



12.0 Ameliorative Measures and Recommendations

12.1. Track Design and Fencing

As stated in the Project Application EA, the track design and engineering will be as per the *Coastal Dune Management Manual* (Kidd 2001). A current concept design is in line with specifications provided by PMHC is shown in Figure 11. The track consists of an elevated walkway with cement landings at the western end, and stairs at the eastern end.

To avoid clearing, the formal access will follow the existing maintained track (as shown in preceding photos) which currently has a bend near the beach (AECOM 2010), minimising its potential to act as a funnel for maritime stresses. The access will be no wider than 2m.

12.2. Fencing and Barrier Plantings

Fencing using a minimum of 4-strand plastic coated plain wire and treated wooden posts is recommended to be erected along the edges of the path as a visual delineation of the access's boundary. Locked gates are to be provided at designated locations for access to undertake bush regeneration works on either side.

On the outer side of the fenceline (north and south), barrier plantings running parallel to the fence are to be established to deter the public from crossing the fenceline and making new paths to the beach. Plantings are to consist primarily of Spiney-Headed Matrush (*Lomandra longifolia*) and *Gahnia* spp where edaphics suit. As noted in Section 12, these barrier plantings will be integrated into the edge treatment to not only deter trespass but establish an effective closed edge.

12.3. Edge Treatment and Regeneration

As noted previously, Landcare is currently and primarily undertaking bush regeneration works of the Crown Reserve, with assistance from PMHC and the proponent (James Dunn, pers. comm.).

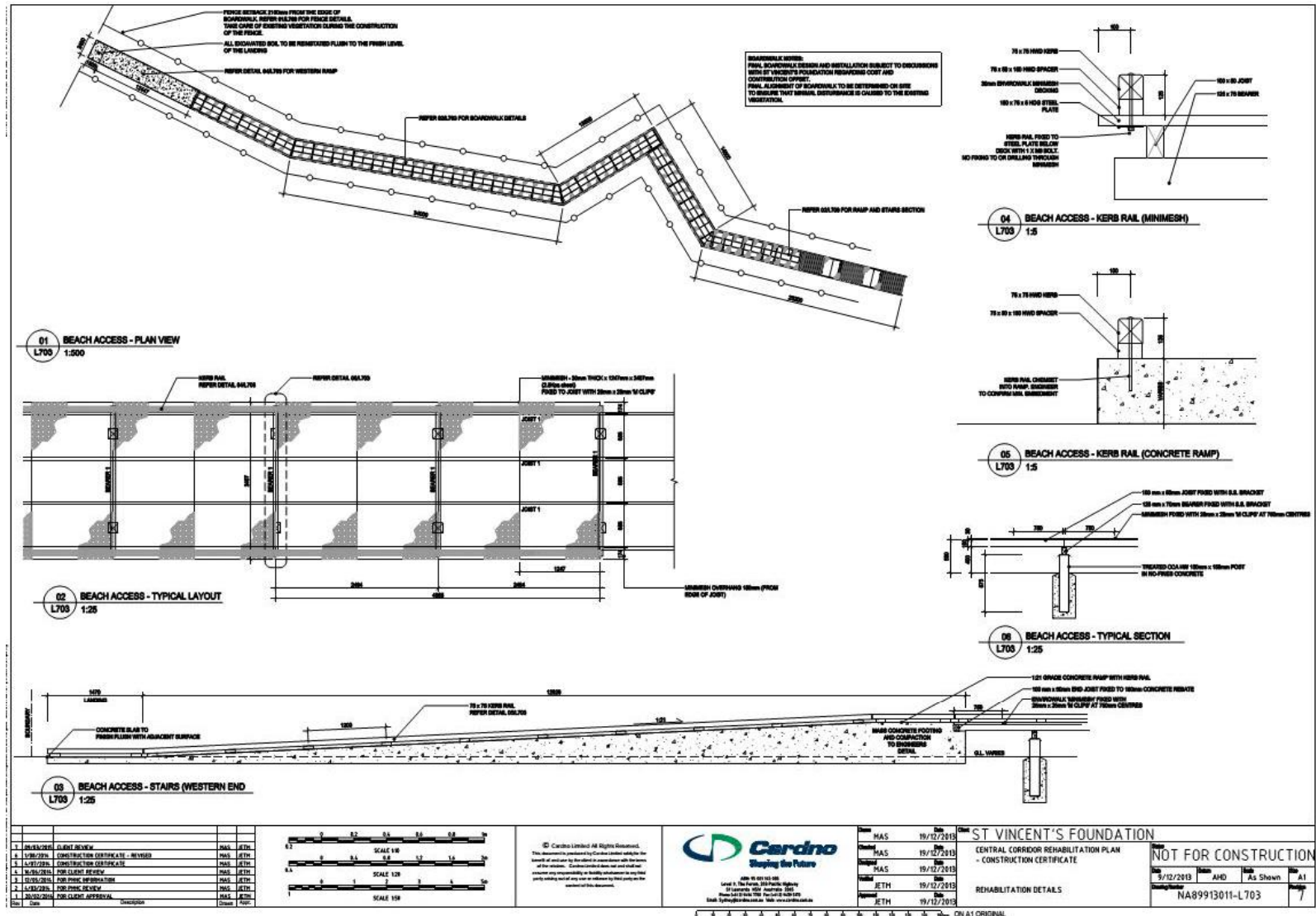
To mitigate the range of impacts associated with formalising the beach access, the proponent will engage a bush regenerator to establish a closed edge adjacent to the track along its entire length and throughout the extent of the nominated vegetated regeneration area (recommended to be at least 25m either side of the track as shown in Figure 10).

This will be achieved by:

- Elimination of weeds.
- Planting of the pungent-leaved barrier plantings along the edge of the track to discourage wandering.
- Planting of rainforest and Banksia woodland edge species (eg Satinwood, *Melaleuca thymifolia*, *Banksia integrifolia*, etc) in a structure designed to integrate with the structure of the edge plantings and infill canopy gaps within the nominated vegetated regeneration area and effectively enclose the track within closed forest along its length.



Figure 11: Concept beach access design





12.4. Litter Control, Lighting and Signage

Signage will be erected at the beach access which states:

- The vegetation outside the access is an EEC which has been regenerated by Landcare, the proponent and PMHC. Clearing or damage to this vegetation is subject to fines, etc.
- Litter is to be placed in the appropriate bins. Fines apply if not.
- No fires.
- Dogs to be leashed and not to enter vegetation.
- Straying outside the access is not permitted.

