Prepared for D & J Brewer

Proposed subdivision, Lot 2, DP 250984, Grandfathers Gully Road, Lilli Pilli, NSW

Target Southern Brown Bandicoot Survey and Assessment FINAL

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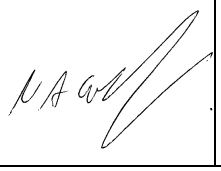
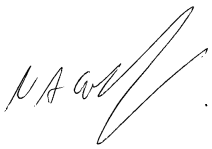
Final	25.03. 08	name	Eleanor Stalenberg 	name	Nick Graham-Higgs 	name	Nick Graham-Higgs 

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The following definitions given below will be used in this report.

activity - has the same meaning as in the *Environmental Planning and Assessment Act 1979* (*EP&A Act*). The nature of the proposed activity is described in section 2.2.

CMA – Catchment Management Authority.

DECC – Department of Environment and Climate Change.

DoP – Department of Planning.

endangered population - population specified in Part 2 of Schedule 1 of the *Threatened Species Conservation Act 1995 (TSC Act)* or in Schedule 4 of the *Fisheries Management Act 1994* (*FMA*).

endangered ecological community (EEC) - an ecological community specified in Part 3 of Schedule 1 of the *TSC Act* or Schedule 4 of the *FMA .*

LGA – Local Government Area.

likely - taken to be a real chance or possibility (NPWS 1996).

locality - means the area within a 5 km radius of the subject site.

local population - the population that occurs within the study area, unless the existence of contiguous or proximal occupied habitat and the movement of individuals or exchange of genetic material across the boundary can be demonstrated (NPWS 1996).

region - means a biogeographical region that has been recognised and documented such as the Interim Biogeographical Regions of Australia (IBRA). The study area is located within the South East Corner Bioregion.

SBB – Southern Brown Bandicoot

subject site – the area to be directly affected by the proposal (NPWS 1996).

study area – the study areas includes the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly (NPWS 1996). In this assessment, the study area extends into the vegetation between the northern-western boundary and the powerline easement.

threatened biota - means those threatened species, endangered populations or endangered ecological communities considered known or likely to occur in the study area.

threatened species – a species specified in Schedule 1 Part 1 (endangered species), Part 4 (presumed extinct) and Schedule 2 (vulnerable species) of the *TSC Act* or Schedules 4 and 5 of the *FMA.*

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1. INTRODUCTION

This report was commissioned by Mr David Brewer to support a Development Application to the NSW Department of Planning (DoP) for a rural residential subdivision which has been categorised as a state significant project under Schedule 2 of SEPP 2005 (Planning Initiatives 2007). The development application was supported by numerous specialist reports within the Environmental Assessment (EA). Relevant to biodiversity were a Flora and Fauna Assessment (PMA Consulting 2005) and an addendum to this report (**ngh**environmental 2007a) due to legislative changes to the assessment process after the completion of the PMA report.

However, a review of the Development Application by the Department of Environment and Climate Change (DECC) resulted in the requirement that additional survey and assessment on Southern Brown Bandicoot (*Isoodon obesulus obesulus*) (SBB) must be undertaken.

The aim of this report is to undertake a target survey for SBB to prepare an assessment of significance for this species in relation to the proposed activity. This report provides information on the proposal in section 2 and the existing environment in section 3. Section 4 reviews the general ecology, the legislative framework relevant to the species and it's status on the south coast and Eurobodalla LGA. Section 5 & 6 details the methods and results of the study, while section 7 discusses the results and the likelihood of occurrence. Section 8 provides the results of the assessment of significance undertaken in accordance with NSW and commonwealth legislation while section 9 provides a conclusion. A number of appendices detail a series of data collected during the survey, the output of the statistical analysis, NSW and Commonwealth Assessments of Significance and correspondence relevant to the design and implementation of the survey from DECC.

2. PROPOSED ACTIVITY

The proposed activity is for a rural-residential subdivision. This would consist of 13 lots between 0.5ha and 1.56ha and an access road. It is expected that asset protection zones in accordance with the Planning for Bushfire guidelines would be created post-development. As such, it is expected that 0.6 ha of native vegetation would be removed as a result of the proposed activity. Further detail on the proposed activity is available in the EA (Planning Initiatives 2007).

Figure 1: The proposed layout for the rural-residential subdivision. Green shading depicts patches of existing native vegetation (courtesy of Conway, Burrows and Hancock).

3. EXISTING ENVIRONMENT

3.1. Subject site

The land subject to the proposed activity is located at Lot 2, DP 250984, Grandfathers Gully Road, Lilli Pilli, NSW and comprises approximately 10.2 hectares (Planning Initiatives 2007). It is currently zoned 1 (c) Rural Holdings under the Eurobodalla Urban Local Environment Plan (ESC 1999) and is now referred to as the 'subject site'.

The subject site consists of both cleared and forested land, with much of the existing vegetation consisting of regrowth. In the past, much of the subject site has been used for the purposes of agriculture with a long history of deer farming. The remaining vegetation is characterised by Coastal Lowlands Cycad Dry Shrub Forest (Forest Ecosystem 9 in Thomas et al 2000) on the ridges and upper slopes, tending towards Northern Foothills Moist Shrub Forest (FE21) in the gullies and lower parts of the subject site (**ngh**environmental 2007a)

The subject site is located approximately 10 kilometres south-east of the coastal town of Batemans Bay in the Eurobodalla LGA.

3.2. Landscape Context

The subject site is located within a matrix of land uses. To the north-west, a large waste disposal facility dominates, and adjacent to the site are a number of similar rural-residential allotments. Across George Bass Drive is 'Public Open Space', zoned 6 (a1) in the Eurobodalla Urban Local Environmental Plan (ESC 1999). It has been suggested that this open space is one of the last remaining areas outside of formal conservation areas of relatively undisturbed vegetation that provides connectivity between the ocean and vegetation further inland (Andrews 2006). To the south, Lilli Pilli Beach Estate and other residential areas dominate.

Figure 2: Landscape context of the subject site (courtesy of Department of Lands SIX Viewer).

4. SOUTHERN BROWN BANDICOOT

This section provides general information on the species, relevant legislation and planning policies and the status of the species on the south coast and within the Eurobodalla LGA.

4.1. Species Information

The SBB is found across south-east mainland Australia, south-west Western Australia, Tasmania, Cape York and a number of offshore islands in South Australia (DECC 2006). Strahan (1995) recognises five sub-species with each being geographically isolated from another. Within NSW, the SBB (*Isoodon obesulus obesulus*) is regarded as rare and is found from the Hawkesbury River in the north to the Victorian border in the south (DECC 2006). More specifically, the recovery plan recognises that the sub-species occurs primarily in two areas. These being the Ku-ring-gai Chase and Garigal National Parks to the north of Sydney, and in the far south-east corner of NSW to the west and south of Eden (DECC 2006).

The SBB is known to occur in a variety of habitats. The recovery plan for the species includes heathland, shrubland, dry sclerophyll forest with a heathy understorey, sedgeland and woodland (DECC 2006). SBB occupies habitats that are fire prone (Braithwaite 1983) and other authors suggest that the species prefers to occupy early seral stages following disturbance such as fire. Further research has been suggested into how fire events and time since fire impact on SBB (Claridge et al. 1991).

4.2. Relevant Legislation and Planning Policies

4.2.1 NSW Threatened Species Conservation Act 1995

Section 94 of the NSW *Threatened Species Conservation Act 1995* ('the TSC Act') specifies that seven factors must be considered by consent authorities regarding the effect of a proposed development or activity on threatened species, populations or ecological communities, or their habitats. While this Act is not applicable for Part 3A projects, it is considered by the authors of this report to provide the most appropriate and transparent characterisation of potential impact.

If the determination is made that there is likely to be a significant effect then either;

- A Species Impact Statement (SIS) must be prepared and the concurrence of the Director-General of the Department of Environment and Climate Change (DECC) obtained prior to the consent authority making a determination, or
- The proposal may be modified such that a significant effect on threatened species, populations or ecological communities, or their habitats is unlikely.

The SBB is listed under schedule 1 of the TSC Act as endangered. The TSC Act defines 'endangered' as a species, population or ecological community that is likely to become extinct or is in immediate danger of extinction.

This report applies the seven part test to the SBB which may potentially be impacted by the proposal in order to characterise the significance of the impact (Section 7 & Appendix D).

4.2.2 Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

Matters of national significance are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC* Act) and include threatened species and communities, migratory species, Ramsar wetlands of international importance, the Commonwealth marine environment, World Heritage properties, National Heritage places and Nuclear actions.

The significant impact guidelines provide overarching guidance on determining whether an action is likely to have a significant impact on a matter of national environmental significance protected by the EPBC Act (DEH 2006).

The SBB is listed as endangered under the EPBC Act. As such, this report undertakes an assessment of significance in accordance with these significant impact guidelines (Section 7; Appendix E).

4.2.3 Fauna Habitat Linkages of Select Rural Residential Areas in the Eurobodalla Shire

Analysis of urban lands in various areas across the Eurobodalla LGA have suggested a number of habitat linkages for fauna movement (Daly 2001). To the north-west and south of the study area, it is suggested that a fauna movement corridor is present roughly situated from Malua Bay to the north-west along Ridge Rd and from Sunshine Bay south-west into Mogo State Forest (Figure 3). Andrews (2006) suggests that the Lilli Pilli area provides one of the last remaining areas of vegetation that provides connectivity from the ocean to vegetation to the south-west and west.

Figure 3: Habitat corridors as defined by Daly (2001) in the Surf Beach & Malua Bay areas. Red polygon depicts subject land (Base map courtesy of six viewer, Department of Lands).

4.3. Southern Brown Bandicoot on the NSW South Coast

On the NSW Far South Coast, the SBB has a patchy distribution and is almost exclusively restricted to the coastal fringe (DECC 2006). Searches of the DECC NSW Atlas of Wildlife Database document 79 records of this species, with the majority of these in the far south east corner (Figure 4; DECC 2008a). The majority of records in the south coast region come from public land including Ben Boyd National Park, East Boyd State Forest, Nadgee Nature Reserve,

Nadgee State Forest, South-east Forests National Park, Timbillica State Forest and Yambulla State Forest (DECC 2006). Maroota, Mumbulla, Nalbaugh and Nullica State Forests have a small number of records (DECC 2006). Searches of the BioNet Fauna Database reveal a similar pattern of distribution.

