Data on the avifauna of the LHIG is taken from Hutton (1991), McAllan *et al.* (2004) and DECC (2007) and supplemented by personal observations of LHI Board (Hank Bower) and OEH (Nicholas Carlile, Terry O'Dwyer, Dean Portelli) ecologists and naturalists resident on LHI (Ian Hutton, Jack Shick; >70 years combined experience). Additional data on the occurrence and abundances of non-seabird species was collected during bird surveys undertaken by the Canberra Ornithologist's Group (hereafter COG surveys; Fullagar *et al.* 2014, 2015) in September 2013 and September 2014. In each survey period, 96 sites distributed across the lowlands of the main island (North Head to Little Island, including Transit Hill) were each surveyed 2–4 times. Surveys lasted ten minutes and all non-seabird species observed at the site were recorded. Additionally, individuals of each species occurring within a 50 m radius of the survey point were counted.

Regular non-seabird migrants

The following 12 listed non-seabird species, all of which are shorebirds (families Scolopacidae and Charadriidae), occur as regular migrants on the LHIG:

- Bar-tailed Godwit *Limosa lapponica*
- Double-banded Plover *Charadrius bicinctus*
- Far Eastern Curlew *Numenius madagascariensis*
- Grey-tailed Tattler *Tringa brevipes*
- Latham's Snipe *Gallinago hardwickii*
- Pacific Golden Plover *Pluvialis fulva*
- Red Knot *Calidris canutus*
- Red-necked Stint *Calidris ruficollis*
- Ruddy Turnstone *Arenaria interpres*
- Sharp-tailed Sandpiper *Calidris acuminata*
- Wandering Tattler *Tringa incana*
- Whimbrel *Numenius phaeopus*

Most, if not all, of these 12 shorebird species may be present in small numbers (see below) during the proposed baiting operations in winter 2017 and are thus considered at risk of impacts from the LHI REP. Since 11 of the species migrate to Australia in August–September (Hayman *et al.* 1986; Higgins and Davies 1996), the timing of baiting operations coincides with a period when the abundance of these species on the LHIG is lowest; thereby minimising the impact of the REP on shorebirds. The remaining species, the Double-banded Plover, leaves its New Zealand breeding grounds in Feb-Mar (Hayman *et al.* 1986; Higgins and Davies 1996). None of the species have been recorded breeding on the LHIG (all species except the Double-banded Plover breed in the northern hemisphere; Hayman *et al.* 1986).

Table 21 summarises data on occurrence and abundance of the 12 regular shorebird migrants collected during the COG surveys in 2013 and 2014. All species consistently occurred at low abundance or were not detected, and had highly localised distributions on LHI. It should be noted that—with the possible exception of the Double-banded Plover—the abundance of each species in September could be higher, but is unlikely to be lower, than their abundance in July because 11 of the species migrate to Australia in August–September (Hayman *et al.* 1986; Higgins and Davies 1996). Double-banded Plovers depart from Australia, including LHI, in spring (Higgins and Davies 1996), so the infrequent detection of this species in the COG surveys may be a poor predictor of the expected abundance of this species in winter 2017 (but see below).

Table 21 Occurrence and abundance of regular shorebird migrants on LHI recorded in COG surveys.

The percentage of survey sites (n=96) where the species was present, the percentage of surveys (n=300 in 2013, 384 in 2014) that detected the species, and the maximum count within a 50m radius of the survey point summed across survey sites are shown for each species.

Species	Survey sites (%) 2013/2014	Surveys (%) 2013/2014	Max. count 2013/2014
Bar-tailed Godwit	2.1 / 6.3	0.7 / 2.1	13 / 12
Double-banded Plover	0.0 / 3.1	0.0 / 0.8	0 / 0
Far Eastern Curlew	0.0 / 1.0	0.0 / 0.3	0 / 0

Grey-tailed Tattler	0.0 / 0.0	0.0 / 0.0	0 / 0
Latham's Snipe	0.0 / 0.0	0.0 / 0.0	0 / 0
Pacific Golden Plover	5.2 / 0.0	0.2 / 0.0	26 / 0
Red Knot	0.0 / 0.0	0.0 / 0.0	0 / 0
Red-necked Stint	0.0 / 1.0	0.0 / 0.3	0 / 1
Ruddy Turnstone	3.1 / 3.1	1.0 / 1.0	0 / 0
Sharp-tailed Sandpiper	0.0 / 0.0	0.0 / 0.0	0 / 0
Wandering Tattler	0.0 / 0.0	0.0 / 0.0	0 / 0
Whimbrel	0.0 / 7.3	0.0 / 2.3	0 / 0

The low abundances of shorebirds observed during the COG surveys are consistent with estimates of the number of individuals typically present on the LHIG during winter for the most common shorebird species (I. Hutton pers. comm.): Bar-tailed Godwit (≤20), Double-banded Plover (≤20), Pacific Golden Plover (≤30), Ruddy Turnstone (≤40), and Whimbrel (≤15). Thus, the number of shorebirds that will be present during baiting operations and during the period bait pellets and Brodifacoum residue remains accessible in the environment is not expected to exceed 150 individuals in total.

Shorebirds are at risk of primary and/or secondary poisoning from Brodifacoum. Six New Zealand Dotterels (*Charadrius obscurus*), representing 50% of individuals present at the time of baiting, either died or disappeared during a baiting operation in North Auckland, which was attributed to secondary poisoning from consuming invertebrates (most likely sandhoppers, *Talorchestia* spp.) (Dowding *et al.* 2006). During a rabbit eradication on Rawaki in the Phoenix Islands, two Bristle-thighed Curlews (*Numenius tahitiensis*; 7.4% of the 27 counted during baiting operations), which are closely related to Whimbrels, and five Pacific Golden Plovers (3.5% of 142) were found dead (Pierce *et al.* 2008); however, 12–21 days after the first bait application, an additional 40% of Bristle-thighed Curlews and 54% of Pacific Golden Plover and 90% of Ruddy Turnstones had disappeared (Pierce *et al.* 2008), suggesting mortality may have been higher than indicated by the number of carcasses found. No shorebirds were reported dead during a rat eradication on nearby McKean Island (seven Bristle-thighed Curlews and 72 Pacific Golden Plovers were present during baiting), but shorebird surveys did not continue beyond two weeks after the first bait application (Pierce *et al.* 2008). All three species were observed eating cereal bait pellets on Rawaki, indicating primary as well as secondary poisoning (see Godfrey 1985) can occur in shorebirds (Pierce *et al.* 2008). During a rat eradication on Palmyra Atoll, six Bristle-thighed Curlews (~7% of the number counted prior to baiting), two Pacific Golden Plovers (~3%), two Ruddy Turnstones (~10%) and one Wandering Tattler (~3%) were found dead and tested positive for Brodifacoum residues (Pitt *et al.* 2015). However, like Rawaki, mortality may have been higher than indicated by the number of carcasses. Pitt *et al.* (2015) estimated the maximum proportion of individuals that could have died from Brodifacoum poisoning, based on counts of shorebirds 15 days after the first bait drop, was ~80%, ~47%, ~29% and ~36% respectively for the four species. Twenty-one Ruddy Turnstones, 38 Sanderlings (*Calidris alba*) and one Grey Plover (*Pluvialis squatarola*) were found dead and showed evidence of bait consumption during rodent eradications on six islands in Mexico (Samaniego-Herrera *et al.* in review). In Australia, 28 Ruddy Turnstones were found dead during searches for carcasses immediately after baiting operations on Adele Island in Western Australia (Palmer 2014). Toxicosis was presumed to have been through secondary poisoning from consuming contaminated intertidal invertebrates (Palmer 2014). Three weeks following and seven months prior to the baiting operation, 920 and 1290 Ruddy Turnstones were counted on Adele Island, respectively (R. Clarke unpublished data), suggesting the number known to have died from Brodifacoum poisoning represented a small proportion (<4%) of the population. No dead or sick Bar-tailed Godwits, Grey-tailed Tattlers or Red-necked Stints were found, despite >1,800 individuals of each species being present before and after the baiting operation (Palmer 2014; R. Clarke unpublished data). Similarly, none of the >190 Pacific Golden Plovers, >80 Whimbrels, or >40 Far Eastern Curlews present were found dead or sick (Palmer 2014; R. Clarke unpublished data). This suggests susceptibility to Brodifacoum poisoning may vary considerably among shorebird species, which is likely partly attributable to differences in foraging behaviour.

The numbers of individuals of each shorebird species present on the aforementioned islands is likely to be higher, and in some cases (e.g. Adele Island) by several orders of magnitude, than the number of shorebirds expected to be present on the LHIG during the REP (<150 individuals; see above). Further, the likelihood of primary or secondary poisoning for each individual shorebird is expected to be lower on LHI REP because a lower dose of bait will be dispersed across the island (two applications totalling 20 kg/ha of 20 ppm Brodifacoum) than was done on Adele Island (two applications totalling 44.2 kg/ha of 20ppm Brodifacoum; Palmer 2014), Palmyra Atoll (two applications totalling 155 kg/ha of 25 ppm Brodifacoum; Pitt *et al.* 2015), and Rawaki (two applications totalling 90.9 kg/ha in high-baited area and 24.5 kg/ha in low-baited area); though the dose will be

similar to that used in North Auckland (two applications totalling 15 kg/ha of 20ppm Brodifacoum; Dowding *et al.* 2006). In addition to undertaking baiting when shorebirds numbers are at their lowest on the LHIG and using a lower dose rate, the risk of primary or secondary poisoning of shorebirds will be reduced by hand baiting on lagoon beaches. No evidence of disturbance from helicopter activities was reported for the aforementioned eradications (e.g. Adele Island, Palmyra Atoll, Phoenix Islands) that involved a large number of shorebirds present. Coupled with the habituation of waders to regular movements of aircraft—planes land or take-off at least twice every day on LHI and a large proportion of waders present on LHI roost or forage in the vicinity of the airstrip—excessive disturbance from helicopters resulting in harm or medium- to long-term impacts to shorebirds is highly unlikely. No incidents have been reported during previous occasions when helicopters have been used for operations on LHI.

The number of individuals of each of the 12 regular migrant shorebird species on the LHIG is insignificant at a regional, state, national and international scale (Lane 1987; Hansen *et al.* 2016). For example, the number of individuals present on the LHIG during winter represents <0.1% of the total population size in the East Asian-Australasian Flyway for each of the five most common shorebird species: Bar-tailed Godwit, Double-banded Plover, Pacific Golden Plover, Ruddy Turnstone, and Whimbrel (Hansen *et al.* 2016). Therefore, the proposed REP is highly unlikely to have a significant impact on these species as no modifications will be made to habitat, no invasive species will be deliberately or inadvertently introduced to the LHIG, and the lifecycle of an ecologically significant proportion of the population of any species will not be disrupted.

Irregular or vagrant non-seabird migrants

The following 19 listed non-seabird species occur as irregular migrants or vagrants on LHIG:

- Black-tailed Godwit *Limosa limosa*
- Buff-breasted Sandpiper *Tryngites subruficollis*
- Common Greenshank *Tringa nebularia*
- Common Sandpiper *Actitis hypoleucos*
- Curlew Sandpiper *Calidris ferruginea*
- Fork-tailed Swift *Apus pacificus*
- Glossy Ibis *Plegadis falcinellus*
- Great Knot *Calidris tenuirostris*
- Greater Sand Plover *Charadrius leschenaultii*
- Grey Plover *Pluvialis squatarola*
- Lesser Sand Plover *Charadrius mongolus*
- Little Curlew *Numenius minutus*
- Marsh Sandpiper *Tringa stagnatilis*
- Oriental Cuckoo *Cuculus saturatus*
- Oriental Plover *Charadrius veredus*
- Oriental Pratincole *Glareola maldivarum*
- Pectoral Sandpiper *Calidris melanotos*
- Terek Sandpiper *Xenus cinereus*
- White-throated Needletail *Hirundapus caudacutus*

Fifteen of these species have been recorded on the LHIG on five or fewer occasions since ornithological records commenced in the early 1900s. Further, where dates were given, all species were observed in spring–autumn. The four species recorded on more than five occasions include Common Greenshank (13 records), Curlew Sandpiper (9 records), Common Sandpiper (12 records), and Lesser Sand Plover (23 records). All dated records were in spring–autumn. It is therefore highly unlikely any of the 19 listed non-seabird irregular migrant or vagrant bird species will be present during the proposed baiting operations and for the period bait pellets and Brodifacoum residue remain accessible within the environment. If any species are present, it is highly unlikely there will be more than five individuals present.

None of the 19 species have been recorded breeding on the LHIG and the small number of individuals of each species that have been recorded indicate the LHIG population is not significant at a regional, state, national or international scale.

A significant impact of the REP to these 19 listed species is therefore assessed to be highly unlikely, since an ecologically significant proportion of the population is not expected to be present, there will be no modifications to the habitat utilised by these species, and an invasive species will not be deliberately or inadvertently introduced to the LHIG.

Seabirds

Thirty-five listed seabird species occur on LHIG or in the surrounding waters. These are divided below into species that breed on the island, species that regularly occur at sea surrounding the LHIG, and vagrant species recorded at sea around the LHIG.

Breeding seabirds

Six listed seabird species breed on the LHIG:

- Common Noddy *Anous stolidus*
- Flesh-footed Shearwater *Ardenna carneipes*
- Masked Booby *Sula dactylatra tasmani*
- Providence Petrel *Pterodroma solandri*
- Red-tailed Tropicbird *Phaethon rubricauda*
- Wedge-tailed Shearwater *Ardenna pacifica*

The sizes of the breeding populations of all six species on the LHIG are significant at regional, state and national scales. The breeding populations of Masked Booby and Providence Petrel are also significant at an international scale, as the LHIG is one of only three or two island groups where these taxa breed, respectively (Marchant and Higgins 1990).