Bollard lighting may be placed along the track, if deemed necessary, for safety but pole lights are to be restricted to the western end near the bins. This light must be designed to minimise if not avoid spillage on the adjacent vegetation.

Standard public litter bins with lids and mounted on anti-spill stands will be provided at the beach access.

Part D: Eastern Chestnut Mouse Habitat Review

13.0 Background Information

13.1. Ecology and Preferred Habitat

The species is a large mouse patchily distributed within its range. It is predominantly found within dense wet heath and swamp habitats, but also found in NSW within open areas of thick grassland; heathland amongst open forest; woodland within swampy areas; low closed scrub; and open woodland with grassy groundcover dominated by Bladey Grass and *Poa* spp on ridges, gullies and slopes. These areas are usually associated with a short interval between fire events (Fox 1998, Watts and Tweedie 1993, Meek and Triggs 1996, Luo et al 1994, Luo and Fox 1995).

The Eastern Chestnut Mouse (ECM) is largely nocturnal with limited daytime movements and uses and maintains runways under dense groundcover. It builds a nest constructed out of grass above ground or part of a burrow complex. Breeding in NSW is from about September to March with breeding recorded peaking about 18 months after fire in heath to 6 animals/ha. Average home range sizes likely to be <0.5ha but has been recorded moving up to 250m (Fox 1998).

Overall, the ECM is an omnivorous rodent, with diet depending on seasonal availability of food, state of vegetation regeneration since fire and presence of the Swamp Rat which competitively suppresses the species as vegetation recovers (Fox 1998, Luo *et al* 1994, Luo and Fox 1995). Seed makes up to 45% of diet in summer, dropping to 20% in autumn, which reflects resource availability. Plant material in the diet primarily comprises stem (leaves may be used more in early regeneration stages due to availability), varying from 25-40% in autumn and winter respectively. Fungi (particularly myphageous)



is consumed mainly in winter (25%) and a little less in other seasons except summer (2%) where insects become more important (due to their availability). Fungi use is also limited by abundance of the Swamp Rat (Luo et al 1994).

13.2. Previous Survey and Identified ECM Habitat

13.2.1. Habitat Description

13.2.1.1. Lot 5

In 2003, about 3ha of mostly native grassland on the sandplain east of Duchess Gully on Lot 5 offered suitable open to closed groundcover cover for small terrestrial species.

The densest area of cover consisted of a band of *Restio tetraphyllus* and Saw Sedge along the minor drainage line in the southwest of this plain adjacent to Duchess Gully, with a dense sward of Bladey Grass and Bracken Fern with Spiney Headed Matrush and sporadic *Gahnia* spp. dominating the remainder. This area appeared to not have been slashed for at least 3-5yrs in 2003 (pers. obs.).

Runways were noted under the densest cover in this area, and overall this area of artificially derived habitat was considered suitable for the ECM (Smith *et al* 1995, Strahan 2000, Luo *et al* 1994, Luo and Fox 1995, 1994), hence was surveyed as part of investigations over the property at the time.

The remaining approximately 1ha in the northern end of Lot 5 was predominantly exotic pasture grasses and was noted to be well grazed by cattle and hence was lower and more open. It was considered to offer no significant value to the ECM.

13.2.1.2. Western Hill and Southwestern Regeneration Areas

As noted in Section 1.1, the ECM was previously detected in a small remnant on a low hill in the southwest corner of the property, comprising Bladey Grass dominated grassland around a patch of dry sclerophyll forest on the hill, and a nearby sedge and shrub-dominated drain just to the east of this area. At the time, this area appeared to have escaped regular slashing due to tree cover, a low mound, a narrow drain and probably low pasture value.

This area was also effectively at times a small island of remnant habitat, isolated from other similar habitat due to periodic slashing of the remaining paddock, unless prolonged wet conditions prevented pasture maintenance and the mixture of sedges and grasses (native and exotic) to the east regenerated. This area was formerly fenced off as a regeneration area in 2007.

Also in 2007, approximately 3.2ha of pasture was fenced off along both sides of the main drain to the adjacent northeast, as part of the ongoing bush regeneration project on the property and in line with the masterplan in the EA (AECOM 2010). This area is referred to in this report as the southwestern *Swamp Sclerophyll Forest* EEC regeneration area, and forms part of the Central Corridor.

A mixture of weed control, assisted regeneration and plantings were commenced in this new area and the western hill regeneration area and remain ongoing (see Section 1.2).



13.2.2. Survey Methods and Results

In 2003 80 Elliott A traps were placed in transects in the following areas on the property (see Figure 7 in Darkheart 2008a):

- a) The swamp forest, wet sclerophyll, former nursery and dry sclerophyll in the proposed Northern Corridor.
- b) A low rise and associated drains in the southwest (edge of proposed school site and part of east-west corridor).
- c) A patch of dry sclerophyll in the southeast on a hill adjacent to the Bonny Hills sewage plant (also part of the eastern corridor).
- d) A patch of sparse native and shrub species in the mid-west (part of proposed filling area).
- e) Regrowth swamp forest around the two large lagoons in the southern end of the property.
- f) The patch of dense groundcover (native grassland) east of Duchess Gully and the adjacent patch of dune scrub and riparian vegetation along Duchess Gully.

Areas (b) and (f) were where the ECM was detected. A single ECM was recorded in dense Bladey Grass in the western dry sclerophyll remnant. Three more were recorded in the dense Bladey Grass/Bracken Fern grassland east of Duchess Gully on Lot 5.

14.0 2012 ECM Survey

The objective of this survey was to determine:

- Presence/absence of ECM on Lot 5.
- Presence/absence of ECM in the western hill regeneration area.
- If the ECM has colonised the new southwest EEC regeneration area since 2007.

14.1. Survey Methods

14.1.1. Lot 5

Elliott A traps were set in the numbers and locations detailed in Table 11 and shown in Figure 12. Traps were baited with a mix of rolled oats, peanut butter and sesame seed oil. Due to the cold night temperatures, bedding was placed in each trap to enable trapped mammals to avoid hypothermia. Traps were set for 4 nights.

Hair funnels (Faunatech design) were set in the number and locations shown in Table 11 and Figure 12. These were used as a supplement to trapping given weather conditions/season. Identical bait was used and the funnels were collected after 7 nights.



Table 11: Survey effort per location on Lot 5

	Elliot A	Hair Funnels
Duchess Gully	25	10
Dune Scrub	45	10
Open Paddock/Fern Patches	5	3
Total:	75	23
Total Trap Nights:	300	161
DECC (2007) Minimum Effort Standard:	100	40

14.1.2. Western Hill and Southwest Regeneration Areas

A total of 85 Elliot A traps and 20 hair funnels were set in two main areas from the 23-27th June, as shown in the following table and in Figure 13. Identical baits were used as for Lot 5 and trapping and hair funnels were set at the same time as on Lot 5.

