Sunshine Coast Airport Expansion Project

Wallum Sedgefrog Offset Management Plan

March 2018

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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

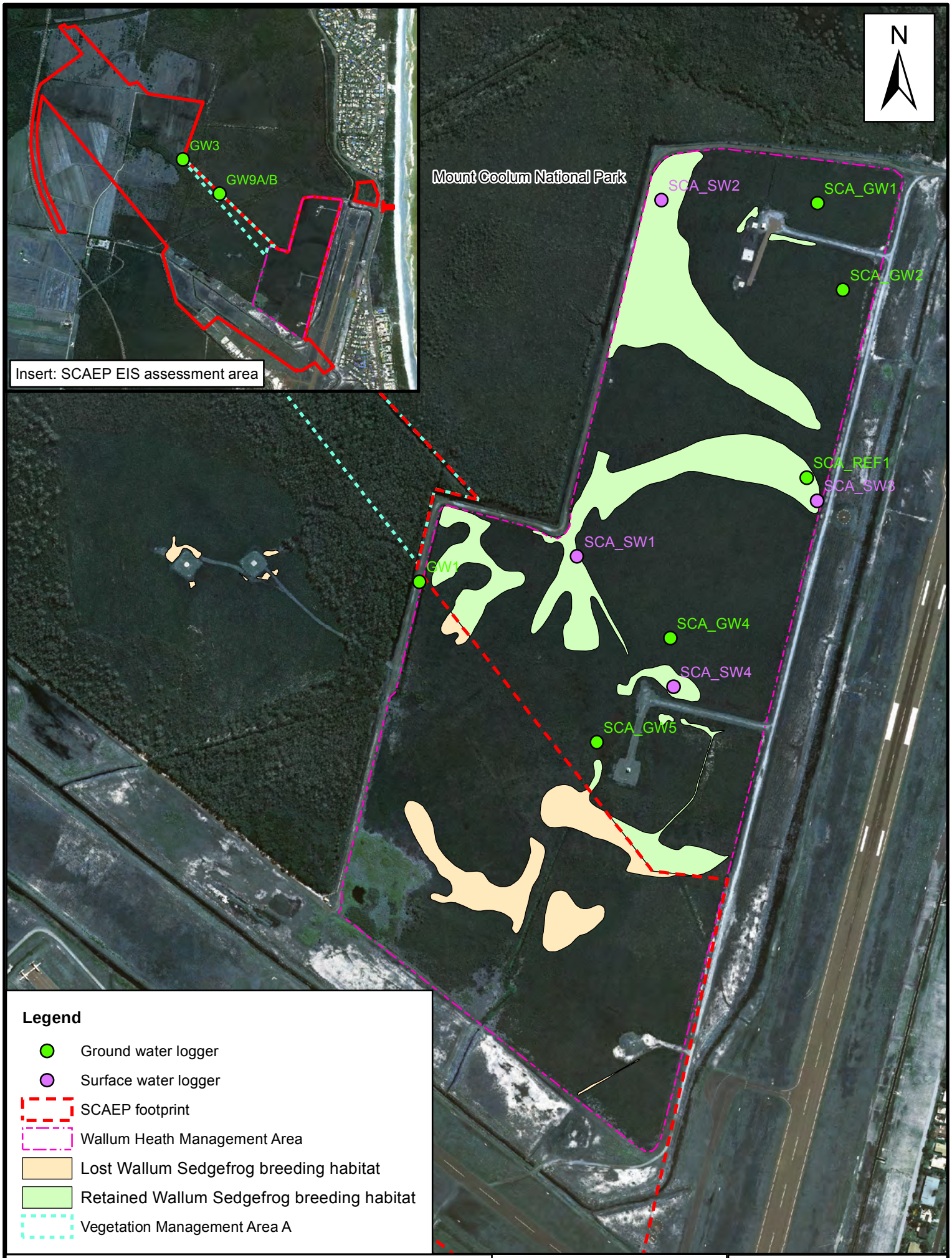


Figure 2.2.
Retained and lost Wallum Sedgefrog breeding habitat at the SCA

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.