4.4. Southern Brown Bandicoot in the Eurobodalla LGA

A single record of the SBB occurs for the Eurobodalla LGA (DECC 2008a). Dr Andrew Claridge, DECC scientist, provides detailed information on this record in email correspondence dated the 3rd March 2008 and additional information is provided from the DECC NSW Atlas of Wildlife Database by Mr Dimitri Young, DECC Threatened Species Coordinator in an email dated the 7th January 2008.

Mr Mike Fleming, former Branch Director with the NSW National Parks and Wildlife Service at Dubbo on the 3rd January 1998 collected the road-killed specimen on George Bass Drive, at or near the crossing with Grandfather's Gully. Dr Andrew Claridge received a hair sample from Mr Mike Fleming who confirms that the hairs were clearly that of a SBB. Discrepancies in the location shown in the public access version for this record to those provided by DECC staff from their database are evident. The data from both sources plot the record further to the west on Ridge Road, some distance to the south of the subject site, and within a small patch of Mogo State Forest. Mapping of the coordinates provided by DECC are provided (Figure 5).

Details of correspondence are provided in Appendix I.

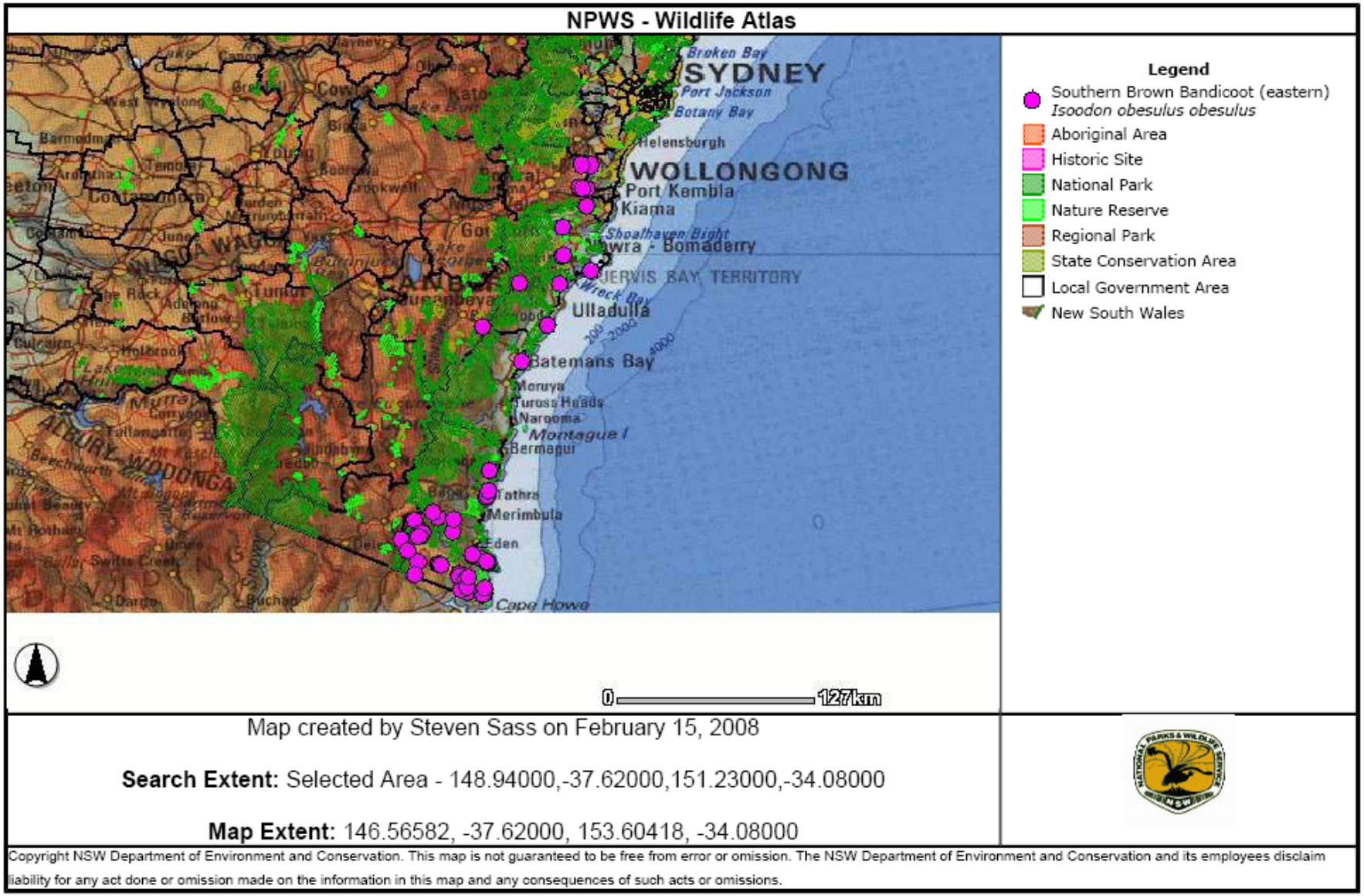


Figure 4: Records of Southern Brown Bandicoot south of Sydney.

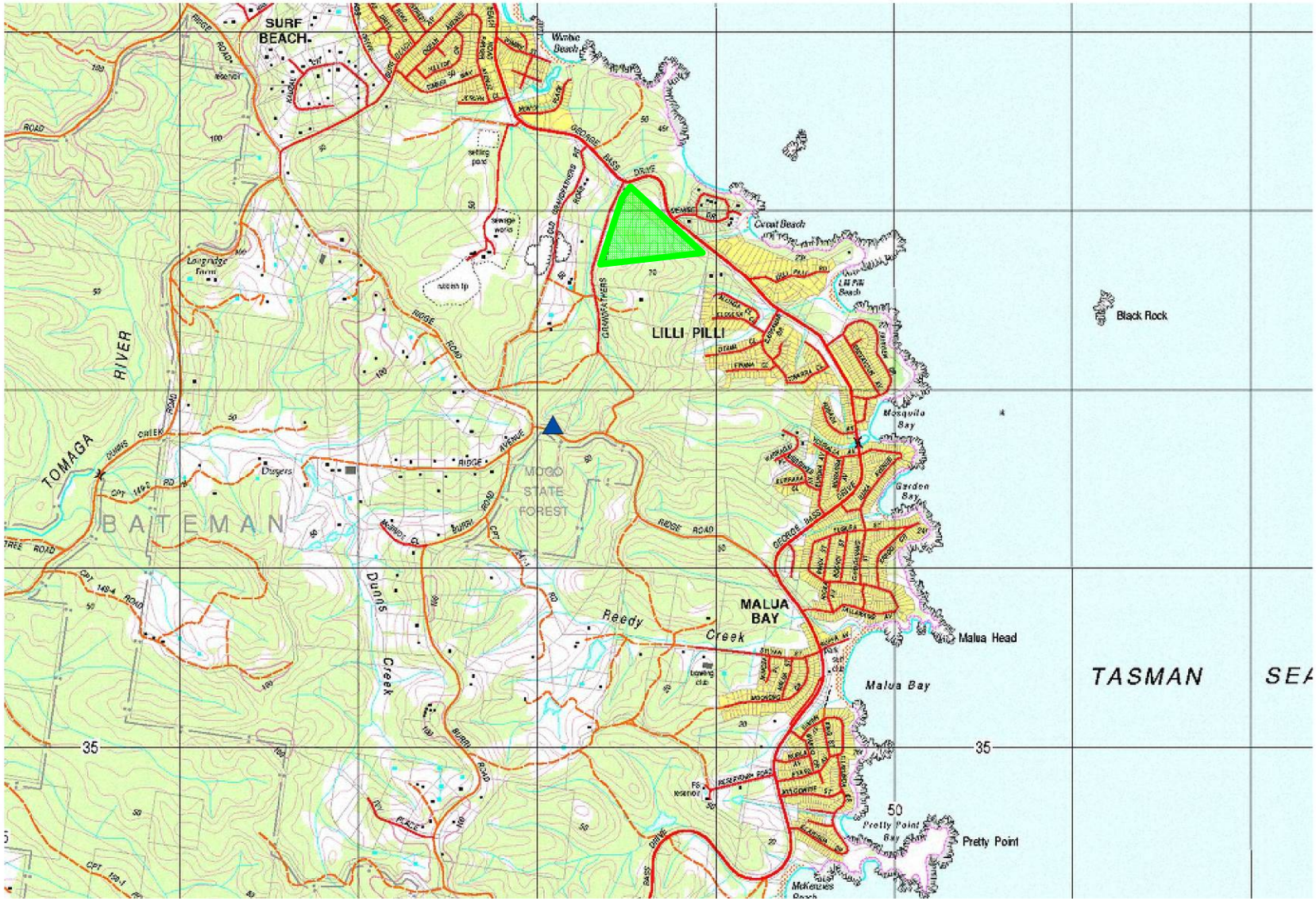


Figure 5: Single record of Southern Brown Bandicoot in the Eurobodalla LGA (point data courtesy of Dr Andrew Claridge, DECC) and the subject site.

4. METHODS

4.1 Sampling techniques

The methodology used in this study is guided by the 'Environmental Impact Assessment Guidelines for SBB' (NSW NPWS 2001). These guidelines were prepared to provide information to assist environmental consultants, proponents and consent authorities who are required to prepare or review assessments of likely impacts on SBB pursuant to the provisions of the *Environmental Planning and Assessment Act* 1979.

The following methodology considers the survey methods proposed within these guidelines and discussions between Mr Dimitri Young, Threatened Species Coordinator and Dr Andrew Claridge (a bandicoot specialist) both of DECC, Queanbeyan (See Appendix I). The methodology was also approved by the Department of Planning in correspondence with the proponent.

1. The study area for the purpose of trapping SBB will encompass the subject land and off-site trapping in the area of vegetation between the subject site and the powerline easement to the north.
2. Field survey was undertaken between the 24th February 2008 and the 1st March 2008.
3. Cage trapping was initially designed to be undertaken using 20 cage traps over 5 consecutive nights, totalling 100 trap nights. However, due to a number of cage traps being stolen from the subject site during the survey period, the methodology was varied to achieve a higher number of traps nights. This was completed using 17 traps over 6 consecutive nights, 3 traps over 4 consecutive nights, and 1 trap over 1 night, giving a total of 115 trap nights.
4. Cage traps were baited with a mixture of peanut butter and rolled oats and alternated with honey and sardines between traps with equal effort to encourage bandicoot capture
5. Traps were checked and closed each morning and re-opened before dusk.
6. Any species of bandicoot captured was photographed and a hair-sample taken for analysis by Ms Barbara Triggs of Genoa, Victoria (an independent expert in hair-sample analysis) to confirm the species identity.
7. Habitat analysis was undertaken at each of the 20 original trap locations recording ground cover attributes, understorey density, connectivity of habitat and other relevant variables.