Table 12: Survey effort per location in the western hill and southwest regeneration areas

	Elliot A	Hair Funnels
Southwest EEC Regeneration Area	40	10
Western Hill	45	10
Total:	85	20
Total Trap Nights:	340	140
DECC (2007) Minimum Effort Standard:	100	40

14.2. Results

14.2.1. Lot 5

No ECM were detected anywhere on Lot 5, despite the intense level of survey. As shown in Table 13 and the total hair survey data in Appendix 1, only common species were recorded.

Furthermore, very few Swamp Rats were recorded. This is a significant result and is discussed further in Section 15.1.

Table 13: Trapping results on Lot 5

Date:	Swamp Rat	Bush Rat	House Mouse	Antechinus
24/6	1	6	2	4
25/6	0	7	2	0
26/6	1	6	1	0
27/6	0	6	2	2
Total:	2	25	7	6



14.2.2. Western Hill Regeneration Area

As shown in the data below, Swamp Rats dominated this area. Antechinus were most common amongst the tree cover where Spiney-Headed Matrush was predominant and shrubs more common.

Table 14: Trapping results in Western Hill regeneration area

Date:	Swamp Rat	Bush Rat	Black Rat	House Mouse	Antechinus	Eastern Chestnut Mouse
24/6	8	0	0	1	7	1
25/6	4	0	0	0	5	1
26/6	6	1	1	0	3	2
27/6	6	0	0	0	3	1
Total:	24*	1	1	1	18*	5*

*includes recaptures

Hair funnels recorded Swamp Rats and Northern Brown Bandicoot.

14.2.3. Southwest EEC Regeneration Area

Trapping results in this area increased over time with Swamp Rats not detected until the third day for some reason (possibly only mere chance). House Mice were most often found in the western end where pasture grasses were dominant.

Table 15: Trapping results in the southwest EEC regeneration area

Date:	Swamp Rat	Bush Rat	House Mouse	Antechinus	Eastern Chestnut Mouse
24/6	0	0	2	0	2
25/6	0	0	2	2	3
26/6	5	0	1	2	5
27/6	2	1	1	1	4
Total:	7*	1	6*	5*	14*

Hair funnels recorded Bush Rats, House Mouse and a single Eastern Chestnut Mouse



Figure 12: Location of traps and hair funnels on Lot 5

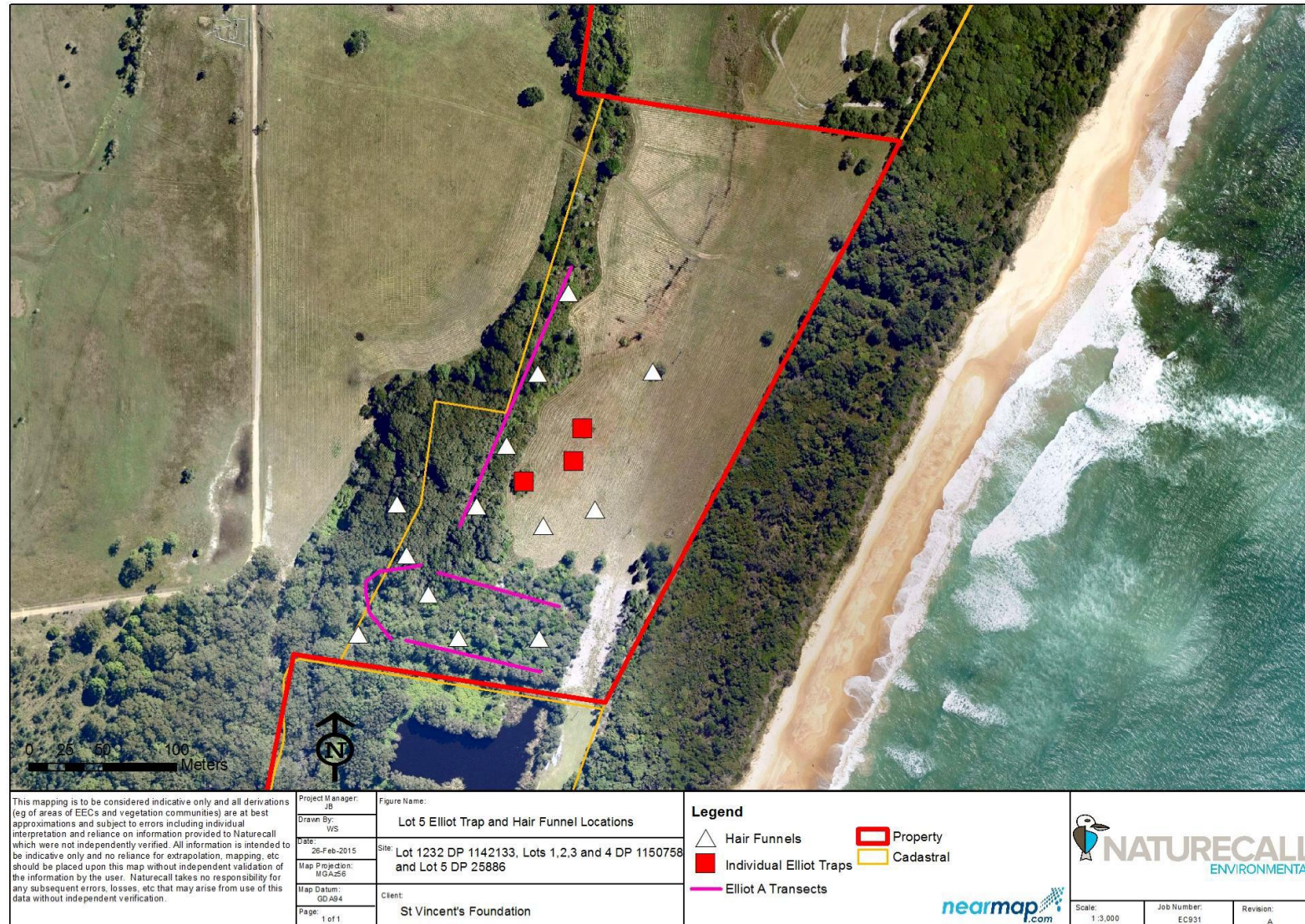




Figure 13: Location of hair funnels and Elliot A transects in the western hill regeneration area