Of the six listed breeding seabirds, only two occur regularly on or around the LHIG in winter when baiting operations will be undertaken: Masked booby (population size 3,000–4,000 breeding pairs; breeds mid-winter–early autumn; Hutton 1991, Carlile and Priddel 2013a, 2013b, 2013c, 2013d) and Providence Petrel (population size ~32,000 breeding pairs; breeds early winter–late spring; Bester 2003). These two species are found on land only in their breeding colonies located on offshore islets (Mutton Bird Island and the Admiralty Islands) and isolated points (Muttonbird and King Points) on the main island (Masked booby), and in the southern mountains (Mount Gower and Mount Lidgbird) and their associated slopes (Providence petrel; though a very small number nest in remote areas of the northern hills). Breeding colonies of both species will be baited using a helicopter; as such they are not at risk of disturbance from human observers. The impact of helicopters (Bell 206) on Blue-footed (*S. nebouxii*) and Brown (*S. leucogaster*) booby on Isabel Island in Mexico was quantified by Samaniego–Hererra *et al.* (2010). Helicopters most commonly flew within 30-100m of nesting boobies, but sometimes as close as 10m. Nest occupancy and breeding success in the sub-colony where bait was distributed using a helicopter did not differ from two sub-colonies baited by hand. Importantly, no nest abandonment was recorded for either species and no boobies were harmed during eradication operations. Further, the most common behavioural responses to helicopter disturbance was 'no reaction' (58%) and 'became alert' (39%). 'Startle' responses (4%) and 'escape' (2%) responses were rarely observed. Most of the time (92%) when birds reacted, they resumed normal behaviour within 10 seconds. Boobies remained alert but did not exhibit signs of stress (e.g. regurgitating, nest abandonment) even during the highest level of disturbance from a helicopter (measured by sound produced, 94 decibel, helicopter height, 10m, and terrain comprised of no vegetation cover). The use of a helicopter (Bell 47) to survey nests of the critically endangered Abbott's booby (*Papasula abbotti*) on Christmas Island found that the typical response of birds sitting in their nests was to look at the helicopter but remain sitting or not respond at all (Commonwealth of Australia 2001). The trial survey recommended using helicopters in future surveys because disturbance was assessed to be negligible or non-existent. Similarly, only minor and transitory impacts from helicopter disturbance were observed in colonies of King Penguins on Macquarie Island (Springer and Carmichael 2012). Collisions with helicopters during baiting operations have been reported for Red-footed Boobies (*S. sula*): four individuals out of ~100 present at the time of baiting operations on Palmyra Atoll (Pitt *et al.* 2015; W. Pitt pers. comm.) and one individual on Enderbury Island in the Phoenix Islands (Pierce and Brown 2011). However, it is noteworthy this species, unlike the considerably larger Masked Booby, perches in trees which may place them at greater risk of taking flight and colliding with a helicopter. The risk of collisions with a helicopter for Masked booby on the LHIG is assessed to be very low because Masked booby rarely fly >10m above the height of the colony, rest and build nests exclusively on the ground, and typically depart from the colony by losing altitude from a standing position at the edge of the islet or promontory (N. Carlile and D. Portelli pers. obs., see Machovsky-Capuska *et al.* 2016). Nonetheless, mitigation measures will be in place to minimise disturbance and the risk of collision. Specifically, helicopter flight times over Masked booby colonies will be restricted to periods when birds are less likely to be leaving or arriving at the colony (movements are greatest shortly after dawn and in the late afternoon), helicopters will be restricted to flying at a height of >30 above colonies and only during light wind (<15 knots), and operational speed will not exceed 50 knots in the vicinity of colonies. In light of the above, the likelihood of a significant impact from helicopter disturbance to Masked booby on the LHIG is assessed to be low.

Providence petrel breeds principally in the southern mountains, particularly the two mountain summits. From March to November annually they arrive at LHI from mid-afternoon onwards to display in the airspace above the breeding sites, find mates and visit burrows (Hutton 1991). Baiting is currently scheduled to commence 1 June 2017. Helicopter strike with those birds involved in courtship and incubation will be avoided by restricting helicopter flights around the southern mountains to midday on each day of baiting. The majority of returns from foraging to provision chicks occur after early July (Marchant and Higgins 1990) avoiding any overlap with proposed helicopter movements.

The remaining four listed breeding seabird species do not begin to arrive at the LHIG until late winter; the expected abundance of these species during July–Sept will be low (<1,000 for each species). Importantly, these five species are expected to be absent when baits are distributed across the LHIG and so are not at risk of disturbance from helicopters or humans during bait distribution. In the unlikely event any birds are present, helicopter flight times will be limited to periods when birds are not flying in the vicinity of the island. Wedge-tailed and Flesh-footed shearwaters begin to fly close to the island in the late afternoon; some individuals will land at this time but most individuals land during or following dusk (N. Carlile and D. Portelli pers. obs.).

All listed breeding seabird species are carnivorous and obtain all their prey at sea (Marchant and Higgins 1990; Onley and Scofield 2007); they are not known to consume any food on land and as such they are highly unlikely to consume cereal bait pellets distributed on land or poisoned rodent carcasses (unlike scavenging bird species that fell victim to secondary poisoning on Macquarie and Rat Islands; Buckelew *et al.* 2011, Springer and Carmichael 2012). Chicks are fed exclusively by regurgitation from adults until they fledge and forage for themselves at sea (Marchant and Higgins 1990; Warham 1990). For example, Wandering Albatross chicks did not consume bait pellets in a trial using non-toxic baits on Macquarie Island (Springer and Carmichael 2012). Any bait pellets dropped into the sea or washed from land sink rapidly and disintegrate within 15 minutes; greatly reducing the likelihood that listed seabirds will seize and consume bait pellets. Furthermore, individuals of all the listed species, except for Common Noddy, typically forage only in deep water (i.e. >2km from the LHIG) (I. Hutton and J. Shick pers. comm.). Therefore, it is highly unlikely any individuals of the seven species are at risk of primary poisoning. Secondary poisoning from consuming marine vertebrates and invertebrates that have consumed bait pellets is potentially a risk to the seven breeding seabird species. However, because most or all individuals of each species forage in deeper waters more than two kilometres from the LHIG (I. Hutton and J. Shick pers. comm.), it is highly unlikely they will consume sufficient prey that have consumed bait pellets within the shallow waters surrounding the LHIG to receive a lethal dose of Brodifacoum. The risk of absorption of Brodifacoum via contact with the skin is extremely low for birds as almost all of their external body surface is covered by a thick layer of feathers (particularly seabirds) or cornified keratinocytic tissue, thereby virtually eliminating contact with the skin.

The only surface-nesting species present during the baiting operation is the Masked booby. This species maintain a cleared area with a radius of 0.75-1m from the centre of its nest (Marchant and Higgins 1990). The aerial bait delivery system will disperse baits at a density of approximately two bait pellets per square metre; thus 1-2 baits will be expected to fall within reach of nesting Masked Boobies. However, as this species feeds exclusively on prey captured at sea (Marchant and Higgins 1999), it is expected that birds will either ignore bait pellets or remove them to outside the cleared area around their nest. Most chicks are expected to hatch after the baiting operation (hatching occurs from July to December; Hutton 1991) and are fed exclusively by regurgitation from adult birds; thus they too are not expected to ingest any bait pellets on the ground around nests. Due to the remoteness and rugged terrain of the location of almost all breeding colonies (>80% of the Masked booby breeding population; >80% of the Providence petrel breeding population) it is not feasible to have human observers present within colonies during aerial baiting operations (to monitor disturbance or collect baits from the vicinity of nests). Furthermore, disturbance was slightly higher in sub-colonies of Blue-footed and Brown boobies baited by hand than in the sub-colony baited using a helicopter on Isabel Island (A. Samaniego-Herrera pers. comm.). The prolonged presence of a human observer in close vicinity of Masked booby nests—to monitor disturbance during the baiting operation or to remove bait pellets as they fall—poses a risk of nest desertion and the death of newly hatched chicks left unattended (see Burger and Gochfeld 1993). In light of the above, removal of bait pellets from the vicinity of Masked booby nests is considered unnecessary. This assessment is supported by the observation that no Blue-footed, Brown, Red-footed or Masked booby were harmed during baiting operations on five islands in the Gulf of California and Caribbean, where bait pellets were not removed from within colonies (Samaniego-Herrera *et al.* 2009, 2010, in press; A. Samaniego-Herrera pers. comm.). The only other breeding seabird present during the baiting operation is the Providence Petrel, which will have limited contact with bait pellets while nesting as it nests either underground or within deep cavities on the ground; further, as stated above, this species is highly unlikely to consume any bait pellets as adults feed exclusively at sea and chicks are fed exclusively by regurgitation from adults.

A significant impact of the proposed rodent eradication programme is assessed to be highly unlikely for listed breeding seabird species. That is, the REP poses no risk to the habitat of these breeding seabirds (no habitat will be modified), will not result in the deliberate or inadvertent introduction of invasive species that may threaten populations of the listed species, and is highly unlikely to result in a disruption to the lifecycle of an ecologically significant proportion of the population of any species. In contrast, it is expected that the REP will have long-term positive impacts on the populations of at least some of these species. For example, the number of Masked Boobies breeding on Tromelin Island increased by 22-23% each year following the eradication of *Rattus norvegicus* (Corre *et al.* 2015). Fledgling productivity of Wedge-tailed Shearwaters on Moku‘auia in Hawaii

doubled in the year following the eradication of rats, both after the initial eradication and an eradication that followed reinvasion (Marie *et al.* 2014). The density of burrows of seven seabird species, including the Flesh-footed shearwater, increased following rat eradication on New Zealand islands (Buxton *et al.* 2016), and the breeding success of Cory's shearwater (*Calonectris diomedea*)—which is a similar size to Providence petrel and Flesh-footed shearwaters—increased following control of black rats at the Chafarinas Islands (Igual *et al.* 2006).

Regularly occurring pelagic seabirds

Seven listed seabird species are regularly, but sometimes infrequently, observed at sea surrounding the LHIG, but do not breed on the LHIG:

- Buller's Albatross *Thalassarche bulleri*
- Campbell Albatross *Thalassarche impavida*
- Northern Giant Petrel *Macronectes halli*
- Northern Royal Albatross *Diomedea sanfordi*
- Shy Albatross *Thalassarche cauta* (including *T. c. cauta*, *T. c. salvini* and *T. c. steadi*)
- Short-tailed Shearwater *Ardenna tenuirostris*
- Southern Royal Albatross *Diomedea epomophora* (*sensu stricto*)

The number of individuals of each species expected to occur within the LHIG is not significant at a regional, state, national or international scale.

These seven regularly occurring pelagic seabird taxa typically forage in deeper water or are observed on migration, as such they are very rarely observed in the relatively shallow waters within two kilometres of the LHIG (I. Hutton and J. Shick pers. comm.). No individuals of these species have been recorded on land in the LHIG. Consequently, regularly occurring pelagic seabird taxa are highly unlikely to come into contact with Brodifacoum baits or come within 2 km of helicopters during the baiting operation and prior to baits disintegrating and residual Brodifacoum reducing to non-toxic levels. The impact of the proposed rodent eradication programme is therefore assessed to be non-existent or negligible for these eight species.

Vagrant pelagic seabirds

Twenty listed seabird species have been recorded on seven or fewer occasions on the LHIG, usually as single individuals, since ornithological records commenced in the early 1900s, but do not breed on the LHIG:

- Black-browed Albatross *Thalassarche melanophris*
- Black-naped Tern *Sterna sumatrana*
- Brown Booby *Sula leucogaster*
- Caspian Tern *Sterna caspia*
- Common Tern *Sterna hirundo*
- Lesser Frigatebird *Fregata ariel*
- Little Tern *Sternula albifrons*
- Long-tailed Jaeger *Stercorarius longicaudus*
- Red-footed Booby *Sula sula*
- Sooty Shearwater *Ardenna griseus*
- Southern Giant Petrel *Macronectes giganteus*
- Wandering Albatross complex *(*comprised of *Diomedea exulans, D. amsterdamensis, D. antipodensis* and *D. dabbenena*; treated here as a single taxon since available records do not distinguish among these morphologically similar and previously conspecific taxa)
- Westland Petrel *Procellaria westlandica*
- Whiskered Tern *Chlidonias leucopterus*
- White-tailed Tropicbird *Phaethon lepturus*
- White-winged Black Tern *Chlidonias leucopterus*
- Wilson‘s Storm- petrel *Oceanites oceanicus*

The number of individuals of each species that may potentially occur within the LHIG is not significant at a regional, state, national or international scale.

Most, if not all, vagrant seabird taxa were recorded only at sea. Of the records where dates were given, all occurred in spring, summer or autumn. It is therefore highly unlikely any of these vagrant seabird taxa will be present during the proposed baiting operations in winter 2017 and for the period baits and Brodifacoum residue will remain accessible within the environment. If any are present, most species are unlikely to occur in shallower water (terns are the possible exception) within 2 km of the LHIG. Therefore, the impact of the REP is assessed to be non-existent or negligible for listed vagrant seabirds.

Table 22 Significant Impacts to EPBC Listed Migratory Birds

Species	EPBC Act Status	Significant Impact from the LHI REP
Migratory Marine Birds and Migratory Wetland Birds		
Bar-tailed Godwit *Limosa lapponica*	Mi	No. Species unlikely to be present in significant numbers and unlikely to have exposure to bait.
Black-browed Albatross *Diomedea melanophris*	V, Mi	No. Species unlikely to be present and unlikely to have exposure to bait.
Black-naped Tern *Sterna sumatrana*	Mi	No. Species unlikely to be present
Black-tailed Godwit *Limosa limosa*	Mi	No. Species unlikely to be present
Brown Booby *Sula leucogaster*	Mi	No. Species unlikely to be present and unlikely to have exposure to bait.
Brown Noddy *Anous stolidus*	Mi	No. Species unlikely to be present in significant numbers and unlikely to have exposure to bait. Helicopters flying baiting transects over noddy roosting-sites may cause birds to take to the wing, and so endanger themselves and the flight crews, however this can be avoided by flying transects when the birds are at sea foraging, avoiding early in the morning or late in the afternoon.
Buff-breasted Sandpiper *Tryngites subruficollis*	Mi	No. Species unlikely to be present
Bullers Albatross *Thalassarche bulleri*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Campbell Albatross *Thalassarche melanophris impavida*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Caspian Tern *Sterna caspia*	Mi	No. Species unlikely to be present in significant numbers and unlikely to have exposure to bait.
Cattle Egret *Ardea ibis*	Mi	No. Species unlikely to be present in significant numbers and unlikely to have exposure to bait.
Chatham Albatross *Thalassarche eremita*	E, Mi	No. Known to forage in the area but unlikely to have exposure to bait.

