and an offset management plan for this area, will need to be approved by the Department.

If additional Wallum Sedgefrog habitat is required to be offsite, the Lower Mooloolah River Environmental Reserve (LMRER), which is a former grazing property tenured a 'Reserve for Environmental Purposes' under the trusteeship of Sunshine Coast Council (Figure 6.1) may be considered.

While providing habitat for low numbers of Wallum Sedgefrog, the amenity of existing habitat for Wallum Sedgefrog and other wallum frog species at LMRER appears low. Increasing the extent and quality of wallum frog breeding habitat at LMRER could therefore help offset the loss of Wallum Sedgefrog habitat at SCA. Preliminary investigations of soil and groundwater conditions at this site suggest breeding ponds constructed in the north and centre of LMRER (to offset the loss of Wallum Froglet and Wallum Rocketfrog habitat at SCA) could provide suitable habitat for Wallum Sedgefrog. Improved management of vegetation in these areas (including weed control and removal of woody regrowth, proposed as part of the offsets for Wallum Froglet and Wallum Rocketfrog) could also improve the amenity of habitat at LMRER for Wallum Sedgefrog.

Offsets for state-listed acid frog species are being created at the reserve, irrespective of offset success or failure at the SCA. These habitats will also support Wallum Sedgefrogs. Details of the creation and augmentation of breeding habitat for Wallum Sedgefrog (and other acid frog species) at LMRER will be provided in the LMRER Operational Area Management Plan (OAMP). This plan is currently in preparation.

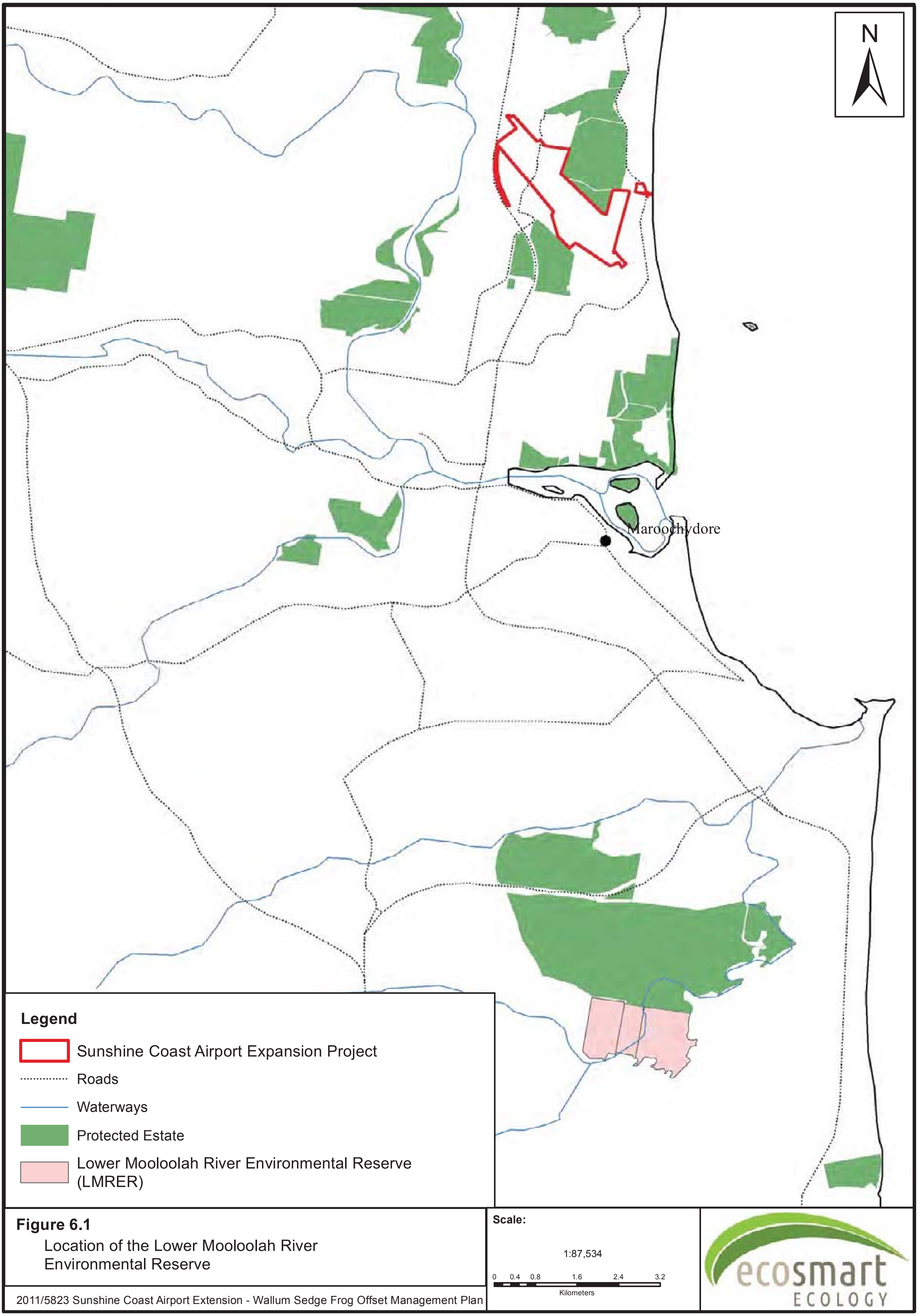


Figure 6.1
Location of the Lower Mooloolah River Environmental Reserve

ecosmart ECOLOGY

7.0 Roles, Responsibilities and Communication

7.1 Roles and Responsibilities

Actions required for successful implementation of this OMP, and the person(s) responsible for their implementation, are summarised in the table below.

Table 7.1. Roles and Responsibilities

Action/Task	Responsible person(s)
Finalise agreement with Air Services Australia regarding tenure and future management of offset areas	Approval holder
Appoint consultants/individuals required to complete this management plan and source any additional expertise required to complete environmental works/recommendations throughout airport operation life (including contingencies).	SCA Project Manager
Install groundwater loggers to inform pond design	Acid frog specialist*
Service groundwater loggers, download data, analysis and develop pond depth criteria	Acid frog specialist*
Development of pond design and construction plan	Rehabilitation consultant (in consultation with Acid frog specialist)
Commence and complete construction of ponds (in accordance with the pond design and construction plan and this OMP)	Contractor (in consultation with acid frog and rehabilitation consultant)
Plant/stock constructed ponds with sedges	Vegetation/wetland rehabilitation specialist
Pre construction weed survey and map, follow-up targeted weed surveys (i.e., within 24 months of pond construction), vegetation surveys, develop weed control plan (as required), undertake weed control measures (as required)	Rehabilitation consultant (in consultation with acid frog specialist, as required)
Groundwater level and quality monitoring	Acid frog specialist*/Groundwater specialist
Surface water monitoring	Acid frog specialist*
Ongoing weed monitoring (i.e., after 24 months following pond construction)	Rehabilitation consultant
Acid frog monitoring (within and outside the SCA at reference sites)	Acid frog specialist*
Annual acid frog monitoring report, data handling, and evaluation of offsets against completion criteria	Acid frog specialist*
Vegetation control	SCA Project Manager/rehabilitation specialist
Oversee compliance (including conditions, EIS commitments, and implementation of this plan)	SCAEP, Coordinator Health Safety and Environment
Review and auditing (Section 8.2)	Independent (third party) wallum frog ecologist.

* The acid frog specialist enacting this plan will be the same as the acid frog and ground parrot specialist in the Acid Frog and Eastern Ground Parrot Operational Area Management Plan (EcoSmart Ecology 2017). This will ensure all environmental values within the SCA are considered in management actions and consistency between the various plans.

7.2 Communication and Contacts

The following is a list of contacts which may be required for environmental management purposes during the life of this management plan.

Table 7.2. Project contacts

Position/Role	Minimum Qualifications/requirements	Current Person
SCA Project Manager	Bachelor of Engineering or higher in relevant field plus 5+ years of professional experience	Ross Ullman
Principal Contractor	Tertiary qualifications relevant to project management plus 5+ years professional experience	TBA
SCAEP, Coordinator Health Safety and Environment	Bachelor of Science or higher in relevant field plus 5+ years professional experience	James Ulyate
Acid frog specialist	• Bachelor of Science or higher in relevant field plus 5+ years professional experience • Detailed knowledge of the ecology of Wallum Sedgefrogs, • Demonstrated experience undertaking surveys for Wallum Sedegfrog. • Demonstrated ability to identify adult and juvenile (i.e., tadpole) Wallum Sedgefrogs, • Demonstrated knowledge and understanding of factors influencing ground and surface water hydrology and water quality in wallum wetlands.	Mark Sanders and Dr Ed Meyer (EcoSmart Ecology)
Rehabilitation consultant	Tertiary qualifications relevant to bush regeneration/conservation/botany plus 5+ years professional experience	TBA
Groundwater specialist	• Bachelor of Science or higher in relevant field plus 5+ years professional experience • Demonstrated knowledge and understanding of factors influencing ground and surface water hydrology	Josh Mitchell (Core Consultants)

8.0 Reporting, Evaluation and Review

8.1 Reporting Requirements

A summary of reporting and evaluation timing and schedule is provided in Table 8.1.

Table 8.1. Reporting and Evaluation timing and schedule

<table>
<tr><th>Task/Report</th><th>Frequency</th><th>Deadline[#]</th></tr>
<tr><td>Breeding pond design and construction plan</td><td>Once-off</td><td>Aug/Sep 2018</td></tr>
<tr><td>Weed monitoring report</td><td rowspan="2">Annual until success, once every 5 years following</td><td rowspan="2">30th August</td></tr>
<tr><td>Acid frog monitoring report</td></tr>
<tr><td>Audits</td><td>Annual until 12 months after completion of SCAEP, every second year thereafter until pond success, and then once every five years until end of approval (30 Jun 2046).</td><td>30 April</td></tr>
</table>

[#] Based on current development schedule, but subject to timing requirements in Table 3.2.

8.1.1 Wallum Sedgefrog breeding pond design and construction plan

Indicative drawings showing the proposed design and location of ponds are provided in Appendix C. The precise location and design of individual ponds will be finalised in a detailed plan guiding construction of ponds within offset areas at SCA. This plan will be completed by suitably qualified personnel prior to construction of ponds, once pre-construction investigations of ground water hydrology are complete. The pond construction plan will show the precise location, extent and bathymetry of individual ponds. The pond design and construction plan will include:

- Results and analysis of pre-construction investigations (e.g., groundwater monitoring data from capacitance water loggers),
- Detailed design drawings showing the size, bathymetry and location of individual ponds within offset areas,
- Preferred access tracks to the ponds which minimise vegetation disturbance (particularly within the SCA),
- Construction and environmental exclusion zones which will not be entered,
- Pond construction methods, and
- Revegetation actions (including the propagation of sedges).

The pond design and construction plan will be developed in consultation with a Wallum Sedegfrog expert and submitted to DEE for comment.

8.1.2 Weed monitoring Report

Weed monitoring will be undertaken biannually for a period of 24 months following the completion of the SCAEP or pond work (whichever is completed last). Weed monitoring reports will be completed by 30th August each year for inclusion in the Acid Frog Monitoring report. The weed monitoring report will include:

- Weed survey timing and methods,
- GIS analysis of weed infestations (as required) and comparison to the 'baseline' weed map (see Section 3.5),
- A risk assessment of new weed outbreaks or existing outbreaks which trigger control action (i.e., extent expanded by > 5% from baseline),
- Species and locations requiring low-impact hand removal and any associated recommendations,
- Success, or otherwise, of weed control undertaken in the monitoring period, and
- A review of monitoring works and recommendations for improvement (as required).

The report will also mention weed control plans developed during the year.

8.1.3 Annual Acid Frog Monitoring Report

Results from the Wallum Sedgefrog monitoring will be reported annually, at the end of August each year so as to include a full summer wet season. In addition to reviewing the effectiveness of management actions and offset progress against the completion criteria (see Section 4.2), the report will include:

- Survey methods, timing and conditions with comment on survey limitations,
- Groundwater and surface water monitoring results (including depth to groundwater, hydroperiod, and water quality data)
- A summary of offset delivery actions completed during the monitoring year,
- Wallum Sedgefrog abundance and breeding success in both created habitat and at reference sites,
- Recommendations to improve the amenity of constructed ponds for Wallum Sedgefrogs,
- Recommendations for woody vegetation (e.g., slashing) control around retained habitat and offset ponds, if required,
- Weed and predatory fish monitoring results (as an attachment/appendix),
- Breaches of this plan, trigger events, and corrective actions (if required), and
- An assessment of the performance of constructed ponds against the completion criteria outlined in this OMP.

The final annual report will include requirements for ongoing monitoring to be completed by SCA for the life of the approval (June 2046). This monitoring program is to include a schedule of tasks and the required frequency of these tasks and may include hydroperiod, water chemistry and vegetation elements to be monitored.

Once completed the report will be submitted to the DEE and include an analysis of the data, as well as all raw data collected during the monitoring period.

8.2 Evaluation and Review

Audits

The Wallum Sedgefrog OMP will be audited yearly until, at least one year after the completion of construction of the AEP. Audits will be every second year after the last annual audit until the success of constructed ponds have been demonstrated and agreed by DEE. Thereafter audits will occur once every five years until end of approval life (30 June 2046). In addition, an audit will occur if:

- Monitoring suggests SCAEP mitigation measures to reduce/avoid impacts on groundwater and surface water quality, groundwater drawdown, fire risk, weed spread, noise and light pollution, or predator incursion may, or have, failed, and
- Unforeseen construction activities, or catastrophic events, affect created or retained Wallum Sedgefrog habitats at the SCA.

Findings and recommendations of audits will be implemented within 12 months of identifying the recommendation and the Wallum Sedgefrog Offset Managenment Plan will be updated every five (5) years. In addition to including audit recommendations, the five-yearly update will include (where relevant):

- Relevant findings from published scientific research or policy statements released since the last review,
- New or altered risks to the implementation of the plan, or the likelihood of offset success,
- New or altered risks to monitoring activities, and
- New or modified measures/corrective actions to mitigate existing or new risks identified in the plan.

Updates will be carried out in accordance with Condition 21 of the EPBC approval (EPBC 2011/5823).

9.0 IMPLEMENTATION SCHEDULE

A schedule summarising the implementation of actions in this OMP is provided below.

Table 9.1. Implementation schedule.

Performance Area	Completion criteria	Management measure/s	Where	When	Related Monitoring
Legally secure approved offset properties for conservation.	Offset legally secured in perpetuity	Negotiate and finalise agreement with relevant parties to legally secure proposed offset sites.	Applies to offset sites	Prior to the commencement of SCAEP clearing works or Jun 2018 (whichever occurs first)	Not Applicable
	Air-side perimeter fence completed and subject to daily patrols	Construction of airside perimeter fence	Round the SCAEP perimeter, including the WHMA and Vegetation Management Area A	Following SCAEP clearing and prior to pond earthworks	Daily monitoring of fence condition/integrity
	Signs placed very 50m around perimeter of WHMA and Vegetation Management Area A	Signs indicated restricted access and value as environmental offset	Every 50m around the WHMA and Vegetation Management Area A.	Installed prior to pond earthworks	During daily monitoring of fence integrity.
Water Chemistry	pH of individual ponds consistent with reference sites	• Offset located on land separated from airport operations by drains and land buffers (airside aprons). • Pre-pond construction investigations tested groundwater chemistry for suitability. • Pond constructed to intercept sub-surface groundwater which has correct water chemistry	Individual ponds created within the WHMA and Vegetation Management Area A.	Pond earthworks to be completed before Aug 2019.	Annual ongoing surface and ground water quality monitoring (Section 5.1.2)
	Turbidity of individual ponds consistent with reference sites				
	Conductivity/salinity and individual ponds consistent with reference sites				
	Tannic acids at created ponds consistent with reference sites				

Performance Area	Completion criteria	Management measure/s	Where	When	Related Monitoring
Hydroperiod	Hydroperiod of created ponds is comparable to reference sites, or holds water for a minimum of two months but is not permanent Constructed ponds hold water long enough to support recruitment when conditions are wet enough to support recruitment at reference sites	• Pre-pond construction investigations monitoring groundwater fluctuations. • Analysis of pre-construction groundwater monitoring to inform pond design (i.e., pond depth).	At one reference site and five additional locations throughout offset areas in the WHMA and Vegetation Management Area A.	Ongoing, pond construction report due Aug/Sep 2018	Ongoing groundwater and surface water level monitoring (Section 5.1.1)
Vegetation	Created ponds have vegetation consistent with Wallum Sedgefrog habitat; (1) dominated by terete sedges, (2) sedge density comparable to reference sites, and (3) ponds free from weed species	• Ponds planted using native sedges as per Section 3.4. • Preparation of weed 'baseline' map to compare future outbreaks/spread • Initial control of weeds prior to pond construction to reduce risks of spread due to machinery transport. • Ongoing weed control as per Section 3.5.	• Sedges planted at individual created ponds • Weeds controlled across the entire WHMA and Vegetation Management Area.	• Planting occurs shortly following completion of pond earthworks. • Planted vegetation checked quarterly in 12 months following planting • Baseline weed assessment and mapping prior to 30th Jul 2018 or SCAEP clearing (whichever occurs first). • Initial weed control within 60 days of initial 'baseline' weed assessment. • Ongoing weed control within 2 months of weed trigger event.	• Vegetation monitoring conducted annually (Section 5.3). • Weed monitoring (Section 5.4) twice annual following baseline map until 24 months after completion of pond earthworks; thereafter annual, until pond reach completion criteria. Once every 5 years until end of approval (2046) after ponds achieve completion criteria.

Performance Area	Completion criteria	Management measure/s	Where	When	Related Monitoring
Predatory Fish	Pond remain free of fish predators or do not support densities higher than reference sites	Pond hydroperiod designed to avoid permanent inundation. If needed, ponds drained and hydroperiod/pond design examined and re-engineered (if needed)	At individual ponds within the WHMA and Vegetation Management Area A.	Ongoing as required until pond success	Acid frog surveys conducted annually (Section 5.2)
Wallum Sedgefrog abundance	Abundance of adult Wallum Sedgefrogs consistent with reference sites	As above	Individual ponds	Ongoing until pond success	Acid frog surveys conducted annually (Section 5.2)
Wallum Sedgefrog recruitment	The proportion of constructed ponds with recruitment consistent with reference sites	As above	Individual ponds	Ongoing until pond success	Acid frog surveys conducted annually (Section 5.2)
N/A	N/A	Review monitoring data and determine whether completion criteria are being met.	Not applicable	Annually	Reported as part of acid frog monitoring
		Audit/OMP review	Not applicable	• Annual audit until one year after SCAEP completion, then every two years until pond success. Audits to occur every five years after pond success. • OMP updated every five years.	Not applicable

10.0 References

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11.0 GLOSSARY

A glossary of relevant terminology and geographic references used throughout the OMP is provided below:

AEP	Airport Expansion Project
BGL	Below ground level
BOS	Biodiversity Offset Strategy
DEE	the federal Department of Environment and Energy
EIS	Refers to the Terrestrial Fauna chapter of the Sunshine Coast Airport expansion project Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
LMRER	Lower Mooloolah River Environmental Reserve
Mt Coolum National Park	Refers to the National Park estate to the north and south of the SCA. Its official title is Mt Coolum section, Noosa National Park
OMP	Offset Management Plan
SCA	The existing Sunshine Coast Airport precinct
SCA	Sunshine Coast Airport
SCAEP	Sunshine Coast Airport Expansion Project
WHMA	Wallum Heath Management Area
WSF	Wallum Sedgefrog

Appendix A
Criteria Reference and Checklist

EPBC conditions of approval (EPBC 2011/5823)

Cond.	Condition Requirement	Plan Ref	Key Management Commitments
15a	The proposed legal mechanism and timelines for securing the offset area/s	Section 3.1	The offset areas will be protected under an agreed offset delivery arrangement under the Queensland *Environmental Offset Act 2014*. The offset agreement will be signed by the Queensland Department of Environment and Heritage Protection (DEHP) and Sunshine Coast Airport by the end of 2017.
15b	Details of the minimum offset area/s proposed to compensate for clearing breeding habitat for *Litoria olongburensis*	Section 2.1	• Creating a minimum of 2.3ha of successful WSF breeding habitat, • The created breeding habitat will be located within a designated 8.27ha within the fenced SCA precinct (see Figure 2.3).
15c	Evidence that the offset/s are in accordance with the EPBC Act Environmental Offsets Policy including a populated copy of the EPBC Act offsets assessment guide with detailed justification for each input	Appendix B	See Appendix B
15d	Information about how the offset area/s provide connectivity with other relevant habitats and biodiversity corridors	Section 2.2.1	• The created habitat will be immediately adjacent Mount Coolum National Park and close to and/or contiguus with areas of retained WSF habitat within the SCA.
15e	A textual description and a map to clearly define the location and boundaries of the offset area/s accompanied by the offset attributes	Section2.2.1 and Figure 2.3	• The location and extent (8.27ha in total) of land available for the creation of 2.3ha of breeding habitat is shown in Figure 2.3. The 8.27ha available for offset includes three distinct areas: o 0.52 ha located in the north of the WHMA, o 1.91ha also located in the north of thee WHMA, and o 5.84ha within Vegetation Management Area A.
15f	A description of the management measures (including timing, frequency and longevity) that will be implemented on the offset area/s for the protection and management of habitat for *Litoria olongburensis*, including details of how the management measures proposed take	Section 3.0 (Table 3.2), Section 5.0 (Table 5.1) and Section 9.0.	Adequately addressed in the plan according to adjacent references. The Plan confirms that management measures take into account the *Litoria olongburensis* recovery plan and the *Litoria olongburensis* threat abatement plan.

	account of the *Litoria olongburensis* recovery plan and the *Litoria olongburensis* threat abatement plan		
15g	Performance and completion criteria for evaluating the management of the offset area/s and criteria for triggering remedial action (if necessary)	Section 4.2	Addressed in adjacent references. • Completion and performance criteria are provided in Section 4.2, • Triggers for remedial actions are provided in Section 0.
15h	A program, including timelines to monitor and report on the effectiveness of the management measures, and progress against the performance and completion criteria	Section 5.0 and 8.0	Addressed in adjacent references. • Monitoring actions are detailed in Section 5.0 and include water monitoring, WSF population monitoring, and weed monitoring/control, • Section 8.1 details reporting requirements, including an annual Acid Frog monitoring report.
15i	A description of potential risks to the successful implementation of the offset/s, a description of the contingency measures that would be implemented to mitigate against these risks and residual risk ratings.	Section 6.0.	Adequately address in adjacent references: • Risks and contingency measures are detailed in Table 6.2 and Section 6.2, • A risk assessment is provided in Section 6.1.

EPBC Environmental Management Plan Guidelines

Recommendations for management planning (derived from the Department's EMP Guidelines).	Where addressed
1. The final/revised draft plan submitted for approval includes an **Approval Holder Declaration** that has been signed by the approval holder (not the consultant/agent).	Cover letter
2. The plan includes an **executive summary** which states the relevant approval conditions, expands upon the purpose of the plan to inform management planning, and outlines the primary strategies to manage key risks and achieve the plan's objectives.	Section 1
3. The plan implements the **EPBC Offset Policy** and **Offsets Assessment Guide**. The plan must justify user inputs to the guide, including: a) condition classes for species habitat (stocking rate, site context, site condition); b) correlate the impact site, and current and proposed future condition classes of the offset site/s, with the above categories; c) identify quantifiable ecological improvements to the offset site/s to meet the future condition; d) provide scientific evidence or agreement[2] that substantiates the *time until ecological benefit* and *confidence in result* values used in the offset guide; and e) substantiate *risk of loss* values used in the offset guide.	Appendix B
4. The plan describes the proposed **offset property/ies,** including nature, location, tenure, connectivity and potential for inclusion in the nature conservation reserve system.	Section 2.2.1
5. The plan includes a scheduleof conservation commitments required to **establishing the offset site/s,** and a process and timeframes for securing, under legally binding instrument, the offset site/s for biodiversity conservation purposes, in perpetuity.	Section 3.1
6. The plan applies user inputs to the EPBC Offset Policy and Offsets Assessment Guide as the basis for management planning. Specifically: a) completion criteria and interim performance targets are derived from ***current condition, future condition with offset*** and ***period to ecological benefit***; b) current and future condition classes (for ecological community and habitat condition) used for management planning are derived from listing advice/criteria, and are agreed by the Department prior to detailed management planning; c) condition class descriptions directly inform selection of management measures; and d) offset attributes and shapefile are provided separately, with submission of the draft plan.	Appendix B
7. The plan states the **environmental outcomes** to be achieved by implementing the plan. The plan defines environmental outcomes as measurable extent and condition targets, or circumstances of, the protected matter (e.g. water quality environmental values, ecological attributes/function).	Section 4.0

[2] See http://www.environment.gov.au/climate-change/publications/fact-sheet-confidence-likelihood

Recommendations for management planning (derived from the Department's EMP Guidelines).	Where addressed
8. The plan includes **performance and completion criteria**. For the purpose of the plan: a) performance criteria are time-bound short and medium term targets, for management interventions and environmental condition, that are used to monitor, evaluate, review and improve the effectiveness of the plan; and b) completion criteria are time-bound longer term values, specified for measurable parameters, that if attained and maintained ensure the plan's environmental outcome/s have been achieved.	Section 4.0
9. The plan includes **management measures** that will be implemented to offset environmental impacts. Each management measure: a) has timeframe/s for implementation; b) is described sufficient to avoid ambiguity and to inform plan implementation; c) is related to quantitative and auditable performance and completion criteria; and d) is derived from recognised principles, practice, or guidelines, and is justified - technically, scientifically and/or legally – as an effective and appropriate measure to achieve the plan's objective/s.	Section 3.0
10. The plan contains a program of activities designed to monitor the effectiveness of management measures and attainment of performance and completion criteria. The **monitoring program** is comprised of the following elements: a) capacity to detect change in environmental condition due to management measures, and to determine attainment of performance and completion criteria; b) capacity to inform timely decisions on corrective actions to ensure performance and completion criteria are achieved, and to support plan evaluation and adaptive implementation; c) the location, nature and number of monitoring sites, including benchmark/reference sites to evaluate management performance (cf seasonal variation) and that for offset management plans verify future condition without offset values used to determine offset requirements; d) capacity to detect change in environmental condition due to offset management actions, that accounts for climatic variability, and that is capable of demonstrating attainment of proposed future condition (completion criteria); e) quantitative (e.g. on-ground survey results) and qualitative baseline data (e.g. photos from photo-point monitoring sites) that establish the current condition of the environment (e.g. ecological community); f) commitments to engage qualified ecologists/appropriate experts to conduct monitoring and survey activities; g) to verify user inputs for future condition without offset; h) how monitoring records will be maintained, analysed and reported; and i) the methodology, frequency and duration of monitoring and survey activities to achieve the above management needs, and justification of the monitoring methodology and survey design.	Section 5.0

Recommendations for management planning (derived from the Department's EMP Guidelines).	Where addressed
11. The plan **assesses the risk** of the plan failing to achieve its objective/s by: a) stating the environmental objective/s of the plan, performance and completion criteria; b) identifying unplanned events or circumstances that would prejudice attainment of the performance and completion criteria. The events or circumstances address scientific/ecological uncertainty, stochastic events and legal/land use planning factors that may represent risks; c) conducting a qualitative assessment of the likelihood and consequence of those events or circumstances, and the residual risk of failure to achieve those criteria due to identified events or circumstances (*assuming management measures will be implemented*); d) characterising **risk** as low, medium, high or severe, and derived from **likelihood** (highly likely, likely, possible, unlikely, rare) and **consequence** (minor, moderate, high, major and critical); and e) explaining how conclusions about risks (consequence, likelihood, risk level) have been reached.	Section 6.1
12. The plan **manages the risk** of plan failure by: a) detailing management measures that will be implemented to achieve the plan's environmental performance and completion criteria; b) specifying measurable values or circumstances that will trigger a contingency response and corrective actions; c) ensuring the monitoring program includes activities to detect the above values or circumstances; d) detailing effective and appropriate corrective actions that may be implemented if a risk is realized; e) explaining how monitoring activities will inform the selection and implementation of corrective actions; and f) enhancing management measures and corrective actions for high risk events or circumstances, thereby providing a margin of safety in order to avoid or mitigate the impacts of those events or circumstances.	Section 6.0 and 5.0
13. Key information used to formulate the plan is specified and (a) the **limitations and/or uncertainty** around the use of the data is stated, and (b) how the limitations and/or uncertainty are addressed during the implementation of the plan. Where there is significant uncertainty a margin of safety is ascribed to management measures until that uncertainty is reduced to an acceptable level or the completion criteria are achieved.	Throughout plan as required
14. The plan includes an **adaptive implementation strategy** to ensure monitoring, risk management, reporting and review activities are coordinated, scheduled and implemented to ensure: a) the plan is subject to continuous improvement processes to achieve its objectives; b) uncertainty, and limitations to information used in formulating the plan, are reduced over time, including through implementing the plan and new information derived from external sources (e.g. academic literature, EPBC policy statements, actual future condition without offset); c) risks of plan failure are periodically reviewed, including in response to changing circumstances or contingency responses.	Section 8.2

Recommendations for management planning (derived from the Department's EMP Guidelines).	**Where addressed**
15. The plan includes a schedule and triggers for **plan review**, including: a) following significant environmental incidents, as defined; b) when there is an identified need to improve performance to attain performance and/or completion criteria; and c) periodically for actions: I. undertaken over longer timeframes such as one, two or five years; and II. in response to implementing corrective actions.	Section 8.2
16. The plan specifies **reporting commitments**, including: a) who the report is provided to; b) where applicable, reporting to the Department required by the conditions of approval; c) annual performance reports, environmental performance monitoring for key risks, incidents, non-compliance, implementation of corrective actions and auditing reports; d) a description of the standard report content; e) a reporting schedule, and where required, triggers for preparing a report; and f) management actions implemented during the reporting period, and condition outcomes maintained or achieved during that period.	Section 8.1
17. The plan includes a schedule and triggers for **auditing** the implementation and effectiveness of the plan, and outlines auditable systems for recording plan implementation and the environmental outcomes achieved.	Section 8.2
18. The plan specifies **accountabilities** for implementing management, monitoring, reporting, review, auditing and contingency responses.	Section 6.2
19. The plan includes **maps**, **plans, figures, images** and **sections** to show: a) the management area in a state and regional context; b) areas with differing environmental condition or quality, and proposed management interventions; c) areas where management measures will be implemented; d) environmentally sensitive areas on or near the project site; e) vegetation or other habitats that require protection, are buffer or 'no-go' zones; and f) monitoring locations and/or where random monitoring/survey activities will be undertaken.	Throughout report as necessary
20. M**aps**, **plans, figures, images** and **sections** used in the plan: a) are scaled to enable the reader to identify, based on local landmarks (trees, fences, structures) the location of features being shown on the map etc; b) include appropriate standard metric scales to represent the information (for example 1:25 000, 1:10 000 and 1:5000). Datum – plans and cross sections refer to AHD; c) have metric measurements, graphic bar scales, local grid lines and standards and north point or orientation of sections (include a key) are used throughout; and d) include title blocks in the lower right hand corner with the following information: EPBC number and project name, title and number of the plan, author, scale, date, source and date of data.	Throughout report as necessary

Recommendations for management planning (derived from the Department's EMP Guidelines).	Where addressed
21. The plan is required under **EPBC Act approval conditions**, and includes a table containing: a) EPBC Act approval condition requirements the plan is intended to address, against each of the individual actions required under approval conditions; b) section and page numbers which address the approval conditions/specific actions. c) the key management commitments relating to each of the approval conditions.	Appendix A
22. The plan **references scientific, legal or other claims or statements** that support the effectiveness of the plan, e.g. references to scientific literature, published guidelines, legislation.	Throughout document, Section 1.0
23. The plan uses the terms '**will'** and **'must'** when committing to management actions, instead of 'where possible', 'as required', 'to the greatest extent possible', 'should' or 'may'.	Throughout document as appropriate
24. The **footer or header** of each page of the plan states the name of the project, the date of the plan and sequential page numbering.	Throughout document
25. The plan includes a **glossary of terms**, acronyms, terms open to different interpretations or not in common use, technical or defined in the approval conditions.	Section 11

Appendix B
EPBC Act Offset Assessment Guide Justification

EPBC Act Offset Assessment Result

Calculations using the EPBC Act Offset Assessment Guide put the 'Quantum of impact' for Wallum Sedgefrog habitat loss at 1.17, with the 'Net present value of offset' calculated as 1.19. This represents a 102.08% impact offset, and therefore the 2.3ha offset proposed in this plan fulfils EPBC offset requirements.

The successful delivery of 2.3ha is based on a comparison between offset sites and reference sites within and outside the SCA. These reference sites are in better condition and have higher Wallum Sedgefrog amenity than habitat being lost to development. As such, the actual net benefit for this species is likely to exceed that calculated using the Offset Assessment Guide (assuming offsets meet the completion criteria outlined in this OMP).

Variable Justification

Calculator Variable	**Input**	**Justification**	**Reference**
IMPACT SITE			
Residual impact (Area of habitat lost)	1.67ha	Construction of the proposed runway will result in the loss of 1.67 ha of known (i.e., occupied) Wallum Sedgefrog habitat used for breeding, foraging and/or shelter (i.e., low wet heath and sedgeland in areas of surface water to the south of the WHMA and near the centre of the existing helicopter training area).	Section 2.1 of this plan EIS Section 8.16.2
Quality of habitat lost	7	The quality of impacted habitat score is 7, which represents the additive value of *Site Condition, Site Context* and *Species Stocking Rate*. This score represent the *overall* quality of habitat being lost to development, taking into account variation in habitat quality within and amongst habitat polygons. With regards the latter (i.e., variation in habitat quality amongst mapped habitat polygons) it is noted that areas of mapped habitat are broadly similar in terms of quality, with the exception of polygon WF05 (which is of a higher quality and supports higher densities of wallum sedgefrog than other areas of lost habitat). Given that this polygon represents only a tiny fraction of the total area of lost habitat being offset (i.e., 0.015 ha out a total of 1.67 ha, or 0.09% of lost habitat), the score of 7 is considered representative of the overall quality of habitat requiring offset. The table below provides criteria for each value against which lost habitat has been assessed. Generally, retained habitats are in much better condition than lost habitats. **Value** | **Criteria**	EIS Section 8.7

<table>
<tr><th>Calculator Variable</th><th>Input</th><th>Justification</th><th>Reference</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td colspan="2">Site Condition</td></tr>
<tr><td>0</td><td>No habitat present</td></tr>
<tr><td>1</td><td>Habitat marginal. Some limited sedge cover (<5%). Suitable breeding hydroperiod unlikely under average conditions or water pH 5-6.</td></tr>
<tr><td>2</td><td>Habitat reasonable with moderate sedge cover (5-50%). Suitable breeding hydroperiod unknown or possible under average conditions. Water pH <5.0.</td></tr>
<tr><td>3</td><td>Excellent habitat with abundant sedges (>50%). Suitable hydroperiod known or considered highly likely under average conditions. Water pH <5.0.</td></tr>
<tr><td colspan="2">Site Context</td></tr>
<tr><td>0</td><td>Surrounded by inhospitable habitat (tilled land, urban development etc)</td></tr>
<tr><td>1</td><td>Surrounded by non-remnant habitats (inc exotic grasslands/grazing) and no breeding habitat nearby.</td></tr>
<tr><td>2</td><td>Surrounded by remnant (non-breeding) habitats, breeding habitat >500m from site, or unknown.</td></tr>
<tr><td>3</td><td>Within approximately 500m of other known habitat and connected by remnant or non-hostile vegetation.</td></tr>
<tr><td colspan="2">Stocking Rates</td></tr>
<tr><td>0</td><td>No adults present or likely</td></tr>
<tr><td>1</td><td>Adults may be present at times, but unlikely to be resident. Breeding unlikely.</td></tr>
<tr><td>2</td><td>Adults in low numbers (<10 individuals/50m) and possibly present in most years, breeding possible under above-average rainfall years.</td></tr>
<tr><td>3</td><td>Adults present at moderate densities (10-50 individuals/50m), breeding likely under average rainfall.</td></tr>
<tr><td>4</td><td>Adults present at high densities (>50 individuals/50m) and breeding likely in most years.</td></tr>
</table>
Using the criteria in the table above, the Site Condition of lost Wallum Sedgefrog was assigned an overall score of 2/3. This assessment is based on EIS surveys conducted during 2012 which were carried out under wetter-than-normal conditions, following a run of years with above-average rainfall. Since the EIS assessment it has become apparent that areas of impacted habitat in the south of the WHMA are less frequently inundated,
</td><td></td></tr>
</table>

Calculator Variable	Input	Justification	Reference
		and faster draining than habitat within the north of the WHMA (due to drainage channels previously constructed in the south of the WHMA). Reduced ponding of surface water and the absence of slashing (which has not been undertaken since 2008) also appears to have brought about an increase in tree cover, further reducing the amenity of Wallum Sedgefrog habitat in the south (due to increased evapotranspiration and reduced penetration of sunlight). Without ongoing intervention (i.e., slashing and removal of woody vegetation) the amenity of impacted (lost) habitat in the south of the WHA would be reduced further. Given the above, it is likely that the quality of Wallum Sedgefrog breeding habitat being lost to development is lower than initially thought and a score of 2 overestimates the value. However, without recent quantitative data from areas of lost habitat the initial score of 2 has been retained. ***Site Context*** has been assigned a score of **3/3** in accordance with criteria outlined in the table above. Areas of habitat lost are surrounded by heath and likely to support movement/dispersal of *L. olongburensis* to and from areas of suitable breeding habitat less than 500 m away (in the centre and north of the WHMA) ***Species Stocking Rate*** has been given a score of **2/4**. During EIS studies low numbers of Wallum Sedgefrogs, typically less than 10 individuals per 50 x 2 m transect, were located within areas of lost habitat in the southern half of the WHMA (see Table B2 at the end of this appendix). Metamorphs and sub-adults were also located in lost habitats suggesting breeding occurred during the survey period (with above-average wet season rainfall). The density/abundance of adult Wallum Sedgefrogs in these areas was much lower than that recorded elsewhere within the SCA (i.e., in retained habitat within the WHMA).	
OFFSET SITE			
Proposed offset area	2.3ha	A total of 2.3ha of proposed Wallum Sedgefrog breeding habitat will be created within the SCA. Within areas of the SCA that do not have priority ecological values (i.e., no existing acid frog breeding habitat or Ground Parrot habitat, as identified in the EIS). Proposed offset areas within the SCA are currently unsuitable for breeding due to the scarcity of ponding water and upright sedges favoured by Wallum Sedgefrogs (including *Baumea* spp and *Balloskion pallens*). The amenity of these areas for Wallum Sedgefrog is therefore low and, other than the occasional animal dispersing from habitat elsewhere in the WHMA, these areas have little or no value as Wallum Sedgefrog habitat. The extent and amenity of Wallum Sedgefrog habitat will be increased by excavating ponds and planting these out with upright sedges native to the local area (e.g., *Baumea rubiginosa, Baumea teretifolia* and *Balloskion pallens*)	EIS Section 8.17.1

Calculator Variable	Input	Justification	Reference
Start quality	3	This value has been obtained by adding the values of *Site Condition, Site Context* and *Species Stocking Rate* for the receiving offset areas within the SCA. Areas where offset ponds will be created within the SCA do not hold surface water and have no suitable habitat for Wallum Sedgefrog. Consistent with the scores defined in 'Quality of lost habitat', *Site Condition* is assigned a score of **0/3**. ***Site Context*** will not change (3/3) from 'Quality of Lost Habitat' as the offset areas are in proximity to lost habitats. ***Species Stocking Rate*** has been given a score of **0/4**. There is no habitat for Wallum Sedgefrog within the offset areas to support adult populations.	Section 2.2
Time over which loss is averted	20	The proposed SCA offset areas will be protected in perpetuity using a VDec. It is therefore possible to apply the maximum allowed value of 20 years in the EPBC Act offset assessment calculator.	Section 3.1.
Time until ecological benefit	20	The ecological benefit of the proposed offsets at SCA will be realised once constructed ponds achieve completion criteria relating to pond hydroperiod, water quality and vegetation cover, and once ponds are colonised by breeding Wallum Sedgefrogs. Detailed investigation of groundwater levels will have been conducted over several years by the time pond construction commences. Data from these investigations will be used to optimise the design/bathymetry of ponds and ensure ponds intercept groundwater long enough to support successful recruitment of Wallum Sedgefros (under suitably wet conditions). Water quality data from groundwater monitoring wells located in offset sites indicate that groundwater chemistry is highly suitable for Wallum Sedgefrogs (i.e., low in pH, low in salinity, and with high levels of tannin-staining). Ponds are therefore likely to meet completion criteria relating to pond hydroperiod and water quality soon (1-2 years) after construction, unless there is a shortage of rain (in which case ponds may not hold water long enough to support successful recruitment of Wallum Sedgefrogs). Under suitably wet conditions, sedges planted in and around constructed ponds can establish rapidly. Based on previous experience at other sites (Bayley and Sanders 2016; E. Meyer, unpub. obs.) sedge cover suitable for Wallum Sedgefrogs may therefore be achieved within three or less years (except under drought conditions, in which case sedges may take longer to establish and spread). For ponds to support successful breeding and recruitment of Wallum Sedgefrogs, animals must first colonise ponds from areas of nearby habitat. Given the proximity of offset areas to known/occupied Wallum Sedgefrog habitat elsewhere in the WHMA and the high level of connectivity between these areas, Wallum Sedgefrogs will	N/A

Calculator Variable	Input	Justification	Reference
		be able to colonise constructed ponds in short order (i.e., within 12-18 months) once offset ponds have achieved completion criteria relating to pond hydroperiod, water quality and vegetation cover. Given the above, and barring unforeseen impacts or stochastic events (e.g., prolonged drought), time to ecological benefit (i.e., successful breeding and recruitment within constructed ponds) will be quick, and is likely to occur within 20 years.	
Risk of loss without offset	0%	The risk of loss without an offset is very low, as the WHMA and Vegetation Management Area A is owned by Sunshine Coast Council with no current intent to develop the site.	N/A
Future value/quality without offset	3	The score applied for 'Future quality without offset' is the same as the score obtained for 'Start quality' (see above), as without proposed offsets, existing habitat in offset areas is likely to remain unsuitable for Wallum Sedgefrog for the foreseeable future.	See 'start quality' above
Risk of loss with offset	0%	Risk of loss with offset is 0%. There is a negligible chance that the area of available Wallum Sedgefrog habitat will reduce or become degraded to the extent that it will not support these species, with the offset actions and legal protection applied.	N/A
Future quality/value with offset	9	The same approach used for 'Start quality' and 'Future quality without offset' has been applied to give a score of 9. ***Site Condition*** will be improved to **3/3** as offset success will be measured against reference sites in better condition and with higher sedge cover (>50%) than areas of impacted (lost) habitat, including two sites in National Park (see Quality of Lost Habitat). In addition to this, offset sites located within the WHMA are situated in dry heath where melaleuca regrowth is more limited and, as such, are unlikely to be impacted by melaleuca regrowth as areas of lost habitat in the south of the WHMA are. It is also anticipated that offset sites will hold water more frequently and for longer than impacted (lost) habitat and support higher densities of terete sedges favoured by Wallum Sedgefrog than areas of lost habitat in the south of the WHMA. Therefore, the condition of habitat at offset sites will ultimately be better than that of impacted (lost) habitat. ***Site Context*** remains as **3/3** as the offset areas do not increase connectivity between existing habitat areas, however they are adjacent to and complement areas of retained habitat within the SCA and Mount Coolum National Park. ***Species Stocking*** will conservatively increase to **3/4** as offset ponds are likely to hold water for longer and more frequently, and also contain higher densities of terete sedges. These conditions will support more frequent breeding and higher densities of adults. Reference sites which will be used to benchmark/gauge the success of offsets, also have considerably higher densities of adult Wallum Sedgefrogs.	Section 3.0, EIS Section 8.17.1

Calculator Variable	Input	Justification	Reference
Confidence in results	90%	There is a high confidence of achieving offset success within the WHMA and Vegetation Management Area A due to the following: a) Soil and groundwater investigations within offset areas indicate the presence of a shallow, groundwater aquifer perched above an organic hardpan less than 1 m BGL. Soil and groundwater conditions are therefore similar to those found in areas of Wallum sedgefrog breeding habitat elsewhere within the SCA (see Section 2.2). Constructed ponds will therefore hold enough water to support successful breeding (provided ponds are deep enough to intercept groundwater). Ongoing monitoring of groundwater levels will help ensure ponds are built deep enough to do this. b) Groundwater investigations within offset areas indicate the presence of a shallow, groundwater aquifer containing dilute, acidic (pH 4.2-4.9), tannin-stained groundwater less than 1 m BGL. c) Soils within offset areas are sandy, contain very little clay and, appear to be nutrient poor (as indicated by the dominance of heath species aboveground). Groundwater in constructed ponds is therefore unlikely to contain high levels of nutrients and clay fines. d) Offset areas are in close proximity to and contiguous with areas of known/occupied breeding habitat within the SCA (allowing animas to colonise constructed ponds from areas of existing habitat nearby). e) Similar pond designs at Aura (previously Caloundra South) have shown promising results with constructed ponds supporting successful recruitment of other acid frog species (EcoSmart Ecology, 2016).	Sections 2.2 and 3.2, EcoSmart Ecology 2012

Table B1: Sedge density from lost and retained Wallum Sedgefrog habitats within the WHMA. Data collected from 2012 at 1x1m quadrats.