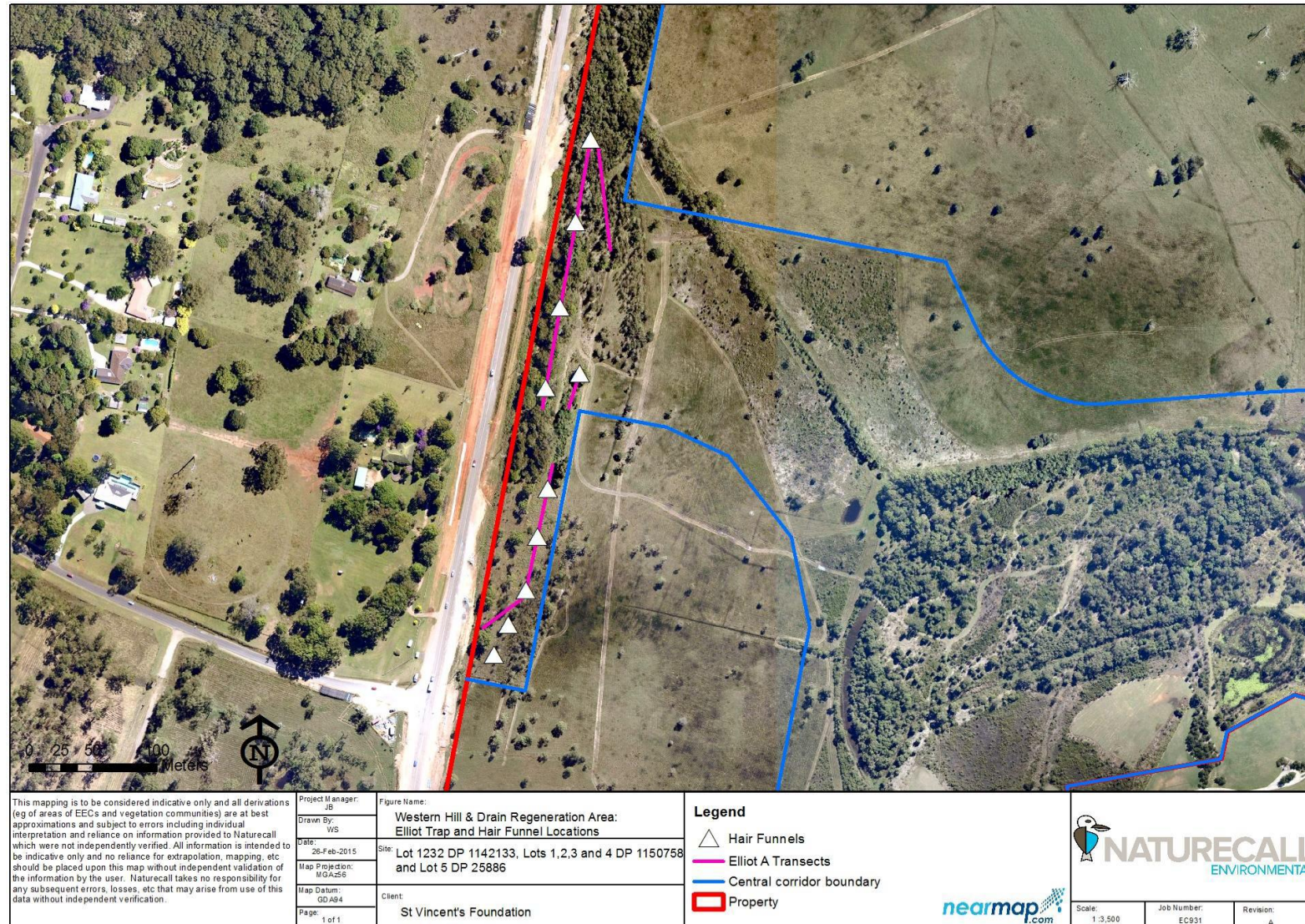




Figure 14: ECM capture locations in the western hill regeneration area.