Common Greenshank *Tringa nebularia*	Mi	No. Species unlikely to be present in significant numbers and unlikely to have exposure to bait.
Common Sandpiper *Tringa hypoleucos*	Mi	No. Species unlikely to be present.
Common Tern *Sterna hirundo*	Mi	No. Species unlikely to be present.
Curlew Sandpiper *Calidris ferruginea*	CE, Mi	No. May be small number present but unlikely to have significant exposure to bait.
Double-banded Plover *Charadrius bicinctus*	Mi,	No. May be small number present but unlikely to have significant exposure to bait.
Eastern Curlew *Numenius madagascariensis*	CE,	No. Species unlikely to be present.
Eastern Great Egret *Ardea modesta*	Mi	No. May be small number present but unlikely to have significant exposure to bait.
Flesh-footed Shearwater *Ardenna carneipes*	Mi	No. Unlikely to have significant exposure to bait.
Fork-tailed Swift *Apus pacificus*	Mi	No. Species unlikely to be present.
Glossy Ibis *Plegadis falcinellus*	Mi	No. Species unlikely to be present.
Gould's Petrel *Pterodroma leucoptera*	E	No. Species unlikely to be present.
Great Knot *Calidris tenuirostris*	Mi	No. Species unlikely to be present.
Greater Sand Plover *Charadrius leschenaultii*	Mi	No. May be small number present but unlikely to have significant exposure to bait.
Grey Plover *Pluvialis squatarola*	Mi	No. Species unlikely to be present.
Grey-tailed Tattler *Heteroscelus brevipes*	Mi	No. Species unlikely to be present in significant numbers.
Latham's Snipe *Gallinago hardwickii*	Mi	No. May be small number present but unlikely to have significant exposure to bait.
Least or Lesser Frigatebird *Fregata ariel*	Mi	No. Species unlikely to be present and unlikely to have exposure to bait.
Lesser Sand Plover *Charadrius mongolus*	Mi	No. Species unlikely to be present.
Little Curlew *Numenius minutus*	Mi	No. Species unlikely to be present.

Little Tern *Sternula albifrons*	Mi	No. May be small number present but unlikely to have significant exposure to bait.
Long-tailed Jaeger *Stercorarius pomarinus*	Mi	No. Species unlikely to be present.
Marsh Sandpiper *Tringa stagnatilis*	Mi	No. Species unlikely to be present.
Masked Booby *Sula dactylatra tasmani*	Mi	No. Unlikely to have exposure to bait. The birds feed at sea, departing before sunrise and returning up until dark to feed their young. As the adults are away from the island during daylight hours, it is very unlikely that any will be hit by the baiting helicopter. Any individuals sitting on eggs are unlikely to be disturbed by helicopter operations.
Northern Giant Petrel *Macronectes halli*	V, Mi	No. Species unlikely to be present and unlikely to have exposure to bait.
Northern Royal Albatross *Diomedea epomophora sanfordi*	E, Mi	No. Species unlikely to be present and unlikely to have exposure to bait.
Oriental Cuckoo *Cuculus saturatus*	Mi	No. Species unlikely to be present.
Oriental Plover *Charadrius veredus*	Mi	No. May be small number present but unlikely to have significant exposure to bait.
Oriental Pratincole *Glareola maldivarum*	Mi	No. Species unlikely to be present.
Pacific Golden Plover *Pluvialis fulva*	Mi	No. May be small number present but unlikely to have significant exposure to bait.
Painted Snipe *Rostratula benghalensis*	E, Mi	No. Species unlikely to be present.
Pectoral Sandpiper *Calidris melanotos*	Mi	No. May be very small number present but unlikely to have significant exposure to bait.
Providence Petrel *Pterodroma solandri*	Mi	No. Helicopter operations around Providence Petrel areas will be timed to occur when the majority of birds are feeding at sea (mid-morning). Some non-breeding birds will be present during the day therefore there is the possibility of collision with low-flying helicopters dropping bait. This will be mitigated as much as possible through pilot education and vigilance. Unlikely that significant disruption to breeding cycle or population level impacts will occur.
Rainbow Bee-eater *Merops ornatus*	Mi	No. Species unlikely to be present.
Red Knot *Calidris canutus*	Mi	No. Species unlikely to be present in significant numbers
Red-footed Booby *Sula sula*	Mi	No. Species unlikely to be present.
Red-necked Stint	Mi	No. Species unlikely to be present in significant numbers.

Calidris ruficollis		
Red-tailed Tropicbird *Phaethon rubricauda*	Mi	No. Species unlikely to be present in significant numbers.
Ruddy Turnstone *Arenaria interpres*	Mi	No. Species unlikely to be present in significant numbers and unlikely to have exposure to bait
Salvin's Albatross *Thalassarche cauta salvini*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Sharp-tailed Sandpiper *Calidris acuminata*	Mi	No. Species unlikely to be present in significant numbers.
Short-tailed Shearwater *Puffinus tenuirostris*	Mi	No. Species unlikely to be present.
Shy Albatross *Thalassarche cauta cauta*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Sooty Shearwater *Puffinus griseus*	Mi	No. Species unlikely to be present in significant numbers.
Southern Giant Petrel *Macronectes giganteus*	E, Mi	No. Species unlikely to be present and unlikely to have exposure to bait.
Southern Royal Albatross *Diomedea epomophora epomophora*	V, Mi	No. Species unlikely to be present and unlikely to have exposure to bait.
Terek Sandpiper *Xenus cinereus*	Mi	No. Species unlikely to be present.
Wandering or Snowy Albatross *Diomedea exulans (sensu lato)* Amsterdam Albatross *Diomedea amsterdamensis* Antipodean Albatross *Diomedea antipodensis* Tristan Albatross *Diomedea dabbenena* Gibson's Albatross *Diomedea antipodensis gibsoni*	V, Mi,	No. Species unlikely to be present and unlikely to have exposure to bait
Wandering Tattler *Tringa incana*	Mi	No. Species unlikely to be present.
Wedge-tailed Shearwater *Puffinus pacificus*	Mi	No. Unlikely to be present in significant numbers and unlikely to have exposure to bait. Any birds in the area will be feeding at sea, departing before sunrise and returning up until after dark sunset and it is very unlikely that any will be hit by the baiting helicopter. Rodent eradication will benefit breeding success.
Westland Petrel	Mi	No. Species unlikely to be present.

Procellaria westlandica		
Whimbrel *Numenius phaeopus*	Mi	No. Species unlikely to be present in significant numbers.
Whiskered Tern *Chlidonias leucoptera*	Mi	No. Species unlikely to be present.
White-bellied Storm-petrel *Fregetta grallaria*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
White-capped Albatross *Thalassarche cauta steadi*	V, Mi	No. Species unlikely to be present and unlikely to have exposure to bait. Will benefit from rodent eradication as a result of the potential to recolonise main island for nesting.
White-tailed Tropicbird *Phaethon lepturus*	Mi	No. Species unlikely to be present.
White-throated Needletail *Hirundapus caudacutus*	Mi	No. Species unlikely to be present in significant numbers and unlikely to have exposure to bait
White-winged Black Tern *Chlidonias leucopterus*	Mi	No. Species unlikely to be present.
Wilson's Storm- petrel *Oceanites oceanicus*	Mi	No. Species unlikely to be present.

5.2.9 Potential Impacts to Listed Migratory Marine Species

Potential impacts to Listed migratory marine species are limited to accidental bait entry into the water (either through aerial distribution or a spill) leading to pollution of water, primary or secondary poisoning. Any potential impacts are likely to be very localised and temporary in nature.

Pollution of marine water resulting in impacts to threatened marine species is considered extremely unlikely considering the minimal amount of bait likely to enter the water, the insolubility of Brodifacoum and the huge dilution factor.

Fish, rays and sharks are unlikely to have sufficient exposure to the bait to have a significant impact at an individual level and certainly not at a population level.

There is no realistic pathway by which marine mammals can be significantly exposed to rodenticide at the LHIG as a result of the proposed aerial baiting with Pestoff® 20R. The combination of Brodifacoum being practically insoluble in water, the infinitesimal amount of Brodifacoum that may land in the sea and the huge dilution factor preclude any significant effect upon marine mammals. Marine mammal species are also rare visitors to LHI waters, passing through on the annual migration and are therefore unlikely to encounter the bait.

It is very unlikely that Green Turtles *Chelonia mydas* could be exposed to rodenticides by consuming baits directly or prey items that have ingested rodenticides. Adult Green Turtles feed exclusively on various species of seagrass and seaweed. Plants have not been documented to take up and store anticoagulants; therefore no effect on adult Green Turtles is expected to occur from ingestion of rodenticide in their food.

Juvenile Green Turtles and the other four species of turtle (Flatback Turtle *Natator depressus*, Hawksbill Turtle *Eretmochelys imbricata*, Leatherback Turtle *Dermochelys coriacea* and Loggerhead Turtle *Caretta caretta*) that may be encountered in the marine park are carnivorous, and will eat soft corals, shellfish, crabs, sea urchins and jellyfish. However, it is unlikely that these turtles will encounter marine invertebrates that may have been contaminated with Brodifacoum as a result of aerial baiting the LHIG with Pestoff® 20R. The mitigation techniques that will be used to minimise bait going into the lagoon i.e. hand baiting of the foreshore and use of a deflector on the bucket will minimise access to bait in that area. Evidence against the existence of a significant dietary exposure pathway for invertebrates is outlined in section 3.1 f).

No turtle nesting occurs on the LHIG.

In summary, the proposed baiting of LHI does not pose a threat to listed marine life (Cetaceans, turtles, fish or sharks) because:

- The use of specialised equipment on the bait hopper will ensure minimal bait entry to the water. The amount of bait that may bounce off the cliffs to fall into the sea will be minimal (Howald *et al.* 2005; Samaniego-Herrera *et al.* 2009);
- The breakdown of baits that do land in the sea will be rapid (Empson and Miskelly 1999), therefore the opportunity for fish to take baits will be limited;
- Fish have shown a lack of interest in baits (Samaniego-Herrera *et al.* 2009, U.S. Fish and Wildlife Service and Hawai'i Department of Land and Natural Resources 2008), so it is unlikely that many fish will take baits;
- The possible death of those few fish that find and eat enough baits to prove fatal does not pose a threat at the population level;
- Baiting other islands using similar methods, although sometimes using significantly more bait, has not resulted in adverse effects on the marine environment
- Any potential impacts are likely to be very localised and temporary in nature.

Further details regarding potential impacts to the marine environment are provided in Section 5.2.10.

Table 23 Significant Impacts to EPBC Listed Migratory Marine Animals

Species	EPBC Act Status	Significant Impact from the LHI REP
Antarctic Minke Whale *Balaenoptera bonaerensis*	Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Brysdes Whale *Balaenoptera edeni*	Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Blue Whale *Balaenoptera musculus*	E, Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Pygmy right whale *Caperea margniata*	Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait
Great White Shark *Carcharodon carcharias*	V, Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Loggerhead Turtle *Caretta caretta*	E, Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Green Turtle *Chelonia mydas*	V, Mi	No. Unlikely to have sufficient exposure to bait.
Leatherback Turtle *Dermochelys coriacea*	E, Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Hawksbill Turtle *Eretmochelys imbricata*	V, Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Southern Right Whale *Eubalaena australis*	E, Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Dusky Dolphin *Lagenorhynchus obscurus*	Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait
Mackeral Shark *Lamna Nasus*	Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait
Reef Manta Ray *Manta alfredi*	Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Giant Manta ray *Manta birostris*	Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Humpback Whale *Megaptera novaeangliae*	V, Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Flatback Turtle *Natator depressus*	V, Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Killer Whale *Orcinus Orca*	Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Sperm Whale *Physeter macrocephalus*	V, Mi	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.

5.2.10 Potential Impacts to the Commonwealth Marine Area

Potential impacts to the Commonwealth marine environment and the Lord Howe Commonwealth Marine Reserve from the proposed LHI REP are limited to:

- accidental bait entry into the water (either through aerial distribution or a spill) leading to:
- pollution of water
- primary or secondary poisoning of fish, marine mammals, marine reptiles, marine invertebrates or sea birds that inhabit or transit through the Lord Howe Commonwealth Marine Reserve.

Any potential impacts are likely to be very localised and temporary in nature.

As no underwater operations will occur, no impacts are expected to marine cultural heritage values.

Pollution of water

The fate of the Pestoff bait pellet and the toxin Brodifacoum in the marine environment is described in Section 5.2.1 above.

As mentioned previously, the application rate of Pestoff 20R over the LHI group will be two applications (14- 21 days apart); 12 kg/ha and 8 kg/ha giving a total application rate of 20 kg/ha of Pestoff 20R pellets. For simplicity this can be considered a single application. At 20 mg/kg Brodifacoum concentration this will result in application of 0.4 g/ha of Brodifacoum. In the marine and aquatic environment, the dosage rate of 0.4 g/ha Brodifacoum equates to 0.4 g /1.5ML (1 ha of water 15cm deep) or 0.2 ug/L in the worst case scenario. This worst case scenario assumes that the entire 20kg/ha (i.e. all of the bait from coastal swaths in both bait drops) ends up in the water. This is considered highly unlikely considering Howald *et al.* (2005) showed that when baits were applied aerially to steep cliffs, (application rate of 15 kg/ha) a mean of only 72 baits over 500 m stretch of coast (~2 ha) ended up in the water. This would equate to less than 0.5% out of the approximate 15,000 baits applied over that area ended up in the sea. Using a similar percentage of bait that could bounce off the cliffs and ended up in the sea in the LHI REP situation, a more likely predicted environmental concentration in the marine environment would be in the order of 0.01 ug/L. This concentration would still be three nautical miles from the Commonwealth marine environment.

It is possible for marine organisms to absorb Brodifacoum through their gills or skin (Empson and Miskelly 1999), and Brodifacoum is considered to be toxic to aquatic organisms, but at concentrations in their environment many orders of magnitude greater than those that could be associated with the small amount of bait that may be deposited in the sea as the result of rodent baiting operations conducted on nearby land. Even the 0.2 ug/L in the worst case scenario described above is still orders of magnitude below the known Lethal Concentrations (LC) for the most sensitive marine species. LC, referring to the concentration of a chemical in a medium such as air or water, is the measure of the toxicity of that chemical to a particular test subject. Typically it is defined as LC_{50} for exposure for a certain amount of time; the 50 indicating the concentration likely to kill 50% of those organisms exposed to it.