4.2 Selection of survey sites

The selection of survey sites was based on an obvious bias toward maximising the potential for mammal capture. This was done by selecting survey sites within the existing vegetation on the subject site and within vegetation adjacent to the northern boundary. 21 survey sites were selected with a cage trap placed at each (Figure 6). GPS coordinates are also provided (Table 1). Habitat attributes were recorded at the original 20 sites.

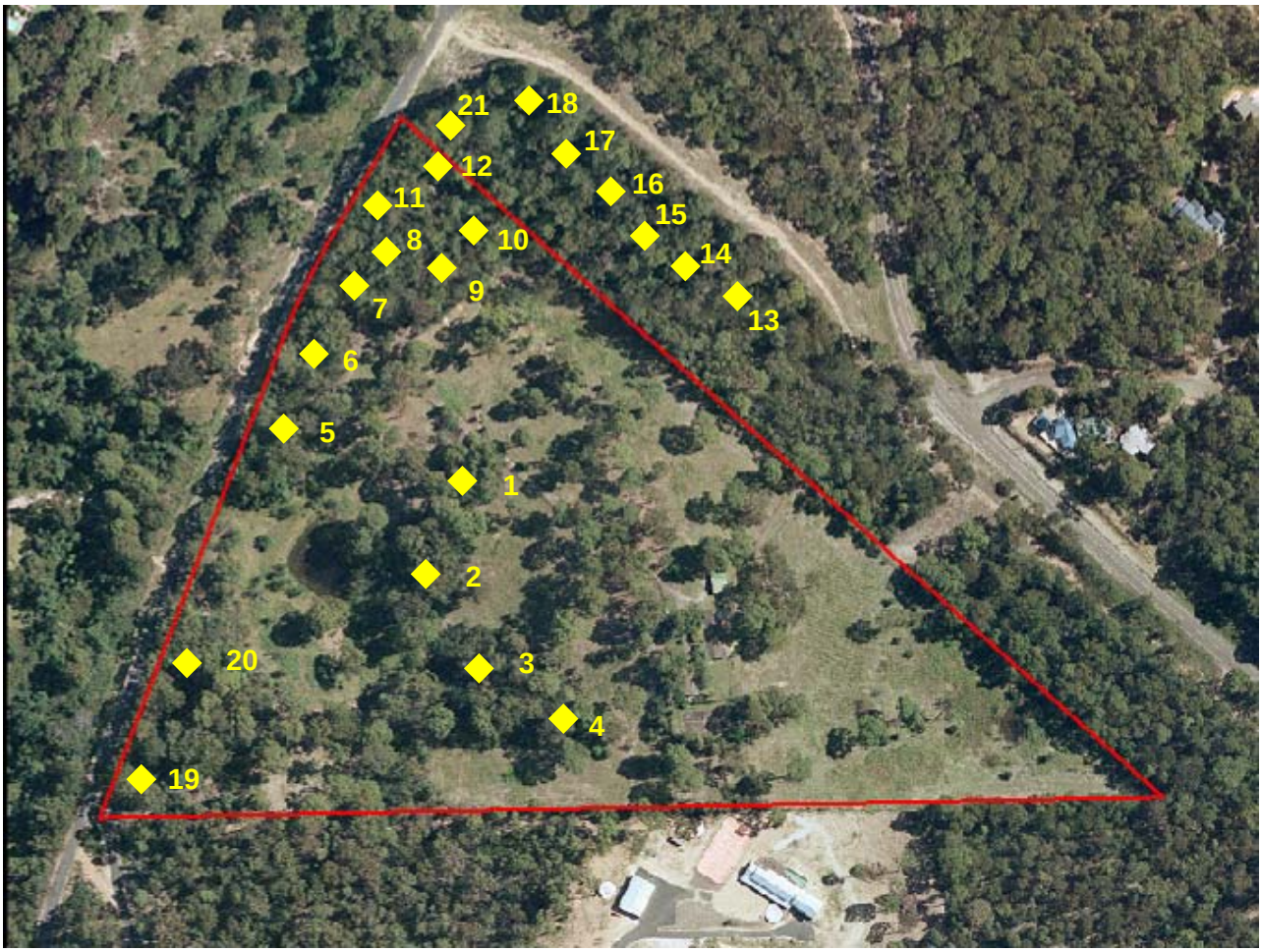


Figure 6: Location of survey sites in the study area (base image courtesy of NSW Spatial Exchange Viewer, Department of Lands).

4.3 Habitat analysis

Variables at 20 of the survey sites were recorded using the general attributes relevant to habitat as developed by the Department of Land and Water Conservation as a tool to measure the biodiversity values (Oliver 2004). Variables at site 21 were not recorded as this location was used for only one trap night.

Habitat variables were assessed within a 20m quadrat where the cage trap represented a centre point of this quadrat. Further details on these variables are provided (Table 1).

Table 1: Habitat variables measured at each survey site in a 20m quadrat.

Habitat Variable	*Details*
LOGS100300	Number of logs with a diameter between 100 – 300mm.
LOGS300+	Number of logs with a diameter greater than 301mm.
LOGM100300	Lineal metres of logs between 100-300mm
LOGM300	Lineal metres of logs greater than 301mm.
HOLLOGSTND	Number of hollows observed in live or dead standing trees
HOLLOGGRND	Number of hollow logs on the ground.
NATIVEPLNTS#	Number of native plant species present in the quadrat.
OVERSTOREY%	Percentage cover of overstorey vegetation.
MIDSTOREY%	Percentage cover of midstorey vegetation.
NATIVEGRASSES%	Percentage cover of native grasses.
OTHNATIVE%	Percentage cover of other native flora.
EXOTICPLANTS%	Percentage cover of exotic flora species.
BAREGRND%	Percentage cover of bare ground.
LITTER%	Percentage cover of litter.
ROCK%	Percentage cover of exposed rock outcropping.
PATS#	Number of introduced and native past
OVERSTOREYDBH	Dbh of dominant overstorey species.
OVERSTOREYM	Height of dominant overstorey species.
MIDSTOREYDBH	Dbh of dominant midstorey species.
MIDSTOREYM	Height of dominant midstorey species.
DIGGINGS	Presence/Absence of bandicoot diggings.

4.4 Statistical analysis of Habitat variables

Statistical analysis was undertaken on the habitat variables as detailed within Table 1 at each trapping survey site. However, as only one trap night was undertaken at site 21, this site is excluded from any analysis.

As such, habitat variables for each of the 20 survey sites were examined to determine differences in habitat. Non-metric multidimensional scaling (MDS) was used for this analysis because it is considered more robust to non-lineal effects when compared to other ordination techniques (Minchin 1987). Ordinations were performed in two dimensions, with 100 iterations for each dimension to guard against dissolute explanation (Wilkinson 1989). These values were then plotted against each other to form a dimensional scatter plot to allow visual inspection potential differences in habitat.

To facilitate interpretation, Spearman rank correlations were conducted between the scores of each dimension and the habitat variables at each site. This procedures allows a determination of the variables that were most correlated with each of the two dimensional MDS axes and therefore, contribute most to the differences in habitat at each survey site.

One-way analysis of similarities (ANOSIM) was then performed in order to compare the presence or absence of ground-dwelling mammals at each survey site (Minchin 1987) using a 0.05 level of significance.

Results from ANOSIM also calculate a test statistic 'R' identifying the observed differences between the fragments and the vegetation types (Clarke & Warwick 1994).

'R' values are generated for both global and pairwise comparisons and can be interpreted as follows:

R = 1 indicates total separation of areas
R = >0.75 indicates the areas are well separated
R = >0.5 there may be overlap but the areas remain different
R = <0.25 indicates the areas are hardly separated
R = 0 indicates the areas are indistinguishable from one another

All statistical analyses were performed using PRIMER (Primer-E Ltd 2001) and SPSS 16.0 (SPSS Inc. 2007).

5 RESULTS

5.1 Mammals

5.1.1 Cage Trapping

Cage trapping undertaken during this study revealed a total of three species of mammal; none of which are listed as threatened species under the NSW *Threatened Species Conservation Act 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.* These were the Bush Rat (*Rattus fuscipes*), Common Brushtail Possum (*Trichosurus vulpecular*) and Long-nosed Bandicoot (*Perameles nasuta*). Captures consisted of two Common Brushtail Possums (Site 4 & 20), nine Bush Rats (Site 4, 7, 9, 12, 13, 14 & 18) and one Long-nosed Bandicoot (Site 4). No SBB were recorded during the survey.

5.1.2 Hair Sample Analysis

While it was determined in the field that the bandicoot species captured was a Long-nosed Bandicoot, the 'Environmental Impact Assessment Guidelines for SBB' (NSW NPWS 2001) suggest that hair sample from bandicoot captures should be analysed by an independent specialist to confirm species identity. Analysis by Barbara Triggs of Genoa, Victoria confirms that the bandicoot captured during this study was a Long-nosed Bandicoot (*Perameles nasuta*).

5.2 Analysis of Habitat variables

The MDS ordination revealed that two dimensions were sufficient to provide a reliable representation of the 20 habitat variables presented in Table 1 (stress value = 0.08) (Appendix C). The MDS ordination provides a visual representation of the differences in habitat variables of the 20 survey sites (Appendix C). Sites with similar habitat attributes are spatially close, while those further away represent sites with differing habitat attributes.

The 21 habitat variables were then correlated within each MDS dimension using Spearman-rank correlations to determine which habitat variables were influencing these differences between sites. Five of the 21 habitat variables were statistically correlated to the first dimension, while 3 variables were significantly correlated to the second dimension (Appendix C). Significant correlations with the first dimension and therefore contributing most to these differences in habitat at each site were the number of native plant species, the percentage cover of the midstorey vegetation, the percentage cover of native grasses, the percentage cover of other native flora species and the percentage cover of litter (Appendix C).