	Lost Habitats	Retained Habitats
Mean cover (%)	12.9	24
Std Dev	16.3	26.2
Max	35	75
Min	0	0
No. Samples	7	10

Table B2: Wallum Sedgefrog abundance along 50m transects in lost and retained habitat at the WHMA. Data collected from 2012.

	Lost habitat	Retained Habitat
Mean	6.9	19.9
Std Dev	5.1	24.0
Max	17	91
Min	0	0
No. Samples	8	19

Appendix C
Indicative Pond design and layout

LEGEND

RETAINED HABITAT

OFFSET HABITAT

CADASTRAL BOUNDARY

PROPOSED FROG POND

PX POND NUMBER

NOTES

1. FOR TYPICAL POND DETAILS AND CROSS SECTION REFER TO DRG. NO. 252448-02.
2. POND LOCATIONS AND SHAPES ARE INDICATIVE ONLY AND WILL BE CONFIRMED IN THE POND DESIGN AND CONSTRUCTION PLAN.

NOT FOR CONSTRUCTION

Issue	Description	Date	By	Chkd	Appd
2	CONCEPT DESIGN	21/02/18	KM	MD	MD
1	CONCEPT DESIGN	3/11/17	KM	JS	MD

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ABN 18 000 966 165

Client
Sunshine Coast COUNCIL

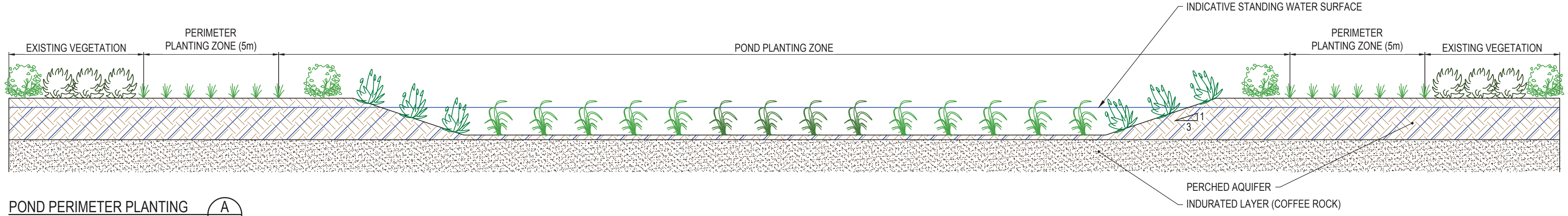
Job Title
BIODIVERSITY OFFEST STRATERGY

A1 / A3 1:2000 / 1:4000 0 20 40 60 80m

WSF FRONG PONDS LOCATION PLAN

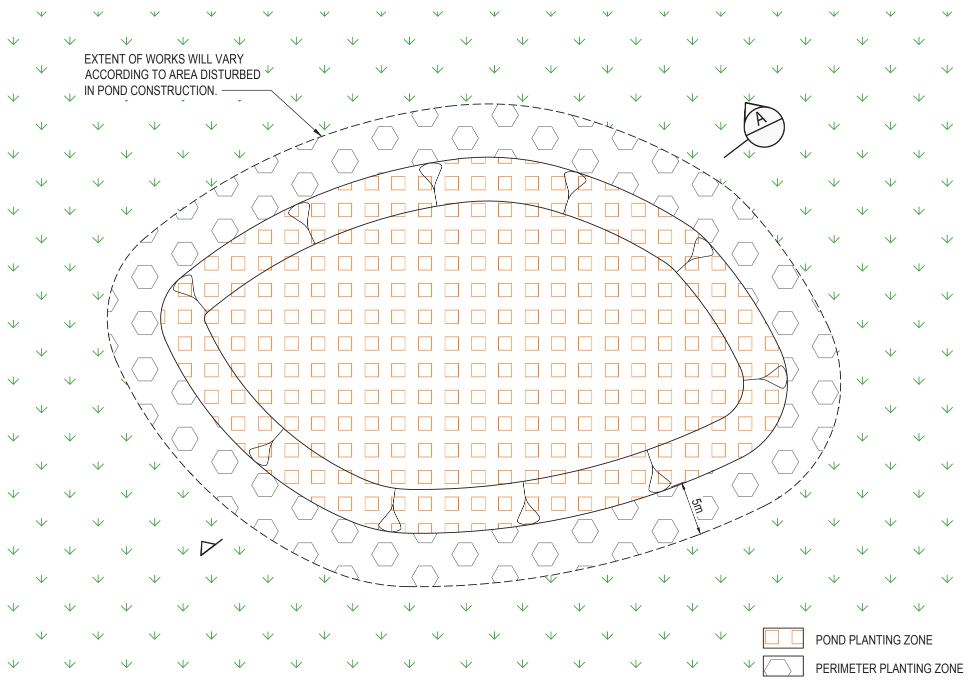
Scale at A1 1:2000m
Discipline
Job No 252448
Drawing Status CONCEPT DESIGN
Drawing No 252448-01
Issue 2

User : Kaitlin Mooney Plot Date : 21/02/2018 8:50:53 AM



POND PERIMETER PLANTING (A)

SCALE 1:100 @ A3



POND TYPICAL PLAN

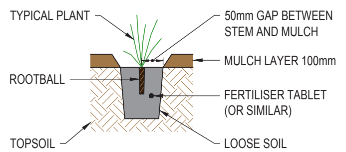
NOT TO SCALE

PERIMETER PLANTING ZONE (3/m^2)

BOTANICAL NAME	COMMON NAME	% MIX
BALOSKION pallens	Bog Rush	5%
BALOSKION tertraphyllum	Swamp Foxtails	5%
BLECHNUM indicum	Water Fern	10%
EMPODISMA minus	Spreading Rope Rush	10%
GAHNIA siberiana	Saw Sedge	24%
GLEICHERNIA dicarpa	Pouched Coral Fern	10%
LEPTOCARPUS tenax	Slender Twine Rush	12%
SCHOENUS brevifolius	Bog Rush	14%

POND PLANTING ZONE (5/m^2)

BOTANICAL NAME	COMMON NAME	% MIX
BAUMEA rubiginosa	Soft Twig-Rush	25%
BAUMEA articulata	Jointed Twig-Rush	20%
LEPIRONIA articulata	Grey Sedge	15%
BALOSKION pallens	Pale Cord-Rush	25%
FIMBRISTYLIS nutans		15%



TYPICAL PLANTING DETAIL

NOT TO SCALE

NOTES

1. FOR LOCATION PLAN REFER TO DRG. NO. 252448-01.
2. DEPTH, EASTING AND NORTHING ARE ESTIMATES ONLY BASED ON EXISTING DATA.
3. 10m^2 MIN. POND STANDING WATER SURFACE AREA.
4. ALL SOIL AND GROUNDWATER VALUES ARE BASED ON PRELIMINARY INVESTIGATION ONLY. DEPTH OF PONDS TO BE CONFIRMED ON SITE.
5. BATTER SLOPES OF POND TO BE NO STEEPER THAN 1:3.

WEED MANAGEMENT

- HAND REMOVAL OF LARGE WEEDS.
- SPOT SPRAY WEEDS WITHIN WORKS ZONE.
- ONLY CONTRACTORS THAT ARE EXPERIENCED AND TRAINED IN PLANT IDENTIFICATION AND WEED REMOVAL TECHNIQUES SHALL BE EMPLOYED TO REMOVE VEGETATION AND WEEDS.
- ALLOW A MINIMUM OF ONE WEEK FOR HERBICIDE TO SHOW RESULTS AND FOLLOW UP WITH ANOTHER SPOT SPRAY.
- ALLOW ANOTHER WEEK FOR SECOND HERBICIDE SPRAY APPLICATION TO BE SUCCESSFUL PRIOR TO SOIL PREPARATION.

PLANTING PREPARATION

- THE AREA TO BE PLANTED IS TO BE DETERMINED ONSITE, ACCORDING TO AREA DISTURBED IN POND CONSTRUCTION PHASE.
- DIG HOLE 100mm BY 100mm MIN. AREA.
- AMELIORATE WHERE REQUIRED.
- MULCH WITH HARDWOOD WOODCHIP PRIOR TO PLANTING (100mm MIN. DEPTH).

PLANTING

PLANT SPECIES AND LAYOUT IS TO BE UNDERTAKEN IN ACCORDANCE WITH THE DESIGN DRAWINGS. CHANGES TO SPECIES SHOULD BE CONFIRMED BY DESIGNER.

PLANTING TECHNIQUE

WATER CRYSTALS AND FERTILISER MAY BE USED TO ASSIST WITH ESTABLISHMENT.

MAINTENANCE

- ON COMPLETION OF WORKS PHASE THE ESTABLISHMENT PERIOD WILL BEGIN FOR A DURATION OF 12 WEEKS.
- IRRIGATION MAY BE REQUIRED WITHIN THIS PERIOD.

NOT FOR CONSTRUCTION

Issue	Description	Date	By	Chkd	Appd
2	CONCEPT DESIGN	21/02/18	KM	MD	MD
1	CONCEPT DESIGN	3/11/17	KM	JS	MD

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Client: Sunshine Coast COUNCIL

Job Title: BIODIVERSITY OFFEST STRATERGY

WSF FRONG PONDS PERIMETER PLANTING PLAN AND NOTES

Scale at A1: 1:50m
Discipline:
Job No: 252448
Drawing Status: CONCEPT DESIGN
Drawing No: 252448-02
Issue: 2

User : Kaitlin Mooney Plot Date : 21/02/2018 8:49:31 AM

Sunshine Coast Airport

Sunshine Coast Airport Expansion Project

Mount Emu She-oak Translocation and Management Plan

252448-TP-2.0

Final | 19 December 2017

Job number 252448

Arup
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Tables

Figures

Appendices

1 Introduction

This Mount Emu She-oak *Allocasuarina emuina* Translocation Plan describes the commitments and on-site mitigation measures to be implemented for the management of the known Mount Emu She-oak populations that will be subject to translocation and protection as part of the Sunshine Coast Airport Expansion Project (SCAEP). The translocation is necessary to compensate for unavoidable impacts to the Commonwealth listed species resulting from the proposed construction and operation of a new runway to replace the existing runway at the Sunshine Coast Airport (SCA). The balance of the Mount Emu She-oak area that will not be impacted will require ongoing monitoring and maintenance to manage a viable population in the long-term.

In October 2017 a draft Translocation and Management Plan was prepared by Arup to support a request for quote from suitably qualified contractors to implement the plan. In November 2017, FuturePlus Environmental (FPE) were awarded the contract and a workshop was held on 6 December to finalise details of the plan. This current version of this plan has been updated to include details on the final translocation, habitat restoration and management requirements for the three year maintenance period. This plan will be published on the SCAEP project website, prior to the commencement of translocation works. It will remain a live document during the translocation works and ongoing maintenance to track the progress of the mitigation measures to protect and restore the Mount Emu She-oak population within the SCAEP area.

1.1 Background

SCA is proposing to construct and operate a new runway to replace the existing runway at the airport. The Sunshine Coast Airport Expansion Project (the Project or SCAEP), has been designated a coordinated project under the Queensland *State Development and Public Works Organisation Act 1971* (SDPWO Act) and a controlled action under the Australian *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

An Environmental Impact Statement (EIS) has been prepared by SCA for the Project, with the EIS process being led by the Queensland Coordinator-General, with the Australian Department of Environment (DOE) carrying out an assessment of relevant matters of National environmental significance (MNES) under the bilateral agreement. The Coordinator-General recommended that the Project proceed and the final report on the EIS was published in May 2016. Approval under the EPBC Act for MNES species affected by the proposal was granted in July 2016.

The project includes the construction of a new 2,450m runway, in a northwest/southwest alignment on existing SCA land that is predominately former sugar cane fields. The new alignment will result in the clearing of approximately 3.69 ha of habitat supporting a known population of Mount Emu She-oak, located within the Project area (the Impact Area) (Figure 1).

A Biodiversity Offset Strategy (BOS) has been developed by SCA which identifies strategies and commitments for compensating impacts to Mount Emu She-oak as a result of the Project. This includes transplantation of the 4.41ha of impacted Mount Emu She-oak to an alternative habitat area to the north of the site using tile movement methodology.

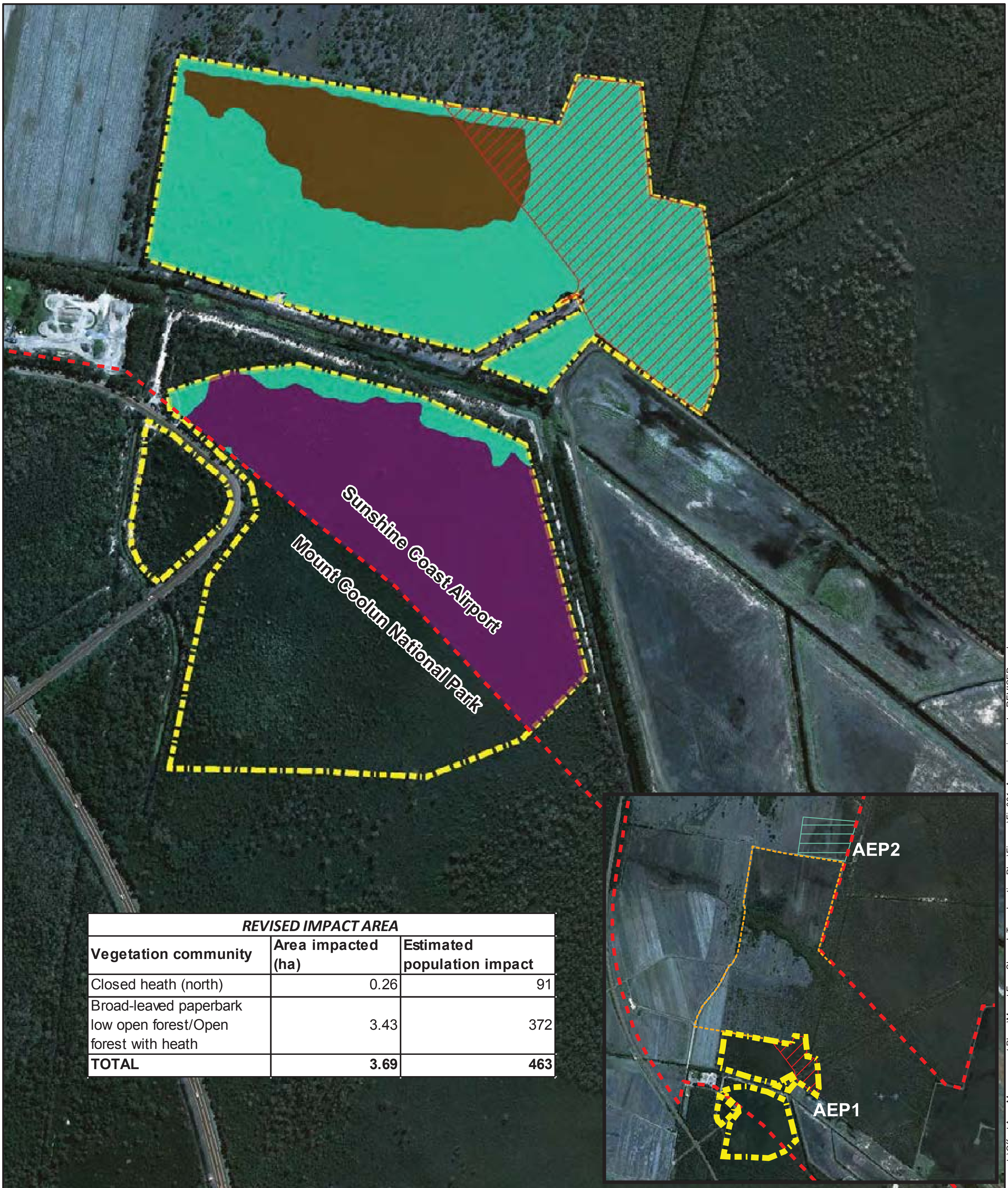
This Mt Emu She-oak Translocation Plan follows the recommendations set out in the BOS and addresses Conditions 1-11 of the EPBC Act approval.

1.2 Objectives of the Translocation

This Translocation and Management Plan aims to support the conservation of two known Mount Emu She-oak*)* populations located at SCA by establishing and maintaining self-sustaining populations that have the capacity to survive in the short and long term. More specifically, the objectives of this plan are to meet the outcomes for the site prescribed by the EPBC Act approval (Table 1).

Table 1: Mt Emu She-oak Translocation Objectives

Outcome	Criteria	Timeframe
Outcome 1	Ensure no net loss in the condition and extent of *Allocasuarina emuina* within the known population area (excluding the population area impact)	For the life of the approval
Outcome 2	Ensure no net less in the condition and extent of *Allocasuarina emuina* translocated from the population area impact compared to the baseline condition and extent	Within 5 years after the commencement of the translocation and then on for the life of the approval
Outcome 3	Ensure a minimum of 2.6 times increase in the count of *Allocasuarina emuina* translocated from the population area impact compared to the baseline count	Within 20 years after the commencement of the translocation and then on for the life of the approval



REVISED IMPACT AREA		
Vegetation community	**Area impacted (ha)**	**Estimated population impact**
Closed heath (north)	0.26	91
Broad-leaved paperbark low open forest/Open forest with heath	3.43	372
TOTAL	**3.69**	**463**

Airport Boundary
Known Population Area
Initial impact area
Revised impact area
Translocation Receiving Site
Vehicle Access Track

Habitat Type:

Broad-leaved paperbark low open forest
Closed heath (north)
Closed heath (south)

Client
Sunshine Coast Council

Job Title
Sunshine Coast Airport Expansion Project

Map Title
Mount Emu She-oak Impact Site

Meters
0 50 100 150 200

D1	18/12/2017	CW	MJD	LOM
Issue	Date	By	Chkd	Appd

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Scale at A4	Map Status
1:5,000	**Final**

Coordinate System
GDA 1994 MGA Zone 56

Job No	Figure No
225480-00	**001**

J:\252000\252448-00 Biodiversity Offset Strategy\Work\Internal\Documents\Offset Area Management Plans\Mount Emu She-oak Translocation Plan\Figures\Fig001_Aemuina_impacts_REVISED.mxd

2 Mount Emu She-oak

Mount Emu She-oak is a coastal heathland plant species listed as endangered under the EPBC Act (Commonwealth) and the Queensland *Nature Conservation Act 1992* (NC Act) (Qld). A National Recovery Plan for Mount Emu She-oak *Allocasuarina emuina* (the Recovery Plan) has been prepared by the Environmental Protection Agency (Queensland Government).

A detailed description of the taxonomy, biology and ecology of Mount Emu She-oak can be found within the Recovery Plan (Environmental Protection Agency 2007); however relevant information has been included here to assist with on-site species identification and to give an understanding of how ecological processes have influenced the abundance and distribution of the species at SCA.

2.1 Species description

Mount Emu She-oak belongs to the family *Casuarinaceae* (Environmental Protection Agency 2007). The following description has been adapted from Halford (1993) and Johnson (1989) (cited in, Environmental Protection Agency 2007):

Mount Emu She-oak is a dioecious spreading shrub to 2.5m with smooth bark (Photograph 1). Branchlets up to 12cm long ascend the branch; sectioned by small, smooth articles (4-8 mm long, 0.5-0.9mm in diameter) with soft down in the furrows. Each ridge of the branchlet article has 6-8 teeth (0.3-0.7mm long) erect to slightly spreading and not overlapping. Male flowers are unbranched and without stalks. They are approximately 1-3cm long with 8.5-9.5 whorls per centimetre. A small leaf structure, differing in form from the foliage leaves remain attached to the plant beyond the expected time of falling and is associated with the male flowers. The pollen bearing part of the flower can be 0.8-0.9mm long. The cones are cylindrical and 12-28mm long, 6-15mm in diameter and with a sterile apex. The stalk is 3-13mm long and slender. The seeds are dark brown to black and are 4.5-7.5mm long.

Photograph 1: Mount Emu She-oak
Allocasuarina emuina (David Halford 2013)

2.2 Description of the SCA population

Mount Emu She-oak is currently known from 11 populations on the Sunshine Coast. Surveys undertaken at SCA as a part of the Environmental Impact Statement (EIS) for the Project identified two populations occurring on the site. One Mount Emu She-oak Population (AEP1) is located within the Project area and the second population (AEP2) is located north of the Project area, on the western edge of Mount Coolum National Park (see Figure 1).

Mount Emu She-oak population 1 (AEP1) is known as the Finland Road population within the Recovery Plan (Environmental Protection Agency 2007). The population area includes Sunshine Coast Council (SCC) owned freehold land, State land and the South Marcoola Section of the Mount Coolum National Park. The Recovery Plan states that individuals are scattered over the entire area (Environmental Protection Agency 2007).

According to population surveys undertaken in 2003 and 2006, the Finland population constitutes a significant population (Lamont 2010), having:

- The greatest number of individuals out of the other populations described by Lamont (2010) and the Recovery Plan; and
- Representing 47% of the known population (based on 2003 population estimates within the Recovery Plan), or 29% of the known population based on Lamont’s (2010) survey in 2006.

This is due to AEP1’s large area compared to the other populations as opposed to an extraordinarily high density of plants. Density estimates across all 11 populations were 994 plants/ha, with a standard deviation of 525.6 plants/ha (Lamont 2010). Lamont (2010) estimated 12,429 individuals of Mount Emu She-oak existed in the Finland Road populations in 2006 having sampled an area of 11.2ha south of the drainage channel, excluding the area of Wallum Hakea dominated habitat north of the drainage channel (~1,109 plants/ha).

The 4.41ha area of AEP1 that will be subject to translocation at SCA equates to approximately 5% of the Finland Road population. Modifications to the project design, including the diversion of the main access road around areas of high quality habitat, have assisted to minimise this area. These are discussed in the project EIS.

2.3 The ecology of Mount Emu She-oak at SCA

Mount Emu She-oak is restricted to heathland areas between Beerburrum and Noosa in Queensland's Sunshine Coast. The two populations at SCA are located in a flat coastal area between 2m to 4m elevation. Olsen (2002, cited in Environmental Protection Agency 2007) has indicated that the species prefers wetter heath soils, distinguishing it from its close relative *Allocasuarina thalassoscopica*, which occurs predominantly on dry heath soils. Mount Emu She-oak exists on nutrient poor light to medium clays or sandy loams with weak acidic reaction (Environmental Protection Agency 2007).

The current distribution of Mount Emu She-oak at AEP1 and 2 is restricted by conditions provided by cleared habitat and melaleuca forest, the depth of coffee rock and the varying fire history in the two population areas. There does appear to be suitable heath habitat south of AEP1 within the southern Marcoola sections of Mount Coolum National Park, though the population is not known to inhabit this area. Even if the species once existed in this area, the direction of prevailing winds may be limiting the rate of recolonisation. This is because the wind-dispersed seeds have short dispersal distances, with much of the seed germinating within one metre of the adult plant. Thus, whilst northwest winds are common in the autumn months, prevailing south and south-east winds (Lamont 2010) could be reducing the rate of southerly colonisation/recolonisation.

The species has a close relationship with fire. During fire, the above ground parts of Mount Emu She-oak can be irreparably damaged; though seeds are often retained in the cones until they open after fire, allowing the species to successfully regenerate. Surviving adult plants are also able to flower in the growing season following fire whilst there is also evidence suggesting the species can resprout from viable lignotubers when the above ground parts of the plant are destroyed (Environmental Protection Agency 2007).

Across all known Mount Emu She-oak populations on the Sunshine Coast, Lamont (2010) found that the northern and southern population groups (separated by the Maroochy River) were genetically distinct. In the northern region, AEP1 and 2 were found to be genetically distinct from the other nine populations and displayed a high level of genetic similarity despite their current distance of over 1km. Little exchange was detected with the populations that lie approximately 12km to the north (Lamont, pp. 90). AEP1 and 2 were revealed to have a relatively low genetic diversity compared to other populations.

3 Baseline Population Surveys

A baseline survey of AEP1 was carried out on 5th and 14th July 2017 by Arup ecologists to estimate the size, condition and extent of the population occurring within SCA land prior to the translocation works. The purpose of the survey was to (1) quantify the direct impacts of the project on Mount Emu She-oak population size at SCA and (2) allow the required 2.6 times increase in population size to be calculated.

Replicating the EIS methodology, forty-four (44) quadrats were systematically surveyed for Mount Emu She-oak (Figure 2). Quadrats of 10 m x 10 m were equally spaced using a 50m x 50m grid overlayed on aerial photography of the site. One quadrat was positioned within the centre of each grid square, except where areas could not be accessed due to dense ground cover or the existence of other physical barriers such as drainage lines. In each quadrat, two ecologists counted the number of individual Mount Emu She-oak plants present. To allow efficient and effective field identification and detectability, surveys were undertaken during the peak flowering period for the species.

The mean density of Mount Emu She-oak was estimated for the SCA population area within each vegetation type: Closed heath and Broad-leaved paperbark low open forest/ Open forest with heath. Closed heath to the north and south of the drainage channel were assessed as separate habitat types to reduce error in population estimates due to floristic differences in the vegetation impacting Mount Emu She-oak density. These habitat areas are referred to as Closed heath south (i.e. south of the drainage channel) and Closed heath north (i.e. north of the drainage channel).

Airport Boundary

Known Population Area

Impact Site

50m Grid

Quadrats

Vegetation Community

Broad-leaved paperbark low open forest

Closed heath north

Closed heath south

Client

Sunshine Coast Council

Job Title

Sunshine Coast Airport Expansion Project

Map Title

Mount Emu She-oak Population Survey Transect Locations

Meters

0 40 80 120 160

D1	6/10/2017	CW	MJD	LOM
Issue	Date	By	Chkd	Appd

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Scale at A4	Map Status
1:3,690	**Final**

Coordinate System

GDA 1994 MGA Zone 56

Job No	Figure No
225480-00	**002**

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Table 2 shows the results of the population estimates obtained for AEP1 within the 17.35ha of SCA land. A total of 6,752 *A.emuina* individuals were estimated for the area with 628 plants (~9.3%) occurring within the 4.41ha impact area. This is consistent with the EIS estimate of approximately 550 plants in 2013.

Mount Emu She-oak density varied between habitat types with the highest density of Mount Emu She-oak observed in the closed heath located south of the drainage channel (Figure 3). Here, plant density was found to be 880 plants/ ha, with the estimated number of plants in this area being 4,805 (SCA land only).

As discussed in the project EIS, the closed heath area to the north of the drainage channel is dominated by a thick layer of Wallum Hakea that partially restricts the establishment and persistence of other flora. For this reason, Mount Emu She-oak density was found to be 350 plants/ ha, with a total estimate of 953 plants. This is significantly lower than the southern area of AEP1. When compared to closed heath to the south, northern closed heath areas appeared to be in a later stage of succession, where Wallum Hakea has out-competed Mount Emu She-oak in the absence of an appropriate fire regime.

In areas of Broad-leaved paper bark low open forest/ Open forest with heath, Mount Emu She-oak density was found to be 108 plants/ ha. In this vegetation community, it is estimated that 993 plants occur.

When including southern sections of the population area located within Mount Coolum National Park property, AEP1 is estimated to contain 12,096 individuals over a total area of 23.85ha with impacted Mount Emu She-oak accounting for 5% of this total population size. This total population size is consistent with the EIS estimate of 12,152 in 2012 and slightly lower than Lamont's estimate of 12,429 in 2010 (Lamont 2010). However, Lamont's study was based on an assessment of closed heath to south alone and is likely to have overestimated population size for open heath areas to the north of the drainage channel.

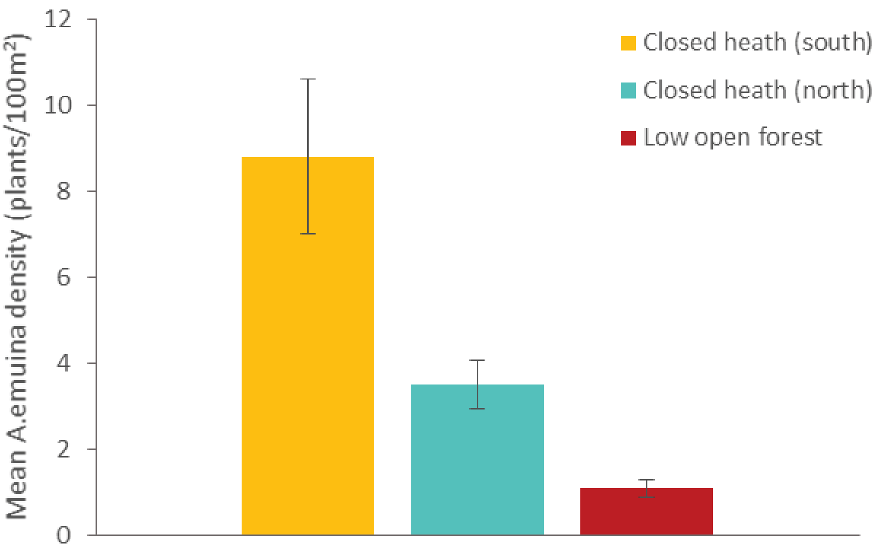

Figure 3: Mean Mount Emu She-oak density in the three different habitat types: Closed heath (south), closed heath (north) and low open forest. Bars represent the standard error.

Table 2: Mount Emu She-oak population estimate by habitat type within SCA land.

Habitat type	Habitat area (ha)		Area sampled (ha)	Plants counted *no.*	Density (plants/ha)	Habitat N	
	Retained	**Impacted**				**Retained**	**Impacted**
Open heath (south)	5.46	0.00	0.20	176	880	4,805	0
Closed heath (north)	2.46	0.26	0.12	42	350	862	91
Broad-leaved paperbark low open forest/Open forest with heath	5.74	3.43	0.12	13	108	621	372
TOTAL	**13.66**	**3.69**	**0.44**	**231**	**-**	**6,124**	**463**

4 Translocation Receiving Site

4.1 Land Tenure and Security

A suitable receiving site for the translocation of the 4.41ha of impacted Mount Emu She-oak population (AEP1) was identified during the EIS process and as a part of the BOS. The site is located on Sunshine Coast Council land immediately north of the Project area. Land owner details for the site are provided in Table 3.

Table 3: Landowner details for Lot 1 SP269581

Landowner Details			
Registered Owner/s on Title:	Sunshine Coast Regional Council		
Real Property Description (Lot and Plan):	Lot 1 SP269581 (Finland Rd, Marcoola) – Airport needs		
Lessee: **(if applicable)**		**Trustee:** **(if applicable)**	
ABN/CAN: **(if applicable)**	37 876 973 913		
Phone number:	07 5475 7272	**Mobile Number:** **(if applicable)**	NA
Facsimile: **(if applicable)**	07 5475 7277	**Primary contact person (if required):**	NA
Email:	mail@sunshinecoast.qld.gov.au		
Postal Address:	Locked Bag 72 Sunshine Coast Mail Centre		

The land will be subject to an Environmental Offsets Agreement under the *Queensland Environmental Offsets Act 2014* to ensure its protection into perpetuity.

4.2 Receiving site suitability

To ensure the translocation of Mount Emu She-oak is most successful, plants should be relocated to areas that offer suitable soil and groundwater conditions.

Wallum and heathland vegetation communities are commonly associated with shallow water tables (particularly after rain), which perch (or semi-perch) on a hardpan layer such as coffee rock. Coffee rock can also inhibit the growth of large trees, such as Broad-leaved Paperbark by limiting root development.

To ensure the receiving site is suitable for supporting coastal heath, soil and groundwater investigations were completed within the site in 2013. The boreholes in the receiving site indicate that there is a coffee rock layer between 0.5m and 1.2m below ground level and the upper soil horizons are sandy loams. These are similar ground conditions to the Mount Emu She-oak impact area. The existence of a smaller population of Mount Emu She-oak and heathland to the east also provides evidence that the area is likely to offer suitable soil and groundwater conditions for the heathland translocation.

Additional soil sampling has been undertaken at the receiving site, prior to the commencement of the translocation works at 19 locations using a hand auger. These investigations have been used to further refine the most suitable location for the translocated Mount Emu She-oak within the receiving site.

Soil samples have been systematically collected using a 50m x 50m grid overlayed on aerial photography of the translocation site. Using a hand auger, each sample will be taken within the centre of each grid square and will involve the collection of soil in 20cm increments up to a depth of 1.5m. Each sample will be deposited on a tarp where the physical properties of the soil will be visually assessed. Data will be collected for soil type, groundwater level and depth to coffee rock. Where soil observations obtained for each grid square are within the suitable ranges identified, these locations will be prioritised for receiving Mount Emu She-oak (Table 4).

Table 4: Suitable soil and groundwater conditions for Mount Emu She-oak

Key Attributes	**Ideal parameters**
Soil type	Nutrient poor light to medium clays or sandy loams with weak acidic reaction
Groundwater level	0.9m to 2.1m below ground level
Depth to coffee rock	0.5m to 0.8m below ground level

During the week commencing 11 December 2017, FPE completed 19 boreholes using a hand auger across the translocation receiving site to assess the parameters specified in Table 4. Preliminary results from these boreholes have been used to finalise the optimal location of placing heath tiles.

5 Translocation Procedures

This section provides a summary of the procedures proposed for the translocation of impacted Mount Emu She-oak at SCA to ensure the protection and appropriate management of impacted and retained populations. Two translocation methods are proposed for use, depending on the target vegetation community:

- Within closed heath habitat areas, translocation works will be undertaken using heath tile movement methodology. The methods for this approach are based on the successful heath tile translocation of a similar vegetation community at the Brightwater Residential Development and the University of the Sunshine Coast.
- Translocation works for impacted plants within areas of Broad-leaved paperbark low open forest/Open forest with heath will involve the movement of individual Mount Emu She-oak plants into areas of the site that will require vegetation management to establish a closed heath community.

There are practical and ecological reasons for utilising a combination of translocation methods to achieve the required outcomes for the maintenance and enhancement of the Mount Emu She-oak population at the SCA.

5.1 General requirements

5.1.1 Qualifications and experience of Project Team

The project team for the translocation and restoration works is provided in Table 5.

The translocation project will be carried out under the direct supervision of a suitably qualified ecologist or bushland restoration specialist. This person must have a university degree in ecology, botany, environmental science or a similar and relevant field. All phases of the planning, implementation, completion and monitoring of the project must be reviewed by the supervising ecologist or bushland restoration specialists.

The on-ground works will be coordinated and supervised by qualified and experienced personnel within minimum qualifications in Certificate III in Horticulture, Conservation Land Management (CaLM) or equivalent experience. The project shall be undertaken by conservation land management specialists who have experience in the collection, propagation and translocation of threatened flora species, especially species belonging to coastal heath communities. Site maintenance will be undertaken by bush regeneration specialists with minimum qualifications in Certificate III Conservation and Land Management or equivalent and at least 10 years of practical ecological rehabilitation experience.

Monitoring and associated reports shall be prepared by a suitably qualified ecologist in preparing ecological monitoring reports.

Table 5: Translocation and restoration project team, role, qualifications, experience and responsibilites

Name / Position	Project Role	Qualifications	Experience	Responsibilities
Paul Wood Company Director / Principal Environmental Scientist	Project Director	BEnvSc MUDIA MEIANZ	Paul is a Director of FPE and has very strong leadership skills and a wealth of relevant industry experience in environmental monitoring, management and regulatory (compliance) reporting. Paul will be responsible for all certification of reports associated with the proposed scope of services.	Certification of final report deliverables to meet FPE quality assurance objectives, regulatory compliance and client expectations.
Kaine Pritchard Contract Administrator/ Senior Environmental Scientist	Project Manager / Ecologist / WHS Manager	BSc (Plant Science and Environmental Studies) Cert IV in Work Health and Safety Cert IV in Assessment and Workplace Training AC/DC Licence	Kaine is a qualified Environmental Scientist with over 12 years' consulting experience in the environmental industry. Kaine has significant experience in environmental management, undertaking weed surveys, experience in habitat restoration and bush regeneration and holds an ACDC licence.	Liaison with Client; Budgeting and resource coordination to achieve project delivery timeframes and budgets; Desktop assessment; Field survey assistance to principal ecologists; Preparation and technical review of all report deliverables; Subcontractor management; and Development of WHS Plan and EMP and site specific SWMS.

Name / Position	Project Role	Qualifications	Experience	Responsibilities
Dr Peter Young Principal Ecologist / Suitably Qualified Person	Principal Botanist / Ecologist	PhD BSc (Plant Ecology & Plant Geography) (Hons) BA (Geography)	Peter is a plant ecologist with over 30 years' experience and has extensive knowledge in the survey, mapping and assessment of native vegetation, fire ecology, regional ecosystems, rainforest botany and ecology, rare and threatened plants/ecosystems, and weed/invasive plant species. Much of his expertise has been developed within southern and central Queensland and has spent 20 years in Queensland Government agencies including Queensland Parks and Wildlife Service (QPWS) and the Department of Environment and Resource Management (DERM). With respect to coastal heath, Peter has detailed understanding of species and community ecology especially fire and soil water relationships as demonstrated by his recent PhD thesis and work history associated with defining and describing regional ecosystems and their conservation requirements in southern Qld.	Specialist input into ecology of Mt Emu She-oak and Wallum Heath Management; Field Survey Lead (Mt Emu She-oak and weeds); and Data analysis, statistical analysis, technical review of reports including recommendations on translocation and weed management.

Name / Position	Project Role	Qualifications	Experience	Responsibilities
Luke Craig Civil Works Site Foreman	Civil Works Coordinator	BSci (Environmental) CPESC	Luke has extensive >15 years' experience in environmental management, investigation, planning, compliance, auditing, monitoring, risk assessment, and regulatory liaison. Over the last five to ten years Luke has successfully fulfilled environmental coordinator and advisor roles or gas and mining civil works around Australia and Papua New Guinea. Luke is a member of IECA and active ESCP professional, skilled in the design, development and certification of ESC for infrastructure projects. Luke has previously managed the Brightwater Estate Heath-Tile translocation as the contracted environmental management consultant.	ESCP development & Certification (CPESC) Manage and supervise civil works for works under the contract; Liaison with Client; Resource coordination to achieve project delivery timeframes and budgets; Inductions and WHS management.
Shadforths Civil Engineering Contractors Civil Contractor	Civil Contractor	Not applicable	Shadforths Civil Engineering Contractors is one of Queensland's largest family owned civil contracting companies with over 500 in-house staff, and one of the state's largest in-house fleets. Shadforths has been operating in QLD for over 40 years and have extensive experience in the relocation of wallum heath vegetation. Shadforths own a specialised transportation truck and associated slabbing bucket and skids for the removal and transport of vegetation tiles.	Delivery and commissioning of site facilities and demobilisation; Carry out all clearing / grooming and mulching works. Undertake the heath tile movement translocation of approximately 1.25ha of closed heath containing the target species; and Miscellaneous civil, ASS and ESC items as specified.
Jim Stuart Weed / Maintenance Coordinator	Weed / Translocation Coordinator	Associate Diploma of Forestry Environmental Management (Short Course) AC/DC Licence Construction White Card	Jim leads a team of over 15 bush regenerators and has had over 30 years in the forestry and natural areas profession.	On-ground weed and translocation management, scheduling and plant maintenance.

Name / Position	Project Role	Qualifications	Experience	Responsibilities
Nick Evans Ecologist / Environmental Scientist	Ecologist / Fauna Spotter	BEnvSc	Nick Evans is an Environmental Scientist / Ecologist with 5 years' experience in conducting ecological assessments, natural resource management, habitat surveys, spotter-catcher works, environmental monitoring, and development and implementation of conservation initiatives.	Pre-Clearance Habitat Survey, Weed Surveys, Fauna Spotter-Catching supervision and associated reporting; and Surveying of Mt Emu She-oak trees
Simone Forman Ecologist / Environmental Scientist	Ecologist / Fauna Spotter	BSc (Environmental & Animal Ecology)	Simone Forman is an Environmental Scientist / Ecologist with 2 years' experience in conducting ecological assessments, natural resource management, habitat surveys, spotter-catcher works, environmental monitoring, and development and implementation of conservation initiatives.	Pre-Clearance Habitat Survey, Weed Surveys, Fauna Spotter-Catching supervision and associated reporting; and Surveying of Mt Emu She-oak trees
Jono Hooper	Ecologist / Fauna	BSc (Environmental) / B.Sc	Jono Hoper is an Environmental Scientist / Ecologist with 5 years' experience in conducting ecological assessments, natural resource management, habitat surveys, spotter-catcher works, environmental monitoring, GIS mapping and development and implementation of conservation initiatives.	Pre-Clearance Habitat Survey, Weed Surveys, Fauna Spotter-Catching supervision and associated reporting; and Surveying of Mt Emu She-oak trees

Name / Position	Project Role	Qualifications	Experience	Responsibilities
Ann Moran Mt Emu She-oak Specialist / Botanist	Technical advise on translocation of Mt Emu She-oak	B.Sc (Environmental Science)	Ann is an experienced botanist who has worked throughout Queensland for over 35 years. She has extensive plant knowledge, particularly of flora on the Sunshine Coast. Ann previously operated her own botanist consultancy and is a well-respected flora expert. Ann has 35 years with specific field experience in translocating mature Mt Emu She-oak plants with 99% success and was involved in the first flora and fauna survey for the Sunshine Coast Airport in 1989 for Maroochy Council.	Specialist input into translocation of Mt Emu She-oak; and Attendance at Full Day Workshop.
Dr. Alison Shapcott Mt Emu She-oak Specialist	Technical advise on translocation of Mt Emu She-oak	BSc(Hons), PhD	Associate Professor Shapcott has been an active participant in several threatened species recovery teams and communicating between land managers, scientists, conservation groups and industry organisations to enable practical solutions. She has been involved in several restoration projects where she provided expert advice and or lead the ecological aspects of the project in collaboration with external bodies. These have included a 15 Ha heath translocation project which included translocation of populations of five vulnerable or rare plant species, a recovery project for the endangered species *Allocasuarina emuina* and a translocation project for the endangered *Cycas megacarpa.*	Specialist input into translocation of Mt Emu She-oak as required.

5.1.2 Environmental Management Plans

The following Environmental Management Plans have been prepared for the translocation and ecological restoration works. These assist with minimising adverse of impacts to the environment as a result of the works and include an:

- Erosion and Sediment Control Plan (Refer to Appendix A); and
- Acid Sulphate Soils Management Plan (Refer to Appendix B).

All site works must be undertaken in accordance with the requirements of these environmental management plans. The Contractor will be required to update the ESCP an ASS management plans in line with the final translocation and restoration methodology.

5.2 Translocation timing

Translocation of Mount Emu She-oak will be timed to coincide with the commencement of the SCAEP early works; expected to be January - March 2018. Although site preparation works are likely to commence immediately, it may be preferable to delay the movement of any plants until the wet season (January to April) so to minimise watering requirements post-works.

5.3 Seed collection and storage

Seed was collected from the impacted and retained population of Mount Emu She-oak on 3 August 2017. Ten fruit each from twenty individual plants in both the closed heath (north) and twenty individuals from the closed heath (south) vegetation communities were collected. These seeds will be stored in a nursery, with germination trials commencing to assess any differences in viability between seeds collected from the different habitat types.

During the pre-clearing survey within areas of Broad-leaved Paperbark open forest to identify individual plants for translocation, seed will be collected from these plants.

A program of germination will be carried out to provide saplings for installation within the closed heath restoration area and, if require, the heath translocation zone. Seed viability is likely to decline over time so it will be necessary for planting and additional seed collection programs to be carried out during the maintenance and monitoring phase of the translocation and restoration works.

5.4 Impact site preparation and treatment

Due to the difference in the type and structure of the vegetation communities that support Mount Emu She-oak in the impacted population area, two types of translocation works are proposed. Areas of closed heath with a lower canopy cover of paperbark trees will be subject to the heath tile translocation procedures and areas that are underneath a canopy of taller trees will be subject to individual plant translocations (Figure 4).

Prior to translocation of the Mount Emu She-oak from the impact site, areas of suitable habitat types to be relocated using the heath tile methodology will be surveyed and pegged by the FPE Principal Botanist. The location of access tracks into the impact area to carry out the translocation works are to be confirmed and surveyed.

5.4.1 Heath tile translocation zone

Based on preliminary mapping prepared for this plan, the total area to be subject to translocation using the heath tile method is approximately 1.25ha. High visibility flagging tape and fencing will be used to ensure impact areas can be easily identified on ground and to mark out the extent of the heath tile translocation works. Tree Protection Fencing and Signs are to be established in accordance with Australian Standards AS4970-2009 *Protection of trees on development sites* to ensure the protection of Mount Emu She-oak population areas to be retained.

The impact area that will be subject to heath tile translocation will need to be slashed and cleared to reduce above ground biomass of Wallum Hakea and other shrub and canopy trees. This may be completed using a forestry mulcher attachment on a positrack or excavator, or a chopper roller. The above ground biomass should be removed to no higher than 500mm above natural ground level. Larger canopy trees need to be felled individually. Felled material is to be mulched on site and retained on the area to be impacted. This will assist in the retention of seed from Mount Emu She-oak plants within the translocation area and will reduce the potential for loss of soil moisture through evaporation.

Impacted areas of heath to be translocated in tiles should also be watered prior to removal to reduce the likelihood of transplanting shock and to assist with establishment in the receiving site.