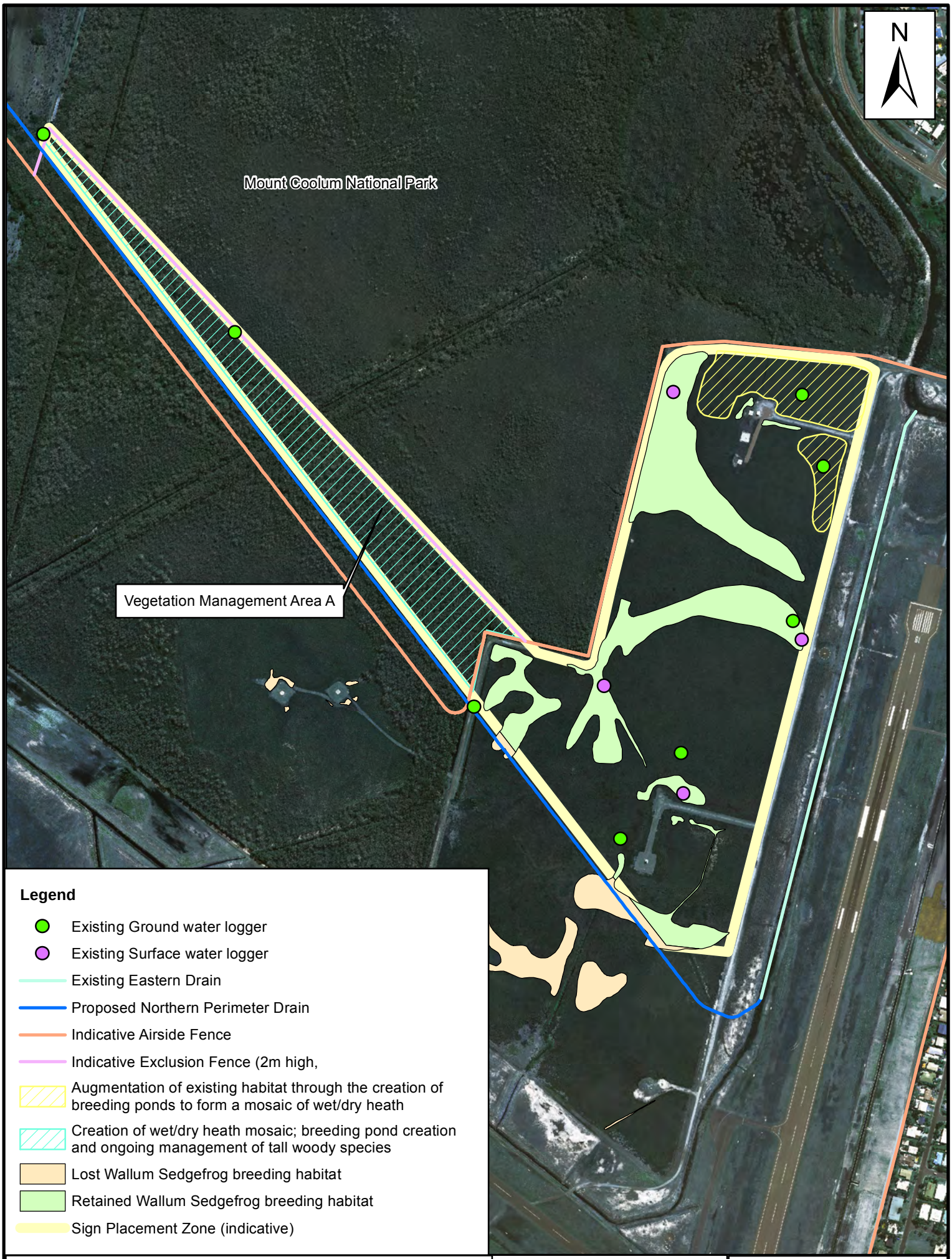


Figure 2.3

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.

Pond Design

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.

Pond Construction Timing

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

Site Preparation

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.