Table 24 Lethal Concentrations (Lc50 Mg/L) of Brodifacoum for a Range of Fish and Aquatic Invertebrates (from Broome et al. 2016)

SPECIES	LC50 mg/L	REFERENCES
Fish	Range: 0.02 - >10.0 mg/L	
Bluegill sunfish (*Lepomis macrochirus*)	0.12 (96-hour LC50)	USEPA (2005)
	0.165 (96-hour LC50)	Eason and Wickstrom (2001)
Crucian Carp (*Carassius carassius*)	>10.0 (24 hour LC50)	USEPA (2005)
	>10.0 (48 hour LC50)	USEPA (2005)
	1.0 (72 hour LC50)	USEPA (2005)
	1.0 (96 hour LC50)	USEPA (2005)
	1.0 (7 day LC50)	USEPA (2005)
	1.0 (14 day LC50)	USEPA (2005)
	0.1 (21 day LC50)	USEPA (2005)
Common carp (*Cyprina carpio*)	>10.0 (24 hour LC50)	USEPA (2005)
	>10.0 (48 hour LC50)	USEPA (2005)

	1 (72 hour LC50)	USEPA (2005)
	1 (96 hour LC50)	USEPA (2005)
Cyprinid (*Leucaspius delineatus*)	>10.0 (24 hour LC50)	USEPA (2005)
	>10.0 (48 hour LC50)	USEPA (2005)
	1.0 (72 hour LC50)	USEPA (2005)
	1.0 (96 hour LC50)	USEPA (2005)
	1.0 (7 day LC50)	USEPA (2005)
	0.1 (14 day LC50)	USEPA (2005)
	0.1 (21 day LC50)	USEPA (2005)
Rainbow trout (*Oncorhynchus mykiss*)	0.155 (24-hour LC50)	Eason and Wickstrom (2001)
	0.051 (96 hour LC50)	Eason and Wickstrom (2001)
	0.02 (96 hour LC50)	USEPA (2005)
	0.025 (96 hour LC50)	USEPA (2005)
	0.04 (96 hour LC50)	(Anonymous 2009)
Tench (*Tinca tinca*)	>10.0 (24 hour LC50)	USEPA (2005)
	>10.0 (48 hour LC50)	USEPA (2005)
	1.0 (72 hour LC50)	USEPA (2005)
	1.0 (96 hour LC50)	USEPA (2005)
	1.0 (7 day LC50)	USEPA (2005)
	0.1 (14 day LC50)	USEPA (2005)
	0.1 (21 day LC50)	USEPA (2005)
Aquatic Invertebrates	Range: 0.34 - >10.0 mg/L	
Daphnia (*Daphnia magna*) 1st instar	1.0 (24 hour LC50)	Eason and Wickstrom (2001)
	0.34 (48 hour LC50)	Eason and Wickstrom (2001)
Adult	0.98 (48 hour LC50)	USEPA (2005)
Tubificid worm (*Tubifex tubifex*)	>10.0 (24 hr. LC50)	USEPA (2005)
	>10.0 (48 hr. LC50)	USEPA (2005)
	>10.0 (72 hr. LC50)	USEPA (2005)
	1.0 (96 hr. LC50)	USEPA (2005)
Mosquito larvae (*Aedes aegypti*)	8.23 (24hr LC50)	Jung and Moon (2011)

The accidental spillage of 360g of Brodifacoum into the sea in New Zealand from a single-point discharge of 18 tonnes of bait was not associated with any long-term adverse effects on the marine environment (see Section 7-2.3.3). This incident represents an extreme example of Brodifacoum contamination. Although 18 tonnes of bait, almost half the total proposed to be applied to the whole of the LHIG, was deposited into the sea at one point, the overall effect was small and localised (Primus *et al.* 2005). There were no report of damage to the surrounding reefs (Primus *et al.* 2005), and what effect there was on the local marine life was limited in extent and transient (*ibid*). Although it is possible that, as a consequence of the aerial baiting of the LHG, some pellets will land in the ocean, the number of such pellets will be small. In an aerial baiting programme conducted on a U.S. island where baits were dispersed at a higher application rate then that proposed for the LHG, the average number of pellets landing per 500 metres of coastline was only 72 (Howald *et al.* 2005). If nine million pellets deposited at one point resulted in a limited and transient effect on the marine environment within a 100 metres of the spill-site (Primus *et al.* 2005) then, intuitively, 14 pellets in 100 metres (Howald *et al.* 2005) would have negligible effect on the marine environment of LHI.

Other baiting operations using similar methods to the one proposed for LHI have not caused harm to marine organisms (Howald *et al.* 2005; Samaniego-Herrera *et al.* 2009), even though the bait application rates in those

operations were up to double that proposed for LHI, and the bait more concentrated (i.e. 50ppm compared to 25 ppm on LHI).

Pollution of water within the Commonwealth marine environment is therefore considered extremely unlikely considering:

- The use of specialised equipment on the bait hopper will ensure minimal bait entry to the water.
- The amount of bait that may bounce off the cliffs to fall into the sea will be minimal (Howald *et al.* 2005; Samaniego-Herrera *et al.* 2009);
- Brodifacoum is practically insoluble, particularly in cold seawater (Primus *et al.* 2005) such as will be found off LHI in August, therefore extremely little Brodifacoum will dissolve out from the baits and remain suspended in the water. This, coupled with the significant dilution factor, will mean that the amount of Brodifacoum assimilated into the marine environment will be many orders of magnitude lower than the concentrations known to be toxic to fish (Empson 1996); and
- the three nautical mile distance of the REP bait distribution from the Commonwealth marine environment
- Baiting other islands using similar methods, although sometimes using significantly more bait, has not resulted in adverse effects on the marine environment as a whole.
- Any potential impacts are likely to be very localised and temporary in nature.

Primary or Secondary Poisoning of Marine Organisms

Marine invertebrates

Because many marine invertebrates scavenge or graze on items on the sea bottom or in intertidal areas, it is possible that a few may pick up bait pellets or pellet fragments prior to the pellets breaking down in the water. Breakdown of a pellet would likely take only a few minutes, especially if the water is rough (Empson and Miskelly 1999). However, evidence against the existence of a significant dietary-exposure pathway for invertebrates comes from field sampling of marine invertebrates following an actual rodenticide application (Howald *et al.* 2005) where no Brodifacoum was detected in invertebrate species. Sampling undertaken after a spill of 18 tonnes of 0.002% (20 ppm) Brodifacoum bait in New Zealand in 2001 (Primus *et al.* 2005,) also demonstrated that even when extremely large amounts of Brodifacoum enter the sea, the effect on the marine environment is transient and localised. Therefore baiting of the Lord Howe Island Group poses negligible risk to local marine invertebrates.

Corals

The rodent eradication will not pose a risk to coral because:

- the pellets and most pellet fragments are too big for the filter-feeding coral polyps to eat;
- the solubility of Brodifacoum in water is poor and the amount of rodenticide in pellets (20 ppm) is low to begin with, thus the risk of corals absorbing dissolved Brodifacoum is negligible; and
- there is no known physiological mechanism by which vertebrate anticoagulants can affect invertebrates.

Fish

If in sufficient quantity, it is possible for fish to absorb Brodifacoum through their gills or skin (Empson and Miskelly 1999). However, the proposed baiting of the LHIG is likely to result in only a small number of baits landing in the sea. Because i) Brodifacoum is practically insoluble in water, ii) the total amount of Brodifacoum is minute, and iii) the dilution factor is great, the risk of fish absorbing Brodifacoum is negligible.

Whilst there is a possibility that individual fish will ingest sufficient pellets to consume a lethal dose, impacts to the values of the Commonwealth Marine Environment are very unlikely. Similarly the likelihood of secondary poisoning is also considered unlikely.

Turtles

It is very unlikely that Green Turtles *Chelonia mydas* could be exposed to rodenticides by consuming baits directly or prey items that have ingested rodenticides. Adult Green Turtles feed exclusively on various species of seagrass and seaweed. Plants have not been documented to take up and store anticoagulants; therefore no effect on adult Green Turtles is expected to occur from ingestion of rodenticide in their food.

Juvenile Green Turtles and the other four species of turtle (Flatback Turtle *Natator depressus*, Hawksbill Turtle *Eretmochelys imbricata*, Leatherback Turtle *Dermochelys coriacea* and Loggerhead Turtle *Caretta caretta*) that may be encountered in the marine park are carnivorous, and will eat soft corals, shellfish, crabs, sea urchins and jellyfish. However, it is unlikely that these turtles will encounter marine invertebrates that may have been contaminated with Brodifacoum as a result of aerial baiting the LHIG with Pestoff® 20R. Evidence against the

existence of a significant dietary exposure pathway for invertebrates is outlined in Marine invertebrates (above). No turtle nesting occurs on the LHIG.

Marine mammals

There is no realistic pathway by which marine mammals can be significantly exposed to rodenticide at the LHIG as a result of the proposed aerial baiting with Pestoff® 20R. The combination of Brodifacoum being practically insoluble in water, the infinitesimal amount of Brodifacoum that may land in the sea and the huge dilution factor preclude any significant effect upon marine mammals.

In summary, the proposed baiting of LHI does not pose a threat to the marine life (Cetaceans, seals, turtles, fish or invertebrates, including coral) or the conservation values of the Lord Howe Island Marine Park because:

- The use of specialised equipment on the bait hopper will ensure minimal bait entry to the water. The amount of bait that may bounce off the cliffs to fall into the sea will be minimal (Howald *et al.* 2005; Samaniego-Herrera *et al.* 2009);
- The breakdown of baits that do land in the sea will be rapid (Empson and Miskelly 1999), therefore the opportunity for fish to take baits will be limited;
- Fish have shown a lack of interest in baits (Samaniego-Herrera *et al.* 2009, U.S. Fish and Wildlife Service and Hawai'i Department of Land and Natural Resources 2008), so it is unlikely that many fish will take baits;
- The possible death of those few fish that find and eat enough baits to prove fatal does not pose a threat at the population level;
- Baiting other islands using similar methods, although sometimes using significantly more bait, has not resulted in adverse effects on the marine environment
- Any potential impacts are likely to be very localised and temporary in nature.

Appendix I – Marine Hypothetical Scenario contains a number of hypothetical examples where the contamination levels resulting from that bait spill have been assumed to exist off the LHIG, and involve representatives of some of the fauna that may be found in the area. This analysis demonstrates that the risks to marine species around the Lord Howe Island Group are negligible, and, accordingly, marine species are not affected species. It also contains a summary of attraction of fish to bait pellets from testing undertaken on Lehua Island, Hawai'i, in 2004 (U.S. Fish and Wildlife Service, 2008).

5.2.11 Potential Impacts to World Heritage Values

Criterion (vii)

No activities are proposed that could damage, degrade, alter or diminish World Heritage values associated with topographical relief, geological formation or scenic landscapes of the LHIG described in Criterion (vii).

No impacts are expected to transition zones for algal or coral reefs or the marine environment described in Criterion (vii). Further detail is provided in section 3.1 f). No impacts are expected to assemblages of temperate and tropical forms.

No impacts are expected to nesting seabirds or habitat described in Criterion (vii). Further detail is provided in section 3.1 d) and e). The proposal will remove a threat to nesting seabirds resulting in positive impacts and improving the World Heritage values.

Criterion (x)

The proposal is unlikely to impact on the number of endemic species, diversity of landscapes or biota described in Criterion (x). The proposal may have some potential impacts to individuals of endemic or threatened species (described in sections below) but this is unlikely to cause World Heritage values associated with endemism, threatened species or biota to be lost, damaged, degraded, notably altered or diminished. Any potential impacts will be localised and temporary.

It is highly likely that if the proposal proceeds and eradication of rodents is accomplished, this will contribute significantly to enhancement of World Heritage values, similar to what has occurred through the eradication of other invasive mammals and weed species on the property. The proposal may result in localised and temporary impacts to several endemic species but will remove a significant threat that if left unchecked would result in the continued degradation of the islands World Heritage values.

Full details of the World Heritage values are contained within the Advisory Body's Evaluation Report 1982 (UNESCO, 2016). Detailed consideration of potential impacts to these values is provided below and in relevant impact assessment sections in Section 5.

Table 25 Potential Impacts to World Heritage Values

World Heritage Value	Potential Impacts Associated with the REP	Assessment of Impacts	Mitigation Measures	Consequences of not proceeding undertaking the REP
Threatened Birds	Direct and secondary poisoning through consumption of baits or deceased rodents	In the absence of mitigation, a significant impact to woodhens is likely to occur from the LHI REP. However with the mitigation proposed in place, it is considered unlikely that either long term population decrease or major disruption to a breeding cycle will occur. Impacts are likely to be temporary. It is therefore considered unlikely that the REP will have a significant impact on woodhens In the absence of mitigation, a significant impact to LHPC is likely to occur from the LHI REP. With the proposed mitigation in place, it is considered possible that the REP will still have a significant impact on LHPC through the temporary disruption of a breeding cycle, although it is unlikely that a long-term population decrease will occur. Any potential impacts will be temporary.	Captive management of significant portions of the population under the care of a team of specialist aviculturists from Taronga Zoo.	Continued competition with rodents for resources (woodhen). Continued exposure to direct and secondary poisoning through consumption of baits or poisoned rodents from the existing control program.
Threatened Reptiles	Primary poisoning (direct consumption) and secondary poisoning (consumption of poisoned invertebrates).	Each species is considered to be at low risk of poisoning, and both are likely to substantially increase in abundance following the removal of rodents.	No specific mitigation	Continued decline from rodent predation
Threatened Invertebrates	Direct poisoning through consumption of baits	Low risk to four species and higher risk to *Gudeoconcha sophiae magnifica*. Land snails are highly threatened by rat predation and it is likely that if rats are not removed these species will become extinct.	Possible brodifacoum testing on surrogates species	Continued decline and likely extinction from rodent predation

Threatened and Migratory Fish and Marine Mammals	Localised and temporary pollution of water, primary or secondary poisoning.	Pollution of marine water resulting in impacts to threatened marine species is considered extremely unlikely considering the minimal amount of bait likely to enter the water, the insolubility of Brodifacoum and the huge dilution factor. Species unlikely to have sufficient exposure to the bait	Minimising bait entry into the water through the use of directional deflector arm on the bait bucket.	Unlikely impact
Threatened Plants	Works associated with building the captive management facility and bait distribution (through potential uptake of Brodifacoum by plants).	No impact is expected to listed plant species. Conversely removal of rodents is expected to significantly benefit individual species (such as the Little Mountain Palm and Phillip Island Wheat Grass) and many vegetation communities through reduced predation on seeds, seedlings and stems of palm-leaf fronds.	No clearing of vegetation	Continued seed and seedling predation from rodents causing population declines.
Migratory Birds	Include primary poisoning from consumption of bait pellets; secondary poisoning from consumption of poisoned rodents or other animals Disturbance as a result of helicopter activities and collisions with the helicopter.	Unlikely to impact most species as a result of either not present during the REP, not present in significant numbers or no exposure to the bait. Helicopter disturbance to two breeding species; Masked booby and Providence petrel unlikely to be significant with mitigation.	Helicopter movements near breeding areas restricted to times of least impact.	Continued predation of chicks and eggs by rodents causing population declines.
Endemic Mammals (LHI Long eared Bat	Secondary poisoning (consumption of poisoned invertebrates	Unlikely to be significantly impacted by the REP	No specific mitigation	Changes unlikely
Other endemic plants 113 endemic plant species (DECC, 2007)	Works associated with building the captive management facility and bait distribution (through potential uptake of Brodifacoum by plants).	No impact is expected to other endemic plant species. Conversely removal of rodents is expected to significantly benefit individual species and many vegetation communities through reduced predation on seeds, seedlings and stems of palm-leaf fronds.	No clearing of vegetation	Continued seed and seedling predation from rodents causing population declines.