5.4.2 Individual plant translocation

A flora survey of the balance of the impacted area will be completed to mark all Mount Emu She-oak plants. The survey will be completed by the FPE survey team, led by Principal Botanist Dr Peter Young.

A georeferenced map of the impact area will be created that has transect lines overlayed utilising Arc GIS. Based on the orientation of the impact site transects would run in a north-westerly to south-easterly direction. This map will be downloaded onto field tablets and utilised during the survey.

Systematic searches for Mt Emu She-Oak plants will be undertaken by walking in swaths of 15 m across the entire impact area. This will involve having three persons spaced evenly apart over the 15 m, covering a search radius of 5m each. Based on this approach, preliminary estimations assume that approximately 3km of transects will need to be covered.

Any individual plants found will be clearly marked with high visibility flagging tape, the GPS position logged using a Differential GPS (DGPS), with an accuracy within 1m, a unique identifier assigned (i.e. AEP1) and the following details collected:

- Height
- Number of stems
- Presence of flower/fruits; and
- Comments on the vigour or health of the plant.

A vinyl tree tag will also be applied to the base of each She-Oak plant, with its unique identifier displayed. The data from the DGPS can then be downloaded, converted and mapped. The information and mapping resulting from the field surveys will be instrumental in refining translocation methodologies. The spread of the individual plants will determine the location of the access tracks through the Melaleuca forest to ensure the most efficient system of plant extraction.

Plants will be watered prior to removal to reduce the likelihood of transplanting shock. The plants will be removed early in the morning and will not be moved during periods of high temperature or strong drying winds. The plant including the root mass and sufficient soil to hold the root system together, will be carefully moved using a spade or a mattock. The area around the root systems is to be carefully excavated to identify the tap root, with any impacts or damage to this tap root to be avoided as much as practical.

The removed plants will be protected from wind and sun exposure, using wet hessian or a similar cover, to minimise stress factors during transport from the impact site to the receiving site. Plants will be installed directly into the receiving site location.

Known Population Area

Translocation treatments

Heath tile translocation

Individual plants translocation

Vegetation Community

Broad-leaved paperbark low open forest

Closed heath north

Closed heath south

Client	Sunshine Coast Council
Job Title	Sunshine Coast Airport Expansion Project
Map Title	Translocation treatment types

Meters: 0, 20, 40, 60, 80

Issue	Date	By	Chkd	Appd
D1	18/12/2017	CW	MJD	LOM

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Scale at A4: 1:1,714	Map Status: Final
Coordinate System: GDA 1994 MGA Zone 56	
Job No: 225480-00	Figure No: 004

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5.5 Receiving site preparation and treatment

The receiving site for the establishment of the translocated Mount Emu She-oak population is located approximately 2km to the north of the impact site. A total area of approximately 4.4 ha has been allocated to receive the 1.25ha heath tile translocation, with the balance of the new population area requiring ecological restoration to reinstate a closed heath vegetation community. Figure 5 shows an indicative layout of the heath tile translocation site and revegetation site, with a schematic representation of other required site works.

5.5.1 Site survey and vegetation clearing

Prior to removing any Mount Emu She-oak from the impact site, the receiving site will be surveyed and pegged to allow for the on-ground identification of areas that will be receiving the translocated heath tiles and individual Mount Emu She-oak plants. The final location and dimensions of the heath tile translocation areas will be dependent on the results of the soil sampling and the recommendations of the ecologist or rehabilitation specialist.

The soil and geology assessments completed by FPE during the week commencing 11 December 2017, identified an area in the south-west corner of the receiving site that contained coffee rock at a suitable depth below ground level. In this area, coffee rock was detected at 1.0m below ground level. Coffee rock was not detected at any other locations across the receiving site.

The site consists predominantly of exotic pasture with occasional *Melaleuca quinquenervia* as a scattered canopy tree. However areas of dense Melaleuca/slash pine regrowth are also located along the eastern boundary. All existing vegetation on the site will be cleared to natural ground level in preparation of receiving translocated Mount Emu She-oak and to allow for machinery and vehicle access.

Prior to the commencement of clearing works, Tree Protection Fencing and Signs are to be established in accordance with Australian Standards AS4970-2009 *Protection of trees on development sites.* These are to be maintained on site for the duration of the translocation works. Immediately before clearing, a licensed wildlife spotter/catcher is to inspect all vegetation to be removed. Any fauna encountered are to be relocated/ ushered to adjoining vegetation.

Whilst the clearing works are being undertaken, a registered fauna spotter/catcher should be on-site in the event that fauna are observed which require relocation or in case of fauna injury. All vegetation removed is to be mulched on-site and stockpiled in cleared open areas on site. Exotic vegetation is to be disposed of at an approved offsite disposal facility.

5.5.2 Earthworks

Following vegetation clearing works the existing topsoil will need to be excavated and removed from the heath tile receiving area. Top soil is to be removed from areas identified for receiving translocated heath to a depth of 300mm. Soils are to be stockpiled in cleared open areas on site for reuse at the impact site to fill the hole left from the translocated heath.

All works must be undertaken in accordance with the Erosion and Sediment Plan prepared for the project (**Appendix A**).

Translocation Site Coordinates

Point	Easting (m)	Northing (m)
A	508046	7059880
B	508336	7059860
C	508274	7059640
D	508017	7059680
E	508152	7059660
F	508171	7059750

Airport boundary
Translocation Site Receiving Area
Vehicle Access Track

Indicative Management Areas

Heath tile translocation
Heath restoration and translocated plants

Client
Sunshine Coast Council

Job Title
Sunshine Coast Airport Expansion Project

Map Title
Mount Emu She-oak Translocation Site

Meters
0 30 60 90 120

D1	12/10/2017	CW	MJD	LOM
Issue	Date	By	Chkd	Appd

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Scale at A4	Map Status
1:2,500	**Final**

Coordinate System
GDA 1994 MGA Zone 56

Job No	Figure No
225480-00	**005**

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5.6 Heath tile preparation, removal and installation

The intent of the heath tile translocation is to move the top 300mm of topsoil, with associated root systems and soil ecosystem, from the impacted site to the prepared translocation receiving site. It is recommended that an excavator with a fabricated tray-shaped bucket should be used to remove the heath in tiles (Photograph 3). The heath tiles will contain the vegetation, topsoil and the existing seed bank. By translocating the entire vegetation community and the soil seed bank, it is considered that there will be a higher chance of success in establishing a viable Mount Emu She-oak population.

FPE's proposed methodology, although based on past methodologies has been developed specifically for the target species and site conditions. The proposed methods have been based on the use of existing equipment held for previous projects, removing the need for project delays due to equipment fabrication.

Specific requirements have been detailed as follows;

- The cut interface shall be kept moist at all times by regular passes of the Moxy water cart;
- Using a fabricated heath tile cutting bucket fitted to a 30 tonne digger (or similar) a 4m2 tile of heath shall be cut with each pass;
- Each tile shall be dug to approximately 300mm and retain the top 500mm of vegetation. This is to ensure the roots and soil associated with identified vegetation are left relatively undisturbed during the process;
- The tiles are then placed on a tile unit carrier which can hold two (2) tiles (8m2 in total) with a void in the middle around the quick hitch which is capable of carrying additional soils and mulch that may have fallen from the tile;
- A 6-wheel Moxie, with fabricated flat trays large enough to fit two carrier trays, shall be loaded for direct haulage to the receival area;
- In addition, two slides which can carry up to three unit carriers have also been fabricated to assist in wet areas and or inclement weather where Moxie access off haul roads is not possible;
- Works will include around 30 loads per working day, totalling approximately 500m2 of heath;
- Post heath tile movement a guard layer of fine grained agricultural lime shall be spread at 5 kg/m2 in accordance with the approved ASSMP and hydromulched for temporary soil stabilisation;
- At the receival area the tiles shall be placed gently on moist (Moxy water cart to maintain 50m2 wetted area ahead of tile placement) and lightly ripped (using digging bucket teeth) subsoils in the same order, orientation and approved level;
- Immediate watering shall be undertaken by the water cart in accordance with the proposed watering regime; and
- Daily records of the tile quantities, plant movements, watering details and monitoring shall be kept by FPE.

Photograph 2: Example heath tile translocation methodology employed by Shadforths Civil Contractors.

5.7 Closed heath habitat restoration

Within the balance area that will not be subject to heath tile translocation, ecological restoration works will be required to remove exotic species and Broad-leaved Paperbark regrowth to create areas of closed heathland that is suitable for supporting Mount Emu She-oak. The treatments to these areas will be a combination of assisted regeneration and revegetation works. The scale of any revegetation works will need to be informed by the maintenance and monitoring results. These areas will be used for installation of the individual Mount Emu She-oak plants that are translocated from the receiving site and planting of nursery-raised plants

Primary actions associated with areas requiring assisted regeneration are the control of exotic and declared pest plants. There is currently evidence of recruitment of native trees, shrubs and groundcovers in this area. Fire management within these areas is recommended to be excluded for the maintenance period to allow sufficient time for natural regeneration of canopy and shrubs to occur. Introduction of ecological burns at this early stage in succession can reduce canopy and shrub cover.

Preliminary soil tests are to be undertaken to set a baseline of soil condition and composition prior to any revegetation works. A minimum of 4 samples are to be taken from the site with physical and chemical analysis undertaken by a NATA accredited soil analysis laboratory. Information received from testing may inform the requirements of planting hole fertilisation or soil amelioration to benefit plant establishment.

5.7.1 Weed and exotic species treatment

A site survey is to identify all restricted invasive plants and environmental weeds. Specific weed treatments are to be in accordance with the Department of Agriculture and Fisheries (DAF) information sheets (http://www.daff.qld.gov.au/4790_10168.htm#L). Specific control methods are to be dependent on the age, size, location and health of the weed specimen. For example, hand removal or foliar spraying for small woody weeds or grasses and cut-stumping or stem scaping for large woody weeds. When applying chemical treatments native trees and shrubs are to be avoided. Follow up weed removal should be timed to treat weeds and exotic species prior to seed set.

Following chemical treatment of grassy exotic species, slashing is to occur and the slashed vegetative material retained on site as mulch. If required to achieve suitable ground protection, native mulch (composted) is to be applied on the site.

Following any chemical treatment of exotic grasses the dead vegetative material should be slashed and retained on the site to provide soils stabilisation and cover. Native forest mulch should then be applied to any bare soil to a depth of 75mm. It is recommended that native vegetation from the SCAP clearing site is chipped on site, stored and allowed to compost into mulch. Any externally sourced mulch material should also include a Weed Hygiene Declaration to ensure the material is free from any weed propagules.

Fencing around the northern, southern and western property boundary will be installed to minimise the spread of weed seed from outside of the site entering the translocation and restoration site. This will consist of hessian panels strung between star pickets. The fence is recommended to be approximately 2m in height, with the bottom of the fence fastened to the ground or buried just below ground level.

5.7.2 Live topsoil placement

Opportunities to utilise topsoil from areas of impacted, remnant native vegetation across the SCAEP project site should also be investigated to improve the seed bank of the restoration area. It is recommended that a map of suitable areas of impacted coastal heath is prepared by a suitably qualified ecologist or botanist. During preliminary earthworks for the SCAEP project the topsoil in these areas should be stored separately and moved to the closed heath habitat restoration areas.

If live topsoil is to be implemented, the topsoil from the restoration site that contains weed or exotic seed material should be removed and disposed of outside the site. The area and depth of topsoil to be stripped should be sufficient to receive the volume of translocation to

5.7.3 Infill planting

Depending on the progress of the ecological restoration works, revegetation and infill planting may be carried out the habitat restoration zone. The planting density within each zone has been estimated to achieve a plant community structure consistent with the remnant clearing area. Planting densities may be adjusted depending on the rate of natural recruitment evident. The densities provided in Table 6 are to be used for site monitoring to assess the success of the rehabilitation and to guide subsequent planting events over the maintenance period.

Table 6: Flora species suggested to be used for infill planting if required.

Stratum	Species name	Common name
Shrub (3 plant/m^2)	*Allocasuarina emuina*	Black She-oak
	Baeckea frutescens	Weeping Baeckea
	Baekea imbricata	Spindly Baekea
	Banksia robur	Wallum Banksia
	Bauera capitata	Wallum Baurea
	Boronia falcifolia	Wallum Boronia
	Boronia parviflora	Swamp Boronia
	Conospermum taxifolium	Devil's Rice
	Dillwynia floribunda	Showy Parrot Pea
	Dillwynia retorta	Heath Parrot Pea
	Epachris microphylla	Coral Heath
	Epachris pulchella	Wallum Heath
	Goodenia stelligera	Wallum Goodenia
	Hakea actides	Wallum Hakea
	Leptospermum liversidgei	Wallum Tea-tree
	Leptospermum thymifolia	
	Melaleuca pachyphylla	Swamp Bottlebrush

Stratum	Species name	Common name
	Melastoma malabathricum subsp. malabathricum	Native Blue-tongue
	Persoonia virgata	Wallum Geebung
	Petrophile shirleyae	Conesticks
	Philotheca queenslandica	Queensland Wax Flower
	Pultenaea myrtoides	Swamp Pea
	Pultanaea robusta	Tall Swamp Pea
	Strangea linearis	
	Woolsia pungens	Woolsia
Ground (5 plants/m^2)	*Baumea articulata*	Jointed Twigrush
	Baumea rubiginosa	Soft Twigrush
	Baumea teretifolia	Twigrush
	Chorizandra cymbaria	Bristle Rush
	Empodisma minus	Spreading Rope Rush
	Gahnia sieberiana	Red-fruited Saw Sedge
	Goodenia stelligera	Wallum Goodenia
	Hibbertia scandens	Twining Guinea Flower
	Leersia hexandra	Swamp Rice Grass
	Lepironia articulata	Grey Segde
	Sporadanthus interruptus	
	Xanthorrhoea fulva	Swamp Grass Tree

5.8 Practical completion performance objectives and criteria

Following the implementation of the translocation and restoration works, the performance objectives and criteria defined in Table 7 will need to be met to achieve practical completion and commence the maintenance works.

Table 7: Performance objectives and criteria to achieve practical completion

Performance objective	Measureable criteria
Translocation of approximately 1.25ha of closed heath vegetation community	• Evidence that the root systems have established into the receiving environment. • Adequate watering records provided to demonstrate translocated area was sufficiently watered in.
Evidence of growth and establishment of Mount Emu She-oak plants within heath tile translocation site	• Recorded evidence of recruitment of Mount Emu She-oak plants. • Evidence of population increases through yearly surveys.
Reduction in cover of exotic and weed species in the restoration sites	• No more than 10% cover of exotic species across the entire translocation and restoration site. • No more than 5% cover of restricted invasive plants across the entire translocation and restoration area
Evidence of native species regeneration within the translocation site and restoration site.	• Records of at least 20 species from Table 6 of this report within the restoration area. • No reduction in species richness within the translocation site. • Recorded evidence of native species recruitment within the restoration and translocation site.

6 Short-term Management and Maintenance

The following section presents the management and maintenance requirements that must be implemented at the translocation and restoration site within the first three years following practical completion of the translocation and restoration work.

These prescribed measures are crucial to achieving the objectives identified in Section 1.2 and are to be implemented until such a time as Mount Emu She-oak have become established and evidence of recruitment is observed.

Figure 5 shows indicative receiving areas for translocated Mount Emu She-oak heath (Area 1) and individual plants (Area 2) at the site. Different approaches to the management of these areas may be required in the short-term to establish and/or maintain a suitable wallum/closed heath habitat for Mount Emu She-oak.

To minimise the loss of translocated plants, after-care is to occur following the translocation works and any subsequent planting events on an as-needs basis.

6.1 Watering

The translocated heath tiles will require sufficent watering to encourage successful establishment. There is limited access to a reliable water supply at the translocaton site, so there may be a requirements to install a water tank that is filled periodically to irrigate the area of translocated Mount Emu She-oak and restored heath habitat. **Error! Reference source not found.** Figure 5 shows the proposed location of the water tank to be confirmed by the appointed contractor. Consideration for the installation of an irrigation system will also be required to ensure all areas of the translocation and restoration sites can be suitably irrigated.

Areas containing translocated heath tiles and individual Mount Emu She-oak plants (Area 1 & 2) are to be watered immediately after planting. Watering will occur regularly throughout the initial establishment period, becoming less frequent with time.

Table 8: Proposed watering regime for translocated Mount Emu She-oak

Week	Frequency
Week 1 & 2	Once every day
Week 3 & 4	Once every second day
Week 5 - 8	Twice every week
Week 9 - 12	Once a week

Table 8 provides an indicative watering schedule for the site. However, local rainfall levels and soil moisture content should be appropriately monitored and watering regimes altered as necessary.

An irrigation system will be established on the site, that consists of:

- Two x 22,500 L galvanised tanks will be delivered to site and placement in vicinity of the translocation area for access by water truck;
- Establish a water source onsite sourced from the existing drain located to the south east of the translocation area
- Powering of pumps to pump water to the storage tanks will consist of either a submersible pump and solar panel power, or fuel powered generator (or similar);

- Delivery of water to the irrigation area will be powered by fuel powered generator and pump (or similar);
- For the initial heath tile translocation, temporary "solid set" type irrigation is proposed. In this type of irrigation, sprinklers with an inlet pipe diameter size of 20 - 25mm shall be utilised at either rectangular or triangular spacing. The application rate of these sprinklers shall not exceed the uptake rate of the soil;
- Pipework supplying the sprinklers shall be laid on the ground, with the sprinklers being supported by star pickets. The intent of the system is temporary, no longer than 12 months, with the subsequent removal not requiring a high labour input;
- A subsequent planting of young She-oaks is expected to be carried out in 2020 that will also require temporary irrigation. In this instance, direct watering is proposed; and
- The irrigation system including tanks, delivery pipe and sprinklers will be demobilised upon approval by the project principal ecologist.

6.2 Supplementary planting

Supplementary planting may be necessary where the translocated Mount Emu She-oak do not establish or self-propagate. This is to include the planting of nursery-raised Mount Emu She-oak seedlings germinated from seed sourced from the SCA Mount Emu She-oak populations.

6.3 Weed control

Weed control should commence immediately following the translocation with ongoing control implemented over the three year maintenance period at the following frequencies:

- Year 1: Twelve visits to target exotic and restricted invasive species
- Year 2: Six visits to target exotic and restricted invasive species
- Year 3 Six visits to target exotic and restricted invasive species

Area 2 is likely to be particularly susceptible to weed invasion until suitable native species cover is established. More regular weed control within this area may be necessary. Care needs to be taken to avoid harming Mount Emu She-oak plants and seedlings with a preference given to hand-weeding methods. Herbicide treatments using a Glyphosate based bioactive safe for use in waterway environments should only be used where it is determined hand weeding is inadequate.

6.4 Thinning

The continued management of any Melaleuca thickening at the translocation site will be required; particularly within Area 2. Subject to monitoring and the scale of thickening, this may involve the individual removal of Melaleuca plants or slashing of the entire area.

6.5 Fires

Fires must be controlled at the translocation site to allow adequate time for Mount Emu She-oak to establish and juvenile plants to mature and set seed. It is estimated that Mount Emu She-oak plants grown from seedlings will require two growing seasons before flowering and another six (6) months for seeds to mature. As such, a burn of the translocated area should be scheduled for no sooner than 2020.

6.6 Maintenance period performance objectives and criteria

The translocated population and the retained population will require ongoing monitoring to assess the progress of the works towards the ultimate requirement to achieve a 2.6 times increase in population size within 20 years.

The maintenance requirements in this section relate to the initial three year maintenance requirements to be implemented by the Contractor. Table 9 defines performance criteria that are to be met during the initial three year maintenance period so that off-maintenance can be achieved and Table 10 provides a summary of the actions required each year during the maintenance period. Following this initial three year maintenance period, further maintenance will be required.

Table 9: Performance criteria to be reviewed with yearly monitoring and reporting requirements.

Performance objective	Measureable criteria
Establishment of a closed heath vegetation community	• Flora species richness and diversity characteristic of a remnant closed heath community. • Floristic structure, including shrub and groundcover height and Foliage Projective Cover (FPC), characteristic of a remnant closed heath community.
Self-sustaining Mount Emu She-oak population	• Recorded evidence of recruitment of Mount Emu She-oak plants. • Evidence of population increases through yearly surveys.
Absence of exotic species and weeds	• No more than 5% cover of exotic species across the entire translocation and restoration site. • No restricted invasive plants
Implementation of appropriate fire regimes	• Investigate the suitability of commencing a prescribed burn regime, using a patch mosaic pattern in the translocation area commencing in 2020. • Development of fire management plan defining a patch mosaic burn regime with areas to be burnt every 8-12 years.

Table 10: Indicative schedule of maintenance tasks

Performance criteria and management actions	Year 1	Year 2	Year 3
Maintenance actions			
Weed control	Intensive mechanical and chemical weed control, with 12 visits by team required to target weed species prior to seeding.	Intensive mechanical and chemical weed control, with 6 visits by team required to target weed species prior to seeding.	Intensive mechanical and chemical weed control, with 6 visits by team required to target weed species prior to seeding.
Erosion control and mulching	Erosion control and mulch to be installed where required following weed treatment and removal works.	Reapply mulch as needed to bare ground or new plantings	Reapply mulch as needed to bare ground or new plantings
Watering	As required	As required	As required
Live topsoil placement	As required	As required	As required
Infill planting	Sourcing of seedlings or seeds from local provenance plant material. Identification and preparation of planting sites	Monitoring for success and replacement of failed plants.	Monitoring for success and replacement of failed plants.
Installation of individual Mount Emu She-oak plants	No actions	Planting, watering and weed control around installed plants	Planting, watering and weed control around installed plants
Ecological burns	No actions	No actions	Plan for ecological burn at end of maintenance period.

7 Indicative implementation and maintenance program

TAKSK	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Year 1				Year 2				Year 3			
Implementation phase																						
Pre-start meeting																						
Finalise environmental management plans																						
Site establishment and mobilisation																						
Survey and peg area to be translocated																						
Survey and mark individual Mount Emu She-oak plants																						
Carry out soil investigations within receiving site																						
Survey and peg translocation receiving site																						
Carry out heath tile translocation																						
Carry out weed treatment in restoration area																						
Remove individual plants and transfer to receiving site																						
On maintenance inspection																						
Three year maintenance phase																						
Weed treatment																						
Watering																						
Infill planting (if required)																						
Live topsoil installation (if required)																						
Ecological monitoring																						

8 Long-Term Management of Mount Emu She-oak Populations

This section identifies measures that must be implemented for the long-term protection and management of both retained and translocated Mount Emu She-oak populations at SCA. These prescribed measures are crucial to achieving the objectives identified in Section 1.2 and are to be implemented immediately for retained Mount Emu She-oak population areas and subsequently for translocated population areas.

Long term management of Mount Emu She-oak populations at SCA is to occur indefinitely. However, a 20 year timeframe has been set for achieving the required 2.6 times increase in the translocated Mount Emu She-oak population size.

The Recovery Plan identifies several threats known to the Finland Road Mount Emu She-oak population (AEP1). If not appropriately managed, these have the potential to impact the long-term success and viability of translocated and retained Mount Emu She-oak habitat areas at SCA. These are discussed further below.

8.1 Airport development

Closed heath vegetation communities are particularly dependent on a shallow groundwater aquifer, especially the perched aquifer above the coffee rock. Runway construction as a part of the SCAEP may impact the condition and extent of retained and translocated Mount Emu She-oak populations at SCA indirectly through changes in groundwater quality (particularly salinity) and levels. Hydraulically delivered sand used in runway construction may cause saline water to infiltrate areas of surrounding habitat, increasing salinity levels and raising groundwater levels. Proposed mitigation measures including strict development controls and the use of a high quality liner within the base of the new runway area are aimed to minimise the potential for this to occur. These measures are discussed further in the project EIS.

Surface and groundwater monitoring will also be undertaken by SCC during the SCAEP works to monitor and manage any potential development impacts to Mount Emu She-oak populations. This will include observing salinity and groundwater levels obtained from boreholes located within the vicinity of retained and translocated Mount Emu She-oak populations.

8.2 Inappropriate fire regimes

Inappropriate fire regimes may impact the viability of Mount Emu She-oak plants (Environmental Protection Agency 2007). Field observations have suggested that Mount Emu She-oak may begin to senesce after approximately 10-15 years in the absence of fire (Olsen 2002 in Lamont 2010) whilst parent plants may succumb to fungal attack from *Phytophthora cinnamomii* (Lamont 2010). The viability of the seedbank of several species of *Allocasuarina* has been found to decrease over similar timeframes (Halford 1993a; Pannell & Myerscough 1993; McKiernan 1997 in Lamont 2010).

Fire initiates the germination of soil-stored seeds and facilitates the release of seeds from cones stored on adult plants (Environmental Protection Agency 2007). However, despite the species' adaptation to fire, there are a few factors that can influence reproduction success post fire (Halford 1993, in Environmental Protection Agency 2007), including:

- Fire frequency: it is suggested that the plant requires two growing seasons before reproduction commences and another six months before the seeds can mature
- Fire intensity: A low intensity fire may not sufficiently stimulate the opening of cones
- Fire seasonality: Seasonal rainfall levels, soil and ambient temperatures and levels of sunlight post fire could also affect seedling recruitment after fire.

Within AEP1, wildfires are reported as occurring in 1994 and 2002 for the southern area (Queensland Parks and Wildlife Service, 2012), whilst the Recovery Plan for the species notes that a fire occurred in 2001. The 2001 fire mentioned in the Recovery Plan may in fact be the same as the 2002 fire mentioned by the Queensland Parks and Wildlife Service (QPWS), given that the QPWS actively manages fire within the area. There is no recent evidence of fire within the area of Mount Emu She-oak habitat north of the drainage channel, as evidenced by the differing vegetation characteristics between the north and south areas. This is likely due to the fact that this area is SCA land and fires managed by QPWS were restricted to lands south of the drainage channel (i.e. predominantly the National Park area). Here, the Mount Emu She-oak habitat contains a dense layer of tall Wallum Hakea whilst the southern area is more open and floristically diverse. The Recovery Plan notes that the AEP1 population exhibited germination after a fire in 2001 (pp. 9), potentially explaining why the population density of Mount Emu She-oak is much higher in the southern portion.

According to Watson (2001), fires occurring at a range of frequencies between 7 and 20 years, but more commonly between 8 to 12 years are preferable for maintaining coastal heathland biodiversity. Burns should be planned to occur following rainfall events when the substrate is saturated (Watson 2001). This will assist to avoid the risk of peat fire which can cause major shifts in species composition (Brown & Podger 1982, cited in Watson 2001).

Table 11 outlines the proposed fire requirements for Mount Emu She-oak populations at SCA.

Table 11: Proposed fire requirements for Mount Emu She-oak populations at SCA

Fire intervals	8-12 years
Spatial scale of burn	Small scale, patch mosaic burns within pre-determined areas taking into account the age/class structure of the Mount Emu She-oak populations.
Interval till next fire event	Translocated populations will require sufficient time to establish and any juvenile plants to mature and set seed. The first burn in the translocated population area is recommended no sooner than 2020. A burn should be planned for retained areas of AEP1 shortly after the completion of translocation works (i.e. 2018-2019).
Fire intensity	Natural vegetation on site will determine what fire intensity will be achieved. A fire load base will need to be determined so as timing of the burn will result in a moderate intensity fire. The heath substrate must be saturated to avoid the risk of peat fire.
Fire season	Autumn and winter

8.3 Weed invasion and competition

Weed control measures are to be implemented on site for the duration of the maintenance period to minimise the competitive impacts of exotic species on Mount Emu She-oak. Weeds may establish at the edge of retained heathland habitat as a result of disturbance and increased nutrient inputs from SCA activities including runway construction works. Translocated habitat areas are also likely to incur some weeds from propagules stored within the soil or deposited from machinery and vehicles undertaking the translocation and maintenance works. If not appropriately managed, weeds may pose a considerable threat to the long-term viability of Mount Emu She-oak populations at SCA.

Control and removal of invasive weeds will ensure Mount Emu She-oak are provided with favourable conditions for population establishment, expansion and persistence. Table 12 provides a list of weed species that are known to occur on site and preferred control methods. Inspections of the site should be carried out at least once every six (6) months to identify and control any weed species present.

Table 12: Exotic species known to occur at SCA and preferred control methods

Family	Species Name	Common Name	Biosecurity Act 2014 classification	Control Methods
Asteraceae	*Baccharis halimifolia*	Groundsel Bush	Restricted invasive	Hand pull small plants. Dig out larger plants or cut stump and immediately spray or paint with herbicide.
Poaceae	*Megathyrsusmaximus var. maximum*	Guinea Grass	-	Foliar spray with herbicide
Pinaceae	*Pinus elliottii*	Slash Pine	-	Stem injection or cut stump and paint with herbicide.

9 Monitoring and Reporting Requirements

Following the translocation works, a population monitoring program will be implemented for the translocated and retained populations of Mount Emu She-oak at the SCA site. The monitoring program will measure annual progress towards achieving the translocation objectives identified in Section 1.2 for a period of 20 years. This section provides a description of the performance objectives and criteria to be achieved by the end of the three year maintenance period. However, monitoring beyond this time period is recommended to inform the ongoing management of retained and translocated Mount Emu She-oak populations at SCA.

9.1 Methodology

To assess the condition of the translocated community, four (4) permanent 100 m x 50 m transects will be placed throughout the translocation site. The centre point of each transect will be marked with a star picket, and the coordinates of the start point and centre point will be recorded, as well as the bearing.

Data on the floristic structure and condition of the vegetation community will be collected using the methodology defined in BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2 (Eyre et al 2015). Each transect will be surveyed annually during peak flowering season for 20 years.

Annual surveys of the retained and translocated Mount Emu She-oak populations will also be carried out to monitor changes in population size compared with baseline estimates. As per the baseline population surveys, 10 m x 10 m transects will be equally spaced using of a 50 m x 50 m grid overlayed on aerial photography of the population areas. One quadrat will be positioned within the centre of each grid, except where areas cannot be accessed due to dense ground cover or the existence of other physical barriers such as drainage lines. In each quadrat, two ecologists/ botanists will count the number of individual Mount Emu She-oak plants present.

9.2 Reporting

During the 20 year monitoring period, annual reports will be prepared to assess the progress of the translocation and restoration works towards the required outcomes. The aim of the reports will be to document progress towards addressing the objectives outlined in Section 1.2. This includes achieving the required 2.6 times increase in population size of translocated Mount Emu She-oak populations. And meeting the performance objectives defined in Section 8.1 of this report.

Monitoring reports are to include schedules of any management works undertaken for retained and translocation Mount Emu She-oak population at SCA.

The results of surface and groundwater monitoring undertaken by SCC at SCA during the SCAEP works should also be addressed within monitoring documentation. This is to include salinity and groundwater levels obtained from boreholes located within the vicinity of retained and translocated Mount Emu She-oak populations.

10 References

Environmental Protection Agency 2007. *National recovery plan for Mt Emu She-oak Allocasuarina emuina*. Report to Australian Government Department of the Environment and Water Resources. Queensland Parks and Wildlife Service, Brisbane.

Eyre. T.J., Kelly, A.L., Neldner, V.J., Wilson, B.A., Ferguson, D.J., Laidlaw, M.J. and Franks, A.J. 2015. *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual*. Version 2.2. Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane.

Hall Contracting Pty Ltd. No date. *Completed projects: Brightwater vegetation Translocation*. Buderim.

Lamont, R.W. 2010. *Conservation genetics and ecology of the endangered heathland shrub, Allocasuarina emuina*. PHD Thesis.

Watson, P. 2001. *The role and use of fire for biodiversity conservation in south-east Queensland: Fire management guidelines derived from ecological research*. SEQ Fire and biodiversity Consortium.

Appendix A

Erosion and Sediment Control Plan

Our Ref: 5141

14 December, 2017

Erosion and Sediment Control Plan

Mt Emu She-Oak Translocation Project

Sunshine Coast Airport Expansion Project, Marcoola

Client: Sunshine Coast Council

Future-Plus Environmental (Sunshine Coast)
4/40 Technology Drive, Warana QLD 4556

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In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

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In this note, a reference to loss and damage includes past and prospective economic loss, loss of profits, damage to property, injury to any person (including death) costs and expenses incurred in taking measures to prevent, mitigate or rectify any harm, loss of opportunity, legal costs, compensation, interest and any other direct, indirect, consequential or financial or other loss.

Signed on behalf of
Future-Plus Environmental

Date: 14 December 2017

PWood.

Paul Wood
Director

DOCUMENT CONTROL INFORMATION

Project Number: 5141

Project Manager: Kaine Pritchard

Client: Sunshine Coast Council

Report Title: Construction Environmental Management Plan

Project: Sunshine Coast Airport Expansion Project

Site Address: Marcoola, QLD 4564

Document Review

Document Version	Document Status	Author	Reviewed By	Approved By
FPE Ref: 5141-171212-1.0_ESCP	Client Issue	LC	KP	PW

Issue Approval

Destination	Document Version	Date Dispatched
Sunshine Coast Council	0.1	14/12/2017

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LIST OF APPENDICES

1.0 INTRODUCTION

Future-Plus Environmental (FPE) are pleased to provide the revised Erosion and Sediment Control Plan (ESCP) for the Mt Emu She Oak Translocation Project hereafter referred to as the 'Project", for the Sunshine Coast Airport Expansion Project (SCAEP). FPE are the principal contractor for the Project.

The site has a very low erosion risk, with the EIS report estimating a soil loss rate of 14 t/ha/y during construction. Potential erosion impacts are lessoned by the sandy nature of the sites soils and slopes significantly less than 1%. The EIS identifies waterway banks and stockpile embankments as areas where erosion is most likely to occur during the construction works. The purpose of the following ESCP is to manage the environmental impacts associated with the exposure and disturbance of soils during the project works.

2.0 EROSION AND SEDIMENT CONTROL PLAN

2.1 PERFORMANCE OBJECTIVES

All E&SC's shall be in accordance with the Manual for Erosion & Sediment Control, Version 1.2, (Sunshine Coast Regional Council, 2008), and Soil Erosion and Sediment Control Engineering Guidelines for Queensland Construction Sites. E&SC measures shall be constructed to achieve stable discharges from the construction site during a 25.9mm rainfall event (1 year, 2 hr ARI Marcoola).

The ESCP also aims to:

- Minimise the area of disturbance to no greater than the area necessary for construction works to occur;
- Minimise erosion of soils during construction works;
- Minimise loss of sediment from site during construction works; and
- Controls meet the following criteria:
  - pH >4.5[1]
  - Suspended Solids < 50mg/L
  - Turbidity < 75 NTU

2.2 METHODOLOGY

The management strategy for erosion and sediment control is as follows:

---

[1] Note: Due to the pH sensitive receiving environment (i.e. Wallum heath ecosystem which are naturally acidic) no treatment of discharge waters, to increase pH, is recommended unless pH <4.5.

- Phase 1 – Site Set Up
- Phase 2 – Heath Tile Translocation Works
- Phase 3 – Individual Translocation Works
- Phase 4 – Completion

An ESCP has been drafted for each of the project phases. The plans are attached as Appendix A.

2.3 MONITORING

A rain gauge shall be installed at the site office and checked daily at 9am for direct comparisons with the BOM weather station situated within the project area. FPE's site supervisor shall undertake daily checks on weather forecasts and warnings.

Weekly inspections will be carried out to check:

- Works are only occurring within designated area and no-go fencing is in place;
- Erosion and Sediment Control measures, to ensure they are cleaned out and maintained in working order;
- Stabilisation is occurring in accordance with the plans;
- For litter and debris; and
- For discharges from sediment traps.

2.4 ACTIONS SIGNIFICANT RAIN EVENTS

Should a significant rainfall event be predicted within the seven day BOM outlook for the works area, the site foreman shall inspect the works area two days prior and ensure all ESC's are in place and functional (i.e. in good working order and have sufficient sediment storage capacities 70%). Post rainfall, prior to starting works, the foreman shall undertake a post rainfall ESC inspection to identify any controls requiring maintenance.

2.5 REPORTING

FPE's site supervisor shall maintain a log of inspections, maintenance actions which shall be detailed in the site diary. Records (including inspections and monitoring) are to be logged and kept for verification of compliance on a as need basis.

2.6 INCIDENTS AND CORRECTIVE ACTIONS

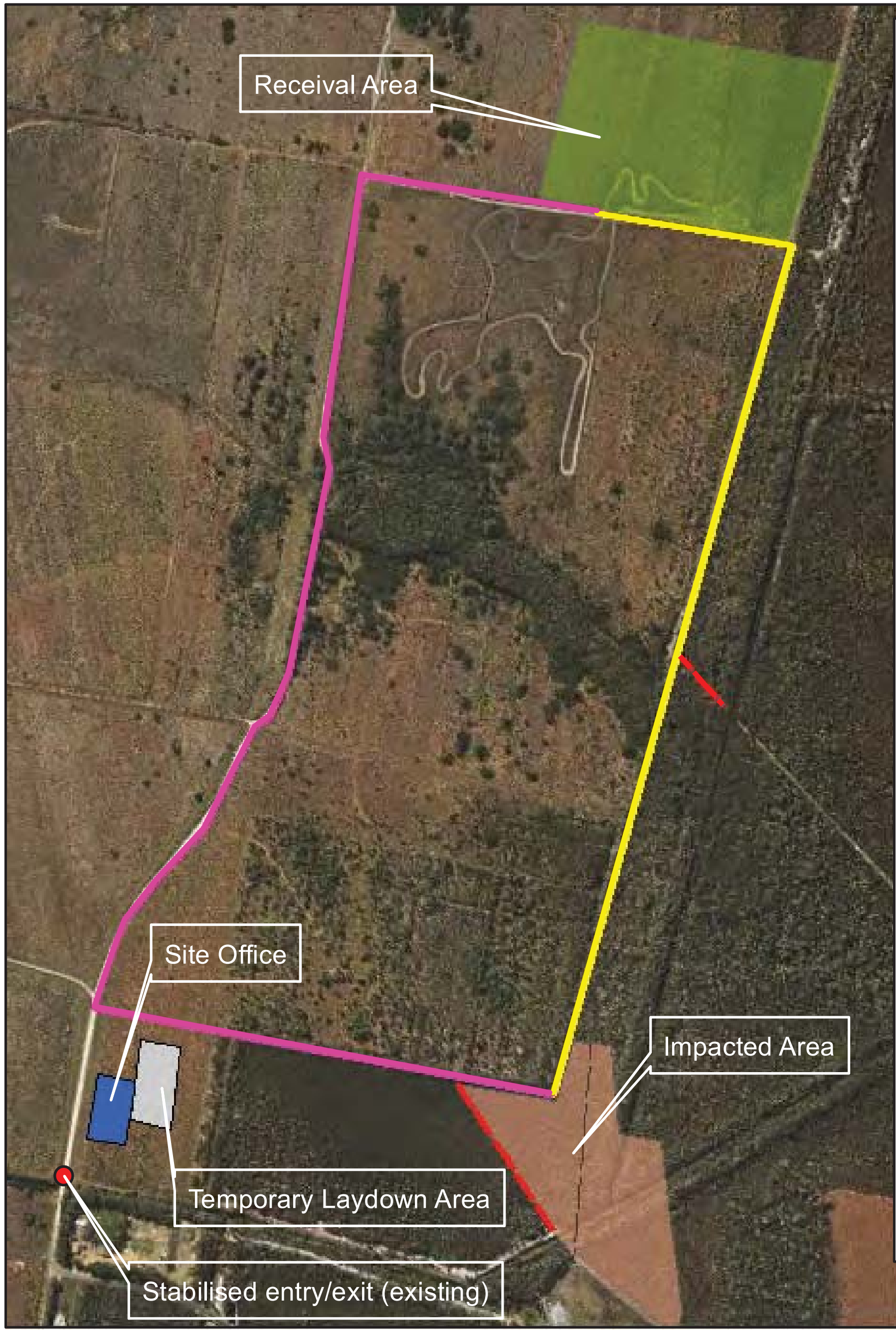
An incident shall be raised when erosion and sediment controls are not effectively protecting the waterway/downstream environment. Corrective actions shall include but not limited to:

- Undertake a survey of erosion and sediment control measures and determine effectiveness of current controls;
- Reassess the risks of the works areas and determine if further controls will remedy any problems;
- Seek the assistance of an appropriately qualified professional for advice on erosion sediment control devices; and
- Implement all required works and recommendations to achieve compliance.

3.0 SUMMARY

It is expected that the controls detailed in the above-mentioned plans will form the minimum base of controls required during the project and that FPE will audit the project throughout the construction phase to identify any additional controls required to comply with the project's environmental objectives. Furthermore, it is expected that FPE will continue to prepare progressive plans that address the specific staging of works and or reflect changes made to the erosion and sediment controls detailed in the above-mentioned plans.

Appendix A.
ESCPs



Technical Notes

Objectives

To minimise environmental harm caused by the release of sediment laden water to the receiving environment.

For and during all rainfall events all other reasonable and practicable measures to minimise erosion and sediment discharge should be undertaken by the principle contractor or their representatives.

Stormwater quality leaving the site is <50mg/L Suspended Solids, <75 NTU Turbidity and >4.5 pH.

Management Strategy

The site supervisor shall be responsible for the:

- Implementation of the E&SC's outlined for Phase 1;
- Education of relevant site personnel on the E&SC's to be undertaken;
- Monitoring of the continued effectiveness of the controls during the works;
- Updating of the ESCP where necessary;
- Daily review of the 7 day BOM forecast for the works area; and
- All other control measures outlined in the CEMP and subsequent management plans for works area.

Tasks / Actions

The single stabilised entry / exit point on Finland Road shall be utilised for the project.

Identify all no go areas and delineate.

Identify all drainage lines and waterways intersecting the Temporary stockpile and site office area and construct stabilised outlet points where required. Refer to standard drawings SD-EST-1, SD-FR-1 and SD-RCD-1.

Undertake drainage control measures including:

- Divert 'clean' up-slope water around any soil disturbance where possible; and
- Transport stormwater through the work site in a non-erosive manner.

Undertake erosion control measures including:

- Limit the area of exposure; and
- Mulch to cover disturbed areas open without activity.

Any long term soil stockpiles situated in the laydown area (>3 weeks) shall be controlled by sediment fences on the down slope side if erosion is identified.

Legend

- LV/HV (limited) access
- HV access
- No Go Zone

N

90 45 0 90 Meters

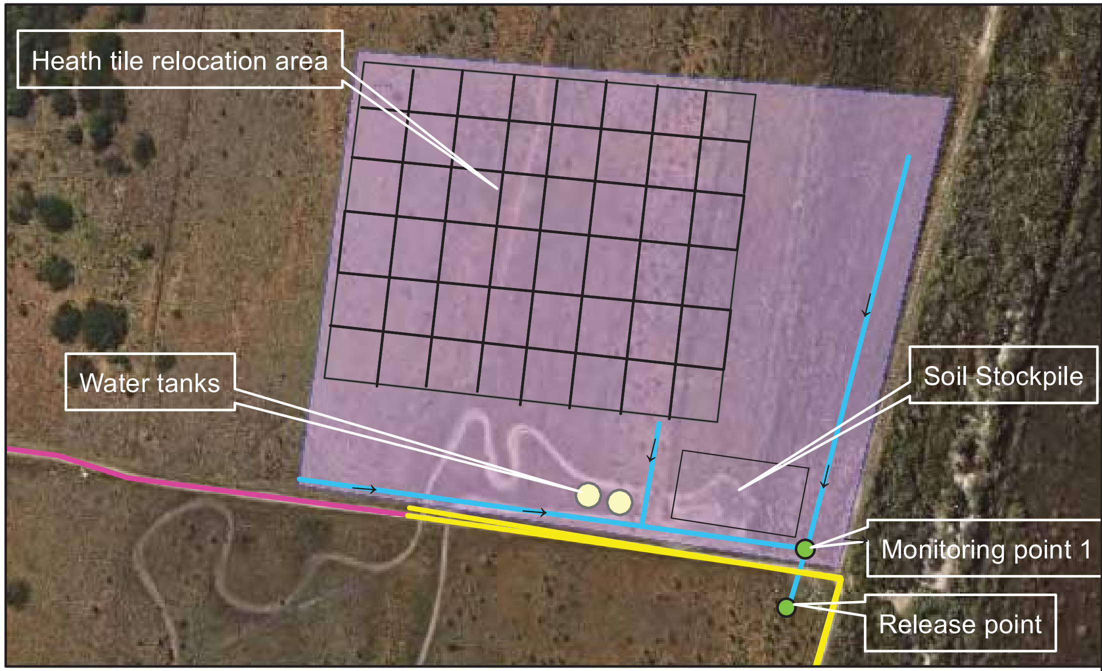
1 cm = 89 m

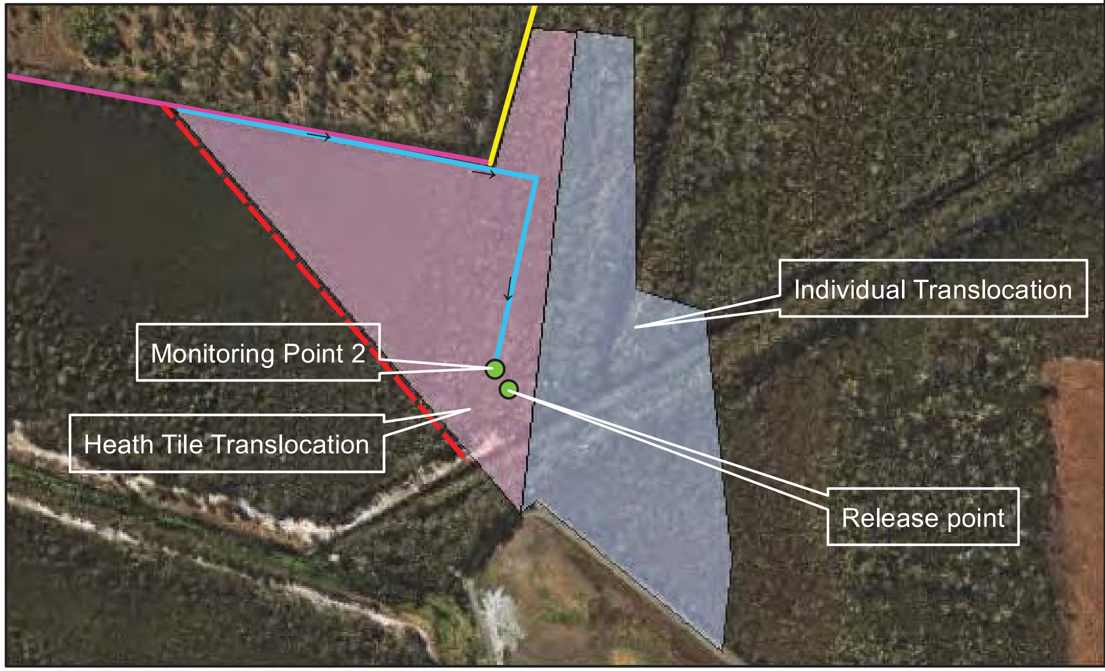
future-plus ENVIRONMENTAL

EROSION & SEDIMENT CONTROL PLAN: PHASE 1 - SITE SETUP
Document Name: 5141-171212_P1

Project: MT EMU SHE-OAK TRANSLOCATION PROJECT
Client: SUNSHINE COAST AIRPORT
Location: FINLAND ROAD, MARCOOLA QLD

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994





Technical Notes

Objectives

To minimise environmental harm caused by the release of sediment laden water to the receiving environment.