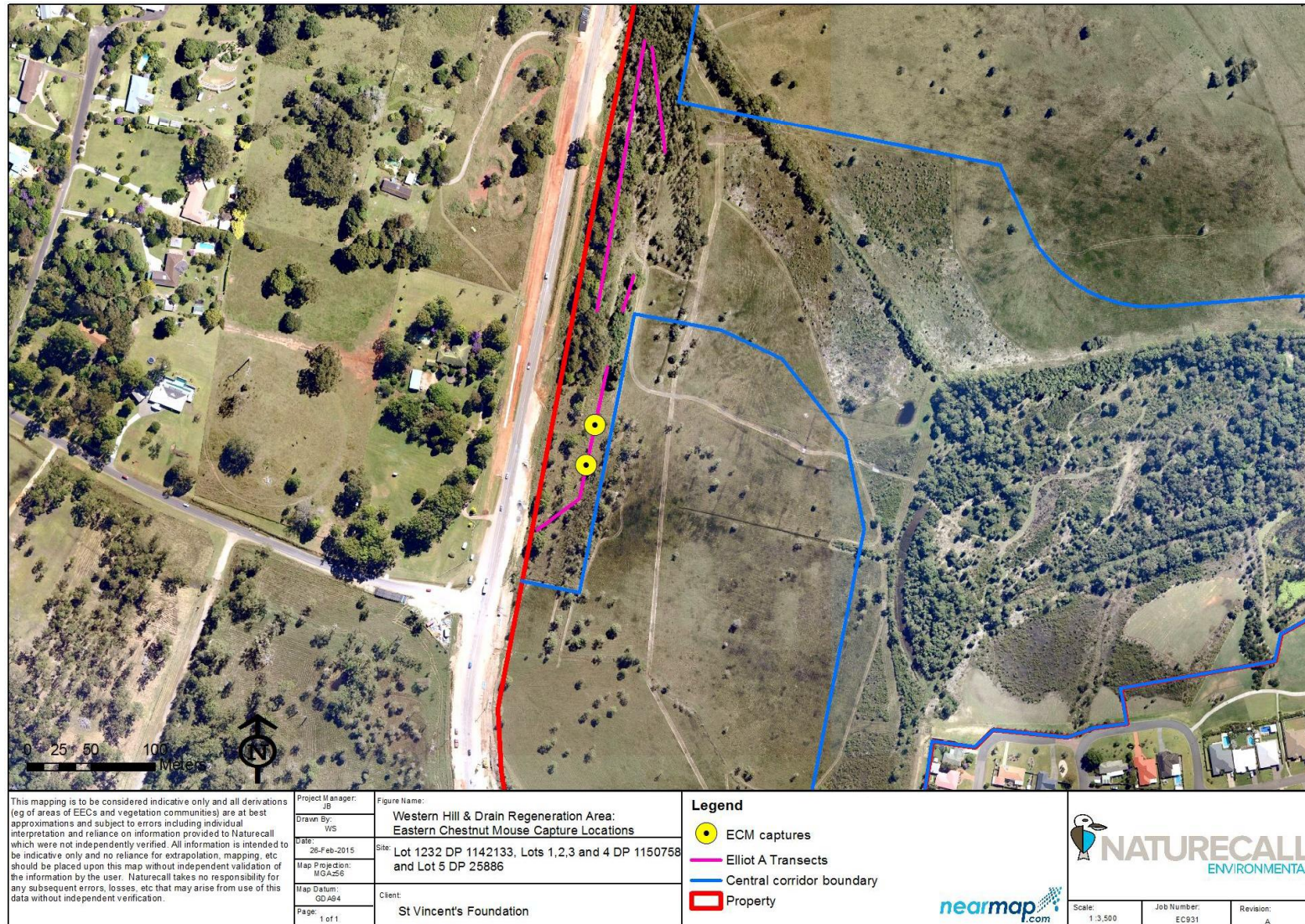




Figure 15: Location of hair funnels and Elliot A transects in the southwestern EEC regeneration area.

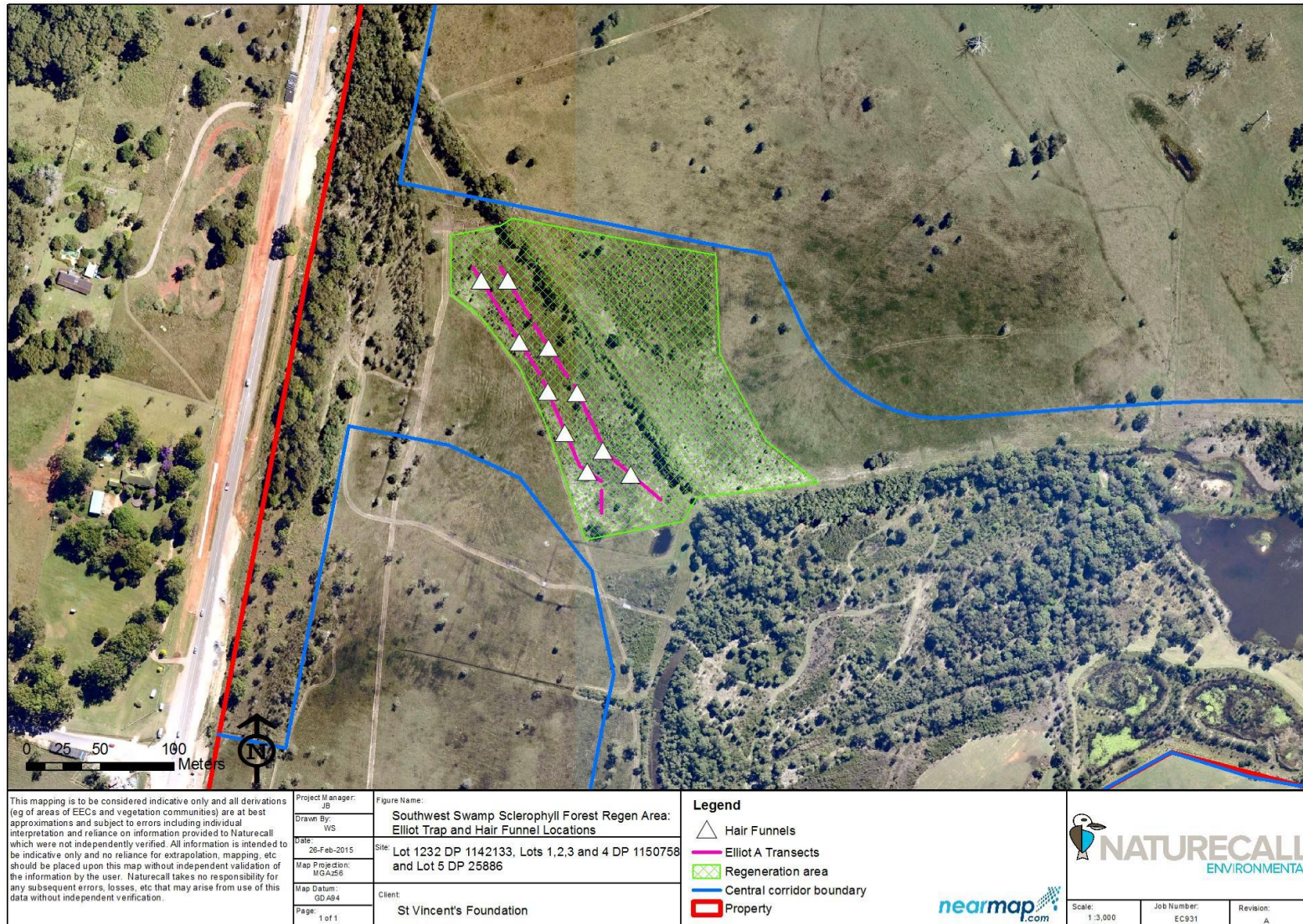
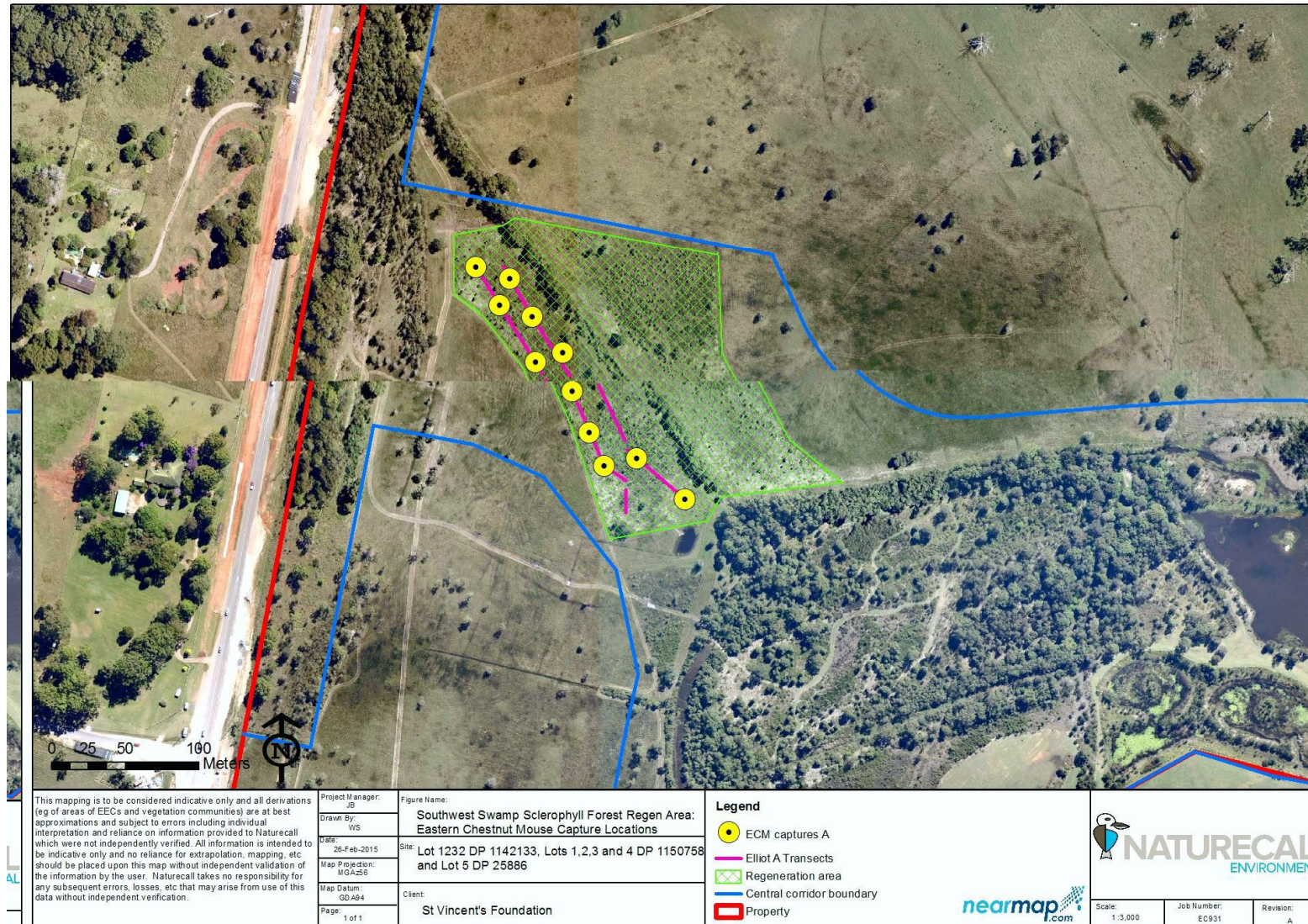