For dimension two, the lineal metres of logs of both size classes and percentage cover of the midstorey vegetation were significant to the differences of each survey site (Appendix C). Conversely, little overlap between variables across each dimension occurred. Only the percentage cover of midstorey vegetation was significant for each MDS dimension.

However, an Analysis of Similarities (ANOSIM) revealed that there was no statistical difference in habitat variables at the 20 survey sites where terrestrial mammal species were trapped (ie, Bush Rat or Long-nosed Bandicoot) and sites where no terrestrial mammal species were trapped (*global R*= 0.038, *p*=>0.05).

All habitat data is presented in raw form (Appendix B).

6. DISCUSSION

6.1 Mammal community

The field survey revealed three mammal species during the cage trapping session. Previous studies on the subject land revealed additional mammal species, but no SBB or evidence of their presence have been recorded (PMA Consulting 2005; nghenvironmental 2007a). The three mammal species trapped during this survey are considered common species in the forests of the NSW south coast; although reports from local residents suggest that the common Long-nosed Bandicoot may be in decline (Andrews 2006).

6.2 Timing of the survey

The guidelines for EA for the SBB state that trapping should only be carried out between September and April and to avoid trapping in heavy rain (NSW NPWS 2001). Only 1.2mm of rainfall occurred during the survey period (BOM 2008). As such, the timing of the survey is considered appropriate for the trapping of SBB.

6.3 Previous surveys for Southern Brown Bandicoot in the locality

While it is acknowledged that no surveys were conducted by DECC after the record of SBB was made, numerous surveys and environmental assessments have been undertaken in the vicinity of the subject site which provide valuable information relevant to the potential presence of a local population of SBB.

PMA Consulting (2005) undertook searches for evidence of a number of mammals including SBB such as scats and diggings. No SBB or evidence of their presence was recorded during this study.

Adjacent to the site, Andrews (2006) undertook a field survey of the open space lands of Lilli Pilli. Twenty-four species of mammal were recorded during this study, of which only two were introduced species. Surveys over summer and winter 2005 did not reveal any bandicoot species, including the non-threatened Long-nosed Bandicoot using recognised methods such as cage trapping, hair tube analysis and elliot traps. The survey effort in this study was high with 136 cage trap nights, 176 elliot trap nights and 734 hair tube nights undertaken (Andrews 2006). Within this report, it is also reported that local resident Judy Thompson states that Long-nosed Bandicoots were once present on this site and in local backyards, but have since vanished (Andrews 2006).

In October 2006, **ngh**environmental conducted a flora and fauna survey 500m to the north-west of the subject site (nghenvironmental 2007b). 20 cage traps over 5 consecutive nights (100 trap nights) and 30 hair tubes over 9 consecutive nights (270 nights) did not reveal any SBB, although numerous other mammal species were recorded.

Discussions with ex-NSW Forests ecologist Mike Crowley were undertaken to ascertain the extent of surveying that this agency had undertaken for the SBB within Mogo State Forest located to the west of the subject site and also the location of the plotted data which contradicts the description in DECC records. Mike advised that extensive surveys during the period 1998-2005 by NSW Forests, which also included the Comprehensive Regional Assessment (CRA) surveys, failed to record SBB (Mike Crowley, personal communication, 3rd March 2008). These surveys were conducted using hair tubes and scat analysis, both recognised techniques for detecting SBB. Mike also stated that during his 30 years experience in conducting fauna surveys throughout the Eurobodalla LGA he had not recorded SBB.

6.4 Likelihood of occurrence of Southern Brown Bandicoot

While the single record of SBB was recorded in 1998 and confirmed by hair analysis by Dr Andrew Claridge of DECC, no SBB had been recorded prior to this record, or after this record despite considerable survey effort (see section 6.3 for details).

Discussions with Judy Thompson (Lilli Pilli Landcare Group) resulted in her providing a 2002 record of SBB in her garden in Lilli Pilli (Judy Thompson, personal communication, 27 February 2008).

However, the accuracy of this identification is tenuis, as the individual was observed moving quickly through the garden.

While PMA Consulting found no evidence of SBB at the subject site, a further study undertaken by **ngh**environmental (2007a) provided an addendum to the PMA report. This report made an evaluation of the habitat present and concluded that as the majority of the site is cleared, and that searches of the vegetated areas failed to reveal any bandicoot diggings, it was unlikely that the site provided any suitable habitat for the SBB (nghenvironmental 2007a).

In their review of threatened species that had potential to occur in the Grandfathers Gully area, Andrews (2006) stated that no bandicoot diggings were found on the Lilli Pilli Open Space Common and that is 'unlikely' to occur at the site due to an absence of suitable habitat.

While a confirmed record by hair analysis is undisputable, the target surveys undertaken during this study, and those in previous surveys in the direct locality, reflect the extremely low density of this population of SBB, should it be present in the locality. Home range studies of any species are often difficult, and such factors as habitat structure may influence home range size (NPWS 2001). Despite this, the home range of SBB has been reported as between 0.5ha to 6ha (NPWS 2001) while the recovery plan suggests up to 9ha (DECC 2006). However, it has been suggested that males have a home range of between 5-20 hectares, while females forage over a much smaller area of between 2-3 hectares (DECC 2008b).

It is unknown what sex the road-killed SBB was, so no extrapolation of potential home range can be undertaken. However, Dr Claridge stated in email communication that

> *"the actual location itself, near the Coastal Lowlands Cycad Forest, does not strike me as being all that promising as habitat for the species but immediately to the west of George Bass Drive the habitat dries out and there was heathy (ie. prickly) understorey elements – from memory. My guess is that the animal likely came from habitat to the west of George Bass Drive but east of the Princes Hwy inland" (Dr Andrew Claridge, personal communication, email 03/03/2008).*

The subject site does not possess any 'heathy' flora species, and the remaining vegetation of the gullies and north-western and south-western corners is dominated by Northern Foothills Moist Shrub Forest. The vegetation communities of the subject site are described (nghenvironmental 2007a).

> *'The subject site is on Ordovician metasediments and the existing vegetation is typical of this part of the south coast on clay soils, being species derived from Coastal Lowlands Cycad Dry Shrub Forest (Forest Ecosystem 9 in Thomas et al 2000) on the ridge and upper slopes, tending towards Northern Foothills Moist Shrub Forest (Forest Ecosystem 21) in the gullies and lower parts of the site. In both these communities the dominant tree is spotted gum (Corymbia maculata) with blackbutt (Eucalyptus pilularis), white stringybark (E. globoidea) and grey ironbark (E. fibrosa). Small trees consist largely of black sheoak (Allocasuarina littoralis) and wattles, Acacia mabellae, A. longifolia, A. mearnsii and A. implexa. The understorey is drier in the Cycad Dry Shrub Forest and includes burrawang (Macrozamia communis) and shrubs including Acacia stricta, Acacia terminalis, Hibbertia aspera, Daviesia ulicifolia, Leucopogon lanceolatus and Bursaria spinosa. In the moister forest type, which occurs on the lower slopes in a few spots around the site edges and in the gully there are tall shrubs including Acacia longissima, Acacia paradoxa, Acacia longifolia, Leptospermum polygalifolium and Ozothamnus diosmifolius, and a groundcover dominated by grasses Microlaena stipoides, Entolasia marginata and graminoids Lepidosperma urophorum and Lomandra spp.'*

Claridge & Barry (2000) confirm that ground-dwelling mammals such as bandicoots are more likely to occur in forest communities where the soil fertility is low. Forests NSW in their Species Management Plan for SBB in the southern region also imply this, suggesting that that dry shrubby forests contain the most likely habitat for SBB (Forests NSW 2007). They suggest that

> *'Dry Shrubby forests contain the most likely habitat for I. obesulus where heathy understoreys occur under an often sparse eucalypt overstorey in areas of poorly drained subsoil. These understoreys are dominated by, but not limited to, species such as Melalueca squarrosa,*

Banksia spinulosa, B. serrata, Daviesia buxifolia, Xanthorrheoa sp, Epacris impressa, Pteridium esculentum, and Lomandra longifolia. Eucalypt species often associated with these understorey habitat types include E. consideniana, E. ovata, and E. globoidea.'

The flora survey undertaken by nghenvironmental (2007a) found only *Eucalyptus globoidea* and *Lomandra longifolia*, both common plant species to nearly all forest types on the NSW South Coast. Eucalypts typical of dry heathy environments such as Yertchuk (*Eucalyptus consideniana*) and Silvertop Ash (*Eucalyptus seiberi*) are not present on the subject site (nghenvironmental 2007a). Vegetation matching the description provided by Forests NSW could loosely fall into Forest Ecosystem (FE) 138 (Northern Plateau and Escarpment Heath Dry Shrub forest) which is also not present on the subject site (PMA Consulting 2005; nghenvironmental 2007a).

Within the Eurobodalla LGA, twenty five vegetation communities using the classification of Thomas et al (2000) are considered to provide potential habitat for SBB (NSW NPWS 2001). None of these communities are found within or directly adjacent to the subject site. A thin lineal strip directly adjacent to the coastline identified as an intergrade community between FE22 and FE23 (Southern Coastal Hind Dune/Headland Scrub and Southern Coastal Dune Complex) mapped as FE2223 is detailed on Map 6 in Miles (2006). This vegetation is not located on, or directly adjacent to, the subject, but within 1km of it. An extent of *E.consideniana* with a very thick undergrowth of Allocasuarina on thin, skeletal soils on a series of low, dry ridges is present in the north-western corner of the Lilli Pilli Open Space Reserve, into the vegetation adjacent to Old Grandfathers Gully Pit Road, approximately 200 m from the closest boundary of the subject site (pers.obs). Again, this habitat type is now found on the subject site.

During this study, some variables were found to influence the habitat at each trapping location, with some variables contributing greater to the differences in these sites than others, including the percentage cover of mid-storey vegetation. However, comparing sites of terrestrial mammal capture to those where none were trapped and non-trapped, found that there was no statistical difference in these habitat variables suggesting that the habitat present is largely similar.

The importance of ground cover to bandicoots has been previously discussed. Claridge & Barry (2000) found that with an increase in ground cover vegetation (between 0.5m-2m) there was an increased probability of bandicoot digging occurrence. Litter and bare gound dominates much of the ground cover within the vegetated areas of the subject site with most sites presenting a litter coverage of greater than 50% (Appendix B). Further, mid-storey vegetation was present and much of this was quite tall. Fifteen of the 20 surveys sites presented *Allocasuarina* that was greater than 3m in height, and the mean percentage cover of all sites of mid-storey vegetation was around 60 percent (Appendix B).