For and during all rainfall events all other reasonable and practicable measures to minimise erosion and sediment discharge should be undertaken by the principle contractor or their representatives.

Stormwater quality leaving the site is <50mg/L Suspended Solids, <75 NTU Turbidity and >4.5 pH.

Management Strategy

The site supervisor shall be responsible for the:

- Implementation of the E&SC's outlined for Phase 1;
- Education of relevant site personnel on the E&SC's to be undertaken;
- Monitoring of the continued effectiveness of the controls during the works;
- Updating of the ESCP where necessary;
- Daily review of the 7 day BOM forecast for the works area; and
- All other control measures outlined in the CEMP and subsequent management plans for works area.

Tasks / Actions

All stormwater captured from the void post tile translocation, at both the impacted and receival areas, shall be diverted by constructing shallow catch drains, to a sediment trap for settling and testing and subsequent release (by pumping or similar). It should be noted that the void itself acts as a large sediment trap for all rainfall events and the sediment trap shall be used more as a collection sump.

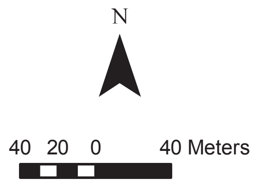
Monitoring points (MP1 and MP2) shall be monitored during release events for water quality parameters listed above.

The pump release points shall be stabilised by mulch bunds or similar, and pump rates set to ensure no soil offsite is entrained.

The temporary soil stockpile at the receival site shall be stabilised by constructing a sediment fence on the down slope side.

Legend

- Indicative shallow drainage line
- HV access
- LV/HV (limited) access
- No Go Zone



1 cm = 40 m

future-plus ENVIRONMENTAL

EROSION & SEDIMENT CONTROL PLAN:
PHASE 2 - HEATH TILE TRANSLOCATION WORKS
Document Name: 5141-171212_P2

Project: MT EMU SHE-OAK TRANLOSCATION PROJECT
Client: SUNSHINE COAST AIRPORT
Location: FINLAND ROAD, MARCOOLA QLD

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

Technical Notes

Objectives

To minimise environmental harm caused by the release of sediment laden water to the receiving environment.
For and during all rainfall events all other reasonable and practicable measures to minimise erosion and sediment discharge should be undertaken by the principle contractor or their representatives.
Stormwater quality leaving the site is <50mg/L Suspended Solids, <75 NTU Turbidity and >4.5 pH.

Management Strategy

The site supervisor shall be responsible for the:

- Implementation of the E&SC's outlined for Phase 1;
- Education of relevant site personnel on the E&SC's to be undertaken;
- Monitoring of the continued effectiveness of the controls during the works;
- Updating of the ESCP where necessary;
- Daily review of the 7 day BOM forecast for the works area; and
- All other control measures outlined in the CEMP and subsequent management plans for works area.

Tasks / Actions

The individual relocation is to be undertaken by hand, using shovels for the majority of plants however some larger plants may require mechanical aid to be dug. The plants shall be transported directly to the receival area for immediate replanting. The disturbances to soils shall be limited to vegetation clearing for access tracks and the installation of the temporary drain crossings.
The access tracks shall be constructed by mulching the vegetation to ground level leaving the mulch insitu for LV trafficability. 100% cover of the access tracks is required for LV access therefore achieving best practise E&SC objectives. In areas of the tracks where insufficient mulch exists, mulch shall be transported and spread to ensure 100% cover.
The installation of two temporary drain crossings shall be constructed by:

- Scheduling the works within a BOM predicted two to three day fine weather event;
- Should rainfall be predicted prior to final stabilisation works, all batters shall be mulched to achieve 100% cover; and
- All concentrated flow paths exiting directly into the drains from the temporary crossing stabilised by adequate velocity controls (e.g. SD-FR-1 and SD-RCD-1 or similar).

Legend

Temporary Crossing

Access roads

N

30 15 0 30 Meters

1 cm = 27.9 m

future-plus ENVIRONMENTAL

EROSION & SEDIMENT CONTROL PLAN:
PHASE 3 - INDIVIDUAL PLANT RELOCATION WORKS
Document Name: 5141-171212-P3

Project: MT EMU SHE-OAK TRANSLOCATION PROJECT
Client: SUNSHINE COAST AIRPORT
Location: FINLAND ROAD, MARCOOLA QLD

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994

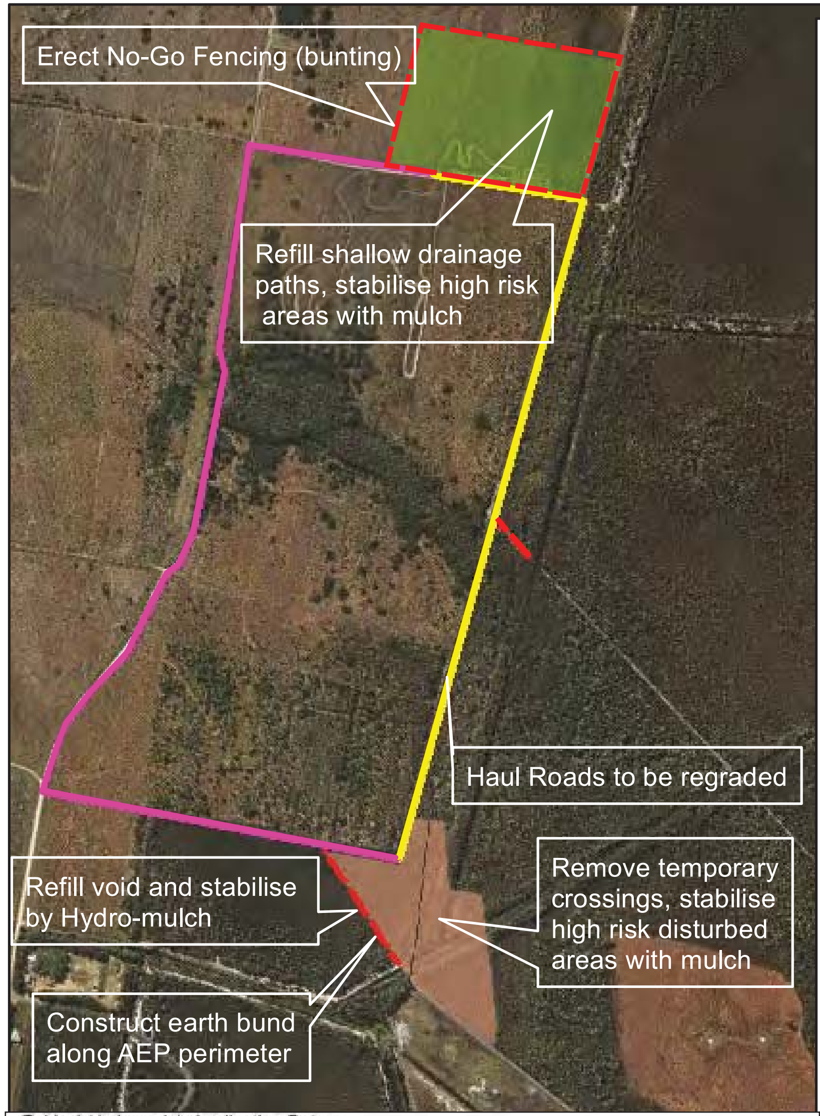


Table 1 Hydromulch Application Rates

Type	Application Rate (dry weight) kg/ha	Kg of Binder (dry weight) to 1000L of H2O	Min H2O	Controlled release Fertiliser (kg/ha)	Jap Millet Sterile (kg/ha)
Sugar Cane Mulch	6000	3	40,000	N:7-18	10
Wood Fibre	2500	2	30,000	P:1-4	
Industrial Hemp	6000	3	40,000	K:4-8	

Technical Notes

Objectives

To minimise environmental harm caused by the release of sediment laden water to the receiving environment.

For and during all rainfall events all other reasonable and practicable measures to minimise erosion and sediment discharge should be undertaken by the principle contractor or their representatives.

Stormwater quality leaving the site is <50mg/L Suspended Solids, <75 NTU Turbidity and >4.5 pH.

Management Strategy

The site supervisor shall be responsible for the:

- Implementation of the E&SC's outlined for Phase 1;
- Education of relevant site personnel on the E&SC's to be undertaken;
- Monitoring of the continued effectiveness of the controls during the works;
- Updating of the ESCP where necessary;
- Daily review of the 7 day BOM forecast for the works area; and
- All other control measures outlined in the CEMP and subsequent management plans for works area.

Tasks / Actions

Impacted area

Post filling of the void the AEP1 population to the south of the project area shall be protected from overland flows from the exposed soils by the construction of earth bund 0.3m in height by 1.5m wide (stabilised by seeded hydromulch) along the perimeter.

Seeded hydromulch shall be applied to all exposed soils of the impacted area. Using a purpose built machine capable of producing a homogenous slurry, uniformly applying the slurry over the area in accordance with Table 1 (bottom left).

Hydromulching methodology is to ensure that the first pass consists of a slurry of water, fibre (approximately 10% of the total specified), seed and fertiliser to prepare the surface. The second pass and subsequent passes shall consist of a slurry of water, fibre and binder only.

Receival Area

All voids shall be filled and all exposed surfaces stabilised by spreading mulch to achieve 100% cover.

Erect no-go fencing around the perimeter of the receival area.

Temporary Culverts

Upon completion of individual translocation works, remove all crossing materials from drain and spread millet seeds on all exposed batters.

Access tracks

All haul and LV tracks shall be graded to be accessible prior to demobilisation.

Legend

LV/HV (limited) access

HV access

No Go Zone

N

110 55 0 110 Meters

1 cm = 115 m

future-plus ENVIRONMENTAL

EROSION & SEDIMENT CONTROL PLAN: PHASE 4 - SITE COMPLETION

Document Name: 5141-171212_P4

Project: MT EMU SHE-OAK TRANSLOCATION PROJECT

Client: SUNSHINE COAST AIRPORT

Location: FINLAND ROAD, MARCOOLA QLD

Coordinate System: GDA 1994 MGA Zone 56

Projection: Transverse Mercator

Datum: GDA 1994

Appendix B

Acid Sulphate Soils Management Plan

Our Ref: 5141

14 December, 2017

ASS Risk Assessment and Revised Management Plan

Mt Emu She-oak Translocation Project

Sunshine Coast Airport Expansion Project, Marcoola

Client: Sunshine Coast Council

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DOCUMENT CONTROL INFORMATION

Project Number: 5141

Project Manager: Kaine Pritchard

Client: Sunshine Coast Council

Report Title: ASS Risk Assessment and Revised Management Plan

Project: Sunshine Coast Airport Expansion Project

Site Address: Marcoola, QLD 4564

Document Review

Document Version	Document Status	Author	Reviewed By	Approved By
5141-171212-0.1_ASS	Client Issue	LC	KP	PW

Issue Approval

Destination	Document Version	Date Dispatched
Sunshine Coast Council	0.1	14 December 2017

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Signed on behalf of
Future-Plus Environmental

Date: 14 December 2017

Paul Wood

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1.0 INTRODUCTION

1.1 PURPOSE

The Mt Emu She-oak (*Allocasuarina emuina*) Translocation Project (Project) is necessary to compensate for the unavoidable impacts to the EPBC listed endangered species resulting from the Sunshine Coast Airport Expansion Project (SCAEP). Heaths where Mt Emu She-Oak exists are described as Closed Wallum Heath. Wallum heaths are naturally acidic and are pH sensitive environments. Any treatment of Acid Sulfate Soils (ASS) in close proximity to, or in areas that are hydrologically connected to the Wallum Heath, can have a negative affect on the heaths acidic ecology.

The Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines (2014) state:

'Disturbance of acid sulfate soils adjacent to sensitive, acidic soft water environments must be avoided since use of neutralising agents will produce leachates that raise aquatic pH, adding hardness to water and putting acidophilic ecosystems at risk. Essentially, addressing one problem will create another'.

Following discussions with Wallum Heath Ecologists, it was agreed that if the risk of ASS (or strongly acidic soils) disturbance was low enough, to not justify the spreading of lime adjacent to the non impacted heath community, it would be of benefit. The purpose of the risk assessment is to determine:

- If the recommended treatment options outlined in the approved ASSMP (Core, 2017) for the site are required for soils to be placed adjacent to the Wallum Heath communities; and
- Where treatment is recommended, to ensure the treatment does not impact Wallum Heath communities onsite or adjacent to the site.

1.2 PROPOSED SOIL DISTURBANCES

The project is proposing to undertake two methods of translocation of the Mt Emu She-oak:

1. Heath Tile Method (up to 2ha); and
2. Individual Relocation (approximately 411 plants).

The proposed heath tile translocation operation will comprise excavations to a depth of 300 mm and relocating them to the proposed receival area. The receival area will be prepared by stripping 300 mm depth of topsoil material prior to the vegetation replacement. The spoil from the receival area will be used to fill the excavation left within the translocation area. Approximately 3,000m^3 of topsoils shall be disturbed per hectare of heath tile translocation.

The individual relocation is to be undertaken by hand, using shovels for the majority of plants however some larger plants may require mechanical aid to be dug. The plants shall be transported directly to the receival area for immediate replanting.

1.3 ASS INVESTIGATIONS

Core on behalf of the Sunshine Coast Council (SCC) has undertaken both ASS and Groundwater Investigations for both the impact and receival areas. The Core ASSMP is attached as **Appendix A**. In summary Core identified actionable levels of net acidity within the upper 0.5m bgl. However, Core noted that:

- The acidity was 100% of the net acidity values were due to existing acidity, with no potential for further acid generation indicated.
- The existing acidity present may be due to organic acids rather than oxidised sulfur (note in only one sample, BH17 0.0-0.25m which is now outside of the proposed receival area boundary, recorded net sulfuric acidity of 0.02%S).

Core concluded that the soil results:

"indicate there is likely to be disturbance of soils with existing acidity during the proposed translocation of the Emu Mountain She Oak. However, the levels of existing acidity are generally low, and the proposed disturbance is considered unlikely to generate further acidity or cause further acidity to migrate offsite."

1.4 ASSMP TREATMENT RECOMMENDATIONS

The Core ASSMP recommends the spreading of a 5kg/m^2 lime guard layer prior to the refilling the void post heath tiling at the Impacted Area. Liming of the disturbed soils is not recommended if the soils are to remain onsite (which is proposed).

2.0 RISK ASSESSMENT

The following risk assessment process is based on the risk guide from the AS/NZS ISO31000: 2009. The assessment considers risks to the environment from the disturbance of ASS (or strongly acidic soils). Measures of consequence and risk have been contextualised by the following:

- Core ASS Investigation and Management Plan (2017);
- Proposed soil disturbances during the Mt Emu She-oak Translocation Project; and
- End point ASS management of applying a lime guard layer adjacent to Wallum Heath containing Endangered species listed under the EPBC Act.

2.1 RISK ASSESSMENT TABLES

Table 1: Defined measures of consequence

Level	Descriptor	Consequence
1	Insignificant	Insignificant impact or not detectable environmental impact
2	Minor	Potentially harmful to site ecosystems with impacts contained to site
3	Moderate	Potentially harmful to adjacent ecosystem with local impacts primarily contained to on-site
4	Major	Potentially lethal to local ecosystem; predominantly local, but potential for off-site impacts
5	Catastrophic	Potentially lethal to regional ecosystem or threatened species; widespread on-site and off-site impacts

Table 2 Risk Ratings

Likelihood	Consequence				
	1 Significant	2 Minor	3 Moderate	4 Major	5 Catastrophic
A Rare	Low	Low	Low	High	High
B Unlikely	Low	Low	Moderate	High	Very High
C Possible	Low	Moderate	High	Very High	Very High
D Likely	Low	Moderate	High	Very High	Very High
E Almost certain	Low	Moderate	High	Very High	Very High

Based on the above guidance a risk assessment has been undertaken and is presented in **Table 3** below.

Table 3 Hazard Identification and Risk Assessment for ASS Management and Treatment during the Mt Emu She-oak Translocation Project

Source	Hazardous event	Hazard type	Risk Information	Maximum Risk Rating			Preventative Measure	Residual Risk Rating		
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
Acidic leachate post filling the void	Increasing the acidity of the receiving environment post refilling of the void at the impacted area.	Enviro	Soil pH_{KCl} of the soils to be used to fill void presently range between 4.5-5.1. No potential sulfuric acidity exists within the soil. Receiving environment acidic.	2	B	Low	A 5 kg/m^2 guard layer shall be applied to the balance of Impacted Area if the average pH_f of the stockpiled soils is <4.	3	A	**Low**
Liming of soils	Treatment of ASS using neutralising agent causes changes adjacent Wallum Heath ecosystem.	Enviro	Neutralising agents will produce leachates that raise aquatic pH, adding hardness to water and putting acidophilic ecosystems at risk	3	C	High	NO lime guard layer shall be applied within 20m of the non-impacted heath population. Note the soils used for refilling the void shall be tested for acidity and must achieve an average pH_f of >4 prior to being used as fill.	2	B	**Low**

3.0 CONCLUSION AND RECOMMENDATIONS

Based on the above risk assessment the following management shall be undertaken for disturbed soils during the translocation works:

- NO lime guard layer shall be applied within 20m of the non-impacted heath population located adjacent to the south of the impacted area, however soils to be used as fill shall have an average pH_f of >4;
- A 5 kg/m^2 guard layer shall be applied to the balance of the impacted area before placement of the soils (transported from the receival area) if the average pH_f of the stockpiled soils is <4.0; and
- Testing the stockpiled soils to be undertaken at a rate of 1 sample per 500m^3.

4.0 VERIFICATION AND MONITORING

All monitoring results, photographs and lime delivery dockets shall be kept and presented in the daily dairy for quality assurance and validation purposes.

Appendix A.

Core ASSMP 2017

Acid Sulfate Soil Investigation
Emu Mountain She Oak
Sunshine Coast Airport Expansion, Finland Road,

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Report Number: J000030-0012-R-Rev0

August 2017

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1.0 INTRODUCTION

Core Consultants Pty Ltd (Core) were requested by Sunshine Coast Council (SCC) to undertake an Acid Sulfate Soil (ASS) Investigation on two areas of Sunshine Coat Airport (SCA) Expansion Project located at Finland Road, Marcoola. The two areas consisted of the Emu Mountain She-Oak translocation area and the receival area. The location of the both areas is shown in Plate 1 below.

It is understood that SCC require the ASS investigation as part of the relocation of a population of Emu Mountain She-Oak located within the SCA Expansion area.

The ASS Investigation was carried out by Core in accordance with our proposal Q001087-001-L-Rev0, dated 18 July 2017.

The assessment included a desk top review of published maps and data relating to the topography, ASS mapping and geology of the site in addition to an ASS intrusive investigation to establish the presence or absence of ASS within the proposed translocation and receival areas.

Plate 1:Translocation and Receival Area Locations *(Aerial image sourced from State of Queensland (Queensland Globe), Copyright © State of Queensland 2017, under licence. Annotations by Core Consultants Pty Ltd.)*

2.0 PROPOSED EMU MOUNTAIN SHE OAK TRANSLOCATION

Information provided by SCC indicates that the proposed translocation area covers approximately 4.5 ha, and the receival area will be of a similar footprint.

Recent discussions with SCA indicates that the proposed translocation operation will comprise excavation of heath tiles to a depth of 300 mm and relocating them to the proposed receival area. The receival area will be prepared by stripping 300 mm depth of topsoil material prior to the vegetation replacement.

The spoil from the receival area will be used to fill the excavation left within the translocation area. The operation will be undertaken in several stages so that excess topsoil spoil management is limited to low stockpile volumes.

3.0 SITE LOCATION

The investigation areas are located with the proposes SCA Expansion area and are shown in Plate 1 above. The translocation area is dominated by Emu Mountain She Oak (Refer to Photograph No. 1), while the receival area is cleared. Both areas are relatively flat with elevations close to 0 m Australian Height Datum (AHD). There are several man-made drains for the existing Sunshine Coast Airport that intersect the translocation area, while the nearest surface water receptor to the receival area is the Marcoola drain located approximately 450 m to the north.

Photograph 1 – Borehole Location BH5, Emu Mountain She Oak Translocation Area.

4.0 ACID SULFATE SOIL OVERVIEW

The formation of ASS is commonly the result of marine or estuarine deposition of sulfate and iron bearing sediments in the presence of an abundant source of readily decomposable organic matter resulting in the deposition of pyrite. This pyrite is stable within the soil so long as anoxic conditions prevail. Oxidation of this material produces acidic conditions. Oxidation typically occurs when the material below the water table is exposed to air following excavation, or is drained by lowering the water table during dewatering processes.

Previous experience and available guidelines indicate that ASS are normally restricted in extent to recent (Holocene to Pleistocene age) soil horizons deposited in a saline environment below RL 5 m. The State Planning Policy 2014 (SPP14) "State Interest Guideline – Water Quality" (August 2014) (SPP14) applies to land, soil and sediment at or below 5 m AHD where the natural ground level is less than 20 m AHD. Within such areas the SPP applies to development involving any of the following:

- Excavating or otherwise removing 100 m³ or more of soil or sediment; or
- Filling of land involving 500 m³ or more of material with an average depth of 0.5 m or greater.

The SCA expansion area, which occupies some 460 hectares, lies below 5m AHD and is situated mainly on recent alluvial deposits of Quaternary age (interpreted as being mainly of Pleistocene age) overlying residual geology, predominantly sandstone of the Landsborough Sandstone formation. The entirety of the expansion area is underlain by 'undifferentiated coastal plain' comprising "sands and mud" that is known to also contain "clay/silt (active stream channel and low terraces)" which include some Holocene age deposits likely to include ASS. Typically, ASS occur only in Holocene deposits, although some low level ASS may occur in the more recent of the older Pleistocene deposits.

The proposed development involves excavations that would exceed the above trigger levels. SPP14 is therefore applicable to this site due to the extent of proposed earthworks activities and an assessment of potential disturbance of ASS is required.

The aims of this investigation were to:

- Conduct an ASS investigation in general accordance with the requirements of the State Planning Policy 2014 "State Interest Guideline – Water Quality" (August 2014) with sampling and analysis planned to use the Queensland Department of Natural Resources and Mines (NRM) "Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland - 1998", developed by the Queensland Acid Sulfate Soils Investigation Team (QASSIT).
- Quantitatively identify the presence or absence of ASS across the proposed disturbance areas;
- If necessary, assess the likely impact of the proposed development on ASS and groundwater;
- If necessary, provide prudent management measures so that the release of acid leachate from disturbed soil and groundwater does not have significant adverse effects on the natural and built environment or human health; and
- Advise whether a stand-alone ASS Environmental Management Plan (ASS EMP) is required for the proposed works.

The results of the ASS investigation are set out in the following sections and follow the format set out in the State Planning Policy 2014 Guideline.

5.0 METHODOLOGY

5.1 Published Information

Assessment and review of published maps and data of the following criteria was undertaken for the proposed development area:

- Topography and height above sea level (AHD);

- Published maps of ASS distribution in South East Queensland; and
- Regional geology and indicative soil types and their origins.

The findings from the desktop assessment are presented in Section 6.1.

5.2 Field Investigation

In line with the Queensland Guidelines, two boreholes per ha for areas >4 ha are required for an ASS investigation. It should be noted that the Queensland Guidelines require an ASS investigation to extend to 1 m below the proposed depth of disturbance.

Twenty boreholes, including two groundwater monitoring wells were advanced to depths of up to 1.5 m below ground level (bgl) within the translocation and receival areas. Borehole locations are shown on Plates 2 and 3 and are summarised in Table 1 below.

Table 1: Borehole Distribution

Translocation Area (<5 m AHD)	Receival Area (<5m AHD)
10 boreholes to 1.5 m depth (BH1-EMS to BH10-EMS) including one groundwater monitoring well (GW1)	10 boreholes to 1.5 m depth (BH11-EMS to BH20-EMS) including one groundwater monitoring well (GW2)

Boreholes were drilled using a combination of 4WD-mounted solid flight auger rig (using push tube sample techniques to recover undisturbed soil samples where possible) and hand augering due to access constraints. The fieldwork was carried out in the presences of an experienced Environmental Scientist from Core.

Samples for ASS testing were recovered from the boreholes at approximately 0.25 m intervals to the depth of each borehole. ASS sampling protocols outlined in the “Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1988” (Ahern et al., 1998) were observed in the field to minimise oxidation of the samples prior to laboratory testing.

The location of each borehole was recorded using a hand-held GPS unit with a differential correction signal, having an accuracy of ± 5 m. Borehole coordinates are presented on the Reports of Boreholes in Appendix A, together with explanatory notes. Subsurface conditions are discussed in Section 6.2.

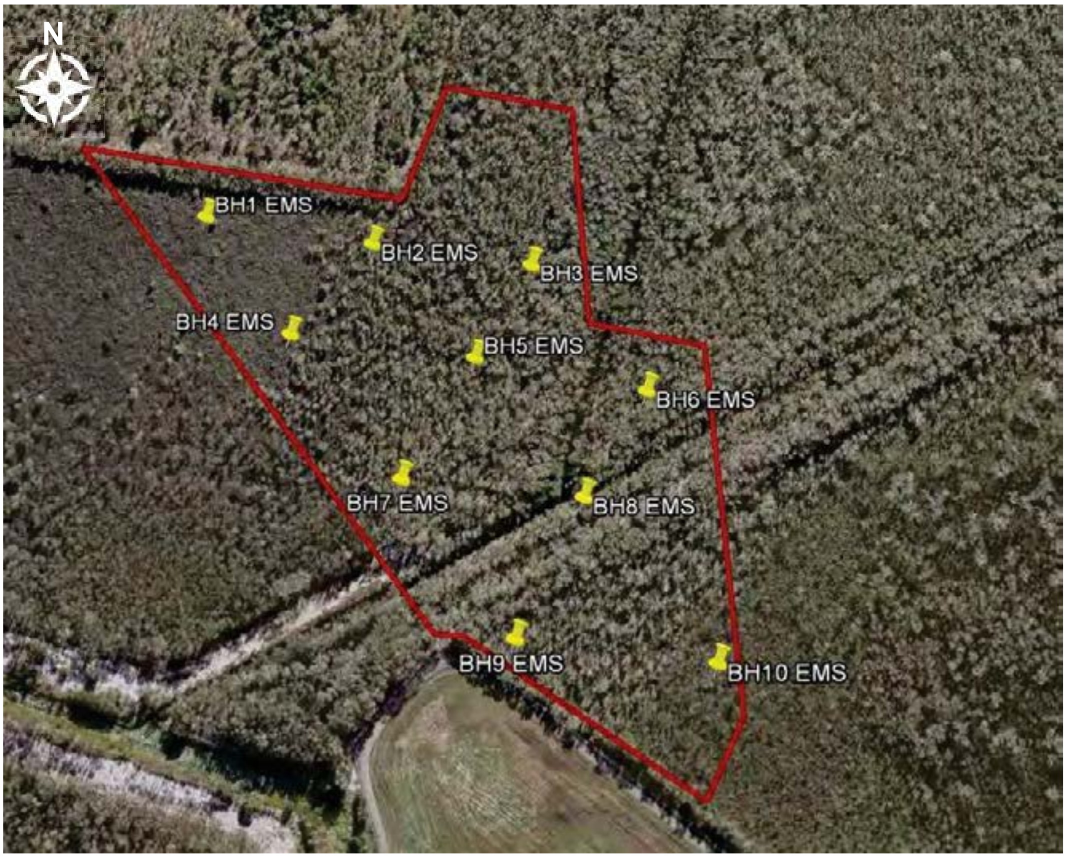


Plate 2: Borehole Locations – Translocation Area *(Aerial image sourced from State of Queensland (Queensland Globe), Copyright © State of Queensland 2017, under licence. Annotations by Core Consultants Pty Ltd.)*

Plate 3: Borehole Locations – Receival Area *(Aerial image sourced from State of Queensland (Queensland Globe), Copyright © State of Queensland 2017, under licence. Annotations by Core Consultants Pty Ltd.)*

5.3 Groundwater Monitoring Well Installation and Sampling

Groundwater monitoring wells (GW1 and GW2) were installed in boreholes BH7-EMS and BH12-EMS, respectively. The wells were constructed using 50 mm diameter PVC pipe slotted over the bottom 1.0 m. The screened sections were gravel packed and then sealed with a bentonite plug. Well construction details are shown on the borehole reports (ref. Appendix A).

Groundwater quality monitoring was undertaken to enable an appraisal of the influence of ASS (if any) on water quality.

The groundwater levels were measured at each well by an experienced Environmental Scientist on 29 June 2017. A groundwater sample was only recovered from GW1, as GW2 contained insufficient water for sampling. The groundwater sample from GW1 was tested in the field for temperature, pH, salinity and electrical conductivity (EC) using a calibrated water quality meter.

The sample was then dispatched to Australian Laboratory Service (ASL) to undergo further analysis. ALS is National Association of Testing Authorities (NATA) accredited for the analytical tests. Results of groundwater monitoring are summarised in Section 6.4. ALS laboratory results are attached in Appendix C.

Groundwater sampling, field testing, sample handling and dispatch procedures were performed in accordance with Core procedures, the Department of Environment and Heritage Protection (EHP) *Monitoring and Sampling Manual 2009* Version 2 September 2010 and the Murray Darling Basin Groundwater Quality Sampling Guidelines (MBDC 1997).

5.4 Laboratory Testing Program

A total of 120 samples were screened at Core's Maroochydore laboratory to assess field pH (pH_F) and pH after oxidation (pH_{FOX}) using 30 % hydrogen solution buffered to between pH 4.5 to pH 5.5.

The pH_F/pH_{FOX} screening method consists of two steps. In the first step, the field pH of a 1:5 soil/water suspension is measured (pH_F). In the second step, a 30% Hydrogen Peroxide solution is added to the sample which is then heated to accelerate the oxidation of the sample. The pH after oxidation (pH_{FOX}) is then measured. A significant difference between the pH_F and pH_{FOX} results is indicative of PASS; however, test results may be affected by other inclusions such as shell material and organics.

Based upon the results of these screening tests, 40 samples (approximately two samples per borehole) were selected and dispatched to Eurofins/MGT laboratory to undergo quantitative analysis by the Chromium Reducible Sulfur suite in accordance with ASS Method 23F and 22B laboratory procedures of Ahern et al (2004).

This method includes analysis of 'inherent buffering capacity' from naturally occurring alkaline materials (i.e. calcite, coral debris, fine shell fragments) and 'retained acidity' which includes sulfur held in stable oxidation minerals such as 'jarosite' and allows for calculation of 'net acidity'. The Chromium Reducible Sulfur test method was selected in preference to the Suspension Peroxide Oxidation Combined Acidity & Sulfur (SPOCAS) method as it gives more accurate indications of pyrite content where significant amounts of organic matter (and organic derived acidity) are present in the soil samples.

An overall acid-base accounting method was used to calculate a 'net acidity' value which is used to qualify analytical test results and calculate liming rates. This equation is given by:

> Net Acidity = Actual Acidity (as TAA) + Retained Acidity (as S_{NAS}) + Potential Acidity (as S_{CR}) - insitu Acid Neutralising Capacity (ANC).

The Eurofins/MGT laboratory certificates of analysis, chain of custody documents and laboratory quality control documents are attached in Appendix C and the results are summarised in Appendix B, Table B1. Observations and discussion on the laboratory findings are given in Sections 6.7.

6.0 RESULTS OF THE INVESTIGATION

6.1 Published Data

The 1:100,000 Series Nambour Special Geological Map (Sheet 9444 & Part 9544, First Edition 1999) indicates that most of the site is underlain by Quaternary (Pleistocene) age '*undifferentiated coastal plains'* comprising '*sands and mud'* that is known to also contain "*clay/silt (active stream channel and low terraces*)". The Quaternary deposits are inferred to be underlain by the older Landsborough Sandstone and/or Nambour Formation.

The Nambour Special Geology Map shows Holocene alluvium comprising "clay/silts of the active stream channels and lower terraces" to the north west of the site (denoted Qhct in Plate 4), associated with the South Maroochy River.

An extract from the abovementioned geology map is provided in Plate 4 below.

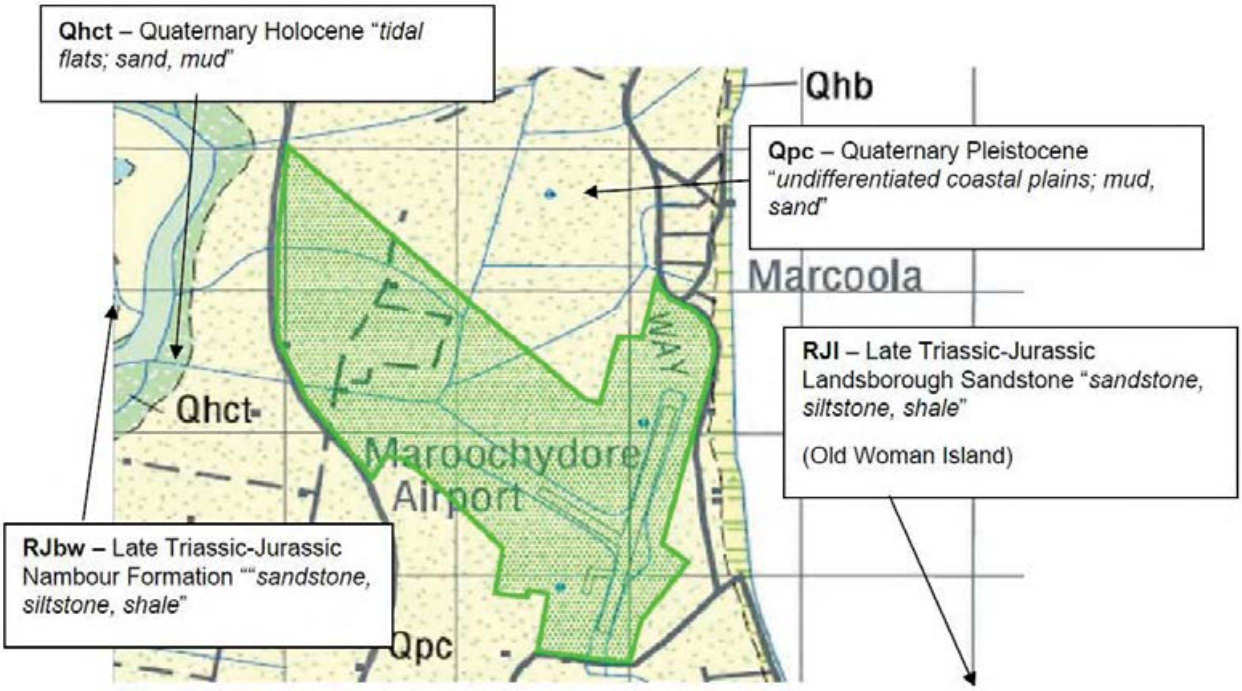
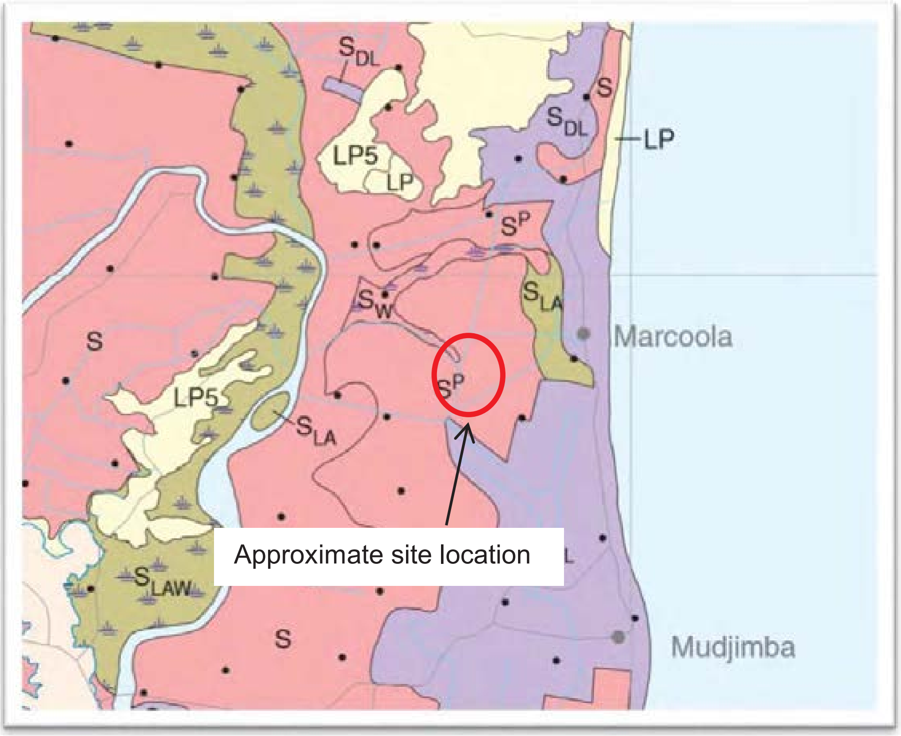


Plate 4: Extract of Regional Geology Map

Reference to the Acid Sulfate Soils Map for the Redcliffe to Teewah area prepared by the Queensland Government, Department of Natural Resources 1999, indicates that the area is underlain by "Disturbed urban or industrial land (<5 m AHD) likely to contain Acid Sulfate Soil".

An extract from the abovementioned acid sulfate soils map is provided in Plate 5 below.



ACID SULFATE SOILS (ASS)[1] ON RELATIVELY UNDISTURBED LAND

S — Land where ASS occurs within 5m of the surface. Virtually all land in this category has at least one 'potential acid sulfate soil' layer[3] and some of this land will have an 'actual acid sulfate soil' layer[2].

NOTE: S^P - indicates sediments of Pleistocene age[1].

Plate 5: Extract from published ASS map

6.2 Subsurface Conditions

The soil profiles encountered were consistent across both areas and generally comprised:

- Silty Sand (Topsoil), dark grey / grey, fine to medium grained with organics to depths of up to 0.5 m bgl, underlain by;
- Alluvial, fine to medium grained, Sand, Silty Sand with the sands at most locations displaying various strengths of cementation to depths ranging between 0.9 m bgl to 1.5 m bgl.

Reports of boreholes and explanatory notes are presented in Appendix A.

6.3 Groundwater

Groundwater seepage/inflow was observed at depths of between 0.4 m bgl to 1.5 m bgl at the time of drilling. Results of seepage/inflow observations are included on the individual borehole reports in Appendix A.

The groundwater level was found to range from 0.45 m bgl to 0.8 m bgl during groundwater monitoring on 29 June 2017. Results of monitoring observations are included in Table 2 below.

It should be noted that the investigation was carried out during a seasonal dry period, and that groundwater levels would be expected to rise above present levels during wet weather events and following periods of heavy or persistent rainfall.

6.4 Groundwater Quality Analysis

A groundwater sample was collected from GW1 on 29 June 2017 to provide an initial assessment of groundwater conditions. The results are summarised in Table 2.

Table 2: Results of Groundwater Analysis

Parameter	GW1
Field Results	
Groundwater Level (m bgl)	0.45
Field pH	4.7
Electrical Conductivity (µS/cm)	261
Temperature (°C)	22.0
Observations	turbid, dark brown
Laboratory Results	
Total Dissolved Solids (mg/L)	412
Total Alkalinity as $CaCO_3$ (mg/L)	<1
Acidity as $CaCO_3$ (mg/L)	238
Sulfate as SO_4 (mg/L)	21
Chloride (mg/L)	83
Cl:SO_4 Ratio	-
Calcium (mg/L)	3
Magnesium (mg/L)	5
Potassium (mg/L)	<1
Sodium (mg/L)	48
Aluminium (filtered) (mg/L)	0.23
Iron (filtered) (mg/L)	4.45

The groundwater level was measured at 0.45 m bgl on 29 June 2017. It is anticipated that the extent of groundwater seepage encountered during the proposed Emu Mountain She Oak translocation will be dependent upon the prevailing weather conditions at that time, but could rise closer to the ground surface.

The groundwater pH result of 4.7 indicates that the groundwater is moderately acidic. Electrical conductivity (EC) value of 261 µs/cm, indicates the groundwater is fresh.

The Chloride:Sulfate (Cl^-:SO_4^{2-}) ratio is used to assess whether elevated sulfate levels have derived from exposure of acid sulfate soils. A Cl:SO4 ratios of less than two are generally considered to be a strong indication of an extra source of sulphate from previous oxidation of ASS. In this case the chloride and sulfate concentrations recorded from GW1 were considered too low to provide reliable information from which any conclusions could be drawn.

Dissolved iron (Fe) concentrations in the groundwater was relatively high which is indicative of an iron rich environment, common along coastal Southeast Queensland. Dissolved aluminium (Al) concentrations recorded was relatively low.

6.5 Preliminary Screening Results

Results of preliminary screening are summarised in Appendix B, Table B1.

In this investigation, soil pH (represented by pH_F results) was found to range between pH 4.4 and pH 5.8 (moderately acidic to slightly acidic), with a significant number of samples being between pH 4.0 to pH 5.0, indicating a low to moderate probability of the presence of actual ASS at most locations.

Generally, only slight differences in the pH_{FOX} and pH_F test results were recorded for most of the samples tested. All samples displayed a mixture of low to moderate level reactions to the addition of hydrogen peroxide. The pH_{FOX} ranged from pH 1.5 to pH 4.9 and was generally observed below pH 3.0 for most samples. This suggests a moderate to high potential for the presence of potential ASS (PASS).

6.6 Quantitative Soils Analysis

Table 3 below shows the ASS action levels adopted in Queensland. These categories are used to identify whether action / management of ASS spoil is required, based on ‘net acidity’. For major fill works and disturbances of more than 1,000 tonnes, an action criterion of 0.03% S equivalents (18 moles / tonne) is adopted for all soil types.

Table 3: ASS Action Criteria

Type of Material		Action Criteria 1-1000 tonnes disturbed		Action Criteria > 1000 tonnes disturbed (and major fill projects)	
		Existing + Potential Acidity		Existing + Potential Acidity	
Texture range McDonald et al. (1990)	Approx. clay content (%)	Equivalent sulfur %S oxidisable	Equivalent acid mol H^+/ tonne	Equivalent sulfur %S oxidisable (oven-dry basis)	Equivalent acid mol H^+/ tonne (oven-dry basis)
Coarse Texture Sands to loamy sands	≤5	0.03	18	0.03	18
Medium Texture Sandy loams to light clays	5 – 40	0.06	36	0.03	18
Fine Texture Medium to heavy clays and silty clays	≥40	0.10	62	0.03	18

Results of the 40 samples analysed are summarised below:

Translocation Area

- One sample returned a Titratable Actual Acidity (TAA) results above the action criterion of 18 mol H+/ tonne with a concentration 75 mol H+/ tonne.
- Oxidisable Sulfur was not present as S_{CR} at levels above action criteria of 0.03%S in any of the 20 samples analysed.
- No samples returned pH_{KCl} values exceeding pH 6.5, and as such no further analysis for acid neutralising capacity (ANC) was carried out.
- No samples returned pHKCl values less than pH 4.5, and as such no further analysis for retained acidity (S_{NAS}) was carried out.

The quantitative test results for samples analysed indicate low levels of existing acidity with levels ranging from below the laboratory limit of reporting (2 mol H+/tonne) up to 75 mol H+/tonne.