Figure 16: Location of Eastern Chestnut Mouse captures in the southwestern EEC regeneration area





15.0 Discussion and Review

15.1. Lot 5 ECM

As shown in Table 13, survey of Lot 5 failed to detect any ECM, and only recorded 2 Swamp Rats in the isolated fern patches near where the species was previously detected on this Lot.

This result strongly suggests the threatened species has been displaced from the open grassland where it was originally recorded in 2003, and is not persisting in the adjacent potential refugia. The lack of abundance of Swamp Rats is also considered significant given the overlap of habitat requirements of these competitive species.

The following section reviews the results in terms of ongoing agricultural management and suitability of the adjacent refugia habitats for the ECM.

15.1.1. Displacement by Routine Agriculture Management Activities

As detailed in Darkheart (2008a) since the 2003 survey, the native and exotic grassland, like the remainder of the property, have continued to be maintained for beef cattle production by the caretaker of the property. As part of this, Lot 5 has been periodically slashed depending on seasonal variations in rainfall. During the 2006 survey, the grassland was simply a low pasture unsuitable for any small mammals. During the site visits in 2008, it was also in this condition.

Prior to the 2012 survey, recent years had been exceptionally wet years which limited pasture management practises, and cattle have also been removed from the property. This saw a decline in regular pasture maintenance with Lot 5 appearing to have been last slashed within the preceding 12 months (www.nearmap.com). Review of aerial photos show the northern two thirds of the property was previously slashed at least once a year.

Consequently, the native grassland was around the densest it has been for >5yrs at time of survey. The following photos illustrate the limited cover currently present post 2003, which would be unsuitable for the ECM due to exposure to predators, e.g. raptors and foxes.



Photo 19: View south of northern limit of previous ECM habitat



Photo 20: Southwest corner of Lot 5





Photo 21: Hair funnel in densest patch of Bracken Fern in open paddock of Lot 5

Note openness of this habitat which predisposes fauna to a very high predator exposure.



Photo 22: Current habitat on Lot 5 where Eastern Chestnut Mouse was caught in 2003

Also note the overhead powerline and its associated buffer zone (approx. 30m wide) dissecting the dune scrub.



These photos illustrate that the habitat in which the species was formerly detected in 2003 has not been suitable for some time. Consequently, it is clear that the species has been effectively displaced from this habitat since that time.



15.1.2. Review of Refugia and Potential to Re-Occur

Based on the ecology of this species and its preference for habitats regenerating from disturbance (Luo *et al* 1994, 1995, Luo and Fox 1994, Meek and Briggs 1996), it is logical to deduce that the species needs refuge habitats to persist in until disturbed habitats have regenerated to a sufficient level to allow colonisation.

As recovery may take years, logically such habitats must be suitable and capable in terms of providing sufficient foraging and refugia resources to support the species' full lifecycle and maintain recruitment levels above mortality. The latter is essential to allow future expansion into recovering habitat (Luo *et al* 1994, 1995, Luo and Fox 1994, Meek and Briggs 1996, Lindenmayer and Fisher 2006, Amarasekare and Possingham 2001, Elkin and Possingham 2008).

Hypothetically thus, given the species' preference for dense cover and limited ability to move through a hostile matrix such as expanses of pasture which dominate the property, the ECM population previously detected in the rank grassland on Lot 5 in 2003 should have been displaced to adjacent habitats by slashing. To remain viable in this refugia, it would be expected to persist until the disturbed habitat sufficiently regenerated and re-colonisation was feasible. Consequently, to validate this hypothesis, its presence in these habitats when preferred habitat is uninhabitable would logically indicate this fact.

As shown in Figures 2 and 8, these adjacent habitats offering potential refugia on Lot 5 are:

- Dune scrub, predominantly consisting of a dense cover of Coastal Teatree (*Leptospermum laevigatum*) and *Monotoca elliptica*.
- Dry sclerophyll, as a small remnant ranging from 14-75m wide along the eastern side of Duchess Gully with another stand on the rear of the hill to the east.
- Swamp forest, located at the western end of the dune scrub and extending onto the adjacent STP and along Duchess Gully. Consists of a canopy of Swamp Mahogany and Broad-leaved Paperbark with a very tall dense cover (often closed) of Batwing Fern (*Histiopteris incisa*), *Gahnia clarkei* and/or False Bracken.
- Littoral rainforest and other habitats in the Crown Reserve (see Section 6).