Foraging is typically known to occur within areas that have a high density of ground cover (Claridge & Barry 2000). During the week long survey period, the previous site visit in 2007 and in surveys by PMA Consulting (2005) extensive searches for bandicoot diggings were undertaken across the subject site including the vegetation between the proposed development and the powerline easement to the north, and only one bandicoot digging was located (near to site 4). With only one individual Long-nosed Bandicoot trapped and the paucity of bandicoots or their signs over such a period of time suggests that the subject site does not provide suitable for SBB and only very marginal habitat for Long-nosed Bandicoot.

Figure 7: Potential Movement Corridors in the locality (subject site shown by red polygon) (Courtesy of NSW Departments of Lands SIX Viewer).

6.5 Habitat connectivity of the subject site and adjacent vegetation

Much of the subject site consists primarily of cleared land, with past land use such as deer farming evident by the large fence. However, a portion of native vegetation is present in the north-western portion of the subject site, the south-western corner and the riparian gully in the southern portion (Figure 1). The site vegetation has been previously assessed as being cleared in the previously logged due to an absence of large trees and tree hollows (PMA Consulting 2005; nghenvironmental 2007a).

Habitat connectivity is relatively poor on the subject site, with much of the remaining vegetation flanking the boundaries of Lot 2 apart from the vegetation of the riparian corridor leading up from Grandfathers Gully Rd toward the existing house. However, the value of this vegetation as a corridor to facilitate movement is dubious as it is essentially a 'dead-end' and does not lead, or connect to other areas of vegetation. The vegetation of the western boundary does provide a limited corridor to facilitate north-south movement along Grandfathers Gully Road. However, the value of this is compromised by the proximity of the roads, and its limited width, and is unlikely to contribute to fauna movement when corridors of highly quality are evident in the wider locality.

Andrews (2006) suggests that the Lilli Pilli area provides one of the last remaining areas of vegetation that provides connectivity from the ocean to vegetation to the south-west and west. Connectivity can be defined as the property of habitat to maintain the exchange of individuals between habitat patches (Morrison 2002). Jackson (2000) explains that with a lack of landscape connectivity, faunal diversity in mammals generally decreases.

Much of the subject site itself is dominated by cleared land (see Figure 7). Determined from aerial imagery and a visit to these areas, a higher level of local connectivity in the locality is apparent to the north-west and south-west of the subject site including the vegetation directly associated with the meandering ephemeral creek of Grandfathers Gully (see arrows on Figure 7).

The habitat corridors between Lilli Pilli Open Space Common and land adjacent to Old Grandfathers Gully Pit Rd are based on the presence of *E.consideniana* and a very thick undergrowth of Allocasuarina. A series of low, gravely ridges also present a thin, skeletal soils and offer a level of continuous vegetation from the open space common, between the sewerage treatment works and an old quarry and up to Ridge Road and a portion of Mogo State Forest.

The habitat corridor defined to the south-east of the subject site (Figure 7) is based solely on the presence of a continuous extent of vegetation between the southern end of the Lilli Pilli Open Space Common toward Ridge Rd and a portion of Mogo State Forest.

Grandfathers Gully Creek, across the road from the subject site, also provides a potential movement corridor, with a thick layer of ground vegetation such as bracken fern and Lomandra.

7. ASSESSMENT OF SIGNIFICANCE ON SOUTHERN BROWN BANDICOOT

This section reviews the significance of the potential impacts of the proposed development on the Southern Brown Bandicoot.

7.1 NSW legislation

In accordance with section 5A of the *Environmental Planning and Assessment Act 1979,* an Assessment of Significance has been prepared by using seven factors which must be considered when determining if the proposed activity '*is likely to have a significant effect on the threatened species, populations or ecological communities, or their habitats'* that are listed as under the Schedule 1 & 2 of the *Threatened Species Conservation Act 1995.* These seven factors must be taken into account by the consent or determining authority when considering a development proposal or development application. This enables a decision to be made as to whether there is likely to be a significant effect on the species and hence if a Species Impact Statement is required (NSW NPWS, 1995).

This assessment should be read in conjunction with section 6 which discusses the timing of the survey, the mammals present, past surveys in the locality and the likelihood of occurrence of Southern Brown Bandicoot. The nature of the subject site, being predominately cleared, the absence of key vegetation communities or species such as *E.consideniana*, the intensity of this and past surveys in the locality, and that potential movement corridors are not present on the subject site, suggests that the site does not provide habitat for SBB. As a precautionary approach, the NSW assessment of significance was undertaken and it was determined that the proposed activity is *'unlikely'* to have a *'significant effect'* on SBB (provided in Appendix D).

7.2 Commonwealth legislation

The *EPBC Act 1999* provides a mechanism for assessing the environmental impact of activities and developments, where "matters of national environmental significance" (NES) may be affected by the proposed activities.

Matters of NES relevant to the study area include Nationally Important Wetlands, Threatened species and Migratory species.

As this report considers the impacts on the SBB which is listed as endangered under this legislation, an assessment was undertaken as having a potential to be impacted on by the proposed activity and other matters of NES as detailed (Appendix E).

It was determined that it is *'unlikely'* that the Southern Brown Bandicoot will be significantly impacted by the proposed activity.

Therefore, the proposed activity will not require referral to the Commonwealth Minister.

8. CONCLUSION

This report documents the findings in relation to the target survey of the SBB on and adjacent to the Grandfathers Gully site. During this survey, no SBB were recorded. A review of other surveys in the direct locality, during the Southern CRA surveys, or by an ex-Forests NSW ecologist with 30 years experience in the Eurobodalla LGA have also not recorded SBB.

Previous studies at the subject site and across the road at the Lilli Pill Open Space Common failed to find any bandicoot diggings and assessed that the SBB is unlikely to occur due to an absence of suitable habitat. Extensive searches during this survey found only one bandicoot digging adjacent to where a Long-nosed Bandicoot was trapped.

Within the Eurobodalla LGA, twenty five vegetation communities using the classification of Thomas et al (2000) are considered to provide potential habitat for SBB (NSW NPWS 2001). None of these communities are found within or directly adjacent to the subject site.

Habitat connectivity is relatively poor on the subject site, with much of the remaining vegetation flanking the boundaries of Lot 2 apart from the vegetation of the riparian corridor leading up from Grandfathers Gully Rd toward the existing house. However, the value of this vegetation as a corridor to facilitate movement is dubious as it is essentially a 'dead-end' and does not lead, or connect to other areas of vegetation. The vegetation of the western boundary does provide a limited corridor to facilitate north-south movement along Grandfathers Gully Road. However, the value of this is compromised by the proximity of the roads, and its limited width, and is unlikely to contribute to fauna movement when corridors of highly quality are evident in the wider locality.

The nature of the subject site, being predominately cleared, the absence of key vegetation communities or species such as *E.consideniana*, the intensity of this and past surveys in the locality, and that potential movement corridors are not present on the subject site, suggests that the site does not provide habitat for SBB. However, as a precautionary approach, the NSW and Commonwealth assessment of significance was undertaken from this and it was assessed that the proposed activity is unlikely to have a significant impact on SBB.

8. REFERENCES

Andrews, N. 2006, Flora and Fauna Study: Grandfathers Gully, Lilli Pilli, NSW. *Prepared for Eurobodalla Shire Council*.

BOM 2008, Daily Weather Observations at Batemans Bay Weather Station. www.bom.gov.au

Braithwaite, R.W. 1983, Southern Brown Bandicoot *Isoodon obesulus,* in *The Australian Museum Complete Book of Australian Mammals*, ed. R. Strahan Angus & Robertson, Sydney.

Claridge, A.W & Barry, S.C 2000, Factors influencing the distribution of medium-sized ground-dwelling mammals in southeastern mainland Australia. *Austral Ecology* 25 pp. 676-688.

Claridge, A. W., NcNee, A., Tanton, M. T. & Davey, S. M. 1991, Ecology of Bandicoots in undisturbed forest adjacent to recently felled logging coupes: a case study from the Eden Woodchip Agreement Area, in *Conservation of Australia's Forest Fauna.* Ed. Lunney, D Royal Zoological Society of NSW, Mosman.

Clarke, K.R & Warwick, R.M 1994, Changes in Marine Communities: An approach to statistical analysis and interpretation. Plymouth Marine Laboratory, UK.

Cockburn, A. 1990, Life history of the bandicoots: developmental rigidity and phenotipic plasticity, in aphic range and habitat preference of *Isoodon obesulus* and *Perameles nasuta*, in *Bandicoots and Bilbies*, (Seebeck ed) Surrey Beatty & Sons.

Daly, G. 2001, Assessment of Fauna Habitat Linkages and Considerations for Management. Select Rural Residential Areas Eurobodalla Shire. *Prepared for Eurobodalla Shire Council*.

DECC. 2006, Southern Brown Bandicoot (*Isooden obesulus*) Recovery Plan. *NSW DEC, Hurstville*.

DECC. 2008a, *NSW Atlas of Wildlife Database* (online). www.wildlifeatlas.nsw.gov.au

DECC. 2008b, Threatened Species Home Page: Southern Brown Bandicoot - profile. *Www.Threatenedspecies.Environment.Nsw.Gov.Au*.

DEH 2006, EPBC Act Policy Statement 1.1: Significant Impact Guidelines. Department of Environment & Heritage, Canberra.

ESC. 1999, Eurobodalla Urban Local Environmental Plan. *Eurobodalla Shire Council*.

Forests NSW 2007, Species Management Plan for Southern Brown Bandicoot.

Jackson S.M. 2000, Home-range and den use of the mahogany glider, *Petaurus gracilis*, *Wildlife Research*, vol. 27, pp. 49-60.

Lobert, B. & Lee, A. K. 1990, Reproduction and life history of *Isoodon obesulus* in Victorian heathland, in *Bandicoots and Bilbies*, (Seebeck ed), Surrey Beatty & Sons.

Miles, J, 2006, *Recognition and Management of Endangered Ecological Communities in the south-east corner of NSW*. A report for the Southern Rivers Catchment Management Authority.

Minchin, P. R. 1987, An evaluation of the relative robustness of techniques for ecological ordination. *Vegetatio,* **69**, pp. 89-107.