Results of S_{CR} tests indicate negligible levels of PASS recorded with potential acidity levels below the QASSIT ‘Action Criteria’ and the laboratory detection levels (<0.005%S).

Of the 20 samples analysed, net acidity exceeded the relevant QASSIT ‘Action Criteria’ (for bulk earthworks) in one sample (BH6 0.0-0.25 m) and was equal to the exceedance criteria at 2 other locations (BH3 0.25-0.5 m and BH7 0.0-0.25 m), indicating that some level of management and/or lime neutralisation treatment may be required if these soils are disturbed.

Receival Area

- Ten samples returned Titratable Actual Acidity (TAA) results equal to or above the action criterion of 18 mol H+/ tonne (0.03%S), ranging between 18 mol H+/ tonne to 95 mol H+/ tonne.
- Oxidisable Sulfur was not present as S_{CR} at levels above action criteria of 0.03%S in any of the 20 samples analysed.
- No samples returned pH_{KCl} values exceeding pH 6.5, and as such no further analysis for acid neutralising capacity (ANC) was carried out.
- No samples returned pHKCl values less than pH 4.5, and as such no further analysis for retained acidity (S_{NAS}) was carried out.

The quantitative test results for samples analysed indicated low levels of existing acidity were identified in the samples collected, with levels ranging from below the laboratory limit of reporting (2 mol H+/tonne) up to 95 mol H+/tonne.

Results of S_{CR} tests indicate low to negligible levels of PASS with potential acidity levels below the QASSIT 'Action Criteria' with concentrations ranging from <0.005%S to 0.01%S.

Of the 20 samples analysed, net acidity exceeded the relevant QASSIT 'Action Criteria' (for bulk earthworks) in nine samples indicating that some level of management and/or lime neutralisation treatment may be required if these soils are disturbed.

6.7 Extent and severity

The SPP14 Guidelines require that the level of treatment for management of ASS is based on treatment of all existing and potential acidity. The results of the laboratory testing have been accumulated in an Acid-Base Account to give the Net Acidity for each sample in units of mol H+/tonne as presented in Table B1 in Appendix B. This value has been calculated from sulfur trail potential acidity (S_{cr}) plus actual acidity (TAA).

Translocation Area

Based on testing carried out to date, soils with actionable levels of existing acidity appear to be distributed within the upper 0.5 m bgl. It should be noted that 100% of the net acidity values were due to existing acidity, with no potential for further acid generation indicated. The existing acidity present may be due to organic acids rather than oxidised sulfur. Recommended liming rates for these soils if disposed off-site or used in other areas of the SCA project are presented below in Table 4.

Receival Area

Based on testing carried out to date, soils with actionable levels of existing acidity appear to be distributed within the upper 0.5 m bgl. It should be noted that 100% of the net acidity values were due to existing acidity, with no potential for further acid generation indicated. The existing acidity present may be due to organic acids and minor oxidised sulfur. Recommended liming rates for these soils if disposed off-site or used in other areas of the SCA project are presented below in Table 4.

Table 4: Recommended Liming Rates

Location	Treatment Rate
Translocation Area	10 kg $CaCO_3/m^3$ *
Receival Area	13 kg CaCO3/m^3 *

Note: * Liming rate based on highest individual values within the areas.

6.8 Risk Assessment

Technically, given the large size of the planned translocation and receival area, the level of management of ASS required in accordance with the Queensland Soil Management Guidelines - Table 4-2 (i.e. the use of greater than 25 tonnes of aglime) would likely be classified as EH (extremely high level). However, given the proposed depth of excavation, the low levels of acidity detected within the areas and the low to negligible risk of future generation of additional acidity the overall risk is consider low to moderate.

Furthermore, spoil won from the excavation of the receival area is to be placed directly into the excavation from the translocation area. Given the naturally acidic natural of the local environment and the similar soil properties and chemistry this method of translocation is consider to pose a non-worsening effect.

Nonetheless, management of this existing acidity will be needed to be addressed and specific management measures must be carried out in order to further reduce the overall risk.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The results of this investigation indicate there is likely to be disturbance of soils with existing acidity during the proposed translocation of the Emu Mountain She Oak. However, the levels of existing acidity are generally low, and the proposed disturbance is considered unlikely to generate further acidity or cause further acidity to migrate offsite.

The following recommendations should be adopted to manage the risk of environmental harm during proposed earthworks:

- Spoil won from the receival area should be placed directly within the excavation of the translocation area. If stockpiling is required additional management measures are provided in Section 7.1
- A lime guard layer should be applied to the base of translocation area following removal of the heath tiles. Lime guard layers should be applied at the rate of 5 kg of lime per m^2.
- No lime guard layer will be required at the base of the receival area.
- Groundwater is unlikely to be encountered within the proposed shallow excavations of the translocation and receival areas. Management of rainfall collected from the site is incorporated in Section 7.2.
- If acidic soils are to be removed off-site or placed in other areas of the SCA project, lime treatment should be carried out to neutralise acidity as per Table 4 above. If lime treatment is required than additional management measure (i.e. lime treatment pads, mixing procedures, verification testing etc.) will be required and a stand-alone ASS MP should be developed.
- An accurate spatial tracking system should be developed to control the movement and final location of excavated soil.

7.1 Stockpiles and Handling

Wherever practical, earthworks handling should involve transporting directly from cut to fill areas and stockpiling of acidic soils should be avoided.

Where it is necessary to stockpile acidic soils the following additional management measures must be followed:

- Stockpiles are to be contained by bunds with stormwater runoff directed to a collection sump. Bunds are to be constructed from low permeability materials that are not acid soils or have been fully lime treated.
- A guard layer of neutralising agent should be spread across the soil surface prior to placement of the stockpile. The rate of neutralising agent applied should be based on 0.3 times the average total potential plus existing acidity for every 1 m height of soil in the stockpile.
- The surface area of the stockpile is to be minimised by shaping and sealed by surface compaction to reduce moisture loss and rainfall entry.

7.2 Water Management

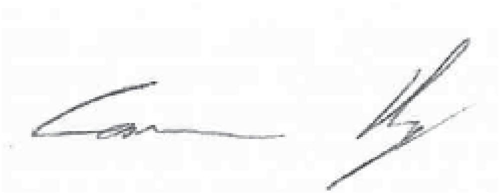
Groundwater is unlikely to be encountered during excavations. However, any waters collected within the excavation areas should be directed into a temporary basin/holding point for testing prior to any discharge.

8.0 LIMITATIONS

Should you require any further information please contact the undersigned. We draw your attention to the document, Limitations, which is included in Appendix D.

Core Consultants Pty Ltd

Yours sincerely,



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Associate/Senior Environmental Scientist

CK/JM/ck

A.B.N. 75 603 384 050

APPENDIX A

Reports of Boreholes

REPORT OF BOREHOLE: BH 1 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	507898.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058628.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling: METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	Field Material Description: GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, grey, trace rootlets			
			0.5	0.50				SP	SAND (ALLUVIUM): fine to medium grained, pale brown	M		
				0.70					Becoming pale yellow			
			1.0							M - W		
		Groundwater encountered at 1.2m depth		1.20				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 2 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	507972.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058615.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets			
			0.5	0.50				SP	SAND (ALLUVIUM): fine to medium grained, brown, trace silt	M		
				0.80					Becoming pale brown			
			1.0									
				1.30					Becoming dark grey	M - W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 3 EMS

core consultants pty ltd

CLIENT: Sunshine Coast Council		EAST:	508042.0 m	SHEET	1 OF 1
PROJECT: Airport Expansion		NORTH:	7058605.0 m	LOGGED:	SR
LOCATION: Finland Rd		CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO: J000030		DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets	M		
				0.30				SP	SAND (ALLUVIUM): fine to medium grained, pale brown	M		
			0.5									
		Groundwater encounted at 0.9m depth	1.0							M - W		
				1.40				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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core consultants pty ltd

REPORT OF BOREHOLE: BH 4 EMS

CLIENT:	Sunshine Coast Council	EAST:	507939.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058573.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, grey, trace organics, trace rootlets	M		
		Groundwater encountered at 0.8m depth	0.5	0.30				SP	SAND (ALLUVIUM): fine to medium grained, grey, trace silt	M / M - W		
			1.0	1.00				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 5 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508019.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058562.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace silt	M		
			0.5	0.50				SP	SAND (ALLUVIUM): fine to medium grained, pale brown	M		
		Groundwater encountered at 1.0m depth	1.0							M - W		
				1.30				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 6 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508093.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058547.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets			
				0.30				SP	SAND (ALLUVIUM): fine to medium grained, grey and brown, trace silt	M		
			0.5									
			1.0									
				1.30				SP	Becoming grey			
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 7/GW1 EMS

CLIENT:	Sunshine Coast Council	EAST:	507990.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058508.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	PIEZOMETER DETAILS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets	M		GW1; 1.0m Stick up; Bentonite
				0.30				SP	SAND (ALLUVIUM): fine to medium grained, pale brown, trace silt			
			0.5									Sand Filter Pack
				0.60					Becoming pale brown and grey			
			1.0									Slotted Screen
		Groundwater encountered at 1.3m depth								M - W		
				1.40				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 8 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508067.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058500.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, grey, trace rootlets	M		
			0.5	0.40				SP	SAND (ALLUVIUM): fine to medium grained, brown, trace silt			
			1.0	0.90					Becoming pale grey			
										M - W		
				1.40				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
		Groundwater encountered at 1.5m depth	1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 9 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508040.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058440.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets	M		
			0.5	0.45				SP	SAND (ALLUVIUM): fine to medium grained, grey, trace silt			
			1.0	0.80					Becoming pale brown and yellow	M - W		
			1.5	1.40				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey, becoming indurared	W		
				1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 10 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508123.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7058430.0 m	LOGGED:	SR
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace organics	M		
		Groundwater encountered at 0.4m depth	0.5	*0.25*				SP	SAND (ALLUVIUM): fine to medium grained, brown	W		
			1.0	*1.10*				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey, becoming indurated			
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 11 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508036.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059716.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	26/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
		Groundwater seepage encountered at 0.7m depth	0.0		0.00 m ASS samples collected at 0.25m intervals			SC	CLAYEY SAND (ALLUVIAL): fine to medium grained, dark grey, trace rootlets	M - W		
				0.30				SP	SAND (ALLUVIAL): fine to medium grained, grey, trace silt	M		
			0.5	0.80					Becoming pale grey	M - W		
			1.0									
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 12/GW2 EMS

consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508135.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059703.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	26/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	PIEZOMETER DETAILS
0.0		0.00 m ASS samples collected at 0.25m intervals	SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets		GW2; 1.0m Stickup
	0.20		SP	SAND (ALLUVIAL): fine to medium grained, pale brown and grey, trace silt		Bentonite
0.5	0.50			Becoming grey	M	
1.0						Sand Filter Pack
	1.20		SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey		Slotted Screen
1.5	1.50			END OF BOREHOLE @ 1.50 m BACKFILLED		
2.0						

WATER: Groundwater encountered at 0.8m depth

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF BOREHOLE: BH 13 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508245.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059687.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	26/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace organics, trace rootlets	M		
				0.25				SP	SAND (ALLUVIUM): fine to medium grained, grey, trace silt	M		
		Groundwater encountered at 1.1m depth	0.5 1.0							W		
				1.30				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 14 EMS

core consultants pty ltd

CLIENT: Sunshine Coast Council		EAST:	508257.0 m	SHEET	1 OF 1
PROJECT: Airport Expansion		NORTH:	7059741.0 m	LOGGED:	HO
LOCATION: Finland Rd		CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO: J000030		DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets	M		
				0.30				SP	SAND (ALLUVIUM): fine to medium grained, grey, with some silt			
			0.5									
		Groundwater encountered at 1.0m depth	1.0									
				1.30				SP	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 15 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508144.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059753.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SC	CLAYEY SAND (ALLUVIUM): fine to medium grained, grey, low plasticity clay, trace rootlets	M - W		
		Groundwater encountered at 0.6m depth	0.5	0.20				SP	SAND (ALLUVIUM): fine to medium grained, pale grey			
			1.0	1.20				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey, becoming indurated	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 16 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508041.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059765.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SM	SILTY SAND (TOPSOIL): fine to medium grained, dark grey to pale brown	M		
		Groundwater encountered at 0.5m depth	0.5	*0.40*				SP	SAND (ALLUVIUM): fine to medium grained, brown and yellow	W		
			1.0									
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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core consultants pty ltd

REPORT OF BOREHOLE: BH 17 EMS

CLIENT:	Sunshine Coast Council	EAST:	507953.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059826.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SC	CLAYEY SAND (ALLUVIUM): fine to medium grained, dark grey, medium plasticity clay, trace rootlets	M - W		
				0.40					Becoming brown	M		
			0.5									
		Groundwater encountered at 1.1m depth	1.0	1.00				SP	SAND (ALLUVIUM): fine to medium grained, brown	M - W		
				1.30				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey, becoming indurated	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 18 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508047.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059816.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected in 0.25m intervals			SC	CLAYEY SAND (ALLUVIUM): fine to medium grained, dark grey, medium plasticity clay, trace rootlets	M - W		
				0.35				SP	SAND (ALLUVIUM): fine to medium, grey, trace silt	M		
		Groundwater encountered at 0.5m depth	0.5									
				0.60					Becoming pale grey			
				0.90				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey, becoming indurated	W		
			1.0									
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 19 EMS

core consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508154.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059806.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.25m intervals			SP	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace rootlets	M		
				0.40				SP	SAND (ALLUVIUM): fine to medium grained, pale grey	M		
		Groundwater encountered at 1.2m depth		1.20					Becoming pale grey	M - W		
				1.30				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	1.50					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

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REPORT OF BOREHOLE: BH 20 EMS

consultants pty ltd

CLIENT:	Sunshine Coast Council	EAST:	508269.0 m	SHEET	1 OF 1
PROJECT:	Airport Expansion	NORTH:	7059796.0 m	LOGGED:	HO
LOCATION:	Finland Rd	CONTRACTOR:	Core Consultants	LOGGED DATE:	14/06/17
JOB NO:	J000030	DRILL RIG:	Hand Auger	CHECKED:	CJ
		INCLINATION:	-90° HOLE DIA. 100 mm	CHECKED DATE:	05/07/17

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0		0.00 m ASS samples collected at 0.2m intervals			SP	SILTY SAND (TOPSOIL): fine to medium grained, dark grey, trace organics	M		
				0.30				SM	SAND (ALLUVIUM): fine to medium grained, dark grey	M		
			0.5									
				0.80					Becoming pale grey	M		
			1.0									
		Groundwater encountered at 1.1m depth								M - W		
				1.40				SM	SILTY SAND (COFFEE ROCK): fine to medium grained, dark grey	W		
			1.5	*1.50*					END OF BOREHOLE @ 1.50 m BACKFILLED			
			2.0									

This report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

core consultants pty ltd

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary blade or drag bit	NQ	Diamond Core - 47 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
*V	V-Bit	RAB	Rotary Air Blast	HQ	Diamond Core - 63 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	HMLC	Diamond Core – 63mm
HA	Hand Auger	PT	Push Tube	BH	Tractor Mounted Backhoe
ADH	Hollow Auger	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
DTC	Diatube Coring	JET	Jetting	EE	Existing Excavation
WB	Washbore or Bailer	NDD	Non-destructive digging	HAND	Excavated by Hand Methods

PENETRATION/EXCAVATION RESISTANCE

L **Low resistance.** Rapid penetration possible with little effort from the equipment used.

M **Medium resistance.** Excavation/possible at an acceptable rate with moderate effort from the equipment used.

H **High resistance** to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.

R **Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

WATER

▽	Water level at date shown	◁	Partial water loss
▷	Water inflow	◀	Complete water loss

GROUNDWATER NOT OBSERVED — The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.

GROUNDWATER NOT ENCOUNTERED — The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (s_v = peak value, s_r = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure tests
DCP	Dynamic cone penetration test
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure (u) measurement

Ranking of Visually Observable Contamination and Odour (for specific soil contamination assessment projects)

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$$

SCR = Solid Core Recovery (%)

$$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum \text{Axial lengths of core} > 100\text{ mm}}{\text{Length of core run}} \times 100$$

METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT REPORTS

FILL

GRAVEL (GP or GW)

SAND (SP or SW)

SILT (ML or MH)

CLAY (CL, CI or CH)

ORGANIC SOILS (OL or OH or Pt)

COBBLES or BOULDERS

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

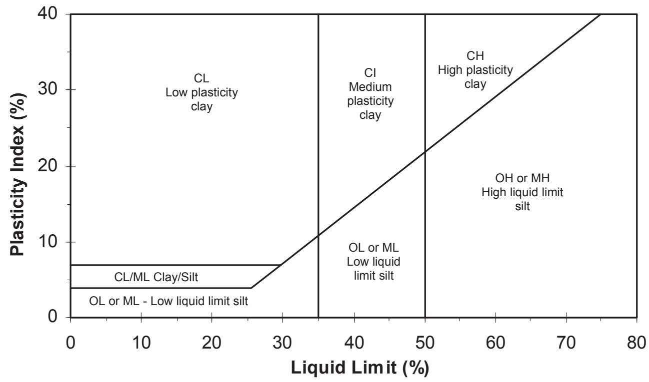
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. The material properties are assessed in the field by visual/tactile methods.

Particle Size

Major Division	Sub Division	Particle Size
BOULDERS		> 200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.075 mm
CLAY		< 0.002 mm

Plasticity Properties



MOISTURE CONDITION

AS1726 - 1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

AS1726 - 1993

Symbol	Term	Undrained Shear Strength	Symbol	Term	Density Index %	SPT “N” #
VS	Very Soft	0 to 12 kPa	VL	Very Loose	Less than 15	0 to 4
S	Soft	12 to 25 kPa	L	Loose	15 to 35	4 to 10
F	Firm	25 to 50 kPa	MD	Medium Dense	35 to 65	10 to 30
St	Stiff	50 to 100 kPa	D	Dense	65 to 85	30 to 50
VSt	Very Stiff	100 to 200 kPa	VD	Very Dense	Above 85	Above 50
H	Hard	Above 200 kPa				

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

APPENDIX B

Table B1: Summary of ASS Field and Laboratory Analysis Results

BH ID	Depth (m)	BH	Description	Quick Screening Test						Existing Acidity		Potential Acidity		Acid Neutralising Capacity			Retained Acidity					Acid Base Accounting			Required Lime Rate	
				pH_F	AASS likelihood[1]	pH_{FOX}	PASS likelihood [2]	Reaction	Remark	pH KCl	Titratable Actual Acidity	Chromium Reducible Sulfur	acidity - Chromium Reducible Sulfur	Acid Neutralising Capacity	acidity - Acid Neutralising Capacity	sulfidic - Acid Neutralising Capacity	Net Acid Soluble Sulfur	acidity - Net Acid Soluble Sulfur	sulfidic - Net Acid Soluble Sulfur	KCl Extractable Sulfur	HCl Extractable Sulfur	ANC Fineness Factor	Net Acidity (sulfur units)	Net Acidity (acidity units)		
				pH Unit		pH Unit				pH Unit	mole H+ / t	% S	mole H+ / t	% CaCO3	mole H+ / t	% pyrite S	% S	mole H+ / t	% pyrite S	% S	% S		% S	mole H+ / t	kg CaCO3/t	kg $CaCO3/m^3$
BH1	0.0_0.25	BH1_0.0_0.25	Silty SAND (Topsoil), grey	5.0	L	4.1	L	l-m		5.2	7.2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.25_0.5	BH1_0.25_0.5		5.2	L	4.6	L	l-m																		
	0.5_0.75	BH1_0.5_0.75	SAND (Alluvium), pale brown	5.0	M	4.7	L	m		5.5	2.7	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH1_0.75_1.0	SAND(Alluvium), pale yellow	5.2	L	4.6	L	m																		
	1.0_1.25	BH1_1.0_1.25		5.1	L	4.9	L	l																		
	1.25_1.5	BH1_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.0	M	3.7	L	l																		
BH2	0.0_0.25	BH2_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	3.0	M	l		5.0	13.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.02	13	< 1	1
	0.25_0.5	BH2_0.25_0.5		4.8	M	3.5	L	L																		
	0.5_0.75	BH2_0.5_0.75	SAND (Alluvium), brown	5.2	L	4.1	L	L																		
	0.75_1.0	BH2_0.75_1.0	SAND (Alluvium), pale brown	5.2	L	4.8	L	L		5.4	3.9	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH2_1.0_1.25		5.1	L	4.3	L	L																		
	1.25_1.5	BH2_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.1	L	4.5	L	L																		
BH3	0.0_0.25	BH3_0.0_0.25	Silty SAND (Topsoil), grey	4.9	M	3.1	L	L		4.8	17.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.03	17	1.2	2
	0.25_0.5	BH3_0.25_0.5	SAND (Alluvium), pale brown	5.1	L	4.6	L	L																		
	0.5_0.75	BH3_0.5_0.75		5.1	L	4.3	L	L		5.5	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH3_0.75_1.0		5.1	L	4.7	L	L																		
	1.0_1.25	BH3_1.0_1.25		5.1	L	4.7	L	L																		
	1.25_1.5	BH3_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	4.9	M	3.1	L	L																		
BH4	0.0_0.25	BH4_0.0_0.25	Silty SAND (Topsoil), grey	5.0	M	2.8	H	L																		
	0.25_0.5	BH4_0.25_0.5		4.8	M	3.4	L	L		5.2	5.8	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH4_0.5_0.75	SAND (Alluvium), pale brown	5.0	M	4.3	L	L																		
	0.75_1.0	BH4_0.75_1.0		4.8	M	4.4	L	L		5.4	4.3	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH4_1.0_1.25	Silty SAND ("Coffee Rock"), dark grey	4.9	M	3.6	L	L																		
	1.25_1.5	BH4_1.25_1.5		4.9	M	3.9	L	L																		
BH5	0.0_0.25	BH5_0.0_0.25	Silty SAND (Topsoil), grey	5.2	L	2.6	H	L																		
	0.25_0.5	BH5_0.25_0.5		5.4	L	3.9	L	L		5.5	3.1	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH5_0.5_0.75	SAND (Alluvium), pale brown	5.3	L	3.9	L	L																		
	0.75_1.0	BH5_0.75_1.0		5.3	L	4.3	L	L																		
	1.0_1.25	BH5_1.0_1.25		5.2	L	2.9	H	M		5.5	2.5	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.25_1.5	BH5_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.1	L	2.0	H	M																		
BH6	0.0_0.25	BH6_0.0_0.25	Silty SAND (Topsoil), dark grey	5.0	M	1.7	H	M		4.5	75.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.12	75	5.6	10
	0.25_0.5	BH6_0.25_0.5		5.1	L	1.8	H	M																		
	0.5_0.75	BH6_0.5_0.75	SAND (Alluvium), pale grey	5.2	L	2.2	H	M		5.3	5.3	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH6_0.75_1.0		5.1	L	1.8	H	M																		
	1.0_1.25	BH6_1.0_1.25		5.1	L	1.8	H	M																		
	1.25_1.5	BH6_1.25_1.5	SAND (Alluvium), grey	5.1	L	2.2	H	M																		
BH7	0.0_0.25	BH7_0.0_0.25	Silty SAND (Topsoil), dark grey	5.1	L	2.1	H	M		4.8	18.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.03	18	1.4	3
	0.25_0.5	BH7_0.25_0.5		5.2	L	2.4	H	L																		
	0.5_0.75	BH7_0.5_0.75	SAND (Alluvium), pale brown	5.2	L	2.4	H	L																		
	0.75_1.0	BH7_0.75_1.0	SAND (Alluvium), pale grey	5.2	L	2.6	H	L		5.7	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH7_1.0_1.25		5.2	L	2.3	H	L																		
	1.25_1.5	BH7_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.0	M	3.1	L	L																		
BH8	0.0_0.25	BH8_0.0_0.25	Silty SAND (Topsoil), grey	4.8	M	1.8	H	L																		
	0.25_0.5	BH8_0.25_0.5		5.2	L	2.6	H	L		5.1	8.8	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH8_0.5_0.75	SAND (Alluvium), pale brown	5.2	L	2.9	H	L																		
	0.75_1.0	BH8_0.75_1.0	SAND (Alluvium), pale grey	5.2	L	2.5	H	L		5.5	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH8_1.0_1.25		5.1	L	2.8	H	L																		
	1.25_1.5	BH8_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.0	M	1.7	H	L																		
BH9	0.0_0.25	BH9_0.0_0.25	Silty SAND (Topsoil), dark grey	5.3	L	2.0	H	L																		
	0.25_0.5	BH9_0.25_0.5		5.8	L	3.0	H	L		5.4	2.4	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH9_0.5_0.75	SAND (Alluvium), grey	5.5	L	2.5	H	L																		
	0.75_1.0	BH9_0.75_1.0	SAND (Alluvium), pale brown	5.5	L	3.3	M	L		5.8	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH9_1.0_1.25		5.5	L	3.1	M	L																		
	1.25_1.5	BH9_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.5	L	3.7	L	L																		
BH10	0.0_0.25	BH10_0.0_0.25	Silty SAND (Topsoil), dark grey	4.7	M	2.5	H	L		5.0	9.1	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.25_0.5	BH10_0.25_0.5		4.4	M	2.6	M	L																		
	0.5_0.75	BH10_0.5_0.75	SAND (Alluvium), pale brown	4.8	M	2.5	H	L		5.2	5.4	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH10_0.75_1.0		5.2	L	3.6	L	L																		
	1.0_1.25	BH10_1.0_1.25		5.2	L	2.8	H	L																		
	1.25_1.5	BH10_1.25_1.5	SAND (Alluvium),grey	5.2	L	3.3	L	L																		

BH ID	Depth (m)	BH	Description	Quick Screening Test						Existing Acidity		Potential Acidity		Acid Neutralising Capacity			Retained Acidity					Acid Base Accounting			Required Lime Rate	
				pH_F	AASS likelihood[1]	pH_{FOX}	PASS likelihood [2]	Reaction	Remark	pH KCl	Titratable Actual Acidity	Chromium Reducible Sulfur	acidity - Chromium Reducible Sulfur	Acid Neutralising Capacity	acidity - Acid Neutralising Capacity	sulfidic - Acid Neutralising Capacity	Net Acid Soluble Sulfur	acidity - Net Acid Soluble Sulfur	sulfidic - Net Acid Soluble Sulfur	KCl Extractable Sulfur	HCl Extractable Sulfur	ANC Fineness Factor	Net Acidity (sulfur units)	Net Acidity (acidity units)		
				pH Unit		pH Unit				pH Unit	mole H+ / t	% S	mole H+ / t	% CaCO3	mole H+ / t	% pyrite S	% S	mole H+ / t	% pyrite S	% S	% S		% S	mole H+ / t	kg CaCO3/t	kg CaCO3/m^3
BH11	0.0_0.25	BH11_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	3.3	L	L																		
	0.25_0.5	BH11_0.25_0.5		4.8	M	3.7	L	L		5.1	7.8	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH11_0.5_0.75	SAND (Alluvium), grey	4.8	M	3.3	L	L																		
	0.75_1.0	BH11_0.75_1.0		4.7	M	3.3	L	L		5.3	4.4	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH11_1.0_1.25		4.8	M	3.1	L	L																		
	1.25_1.5	BH11_1.25_1.5	SAND (Alluvium), pale grey	4.7	M	3.1	L	L																		
BH12	0.0_0.25	BH12_0.0_0.25	Silty SAND (Topsoil), dark grey	5.0	M	3.1	L	L																		
	0.25_0.5	BH12_0.25_0.5		4.7	M	3.2	L	L		5.1	8.7	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.5_0.75	BH12_0.5_0.75	SAND (Alluvium), pale brown	4.8	M	3.0	M	L																		
	0.75_1.0	BH12_0.75_1.0		4.8	M	2.8	H	L																		
	1.0_1.25	BH12_1.0_1.25		4.8	M	2.8	H	L		5.6	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.25_1.5	BH12_1.25_1.5	SAND (Alluvium), dark grey	4.9	M	2.7	H	L																		
BH13	0.0_0.25	BH13_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	2.8	H	L																		
	0.25_0.5	BH13_0.25_0.5		4.7	M	2.7	H	L		4.8	22.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.04	22	1.7	3
	0.5_0.75	BH13_0.5_0.75	SAND (Alluvium), pale grey	4.8	M	2.7	H	L																		
	0.75_1.0	BH13_0.75_1.0		4.9	M	3.1	L	L																		
	1.0_1.25	BH13_1.0_1.25		4.7	M	2.6	H	L		5.2	7.6	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.25_1.5	BH13_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.1	L	3.0	H	L																		
BH14	0.0_0.25	BH14_0.0_0.25	Silty SAND (Topsoil), dark grey	4.6	M	2.8	M	M																		
	0.25_0.5	BH14_0.25_0.5		4.4	M	2.3	H	M		4.7	28.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.05	28	2.1	4
	0.5_0.75	BH14_0.5_0.75	SAND (Alluvium), grey	4.8	M	2.7	H	L																		
	0.75_1.0	BH14_0.75_1.0		4.7	M	3.0	M	L																		
	1.0_1.25	BH14_1.0_1.25		4.9	M	2.6	H	L																		
	1.25_1.5	BH14_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	5.1	L	1.5	H	M		4.8	30.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.05	30	2.3	4
BH15	0.0_0.25	BH15_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	2.0	H	M																		
	0.25_0.5	BH15_0.25_0.5		4.8	M	2.9	M	L		5.0	13.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.02	13	1.0	2
	0.5_0.75	BH15_0.5_0.75	SAND (Alluvium), pale grey	4.9	M	2.9	H	L																		
	0.75_1.0	BH15_0.75_1.0		4.9	M	2.8	H	L		5.5	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.0_1.25	BH15_1.0_1.25		5.0	M	2.6	H	L																		
	1.25_1.5	BH15_1.25_1.5	SAND (Alluvium), grey	4.9	M	2.5	H	L																		
BH16	0.0_0.25	BH16_0.0_0.25	Silty SAND (Topsoil), dark grey	4.9	M	2.0	H	M		4.8	23.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.04	23	1.7	3
	0.25_0.5	BH16_0.25_0.5		4.9	M	2.4	H	M																		
	0.5_0.75	BH16_0.5_0.75	SAND (Alluvium), pale brown	5.0	M	2.6	H	L		5.3	3.7	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH16_0.75_1.0		5.0	M	2.7	H	L																		
	1.0_1.25	BH16_1.0_1.25		5.0	M	2.5	H	L																		
	1.25_1.5	BH16_1.25_1.5	SAND (Alluvium), pale brown	5.0	M	2.8	H	L																		
BH17	0.0_0.25	BH17_0.0_0.25	Silty SAND (Topsoil), dark grey	4.9	M	2.0	H	M		4.5	92.0	< 0.005	< 3	n/a	n/a	n/a	< 0.02	< 10	< 0.02	< 0.02	< 0.02	1.5	0.15	92	6.9	12
	0.25_0.5	BH17_0.25_0.5		4.9	M	2.0	H	H		4.5	95.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.15	95	7.1	13
	0.5_0.75	BH17_0.5_0.75	SAND (Alluvium), pale brown	4.9	M	2.3	H	L																		
	0.75_1.0	BH17_0.75_1.0		4.6	M	2.0	H	L																		
	1.0_1.25	BH17_1.0_1.25		4.7	M	2.4	H	L																		
	1.25_1.5	BH17_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	4.7	M	2.5	H	L																		
BH18	0.0_0.25	BH18_0.0_0.25	Silty SAND (Topsoil), dark grey	4.9	M	2.4	H	L		4.8	25.0	0.01	3.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.05	29	2.2	4
	0.25_0.5	BH18_0.25_0.5		4.8	M	2.2	H	L																		
	0.5_0.75	BH18_0.5_0.75	SAND (Alluvium), pale grey	4.9	M	2.4	H	L		5.4	2.8	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	0.75_1.0	BH18_0.75_1.0		4.8	M	2.5	H	L																		
	1.0_1.25	BH18_1.0_1.25		4.7	M	2.3	H	L																		
	1.25_1.5	BH18_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	4.7	M	2.5	H	L																		
BH19	0.0_0.25	BH19_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	2.7	H	L																		
	0.25_0.5	BH19_0.25_0.5		4.8	M	2.7	H	L		4.9	18.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.03	18	1.4	3
	0.5_0.75	BH19_0.5_0.75	SAND (Alluvium), pale grey	4.6	M	2.1	H	L																		
	0.75_1.0	BH19_0.75_1.0		4.8	M	2.7	H	L																		
	1.0_1.25	BH19_1.0_1.25		4.8	M	2.6	H	L		5.6	< 2	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	< 0.02	< 10	< 1	1
	1.25_1.5	BH19_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	4.7	M	2.9	M	L																		
BH20	0.0_0.25	BH20_0.0_0.25	Silty SAND (Topsoil), dark grey	4.8	M	2.8	H	M		4.6	39.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.06	39	2.9	5
	0.25_0.5	BH20_0.25_0.5		4.9	M	2.9	H	M		4.7	35.0	< 0.005	< 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.5	0.06	35	2.6	5
	0.5_0.75	BH20_0.5_0.75	SAND (Alluvium), pale grey	4.8	M	2.6	H	L																		
	0.75_1.0	BH20_0.75_1.0		5.0	M	3.0	H	L																		
	1.0_1.25	BH20_1.0_1.25		4.9	M	3.0	M	L																		
	1.25_1.5	BH20_1.25_1.5	Silty SAND ("Coffee Rock"), dark grey	4.8	M	2.2	H	L																		

1. Actual Acid Sulfate Soil (AASS) likelihood is indicated by Low (L & no shade)($pH_F > 5$), Medium (M & yellow shade)(pH_F 5 ≤ $pH_F < 4$) and High (H & red shade)($pH_F \leq 4$).
2. Potential Acid Sulfate Soil (PASS) likelihood is indicated by Low (L & no shade)(Δ pH from pH_F to pH_{FOX} is < 2 pH units), Medium (M & yellow shade)(Δ pH from pHF to pH_{FOX} is ≥ 2 pH units OR pHFOX is <3)) and High (H & red shade)(Δ pH from pHF to pH_{FOX} is ≥ 2 pH units AND pHFOX is <3)
3. Reaction L = Low strength, M = Medium strength, H = High strength, X = Extreme strength.
4. The letter in the remark column indicates the presence of the following. O - Organic; S - Shells;iron- Iron/Iron Oxide; P - Pyrite; and C - Coral.
5. Shaded TAA & S_{CR} results are those exceeding the QASSIT action levels of 18 mol H^+/t or 0.03 %S.
6. Acid-Base Account = Total Acidity (i.e.. Potential + Actual + Retained) - Total ANC
7. Shaded Net Acidity (sulfur units) %S and Net Acidity (acidity units) /t results are those exceeding the QASSIT action levels of 0.03 %S or 18 mol H+/t
8. Required Lime Rate is calculated from the net Acid-Base Account with a factor of safety = 1.5 and bulk density of 1.8 t/m^3

APPENDIX C

ASS Soil Laboratory Testing Results

TEST REQUEST FORM

Order No.: PO001180
Job No.: J000030 TASK 12000
Job Name: SCC/SCA Expansion/Finland Road

C.O.C. No.: TR-03 Quotation No.

Sampled By: SR Contact Name: Josh Mitchell

Email Report to: [illegible]

Prior Storage: Core Lab Freezer

Borehole Number (BH#)	Sample Depth (m)		Media	No. of Bags	SAMPLE DATE		pH Field	pH ox	CRS Chromium Suite														Remarks and or Other Details
1	0	0.25	Soil	1	15/06/2017				X														
1	0.5	0.75	Soil	1	15/06/2017				X														
2	0	0.25	Soil	1	15/06/2017				X														
2	0.75	1	Soil	1	15/06/2017				X														
3	0	0.25	Soil	1	15/06/2017				X														
3	0.5	0.75	Soil	1	15/06/2017				X														
4	0.25	0.5	Soil	1	15/06/2017				X														
4	0.75	1	Soil	1	15/06/2017				X														
5	0.25	0.5	Soil	1	15/06/2017				X														
5	1	1.25	Soil	1	15/06/2017				X														
6	0	0.25	Soil	1	15/06/2017				X														
6	0.5	0.75	Soil	1	15/06/2017				X														
7	0	0.25	Soil	1	15/06/2017				X														
7	0.75	1	Soil	1	15/06/2017				X														
8	0.25	0.5	Soil	1	15/06/2017				X														
8	0.75	1	Soil	1	15/06/2017				X														
9	0.25	0.5	Soil	1	15/06/2017				X														
9	0.75	1	Soil	1	15/06/2017				X														
10	0	0.25	Soil	1	15/06/2017				X														
10	0.5	0.75	Soil	1	15/06/2017				X														
11	0.25	0.5	Soil	1	14/06/2017				X														
11	0.75	1	Soil	1	14/06/2017				X														
12	0.25	0.5	Soil	1	14/06/2017				X														
12	1	1.25	Soil	1	14/06/2017				X														
13	0.25	0.5	Soil	1	14/06/2017				X														
13	1	1.25	Soil	1	14/06/2017				X														
14	0.25	0.5	Soil	1	14/06/2017				X														
14	1.25	1.5	Soil	1	14/06/2017				X														
15	0.25	0.5	Soil	1	14/06/2017				X														
15	0.75	1	Soil	1	14/06/2017				X														
16	0	0.25	Soil	1	14/06/2017				X														
16	0.5	0.75	Soil	1	14/06/2017				X														
17	0	0.25	Soil	1	14/06/2017				X														
17	0.25	0.5	Soil	1	14/06/2017				X														
18	0	0.25	Soil	1	14/06/2017				X														
18	0.5	0.75	Soil	1	14/06/2017				X														
19	0.25	0.5	Soil	1	14/06/2017				X														
19	1	1.25	Soil	1	14/06/2017				X														
20	0	0.25	Soil	1	14/06/2017				X														
20	0.25	0.5	Soil	1	14/06/2017				X														

Checked by:
Date Sent 23/6/16

Date Received By Eurofins: 22/6/17

core

			# CON NOTES	POST CODE
E	CN	HD		MASS
AP	CR			

4pr

17.8
18.4
17.6

17.93

Sample Receipt Advice

Company name:	**Core Consultants Pty Ltd**
Contact name:	Josh Mitchell
Project name:	SCC/SCA EXPANSION/FINLAND ROAD
Project ID:	J000030
COC number:	TR_03
Turn around time:	5 Day
Date/Time received:	Jun 22, 2017 4:00 PM
Eurofins | mgt reference:	**551297**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Ryan Gilbert on Phone : or by e.mail: RyanGilbert@eurofins.com

Results will be delivered electronically via e.mail to Josh Mitchell - jmitchell@coreconsultants.com.au.