Other endemic land birds LH Golden Whistler Silvereye	Primary poisoning from consumption of bait pellets; secondary poisoning from consumption of poisoned invertebrates	Both species highly unlikely to consume bait and unlikely to consume sufficient poisoned invertebrates. Potential for individuals to succumb to poisoning but unlikely to have significant impact at a species level.	No specific mitigation	Continued competition with rodents for resources.
Other endemic terrestrial invertebrates Up to 60% of some invertebrate groups	Primary poisoning from consumption of bait pellets;	Unlikely to be significantly impacted by the REP	No specific mitigation	Continued decline from rodent predation.
Other endemic marine species	Localised and temporary pollution of water, primary or secondary poisoning.	Pollution of marine water resulting in impacts to threatened marine species is considered extremely unlikely considering the minimal amount of bait likely to enter the water, the insolubility of Brodifacoum and the huge dilution factor. Species unlikely to have sufficient exposure to the bait	Minimising bait entry into the water through the use of directional deflector arm on the bait bucket.	Unlikely impact.

5.2.12 Potential Impacts to National Heritage Values

The National Heritage values of the LHIG are intrinsically linked to the World Heritage values as evidence by the National Heritage criterion (A, B, C and E) referencing the World Heritage Criteria (vii) and (x). As the proposal is unlikely to cause World Heritage values to be lost, damaged, degraded, notably altered or diminished (see above section), it is also unlikely that National Heritage values will lost, damaged, degraded, notably altered or diminished. Any potential impacts will be localised and temporary.

It is highly likely that if the proposal proceeds and eradication of rodents is accomplished, this will contribute significantly to enhancement of World Heritage values and therefore National Heritage values.

5.2.13 Potential Long Term Ecological Changes.

While it is difficult to predict the long term ecological changes that are expected to occur on LHI following successful rodent eradication, evidence from rodent eradication projects elsewhere has shown that a wide range of taxa benefit from the eradications of invasive mammals. For example, a recent review by Jones *et al.* (2016) found that 236 native species have benefitted from the eradication of invasive mammals worldwide. Rodent eradications made up 57% of the studies reviewed and the benefits included population recoveries, re-colonisations and re-introductions, and increases to vegetation cover. Examples relevant to this include, a doubling of reproductive output (number of chicks produced) by Wedge-tailed Shearwaters on Moko'auia Island following eradication of Black Rats (Marie *et al.* 2014); a 23% increase in the number of breeding pairs of Masked Boobies, and re-colonisation by White Terns on Tromelin Island following eradication of Norway Rats (Le Corre *et al.* 2015); an increase in the density of burrows of seven seabird species, including the Flesh-footed Shearwater, following rat eradication on New Zealand Islands (Buxton *et al.*2016); increases in abundance of four species of land birds on Hawadax Island, Alaska, five years after rodents were eradicated (Croll *et al.* 2016); recovery of invertebrate (cricket) populations after rodent eradication in the Falkland Islands (St Clair *et al.* 2011); and dramatic increases in plant cover on Tromelin Island after rodent eradication (Le Corre 2015). It is expected that LHI populations of seabirds, land birds, invertebrates and vegetation would similarly benefit in the long-term from the eradication of rodents.

Unassisted re-colonisations by species that were formerly present on LHI are also difficult to predict but two of the most likely species to re-colonise are white-bellied storm-petrel and Kermadec petrel. Both of these species formerly bred on the main island (Hindwood, 1940) with their extirpation purportedly due to the impacts of invasive rodents. Re-colonisation by the white-bellied storm-petrel could be assisted through the use of a call-playback system to attract potential re-colonisers. Re-introductions are also possible for a number of species that have been extirpated from the main island but still exist on offshore islets in the LHIG; these include the Lord Howe Island Wood-feeding Cockroach *Panesthia lata* and the Lord Howe Island Phasmid *Dryococelus australis*.

Negative impacts on native populations have also been reported following rodent eradications. Most negative impacts are due to poisoning either from consumption of baits or through secondary poisoning following consumption of poisoned rodents. Such impacts are usually short term and populations recover once the baiting operations have ceased (Jones *et al.* 2016). Species at risk of being affected by bait consumption or secondary poisoning that occur in the LHIG include the Lord Howe Woodhen and the Lord Howe Pied Currawong (DECC, 2007a). Comprehensive mitigation plans are in place for both of these species (see section 6). Other documented impacts of island eradication programs on non-target species have involved species that consumed rodents as a primary food source. No species in the LHIG are expected to be impacted in this way other than the introduced Masked Owl, which is proposed to be eradicated concurrently with the REP.

If the eradication is not successful but rodent populations are substantially reduced, it is expected that any ecological changes, positive or negative, will be only temporary until rodents return to pre-REP levels. If rats are successfully removed, but mice remain it could be expected that the mouse population would initially increase exponentially, and then settle into some sort of equilibrium at a much higher density than current levels. It is likely that major benefits would still accrue to the palm industry and to many natural environments attributes (e.g. return of smaller seabirds, recovery of *Placostylus* populations, and possible establishment of 'analogue' species to replace extinct taxa). Other benefits may accrue, such as partial recovery of lizard populations, but not to a level which could be expected if all rodents were removed. Invertebrate populations, particularly larger and/or ground-dwelling species, may not show any recovery if mice remained. Re-introduction of the Phasmid may still be possible, given that they co-existed with mice prior to the rat invasion, but population establishment may be retarded or even prevented by the population imbalance of potential predators and their prey.

The 'nuisance value' of mice around residences would be likely to increase, necessitating on-going control. Some appreciable economic, social and conservation problems will remain if mice survive an eradication attempt, but significant gains will have been made in all aspects even if rats only are removed.

Because it is difficult to accurately predict long-term ecological impacts of the REP, a series of programmes to monitor potential benefits to biodiversity (population increases, expansions of breeding areas etc.) and the outcomes of mitigation measures for non-target species have either been established or are planned for future implementation. For example, in Part 2 of the REP Action Plan, pre-eradication monitoring is being undertaken to collect baseline data to enable determination of subsequent short-, medium- and long-term trends and changes

in the distribution and abundance of key taxa following the removal of exotic rodents from LHI. Taxa included in these studies are: land birds; Black-winged petrel, Little shearwater; land snails; ground and tree dwelling invertebrates; Big Mountain Palm; Little Mountain Palm and fruiting plants.

Part 3 of the Action Plan is comprised of the capture and management of LHPC and LHW, monitoring of LHPC remaining in the wild during rodent eradication activities, and the staged release and monitoring of LHPC and LHW following the bait drop. Biodiversity benefits monitoring will also continue for the range of taxa monitored in Part 2 of the Action Plan. The monitoring project will be managed by the LHI Rodent Eradication Project Manager (LHI REPM) and coordinated by the Science Division of the OEH Heritage NSW (Science Manager). Fieldwork and analysis will be undertaken by OEH staff, collaborating scientists or contractors. Involvement of the Lord Howe Island community will be encouraged for all projects, subject to skills and licensing restrictions. For details of monitoring plans see Section 6.5.

5.2.14 Cumulative Impacts

Potential cumulative impacts from the REP were considered with:

- Other potential actions - the proposed wind turbines on LHI and ;
- Other key threatening processes on the island such as weeds, habitat clearing and degradation, other human related threats and anthropogenic climate change.

The wind turbine proposal forms part of the Hybrid Renewable Energy Project, which aims to reduce diesel consumption and the costs of electricity generation on the island. The current proposal is stage 2 of the HREP. Stage 1 has been approved by the Board, and comprises an access road to the solar farm, a photovoltaic solar farm, a battery bank and associated infrastructure.

A biodiversity assessment of the wind turbine project undertaken in 2016 (NGH Environmental, 2016) found the following:

- The turbines would be sited in a cleared paddock around 1.5 hectares in size. The site carries exotic pasture and is primarily used for dairy cattle grazing. No threatened flora species recorded were recorded at the site.
- The site has minimal habitat value for wildlife. It may be used for foraging by some insect and bird species, but is unlikely to provide limiting or essential habitat resources for local fauna. Birds including the LHI currawong use the airspace above the paddock).
- Seven-part tests of significance for NSW threatened species and Assessments of Significance for nationally threatened and listed migratory species conclude that the proposal would not result in significant impact to these species.

As the LHI currawong is the only species on which the REP will have a potential significant impact (temporary disruption to one breeding cycle) and the wind turbine is unlikely to have an impact on currawongs, no significant cumulative impacts are expected from the wind turbines and REP.

When potential impacts of the REP are considered with other threats including climate change, no significant cumulative impact is expected. This is due to the localised and short term nature of potential impacts from the REP and excepted long term benefits to species and ecosystem recovery in the absence of rodents.

When considered as one action out of many related conservation and recovery actions currently being implemented or planned by the LHIB, the REP will add significant contribution to net positive cumulative impacts for species and biodiversity for the LHIG.

In contrast, not proceeding with the REP would allow continued impacts from predation and completion by rodent on a range of species, increasing cumulative impacts with other threats (DECC, 2007).

6 Proposed Safeguards and Mitigation Measures

Measures used to mitigate potential environmental harm are summarised below. The LHIB are the responsible party for implementing the mitigation measures with assistance from OEH Science Division for some monitoring aspects. Mitigation will be undertaken with regard to relevant standards, statutory obligations and relevant approval conditions from the various approvals agencies (see section 7). Costs for all mitigation measures proposed are well understood and have been included in the funded project budget. Sufficient budget remains to implement the proposed measures.

6.1 Bait selection

Baits dyed green are often avoided by birds. This has been verified in trials conducted on LHI in 2007 with non-toxic Pestoff® pellets (DECC, 2007a). In that trial the Emerald Dove ate red pellets and brown pellets when offered to it, but ignored completely the green pellets. Baits to be used for the rodent eradication will be green.

The lower concentration of Brodifacoum in the bait, namely 20 parts per million, also reduces the possibility of non-target kills while still being highly lethal to rodents. Baiting on LHI currently involves the use of bait containing 50 parts per million of Brodifacoum which is 250% as toxic as that proposed for the eradication.

Pestoff® Rodent Bait 20R pellet product breaks down more quickly than most commercial rodenticides which tend to contain waxes and other compounds aimed at extending bait life in the field. This would extend unacceptably, the period of non-target risk. The more rapid physical bait breakdown rate for Pestoff® Rodent Bait 20R and its lower toxicity provide an effective compromise between maintaining target animal efficacy and reducing non-target risk.

An expected outcome of this mitigation is reduced non target species impacts.

6.2 Timing of baiting

The eradication is proposed to occur in June – August. It is at this time of year that most migratory seabirds are absent from the LHI Group. Even though seabirds are unlikely to eat baits and rodents, conducting the baiting when they are not present eliminates the already negligible risk to them.

The risk of collision with helicopter to the several seabird species that are present during the baiting will be reduced by taking advantage of the diurnal movements of seabirds. In this way sections of LHI will be baited when those birds are foraging at sea and away from their roosting grounds. To reduce disturbance to those species that are present throughout the day, baiting height for the helicopters will be set at an altitude that does not unduly disturb roosting or nesting birds.

An expected outcome of this mitigation is reduced non target species (seabird) impacts.

6.3 Minimising Bait Entry in the Water

Baiting around the coast line will occur above the mean high water mark to minimise bait entry into the marine environment. A deflector arm can be attached to the spreader bucket to restrict the arc of the swathe to 180^{o} and will be used particularly when baiting the edge of buffer zones and to minimise bait entry into the marine environment when baiting coastal areas.

The Lagoon foreshore and some other beaches will be hand baited.

Expected outcomes of this mitigation are minimised bait entry into the water to reduce risks of pollution, marine non target species, impacts and bioaccumulation.

6.4 Captive Management

Woodhen and currawongs are highly susceptible to poisoning; the former from eating baits and poisoned rodents, the latter from preying on poisoned rodents. A large proportion of the population of the woodhen (80-85%) and currawongs (50-60%) will be taken into captivity to mitigate the risk of poisoning from the proposed baiting.

The period of captivity will start from approximately two months before baiting commences until baits and rodent carcasses have broken down (or for a total period of up to nine months). The time that baits are available is estimated to be 100 days although the rate of bait breakdown will be monitored (as described in Section 2.1) to ensure birds are not released at a time which may put them at risk.

Significant experience has been gained in managing woodhen populations in captivity on LHI. During a recovery program for the species (1981-1983), protocols for capturing and housing woodhens were established (Gillespie, 1993). The highly successful captive breeding and release program resulted in the release of 82 birds bred from

just three breeding pairs originally captured (NPWS, 2002). Prior to the commencement of the program it was estimated that only 37 individuals remained in the wild.

In preparation for the LHI REP, a captive management pilot study was conducted in 2013 for woodhen and currawongs on LHI (Taronga Conservation Society Australia, 2014) has also added significant knowledge on the captive management of the two species. The pilot study showed that woodhens and currawongs could be held in large groups for prolonged periods with no observable impact. All 20 woodhens and 10 currawongs were successfully released at their individual capture sites. The trial report is included in Appendix E – Captive Management Package.

The expected outcome of this mitigation is protection of species at risk from the REP.

6.4.1 Bird capture

Only experienced staff will be involved in the capture of both species. These include rangers on LHI who are involved in the capture of woodhen for banding as part of the annual monitoring of the population and OEH scientific officers (with assistance from the LHIB rangers) that have been catching and banding currawongs since 2005 to determine their population status and movements. Hand-nets will be used to capture woodhen, and clap-traps will be used for currawongs. Upon capture, birds will be placed into cloth bags or ventilated cardboard boxes (one bird per bag or box) and taken to the holding facility where they will be checked by a veterinarian. A veterinarian with bird experience will be on site during all capture and release operations.

Birds will be collected from across the island including Mt Gower which will be accessed by helicopter to minimise stress to the birds. The Woodhen Survey Manual (Harden, 1999) provides details around how to capture woodhens.

6.4.2 Captive Housing Design and Location

The design plans for the holding pens used for each species during the 2013 trial were prepared by an experienced aviculturist from Taronga Zoo considering knowledge gained from previous facilities built to house these birds (both at Taronga Zoo and on LHI) as well as advice from New Zealand where the Weka, a species similar to the woodhen, had been kept in captivity during rodent-eradication operations undertaken in that country. These, together with recommendations from the pilot study will be used to inform the detailed design of the larger facility needed during the REP.