Morrison M.L. 2002, *Wildlife restoration: techniques for habitat analysis and animal monitoring*, Island Press, Washington, U.S.A.

nghenvironmental. 2007a, Biodiversity Addendum: Proposed subdivision, Lot 2, DP 250984, Grandfathers Gully Road, Lilli Pilli, NSW. *Report Prepared for D & J Brewer*.

nghenvironmental. 2007b, Flora and Fauna Impact Assessment: Proposed Bulky Goods Retail Centre, Surf Beach, NSW. *Report Prepared for Eurobodalla Shire Council and Walker Corporation Pty. Ltd*.

NPWS. 2001, Threatened Species Information: Southern Brown Bandicoot *Isoodon obesulus*. *NSW National Parks and Wildlife Service, Hurtsville, NSW*.

NSW NPWS. 2001, Environmental Impact Assessment Guidelines for Southern Brown Bandicoot. *NSW National Parks and Wildlife Service, Hurstville, NSW*.

Oliver, I. 2004, A framework and toolkit for scoring the biodiversity value of habitat, and the biodiversity benefits of land use change. *Ecological Management and Restoration,* **5**(1), pp. 75-77.

Opie, A. Gullan, P & Mansergh, I. 1990, Prediction of the geographic range and habitat preference of *Isoodon obesulus* and *Perameles nasuta*, in *Bandicoots and Bilbies*, (Seebeck ed), Surrey Beatty & Sons.

Planning Initiatives. 2007, Environmental Assessment, Proposed subdivision, Lot 2 Grandfathers Gully Road, Lilli Pilli, NSW.

PMA Consulting. 2005, Flora and Fauna Assessment: Proposed Subdivision Lot 2 Grandfathers Gully Road, Lilli Pilli, NSW. *Prepared for D & J Brewer.*

Primer-E Ltd. 2001, PRIMER 5.2.9 for Windows. Standard Version. Primer-E Ltd, Plymouth, United Kingdom.

SPSS Inc. 2007, SPSS for Windows, Standard Version 16. SPSS Inc, USA.

Strahan, R. (ed). (1995). *The Mammals of Australia*. Reed Books, Australia.

Thomas, V., Gellie, N. & Harrison, T. 2000, Forest ecosystem classification and mapping for the Southern CRA region, Volume II Appendices. NSW National Parks & Wildlife Service, Southern Directorate. A report undertaken for the NSW CRA/RFA Steering Committee.

Wilkinson, L. 1989, SYSTAT the system for statistics, Version 5.1. *SYSTAT, Evanston, Illanois, USA*.

APPENDICES

APPENDIX A: TRAPPING DATA

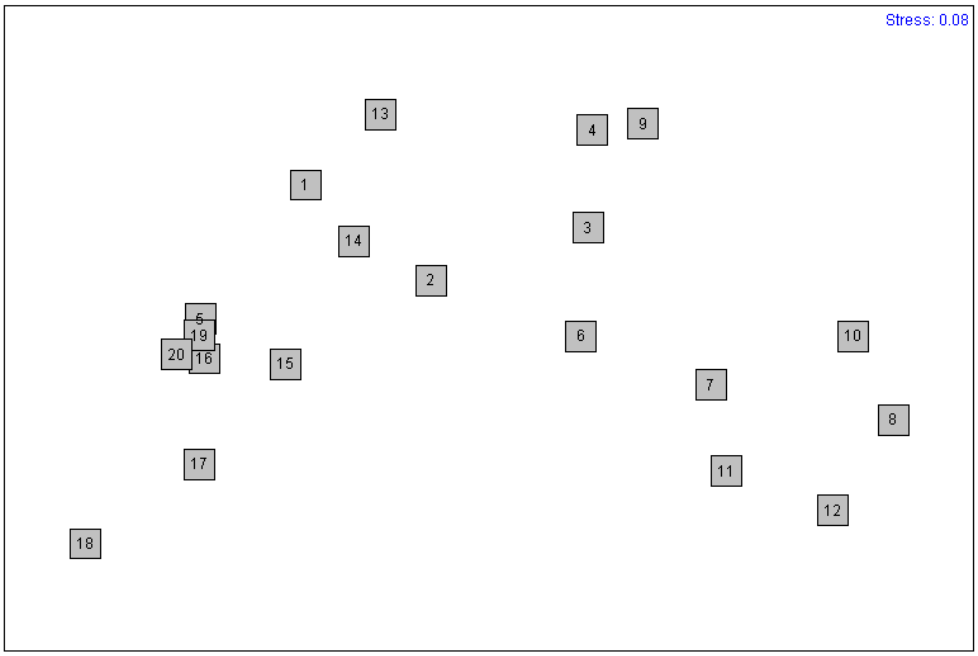
	Survey Site No.																			
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Bush Rat	0	0	0	1	0	0	2	0	2	0	0	1	1	1	0	0	0	1	0	0
Long-nosed Bandicoot	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brush tailed Possum	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Number of captures at each survey site by species.

APPENDIX B: HABITAT DATA

	Survey Site No.																			
Habitat Variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
LOGS100300	0	2	0	0	0	1	1	3	1	1	3	1	2	2	2	2	6	3	0	0
LOGS300+	0	0	0	0	0	0	0	1	1	1	6	2	0	0	2	0	2	1	0	0
LOGM100300	0	6	0	0	0	6	3	9	4	13	18	10	15	6	6	9	20	40	0	0
LOGM300	0	0	0	0	0	0	0	10	1	4	12	6	0	0	8	0	9	15	0	0
HOLLLOGSTND	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOLLLOGGRND	0	0	0	0	0	0	1	2	1	2	0	0	0	0	1	0	1	1	0	0
NATIVEPLNTS#	8	12	10	8	6	7	12	12	12	15	12	20	11	8	8	7	12	7	8	6
OVERSTOREY%	75	60	40	60	60	50	65	65	60	65	55	65	40	55	55	60	60	30	60	60
MIDSTOREY%	50	55	60	40	80	60	60	40	30	30	60	60	40	50	70	80	90	90	85	90
NATIVEGRASSES%	15	20	40	30	5	50	60	70	30	60	60	70	20	15	10	5	0	5	5	5
OTHNATIVE%	0	10	10	10	0	0	5	15	20	10	10	10	2.5	5	2	0	0	1	0	0
EXOTICPLANT%	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BAREGRND%	5	0	0	0	5	0	5	0	0	0	0	0	2.5	0	0	0	0	4	0	0
LITTER%	80	70	50	50	90	50	30	15	50	30	30	10	75	80	88	95	95	90	95	95
ROCK%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PATS#	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OVERSTOREYDBH	0.3	0.6	1.2	0.5	0.5	0.6	0.4	0.2	0.7	0.3	0.2	0.2	0.7	1	1.2	0.2	0.3	1.2	0.5	0.5
OVERSTORYM	12	20	20	15	15	15	15	12	20	12	13	13	20	20	20	10	20	25	20	15
MIDSTOREYDBH	0.07	0.05	0.05	0.08	0.05	0.05	0.03	0.01	0.1	0.04	0.03	0.02	0.03	0.01	0.07	0.05	0.05	0.07	0.03	0.05
MIDSTOREYM	3	4	5	5	3	3	2	2	1.5	3	4	2.5	3	4	5	4	4	5	3	4
DIGGINGS	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX C: STATISTICAL ANALYSIS



MDS ordination of the habitat variables of the 20 survey sites.

Spearman-rank correlation coefficients of the 21 habitat variables against the two MDS dimensions. Significance at 0.01 is marked with two asterisks (two-tailed).

Habitat variables	***Dimension 1***	***Dimension 2***
LOGS100300	-0.84	-0.487
LOGS300+	0.296	-0.502
LOGM100300	-0.130	-0.563**
LOGM300	0.085	-0.726**
HOLLOGSTND	0.102	0.316
HOLLOGGRND	0.375	-0.285
NATIVEPLNTS#	0.714**	-0.233
OVERSTOREY%	0.282	0.055
MIDSTOREY%	-0.728**	-0.578**
NATIVEGRASSES%	0.962**	-0.181
OTHNATIVE%	0.767**	0.206
EXOTICPLANTS%	0.120	0.367
BAREGRND%	-0.266	0.018
LITTER%	-0.979**	0.118
ROCK%	-	-
PATS#	-	-
OVERSTOREYDBH	-0.351	0.198
OVERSTOREYM	-0.448	0.081
MIDSTOREYDBH	-0.277	0.344
MIDSTOREYM	-0.464	-0.80
DIGGINGS	0.120	0.367

APPENDIX D: NSW ASSESSMENT OF SIGNIFICANCE

In accordance with section 5A of the *Environmental Planning and Assessment Act 1979,* an Assessment of Significance has been prepared by using seven factors which must be considered when determining if the proposed activity '*is likely to have a significant effect on the threatened species, populations or ecological communities, or their habitats'* that are listed as under the Schedule 1 & 2 of the *Threatened Species Conservation Act 1995.* These seven factors must be taken into account by the consent or determining authority when considering a development proposal or development application. This enables a decision to be made as to whether there is likely to be a significant effect on the species and hence if a Species Impact Statement is required (NSW NPWS, 1995).

This assessment should be read in conjunction with section 6 which discusses the timing of the survey, the mammals present, past surveys in the locality and the likelihood of occurrence of Southern Brown Bandicoot.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Southern Brown Bandicoot *Isoodon obesulus*

Research suggests that this species prefers scrubby habitat with low ground cover that is occasionally burnt out (Braithwaite 1983), Stoddart & Braithwaite (from Cockburn 1990) argue that the species prefers regrowth habitat that has either been recently burnt or cleared. Geographic range prediction of *I. obesulus* in Gippsland identified optimum habitat as being lowland sclerophyll forest, from sea level to 300 m ASL, principal tree species are *Eucalyptus seiberi* and *E. globoidea*, with a sparse shrub layer consisting of a range of sclerophyllous species. Other potential habitats include *Leptospermum myrsinoides* heathland, a woodland with a heath understorey on sandy soils and Banksia Woodland (Opie *et al.* 1990). Within the Eurobodalla LGA, twenty five vegetation communities using the classification of Thomas et al (2000) are considered to provide potential habitat for SBB (NSW NPWS 2001). None of these communities are found within or directly adjacent to the subject site. A thin lineal strip directly adjacent to the coastline identified as an intergrade community between FE22 and FE23 (Southern Coastal Hind Dune/Headland Scrub and Southern Coastal Dune Complex) mapped as FE2223 is detailed on Map 6 in Miles (2006). This vegetation is not located on, or directly adjacent to, the subject, but within 1km of it.