Pond Construction

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

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

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

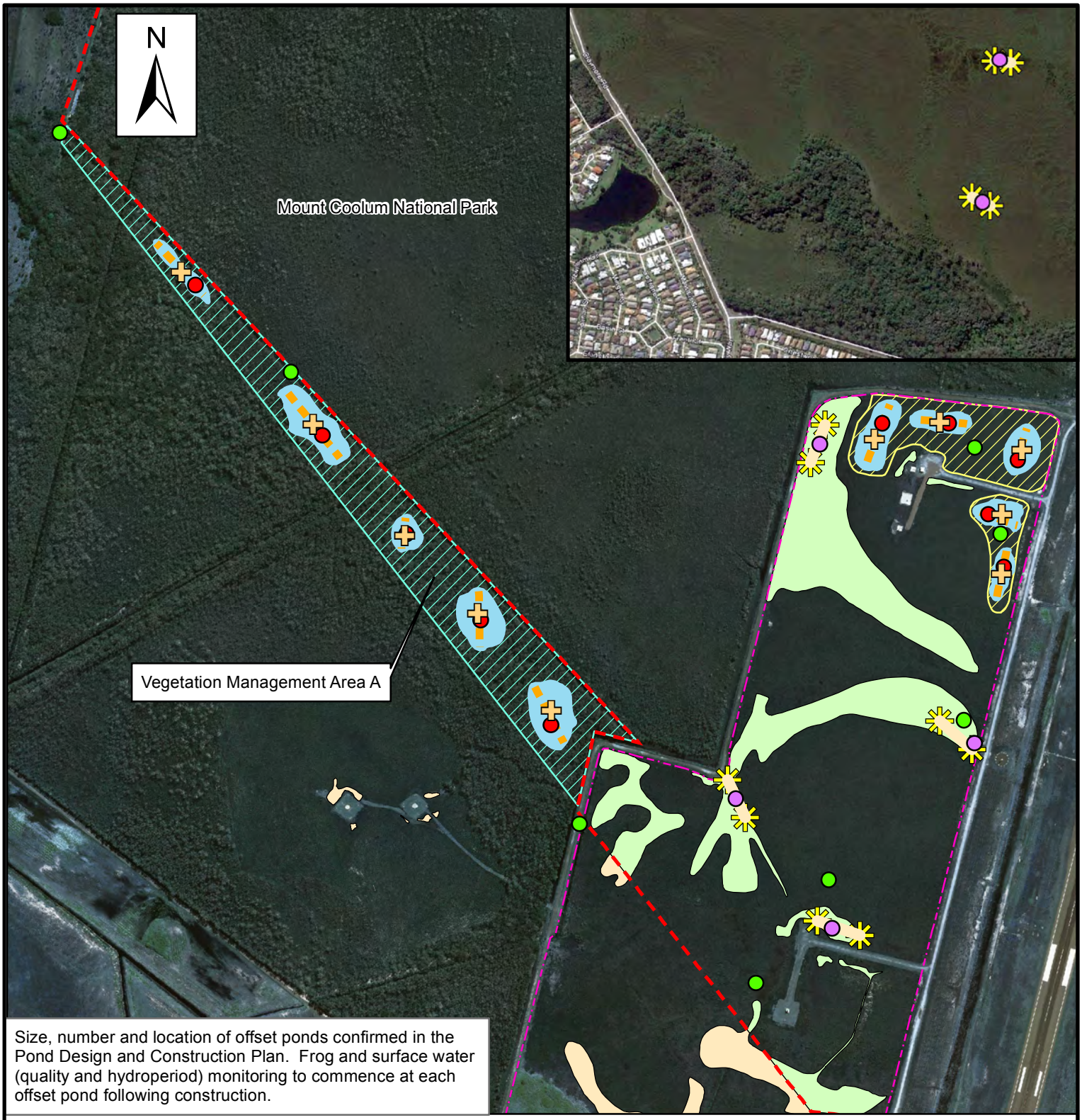
Monitoring Objective: (1) To determine whether the hydroperiod of constructed ponds is comparable with that with that of reference sites, and (2) to collect data on groundwater levels informing pond design (depth).

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.



Size, number and location of offset ponds confirmed in the Pond Design and Construction Plan. Frog and surface water (quality and hydroperiod) monitoring to commence at each offset pond following construction.

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 and 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				
Likelihood		**Minor**	**Moderate**	**High**	**Major**	**Critical**
	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.