Company Name:	Core Consultants Pty Ltd	**Order No.:**	PO001180	**Received:**	Jun 22, 2017 4:00 PM
Address:	55 Kingford Smith Parade Maroochydore QLD 4558	**Report #:**	551297	**Due:**	Jun 29, 2017
		Phone:	07 5475 5900	**Priority:**	5 Day
		Fax:		**Contact Name:**	Josh Mitchell
Project Name:	SCC/SCA EXPANSION/FINLAND ROAD				
Project ID:	J000030				

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH1_0_0.25	Jun 15, 2017		Soil	B17-Jn22784	X	X
2	BH1_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22785	X	X
3	BH2_0_0.25	Jun 15, 2017		Soil	B17-Jn22786	X	X
4	BH2_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22787	X	X
5	BH3_0_0.25	Jun 15, 2017		Soil	B17-Jn22788	X	X
6	BH3_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22789	X	X
7	BH4_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22790	X	X
8	BH4_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22791	X	X
9	BH5_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22792	X	X

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	Maroochydore	**Phone:**	07 5475 5900	**Priority:**	5 Day
	QLD 4558	**Fax:**		**Contact Name:**	Josh Mitchell
Project Name:	SCC/SCA EXPANSION/FINLAND ROAD				
Project ID:	J000030				

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
10	BH5_1.0_1.25	Jun 15, 2017		Soil	B17-Jn22793	X	X
11	BH6_0_0.25	Jun 15, 2017		Soil	B17-Jn22794	X	X
12	BH6_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22795	X	X
13	BH7_0_0.25	Jun 15, 2017		Soil	B17-Jn22796	X	X
14	BH7_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22797	X	X
15	BH8_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22798	X	X
16	BH8_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22799	X	X
17	BH9_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22800	X	X
18	BH9_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22801	X	X
19	BH10_0_0.25	Jun 15, 2017		Soil	B17-Jn22802	X	X
20	BH10_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22803	X	X

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NATA # 1261 Site # 18217

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NATA # 1261 Site # 20794

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Phone : +61 8 9251 9600
NATA # 1261
Site # 18217

Company Name:	Core Consultants Pty Ltd	**Order No.:**	PO001180
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Received:	Jun 22, 2017 4:00 PM
Due:	Jun 29, 2017
Priority:	5 Day
Contact Name:	Josh Mitchell

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
21	BH11_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22804	X	X
22	BH11_0.75_1.0	Jun 14, 2017		Soil	B17-Jn22805	X	X
23	BH12_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22806	X	X
24	BH12_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22807	X	X
25	BH13_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22808	X	X
26	BH13_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22809	X	X
27	BH14_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22810	X	X

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Address:	55 Kingford Smith Parade	**Report #:**	551297	**Due:**	Jun 29, 2017
	Maroochydore	**Phone:**	07 5475 5900	**Priority:**	5 Day
	QLD 4558	**Fax:**		**Contact Name:**	Josh Mitchell
Project Name:	SCC/SCA EXPANSION/FINLAND ROAD				
Project ID:	J000030				

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
28	BH14_1.25_1.5	Jun 14, 2017		Soil	B17-Jn22811	X	X
29	BH15_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22812	X	X
30	BH15_0.75_1.0	Jun 14, 2017		Soil	B17-Jn22813	X	X
31	BH16_0_0.25	Jun 14, 2017		Soil	B17-Jn22814	X	X
32	BH16_0.5_0.75	Jun 14, 2017		Soil	B17-Jn22815	X	X
33	BH17_0_0.25	Jun 14, 2017		Soil	B17-Jn22816	X	X
34	BH17_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22817	X	X
35	BH18_0_0.25	Jun 14, 2017		Soil	B17-Jn22818	X	X
36	BH18_0.5_0.7	Jun 14, 2017		Soil	B17-Jn22819	X	X

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Site # 18217

Company Name: Core Consultants Pty Ltd
Address: 55 Kingford Smith Parade
Maroochydore
QLD 4558

Project Name: SCC/SCA EXPANSION/FINLAND ROAD
Project ID: J000030

Order No.: PO001180
Report #: 551297
Phone: 07 5475 5900
Fax:

Received: Jun 22, 2017 4:00 PM
Due: Jun 29, 2017
Priority: 5 Day
Contact Name: Josh Mitchell

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
	5						
37	BH19_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22820	X	X
38	BH19_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22821	X	X
39	BH20_0_0.25	Jun 14, 2017		Soil	B17-Jn22822	X	X
40	BH20_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22823	X	X
Test Counts						40	40

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Certificate of Analysis

Core Consultants Pty Ltd
55 Kingford Smith Parade
Maroochydore
QLD 4558

NATA Accredited
Accreditation Number 1261
Site Number 20794

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Josh Mitchell**

Report **551297-S**
Project name SCC/SCA EXPANSION/FINLAND ROAD
Project ID J000030
Received Date Jun 22, 2017

Client Sample ID			**BH1_0_0.25**	**BH1_0.5_0.75**	**BH2_0_0.25**	**BH2_0.75_1.0**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B17-Jn22784**	**B17-Jn22785**	**B17-Jn22786**	**B17-Jn22787**
Date Sampled			**Jun 15, 2017**	**Jun 15, 2017**	**Jun 15, 2017**	**Jun 15, 2017**
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	5.2	5.5	5.0	5.4
Acid trail - Titratable Actual Acidity	2	mol H+/t	7.2	2.7	13	3.9
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	13	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	65	100	63	80
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	10	8.1	13	15

Client Sample ID			BH3_0_0.25	BH3_0.5_0.75	BH4_0.25_0.5	BH4_0.75_1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22788	B17-Jn22789	B17-Jn22790	B17-Jn22791
Date Sampled			Jun 15, 2017	Jun 15, 2017	Jun 15, 2017	Jun 15, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	4.8	5.5	5.2	5.4
Acid trail - Titratable Actual Acidity	2	mol H+/t	17	< 2	5.8	4.3
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.03	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.03	< 0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	17	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	1.2	< 1	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	76	86	90	91
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	12	6.3	15	19

Client Sample ID			BH5_0.25_0.5	BH5_1.0_1.25	BH6_0_0.25	BH6_0.5_0.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22792	B17-Jn22793	B17-Jn22794	B17-Jn22795
Date Sampled			Jun 15, 2017	Jun 15, 2017	Jun 15, 2017	Jun 15, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	5.5	5.5	4.5	5.3
Acid trail - Titratable Actual Acidity	2	mol H+/t	3.1	2.5	75	5.3
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	0.12	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	0.12	< 0.02

Client Sample ID			BH5_0.25_0.5	BH5_1.0_1.25	BH6_0_0.25	BH6_0.5_0.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22792	B17-Jn22793	B17-Jn22794	B17-Jn22795
Date Sampled			Jun 15, 2017	Jun 15, 2017	Jun 15, 2017	Jun 15, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	75	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	5.6	< 1
Extraneous Material						
<2mm Fraction	0.005	g	50	85	57	51
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	9.5	13	13	7.1

Client Sample ID			BH7_0_0.25	BH7_0.75_1.0	BH8_0.25_0.5	BH8_0.75_1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22796	B17-Jn22797	B17-Jn22798	B17-Jn22799
Date Sampled			Jun 15, 2017	Jun 15, 2017	Jun 15, 2017	Jun 15, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	4.8	5.7	5.1	5.5
Acid trail - Titratable Actual Acidity	2	mol H+/t	18	< 2	8.8	< 2
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.03	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.03	< 0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	18	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	1.4	< 1	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	72	130	99	110
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	9.6	6.8	9.5	13

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Client Sample ID			BH9_0.25_0.5	BH9_0.75_1.0	BH10_0_0.25	BH10_0.5_0.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22800	B17-Jn22801	B17-Jn22802	B17-Jn22803
Date Sampled			Jun 15, 2017	Jun 15, 2017	Jun 15, 2017	Jun 15, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	5.4	5.8	5.0	5.2
Acid trail - Titratable Actual Acidity	2	mol H+/t	2.4	< 2	9.1	5.4
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	100	81	130	110
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	19	21	21	20

Client Sample ID			BH11_0.25_0.5	BH11_0.75_1.0	BH12_0.25_0.5	BH12_1.0_1.25
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22804	B17-Jn22805	B17-Jn22806	B17-Jn22807
Date Sampled			Jun 14, 2017	Jun 14, 2017	Jun 14, 2017	Jun 14, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	5.1	5.3	5.1	5.6
Acid trail - Titratable Actual Acidity	2	mol H+/t	7.8	4.4	8.7	< 2
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02

Client Sample ID			BH11_0.25_0.5	BH11_0.75_1.0	BH12_0.25_0.5	BH12_1.0_1.25
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22804	B17-Jn22805	B17-Jn22806	B17-Jn22807
Date Sampled			Jun 14, 2017	Jun 14, 2017	Jun 14, 2017	Jun 14, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	< 1	< 1
Extraneous Material						
<2mm Fraction	0.005	g	84	87	110	140
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	17	17	16	17

Client Sample ID			BH13_0.25_0.5	BH13_1.0_1.25	BH14_0.25_0.5	BH14_1.25_1.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22808	B17-Jn22809	B17-Jn22810	B17-Jn22811
Date Sampled			Jun 14, 2017	Jun 14, 2017	Jun 14, 2017	Jun 14, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	4.8	5.2	4.7	4.8
Acid trail - Titratable Actual Acidity	2	mol H+/t	22	7.6	28	30
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.04	< 0.02	0.05	0.05
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.04	< 0.02	0.05	0.05
Net Acidity (Acidity Units)	10	mol H+/t	22	< 10	28	30
Liming Rate[S01]	1	kg CaCO3/t	1.7	< 1	2.1	2.3
Extraneous Material						
<2mm Fraction	0.005	g	180	150	69	87
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	15	16	14	16

Client Sample ID			BH15_0.25_0.5	BH15_0.75_1.0	BH16_0_0.25	BH16_0.5_0.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22812	B17-Jn22813	B17-Jn22814	B17-Jn22815
Date Sampled			Jun 14, 2017	Jun 14, 2017	Jun 14, 2017	Jun 14, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	5.0	5.5	4.8	5.3
Acid trail - Titratable Actual Acidity	2	mol H+/t	13	< 2	23	3.7
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.02	< 0.02	0.04	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.02	< 0.02	0.04	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	13	< 10	23	< 10
Liming Rate[S01]	1	kg CaCO3/t	1.0	< 1	1.7	< 1
Extraneous Material						
<2mm Fraction	0.005	g	92	85	85	65
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	17	18	19	16

Client Sample ID			BH17_0_0.25	BH17_0.25_0.5	BH18_0_0.25	BH18_0.5_0.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22816	B17-Jn22817	B17-Jn22818	B17-Jn22819
Date Sampled			Jun 14, 2017	Jun 14, 2017	Jun 14, 2017	Jun 14, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	4.5	4.5	4.8	5.4
Acid trail - Titratable Actual Acidity	2	mol H+/t	92	95	25	2.8
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.15	0.15	0.04	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	3.0	< 3
Sulfur - KCl Extractable	0.02	% S	< 0.02	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	< 0.02	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	< 0.02	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	< 10	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	< 0.02	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.15	0.15	0.05	< 0.02

Client Sample ID			BH17_0_0.25	BH17_0.25_0.5	BH18_0_0.25	BH18_0.5_0.75
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22816	B17-Jn22817	B17-Jn22818	B17-Jn22819
Date Sampled			Jun 14, 2017	Jun 14, 2017	Jun 14, 2017	Jun 14, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
Net Acidity (Acidity Units)	10	mol H+/t	92	95	29	< 10
Liming Rate[S01]	1	kg CaCO3/t	6.9	7.1	2.2	< 1
Extraneous Material						
<2mm Fraction	0.005	g	68	64	94	120
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	25	22	19	16

Client Sample ID			BH19_0.25_0.5	BH19_1.0_1.25	BH20_0_0.25	BH20_0.25_0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B17-Jn22820	B17-Jn22821	B17-Jn22822	B17-Jn22823
Date Sampled			Jun 14, 2017	Jun 14, 2017	Jun 14, 2017	Jun 14, 2017
Test/Reference	LOR	Unit				
Chromium Suite						
pH-KCL	0.1	pH Units	4.9	5.6	4.6	4.7
Acid trail - Titratable Actual Acidity	2	mol H+/t	18	< 2	39	35
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	0.03	< 0.02	0.06	0.06
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.03	< 0.02	0.06	0.06
Net Acidity (Acidity Units)	10	mol H+/t	18	< 10	39	35
Liming Rate[S01]	1	kg CaCO3/t	1.4	< 1	2.9	2.6
Extraneous Material						
<2mm Fraction	0.005	g	93	120	100	98
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
% Moisture	1	%	17	18	20	17

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chromium Suite			
Chromium Suite	Brisbane	Jun 26, 2017	6 Week
- Method: LTM-GEN-7070			
Extraneous Material	Brisbane	Jun 26, 2017	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Jun 23, 2017	14 Day
- Method: LTM-GEN-7080 Moisture			

Company Name:	Core Consultants Pty Ltd	**Order No.:**	PO001180	**Received:**	Jun 22, 2017 4:00 PM
Address:	55 Kingford Smith Parade	**Report #:**	551297	**Due:**	Jun 29, 2017
	Maroochydore	**Phone:**	07 5475 5900	**Priority:**	5 Day
	QLD 4558	**Fax:**		**Contact Name:**	Josh Mitchell
Project Name:	SCC/SCA EXPANSION/FINLAND ROAD				
Project ID:	J000030				

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH1_0_0.25	Jun 15, 2017		Soil	B17-Jn22784	X	X
2	BH1_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22785	X	X
3	BH2_0_0.25	Jun 15, 2017		Soil	B17-Jn22786	X	X
4	BH2_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22787	X	X
5	BH3_0_0.25	Jun 15, 2017		Soil	B17-Jn22788	X	X
6	BH3_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22789	X	X
7	BH4_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22790	X	X
8	BH4_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22791	X	X
9	BH5_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22792	X	X

Company Name:	Core Consultants Pty Ltd	**Order No.:**	PO001180	**Received:**	Jun 22, 2017 4:00 PM
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	Maroochydore	**Phone:**	07 5475 5900	**Priority:**	5 Day
	QLD 4558	**Fax:**		**Contact Name:**	Josh Mitchell
Project Name:	SCC/SCA EXPANSION/FINLAND ROAD				
Project ID:	J000030				

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
10	BH5_1.0_1.25	Jun 15, 2017		Soil	B17-Jn22793	X	X
11	BH6_0_0.25	Jun 15, 2017		Soil	B17-Jn22794	X	X
12	BH6_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22795	X	X
13	BH7_0_0.25	Jun 15, 2017		Soil	B17-Jn22796	X	X
14	BH7_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22797	X	X
15	BH8_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22798	X	X
16	BH8_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22799	X	X
17	BH9_0.25_0.5	Jun 15, 2017		Soil	B17-Jn22800	X	X
18	BH9_0.75_1.0	Jun 15, 2017		Soil	B17-Jn22801	X	X
19	BH10_0_0.25	Jun 15, 2017		Soil	B17-Jn22802	X	X
20	BH10_0.5_0.75	Jun 15, 2017		Soil	B17-Jn22803	X	X

Company Name:	Core Consultants Pty Ltd	**Order No.:**	PO001180	**Received:**	Jun 22, 2017 4:00 PM
Address:	55 Kingford Smith Parade Maroochydore QLD 4558	**Report #:**	551297	**Due:**	Jun 29, 2017
		Phone:	07 5475 5900	**Priority:**	5 Day
		Fax:		**Contact Name:**	Josh Mitchell
Project Name:	SCC/SCA EXPANSION/FINLAND ROAD				
Project ID:	J000030				

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
21	BH11_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22804	X	X
22	BH11_0.75_1.0	Jun 14, 2017		Soil	B17-Jn22805	X	X
23	BH12_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22806	X	X
24	BH12_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22807	X	X
25	BH13_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22808	X	X
26	BH13_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22809	X	X
27	BH14_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22810	X	X

ABN– 50 005 085 521
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NATA # 1261
Site # 1254 & 14271

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Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
2/91 Leach Highway
Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 18217

Company Name: Core Consultants Pty Ltd	**Order No.:** PO001180	**Received:** Jun 22, 2017 4:00 PM	
Address: 55 Kingford Smith Parade, Maroochydore, QLD 4558	**Report #:** 551297	**Due:** Jun 29, 2017	
	Phone: 07 5475 5900	**Priority:** 5 Day	
	Fax:	**Contact Name:** Josh Mitchell	
Project Name: SCC/SCA EXPANSION/FINLAND ROAD			
Project ID: J000030		**Eurofins | mgt Analytical Services Manager : Ryan Gilbert**	

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
28	BH14_1.25_1.5	Jun 14, 2017		Soil	B17-Jn22811	X	X
29	BH15_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22812	X	X
30	BH15_0.75_1.0	Jun 14, 2017		Soil	B17-Jn22813	X	X
31	BH16_0_0.25	Jun 14, 2017		Soil	B17-Jn22814	X	X
32	BH16_0.5_0.75	Jun 14, 2017		Soil	B17-Jn22815	X	X
33	BH17_0_0.25	Jun 14, 2017		Soil	B17-Jn22816	X	X
34	BH17_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22817	X	X
35	BH18_0_0.25	Jun 14, 2017		Soil	B17-Jn22818	X	X
36	BH18_0.5_0.7	Jun 14, 2017		Soil	B17-Jn22819	X	X

Company Name: Core Consultants Pty Ltd
Address: 55 Kingford Smith Parade
Maroochydore
QLD 4558

Order No.: PO001180
Report #: 551297
Phone: 07 5475 5900
Fax:

Received: Jun 22, 2017 4:00 PM
Due: Jun 29, 2017
Priority: 5 Day
Contact Name: Josh Mitchell

Project Name: SCC/SCA EXPANSION/FINLAND ROAD
Project ID: J000030

Eurofins | mgt Analytical Services Manager : Ryan Gilbert

Sample Detail						Chromium Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 18217							
	5						
37	BH19_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22820	X	X
38	BH19_1.0_1.25	Jun 14, 2017		Soil	B17-Jn22821	X	X
39	BH20_0_0.25	Jun 14, 2017		Soil	B17-Jn22822	X	X
40	BH20_0.25_0.5	Jun 14, 2017		Soil	B17-Jn22823	X	X
Test Counts						40	40

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

ug/L: micrograms per litre

ppb: Parts per billion

org/100mL: Organisms per 100 millilitres

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/L: milligrams per litre

ppm: Parts per million

%: Percentage

NTU: Nephelometric Turbidity Units

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery									
Chromium Suite									
Chromium Reducible Sulfur			%	94			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	B17-Jn22784	CP	pH Units	5.2	5.2	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B17-Jn22784	CP	mol H+/t	7.2	7.4	3.5	30%	Pass	
sulfidic - TAA equiv. S% pyrite	B17-Jn22784	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Chromium Reducible Sulfur	B17-Jn22784	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B17-Jn22784	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
Sulfur - KCl Extractable	B17-Jn22784	CP	% S	n/a	n/a	n/a	30%	Pass	
HCl Extractable Sulfur	B17-Jn22784	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur	B17-Jn22784	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - acidity units	B17-Jn22784	CP	mol H+/t	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B17-Jn22784	CP	% S	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity (ANCbt)	B17-Jn22784	CP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	B17-Jn22784	CP	% S	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	B17-Jn22784	CP	factor	1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B17-Jn22784	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acidity (Acidity Units)	B17-Jn22784	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Liming Rate	B17-Jn22784	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B17-Jn22792	CP	%	9.5	9.3	2.0	30%	Pass	
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	B17-Jn22794	CP	pH Units	4.5	4.5	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B17-Jn22794	CP	mol H+/t	75	75	<1	30%	Pass	
sulfidic - TAA equiv. S% pyrite	B17-Jn22794	CP	% pyrite S	0.12	0.12	<1	30%	Pass	
Chromium Reducible Sulfur	B17-Jn22794	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B17-Jn22794	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
Sulfur - KCl Extractable	B17-Jn22794	CP	% S	n/a	n/a	n/a	30%	Pass	
HCl Extractable Sulfur	B17-Jn22794	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur	B17-Jn22794	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - acidity units	B17-Jn22794	CP	mol H+/t	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B17-Jn22794	CP	% S	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity (ANCbt)	B17-Jn22794	CP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	B17-Jn22794	CP	% S	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	B17-Jn22794	CP	factor	1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B17-Jn22794	CP	% S	0.12	0.12	n/a	30%	Pass	
Net Acidity (Acidity Units)	B17-Jn22794	CP	mol H+/t	75	75	n/a	30%	Pass	
Liming Rate	B17-Jn22794	CP	kg CaCO3/t	5.6	5.6	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B17-Jn22802	CP	%	21	22	3.0	30%	Pass	

eurofins | mgt

Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	B17-Jn22804	CP	pH Units	5.1	5.1	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B17-Jn22804	CP	mol H+/t	7.8	8.2	4.3	30%	Pass	
sulfidic - TAA equiv. S% pyrite	B17-Jn22804	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Chromium Reducible Sulfur	B17-Jn22804	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B17-Jn22804	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
Sulfur - KCl Extractable	B17-Jn22804	CP	% S	n/a	n/a	n/a	30%	Pass	
HCl Extractable Sulfur	B17-Jn22804	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur	B17-Jn22804	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - acidity units	B17-Jn22804	CP	mol H+/t	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B17-Jn22804	CP	% S	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity (ANCbt)	B17-Jn22804	CP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	B17-Jn22804	CP	% S	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	B17-Jn22804	CP	factor	1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B17-Jn22804	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acidity (Acidity Units)	B17-Jn22804	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Liming Rate	B17-Jn22804	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B17-Jn22812	CP	%	17	17	1.0	30%	Pass	
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	B17-Jn22814	CP	pH Units	4.8	4.8	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B17-Jn22814	CP	mol H+/t	23	22	4.7	30%	Pass	
sulfidic - TAA equiv. S% pyrite	B17-Jn22814	CP	% pyrite S	0.04	0.04	5.0	30%	Pass	
Chromium Reducible Sulfur	B17-Jn22814	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B17-Jn22814	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
Sulfur - KCl Extractable	B17-Jn22814	CP	% S	n/a	n/a	n/a	30%	Pass	
HCl Extractable Sulfur	B17-Jn22814	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur	B17-Jn22814	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - acidity units	B17-Jn22814	CP	mol H+/t	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B17-Jn22814	CP	% S	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity (ANCbt)	B17-Jn22814	CP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	B17-Jn22814	CP	% S	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	B17-Jn22814	CP	factor	1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B17-Jn22814	CP	% S	0.04	0.04	n/a	30%	Pass	
Net Acidity (Acidity Units)	B17-Jn22814	CP	mol H+/t	23	22	n/a	30%	Pass	
Liming Rate	B17-Jn22814	CP	kg CaCO3/t	1.7	1.7	5.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B17-Jn22822	CP	%	20	21	2.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised By

Ryan Gilbert	Analytical Services Manager
Bryan Wilson	Senior Analyst-Metal (QLD)
Jonathon Angell	Senior Analyst-Inorganic (QLD)

Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

CERTIFICATE OF ANALYSIS

Work Order	: **EB1713441**	Page	: 1 of 5
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: JOSH MITCHELL	Contact	: Customer Services EB
Address	: 55 Kingsford Smith Parade Maroochydore Queensland 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 5475 5900	Telephone	: +61-7-3243 7222
Project	: J000030 - Sunshine Coase Airport Expansion - Groundwater Monitoring	Date Samples Received	: 30-Jun-2017 15:20
Order number	: PO001493 TR13	Date Analysis Commenced	: 01-Jul-2017
C-O-C number	: TR13	Issue Date	: 11-Jul-2017 16:58
Sampler	: SR		
Site	: ----		
Quote number	: BNBQ/061/16		
No. of samples received	: 15		
No. of samples analysed	: 15		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Tom Maloney	Nutrients Section Supervisor	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED041G (Sulfate as SO4): Sample EB1713441_004 was diluted due to matrix interference. LOR adjusted accordingly.
- EA015H (TDS): Unable to report TDS for samples 4-7 (GW4-GW7) due to matrix interference.
- TDS by method EA-015 may bias high due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- Ionic Balance out of acceptable limits for some samples due to analytes not quantified in this report.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	GW1 - EMS	GW2	GW3	GW4	GW5
			Client sampling date / time	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]
Compound	*CAS Number*	*LOR*	*Unit*	EB1713441-001	EB1713441-002	EB1713441-003	EB1713441-004	EB1713441-005
				Result	Result	Result	Result	Result
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	412	274	499	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	45	<1	29	5
Total Alkalinity as CaCO3	----	1	mg/L	<1	45	<1	29	5
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	238	22	157	127	132
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	21	42	194	<5	79
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	83	13	112	71	32
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	3	1	4	1	6
Magnesium	7439-95-4	1	mg/L	5	5	28	5	14
Sodium	7440-23-5	1	mg/L	48	41	70	63	34
Potassium	7440-09-7	1	mg/L	<1	<1	<1	<1	2
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.23	1.41	7.25	2.92	0.47
Iron	7439-89-6	0.05	mg/L	4.45	1.21	29.9	2.18	0.56
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	2.78	2.14	7.20	2.58	2.65
Total Cations	----	0.01	meq/L	----	----	7.95	----	----
Total Cations	----	0.01	meq/L	2.65	2.24	----	3.20	2.98
Ionic Balance	----	0.01	%	----	----	4.95	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	GW6	GW7	GW8	GW9B	GW10A
			Client sampling date / time	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]
Compound	CAS Number	LOR	Unit	EB1713441-006	EB1713441-007	EB1713441-008	EB1713441-009	EB1713441-010
				Result	Result	Result	Result	Result
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	----	----	159	729	283
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	2	4	22	26	7
Total Alkalinity as CaCO3	----	1	mg/L	2	4	22	26	7
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	102	44	64	20	80
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	108	48	4	191	19
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	76	31	40	254	55
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	4	2	<1	9	2
Magnesium	7439-95-4	1	mg/L	8	6	2	64	7
Sodium	7440-23-5	1	mg/L	82	32	30	115	41
Potassium	7440-09-7	1	mg/L	2	1	1	3	3
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.28	0.10	0.22	0.37	1.79
Iron	7439-89-6	0.05	mg/L	1.84	2.44	0.56	0.07	1.09
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	4.43	1.95	1.65	11.7	2.09
Total Cations	----	0.01	meq/L	4.48	2.01	1.50	10.8	2.54
Ionic Balance	----	0.01	%	0.49	----	----	3.85	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	GW10B	GW11A	GW11B	GW12	QA1
			Client sampling date / time	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]	[29-Jun-2017]
Compound	CAS Number	LOR	Unit	EB1713441-011	EB1713441-012	EB1713441-013	EB1713441-014	EB1713441-015
				Result	Result	Result	Result	Result
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	366	247	663	308	760
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	25	1	22	14	24
Total Alkalinity as CaCO3	----	1	mg/L	25	1	22	14	24
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	20	44	20	32	15
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	28	4	176	129	191
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	112	28	215	43	257
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	4	1	8	4	9
Magnesium	7439-95-4	1	mg/L	10	2	31	24	66
Sodium	7440-23-5	1	mg/L	74	16	147	49	116
Potassium	7440-09-7	1	mg/L	1	<1	3	<1	4
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	1.32	0.24	0.65	0.45	0.38
Iron	7439-89-6	0.05	mg/L	0.72	0.36	0.09	1.73	0.07
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	4.24	0.89	10.2	4.18	11.7
Total Cations	----	0.01	meq/L	4.27	0.91	9.42	4.31	11.0
Ionic Balance	----	0.01	%	0.30	----	3.81	1.50	2.98

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB1713441**	Page	: 1 of 5
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: JOSH MITCHELL	Contact	: Customer Services EB
Address	: 55 Kingsford Smith Parade Maroochydore Queensland 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: 07 5475 5900	Telephone	: +61-7-3243 7222
Project	: J000030 - Sunshine Coase Airport Expansion - Groundwater Monitoring	Date Samples Received	: 30-Jun-2017
Order number	: PO001493 TR13	Date Analysis Commenced	: 01-Jul-2017
C-O-C number	: TR13	Issue Date	: 11-Jul-2017
Sampler	: SR		
Site	: ----		
Quote number	: BNBQ/061/16		
No. of samples received	: 15		
No. of samples analysed	: 15		

ilac-MRA NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Tom Maloney	Nutrients Section Supervisor	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 975765)									
EB1713437-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	60	79	26.8	No Limit
EB1713441-003	GW3	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	499	479	4.16	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 975767)									
EB1713441-014	GW12	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	308	330	6.80	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 975453)									
EB1713414-003	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	12	10	16.1	0% - 50%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	12	10	16.1	0% - 50%
EB1713441-001	GW1 - EMS	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.00	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 975454)									
EB1713441-011	GW10B	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	25	25	0.00	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	25	25	0.00	0% - 20%
ED038A: Acidity (QC Lot: 975944)									
EB1713402-001	Anonymous	ED038: Acidity as CaCO3	----	1	mg/L	11	11	0.00	0% - 50%
EB1713422-002	Anonymous	ED038: Acidity as CaCO3	----	1	mg/L	355	354	0.366	0% - 20%
ED038A: Acidity (QC Lot: 975945)									
EB1713441-009	GW9B	ED038: Acidity as CaCO3	----	1	mg/L	20	20	0.00	0% - 20%
EB1713454-004	Anonymous	ED038: Acidity as CaCO3	----	1	mg/L	5	5	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 974723)									
EB1713414-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	24	23	0.00	0% - 20%
EB1713441-006	GW6	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	108	113	4.53	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 974724)									
EB1713414-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	34	35	0.00	0% - 20%
EB1713441-006	GW6	ED045G: Chloride	16887-00-6	1	mg/L	76	78	2.58	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 975890)									
EB1712899-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	<1	<1	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	<1	<1	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	2	2	0.00	No Limit
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.00	No Limit
EB1713441-006	GW6	ED093F: Calcium	7440-70-2	1	mg/L	4	4	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	8	8	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	82	82	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	2	2	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 975891)									
EB1713441-006	GW6	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.28	0.28	0.00	0% - 20%
		EG020A-F: Iron	7439-89-6	0.05	mg/L	1.84	1.87	1.60	0% - 20%
EB1713287-015	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 975893)									
EB1713454-002	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EB1713456-004	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 975765)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	99.4	88	112
				<10	2000 mg/L	97.0	88	112
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 975767)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	108	88	112
				<10	2000 mg/L	105	88	112
ED037P: Alkalinity by PC Titrator (QCLot: 975453)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	103	80	120
ED037P: Alkalinity by PC Titrator (QCLot: 975454)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	104	80	120
ED038A: Acidity (QCLot: 975944)								
ED038: Acidity as CaCO3	----	----	mg/L	----	100 mg/L	100	90	110
ED038A: Acidity (QCLot: 975945)								
ED038: Acidity as CaCO3	----	----	mg/L	----	100 mg/L	100	90	110
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 974723)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	109	85	118
				<1	100 mg/L	90.7	85	118
ED045G: Chloride by Discrete Analyser (QCLot: 974724)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	102	90	115
				<1	1000 mg/L	103	90	115
ED093F: Dissolved Major Cations (QCLot: 975890)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
ED093F: Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 975891)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	102	79	118
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	92.7	82	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 975893)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	102	79	118
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	94.4	82	114

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 974723)							
EB1713414-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 974724)							
EB1713414-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	99.5	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 975891)							
EB1713414-001	Anonymous	EG020A-F: Aluminium	7429-90-5	0.5 mg/L	94.7	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 975893)							
EB1713454-001	Anonymous	EG020A-F: Aluminium	7429-90-5	0.5 mg/L	96.9	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1713441**	Page	: 1 of 6
Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: JOSH MITCHELL	Telephone	: +61-7-3243 7222
Project	: J000030 - Sunshine Coase Airport Expansion - Groundwater Monitoring	Date Samples Received	: 30-Jun-2017
Site	: ----	Issue Date	: 11-Jul-2017
Sampler	: SR	No. of samples received	: 15
Order number	: PO001493 TR13	No. of samples analysed	: 15

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB1713414--002	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Clear Plastic Bottle - Natural (EA015H)								
GW1 - EMS,	GW2,	**29-Jun-2017**	**----**	----	----	**03-Jul-2017**	06-Jul-2017	✓
GW3,	GW8,							
GW9B,	GW10A,							
GW10B,	GW11A,							
GW11B,	GW12,							
QA1								
ED037P: Alkalinity by PC Titrator								
Clear Plastic Bottle - Natural (ED037-P)								
GW1 - EMS,	GW2,	**29-Jun-2017**	**----**	----	----	**01-Jul-2017**	13-Jul-2017	✓
GW3,	GW4,							
GW5,	GW6,							
GW7,	GW8,							
GW9B,	GW10A,							
GW10B,	GW11A,							
GW11B,	GW12,							
QA1								

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
ED038A: Acidity							
Clear Plastic Bottle - Natural (ED038)							
GW1 - EMS, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	29-Jun-2017	----	----	----	03-Jul-2017	13-Jul-2017	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
GW1 - EMS, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	29-Jun-2017	----	----	----	01-Jul-2017	27-Jul-2017	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
GW1 - EMS, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	29-Jun-2017	----	----	----	01-Jul-2017	27-Jul-2017	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
GW1 - EMS, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	29-Jun-2017	----	----	----	04-Jul-2017	27-Jul-2017	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
GW1 - EMS, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9B, GW10A, GW10B, GW11A, GW11B, GW12, QA1	**29-Jun-2017**	**----**	----	----	**04-Jul-2017**	26-Dec-2017	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Acidity as Calcium Carbonate	ED038	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Alkalinity by PC Titrator	ED037-P	3	27	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	4	35	**11.43**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	3	18	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Acidity as Calcium Carbonate	ED038	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Alkalinity by PC Titrator	ED037-P	2	27	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	4	18	**22.22**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	18	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Acidity as Calcium Carbonate	ED038	WATER	In house: Referenced to APHA 2310 B Acidity is determined by titration with a standardised alkali to an end-point pH of 8.3. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)

Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EB1713441**

Client	: **CORE CONSULTANTS**	Laboratory	: Environmental Division Brisbane
Contact	: JOSH MITCHELL	Contact	: Customer Services EB
Address	: 55 Kingsford Smith Parade Maroochydore Queensland 4558	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: JMitchell@coreconsult.com.au	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: 07 5475 5900	Telephone	: +61-7-3243 7222
Facsimile	: ----	Facsimile	: +61-7-3243 7218
Project	: J000030 - Sunshine Coase Airport Expansion - Groundwater Monitoring	Page	: 1 of 2
Order number	: PO001493 TR13	Quote number	: EB2015CORECON0001 (BNBQ/061/16)
C-O-C number	: TR13	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: SR		

Dates

Date Samples Received	: 30-Jun-2017 15:20	Issue Date	: 30-Jun-2017
Client Requested Due Date	: 06-Jul-2017	Scheduled Reporting Date	: **06-Jul-2017**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 7.5°C - Ice present
Receipt Detail	: MEDIUM ESKY	No. of samples received / analysed	: 15 / 15

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EA015H Total Dissolved Solids - High Level	WATER - ED038 Default Acidity as CaCO3 only	WATER - EG020F Dissolved Metals by ICPMS	WATER - NT-01 & 02 Ca, Mg, Na, K, Cl, SO4, Alkalinity
EB1713441-001	[29-Jun-2017]	GW1 - EMS	✓	✓	✓	✓
EB1713441-002	[29-Jun-2017]	GW2	✓	✓	✓	✓
EB1713441-003	[29-Jun-2017]	GW3	✓	✓	✓	✓
EB1713441-004	[29-Jun-2017]	GW4	✓	✓	✓	✓
EB1713441-005	[29-Jun-2017]	GW5	✓	✓	✓	✓
EB1713441-006	[29-Jun-2017]	GW6	✓	✓	✓	✓
EB1713441-007	[29-Jun-2017]	GW7	✓	✓	✓	✓
EB1713441-008	[29-Jun-2017]	GW8	✓	✓	✓	✓
EB1713441-009	[29-Jun-2017]	GW9B	✓	✓	✓	✓
EB1713441-010	[29-Jun-2017]	GW10A	✓	✓	✓	✓
EB1713441-011	[29-Jun-2017]	GW10B	✓	✓	✓	✓
EB1713441-012	[29-Jun-2017]	GW11A	✓	✓	✓	✓
EB1713441-013	[29-Jun-2017]	GW11B	✓	✓	✓	✓
EB1713441-014	[29-Jun-2017]	GW12	✓	✓	✓	✓
EB1713441-015	[29-Jun-2017]	QA1	✓	✓	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ACCOUNTS DEPARTMENT

- A4 - AU Tax Invoice (INV)	Email	accounts@coreconsult.com.au
- Chain of Custody (CoC) (COC)	Email	accounts@coreconsult.com.au

JOSH MITCHELL

- *AU Certificate of Analysis - NATA (COA)	Email	JMitchell@coreconsult.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	JMitchell@coreconsult.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	JMitchell@coreconsult.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	JMitchell@coreconsult.com.au
- A4 - AU Tax Invoice (INV)	Email	JMitchell@coreconsult.com.au
- Chain of Custody (CoC) (COC)	Email	JMitchell@coreconsult.com.au
- EDI Format - XTab (XTAB)	Email	JMitchell@coreconsult.com.au

S ROUSE

- *AU Certificate of Analysis - NATA (COA)	Email	srouse@coreconsult.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	srouse@coreconsult.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	srouse@coreconsult.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	srouse@coreconsult.com.au
- Chain of Custody (CoC) (COC)	Email	srouse@coreconsult.com.au
- EDI Format - XTab (XTAB)	Email	srouse@coreconsult.com.au

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clarity • commitment • passion

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TEST REQUEST FORM

ALS Environmental
2 Byth Street, Stafford QLD 4053
Phone: 3243 7222

Order No.:	PO001493					TR 13						
Job No.:	J000030											
Job Name:	Sunshince Coast Airport Expansion - Groundwater Monitoring											
C.O.C. No.:	TR13		Quotation No.		BN/182/16 A							
Sampled By:	SR		Contact Name:		Josh Mitchell							
Email Report to:	jmitchell@coreconsultants.com.au srouse@coreconsultants.com.au											
SAMPLE ID	Media	Plastic Green	Plastic Purple	Plastic Red	Glass Purple	SAMPLE Date	Total Dissolved Solids	Dissolved Aluminum and Iron	Total Acidity	Major Cations (Ca, Mg, Na, K)	Minor Anions (Cl, SO4, Alkalinity)	Remarks and or Other Details
1 GW1 - EMS	Water	1		2		29/06/2017	X	X	X	X	X	
2 GW2	Water	1		2		29/06/2017	X	X	X	X	X	
3 GW3	Water	1		2		29/06/2017	X	X	X	X	X	
4 GW4	Water	1		2		29/06/2017	X	X	X	X	X	
5 GW5	Water	1		2		29/06/2017	X	X	X	X	X	
6 GW6	Water	1		2		29/06/2017	X	X	X	X	X	
7 GW7	Water	1		2		29/06/2017	X	X	X	X	X	
8 GW8	Water	1		2		29/06/2017	X	X	X	X	X	
9 GW9B	Water	1		2		0/01/1900	X	X	X	X	X	
10 GW10A	Water	1		2		0/01/1900	X	X	X	X	X	
11 GW10B	Water	1		2		0/01/1900	X	X	X	X	X	
12 GW11A	Water	1		2		0/01/1900	X	X	X	X	X	
13 GW11B	Water	1		2		0/01/1900	X	X	X	X	X	
14 GW12	Water	1		2		0/01/1900	X	X	X	X	X	
15 QA1	Water	1		2		0/01/1900	X	X	X	X	X	

Checked by:

Date Sent: 30-6-2017

Date Received By ALS: Greg 30/6/17 15:20

Environmental Division
Brisbane
Work Order Reference
EB1713441

Telephone : + 61-7-3243 7222

APPENDIX D
Limitations

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Sunshine Coast Airport

Sunshine Coast Airport Expansion Project (SCAEP)

Offset Area Management Plan – Corridor

252448-OAMP-02-Corridor

01 | 14 February 2018

Job number 252448

Arup
Arup Pty Ltd ABN 18 000 966 165

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ARUP

Document Verification

ARUP

Job title		Sunshine Coast Airport Expansion Project (SCAEP)			**Job number** 252448
Document title		Offset Area Management Plan – Corridor			**File reference**
Document ref		252448-OAMP-02-Corridor			
Revision	**Date**	**Filename**	252448-OAMP-02-Corridor.docx		
01	14 Feb 2018	**Description**	For SCA review		
			Prepared by	Checked by	Approved by
		Name	Caroline Tan	Matt Davis	Matt Davis
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Issue Document Verification with Document ✓

Contents

Appendices

1 Introduction

1.1 Background

The Sunshine Coast Airport Expansion Project (SCAEP) includes the construction of a new runway and associated infrastructure at the Sunshine Coast Airport (SCA), Marcoola. RWY 13/31 will be in a northwest/southeast alignment on existing SCA land that is predominantly former sugar cane farms. The new alignment will result in clearing of native vegetation communities, fauna habitat and other ecological values considered to be matters of national or State environmental significance.

As part of the offset package for SCAEP, the project has considered offsets for corridor vegetation linking areas of protected (National Park) estate, as this matter has been listed in the current Queensland offset legislation as a matter of State Environmental Significance. The development of RWY 13/31 will result in the loss of remnant vegetation connecting the northern and southern sections of Mt Coolum National Park. This will limit movement of cover-dependent, ground-dwelling fauna. Reduced movement of fauna between northern and southern sections of Mt Coolum National Park increases risk that fauna populations either side of the runway are more vulnerable to stochastic demographic and genetic processes affecting their long-term viability.

The SCAEP Biodiversity Offset Strategy has proposed that Offset Assessment Unit 7 will be revegetated to compensate for loss of ecological connectivity. A 2.5 km vegetated corridor ('the corridor') will be established around the western extent of the development within SCA land, linking the northern and southern sections of Mt Coolum National Park. It is proposed that there will be 48 ha of revegetation works which will be followed by a ten-year monitoring period.

An Offset Area Management Plan (OAMP) is required for each of the land-based offset proposals under SCAEP, specifying how the SCA would deliver the offsets as required by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) controlled action approval and conditions in the *Coordinator-General's evaluation report on the environmental impact statement* (CGER). This OAMP has been prepared to guide the implementation of ecological rehabilitation works within the corridor and fulfil the (relevant) OAMP requirements in relation to the corridor offset proposal.

1.2 Purpose and Scope

This Offset Area Management Plan (OAMP) has been prepared to address project requirements under the BOS for the preparation of an OAMP for land-based offsets delivered at that Offset Assessment Unit 7. The purpose of this OAMP is to, where relevant and appropriate:

- be consistent with the SCAEP Biodiversity Offset Strategy;
- describe the environmental matters to which the offset relates;

- outline further details as to how the offset will be undertaken and timing for delivery of the offsets (e.g. how the site will be treated, restored and managed) to achieve the required conservation outcomes;
- include particulars of the land on which the offset will be undertaken;
- identify, and contain details of, any person with an interest in the land on which the offset will be undertaken;
- describe the existing land uses on which the offset will be undertaken and any impact that land use may have on the delivery of the offset;
- state the specific measures SCA will take to secure the offset and the period over which it will take the measures;
- include the contingency measures contained in the BOS and measures to account for and address risks of the offset not achieving the conservation outcome; and
- include the governance arrangements and procedures for monitoring and auditing the offset.

This OAMP aims to provide:

- Detailed ecological restoration plans using a combination of assisted regeneration and habitat creation; and
- Maintenance and monitoring plans for vegetation condition.

This OAMP is not intended to contain detailed specifications for the implementation of on ground environmental rehabilitation works, rather it is to guide future detailed design for these works which will be included in contractual obligations to be completed by specialist contractors. The final implementation of revegetation works in this OAMP will also be subject to detailed design of other infrastructure elements that can occur within the corridor, such as drainage infrastructure, fauna-proof fencing and fauna friendly culverts.

1.3 Other relevant documents

This OAMP is intended to be read in conjunction with the following documents:

- The SCAEP Biodiversity Offset Strategy (Arup 2016) ('the BOS');
- The SCAEP Offset Delivery Plan (Arup 2017) ('the ODP');
- The SCAEP Environmental Impact Statement – Chapter B8 Terrestrial Fauna (SCA 2014) ('the EIS Fauna Chapter');
- The SCAEP Environmental Impact Statement – Chapter B7 Terrestrial Flora (Arup 2014) ('the EIS Flora Chapter');
- The SCAEP Environmental Impact Statement – Chapter B3 Geology, Soils and Groundwater (SCA 2014) ('the EIS Soils and Groundwater Chapter');
- The SCAEP Acid Frog and Eastern Ground Parrot OAMP (EcoSmart Ecology 2017); and

- The Guide to Determining Terrestrial Habitat Quality (DEHP 2014).

1.4 Offset site location and descriptors

The approximately 2.5km vegetated corridor in Offset Assessment Unit 7 will be established around the western extent of the development within SCA land, linking the northern and southern sections of Mt Coolum National Park (Figure 1). The final alignment and location of the corridor is subject to the final design of the SCAEP.

The lots that will be subject to offset works in the corridor include:

- Lot 1106 SP206556;
- Lot 51 SP298053;
- Lot 1105 SP206553; and
- Lot 54 SP298053 (Appendix A).

As shown in Figure 1, the northern boundary of the corridor runs adjacent to the Maroochy River and the western boundary runs adjacent to the Sunshine Coast Highway. The Maroochy River, mangrove vegetation communities and Casuarina forest communities are on the other side of the highway. The area south of the corridor is cleared land. The area east of the corridor comprises of existing vegetation including sections of Mt Coolum National Park and permanently cleared land that will include the new runway strip and associated infrastructure.

1.5 Land tenure summary

Table 1: Summary of land tenure to which the corridor offset applies

Lot & Plan	Tenure	Local Government Area
Lot 1106 SP206556	Freehold or in the process of being owned in freehold	Sunshine Coast Council
Lot 51 SP298053	Freehold or in the process of being owned in freehold	Sunshine Coast Council
Lot 1105 SP206553	Freehold or in the process of being owned in freehold	Sunshine Coast Council
Lot 54 SP298053	Freehold or in the process of being owned in freehold	Sunshine Coast Council

Legend

Cadastre

Indicative Offset Assessment Units

- 6
- 7
- 8
- 9
- Additional offset area 1
- Additional offset area 2

Client
Sunshine Coast Airport

Job Title
SCAEP Corridor Offset Area Management Plan

Map Title
Offset Areas at the SCA Site and Local Context

Meters
0 100 200 300 400 500 600 700 800

D1	16/03/2018	CT	MJD	MJD
Issue	Date	By	Chkd	Appd

ARUP

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Scale at A4 **1:17,000**	Map Status **Final**
Coordinate System **GDA 1994 MGA Zone 56**	
Job No **252448-00**	Map No **Figure 1**

\\global.arup.com\australasia\BNE\Projects\252000\252448-00 Biodiversity Offset Strategy\Work\Internal\Documents\Offset Area Management Plans\Corridor\Figures\Figure_1_Project_Context.mxd

2 Offset Requirements

2.1 BOS corridor connectivity requirements

The BOS has committed to a number of features and actions required to establish the corridor. These features and actions have informed the revegetation planning, particularly where there may be aircraft safety and operational constraints. However, the northern end of the new runway has since been extended and the final dimensions of the corridor will depend on the detailed design of the project.

The BOS corridor connectivity requirements included:

1. A minimum corridor width of no less than 100m.
2. Revegetation works to establish native vegetation of sufficient density to allow passage by cover-dependent fauna species. Along most of the corridor this vegetation will include native canopy tree species. However, due to aircraft safety and operational constraints, several vegetation management regimes will be required in selected locations:
    a. Regime A, which is outside the corridor area and not relevant to this OAMP.
    b. Regime B which was located either side at the northern end of the proposed runway. Vegetation in these two areas is be managed to ensure that vegetation does not exceed 6m and will exclude flowering species such as those belonging to the genus Melaleuca, Corymbia, Angophora, Lophostemon and Eucalyptus (which could attract flying-fox, risking animal strike).
    c. Regime C which was located at the northern end of the proposed runway and within the runway splay area. Vegetation here is to be maintained to an approximate height of 2m due to safety and operational requirements stipulated by the Civil Aviation Safety Authority (CASA). No flowering species (Melaleuca/Eucalyptus) will be allowed to persist in this area to reduce the risk of bird or flying-fox strike.
3. Fauna friendly culverts over major drains to promote dry passage will be required, particularly for small terrestrial vertebrates. Fauna crossings are recommended to be no less than 4 m in width and will include suitable native vegetation cover such as native grasses and low shrubs. The dual purpose crossing (i.e. fauna and vehicle maintenance crossing) will be 3 m wider than required for vehicular access to allow establishment of suitable vegetation. The safety/maintenance crossing at the northern end of the runway will include no special provision for fauna passage.
4. The BOS considered that a western perimeter drain will be a deterrent to reduce animal access onto the Sunshine Coast Motorway however the western drain is no longer in the scope of the proposal. Instead, a fauna-proof fence will be constructed along the length of the motorway/corridor.

5. Re-use larger logs and coarse woody debris from vegetation clearing works to be spread throughout the rehabilitation and revegetation zones to improve habitat elements for native fauna.
6. A temporary construction compound was proposed to be located outside the proposed ecological corridor to ensure vegetation can be established within the early stages of works.

2.2 ODP monitoring and reporting methodologies

The ODP has outlined certain monitoring and reporting methodologies to be used in the offset areas. Those relevant to the corridor are listed below:

- Monitoring of terrestrial habitat quality and data collection according to the *Guide to Determining Terrestrial Habitat Quality* (DEHP 2014);
- Weed and predatory pest monitoring measures; and
- Relevant reporting elements include an annual report for terrestrial habitat quality, initial weed survey report and reporting from weed and predatory pest monitoring.

Refer to Section 5 of the ODP for further details.

This OAMP is prepared to be consistent with the proposed monitoring and reporting methodologies above.

3 Site Background and Environmental Features

3.1 Site history and current land uses

The pre-clearing Regional Ecosystem mapping (Appendix B) indicates the majority of the corridor consisted of RE 12.2.7 - Melaleuca open woodlands on depositional plains, with RE 12.1.1 - Casuarina open forest mapped across the central part of the corridor area. The southeast part of the corridor is mapped as containing RE 12.2.12 - closed heath on seasonally waterlogged sand plains.

The regulated vegetation mapping shows there is no mapped remnant vegetation within the corridor except for a small patch of RE 12.2.7 in the northeast section (Appendix C).

A review of the site history in the EIS Flora Chapter found that vegetation clearing has occurred in the SCAEP area since European settlement for agricultural and urban development purposes. Aerial photographs obtained for the period between 1958 and 2011 show expansion of sugar cane cropping to the west of the project area, with urban development to the south and east. These land use changes have replaced areas of Melaleuca wetland, mixed open forest, heathland and marine clay pan woodlands over time. The existing SCA land is predominantly former sugar cane farms.

The vast majority of the corridor area is former agricultural land containing various stages of regrowth.

3.2 Soil and geology

The EIS Soils and Groundwater Chapter contains the details of the soil, geology and groundwater conditions at the SCA, including the following findings:

- The SCAEP area sits predominantly on a large Pleistocene coastal plain of sand and mud, and is generally low-lying with very shallow slopes;
- A layer of dense or very dense indurated sand (known locally as ‘coffee rock’) is typically present between around 0.5 m to 5 m below ground; and
- In the north-western portion of the corridor at the end of the proposed runway, there are very soft to stiff clays inferred to be of alluvial origin (‘marine’ clay) and are approximately 30 ha in surface area (Appendix D).

3.3 Vegetation descriptions

3.3.1 Existing vegetation communities

A site condition assessment by Arup ecologists in 2015 found the vegetation composition of the corridor area is primarily degraded grassland, due to the historic and current use as cane lands. The northern section has been removed from cultivation earlier and thus has some native regrowth elements including

Acacia species and *Melaleuca quinquenervia* (Broad-leaved Paperbark). Further to the south, there are still areas under cane cultivation which contain no native canopy cover. Much of the corridor area has exotic grasses, forbs and sedges as the dominant group of species. Pest plants, particularly *Baccharis halimifolia* (Groundsel Bush), were commonly present.