This species is known from one record in the Eurobodalla LGA (DECC 2008a) collected as a road-killed specimen on the 3rd January 1998 on George Bass Drive, at or near the crossing with Grandfather's Gully. Dr Andrew Claridge (DECC scientist) confirms that the hairs were that of a SBB.

Bandicoots are ground-dwelling animals and make nests of grass and leaves among tussocks or low shrubs. As such, they are vulnerable to predation by foxes, feral cats and dogs.

Lobert & Lee (1990) found a high proportion of *I. obesulus* hair and bone fragment in fox scats in an area populated by this species in Victoria and suggested that *I. obesulus* prefers habitat with thick undergrowth, that avian and mammalian predators would find extremely difficult to penetrate. The habitat analysis undertaken in this study revealed that a dense, thick undergrowth was not present in the vegetated areas of the subject site, and that Allocasuarina was quite tall, not offering ground level protection from predators (see section 6). No significant difference was revealed between the habitat of where terrestrial mammals were captured in this survey, and where none were captured.

Only one individual Long-nosed Bandicoot was trapped and one bandicoot digging was found despite considerable searching in this survey, the previous site visit in 2007 and in surveys by PMA Consulting (2005). The paucity of bandicoots or their signs over such a period of time suggests that the subject site does not provide suitable for SBB and only very marginal habitat for Long-nosed Bandicoot.

While it is acknowledged that no surveys were conducted by DECC after the road-kill record of SBB, numerous surveys and environmental assessments have been undertaken in the vicinity of the subject site which provide valuable information relevant to the potential presence of a local population of SBB.

Adjacent to the site, Andrews (2006) undertook a field survey of the open space lands of Lilli Pilli. Twenty-four species of mammal were recorded during this study, of which only two were introduced species. Surveys over summer and winter 2005 did not reveal any bandicoot species, including the non-threatened Long-nosed Bandicoot using recognised methods such as cage trapping, hair tube analysis and elliot traps. The survey effort in this study was high with 136 cage trap nights, 176 elliot trap nights and 734 hair tube nights undertaken (Andrews 2006). Within this report, it is also reported that local resident Judy Thompson states that Long-nosed Bandicoots were once present on this site and in local backyards, but have since vanished (Andrews 2006).

In October 2006, **ngh**environmental conducted a flora and fauna survey 500m to the north-west of the subject site (nghenvironmental 2007b). 20 cage traps over 5 consecutive nights (100 trap nights) and 30 hair tubes over 9 consecutive nights (270 nights) did not reveal any SBB, although numerous other mammal species were recorded.

Discussions with ex-NSW Forests ecologist Mike Crowley were undertaken to ascertain the extent of surveying that this agency had undertaken for the SBB within Mogo State Forest located to the west of the subject site and also the location of the plotted data which contradicts the description in DECC records. Mike advised that extensive surveys during the period 1998-2005 by NSW Forests, which also included the Comprehensive Regional Assessment (CRA) surveys, failed to record SBB (Mike Crowley, personal communication, 3rd March 2008). These surveys were conducted using hair tubes and scat analysis, both recognised techniques for detecting SBB. Mike also stated that during his 30 years experience in conducting fauna surveys throughout the Eurobodalla LGA he had not recorded SBB.

The vegetation communities of the subject site are not conducive to predicted or known potential bandicoot habitat (see Section 6). The nature of the subject site, being predominately cleared, the intensity of this and past surveys in the locality, and that surrounding the site the landscape is largely vegetated and that potential habitat corridors are not present on the subject site (Figure 7) suggests that the site does not provide habitat for SBB.

However, the retention of much of the vegetation, the removal of only a small amount of vegetation (~0.6ha) and the regeneration as proposed in the EA suggests that should the SBB use the subject site in the future, that the proposed activity is unlikely to have an adverse effect on the life cycle of the species such that should a viable local population be present in the locality, the species is unlikely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

There are no endangered populations for SBB listed under Schedule 1 of the *TSC* Act.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

There is no endangered ecological community or critically endangered ecological community present.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

(i) While the vegetation communities of the subject site are not conducive to predicted or known potential bandicoot habitat (see Section 6), our report concludes that habitat for SBB is not considered present on the subject site. The subject site is predominately cleared, with small areas of regrowth spotted gum forest occurring in the north-western and south-western corners along with the riparian corridor. Around 0.6 ha of this regrowth forest will be removed for the creation of the access road and asset protection zones. All existing cleared land on the site will also be subject to extensive regeneration and planting as outlined within the EA.

(ii) Much of the vegetation of the subject site exists as patches on already cleared land which was previously used for a deer farm. The subject site is several hundred metres from a vegetation type that could be considered potential SBB habitat and is already isolated from this by George Bass Drive, a busy arterial road and a 40m wide powerline easement. While 0.6ha of regrowth spotted gum forest will be removed, this extent of clearing will be spread over 7 locations across the subject site, and is not likely to further fragment or isolate any vegetation than is already present.

(iii) As discussed in section 6, the subject site is not considered habitat for SBB, and habitat connectivity is greater off-site (see Figure 7) for a number of reasons including areas of greater potential as habitat and vegetation connectivity (see section 6.5).

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

There is no critical habitat as listed by the *TSC Act* 1995, found within the subject site.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

A recovery plan for SBB was produced by DECC in 2006 which a series of objectives and actions are stated.

One of the specific objectives of this plan is that further target survey work is required for SBB, particularly in southern NSW (DECC 2006). This report documents the results of this target survey, as well as the results of previous known surveys in the locality of the single SBB record for the Eurobodalla Shire. Local knowledge from two individuals in relation to bandicoots is also included. This review provides a large amount of information relevant to the locality and the Eurobodalla LGA.

Clarification of the status of this species is also an objective of the recovery plan. This report documents local surveys, local knowledge and the results of this survey which provides information on the potential occurrence of SBB in the locality.

Other objectives include the identification land management practices, continue state-wide recovery team and regional groups for implementation of recovery plan, undertake research and improve community awareness. These objectives would be considered the role of the regional working groups and state-wide recover team.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Whilst the proposed activity – rural-residential subdivision – is not recognised as a key threatening process under schedule 3 of the *TSC* Act, a number of KTP's are relevant to the proposed activity.

The 'clearing of native vegetation' is recognised as a major factor contributing to the loss of biodiversity. Clearing of any area of native vegetation, may lead to significant impacts on biological diversity such as habitat fragmentation leading to limited gene flow between small isolated populations, which may lead to a reduction in the potential for biodiversity to adapt to environmental change.

The 'removal of dead wood and dead trees' includes the removal of fallen branches and litter as general tidying up and the removal of standing dead trees. While no standing dead trees were recorded, the study area does have dead wood on the ground. Much of these existing features are as a consequence of past clearing activities.

The proposal would involve removal of approximately 0.6 hectares of regrowth spotted gum forest within the subject site to create the access road, building envelopes and asset protection zones. Around 0.6 ha of this regrowth forest will be removed for the creation of the access road and asset protection zones. However, all existing cleared land on the site will also be subject to extensive regeneration and planting as outlined within the EA.

Conclusion

The Assessment of Significance has determined that the proposed activity is *'unlikely'* to have a *'significant effect'* on Southern Brown Bandicoot.

APPENDIX E: COMMONWEALTH ASSESSMENT OF SIGNIFICANCE

As SBB is listed as Endangered under the *EPBC Act* 1999, the following assessment assesses the significance of the proposal's impact upon this species.

Will the action lead to a long-term decrease in the size of a population of a species?

It is unlikely that the development would reduce a population of either species in the long-term.

The vegetation communities of the subject site are not conducive to predicted or known potential bandicoot habitat (see Section 6). The nature of the subject site, being predominately cleared, the intensity of this and past surveys in the locality, and that surrounding the site the landscape is largely vegetated and that potential habitat corridors are not present on the subject site (Figure 7) suggests that the site does not provide habitat for SBB. Therefore, the action is unlikely to lead to a long-term decrease in the size of a population of SBB should one still occur in the locality.

Will the action reduce the area of occupancy of the species?

No. Extensive searches for bandicoot diggings (this survey, nghenvironmental 2007 and PMA Consulting 2005), have resulted in a paucity of bandicoots or their signs over such a period of time. This suggests that the subject site does not provide suitable for SBB and only very marginal habitat for the common Long-nosed Bandicoot. Further, the vegetation communities of the subject site are not conducive to predicted or known potential bandicoot habitat (see Section 6).

Will the action fragment an existing population into two or more populations?

As suitable habitat does not exist on the subject site for SBB and that potential habitat corridors are present to the north-west and south-east, the action will not fragment an existing population into two or more populations should one still be present in the locality.

Will the action adversely affect habitat critical to the survival of a species?

The vegetation communities of the subject site are not conducive to predicted or known potential bandicoot habitat (see Section 6). The nature of the subject site, being predominately cleared and that potential habitat corridors are not present on the subject site (Figure 7) The habitat within the study area is not considered to represent habitat critical for survival of the SBB should it be still present in the locality.

Will the action disrupt the breeding cycle of a population?

Again, known or predicted habitat is not present on the subject site. The site provides limited regrowth spotted gum forest, with limited vegetation at ground level, with litter dominating the ground layers across the majority of the regrowth forest. As SBB require dense layers of ground-level vegetation sympathetic to their nesting requirements and protection from predators, the action is unlikely to disrupt the breeding cycle of this species should it be still be present in the locality.

Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

No. While the vegetation communities of the subject site are not conducive to predicted or known potential bandicoot habitat (see Section 6), our report concludes that habitat for SBB does not exist on the subject site. The subject site is predominately cleared, with small areas of regrowth spotted gum forest occurring in the north-western and south-western corners along with the riparian corridor. Around 0.6 ha of this regrowth forest will be removed for the creation of the access road and asset protection zones. All existing cleared land on the site will also be subject to extensive regeneration and planting as outlined within the EA. Further, the subject site is several

hundred metres from a vegetation type that could be considered potential SBB habitat and is already isolated from this by George Bass Drive, a busy arterial road and a 40m wide powerline easement. While 0.6ha of regrowth spotted gum forest will be removed, this extent of clearing will be spread over 7 locations across the subject site, and is not likely to further fragment or isolation any vegetation than is already present. Finally, habitat connectivity is greater off-site (see Figure 7) for a number of reasons including areas of greater potential as habitat and vegetation connectivity (see section 6.5). As such, the action is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the locality should it still occur.