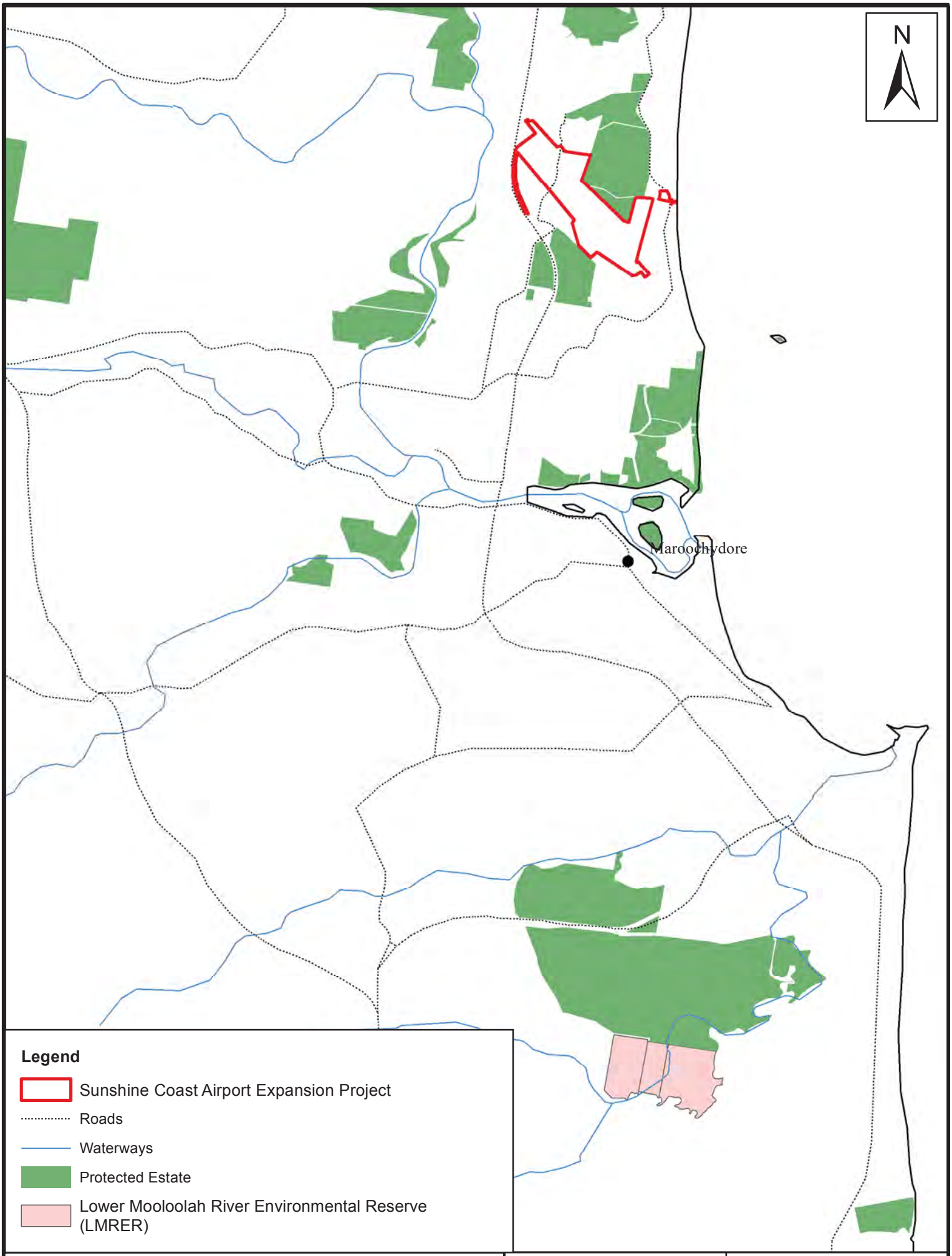


Figure 6.1
Location of the Lower Mooloolah River Environmental Reserve

Scale:
1:87,534
0 0.4 0.8 1.6 2.4 3.2
Kilometers

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

Task/Report	Frequency	Deadline[#]
Breeding pond design and construction plan	Once-off	Aug/Sep 2018
Weed monitoring report	Annual until success, once every 5 years following	30th August
Acid frog monitoring report		
Audits	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).	30 April

[#] 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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Lowe, K., Castley, J. G., Hero, J-M. (2016). Calling phenology and detectability of a threatened amphibian (*Litoria olongburensis*) in ephemeral wetlands varies along a latitudinal cline: implications for management. *Austral Ecology* 41, 938-951.