The existing vegetation communities in the corridor are described in Table 2 and their locations mapped in Figure 2.

Table 2: Existing vegetation communities in the corridor area

Vegetation community	**Description**
Agricultural	These areas have historically been used for cropping since the early 1960s. Used for growing sugar cane, they are largely devoid of native vegetation, with the exception of scattered *Acacia* spp. and eucalypt regrowth along road edges.
Cleared	Areas of the site that have been cleared.
Casuarina open forest	Casuarina open forest, typically RE 12.1.1. This is dominated by *Casuarina glauca*, with *Melaleuca quinquenervia* sub-dominant and occasional *Myoporum acuminatum*. Other flora species observed included a shrub layer of *Alpinia arundelliana*, *Acacia maidenii* and *Livistona decora*. *Hibbertia scandens* was occasional whilst the ground layer consisted mostly of *C. glauca* leaf litter and *Phragmites australis*.
Melaleuca open forest	Melaleuca open forest, typically RE 12.2.7. *Melaleuca quinquenervia* was the dominant canopy species, with occasional Eucalyptus robusta. A well-defined sub-canopy tree layer of *Alphitonia excelsa, Acacia leiocalyx* and *Elaeocarpus reticulatus* was also observed. Within the shrub layer was *Acacia maidenii, Melastoma malabathricum subsp. malabathricum, Leucopogon pimeleoides, Persoonia virgata, Pultenea paleacea* and *Banksia robur*. The ground layer often included *Baloskion tetraphyllum, Blechnum indicum, Sporodanthus interuptus, Empodisma minus* and *Gahnia sieberiana. Hibbertia scandens* was also common as a vine
Melaleuca / slash pine regrowth	Melaleuca / slash pine regrowth, with clumped distributions of *Melaleuca quinquenervia* and *Pinus elliotii*, both at various stages of growth. There was also the occasional *Acacia leiocalyx* and *A. cincinnata*. The ground layer was open and predominantly bare, though *Fimbristylis polytrichoides, Lindsaea incisa, Lycopodiella cernua, Imperata cylindrica* and *Andropogon virginicus* were common in parts.

Legend

Existing vegetation communities

- Agricultural
- Cleared
- Casuarina open forest
- Eucalypt regrowth
- Melaleuca low open forest
- Melaleuca open forest
- Melaleuca/slash pine regrowth

Client
Sunshine Coast Airport

Job Title
SCAEP Corridor Offset Area Management Plan

Map Title
Existing Vegetation Communities in the Corridor

Meters
0 100 200 300 400

Issue	Date	By	Chkd	Appd
D1	16/03/2018	CT	MJD	MJD

ARUP

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Scale at A4	Map Status
1:9,000	Final

Coordinate System
GDA 1994 MGA Zone 56

Job No	Map No
252448-00	Figure 2

\\global.arup.com\australasia\BNE\Projects\252000\252448-00 Biodiversity Offset Strategy\Work\Internal\Documents\Offset Area Management Plans\Corridor\Figures\Figure_2_Veg_comm.mxd

3.3.2 Flora of conservation significance

Field surveys carried out across the SCAEP area in 2012 observed two threatened plant species, *Allocasuarina emuina* (Mount Emu She-oak) and *Phaius australis* (Lesser Swamp Orchid) within the SCAEP project area. The populations of these species that were found are not relevant to the corridor offset.

3.4 Habitat context

3.4.1 Links to other local habitat

The purpose of the corridor offset is to create ecological connectivity between the northern and southern sections of the Mt Coolum National Park, and provide a corridor for fauna movement.

There is a range of remnant vegetation communities in the local area, including Mt Coolum National Park and tidal vegetation types associated with the Maroochy River such as mangroves and Casuarina forest. Fauna proof fencing and fauna crossings/culverts will be situated in the corridor area to maintain passage for fauna with neighbouring habitats, including passage under the Sunshine Coast Highway along the Marcoola Channel to habitats associated with the Maroochy River.

It is expected that the target vegetation communities will support the native fauna species found in existing vegetation of the same type.

3.4.2 Existing native fauna use

As noted in the EIS Fauna Chapter, native vertebrate fauna utilise or may utilise the corridor area despite its disturbed/modified nature, including threatened fauna species. They include:

- Vertebrates which are adapted to open habitats or grasslands and are typically very abundant (including bird species);
- Some species which may venture into disturbed habitat from adjacent remnant vegetation to forage (including bird and mammal species);
- Pest species which are more common in disturbed habitats;
- A few threatened fauna species which may be transient and occur sporadically, or may occasionally ‘spill’ into disturbed habitats from adjacent populations; and
- Birds attracted to aquatic species in nearby waterways.

Refer to the EIS Fauna Chapter for further details of the existing terrestrial fauna values within and around the SCA.

Revegetation works should occur in stages across the corridor (i.e. different areas at different days/times), so that native fauna will have time to move to adjacent habitat areas and can return to inhabit the revegetated areas.

3.4.3 Lack of existing acid frog habitat

Acid frog surveys in areas of suitable habitat at the SCA were undertaken by EcoSmart Ecology in 2010 and 2012. Wallum Rocketfrog was not recorded in the corridor area however Wallum Froglets were heard calling from the remnant Melaleuca open forest patch in the northeast area. (Refer to the Acid Frog and Eastern Ground Parrot OAMP for further details of acid frog habitat within the SCA.)

The corridor area as it currently exists seems unlikely to contain suitable habitat for acid frogs. It is unlikely to be critical to the survival of acid frog populations.

It is important to note that while some of the target vegetation communities in this OAMP can usually provide habitat for acid frog (i.e. wet heath and Melaleuca open forest), soils with high clay content such as 'marine' clay found in the north-western part of the corridor generally do not provide a suitable environment for acid frog. Construction of acid frog breeding ponds in areas with high clay content may result in the encouragement of common frog species, including some that would compete with acid frog.

For the reasons above, it is not recommended that acid frog breeding ponds be constructed in the corridor unless soil analyses demonstrate suitable soils and water conditions are present.

3.5 Cultural heritage

A search of the Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP) database on 26 October 2017 identifies the Kabi Kabi First Nation as the cultural heritage party for this area. At the time of the database request, there were no identified cultural heritage sites within the corridor area.

All parties working under this OAMP need to exercise their duty of care under the *Aboriginal Cultural Heritage Act 2003*.

There are no records of a Queensland cultural heritage site within or adjacent to the corridor area.

4 Opportunities and Constraints

4.1 Regeneration and revegetation success

The existing corridor contains some areas of resilience and regeneration capacity that are critical to the revegetation design, including remnant forest and existing natural regrowth.

The presence of 'marine' clay in the north-western part of the corridor will have a critical influence on the type of vegetation likely to be successful there. Options include Casuarina forest, mangroves and saltpan vegetation. Saltpan vegetation is selected as the target vegetation community for that area because of its naturally low structure, consistent with the BOS corridor connectivity requirements which included height requirements for the areas around the end of the new runway (Refer Section 2.1).

This OAMP has also taken into consideration the risk of bird strike for aircraft using the SCA aerodrome. This OAMP does not propose to create any vegetation communities or habitats that will increase the use of the site by larger birds such as migratory wetland species or raptors.

4.2 Soil and groundwater investigations prior to revegetation works

The final selection of target vegetation communities and their locations/extents within the corridor are subject to more detailed soil and groundwater sampling and analysis at an appropriate scale across the corridor area. The soil and groundwater resources available in the corridor will have a critical influence on revegetation success. Most plant species prefer either sandy or clay soils, and will fail if planted in the wrong environment. In addition, coffee rock can inhibit the growth of large trees, such as *Melaleuca quinquenervia* (Broad-leaved Paperbark) by limiting root development.

Given the historical use of the site, these investigations will also help to set a baseline of soil condition and composition prior to revegetation works.

Prior to commencement of revegetation works, soils are to be analysed by a NATA accredited laboratory to determine soil conditions on site, including if there are any nutrient deficiencies or soil toxicity issues present that may impact plant growth, as well as to identify whether any soil ameliorants are required to correct physical or chemical soil imbalances.

4.3 Bushfire risk management

The adjacent areas containing vegetation (e.g. Mt Coolum National Park and vegetation associated with the Maroochy River) have the potential to provide fuel for bush fires, which could threaten the corridor offset area.

An intense bush fire in the adjacent areas or within the offset area itself has the potential to result in broad-scale loss of planted and regenerating trees.

Monitoring of fire fuel loads will be an important component of the bushfire management strategy, particularly in areas directly adjacent to the offset area. If fuel loads in these areas are determined to be of a significant level, a separate fire management plan may be required to reduce the risk. Firebreaks and access tracks may be required.

4.4 Infrastructure/access

The areas within and adjacent to the corridor will contain infrastructure or access roads, such as the proposed runway and associated infrastructure, a proposed northern perimeter drain, fauna culverts/crossings and fauna proof fencing along the motorway. However, these areas will not jeopardise the delivery of the required area of the offset to meet SCA's obligation. No amendments to the offset delivery will need to be made.

4.5 Security for conservation land use

All sites subject to land-based offset works will require a mechanism to provide long term protection of the conservation land use over the offset areas.

The BOS Section 8.2 has identified two potential measures for freehold land these measures can include:

- Voluntary Declaration (VDec) under the *Vegetation Management Act 1999*; or
- A covenant under the *Land Title Act 1994* or the *Land Act 1994*.

The final mechanism will be confirmed prior to offset delivery. Refer to the BOS Section 8.2 for further details.

4.6 Contingency measures

Contingency plans have been included in the BOS Section 7 as a risk management measure in relation to Mount Emu She-oak, Wallum Sedgefrog and State-listed acid frog species. However, these conservation elements are not relevant to the corridor offset.

5 Rehabilitation Elements

This section outlines the rehabilitation objectives, treatment zones, broad rehabilitation strategy, weed management and predatory pest management

5.1 Rehabilitation objectives

The main objective is to achieve a conservation outcome by achieving a minimum 1 point condition gain in habitat quality score, as measured by the *Guide to Determining Terrestrial Habitat Quality* (DEHP 2014), compared with the impact site habitat quality score over 90% of the offset site in 20 years. The impact site habitat quality score has been assessed to be 7.

It is proposed that this will be achieved through a combination of habitat creation and modification works, as well as management of threatening processes, particularly weed species and exotic predators.

The key performance indicators across the corridor are as follows:

- Annual terrestrial habitat quality monitoring shows progress towards a score of 8 during the ten-year monitoring period.
- Planted stock meets the plant density criteria. Failed plantings are to be replaced.
- Vegetation management aims to be consistent with the BOS corridor requirements where possible and appropriate, particularly due to aircraft safety and operational constraints. Therefore, revegetation zones around the end of the new runway should:
  - Not contain vegetation that exceeds 2m; and
  - Exclude flowering species such as those belonging to the genus Melaleuca, Corymbia, Angophora, Lophostemon and Eucalyptus.
- 100% removal of environmental and declared weeds.
- No off-target damage to native plants from weed control activities.
- During the monitoring period, weed control is triggered by new outbreaks or increases in the extent of existing infestations detected during weed monitoring events.
- Erosion management activities are triggered where the subsoil and topsoil are eroded.

5.2 Rehabilitation treatment zones

The corridor has been divided into distinct Rehabilitation Treatment Zones described in Table 3 and shown in Figure 3.

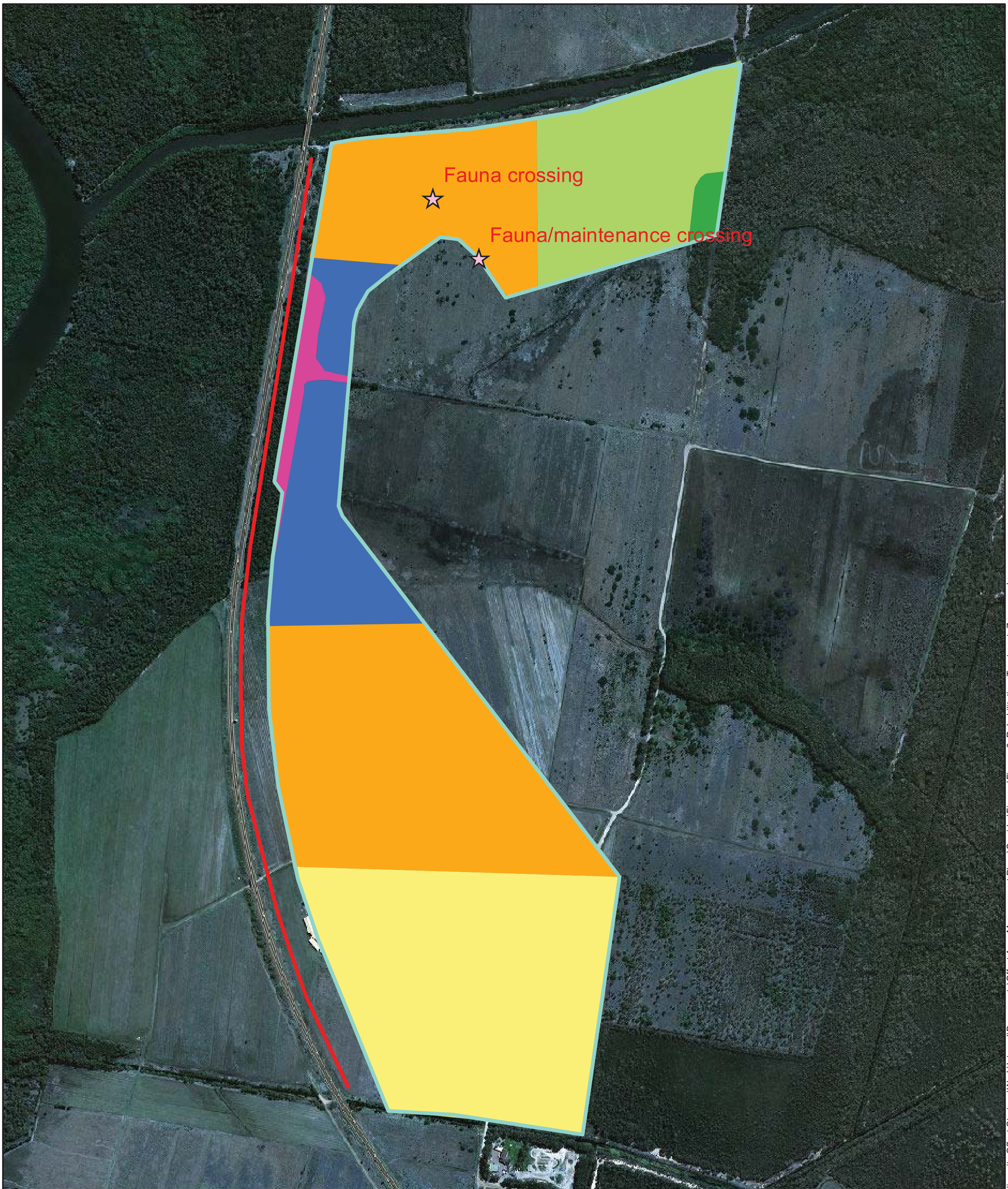
The final selection of target vegetation communities and their locations/extents in the corridor will be subject to the detailed design for the project, as well as further soil and groundwater analyses. Figure 3 also includes the indicative locations for a fauna proof fence along the motorway, as well as a fauna crossing and a dual purpose crossing at the northern perimeter drain, which are subject to the detailed design.

Table 3: Rehabilitation treatment zones and management summary

Zone	Approx. Area	Target vegetation community	Area notes/considerations	Management requirements
1	0.6 ha	*Melaleuca quinquenervia* open forest (RE 12.2.7)	Located in the northeast corner of the corridor. Comprises of a patch of mapped remnant Melaleuca open forest, which appears to be broadly contiguous with the remnant vegetation in the northern section of the Mt Coolum National Park.	• Strategy: Remnant enhancement - proposed to be largely left untouched with weed management required. • Ongoing monitoring during the maintenance period for weeds and to ensure the remnant status has been maintained.
2	9.2 ha	*Melaleuca quinquenervia* open forest (RE 12.2.7)	Located in the north section of the corridor. Comprises of vacant agricultural land that is dominated by pasture/exotic grasses with scattered regrowth in various stages, particularly an area of Melaleuca and Slash Pine regrowth in the eastern side.	• Strategy: Assisted regeneration - primary action will be weed management. • Staged treatment of pasture/exotic grasses from within nodes of native recruitment. • Removal/slashing of Slash Pine particularly in area of regrowth. • Additional reinforcement plantings may be required, e.g. to fill gaps created by weed removal. • Ongoing monitoring during the maintenance period for weeds and to ensure the target vegetation community is achieved.
3	20.1 ha	*Melaleuca quinquenervia* open forest (RE 12.2.7)	Located in the southern portion of the corridor. Comprises of vacant agricultural land that is dominated by pasture/exotic grasses with little to no Melaleuca regrowth.	• Strategy: Reconstruction of target vegetation community. • Site preparation. • Revegetation according to the reconstruction methodology. • Ongoing weed management. • Ongoing monitoring during the maintenance period for weeds and to ensure the target vegetation community is achieved.
4	27.2 ha	Closed or wet heath +/- stunted emergent shrubs/low trees (RE 12.2.12)	Located in the northern and southern parts of the corridor. Comprises of vacant agricultural land that is dominated by pasture/exotic grasses with some scattered regrowth in various stages. Is to be situated outside the extent of 'marine' clay soils present northwest of the	• Strategy: Reconstruction of target vegetation community. • Site preparation. • Revegetation according to the reconstruction methodology. • Ongoing weed management. • Initial slashing/chopping of existing trees and shrubs down to 2m in height, and ongoing slashing/chopping on a semi-regular to regular basis during the maintenance period.

Zone	Approx. Area	Target vegetation community	Area notes/considerations	Management requirements
			new runway. Height restrictions for vegetation likely to apply in this vegetation community located to the north of the new runway due to aircraft safety and operational constraints.	• Ongoing monitoring during the maintenance period for weeds and to ensure the target vegetation community is achieved.
5	7.3 ha	Saltpan or sedgeland vegetation including grassland, herbland and sedgeland on marine clay plains (RE 12.1.2) or managed native grassland/sedgeland. The distribution of these vegetation communities will depend on the local soil conditions.	Located northwest of the new runway, on the 'marine' clay soils present northwest of the new runway. Comprises of vacant agricultural land that is dominated by pasture/exotic grasses with scattered regrowth in various stages. Height restrictions for vegetation likely to apply in this area due to aircraft safety and operational constraints.	• Strategy: Reconstruction of target vegetation community. • Site preparation. • Revegetation according to the reconstruction methodology. • Ongoing weed management. • Initial slashing/chopping of existing trees and shrubs down to 2m in height, and ongoing slashing/chopping on a semi-regular to regular basis during the maintenance period. • Ongoing monitoring during the maintenance period for weeds and to ensure the target vegetation community is achieved.

Zone	Approx. Area	Target vegetation community	Area notes/considerations	Management requirements
6	1.4 ha	*Casuarina glauca* open forest to low open woodland (RE 12.1.1)	Near the central part of the corridor, mostly along the western corridor boundary. Comprises of a patch of Casuarina open forest (RE 12.1.1) which is not mapped as remnant vegetation. This patch is in close proximity to remnant vegetation of the same type on the other side of the motorway and its presence is likely influenced by areas of saltpan associated with the Maroochy River. The nearby culvert west of the corridor may be allowing tidal waters to reach this area. Height restrictions for vegetation likely to apply in this area due to aircraft safety and operational constraints.	• Strategy: Assisted regeneration - primary actions will be weed management and slashing/chopping of existing trees and shrubs down to 2m in height. • Additional reinforcement plantings may be required, e.g. to fill gaps created by weed removal. • Ongoing monitoring during the maintenance period for weeds. • Ongoing slashing/chopping on a semi-regular to regular basis during the maintenance period.
Total	**65.8 ha**			



Legend

- ☆ Fauna Crossings
- Fauna Proof Fencing
- Corridor Boundary

Rehabilitation Treatment Zones

- Zone 1 Paperbark Forest Remnant
- Zone 2 Paperbark Forest Regeneration
- Zone 3 Paperbark Forest Reconstruction
- Zone 4 Heath Reconstruction
- Zone 5 Saltpan Reconstruction
- Zone 6 Casuarina Forest Regeneration

Client
Sunshine Coast Airport

Job Title
SCAEP Corridor Offset Area Management Plan

Map Title
Rehabilitation Treatment Zones

Meters
0 100 200 300 400

Issue	Date	By	Chkd	Appd
D1	16/03/2018	CT	MJD	MJD

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Scale at A4	Map Status
1:9,236	**Final**

Coordinate System
GDA 1994 MGA Zone 56

Job No	Map No
252448-00	**Figure 3**

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5.3 Revegetation strategy

The treatment zones will be subject to a range of environmental restoration techniques during the revegetation phase, including:

- Remnant enhancement where there is existing remnant vegetation;
- Assisted regeneration of existing non-remnant vegetation communities and areas of advanced natural regrowth;
- Reconstruction of self-sustaining vegetation communities where there is no existing vegetation community and insignificant regrowth; and
- Weed and predatory pest management across the corridor site.

5.3.1 Remnant enhancement

This treatment is to be applied to intact areas of remnant native vegetation where native plants are healthy and capable of regenerating without human intervention. Installation of new plants is not considered appropriate in these areas and can be counter to the goal of restoration, however reinforcement or stabilization plantings may be beneficial under certain circumstances (e.g. areas which are actively eroding or lacking flora species or structural integrity). There may be weed impacts present.

5.3.2 Assisted regeneration

This treatment applies to areas where the native plant community is largely healthy and functioning, when native plant seed is still stored in the soil or will be able to reach the site from nearby natural areas, by birds or other animals, wind or water. Natural regeneration processes (seedling germination, root suckering, etc.) are being inhibited by biotic factors, such as weed invasion, soil compaction, cattle grazing, mechanical slashing etc.

In these sites, relatively minor human intervention, such as integrated weed management, minor amelioration of soil conditions, erection of fencing, cessation of slashing, etc. will be enough to trigger the recovery processes through natural regeneration. Intervention with patch-scale reinforcement plantings may be required.

5.3.3 Reconstruction

Applied where an area is highly degraded or altered, when the degree of disturbance has been so great and long-standing that the pre-existing native plant community cannot recover by natural means. For these areas, a greater degree of human intervention is required, such as integrated weed management, cessation of grazing and/or slashing, amelioration of soil conditions such as importation of soils, drainage works or re-shaping of the landscape.

Installation of native species to the area is required, either through planting or direct seeding. Natural regeneration and recruitment is insufficient to initially re-establish the original vegetation. Depending on the circumstances, planting of a broad diversity of species may be unnecessary and the use of pioneer plants may be sufficient to re-establish ecological processes.

5.4 Weed management

5.4.1 Weed species to be controlled

Weed management in this OAMP refers to the removal/control of all environmental and noxious weeds from all treatment zones, including any weeds listed in the following:

- Restricted Invasive Plants of Queensland (DAF 2016);
- Weeds of National Significance (WONS) in the National Weeds Strategy;
- Invasive Naturalised Plants in Southeast Queensland (Queensland Herbarium 2002);
- The Draft Sunshine Coast Council Local Government Area Biosecurity Plan; and
- Other exotic plants known to exhibit weed characteristics (i.e. invasive, competitive characteristics).

In addition, weed management across the corridor should consider invasive native species that may reduce the amenity of habitat for native fauna.

5.4.2 Initial weed survey report

The ODP (Section 5.7.4) requires that a Weed Survey Report will be completed. The report will include:

- Survey methodology, conditions and timing;
- A list of all weed species located during the survey (including exotic or natural species which might adversely affect environmental values);
- Weed survey results including a detailed geo-referenced map of existing weed infestations;
- Additional weed control actions that may be required during construction not outlined in this document; and
- Weeds of concern that should be the subject of immediate control and appropriate control methods for these weeds.

5.4.3 Required weed control measures and general methods

As required by the ODP (Section 3.6.1.3), the following relevant measures are to be undertaken:

- All vehicles and machinery entering the offset areas must be free of plant material, course debris and soil.
- All vehicles will be inspected prior to work commencing to ensure they comply with the above standards.
- Weeds will be monitored to detect new outbreaks or increases in existing infestations. New outbreaks, or increases >5% in the extent of existing infestations (based on pre-construction weed mapping), should trigger weed control.
- Weed control strategies must be undertaken according to the weed management plan and should occur within six months from weed outbreak detection (unless otherwise stipulated within the plan).

All weed management works are to follow best practice principles and be in line with the South East Queensland Ecological Restoration Framework, including general guidelines such as:

- All weed treatments must comply with specific product labels and the relevant permits, regulations, Materials Safety Data Sheets (MSDS) and council weed management protocols.
- The restoration practitioner must have the necessary qualifications and experience to carry out the work proficiently, as well as the applicable licenses (e.g. chemical operator’s license). Knowledge of weed and native plant identification and control is a fundamental requirement.
- Only herbicides suitable for use near water bodies are to be used near water bodies, in accordance with the instructions.
- Herbicide sprays should be used in non-windy conditions only to prevent off-target damage to native plants.
- Controlling erosion and sedimentation that could occur from the weed control should be considered throughout the planning and implementation stages.

5.4.4 Weed hygiene

Many weed species have physical characteristics that allow their seeds and other reproductive parts to be easily spread over long distances. Whenever people or animals move through weed-infested areas, weeds may be spread to new areas.

Steps and procedures to prevent weed spread include:

- As required in the ODP, all vehicles and machinery entering the offset areas must be free of plant material, course debris and soil. All vehicles will be inspected prior to work commencing to ensure they comply with these standards.

- Clean-down procedures for all vehicles, tools, boots and other equipment when leaving weed-infested areas, such as those in the *Queensland Checklist for Clean-Down Procedures* (DAF 2014).
- After removal of weeds from the site, use weed disposal practices recommended by authorities (e.g. transporting it safely to a waste disposal facility or burn it, bury it or add it to onsite mulching). Never dump weed waste in bush or park land.
- Keeping to roads and pathways wherever possible when traversing the site.

5.4.5 Weed management schedule

Maintenance frequency shall be 12 maintenance rotations for Years 1 and 2 (i.e. every month), 8 rotations for Years 3 and 4, and 6 maintenance rotations for years 5-10.

5.5 Assisted Regeneration

5.5.1 General methods

The large majority of revegetation will occur through natural recruitment, which is to be managed to achieve the regeneration of the target vegetation community.

It is expected that the general techniques will follow the principals of:

7. Identifying nodes of resilience;
8. Working to strengthen identified nodes and protect/encourage all existing and naturally regenerating species; and
9. Working outwards from nodes of resilience to increase their size and gradually connect to other nodes.

The assisted regeneration works are to follow best practice principles and be in line with the South East Queensland Ecological Restoration Framework.

It is likely that the most significant impediments to natural regeneration on the site are competition from weeds and limitations of soils resources (e.g. topsoil condition, soil moisture levels and seed sources). Weed management is discussed in Section 5.4 above. Soil and groundwater investigations prior to the revegetation works are discussed in Section 4.2 above.

5.5.2 Reinforcement plantings

The large majority of revegetation in assisted regeneration zones should occur through natural recruitment. Weed management is the primary action and the native regrowth is to be managed to achieve the target vegetation community. However, it is also expected that the Contractor will identify areas that may benefit from patch-scale reinforcement plantings and adapt the management techniques accordingly.

Intervention criteria are suggested below, however the areas that will have planting activities are to be based on the on-site assessment by the Contractor (and considering the regional ecosystem to be established):

- Where natural recruitment in assisted regeneration zones is below 3 – 5 plants per 10 square metres; and
- Where remnant vegetation areas are actively eroding or lacking flora species or structural integrity.

Plant species are to be selected from the species palettes in Appendix E, and should be species suitable for the in situ soil and drainage conditions.

5.6 Reconstruction

5.6.1 Reconstruction methodology

Zones for vegetation community reconstruction have been sited within the parts of the corridor that are generally composed of pasture/exotic grasses and do not have existing vegetation communities or significant regrowth. Also, areas immediately adjacent to the end of the runway have been sited for reconstruction of vegetation communities with naturally low structure (i.e. sedgeland and wet or closed heath).

Reconstruction is generally to occur as follows:

- Site preparation for planting of tubestock.
- Systematic control of existing pasture/exotic grass and herbaceous weeds by application of herbicide in a 1m x 1m ‘spot spray’ in a 2m grid. Allow 2-3 weeks after weed treatment before planting commences. Ongoing weed control across the site, but particularly around planted tubestock, would still be required to manage weed cover and maximise plant growth during the plant establishment and monitoring periods.
- Planting and watering as required below.
- Installation of weed mats, mulch and tree guards as required below.
- Follow-up watering if needed.

Planting should be undertaken in 2 distinct stages:

- Stage 1 involves the planting of pioneer and fast-growing climax phase species. This can commence immediately following initial site preparation.
- Stage 2 involves the planting of successional species and slow growing climax phase species. This can commence approximately 12 months after Stage 1 planting or once a canopy is established. Thinning of some of the pioneer species may be necessary during successional planting works.

Appendix E contains the Stage 1 and 2 species palettes for the target vegetation communities.

5.6.2 Site preparation

Cultivation of soils may be undertaken by preparing individual tubestock locations for planting. Site preparation may include strip or spot herbicide applications, manual removal and pasture slashing activities to maximise the growth potential from planted tubestock.

In addition, soil and groundwater investigations prior to the revegetation works may identify soil ameliorants required to correct physical or chemical soil imbalances. The findings of these investigations must be taken into consideration for site preparation.

5.6.3 Planting specifications

5.6.3.1 Tubestock requirements

As a minimum, all tubestock are required to:

- Be of local provenance;
- Have a significantly established root system;
- Be healthy and display signs of active growth;
- Not display signs if 'yellowing', leaf or stem damage, disease, root curling or restriction related to being 'pot bound';
- Be free of weeds in the container;
- Be a minimum of 25 cm tall for 50 mm tubestock; and
- Be sun hardened.

Plants that do not meet these minimum requirements will be rejected and replaced at the Contractor's expense.

Not all species may be commercially available at the desired time of planting. Once plants have been sourced and availability confirmed, the Contractor is to submit the list and numbers of species available to SCA for approval.

5.6.3.2 Planting and watering

Planting and watering are to occur as follows:

- Planting must not occur unless soil moisture is adequate;
- All stock must be watered immediately prior to planting;
- All planting holes are to be pre-watered prior to installation of tubestock;
- Apply an initial establishment watering;
- Maximum of 2 follow-up watering events in the first 6 weeks 9depending upon weather conditions, species requirements, etc.); and
- Beyond 6 weeks no further watering is anticipated.

Planting should not occur in unsuitable weather conditions such as extreme heat, extreme cold, extreme wet (flooding or saturated soils) or in windy weather, where possible.

5.6.3.3 Mulch

All plants are to have a 350mm x 350mm coir fibre mat with a single fastening pin installed. Organic mulch (e.g. weed free sugarcane mulch) is to be laid over the coir mat to a depth of 100 mm.

5.6.3.4 Specific treatments/fertilisation

Soil investigations prior to revegetation works will determine the baseline soil conditions on site and identify whether soil ameliorants/fertilisers or soil top dressing will be required for the successful establishment of plants.

5.6.3.5 Tree guards

A corflute tree guard (280mm x 250mm x 600mm) is to be installed with each plant with the use of hardwood timber stakes with minimum dimensions of 23mm x 13mm x 900mm. All guards and stakes remain property of SCC at time of decommissioning.

5.6.3.6 Additional tubestock protection

The contractor is responsible for monitoring of tubestock during the establishment phase and where excessive browsing of tubestock by fauna is observed, additional protection such as applications of ‘Deter’ may be required and any plants that have been destroyed are to be replaced.

5.6.4 Performance criteria

Appendix F contains the performance criteria for native vegetation growth. These performance criteria do not apply to the revegetation zone containing remnant vegetation. Activities to be undertaken in the remnant zone as outlined in Table 3 of the OAMP will be to maintain remnant status.

Data collection for the annual terrestrial habitat monitoring will include the data needed to determine whether the performance criteria are being met.

6 Ten Year Maintenance and Monitoring Program

6.1 Maintenance strategy

The key tasks for the ten year monitoring period following the revegetation works will include:

- Maintaining the revegetation zones (replacement plantings, removal of tubestock protection and slashing);
- Habitat quality monitoring;
- Weed monitoring;
- Predatory pest monitoring;
- Erosion management;
- Fire management; and
- Site maintenance activities.

Table 4 details the tasks, time frames and proposed actions for the offset area in the context of the proposed rehabilitation works.

Table 4: Maintenance and monitoring activity schedule

Task	Timeframe/Frequency	Activities
Maintain revegetation zones	1 month after initial installation, every 3 months after initial installation for first 2 years, every 6 months in the following 2 years and every 12 months for the balance of the monitoring period.	All plantings should be assessed to determine survival rate and replaced as required. Tubestock protection also to be removed as required.
	Regular or semi-regular basis as required.	Slashing of trees and shrubs to avoid exceeding height restrictions in the zones where they apply.
Habitat quality monitoring	Annually.	Monitoring and reporting as outlined in Section 6.2.1 below.
Weed management	Biannually for 24 months following plant establishment. Annually for the balance of the monitoring period.	Weed monitoring and reporting as outlined in Section 6.2.2 below. Weed control shall be triggered by new outbreaks or increases in the extent of existing infestations detected during weed monitoring events.
Predatory pest monitoring	Opportunistic basis.	Monitoring and reporting as outlined in Section 6.2.3 below.
Erosion management	As required.	Where subsoil and topsoil is eroded, the Contractor will repair and re-ameliorate subsoil, re-apply topsoil and reinstall vegetation treatment.
Fire management	As required.	Fire regime requirements as outlined in Section 6.3 below

Task	Timeframe/Frequency	Activities
Site maintenance	As required.	Removal of all anthropogenic rubbish observed during revegetation works and monitoring events. Contractors will report all instances of illegal dumping, fires, camping, fence damage or vandalism to the SCC Project Officer as soon as practicable (and include photos).

6.2 Monitoring and reporting

6.2.1 Terrestrial habitat quality

The main objective is to achieve a conservation outcome by achieving a minimum 1 point condition gain in habitat quality score, as measured by the Guide to *Determining Terrestrial Habitat Quality* (DEHP 2014), compared with the impact site habitat quality score over 90% of the offset site in 20 years. The impact site habitat quality score has been assessed to be 7.

The objective of the terrestrial habitat quality monitoring is to assess the progress of the site towards achieving a habitat quality score of 8 within 20 years.

6.2.1.1 Methodology

The relevant key indicators for determining habitat quality in the corridor are:

- Site condition – a general condition assessment of vegetation compared to a benchmark.
- Site context – an analysis of the site in relation to the surrounding environment.

The methodology for collecting data on the overall habitat quality of the corridor will continue to apply the *Guide to Determining Terrestrial Habitat Quality* (DEHP 2014). It will generally be as follows:

- The habitat quality of the corridor is to be monitored at two permanent monitoring transects. The locations of these transects have been established during the Site Condition Assessment performed by Arup in 2015. The details of the assessment for the corridor including location coordinates are contained in the habitat quality scoring sheet (Appendix G).
- One of these transects is situated where data was collected to inform the existing habitat quality score derived to assess the size and scale of this offset package. The second transect is situated in an area of similar vegetation condition and habitat structure.
- All field data will be collected in accordance with the procedures described in the Site Condition Assessment and Site Context Assessment components of the *Guide to Determining Terrestrial Habitat Quality*.
- All field data will be collected and entered into the relevant datasheets, and compared with the benchmark values for the targeted Regional Ecosystems (available from the Department of Environment and Heritage Protection) to

obtain an overall habitat quality score. A reference site is to be used where benchmark values do not exist for a regional ecosystem.

These monitoring events will be completed annually.

6.2.1.2 Reporting

A short report presenting the results of each year's monitoring event will be prepared, including a brief commentary how the works are contributing to the required conservation outcome of a demonstrated gain in habitat quality value.

The reports are to include:

- The raw data of the data collected in the Site Condition Assessment transect;
- Completed Site Context Assessment data with any supporting GIS maps;
- Completed habitat quality score metric;
- Photographs taken at the centre point facing north, south, east and west;
- A description of any threats or disturbances observed;
- Recommendations for any corrective actions to be applied; and
- An assessment or comment on the success of any corrective actions recommended during the previous year's monitoring.

6.2.2 Weed monitoring

Reporting from biannual targeted weed surveys is to continue for 24 months following plant establishment. Survey results will be compared with the baseline weed conditions found in the initial weed survey report.

In subsequent years, weed monitoring need not be as vigorous and only low-level weed surveillance would be required, i.e. annual targeted weed surveys.

The report need only be in the form of a short memo/report and should include:

- Survey methods and results;
- Clear documentation of deviation from the pre-construction weed map/data; and
- Clearly indication of whether further weed control actions are necessary.

6.2.3 Predatory pest monitoring

Incursions by feral cats, foxes and dogs are likely to be limited by the high chain-wire fence surrounding the SCA. As this fence is frequently checked for structural integrity, intensive monitoring of large mammalian predators is considered unnecessary.

Monitoring for the presence of feral cats, foxes and dogs (including scats and tracks) will be conducted in the corridor through:

- Opportunistic observations during all other monitoring activities; and
- The maintenance of a pest register to document sightings of cats, foxes or dogs by Airport ground staff at the SCA.

6.3 Fire management

The fire management requirements for the existing or target vegetation communities are outlined in Table 5. They are based on the *Regional Ecosystem Fire Guidelines* (Queensland Herbarium 2016), which are generic guidelines and additional considerations may include:

- Local conditions, e.g. weather, landforms, infrastructure, and safety of animals and people;
- Accommodating fire-enhanced recruitment of many plant species;
- The composition of the ecosystems' understorey and its response to fire;
- Weed infestations that need to be controlled; and
- Extreme events or recent history such as droughts, cyclones or extra wet conditions may also alter the structure of the vegetation and require fire regimes that vary from the recommended 'typical' fire regimes.

Table 5: Fire regime requirements for each target vegetation community

Melaleuca Open Forest (RE 12.2.7)
SEASON: Late summer to mid-winter (after rain).
INTENSITY: Planned and occasional unplanned burns (typically of higher intensity) influence the ecology of melaleuca ecosystems.
INTERVAL: Heath 8-12 years, Sedge 12-20 years, Mixed grass/shrub 6-20 years.
STRATEGY: Aim for a 25-70% burn mosaic (in association with surrounding ecosystems, as melaleuca ecosystems often just occur in patches or along natural drainage lines). Fires may, depending on the conditions and type of vegetation, burn areas larger than just the melaleuca ecosystem. Ensure secure boundaries from non fire-regime adapted ecosystems, particularly foredune and beach ridge communities. Consider the needs of melaleuca ecosystems based on understorey (i.e., heath dominated, sedge dominated or mixed grass/shrub) when planning burns. High soil moisture (or presence of water on the ground) is required, as avoidance of peat-type fires must be maintained.
ISSUES: Fire regimes for melaleuca ecosystems require further fire research. Melaleuca forests are fire-adapted, but too high an intensity or frequent fire will slow or prevent regeneration and lead to lower species richness (since these communities contain numerous obligate seed regenerating species that require sufficient fire intervals to produce seed). High intensity fires may kill trees and lead to whipstick regeneration. Too frequent fire may result in a net loss of nutrients over time from an already nutrient poor system. Fire associations are significantly influenced by understorey composition. Melaleuca communities with a heath understorey should burn in a similar way to coastal heath (8-12 years). Sedge understorey communities will burn in association with the surrounding ecosystems (so will often burn with them but sometimes not, such that these communities have a slightly less fire frequency). Mixed understorey communities burn in a similar way to dry sclerophyll, in association with the surrounding dry sclerophyll, though somewhat less frequently due to the additional moisture present in melaleuca communities.

Closed or Wet Heath (RE 12.2.12)
SEASON: Late summer to winter.
INTENSITY: Moderate (to high; due to the inherent characteristics of highly flammable vegetation).
INTERVAL: 8-20 years.
STRATEGY: Aim for a burn mosaic of 40-80%. Ensure planned burn conditions are conducive to maintaining integrity of the landscape (i.e., use good soil moisture, recent rainfall and standing water on the ground).
ISSUES: Intervals at the upper end (12-20 years) of the recommended regime may be desirable to counteract detrimental impacts of a high intensity fire over 100% of landscape. This vegetation often contains obligate seed regenerating species and as such, the application of frequent fire may reduce species richness if the intervals between fire are not sufficient for plants to produce seed.

***Casuarina glauca* open forest to low open woodland (RE 12.1.1)**
SEASON: Early winter or storm burning seasons.
INTENSITY: Low to moderate.
INTERVAL: Aim for a 6-7 year minimum threshold at a broad scale planning level.
STRATEGY: Aim to retain at least 25-50% unburnt in any given year. This RE needs disturbance to maintain structure. Use fire to reduce opportunistic native (Allocasuarina spp.) or weed species dominance. Active fire management is required to reduce the accumulation of a significant dry fuel layer. Burns planned in surrounding REs should account for the disturbance requirements of this fringing vegetation.
ISSUES: The fire ecology of this regional ecosystem is poorly known. Monitoring the impact of fire and recovery of the ecosystem's component species is highly desirable. A long fire interval could increase fire intensity when fire occurs, thus detrimentally affecting the tree layer. Recovery should be relatively quick (approximately 10 years to a woodland/open forest community). A 'grassy' ecosystem might be lost if fire is excluded or too frequent (<2 years). Signs of problems in this community might include the regeneration of 'whipstick' communities and/or the presence of weeds (such as lantana). Fire exclusion and buffering from fire is not necessary. Where obligate seeding allocasuarinas are present in the under- and mid-storeys, fires causing 100% leaf scorch will kill these trees; therefore fires of this intensity should be avoided. A seven year minimum fire interval is required for obligate seeding allocasuarinas and casuarinas.

Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains (RE 12.1.2)
STRATEGY: Do not burn deliberately. No fire management required. Largely non-flammable vegetation.

It is recommended that fire management within treatment zones for assisted regeneration and reconstruction be excluded for the maintenance period to allow sufficient time for natural regeneration of canopy and shrubs to occur.

7 Adaptive Management

The contractor must be committed to adaptively manage the site. This includes adapting conservation and land management practices in response to results from the monitoring program and to unforeseen or unplanned management threats and issues, as well as to reflect advances in ecological research and land management technologies. It is expected that in instances where the contractor observes vacancies within revegetation areas (e.g. due to weed control, previously unobserved vacancies or canopy gaps created from tree fall, etc.), reinforcement plantings will occur to speed up the ecological succession process.

8 References

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Department of Agriculture and Fisheries ('DAF') (2016) Restricted invasive plants of Queensland. Queensland Government, Brisbane.

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Queensland Herbarium (2002) Invasive Naturalised Plants in Southeast Queensland, ranked list. Queensland Environmental Protection Agency, Queensland Government, Brisbane.

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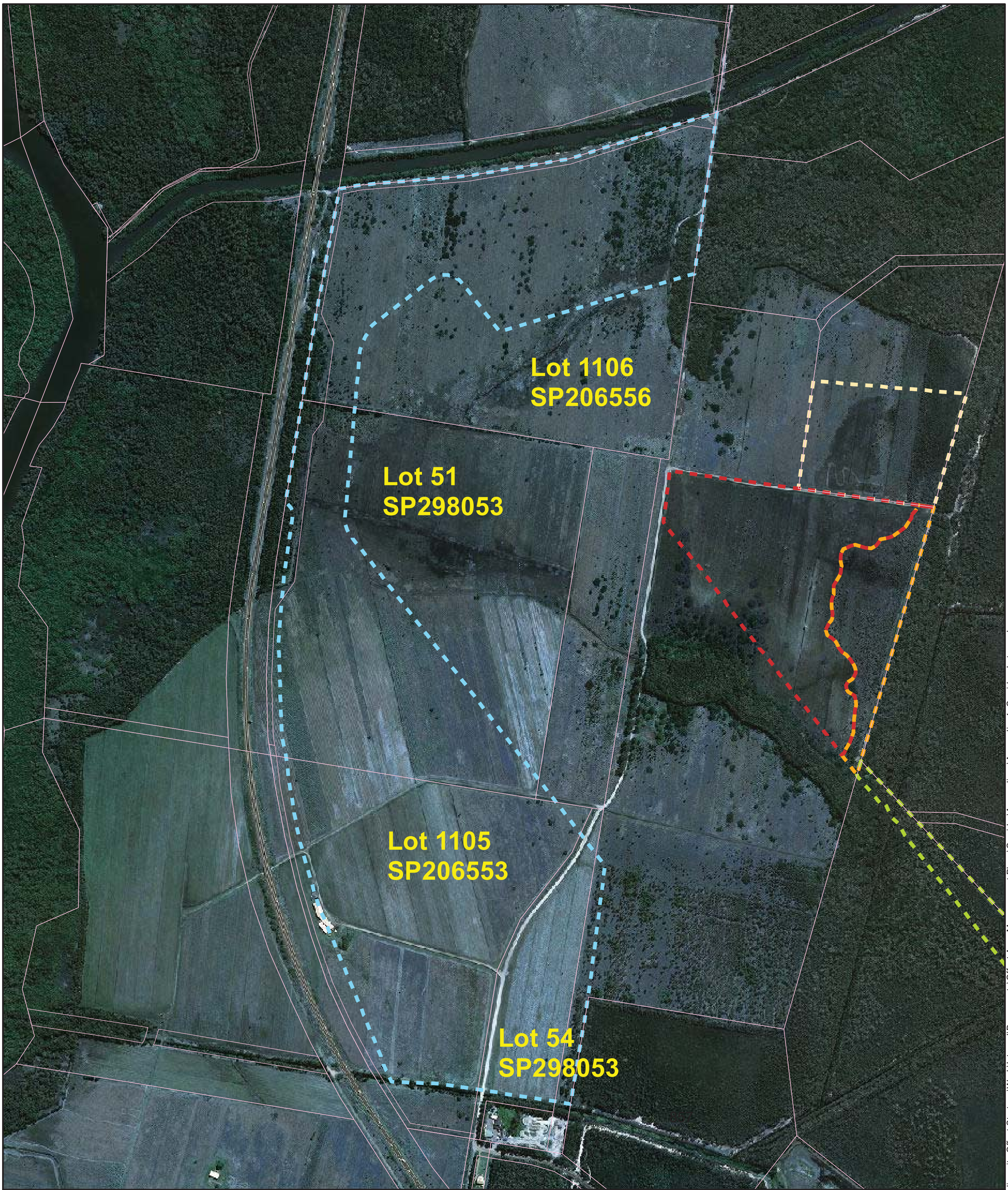
Sunshine Coast Airport ('SCA') (2014) EIS - Volume B: Airport and Surrounds, Chapter B3 – Geology, Soils and Groundwater. Accessed online at 5 November 2017 < https://www.statedevelopment.qld.gov.au/assessments-and-approvals/sca-expansion-project-eis-documents.html>.