Indicative plans from the 2013 pilot study are attached as part of Appendix E – Captive Management Package.

The captive management facilities will be constructed by modifying existing facilities at the Nursery, where the facilities for the pilot study were built. If required, expansion may occur on previously cleared land at the nursery Site (Figure 14).

Woodhens will held in enclosed paddocks 14 m by 14 m (see Figure 12), holding approximately 20 birds each. No aggression was noted during the 2013 trial with similar bird numbers per aviary. For the currawongs, aviaries 1.5 m wide x 3 m high x 6 m long aviaries, will be constructed, holding approximately 2 birds.

Guiding principles used in designing and determining the location of aviaries have included

- Locating the aviaries away from areas frequented by people;
- Providing adequate shade and protection from inclement weather and avian predators;
- Ensuring the birds feel secure by the provision, if need be, of screens between pens containing antagonistic co-specifics;
- Providing cover within pens in which the birds can shelter;
- Ensuring the pens can be effectively cleaned;
- Ensuring drainage is adequate;
- Ensuring internal structures are without sharp surfaces and pointed edges.

A Construction Management Plan for construction of the aviaries was developed in 2013 and will be updated to consider the expansion required for the REP. The 2013 Construction Management Plan is attached to this referral as part of Appendix E – Captive Management Package.

6.4.3 Captive Husbandry and Disease Management

At the commencement of the captive period each bird will be banded (if not already) and examined by a veterinarian from Taronga Zoo who is experienced in avian medicine. The initial health status of individual birds will be determined by detailed physical examination together with body weight measurement and faecal examination for intestinal parasites. While in captivity on LHI, the birds will be under the care and authority of

Taronga Zoo. A team of aviculturists will be employed to manage the holding facility for the period that the birds are held.

During the captive period the birds' behaviour and food intake will be monitored daily by experienced keepers and body weight will be monitored regularly. Parasite loads will be monitored by faecal examination.

At the end of the captive period each bird will undergo another physical examination by a veterinarian to ensure that it is fit for release.

Previous health assessments conducted on the Lord Howe Woodhen and other avian species on the island have not identified infectious diseases causing illness (Curran, 2007, included in Appendix E). The most likely disease or injury scenarios that may arise in the captive trial period include trauma due to con-specific aggression, parasitism especially coccidiosis, and outbreak of stress induced disease due to opportunistic environmental organisms such as salmonellosis and aspergillosis.

Facilities will be available for isolation of sick birds. Basic veterinary diagnostic investigation of any ill birds will be undertaken on the island while samples for more detailed diagnostic testing including histopathology and more complex haematology and serum biochemistry will be sent to Taronga Zoo for processing

A scientific licence issued by the NSW OEH under Section 132C of the National Parks and Wildlife Act 1974 is required to capture woodhen and currawongs on Lord Howe Island. Additionally, all aspects of the capture of these birds will need to be approved by the OEH Animal Care and Ethics Committee.

The capture or housing of birds can result in the injury or death to individuals. Measures taken to reduce the likelihood of injury or death to birds in the program are:

- Experienced staff will be involved in the capture of both species
- A bird-specialist veterinarian will be on site during capture and release operations
- Experienced aviculturists from Taronga Zoo have designed the holding facilities to be sited on LHI
- Experienced aviculturists from Taronga Zoo will manage and care for birds through their period in temporary captivity
- Advice on captive management has been sought from, and will continue to be refined with, specialist aviculturists. Central to this process has been the examination of the successful captive-breeding programme for woodhen undertaken on LHI in the 1980s, the 2013 pilot study, as well as captive trials undertaken in New Zealand with Weka (a species similar to the Woodhen)
- Exclusion of rodents from the facility
- If the holding facilities are found to be inadequate after birds have been taken, attempts will be made to rectify any problems. As a last resort, should the welfare of the birds be at serious risk, the birds can be released back into the wild until deficiencies in the procedure are rectified.

Notwithstanding these precautions, a small number of birds (~ 3) are likely to die in captivity due to natural mortality (e.g., due to old age) because birds captured for the trial will reflect the age structure and general health of birds on LHI.

6.5 Impact Monitoring

An extensive monitoring program will be conducted during and after the REP. This includes

- Monitoring of weather in the lead up to and during the REP. This will ensure bait can be distributed safely and effectively and not during adverse weather conditions.
- Monitoring breakdown of baits after distribution. Bait breakdown will be monitored at random sites using the Craddock Condition Index described above at approximately 30 day intervals until complete disintegration. This will provide confidence in bait breakdown prior to release of captive managed species.
- Soil Monitoring after distribution. Post operational soil samples will be collected to monitor residues of Brodifacoum in the soil. Representative samples will be collected from directly below some toxic bait and at control sites away from bait pellets. Soil samples will be collected approximately 30 days after bait disintegration and approximately every two months (if required, dependant on results). All tests will be conducted at a NATA accredited analytical laboratory. This will provide evidence that pollution has not occurred.
- Random sampling will be conducted on water bodies on the island to monitor Brodifacoum levels after the bait drop. Water samples will be collected within 2 days of each bait drop and approximately weekly 30 (if required, dependant on results). All tests will be conducted at a NATA accredited analytical laboratory. Rain water tanks will be sampled if requested by residents. This will provide evidence that pollution has not occurred and water is safe to drink.

- Analysis of milk samples post baiting. This will provide evidence that milk is safe to drink.
- Monitoring of captive LHW post release (see details below). This will provide evidence of recovery.
- Monitoring of free-ranging LHPC and captive LHPC post-release (see details below). This will provide evidence of recovery.

6.5.1 Monitoring programme for the Lord Howe Pied Currawong

With approval of the REP (baiting) it will be necessary to have a three-phase program involving captivity, monitoring and release of the Lord Howe Pied Currawong (LHPC).

In the first phase, 50–60% of the LHPC adult population will be captured using manually operated, baited butterfly-traps and brought into captivity. This process will target breeding pairs close to the settlement and from Mount Gower to cover the range of birds from the island. Trapping will involve an intensive 3-week program in May 2017 and will include transporting LHPC from Mt Gower by helicopter in conjunction with Woodhen activities (see below). This phase will require the construction of captive management facilities within the lowlands by Taronga Zoo and the LHIB.

The second phase will involve surveys, including trapping and banding free-ranging LHPC not captured in the first phase. Understanding the movements of the free-ranging birds will allow their fate to be broadly monitored. As these individuals are to be left in the wild during the period of risk (i.e. a 6-week period during and in the period immediately following the baiting operation until rodent carcases are deemed to be no longer available for scavenging- based on the recovery and monitoring of the breakdown of fresh rodent carcases) a five-day survey effort will be implemented every two weeks (proposed dates: May 29 – June 2, June 12 – 16; June 26 – 30 July 10 – 14). Any individuals found suffering from the suspected effects of poisoning will be captured and treated in captivity by a qualified aviculturist or vet until they recover.

The final phase will involve the gradual release of captive LHPC. Initially, five pairs of birds will be released at their capture locality. These birds will be monitored using two-staged VHF transmitters (fitted with mortality switch) for a period of two weeks. If all birds remain alive and well, the remainder of the captive currawongs will be released at their capture locality (potentially commencing 31 July 2017). The transmitted birds will be re-caught to remove devices if they have not already become detached due to their inherent ‘weak-link’. Any birds recovered dead from these initial releases will be autopsied to determine cause of death and sampled for Brodifacoum contamination. If tests prove positive the re-release of the remaining birds will be delayed for a further two weeks whereupon the process will be repeated, commencing with initial monitoring of transmitter-fitted individuals.

Population size of the LHPC has been estimated previously using trapping, banding and mark-recapture analysis (Carlile and Priddel 2007). Full monitoring and population estimates will recommence in spring-summer of 2016 to obtain pre-eradication population estimates; the protocols are well-established. With Science Manager consultation, birds attracted to designated locations across the island with food, can be monitored and any unbanded birds caught, banded with an individually unique combination of colour-bands, and released. A second round of surveys will then take place to re-sight captured birds and capture unbanded birds. Population size can then be estimated using mark-recapture analysis, and the size of the population tracked over time. Similar surveys will be performed in spring-summer 2017 allowing comparisons of (i) the persistence of the population following rodent eradication with prior estimates, (ii) the survival of birds that were left in the wild during the period of risk compared to those held in captivity, and (iii) productivity of breeding birds in the first year of a rodent-free environment.

It is suggested that four ten-day survey periods (October to January) are carried out annually for three years following the eradication to monitor population changes of the species in a rodent-free environment. It is expected that if the species experiences negative impacts from a rodent-free environment (through reduced food availability, for example) these impacts will first become apparent during chick provisioning and post fledging survival. Specific attention will be paid to nesting attempts and provisioning behaviour of adults to determine any negative responses to a rodent-free environment. Post-fledging survival will be monitored through subsequent annual surveys.

6.5.2 Monitoring programme for the Lord Howe Woodhen

With approval of the REP (baiting) it will be necessary to have a three-phase program involving captivity, monitoring and release of Lord Howe Woodhen (LHW).

The first phase will be to capture LHW using standard capture techniques (Harden 1999) and bring into captivity the entire accessible LHW population (as part of annual monitoring, more than 70% of the population are captured or sighted for visual retrapping of banded birds). While the capture and transport of birds from the lowland areas will be relatively straightforward, the birds removed from Mount Gower and Erskine Valley will require considerable trapping effort and transport arrangements. Birds will be transported from predetermined ‘nodes’ within the landscape. OEH Science manager will manage birds at the point of capture prior to their

helicopter removal from the southern mountains to captive management facilities in the settlement. Helicopters were previously used to transport LHW with no reported ill-effects (Miller and Mullette 1985).

If not already banded, all LHW held in captivity will be banded prior to release with one individually numbered stainless steel metal band supplied by the Australian Bird and Bat Banding Scheme (ABBBS) on the left tarsometatarsus and one plastic yellow band with a unique three-digit black number on the right tarsometatarsus. The yellow plastic band replaces the previous marking scheme for wild LHW that used three coloured metal bands in addition to the ABBBS band (Harden 1999). The new scheme was adopted in 2014 because the colour coating on metal bands wears off over time, precluding the individual identification of banded LHW by sight. All LHW captured for the captive management program that were banded prior to 2014 will have their three coloured metal bands removed and replaced with a single yellow plastic band as described above. The timing of banding will be at the discretion of the aviculturists and may occur at the time of capture, during health checks while in captivity, or immediately prior to release.

The second phase will involve limited release and monitoring of LHW following the disintegration of baits and rodent carcasses, expected to take 100 days after final baiting. The birds will be released in pairs at their point-of-capture and monitored using 2-stage VHF transmitters. Initially, 6 pairs will be released, three within the settlement and three within the Permanent Park Preserve in the lowlands and Erskine Valley. Following two weeks of movements the birds will be re-captured, transmitters removed and blood collected for analysis of Brodifacoum residue. Following confirmation of the absence of Brodifacoum residue, release of the remaining captive birds will commence. If tests prove positive the re-release of the remaining birds will be delayed for a further two weeks whereupon the process will be repeated, commencing with initial monitoring of a different cohort of transmitter-fitted individuals.

The final phase will involve the release of all remaining captive LHW. These birds will be released at their point-of-capture (potentially commencing 12 October 2017). Birds trapped from Mount Gower may require helicopter transport, however for birds transported by foot into Erskine Valley, the use of specifically designed transport cases may be used to transport birds to be released at sites remote from convenient transport routes. OEH Science Manager will assist LHI Board management with this final phase of the release.

Future surveys of LHW should follow the systematic approach of current annual surveys (Harden 1999) with additional surveys to monitor breeding success. These surveys will assess juvenile recruitment in the first three years following rodent eradication to determine breeding success and chick survival relative to earlier studies.

Annual surveys of LHW are carried out in November–December over two full working weeks following standardised survey protocols (Harden 1999). These surveys were instigated immediately after the 1980–1985 captive breeding and release program and will continue indefinitely. Where possible, all LHW encountered during surveys are individually identified by colour-bands or an ABBBS metal band (if recaptured), or if they are not banded are captured and banded. Surveys thus constitute a census of the population, whereby a concerted effort is made to identify all surviving LHW occupying readily accessible parts of the island (Mount Gower–Erskine Valley, Boat Harbour–Grey Face, Far Flats, Settlement, and Clear Place). Up until 2002, this intensive survey was repeated in April to record the number of surviving juveniles, and thus obtain an index of breeding success for the population. A monitoring program incorporating two surveys per year will be re-instated for three years encompassing one year before (2016–17), immediately after (2017–18), and one year after (2018–19) the captive management of LHW. Supplementary monitoring will also be undertaken in the first few months following the final releases of captive LHW (see below). The April 2017 survey will provide a contemporary estimate of the breeding success index prior to the captive management program. Within two weeks of the final release of captive, an intensive survey will be undertaken to determine the survival of released LHW and identify any surviving individuals not taken into captivity. Searches will be made in any areas normally outside the survey area where LHW are released. Following this intensive survey, fortnightly monitoring of released LHW will be undertaken in areas where high numbers of LHW currently reside. These include:

- Mount Gower (part) - surveyed by contractors experienced in trekking Mount Gower and surveying woodhens
- Golf Course and surrounds – surveyed by LHI Board staff
- Waste Management Facility – surveyed by LHI Board staff
- Residential gardens in the main Settlement – surveyed by LHI Board staff with assistance from members of the LHI community

Additionally, incidental sightings will be solicited from LHI Board staff and island residents using a pro forma and/or an online portal on the LHI Board website. Monitoring will continue until the end of March 2018, after which a second intensive survey will be undertaken in the first two weeks of April 2018. It is expected that the breeding success index will be lower than in 2017–18 because released LHW will have less time to successfully rear offspring over the optimal spring–summer breeding period. The November–December survey in 2018 will provide an estimate of the population size to compare with the estimate obtained prior to the captive management program in November–December 2016. The April 2019 survey will allow a determination of whether breeding success has returned to a level similar to that prior to the captive management program. If breeding success has not returned to a similarly high level, a survey will also be undertaken in April 2020.

6.6 Operational Non Target Species Mitigation

Non target species impacts will be mitigated during the operational phase of the REP. A Non Target Mitigation Plan has been developed to detail the mitigation measures to reduce the incidence of non-target mortalities as a result of the REP. The aim of the plan is to provide clear and effective guidance for the REP team and project stakeholders in the implementation of mitigation, monitoring and adaptive management actions to minimise impacts on non-target species. A summary is provided below and more is provided in the Non Target Mitigation Plan in Appendix F.