In order to assist testing of the above hypothesis, these habitats are briefly evaluated for suitability for the ECM in terms of:

- Structural and floristic characteristics ie presence of suitable refugia and preferred forage species (eg seed-producing grasses and sedges).
- Presence of its competitor, the Swamp Rat, as a surrogate indicator of habitat suitability.

15.1.2.1. Dune Scrub

As illustrated in Photo 19, the dune scrub is considered structurally and probably floristically unsuitable for the ECM due to:

- Sparse, absent or clumped ground cover, hence poor refugia; &



- Lack of floristic diversity, i.e. predominantly limited to Spiney-Headed Matrush, with rare occurrence of *Lepidosperma* sedges and some *Gahnia clarkei* and ferns in the western ecotone: hence poor variety of food resources.

The only species detected in this habitat were House Mice, Brown Antechinus and Bush Rats.

Given the limited diversity of food resources in this habitat, competition with the Black Rat and Bush Rat may also contribute to the absence of the ECM.

The absence of Swamp Rats from this habitat strongly suggests this community lacks preferred food resources for the ECM (Fox 1998, Watts and Tweedie 1993, Meek and Triggs 1996, Luo *et al* 1994, Luo and Fox 1995).

Photo 23: Sample photo of typical groundcover stratum in the dune scrub



15.1.3. Dry Sclerophyll

The dry sclerophyll's groundcover ranged from absent (apart from sparse Saw Sedge or ferns under areas of dense understorey), to sparse Matrush (where the western-most hair funnel was located), to a very dense to closed cover of either Bracken Fern or impenetrable entanglements of Coral Fern on the eastern fringes (see following photo). The latter two areas were where most of the Elliots and hair funnels were set as this was the densest groundcover in the area and hence hypothetically the most likely area where the target species would be detected.

Bush Rats dominated this area in relatively high numbers with a few Antechinus and House Mice.

Surprisingly very few Swamp Rats were detected in this area (only one in each of the two outlying fern clumps in the slashed pasture, suggesting displacement by Bush Rats to the marginal fringe), further suggesting it was also unsuitable for the ECM given their well-studied dietary overlap (Luo and Fox 1995), e.g. very few seed resources or palatable vegetable material.



Photo 24: Dense ferns in dry sclerophyll on eastern fringe of Duchess Gully corridor



15.1.4. Swamp Forest

This community contained the best developed groundcover, reaching >1m in height and generally being closed, as shown in the photo below.

However, trapping only recorded high numbers of Bush Rats, a few Swamp Rats and Antechinus. Again, the lack of floristic diversity of preferred food resources, coupled with lack of disturbance (ie fire) plus competition with the rats, suggest this habitat is only at best marginal potential habitat and unlikely to be a key refuge habitat for the ECM.

Photo 25: Tall dense cover of Batswing Fern and Saw Sedge in the Swamp Forest





15.1.5. Crown Reserve Habitats

As detailed in Section 6, the Crown Reserve contains:

- Littoral rainforest (a low disturbed and intact form).
- Banksia woodland.
- Closed tall shrubland.
- Maritime grassland/foredune complex.

The maritime grassland/foredune complex is not recognised in the literature as suitable for the species, presumably due to constraints such as lack of preferred food sources, limited cover, lack of free water, etc. Previous survey of identical habitat south of Kattang Nature Reserve by the consultant has recorded only Brown Antechinus, Bush Rats, House Mice and Black Rats (Darkheart 2010). A similar assemblage is expected to occur in the adjacent Reserve's occurrence of this community.

The Banksia woodland shares patches of dense Bracken Fern and Saw Sedge fringed with Matrush (similar to surveyed habitats in the Swamp Forest along Duchess Gully) with disturbed sections of the Littoral Rainforest (see Section 6 and Photos 26 and 27). These areas were noted to be subject to inundation by >100mm of water during the vegetation survey which would be a further limitation to their usage by terrestrials.

The remainder of the Reserve has the same groundcover: Spiney Headed Matrush with a variable mix of Tassel Cord Rush (*Baloskion tetraphyllum*). This is generally open to sparse, provides poor refugia for small terrestrials and limited foraging options.

The adjacent Reserve area was not surveyed for this assessment, however the larger northern part of the Reserve opposite the Milland-Seawide development, and north to Middle Head has been previously surveyed (Berrigan and Bray 2002, Parker 2002). Both surveys recorded a relative abundance of Bush Rats, Swamp Rats, Brown Antechinus, Black Rats and bandicoots. These results would mirror those likely to be found by survey of the vegetation in the Reserve adjacent to Lot 5, where very similar structural and floristic assemblages occur.

In addition to this, the Crown Reserve vegetation communities naturally have extremely low (virtually nil for at least decades) fire frequencies, and hence the disturbance regime would not suit the ECM historically or presently.

Consequently, the habitats within the Crown Reserve are not considered suitable as a refuge to maintain a viable population of ECM while the native grassland was rendered unsuitable due to slashing over the last decade.



Photo 26: Saw Sedge and fern patches in Crown Reserve



Photo 27: Typical open cover of matrush in littoral rainforest in the Crown Reserve



15.1.6. Summary – Lot 5

The trapping results combined with a habitat review of adjacent refugia are considered to strongly indicate that the ECM has been effectively displaced from the both the previous known habitat (the grassland on Lot 5) and the habitats adjacent.

The latter result is highly significant, as for the species to recolonise the area suggested by Concept Approval Condition B6 to be managed for the species, a viable population capable of expansion must be present in the adjacent habitats to provide a source population. However, the 2012 survey results and habitat evaluation (and comparison to optimum habitat in the southwest regeneration area) provide clear evidence that the habitats adjacent to the former known habitat on Lot 5 are not suitable short or



long term refugia. Consequently, it appears the small population previously detected on Lot 5 in 2003 has become locally extinct.