Sunshine Coast Airport ('SCA') (2014) EIS - Volume B: Airport and Surrounds, Chapter B7 - Terrestrial Flora. Accessed online at 5 November 2017 < https://www.statedevelopment.qld.gov.au/assessments-and-approvals/sca-expansion-project-eis-documents.html>.

Sunshine Coast Airport ('SCA') (2014) EIS - Volume B: Airport and Surrounds, Chapter B8 - Terrestrial Fauna. Accessed online at 5 November 2017 < https://www.statedevelopment.qld.gov.au/assessments-and-approvals/sca-expansion-project-eis-documents.html>.

Appendix A

Corridor Lot and Plan Numbers



Legend

Cadastre

Indicative Offset Assessment Units

- 6
- 7
- 8
- 9
- Additional offset area 1
- Additional offset area 2

Client
Sunshine Coast Airport

Job Title
Biodiversity Offset Strategy - Corridor

Map Title
Corridor Lot and Plan

Meters
0 100 200 300 400 500

D1	13/03/2018	MTM	RM	EP
Issue	Date	By	Chkd	Appd

ARUP

Level 4, 108 Wickham Street
Fortitude Valley, QLD 4006
Tel +61 (7)3023 6000 Fax +61 (7)3023 6023
www.arup.com

Scale at A4	Map Status
1:10,000	**Final**

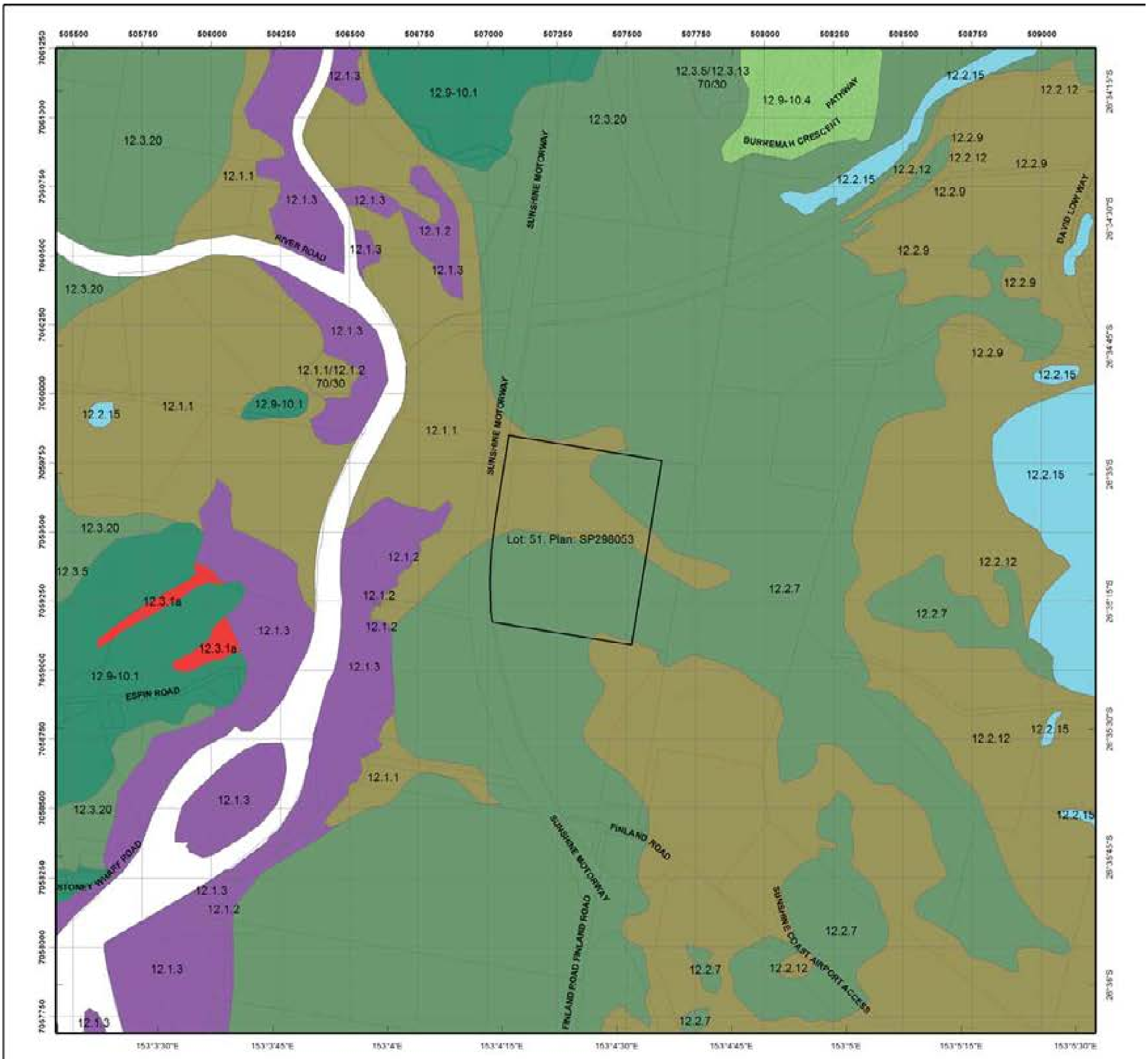
Coordinate System
GDA 1994 MGA Zone 56

Job No	Map No
252448-00	**Appendix 1**

\\global.arup.com\australasia\BNE\Projects\252000\252448-00 Biodiversity Offset Strategy\Work\Internal\Documents\Offset Area Management Plans\Corridor\Appendices\Appendix_1_Corridor_Lots.mxd

Appendix B

Pre-Clearing Vegetation Map



Pre-clearing Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

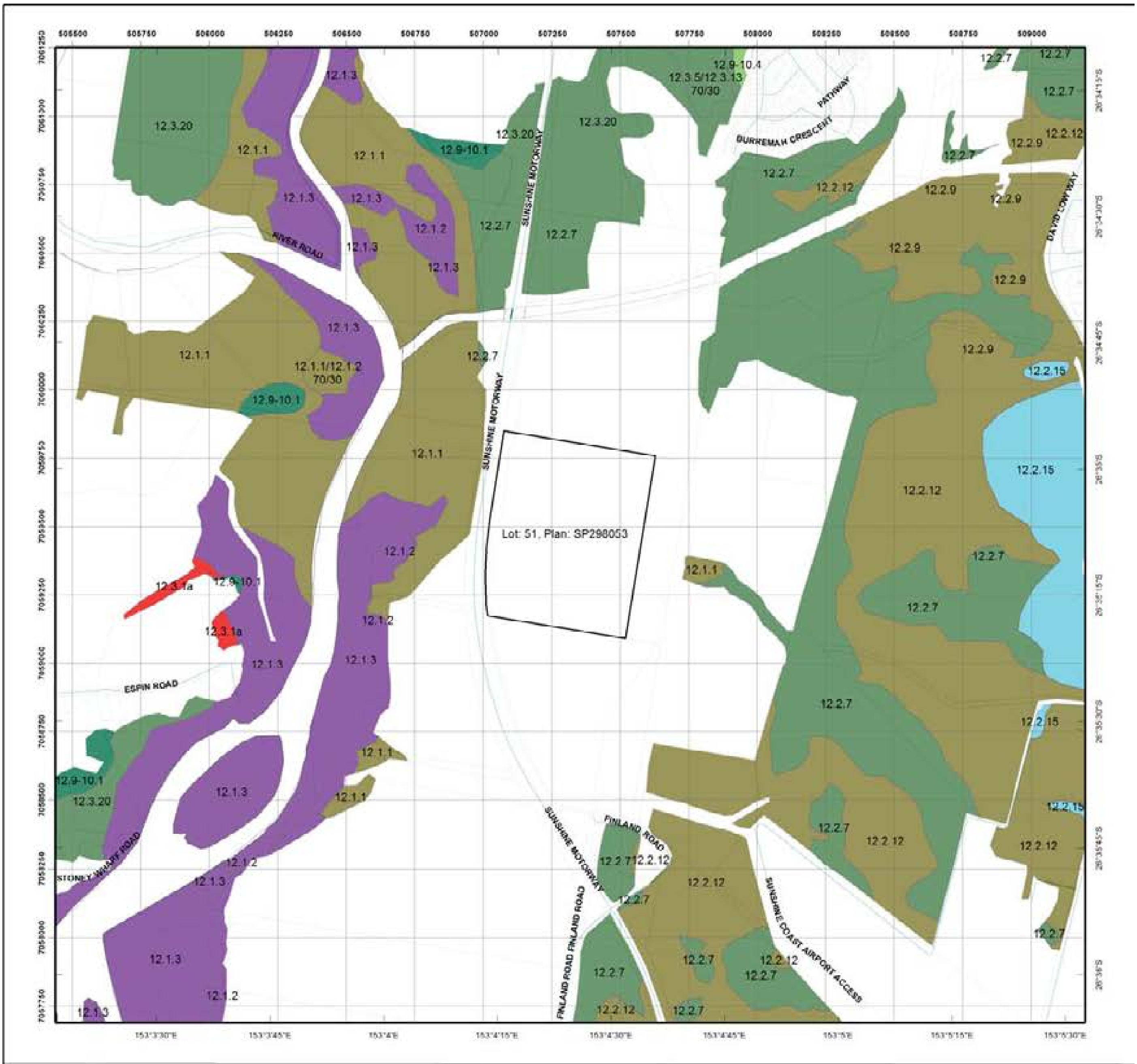
- Lot and Plan
- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
- 3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Water
- Cadastral Boundaries

N

0 0.2 0.4 0.6 0.8 km

This product is projected into GDA 1994 MGA Zone 56

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

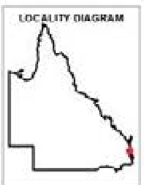


Remnant 2015 Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups

BVG5M Description (BVG1M codes)

- Lot and Plan
- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
- 3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Non-remnant vegetation, cultivated or built environment
- Water
- Cadastral Boundaries



N

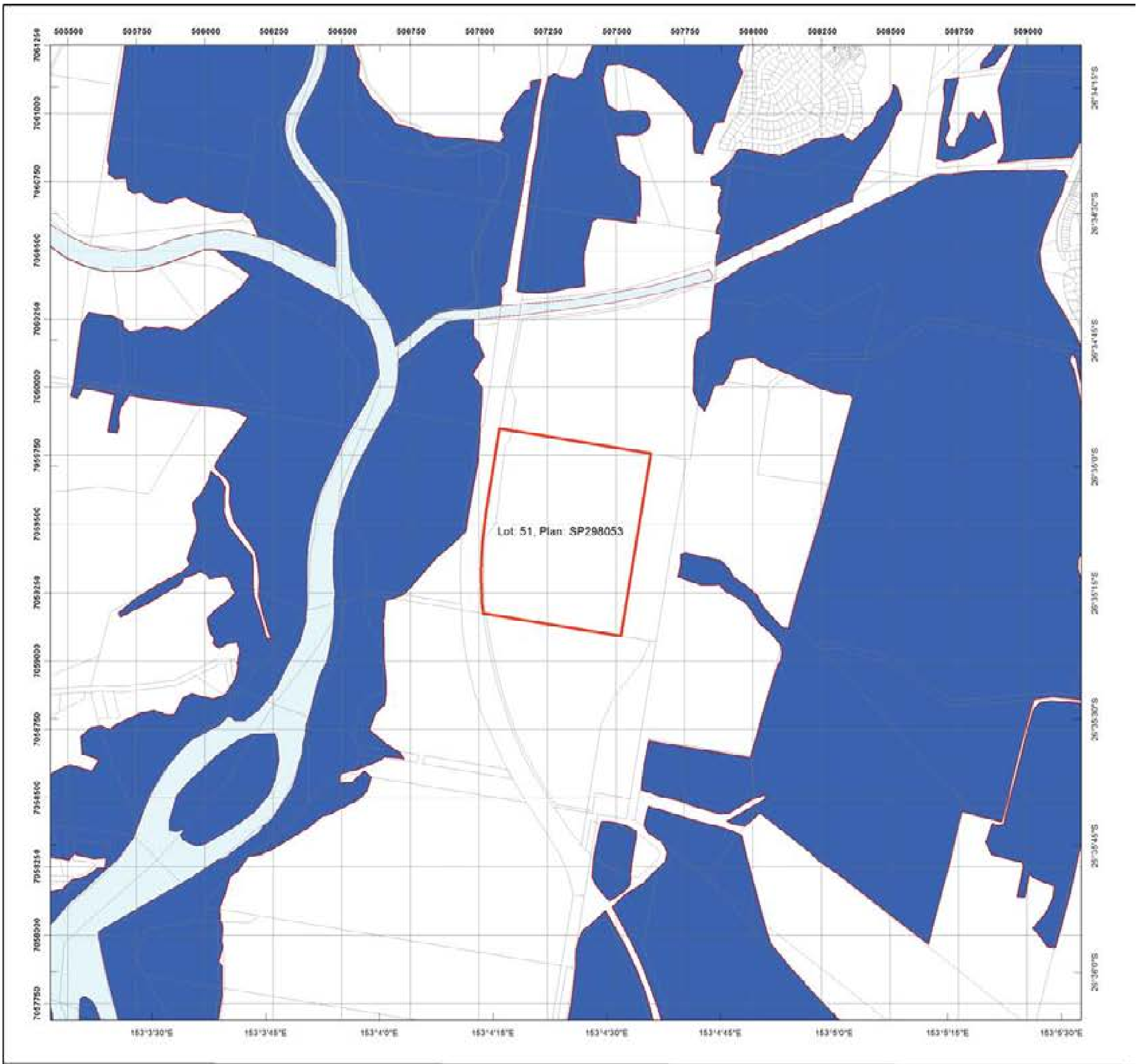
0 0.2 0.4 0.6 0.8 km

This product is projected into GDA 1994 MGA Zone 56

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.
Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Non-remnant vegetation includes regrowth and disturbed native vegetation.

Appendix C

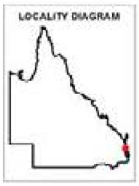
Regulated Vegetation Map



Regulated Vegetation Management Map

Legend

- Lot and Plan
- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Area not categorised
- Cadastral line
  Property boundaries shown are provided as a locational aid only



N

0 200 400 600 800 1,000 m

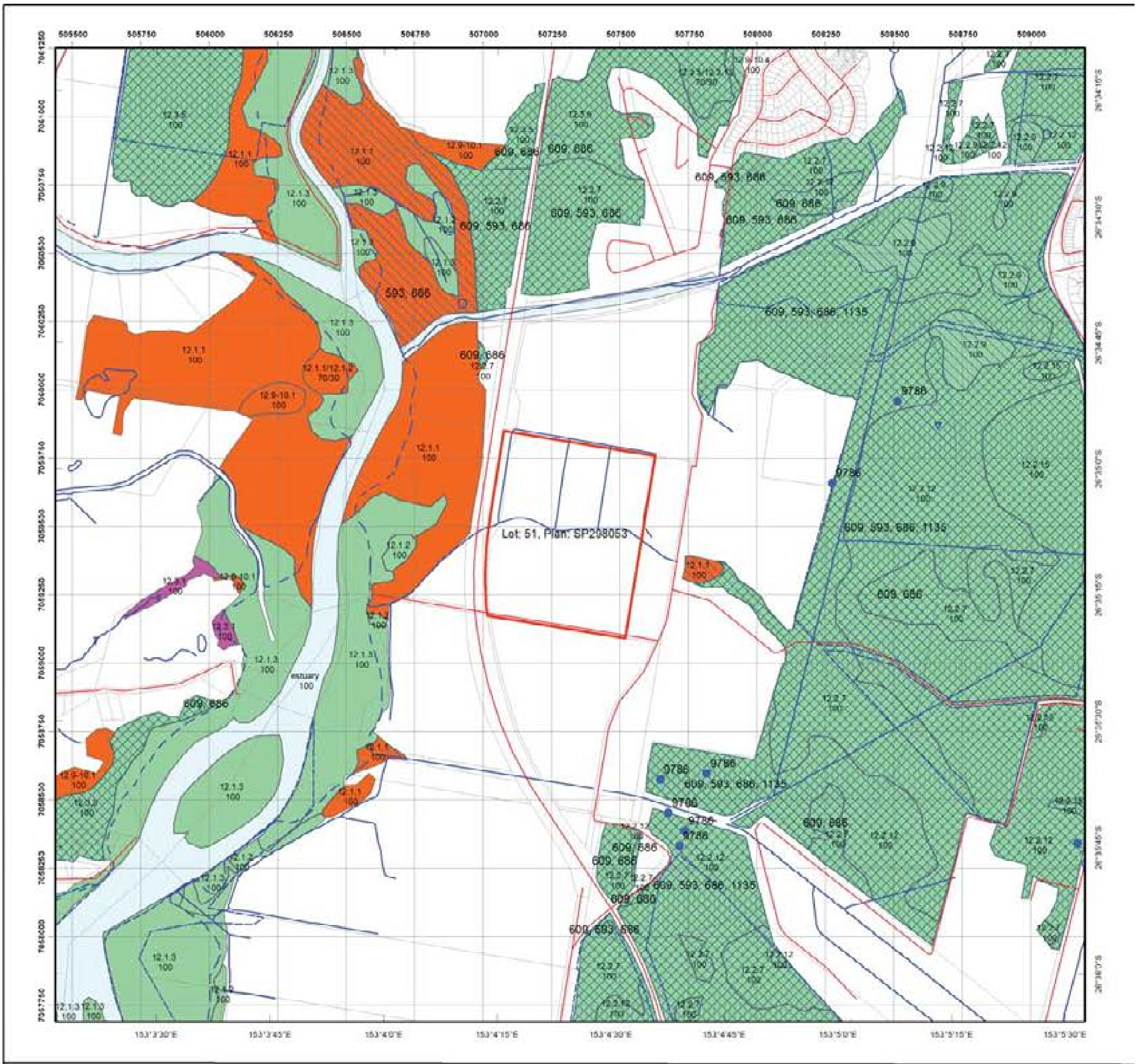
This product is projected into:
GDA 1994 MGA Zone 56

Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.dnrm.qld.gov.au or contact the Department of Natural Resources and Mines.

Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.

Queensland Government



Vegetation Management Supporting Map

Legend

- Lot and Plan
- Category A or B area containing endangered regional ecosystems
- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystem
- Category A or B area containing remnant vegetation
- Category A or B area under Section 20AH
  These areas are edged in yellow and filled with the remnant RE Status
- Category C area containing endangered regional ecosystems
- Category C area containing of concern regional ecosystems
- Category C area that is a least concern regional ecosystem
- Category C area containing high value regrowth vegetation
- Category C area under Section 20AI
  These areas are edged in purple and filled with the remnant RE Status
- Non Remnant
- Water
- Wetland on the vegetation management wetlands map
- Essential habitat on the essential habitat map
- Essential habitat species record
- Watercourses and drainage features on the vegetation management watercourse and drainage features map
  (Stream order shown as black number against stream where available)
- Roads
- National Parks, State Forest and other reserves
- Cadastral line
- Property boundaries shown are provided as a locational aid only

Queensland Government

LOCALITY DIAGRAM

N

0 140 280 420 560 700 m

This product is projected into:
GDA 1994 MGA Zone 56

Labels for Essential Habitat are centred on the area of enquiry.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/- 100 metres.

Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Natural Resources and Mines makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.

Additional information may be required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.dnrm.qld.gov.au or contact the Department of Natural Resources and Mines.

Digital data for the vegetation management watercourse and drainage feature map, vegetation management wetlands map, essential habitat map and the vegetation management remnant and regional ecosystem map are available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Vegetation Management Act 1999 - Extract from the essential habitat database

Essential habitat is required for assessment under the:

- State Development Assessment Provisions - State Code 16: Native vegetation clearing which sets out the matters of interest to the state for development assessment under the *Planning Act 2016*; and
- Self-assessable vegetation clearing codes made under the *Vegetation Management Act 1999*

Essential habitat for one or more of the following species is found on and within 1.1 km of the identified subject lot/s on the accompanying essential habitat map.
This report identifies essential habitat in Category A, B and Category C areas.
The numeric labels on the essential habitat map can be cross referenced with the database below to determine which essential habitat factors might exist for a particular species.
Essential habitat is compiled from a combination of species habitat models and buffered species records.
The Department of Natural Resources and Mines website (http://www.dnrm.qld.gov.au) has more information on how the layer is applied under the State Development Assessment Provisions - State Code 16: Native vegetation clearing and the *Vegetation Management Act 1999*.
Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated.
Essential habitat, for protected wildlife, means a category A area, a category B area or category C area shown on the regulated vegetation management map-

1) (a) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or
2) (b) in which the protected wildlife, at any stage of its life cycle, is located.

Essential habitat identifies endangered or vulnerable native wildlife prescribed under the *Nature Conservation Act 1992*.

Essential habitat in Category A and/or Category B

No records

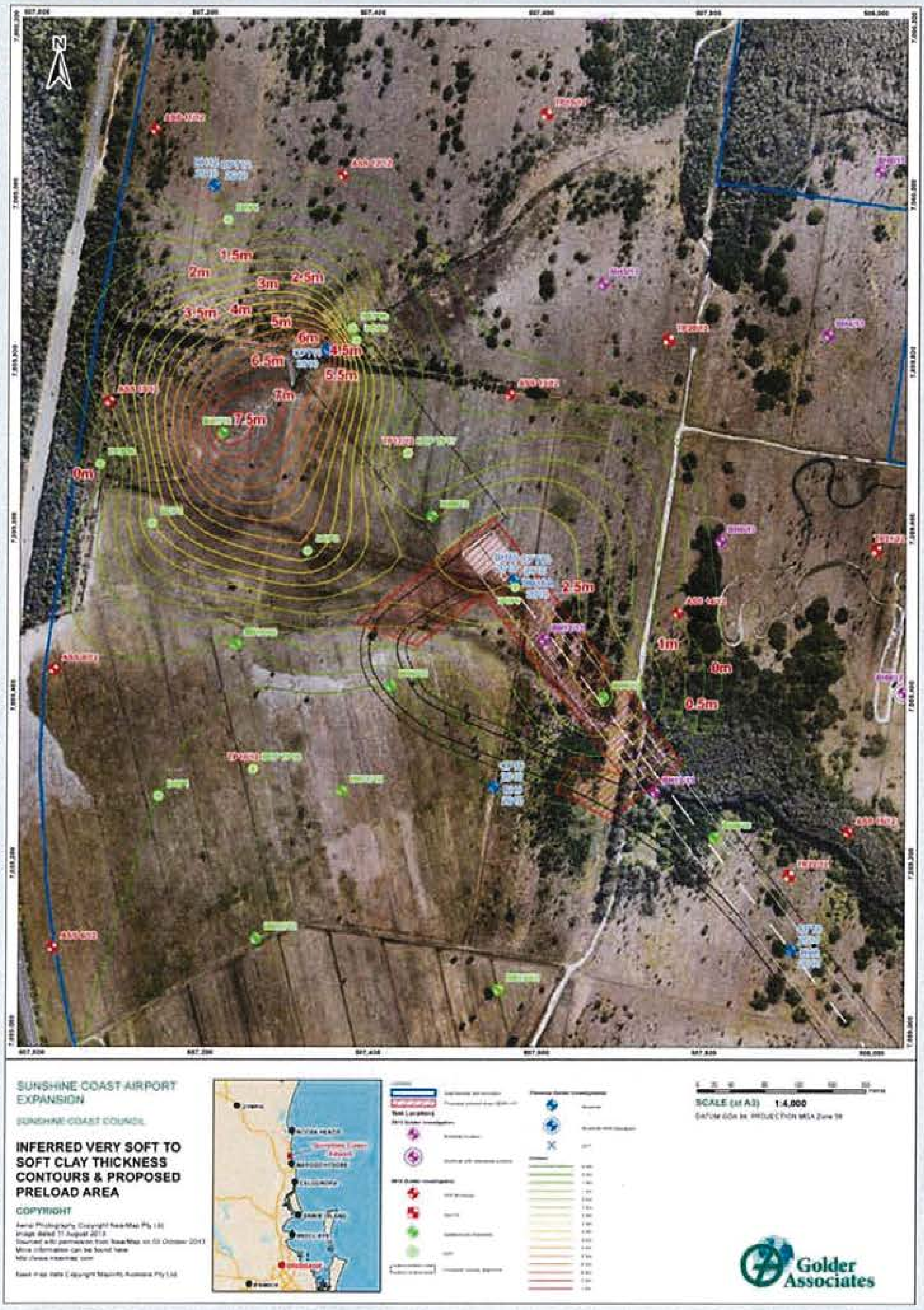
Essential habitat in Category C

No records

Appendix D

Soft Clay Contours (From EIS Soils and Groundwater Chapter)

Figure 3.5a: Inferred very soft to soft clay thickness contours and proposed preload area



Appendix E

Species Palettes

This appendix contains the lists of species suitable for planting in the revegetation zones. The regional ecosystem descriptions are derived from the Regional Ecosystems Species Database for regional ecosystems in the Redland City Council area (prepared by BAAM Ecology, 2014).

Species selection from these palettes must consider the regional ecosystem descriptions and that each vegetation community typically has 'backbone' species that should form the majority of plantings in each zone (they are listed in bold text).

RE 12.1.1 Description:
Casuarina glauca +/- mangroves open-forest. Occurs on margins of Quaternary estuarine deposits.

RE 12.1.1 Species – Reinforcement Planting

Casuarina open forest	
Botanical Name	Common Name
TREES	
Casuarina glauca	**Swamp She-Oak**
SHRUBS	
Pittosporum revolutum	Yellow Pittosporum
HERBACEOUS PLANTS	
Dianella brevipedunculata	Blue Flax Lily
Suaeda australis	Seablight
Sarcocornia quinqueflora	Samphire
VINES	
Parsonsia straminea	Monkey Rope Vine
Stephania japonica var. discolor	Snake Vine
FERNS	
Acrostichum speciosum	Mangrove Fern
Hypolepis muelleri	Swamp bracken
GRASSES/SEDGES	
Sporobolus virginicus	Saltwater Couch
Juncus continuus	
Cyperus polystachyos	

RE 12.1.2 Description:
Saltpan vegetation comprising Sporobolus virginicus grassland and samphire herbland. Grasses including Zoysia macrantha subsp. macrantha sometimes present in upper portions of tidal flats. Includes saline or brackish sedgelands. Occurs on Quaternary estuarine deposits. Marine plains/tidal flats.

RE 12.1.2 Species – Pioneer and Successional Planting

Saltpan vegetation	
Botanical Name	Common Name
SHRUBS	
Enchylaena tomentosa var. glabra	Ruby Saltbush
HERBACEOUS PLANTS	
Bacopa monnieri	
Baumea articulata	Jointed Twigrush
Carpobrotus glaucescens	Coastal Pigface
Einadia hastata	
Einadia trigonos subsp. stellulata	Fishweed
Tecticornia indica	Samphire
Sarcocornia quinqueflora	Samphire
Sesuvium portulacastrum	Sea Purslane
Suaeda australis	Sea Blight
Tetragonia tetragonioides	New Zealand Spinach

Wollastonia biflora	
VINES	
Apium prostratum	Sea Celery
GRASSES/SEDGES	
Eleocharis geniculata	
Fimbristylis ferruginea	Fringe Rush
Cyperus polystachyos	
Fimbristylis polytrichoides	Fuzzy Rush
Isolepis nodosa	Knobby Club Rush
Juncus kraussii	Sea Rush
Phragmites australis	Common Reed
Sarcocornia quinquefolia	Samphire
Schoenoplectus subulatus	
Sporobolus virginicus	Saltwater Couch
Zoysia macrantha	Prickly Couch

RE 12.2.7 description:
Melaleuca quinquenervia or rarely M. dealbata open forest. Other species include Eucalyptus tereticornis, Corymbia intermedia, E. bancroftii, E. latisinensis, E. robusta, Lophostemon suaveolens and Livistona decora. A shrub layer may occur with frequent species including Melastoma malabathricum subsp. malabathricum or Banksia robur. The ground layer is sparse to dense and comprised of species including the ferns Pteridium esculentum and Blechnum indicum the sedges Schoenus brevifolius, Baloskion tetraphyllum, Baumea rubiginosa and Gahnia sieberiana and the grass Imperata cylindrica. Occurs on Quaternary coastal dunes and seasonally waterlogged sandplains, usually fringing drainage systems behind beach ridge plains, or on old dunes, swales and sandy coastal creek levees.

RE 12.2.7 Species – Pioneer Planting

Melaleuca open forest	
Botanical Name	Common Name
TREES	
Acacia disparrima subsp. disparrima	Hickory Wattle
Acacia leiocalyx	Early Black Wattle
Acacia melanoxylon	Blackwood
Alphitonia excelsa	Soap Tree
Glochidion ferdinandi	Cheese Tree
Glochidion sumatranum	Umbrella Cheese Tree
Melaleuca quinquenervia	**Broad-leaved Paperbark**
SHRUBS	
Dodonaea triquetra	
Ficus coronata	Sandpaper Fig
Gompholobium pinnatum	
Melastoma malabathricum	**Blue Tongue**
Pultenaea myrtoides	Swamp Pea
Pultenaea paleacea	
FERNS	
Blechnum indicum	Bungwall or Swamp Water Fern
Grasses/Sedges	
Baloskion pallens	
Baloskion tetraphyllum	
Imperata cylindrica	**Blady Grass**
Juncus continuus	Common Rush
Leersia hexandra	

Themeda triandra	Kangaroo Grass
HERBACEOUS PLANTS	
Dianella caerulea	
Dianella congesta	
Glycine clandestina	
Gonocarpus micranthus subsp. ramosissimus	
Lobelia purpurascens	White Root
Lobelia stenophylla	
Pimelea linifolia	Flax-Leafed Riceflower
Velleia spathulata	Wild Pansies
VINES	
Parsonsia straminea	Monkey Rope Vine

RE 12.2.7 Species – Successional Planting

Melaleuca open forest	
Botanical Name	**Common Name**
TREES	
Allocasuarina littoralis	Allocasuarina littoralis
Corymbia intermedia	Pink Bloodwood
Corymbia tessellaris	
Cupaniopsis anacardioides	
Eucalyptus robusta	**Swamp Mahogany**
Eucalyptus tereticornis	**Queensland Blue Gum**
Lophostemon suaveolens	Apple Swamp Box
Melaleuca quinquenervia	**Swamp Paperbark**
SHRUBS	
Acronychia imperforata	Beach Acronychia
Austromyrtus dulcis	**Midyim Berry**
Banksia integrifolia	
Banksia robur	
Exocarpos cupressiformis	
Grevillea leiophylla	Wallum Grevillea
Hibbertia scandens	Climbing Guinea Flower
Hibbertia stricta	
Hibbertia vestita	
Hibiscus diversifolius	Swamp Hibiscus
Leptospermum polygalifolium	Wild May
Melaleuca pachyphylla	Wallum Bottlebrush
Leptospermum polygalifolium	Thyme honeymyrtle
Muellerina celastroides	
Pultenaea retusa	
FERNS	
Calochlaena dubia	Soft Bracken
Cyclosorus interruptus	
Pteridium esculentum	**Common Bracken**
GRASSES/SEDGES	
Baumea rubiginosa	Soft Twigrush
Blechnum indicum	swamp water fern
Entolasia stricta	
Eragrostis spartinoides	
Gahnia aspera	Rough Saw-sedge
Gahnia clarkei	Tall Saw-sedge
Gahnia sieberiana	**Red-Fruited Saw Sedge**

Lepironia articulata	
Oplismenus aemulus	Basket Grass
Ottochloa gracillima	
Ptilothrix deusta	Feather Sedge
Schoenus apogon var. apogon	Ptilothrix deusta Feather Sedge
Schoenus brevifolius	
Xanthorrhoea fulva	Swamp Grasstree
HERBACEOUS PLANTS	
Boronia falcifolia	
Centella asiatica	Pennywort
Centipeda minima	
Comesperma defoliatum	Leafless milkwort
Eurychorda complanata	Flat stemmed cord rush
Kennedia rubicunda	Red Kennedy pea
Phyllanthus virgatus	Smartweed
Persicaria attenuata	
Stackhousia viminea	Slender Stackhousia
Tricoryne elatior	
Xyris complanata	
VINES	
Desmodium rhytidophyllum	

<u>RE 12.2.12 description:</u>
Closed or wet heath +/- stunted emergent shrubs/low trees. Characteristic shrubs include Banksia spp. (especially B. robur) Boronia falcifolia, Epacris spp., Baeckea frutescens, Schoenus brevifolius, Leptospermum spp., Hakea actites, Melaleuca thymifolia, M. nodosa, Xanthorrhoea fulva with Baloskion spp. and Sporadanthus spp. in ground layer. Occurs on poorly drained Quaternary coastal dunes and sandplains. Low part of sand mass coastal landscapes where water collects from both overland flow and infiltration from adjoining sand dunes.

RE 12.2.12 Species – Pioneer Planting

Closed or wet heath	
Botanical Name	Common Name
SHRUBS	
Aotus ericoides	
Aotus lanigera	
Melaleuca thymifolia	Thyme Honeymyrtle
Pultenaea myrtoides	
Pultenaea paleacea	
GRASSES AND SEDGES	
Baloskion tetraphyllum	
Baloskion pallens	**Tassel Rush**
HERBACEOUS PLANTS	
Gonocarpus micranthus subsp. micranthus	

RE 12.2.12 Species – Successional Planting

Closed or wet heath	
Botanical Name	Common Name
SHRUBS	
Banksia robur	**Swamp Banksia**
Boronia falcifolia	Wallum Boronia
Epacris obtusifolia	
Aotus ericoides	
Hakea actites	

Leptospermum semibaccatum	
Melaleuca nodosa	
Pimelea linifolia	Slender Rice Flower
Sprengelia sprengelioides	
Strangea linearis	
Xanthorrhoea fulva	Swamp Grasstree
Zieria laxiflora	
Baeckea frutescens	
Leptospermum polygalifolium	
Persoonia virgata	
Leptospermum liversidgei	
Banksia oblongifolia	
Boronia falcifolia	
Epacris microphylla	
Epacris obtusifolia	
Hibbertia salicifolia	
Leucopogon leptospermoides	
Epacris pulchella	
GRASSES AND SEDGES	
Empodisma minus	
Eurychorda complanata	
Gahnia sieberiana	Red Fruited Saw Sedge
Hypolaena fastigiata	Tassel Rope Rush
Leptocarpus tenax	Slender Twine Rush
Sporadanthus caudatus	
Sporadanthus interruptus	
Baumea articulata	Jointed Twig-Rush
Caustis blakei subsp. blakei	
Entolasia stricta	
Schoenus brevifolius	
HERBACEOUS	
Goodenia stelligera	Wallum Goodenia
Sowerbaea juncea	Vanilla Lily
Drosera burmanni	
Drosera peltata	
Durringtonia paludosa	Durringtonia
FERNS	
Gleichenia dicarpa	Pouched Coral Fern
Gleichenia mendellii	Coral Fern
Blechnum indicum	Swamp Water Fern
Lindsaea incisa	
Lindsaea ensifolia	

Appendix F

Performance Criteria

Performance Indicators for Target Vegetation Communities

Melaleuca open forest RE 12.2.7 (Zones 2 and 3)

	Year 1	Year 3	Year 5	Year 7	Year 10
Canopy Cover	< 10%	< 30%	30-50%	30-50%	30-70 %
Canopy Height	< 1 m	1-2m	2-4 m	4-6m	> 8m
Weed Cover	< 10%	< 10%	< 5%	< 5%	< 5%
Plant density	1 pioneer per 5 square metres and 3 successional per 5 square metres.				

Closed/wet heath 12.2.12 (Zone 4)

	Year 1	Year 3	Year 5	Year 7	Year 10
Shrub Cover	< 10%	< 30%	30-50%	> 60%	70-100%
Shrub Height	< 1m	< 1m	0.5-1m	0.5-1.5m	0.5-2 m
Weed Cover	< 10%	< 10%	< 5%	< 5%	< 5%
Plant density	2 pioneer per 5 square metres and 3 successional per 5 square metres.				

Saltpan vegetation RE 12.1.2 (Zone 5)

	Year 1	Year 3	Year 5	Year 7	Year 10
Native Cover %	< 10%	< 30%	30-50%	> 60%	80%
Weed Cover	< 10%	< 10%	< 5%	< 5%	< 5%
Plant density	2 pioneer per 5 square metres and 3 successional per 5 square metres.				

Casuarina open forest 12.1.1 (Zone 6)

	Year 1	Year 3	Year 5	Year 7	Year 10
Canopy Cover	< 10%	< 30%	30-50%	30-50%	30-70 %
Canopy Height	< 1 m	1-2m	2-4 m	4-6m	> 8m
Weed Cover	< 10%	< 10%	< 5%	< 5%	< 5%
Plant density	1 pioneer per 5 square metres and 3 successional per 5 square metres.				

Appendix G

Habitat Quality Site Assessment, 2015 - Offset Assessment Unit 7

Habitat Quality Site Assessment Template

PLEASE NOTE - YELLOW INDICATES AN AUTO POPULATED FIELD

For all environmental offset applications you must:

- Complete form (Environmental Offsets Delivery Form 1– Notice of Election and Advanced Offsets Details)
- Complete any other forms relevant to your application
- Provide the mandatory supporting information identified on the forms as being required to accompany your application

This form is useful for undertaking a **habitat quality analysis** of an impact and/or offset/advanced offset site.
Please note that this form should be completed individually for each assessment unit under consideration.

Is this Assessment for: **An Impact Site** ☐ **An Offset Site** ☑ **an Advanced Offset Site** ☐

Habitat Quality Assessment Unit Score Sheet

Part C - Site Data

Property	Sunshine Coast Airport - corridor offset	Date	

Assessment Unit:	Assessment Unit Area (ha)	RE	Bioregion Number
7	38.22	12.2.7	Southeast Queensland

Landscape Photo- Please attach or insert north, south, east and west photos in the spaces provided from row 231-355 below and include details such as Time and Mapping Coordinates in the following row.

Datum			Zone	Easting	Northing
WGS 84	☐	0m Mark	56	153.078	-26.579
GDA 94	☑	50m Mark	56	153.078	-26.5783
Plot bearing			0	Recorders	MJD / FSR

Site description and Location (including details of discrete polygons within the assessment unit)
North-east corner of the proposed corridor offset located on Sunshine Coast Airport land (Lot 1106 on SP206556).   The vegetation composition of the Assessment Unit is predominantly degraded grassland, due to the historic and current use as cane lands. The northern section has been removed from cultivation earlier and has some native regrowth elements. Further to the south, there are still areas under cane cultivation which contain no native canopy cover. Much of the Assessment Unit has exotic grasses, forbs and sedges as the dominant group of species. Declared pest plants, particularly Groundsel Bush *Baccharis halimifolia*, are common across the AU.   The sampling site is located within an area of the most advanced native regrowth, dominated by Wattle *Acacia spp.* and Broad-leaved Paperbark *Melaleuca quinquenervia*.   AU also includes the 4.41ha of land reserved for the Mount Emu She-oak offset, as the current floristic condition of the AU is similar.

Part D - Native Species Richness: (*list species below)

Tree species richness:			
Total number of species	5		
Scientific Name	*Melaleuca quinquenervia*	Common Name	Broad-leaved Paperbark
Scientific Name	*Acacia cincinnata*	Common Name	Coil-pod Wattle
Scientific Name	*Acacia disparrima* subsp. *disparrima*	Common Name	Hickory Wattle
Scientific Name	*Commersonia bartramia*	Common Name	Brown Kurrajong
Scientific Name	*Glochidion sumatranum*	Common Name	Cheese Tree
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Shrub species richness:			
Total number of species	1		
Scientific Name	*Acacia cincinnata*	Common Name	Coil-pod Wattle
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Grass species richness:			
Total number of species	1		
Scientific Name	*Imperata cylindrica*	Common Name	Blady Grass
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Forbs and others (non grass ground) species richness:			
Total number of species	0		
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part E - Non-Native Plant Cover: (*list species below)

Total percentage cover within plot	90.00%		
Scientific Name	*Setaria sp.*	Common Name	Setaria
Scientific Name	*Baccharis halimifolia*	Common Name	Groundsel Bush
Scientific Name		Common Name	Exotic Grasses
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	
Scientific Name		Common Name	

Part F - Coarse Woody Debris: (*list lengths of individual logs in meters)

Total Length of Course Woody Debris (Meters):			
1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

Part G - Native perennial grass cover, organic litter: (*provide percentage cover within each quadrat, and provide average cover)

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Native perennial grass cover	0.00%	3.00%	4.00%	0.00%	15.00%	4.40%

	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Quadrat 5	Average
Organic Litter	90.00%	94.00%	95.00%	20.00%	3.00%	60.40%

Part H- Number of large trees , tree canopy height, recruitment of woody perennial species:

Eucalypt Large tree DBH benchmark used :	50	Non- Eucalypt Large tree DBH benchmark used:	30
Number of large eucalypt trees:	0	Number of large non eucalypt trees:	0
Total Number Large Trees:			

Median Tree Canopy Height Measurements	Canopy:	7.00	Sub-canopy:	4.00	Emergent:	

Number of ecologically dominant layer species regenerating:	3

Part I - Tree canopy cover, Shrub canopy cover

Tree canopy cover %	Canopy:	51.10%	Sub-canopy:	22.90%	Emergent:	
Shrub canopy cover %	1.00%					

Note: Only assess Emergent (E) or Subcanopy (S) layers if the benchmark document stipulates that layers are present *If trees are in the same layer and continuous along the transect you can group them

Part J - Site Context Score

ATTRIBUTE	Size of Patch	Connectedness	Context	Distance to Permanent Water	Ecological Corridors
DESCRIPTION	3 - 26 - 100ha	1 - 0% - 10% connection	1 - <10% remnant	1 - 0-500m	2 - Sharing a common boundary
SCORE	5	0	0	0	4

DOES THIS ASSESSMENT UNIT ALSO CONTAIN A SPECIES HABITAT REQUIREMENT.

YES ☑ PLEASE COMPLETE SPECIES HABITAT INDEX DETAILS BELOW AND THEN ATTACH LANDSCAPE PHOTOS AND SUBMIT AS DIRECTED

NO ☐ PLEASE ATTACH LANDSCAPE PHOTOS BELOW AND SUBMIT AS DIRECTED

Part K - Species Habitat Attributes

Species Habitat Attributes

No	Species Name	CommonName	NCA Status	Attributes	Threats to species	Quality and availability of food and foraging	Quality and availability of shelter	Species mobility capacity	Role of site location to overall population
1	Crinia tinnula	wallum froglet	V	Description	*2 - Moderate threat level*	*1 - Poor*	*1 - Poor*	*2 - Highly restricted (51% - 75% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	7	1	1	4	1
2	Litoria freycineti	wallum rocketfrog	V	Description	*2 - Moderate threat level*	*1 - Poor*	*1 - Poor*	*2 - Highly restricted (51% - 75% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	7	1	1	4	1
3	Litoria olongburensis	wallum sedgefrog	V	Description	*2 - Moderate threat level*	*1 - Poor*	*1 - Poor*	*2 - Highly restricted (51% - 75% reduction)*	1 - Not or unlikely to be critical to species' survival"
				Score	7	1	1	4	1
4				Description					
				Score					
5				Description					
				Score					
6				Description					
				Score					
7				Description					
				Score					
8				Description					
				Score					
9				Description					
				Score					
10				Description					
				Score					
				Maximum Score	7.00	1.00	1.00	4.00	1.00

Attach Landscape Photos Here

North

South

East

West

(FORM COMPLETE)

Please save and forward completed form/s together with Offsets Delivery Form 5 that can be accessed here: QLD Environmental Offsets

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