6.6.1 Helicopter Impacts

Only experienced pilots with island eradication bait application experience will be used during the REP to aerially bait areas around Providence Petrel nest sites. Pilots will be briefed daily before flights to be well informed of the location and direction of departing foraging birds before baiting begins. Although it is very unlikely any birds will be present due to early departure from the island to foraging grounds at sea, pilot safety and bird impacts at anytime must be taken into consideration to eliminate bird strike occurrence.

Providence Petrel breeding grounds are located on the southern end of Lord Howe Island on the slopes of Mt Lidgebird and Mt Gower. Due to the inaccessible terrain, a mitigation team member will view all baiting over-flights from Capella Hill which provides a clear view of all mountainous nesting areas on the southern mountains. In order to view Providence Petrels flight paths behind the mountains a second mitigation team will be observing flight paths via a boat from the ocean behind Mt Gower. Should Providence Petrels display unusual behaviour or become overly agitated during baiting over-flights, the observer will contact the pilot by radio to instruct on an alternative action, which may include gaining further altitude to reduce the proximity to birds while maintaining the flight path, or abandoning the flight path and returning at a later time from a different altitude. Both observers will, in any case, provide a commentary on the birds' behaviour to the pilot during each flight, to supplement or confirm what the pilot will be seeing beneath the helicopter.

6.6.2 Treating and euthanasia of poisoned Non Target species

Daily monitoring for sick and dead non-target species will be undertaken throughout accessible areas of the island. Sick individuals displaying signs of poisoning will be treated with Vitamin K where possible. Where recovery is not observed, euthanasia of poisoned wildlife is considered appropriate for the welfare of affected animals, and to enable mitigation personnel to collect and dispose of what will become a toxic carcass once an animal dies. The removal of these animals may reduce the threat of non-target species poisoning. Euthanasia will only be a feasible option for those animals that are very easily caught and restrained e.g. completely or nearly immobile animals. If an animal is still mobile and not easily caught, it should not be chased. All woodhens and currawongs will all be bought in for treatment with antidote Vitamin K in all instances.

In order to euthanize moribund non target species in New South Wales, necessary training and the appropriate ethics approval to euthanize non-targets is required. Personnel will be trained in euthanasia by blunt trauma/ cervical dislocation as this method is practical for remote field use. Unless a vet is present, it is recommended that all sick animals that can be accessed to be euthanased or rendered unconscious with a strong blow to the head, sufficient for immediate loss of consciousness and for them not to recover.

This method must be properly applied to be effective and humane; therefore training to ensure sufficient skill of the operator is essential. It is proposed that training be undertaken by a number of staff in order to meet these ethics requirements with visiting vets while on the island. These trained staff will then be assigned to search teams during the monitoring period. An appropriate mallet or similar instrument should be used and birds need to be restrained adequately with the head held against a solid surface and one blow with sufficiently force needs to be applied at an appropriate angle to the skull. If not performed correctly, various degrees of consciousness with accompanying pain can occur. All incidents of euthanasia must be documented and reported in weekly reports to SAC and the steering committee. Documentation must include details of the demeanour/condition of the bird prior to euthanasia, as well as details of the method and efficacy of euthanasia. This process will enable appropriately qualified and experienced personnel to make informed assessments and provide advice as required

6.6.3 Collection of Biological Samples

Samples from deceased wildlife may be collected for two different reasons during LHIREP; 1) to confirm species and determine sex of non-target species killed, or 2) to determine the levels of brodifacoum in deceased individuals of the non-target populations.

The collection of samples to assess the amount of brodifacoum within the non-target species is slightly more labour intensive than genetic samples, although very straightforward when abdomens are opened for assessment of haemorrhaging. Samples can be collected to confirm the cause of death on those carcasses where it is unclear, as well as providing information on toxic loads and potentially the longevity of the toxin within non target populations. It must be noted that sample information will have to be sent to Brisbane for testing at a NATA accredited analytical laboratory.

Livers provide the most appropriate tissue for brodifacoum samples to be collected from. These must be frozen once collected. Ten samples to be collected from differing levels of carcass code condition as outlined in the Mitagation Plan Appendix 2. The sample collection process will be in accordance with the 'NZ vertebrate pest residue database guidelines', copies of which will be held on Lord Howe Island and used as a reference by field staff.

6.6.4 Carcass Removal and Disposal

Brodifacoum breaks down in the environment from the action of soil micro-organisms. As pellets and carcasses containing brodifacoum decompose, the toxin also breaks down. The baits and poisoned carcasses can remain toxic for at least seven months after being broadcast. The aim of carcass removal is to remove and dispose of poisoned animal carcasses to ensure that they are unavailable to be scavenged by woodhens and currawongs when they are released. Burial and or incineration at the Waste Management Facility is a practical means of disposal available in remote field situations encountered on LHI.

All carcasses encountered during search and collection must be disposed of in an appropriate manner that ensures safe disposal and meets label requirements. A disposal protocol will be developed by the Mitigation Team Leader prior to the commencement of baiting that will ensure this objective is achieved. This will be based on 2 options for burial and incineration that exist on LHI – in preferred order these are;

- Use of the existing incinerator located at the Waste Management Facility (WMF) to incinerate carcasses (preferred option).
- purpose dug deep burial pits located at the WMF to appropriate depth to allow microbial breakdown of carcasses.

Opening of the skin and body cavity to check for haemorrhaging will also greatly assist decomposition of carcass by allowing better contact between soil and tissue rather than fur/feathers

6.6.5 Contingency planning and adaptive management measures for non target mitigation

Should unexpected impacts occur, an adaptive management framework is critical to ensure impacts are effectively managed over the duration of the operation.

The reality of logistics associated with undertaking works on Lord Howe Island means that large scale approaches for mitigating the effects of the REP baiting operation must be planned and organised and the scope for implementing new measures is limited. However, if the operation is not managed effectively it could lead to long-term and devastating impacts on populations of threatened species, in particular the LHI Woodhen and LHI Currawong. As such, all efforts must be made to ensure that impacts are minimised and this will require the investigation and implementation of appropriate mitigation measures. More detail is given in the Non Target Mitigation Plan in Appendix F.

7 Other Approvals and Conditions

The LHIB is the responsible party for obtaining all required approvals prior to commencement of the REP. The LHIB is also the party responsible for ensuring compliance with any conditions of approvals received and will comply with any monitoring, enforcement or review requirements arising from the approvals.

7.1 Australian Government

Approval from the APVMA in the form of a "Minor Use Permit" for use of the toxin for the LHI REP is required under the *Agricultural and Veterinary Chemicals Code Act 1994.* As the active constituent (Brodifacoum) is registered for use in Australia by the APVMA and therefore has established regulatory standards, a Limited Level Environmental Assessment is applicable. The Limited Level Environmental Assessment considers fate in the environment (soil, air and water) environmental toxicology, bioaccumulation and potential impacts to all species present. The application also included a Work Health and Safety Module and a Safety and Efficacy Module that included impact to Human Health. The application for a Minor Use Permit was submitted in April 2016 and assessment by the APVMA is expected to take approximately nine to ten months. Public Exhibition and Consultation is not required by the APVMA for a Minor Use Permit, however the LHIB has made the application package available to the LHI community post submission. Community feedback received over several years was addressed in the application package.

Primary contact is Karl Adamson, A/ Director Minor Use

karl.adamson@apvma.gov.au

P: +61 2 6210 4831 | F: +61 2 6210 4776 | M: +61 (0)4 2353 6049

Various approvals from the Civil Aviation Safety Authority will be required for the helicopter operations. These will be sought in conjunction with the selected helicopter provider.

7.2 NSW Government

Statutory environmental impact assessment will be undertaken as follows:

- Assessment under Part 4 of the NSW *Environment Planning and Assessment Act 1979* for construction of the Captive Management facility. This will be assessed via a Development Application with a statutory public notification and comment period. The LHIB will be the consent authority. Note: A Species Impact Statement and Threatened Species License under Section 91 of the NSW *Threatened Species Conservation Act 1995* are also required. These will consider potential impacts to threatened species and habitats from the proposal.
- NSW Environmental Protection Agency - permissions to aerially bait within 150 m of dwellings and public places required under the *NSW Pesticides Act 1999.*
- NSW Dept. of Primary Industries (Marine Parks and Fisheries) - assessment under Division 2 of the NSW *Marine Estate Management Act 2014* and *Fisheries Act 1994*. This assessment will consider potential impacts to NSW listed threatened marine species, habitats and the State LHI Marine Park values.

In addition, given the broad public interest in the proposal, a non-statutory Environmental Assessment will be prepared and made publicly available. That document will assist the community to understand the overall purpose of the proposal, the range of approvals required (as above), and enable social and economic factors to be identified and considered.

Advice received from the NSW OEH is that the NSW Assessment Bilateral Agreement would not apply to the Part 4 Assessment.

NSW approvals applications have not yet been submitted.

NSW Approvals primary contact is:

Dimitri Young, Senior Team Leader Planning, North East Region

Regional Operations Group

Office of Environment and Heritage

T: 02 6659 8272

7.3 Local Government

The LHIB has the status of a local government authority, and a consent authority under the Environmental Planning and Assessment Act 1979. The Development Application for the captive management facility will be assessed under the Lord Howe Island Local Environmental Plan 2010. These assessments will consider and address statutory requirements and will include a comprehensive assessment of the impacts, risks and proposed mitigation of the eradication program relevant to each agency's jurisdiction.

Relevant Contact is:

Dave Kelly, Manager Environment and Community Services

Lord Howe Island Board, P.O. Box 5, Lord Howe Island NSW 2898. Telephone 02 6563 2066.

8 Stakeholder Consultation

8.1 Engagement Principles

The LHIB's four service principles establish the standard of service people may expect from the Project (LHIB Guarantee of Service Policy, May 2008).

Respect

We will treat people and the environment with respect. Our client service will be responsive to all people, will recognise equally the rights and interests of Islanders, residents and visitors, and people from culturally and linguistically diverse communities. We will involve the community in the activities of the LHIB.

Helpfulness

We will listen to our stakeholders and the broader community, and explain our processes in a friendly and helpful manner so that interactions with us are clearly understood. We will work to be consistent, accurate and impartial. Access to LHIB programs and information will be supported by communication technology, where possible.

Responsiveness

Our services will be delivered in a timely, ethical and transparent way. Phone calls will be answered promptly and the first person you speak to will aim to have your request dealt with in a way that meets your needs. We will communicate clearly and establish programs to assist in any emergency. Staff will endeavour at all times to meet these service standards.

Continuous improvement

We seek to have our services meet people's needs and to improve all our products and services through collaboration and continuous improvement. We will regularly and systematically consult with people who use our services, and listen to their ideas for improvement.

8.2 Stakeholder Identification

Stakeholders relevant to the Project have been identified and summarised in Figure 30 and are described in further detail below.

Figure 30 Stakeholders Identified

8.2.1 Project Governance Stakeholders

The LHIB

The LHIB is a statutory authority established under the provisions of the Lord Howe Island Act, 1953 (the Act). Under the Act, the LHIB is directly responsible to the Minister for the Environment through the Office of Local Government. Pursuant to the provisions of the Act, the LHIB is charged with the care, control and management of the Island and the affairs and trade of the Island. It is also responsible for the care, improvement and welfare of the Island and residents. The LHIB carries out all local government functions on behalf of the Island residents. It controls all land tenure on the Island and administers all residential and other leases in accordance with the Act.

The LHIB manages the Island Permanent Park Preserve and the protection and conservation of the Island's fauna and flora.

For this project the LHIB is the proponent and is responsible for successful delivery.

Funding Bodies

This project is jointly funded through the LHIB, the Australian Government's National Landcare Programme (formerly Caring for our Country) and the New South Wales Government's Environmental Trust.

Project Steering Committee

A project steering committee was established to oversee and implement the project and have an established terms or reference. The membership of the Steering Committee is currently:

- Federal funding partner – National Landcare Program. Veronica Blazely (Director, Natural Heritage, Department of the Environment)
- State funding partner – NSW Environmental Trust. Peter Dixon (Senior Manager Grants, OEH)
- LHIB. Penny Holloway (Chief Executive Officer, LHIB)
- LHIB. Barney Nichols (locally elected member LHIB)
- Rodent Eradication Expert. Keith Broome (Chair, Island Eradication Advisory Group, NZ Department of Conservation)

Scientific and Technical Advisory Committee

A Scientific and Technical Advisory Committee has also been established to provide expert scientific advice for the range issues expected to be encountered on the Project. It currently consists of

- Nicholas Carlile (NSW OEH – chair)
- Ray Nias (Island Conservation)
- Keith Springer (Tasmania Parks and Wildlife Service)
- Gary Fry Curator of Birds (Taronga Zoo)
- Elaine Murphy (toxicologist NZ Department of Conservation)
- Barry Baker (Birdlife Aust)

8.2.2 Island Stakeholders

Island Residents

There are approximately 350 permanent residents located on Lord Howe Island. These residents are comprised of:

- Traditional Islanders who can trace their ancestors back to the original settlers on the island.
- Long term residents of over 10 years duration who are now permitted to purchase property on the island for residential purposes
- Contract transient residents who have come to the Island to work on short term work contracts for the LHIB or hospitality industries.

There are no indigenous stakeholders on LHI.

Livestock Owners

There are currently 10 residents on Lord Howe Island who hold Special Lease licences on Crown Land for livestock enterprises. The majority of the cattle held are for beef purposes with one owner having both milk and beef production herds. Health restrictions require no meat is to be sold for human consumption on Lord Howe Island but personal on farm use is permitted.

Community Working Group

The Community Working Group (CWG) was set up by Elton Consulting in late 2014 during the community engagement and consultation process. The CWG consists of a mix of representatives from across the Island. All members of the original community liaison group were invited to be part of the CWG and further participation was sought through an open call for self-nomination. Meetings are usually held on a monthly basis to discuss the program and its direction.

Island Businesses

The primary focus of businesses on Lord Howe Island is centred on the tourism industry. Apart from restaurants and accommodation lodges, many enterprises have tailored their core business activities around fishing tours, guided works and boat tours for the 15,000 tourists who visit the island every year. The island also supports a large nursery business that supplies the islands unique Kentia palm for export around the world.

Lord Howe Island Central School

The Lord Howe Island Central School has the recognition of being the most remote school in New South Wales. With its fluctuating number of students from year to year, the school current has over 30 students from prep to early secondary school. The school administration will be consulted well in advance of any baiting program for land and buildings under their direction.