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Wetlands Regulator Assistance Program (WRAP) (2000). Installing Monitoring Wells/Piezometers in wetlands. Available at: https://www.wsdot.wa.gov/NR/rdonlyres/11858D0D.../InstallMonWellsPiezos.pdf

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

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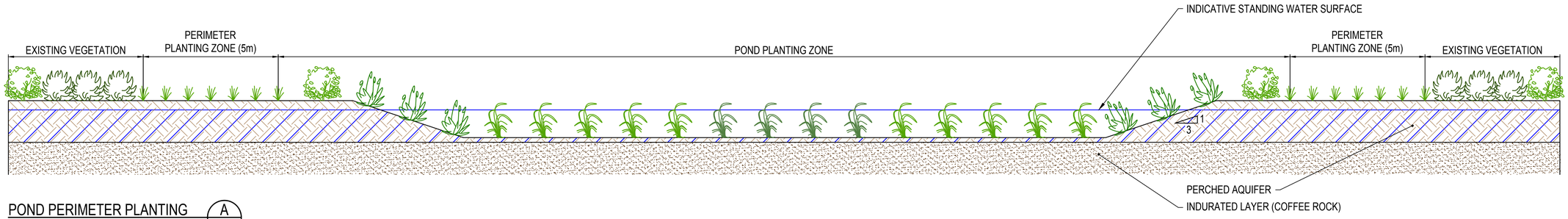
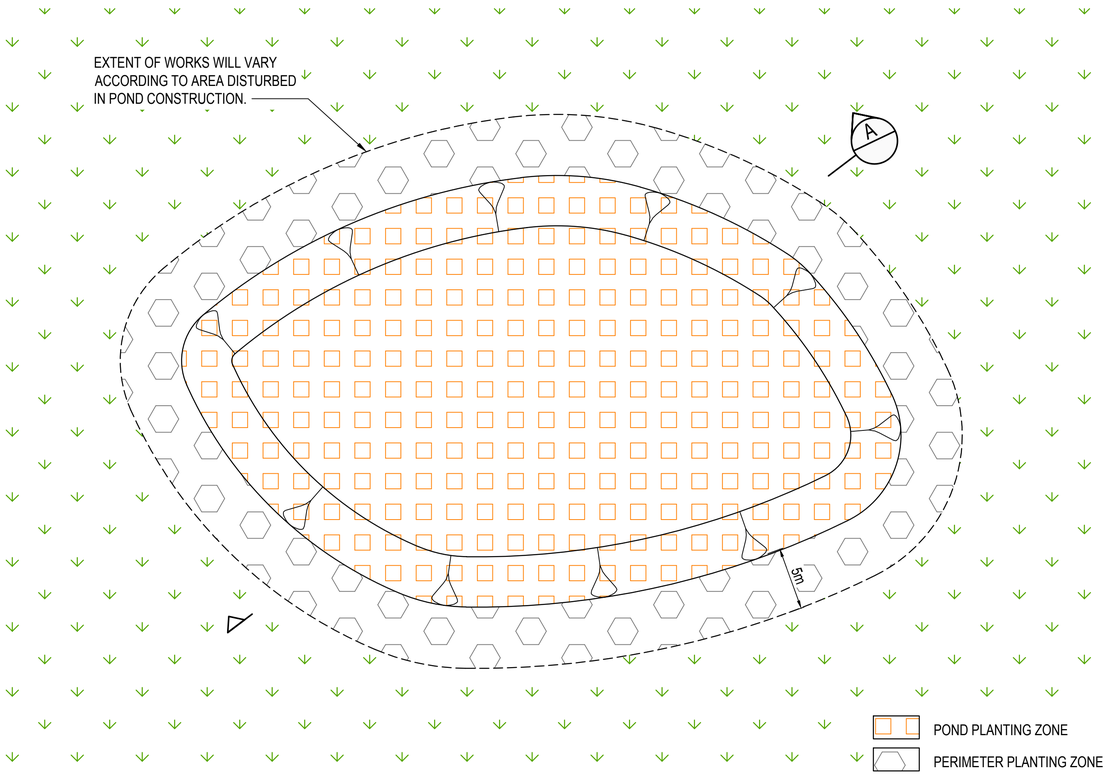
User: Kaitlin Mooney Plot Date: 21/02/2018 8:50:53 AM



POND PERIMETER PLANTING (A)
SCALE 1:100 @ A3



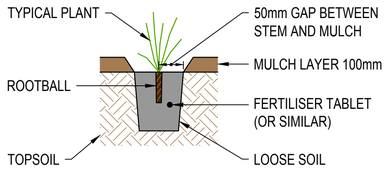
POND TYPICAL PLAN
NOT TO SCALE

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

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