Will the action result in invasive species that are harmful to a critically endangered or endangered/vulnerable species becoming established in the endangered or critically endangered species/vulnerable habitat?

The proposal is for a rural-residential subdivision, which may increase the abundance of weeds in the area if not correctly managed. Weed establishment however, is not likely to adversely impact this SBB.

Will the action interfere with the recovery of the species?

Given the past land use of the site and the extent of cleared land, and that the total area of the site in comparison with the known distribution of SBB is very small, it is unlikely that the action will interfere with the recovery of the species. Conversely, this report has provided details on SBB from past local surveys, discussions with locals providing valuable knowledge and a target survey, this information is likely to assist natural resource managers.

Conclusion

Based on the above assessment, it is unlikely that the Southern Brown Bandicoot will be significantly impacted by the proposal.

Therefore, the proposed activity will not require referral to the Commonwealth Minister.

APPENDIX F: PHOTOGRAPHS OF THE SITE

Trapping site 15.

Trapping site 4

Trapping site 3

Trapping site 1

Trapping site 5

Trapping site 9

APPENDIX G: GPS DATA

Site No.	Easting	Northing
1	248507.0184	6037899.377
2	248504.0732	6037888.245
3	248555.5174	6037797.629
4	248579.2644	6037790.215
5	248417.1072	6037926.234
6	248415.6553	6037932.996
7	248467.5000	6038000.3001
8	248485.4131	6038017.236
9	248493.3565	6038013.423
10	248505.2673	6038025.126
11	248477.6076	6038049.293
12	248470.484	6038048.263
13	248642.8031	6038032.354
14	248615.8642	6038065.859
15	248606.5307	6038053.448
16	248606.9521	6038063.437
17	248586.164	6038087.093
18	248567.4685	6038104.646
19	248342.8101	6037733.804
20	248355.3592	6037795.077

APPENDIX H: QUALIFICATIONS AND EXPERTISE OF AUTHORS

Name	Role	Specialist skills and abilities
Nick Graham-Higgs **NGH Director**	**Project Manager and Internal Review**	Nicholas has worked as an environmental planning and resource consultant since 1992, specialising in natural resource management. A wide range of assignments covering diverse natural and modified environments, have enabled Nick to develop a broad knowledge base in the area of natural resource planning and management
Steven Sass B. App. Sci. (Environmental Science) (Hons) CSU	Ecologist	Steven is an experienced ecologist having undertaken more than 400 aquatic and terrestrial threatened flora and fauna surveys and habitat assessments in eastern Australia since 1990. He has an excellent working knowledge of habitat fragmentation at the landscape and local level, having just completed two years of research into the effects of habitat fragmentation on reptiles, including an extensive review of the determinants of fauna diversity in fragmented landscapes such as urban areas. His knowledge of the impacts of fragmentation on habitats is strengthened in a review of how Yellow-bellied gliders use habitat corridors on the far south coast and how frogs use habitat fragments and corridors in central-western NSW. His ecological expertise is used to design and implement landscape scale biodiversity assessments. These include biodiversity strategies for frog and reptile populations in the Murrumbidgee Irrigation Area (over 200,000 hectares) through surveys and habitat assessments at 160 sites, terrestrial biodiversity surveys and habitat assessments in the Upper Billabong Creek Catchment Area (around 30,000 hectares) and the impact of fire in a large reserve system (over 250,000 hectares) in western NSW. Steven has extensive experience and knowledge of the threatened species of the NSW South Coast. He has undertaken research and monitoring on a variety of species from Nowra to the Victorian Border with a focus on threatened species management.

APPENDIX I: CORRESPONDENCE

1. EMAIL IN RELATION TO SBB RECORD

From: Steven Sass
[mailto:steven@nghenvironmental.com.au] **Sent:**
Monday, 3 March 2008 11:02 AM **To:** Claridge Andrew
Cc: Young Dimitri **Subject:** Re: GRANDFATHERS GULLY

Thanks Andrew.

Thats exactly the type of information I am seeking. I am in no way criticising the authenticity of the record, I just wanted some more information that I can use in my assessment. So if I can use your email as a personal communication within this that would be great?

Regards,

Steven Sass
Project Officer (Ecologist)

nghenvironmental
www.nghenvironmental.com.au Personal Profile: www.nghenvironmental.com.au/steven.html Herpetology: www.nghenvironmental.com.au/herpetology.html

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Claridge Andrew wrote:
OK. Mike Fleming, former Branch Director with NPWS at Dubbo, collected the road-killed specimen on George Bass Drive, at or near the crossing with Grandfather's Gully. My guess is the projection of the record is different to the projection of the map you are looking at (ie. AGD66 versus WGS84), or that you are trying to project it in Zone 55 when it is in Zone 56.

Mike gave me a bunch of hairs from the animal and I can assure you they were clearly Southern Brown Bandicoot
– unmistakingly so. Also, Mike is no dummy and would know his species. Not sure if he ever sent them to Barb for check because the carcass was self-explanatory. I would assume Mike could testify in court as to what he found and I could testify as to the authenticity of the hairs I was given, if push comes to shove. So, no doubt about record as being valid. Death is pretty conclusive.

I visited the site about 12 months after Mike sent me the hairs. The actual location itself, near the Coastal Lowlands Cycad Forest, does not strike me as being all that promising as habitat for the species but immediately to the west of George Bass Drive the habitat dries out and there was heathy (ie. prickly) understorey elements – from memory. My guess is that the animal likely came from habitat to the west of George Bass Drive but east of the Princes Hwy inland. However, no follow-up work was done since we were

focussed on the species elsewhere and there are only so many hours in the day.

I cannot comment about the missing record from the map in the Recovery Plan – since I did not prepare it. My guess is it is hidden/obscured by the Bateman's Bay locality text/triangle.

Not surprised that trapping has not proved all that productive. My records indicate the location of the roadkill

as: -35.780496

150.2131387

Hope this helps,

Andrew Claridge

From: Steven Sass [mailto:steven@nghenvironmental.com.au] **Sent:** Thursday, 28 February 2008 10:24 AM **To:** Claridge Andrew **Subject:** Re: GRANDFATHERS GULLY

Hi Andrew,

Thanks for providing this info to me via Dimitri in relation to Southern Brown Bandicoot in Eurobodalla.

I have been casting my eye over the recovery plan for the species and wanted to ask some questions if I could as well as in relation to the specific record near Grandfathers Gully.

There seems to be some confusion as to the 'actual' location of the record. The widllife atlas shows the record on ridge road, west of Grandfathers Gully Road. However, Dimitri sent the atlas record through, which is more info then we can access through the public version of course, that provides a series of eastings and northings, one refers to the site as described above and the other is several kilometres off-shore. The description refers to the Bass 'Highway', which I am only assuming is George Bass Drive? Do you know the history behind this records (apart from what is mentioned below), or do you have some greater specifics. Do you also know who did the hair analysis?

In the recovery plan, I cant find any specifics relating to the Eurobodalla record. It is not marked on the distribution map showing statewide records, and there is no reference to it in any text, apart from mentioned Eurobodalla as one of the council areas that are a consent authority to development. Would you think that Northern Foothills Forest (Forest Ecosystem 21) and Coastal Lowlands Cycad Forest (FE9) would be a suitable vegetation community for this species?

I am currently in the field executing cage trapping surveys at the site, to date, have revealed bush rats, brushtail possum and a single long-nosed bandicoot (which I have taken a hair sample from also).

Thanks for your time.

Regards,

Steve

2. EMAIL IN RELATION TO METHODS FROM DIMITRI YOUNG, DECC.

Subject: RE: GRANDFATHERS GULLY**From:** "Young Dimitri" <Dimitri.Young@environment.nsw.gov.au>**Date:** Wed, 13 Feb 2008 17:08:42 +1100**To:** <steven@nghenvironmental.com.au>
CC: "Treweek Allison" <Allison.Treweek@environment.nsw.gov.au>, "Jones Sandie" <Sandie.Jones@environment.nsw.gov.au>

Hi Steve,

I have checked your proposed survey methodology for Southern Brown Bandicoot with Dr Andrew Claridge of DECC who has confirmed that it would be adequate.

Regards,

Dimitri Young Threatened Species Coordinator Department of Environment and Climate Change Tel 6298 9731 Fax 6299 4281 Mob 0417 232 659
dimitri.young@environment.nsw.gov.au

From: Steven Sass [mailto:steven@nghenvironmental.com.au] **Sent:** Wednesday, 13 February 2008 1:39 PM **To:** Young Dimitri
Subject: RE: GRANDFATHERS GULLY

Hi Dimitri,

I am preparing a fee proposal for this client to undertake the surveys for southern brown bandicoot in the next two weeks. Can I confirm that 20 cage traps over 5 consecutive nights (100 traps nights) would be adequate survey effort.

Regards,

Steve

3. EMAIL IN RELATION TO METHODS FROM DIMITRI YOUNG, DECC.

Young Dimitri wrote:

Hi Steven,

Further to our telephone conversation regarding targeted surveys for Southern Brown Bandicoot (*Isoodon obesulus*) at Grandfathers Gully, I wish to provide the following advice:
1 Dr Andrew Claridge of DECC has confirmed that the known record for Southern Brown Bandicoot in the vicinity of the site as present on the Atlas of NSW Wildlife was recorded in 1998 at Grandfathers Gully as a road-kill. Hairs sampled from the specimen were confirmed as those of the Southern Brown Bandicoot by an independent specialist.
2 DECC re-iterates its previous advice that targeted surveys for the Southern Brown Bandicoot must be undertaken on the site before the assessment of the impacts of the proposal on the species can be finalised. Surveys should cover both the riparian corridor and other vegetated parts of the site, particularly in

the north-west.
3 Dr Claridge has recommended the use of Digital Infra-red Cameras as the most effective and cost-efficient technique. Bait stations are set up with cameras mounted to them and then left in situ for 2 weeks. Approximately three bait stations each with a camera would suffice for the site. Cameras cost about $600-$700.
4 Alternatively, a program of small cage trapping could be employed, using at least 25 cage traps set over at least 4 nights, to provide coverage of the areas required for targeted survey.

Regards,

Dimitri Young Threatened Species Coordinator

Department of Environment and Climate Change Tel 6298 9731 Fax 6299 4281 Mob 0417 232 659
dimitri.young@environment.nsw.gov.au