The likelihood of the ECM re-colonising this area from the known habitat in the southwest of the property is considered to be at best remote given:

- The only known source population is >1km away. None are known to occur in other habitats in the northern half of the coastal strip and appear unlikely to occur south (aerial photographs suggest unsuitable habitat based on survey results).
- While a wildlife corridor is being established linking this known and evidently growing population in the southwest, to the former habitat on Lot 5, there is no certainty that the species is likely or capable of progressively migrating to Lot 5, or will be incentivised to do so.
- A sufficient number of individuals would have to disperse to the nominated habitat area on Lot 5 to establish a viable population. This would require both a very effective corridor for this groundcover dependant species, and sufficient source habitat to support a population large enough to generate a significant number of emigrants. Such a population has limited potential to eventuate due to the limited extent of potential habitat in the corridor (and hence carrying capacity), and the corridor's effectiveness for this species is constrained by habitat bottlenecks and lack of uniform habitat suitability throughout the corridor for this species.
- The area nominated to be regenerated and managed on Lot 5 under Concept Approval Condition B6 is only about 1.5ha. As the adjacent habitats have been demonstrated to be unsuitable and this area is only distantly connected to high quality habitat, the likelihood of a genetically viable population establishing and being maintained in perpetuity, is extremely remote due to the limited carrying capacity and hence sustainable population size that this 1.5ha could support (in addition to its relative isolation from other known habitat and hence genetic exchange constraints).

Consequently, Concept Approval Condition B6 appears likely to have little if any significant benefit to the ECM.

For this reason and to achieve a greater ecological outcome overall, as detailed in Section 8.2, it is recommended that the Condition be amended to allow regeneration of this area into fully structured Coastal Sands Blackbutt forest to enhance connectivity and carrying capacity for a broader range of species.

15.2. Western Regeneration Areas

15.2.1. Western Hill Offset Area

The western hill offset area's vegetation is detailed in Darkheart (2008a), but generally consists of dry sclerophyll forest with a groundcover of Bladey Grass, Spiney-Headed Matrush and Bracken Fern. The adjacent drain is dominated by a dense cover of *Lepidosperma* spp., with *Babingtonia pluriflora* forming a dense wet heath in a linear pattern.

This area and the adjacent small drain to the east, have not been slashed since the 2003 survey and the former was fenced off in 2007. Since this time the only changes have been supplementary plantings



in the northern end and on the small mound of fill. No burning or slashing has occurred in this area in about 13 years (James Dunn, pers. comm.).

The 2012 survey data shows that this has generally maintained habitat values for the ECM in terms of floristics and structure, however the lack of a disturbance (such as slashing or fire) has resulted in the habitat becoming rank, with dead Bladey Grass dominating the dense sward on the hill. This better suits the Swamp Rat, as evidenced by localised and fewer captures of the ECM in the southern end and an overwhelming abundance of Swamp Rats.

To provide optimum conditions for the ECM and maximise population size, this area clearly needs a planned artificial disturbance regime to establish a mosaic of seral stages which provide both refugia and areas of habitat optimum for the ECM. The current situation and management regime is over-benefiting the Swamp Rat, to the detriment of the ECM's long term viability (Fox 1998, Watts and Tweedie 1993, Meek and Triggs 1996, Luo et al 1994, Luo and Fox 1995).

Photo 28: Open rank grassland where ECM was recorded





Photo 29: Wet heath



Photo 30: Vegetation under the trees



15.2.2. Southwest EEC Regeneration Area

This area forms part of the offset for loss of EECs as part of the proposal and forms part of the wildlife corridor in the Open Space Corridor (AECOM 2010). On both sides of the central drain, approximately 3.2ha has been fenced off and subject to weed control and assisted regeneration to date. Only the



approximately 1.34ha on the southern side of the drain was surveyed for this assessment as shown in Figures 13 to 14. Another approximately 0.97ha in the open space corridor between this area and the southern school site has continued to be maintained for grazing, but has excellent regeneration potential and potential suitability for the ECM.

The vegetation in the current 3.2ha regeneration area is essentially the early stages of open swamp woodland that could eventually become a forest via progressive recruitment and natural infilling. A handful of older Swamp Mahogany about 5-8m high with trunk diameter at breast height (DBH) <20cm occur, but most of the taller vegetation (2-3m high) comprises young *Melaleuca linariifolia*, *M. sieberi*, and *M. stypheloides*, with a clump of Swamp Oak daughters around their parent tree in the southeast corner. Some clumps of dense shrubland (wet heath) occur in lower areas with the dominant species being *Leptospermum* spp with *Pultenaea villosa*.

The groundcover in this area is a complex mosaic of predominantly native species of sedges and grasses, varying with micro-relief; with patches of exotic grasses comprising *Setaria* spp. and Torpedo Grass (**Panicum repens*). The latter are being actively suppressed by bush regenerators engaged by the proponent.

The dominant native sedges and grasses comprise *Lepidosperma* spp, *Chorizandra* spp, *Eleocharis acuta*, *E. sphacelata*, *Juncus articulatus* and *Leersia hexandra*. A diverse range of herbs are also present and some localised occurrences of *Gahnia clarkei*. In addition to this floristic variability is the structural variability. The community could be described as tussocky with patches of taller vegetation mixed in complex mosaics with patches of shorter vegetation, but this structure is also influenced by frequent track making by feral deer.

The following photos indicate habitats in which the ECM was captured (orange tag indicates capture location).

Photo 31: Exotic grassland with native species





Photo 32: Mosaic of native grasses, sedges and shrubs



Photo 33: Wet heath with matted sedge groundcover



15.2.3. Population Size and Density

The *Swamp Sclerophyll Forest* EEC regeneration area surveyed in 2012 is approximately 1.34ha in extent, and the survey results indicate it is supporting at least 5 adult ECM at the time, equating to a density of 1 animal per approximately 2700m². Given the cited home range is <0.5ha, this is a relatively



high density, and given Swamp Rats are also present, indicates the regeneration area currently offers very high quality habitat. A similar sized area with identical habitat (see Photo 30) occurs to the north, hence the total population in these two regeneration areas could be at least 10 animals. While a small size for a population, given a single animal was originally detected on the Western Hill (Berrigan 2003a), this is an extraordinary population increase over an area of habitat that previously did not exist.

The Western Hill area surveyed for this assessment is approximately 2.5ha in extent but only two animals were found here (within 30m of each other) despite similar trapping density. While this equates to a home range of about 1.25ha, considering the detection of the animals in the southern end where trees were absent and the cover thickest and in close proximity to the wet heath; absence from the northern half of the regeneration area; and the observations in the regeneration area: this suggests the home range of these animals is likely to be concentrated in a localised area in the south where a more suitable mosaic of habitats occurs, and hence actual home range is much smaller.

The evident competition with Swamp Rats however throughout the entire area (especially in the wet heath and most of the Bladey Grass area) suggests the population is suppressed (possibly even stimulating high emigration to the regeneration area from the original source population), therefore justifying an interventionist management regime to optimise the habitat and maximise population size and hence its robustness.

Photo 34: Habitat in northern part of EEC regeneration area