Other Community Groups and Stakeholders

- LHIB and staff
- Tourism operators
- LHI School
- LHI Tourism Association
- First Peoples Association
- LHI Chamber of Commerce
- Church Groups
- QANTAS
- Island Trader

8.2.3 Island Visitors

Tourists

Over 15,000 tourists visit Lord Howe Island every year. Popular tourist activities include scuba_diving, bird watching, snorkelling, surfing, kayaking and fishing. To relieve pressure on the small island environment only 400 tourists are permitted at any one time. The island is reached by plane from Sydney or Brisbane in less than two hours.

Other Visitors

Lord Howe Island is also visited every year by research organisations keen to study a greater understanding of the Islands unique flora and fauna. Research is also conducted on the Islands Marine Park which encompasses the world's southernmost barrier coral reef.

8.2.4 Media

The Island is serviced by a locally owned newspaper called “The Signal”. The paper is contributed to by local residents on the issues and events on the island. Being listed on the World Heritage Site for global natural significance, Lord Howe is also the focus of National and International media interest particularly in regards to environmental issues and programs being conducted on the Island.

8.2.5 Other Stakeholders

Suppliers and Contractors

Many contractors and suppliers of labour and services will be required for the program. These will be engaged during the Planning and Approval, Implementation, and Monitoring and Evaluation stages of the project.

Suppliers and Contractors include:

- Bait and bait station suppliers
- GIS system navigation
- Field employees

- Local/Mainland builders for aviary construction
- Helicopter contract services
- Taronga Zoo
- Local boat operators
- Security contractors
- Training facilitators
- Fuel suppliers
- Livestock Valuers
- Captive Management staff
- Veterinarians
- Local Suppliers (inc Lodges)
- Mainland Suppliers and tourism operators

Other Interested and Affected Parties

- Scientific committees
- Research Centres e.g. Universities
- LHI Airport Administration
- LHI Travellers (Flight Booking Administration)
- Invasive Animals CRC
- Local Police Lord Howe Island

8.2.6 Regulatory Stakeholders

Federal

- Federal Minister for the Environment
- Secretary to the Minister
- Federal Department of Environment
- APVMA
- Civil Aviation Safety Authority (CASA)

State

- Premier of NSW
- NSW OEH
- NSW Environment Protection Authority (EPA)
- NSW Marine Parks
- NSW Parks and Wildlife

Local

- Local State Member of Parliament
- LHIB
- Marine Parks
- Local Police

8.3 Stakeholder Interest Summary

A high level summary of primary stakeholder interests is shown below in Table 26.

Table 26 Stakeholder Interest Summary

Stakeholder Group		Primary Interests										
		Human Health and Safety	Terrestrial Environment	Marine Environment	Economy / Tourism	Livestock	Pets	Children	Procurement	Funding	Governance	Project Success
Project Governance Stakeholders	The LHIB	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
	Funding Bodies	☑	☑	☑	☑	☑	☑	☑		☑	☑	☑
	Steering Committee	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
	Scientific and Technical Advisory Committee	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Island Stakeholders	Island Residents	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑
	Livestock Owners					☑						
	Community Working Group	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
	Island Businesses				☑				☑			
	Lord Howe Island Central School	☑	☑	☑			☑	☑				
	Other Community Groups and Stakeholders	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Island Visitors and Temporary Visitors	All	☑	☑	☑				☑				☑
Media	All	☑	☑	☑	☑			☑		☑		☑
Other Stakeholders	Suppliers and Contactors								☑			
	Other Interested and Affected Parties	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Regulatory Stakeholders	All	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑

8.4 Stakeholder Consultation History

Island residents and the LHIB have been involved in the control of rodents (rats and mice) on Lord Howe Island since about 1920.

In 2001, the LHIB commissioned a feasibility study that looked at a long-term solution to the problem, through a program of total eradication. Between 2004 and 2007 the LHIB undertook further investigation and consultation, including looking at the benefits of eradication to the Kentia Palm industry, as well the benefits and risks to the natural environment. These studies led to a Draft Eradication Plan that was prepared in 2009 (LHIB, 2009). The 2009 Plan was sent for extensive expert and peer review by the following:

- the New Zealand Department of Conservation's Island Eradication Advisory Group
- Invasive Species Specialist Group of the Species Survival Commission of the World Conservation Union (IUCN)
- Worldwide Fund for Nature, Australia
- Birds Australia
- Landcare Research, New Zealand
- CSIRO
- Professor Tim Flannery.

The 2009 Eradication Plan was then put on public exhibition between 30 October and 27 November 2009. Numerous submissions on the plan were received. A final plan will be developed addressing comments and considering relevant approvals conditions.

This eradication program has subsequently received significant funding from the New South Wales Government's Environment Trust and the Australia Government's Caring for Our Country Program in 2012.

As part of proceeding with the implementation of the project, the eradication plan and a Human Health Risk Assessment (Toxikos, 2010) was presented to the community by the LHIB with the assistance of consultants "Make Stuff Happen", in 2013. The consultation on the draft plan identified strong views both for and against the removal of rodents, and in particular, the specific eradication program presented involving the use of Brodifacoum and aerial distribution.

In recognition of the differing views within the community, the LHIB decided in early 2014 to put the proposed eradication on hold, and to go back to the community and to discuss with the community what options are available.

Between July 2014 and February 2015, Elton Consulting undertook a series of community consultation visits to Lord Howe Island. They spoke on a one-on-one basis, through personal visits or open sessions at the public hall, to many Island residents, (many multiple times) concerning the issue of rodent control and potential eradication on the Island. They implemented an incremental approach to consultation to unpack the complexity of the community response to the previous rodent eradication process, and to identify what it would take for the community to actively engage in the evaluation of alternatives and options, with the aim to obtain community support or endorsement of any one particular approach.

A Community Working Group was established, based on residents who indicated a willingness to participate, along with an open call for nomination/ involvement, put out through a newsletter to community residents. In working towards a solution, the working group identified many issues (particularly regarding human health, potential impacts to business and tourism and potential impact to the environment) and considered a range of options. The option to "do nothing" was generally not considered an alternative, as there was broad agreement that rats and mice are a problem, and that Lord Howe Island would be better off with no rodents.

Two scenarios were therefore further investigated and discussed, these being:

1. Ongoing management through the existing baiting program, and the potential to expand this.
2. An eradication program as previously proposed or modified where possible to address Island residents' concerns.

It was agreed to develop and implement a community survey to test community support for these scenarios, whilst recognising that many of the community concerns with the proposed eradication could be addressed during the Planning and Approvals Phase. It was agreed that an additional independent Human Health Risk Assessment was needed and should also be progressed.

In May of 2015, an options paper (see Appendix J – Stakeholder Engagement Package) was disseminated to all people registered on the electoral roll for Lord Howe Island, together with an anonymous survey to allow the community to choose between:

- Option 1 - Retain and expand the current management program
- Option 2 - moving to the planning and approvals stage of an eradication program.

A total of 212 respondents (71% of the 299 people on the electoral roll) participated in the survey. 208 survey responses were received before the closing time. An overwhelming majority of respondents agreed (38%) or strongly agreed (53%) that the rodent problem on Lord Howe Island needs to be addressed. A small majority (52%) of all respondents expressed a preference for Option 2 whilst 48% of respondents expressed a preference for Option 1 - Retain and expand the current management program.

In line with the agreed Process for Resolution (Figure 7), the LHIB responded to the majority view and on 19 May 2015 made the decision to proceed to the Planning and Approvals Phase. The final decision by the LHIB, along with the Funding Bodies, to proceed with the eradication or not will be informed by the technical, social and financial feasibility. This will include the status of approvals, level of community support and recommendations from and additional Independent Human Health Risk Assessment.

The Community Working Group has been re-activated and meets monthly to discuss project progress and community concerns. Minutes of the meetings are publicly available through the LHIB website. An updated Communication and Engagement Plan has been developed for the project and is attached to this submission (Appendix J – Stakeholder Engagement Package).

The community will be notified of this Public Environment Report through a newsletter to every householder, email to CWG representatives and a notice in the *Australian* newspaper.

8.5 Engagement Methods

This section details the preferred method of engagement with each stakeholder group during the remaining phases of the project.

Table 27 Preferred Engagement Methods

Stakeholder Group		Preferred Engagement Methods	Project Phase		
			2	3	4
Project Governance Stakeholders	The LHIB	• Monthly project progress updates to CEO	☑	☑	☑
		• Quarterly progress updates at LHIB Meetings	☑	☑	☑
		• Business Papers for issues as required	☑	☑	☑
		• Business paper for Go / No Go Decision	☑		
		• Final project report			☑
	Funding Bodies	• Progress reports as per funding agreement	☑	☑	
		• Final reports as per funding agreement			☑
	Steering Committee	• Quarterly Steering Committee Meetings	☑	☑	☑
		• Out of session review of key documents	☑	☑	☑
		• Ad hoc advice as required	☑	☑	☑
		• Final project report			☑
	Scientific and Technical Advisory Committee	• Review of key documents	☑	☑	☑
		• Ad hoc advice as required			
Island Stakeholders	Island Residents	• One on one consultation primarily through the Property Management Plan process	☑	☑	☑
		• Regular project updates and information sharing through Community Information Bulletin, Signal, Householders and fact sheets	☑	☑	☑
		• Notice of Entry and Pesticide Use notifications		☑	☑

Stakeholder Group		Preferred Engagement Methods	Project Phase		
			2	3	4
	Livestock Owners	• One on one consultation primarily through the Property Management Plan and Livestock Agreement process	☑	☑	☑
		• Notice of Entry and Pesticide Use notifications		☑	☑
	Community Working Group	• Monthly CWG meetings	☑	☑	☑
		• Sub Groups for particular issues if required	☑	☑	☑
	Island Businesses	• One on One consultation primarily through the Property Management Plan process	☑	☑	☑
		• Regular project updates and information sharing through Community Information Bulletin, Signal, Householders and fact sheets	☑	☑	☑
		• Procurement as per LHIB Procurement guidelines	☑	☑	☑
		• Targeted engagement for tourism operators through the LHI Tourism Association	☑	☑	☑
		• Notice of Entry and Pesticide Use notifications		☑	☑
	Lord Howe Island Central School	• One on one consultation primarily through the Property Management Plan process	☑	☑	☑
		• Engagement through P&C Association	☑	☑	☑
		• Regular project updates and information sharing through School Newsletters and fact sheets	☑	☑	☑
		• Targeted education campaign			
		• Notice of Entry and Pesticide Use notifications	☑	☑	☑
				☑	☑
	Other Community Groups and Stakeholders	• One on one consultation primarily through the Property Management Plan process	☑	☑	☑
		• Regular project updates and information sharing through Community Information Bulletin, Signal, Householders and fact sheets	☑	☑	☑
		• Notice of Entry and Pesticide Use notifications		☑	☑
Island Visitors and Temporary Visitors	All	• Targeted engagement through the LHI Tourism Association and tourism operators	☑	☑	☑
		• Up to date website	☑	☑	☑
		• Fact sheets	☑	☑	☑
		• Targeted Media	☑	☑	☑
		• Pesticide Use notifications			☑
Media	All	• Authorised spokespersons only	☑	☑	☑
		• Engagement of PR company	☑	☑	☑

Stakeholder Group		Preferred Engagement Methods	Project Phase		
			2	3	4
		• Up to date website • Proactive media releases for key milestones • Ad hoc media responses assessed on a case by case basis • Engagement of film crew to document eradication	☑ ☑ ☑	☑ ☑ ☑ ☑	☑ ☑ ☑
Other Stakeholders	Suppliers and Contactors	• One on one consultation regarding scheduling and requirements • Procurement as per LHIB Procurement guidelines	☑ ☑	☑ ☑	☑ ☑
	Other Interested and Affected Parties	• Up to date website • Proactive media releases for key milestones • Ad hoc responses assessed on a case by case basis	☑ ☑ ☑	☑ ☑ ☑	☑ ☑ ☑
Regulatory Stakeholders	All	• Informal project progress updates • Face to face pre lodgement meetings for key approvals • Ongoing liaison during assessment and conditions • Reporting on meeting conditions of approval or monitoring etc	☑ ☑ ☑	☑ ☑	☑ ☑

8.6 Engagement Protocols

This section details engagement protocols relevant to various communication and engagement methods outlined in this document.

8.6.1 Property Access

Access to leaseholder and residents properties will at all times be in accordance with "*LHIB Procedure for Access to Leasehold Land"* and the individual Property Management Plan negotiated with owners/occupiers for the Project

No access to dwellings will occur without approval from owners / occupiers.

8.6.2 Community Working Group

Community Working Group- Terms of Reference and group work rules

Terms of Reference

- Share information about the Rodent Eradication program planning and approvals stage
- Provide advice and feedback on the methodology and process of planning and approvals
- Discuss issues and concerns about planning and approvals
- Advise on ways to communicate with the community about the program

How the group will work together

- Focus on the aims and the process to progress Stage 2 Planning and Approvals
- Be polite, general manners as with normal general meeting procedures
- One person speaks at a time
- The ability to raise issues
- Go through the chair to talk
- We can add more as we go

8.6.3 Official Correspondence

All official Correspondence regarding the REP program will at all times be in accordance with "*LHIB Procedures for dealing with official correspondence applied January 2014"*

8.6.4 Media Contact and Liaison

Media contact and liaison for the Project will at all times be in accordance with "*LHIB Procedure for Media Contact and Liaison*"

8.6.5 Pesticide Use Notification

Notification of the use of Pesticides will adhere to the "Lord Howe Island Board's Pesticide Use Notification Plan 2015" http://www.lhib.nsw.gov.au/board/publications/plans.

9 Environmental Record

The LHIB is a statutory body established under the LHI Act, 1953. It is charged with the responsibility of administering the affairs of the Island. The LHIB's charter provides principles and guidance for environment protection and conservation on the Island including to: "*manage, protect, restore, enhance and conserve Lord Howe Island in a manner that recognises the World Heritage values in respect of which the Island is inscribed on the World Heritage List*". Importantly, the LHIB is *"to have regard to the long term and cumulative effects of its decisions"*.

The LHIB has a proven record of responsible environmental management of Lord Howe Island. There are no proceedings under Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against the LHIB. Examples of successful conservation programs aimed at preventing extinctions of threatened species and improving ecosystem integrity include:

- Captive breeding and release program of the Lord Howe Woodhen, which is recognised as one of the most successful threatened species recovery programs ever implemented for any bird species.
- Eradication of feral pigs, cats, goats, invasive ants (African Big-headed Ant in progress), and 68 target weed species (in progress),
- Captive management of the LHI Phasmid through collaboration with Melbourne Zoo
- Implementation of the Lord Howe Island Biodiversity Management Plan (2007), which identifies 200 actions of which, 80% have been implemented, reducing the risk of extinction to a vast array of species and habitats.

The LHIB is successfully implementing a number of environmental sustainability programs including:

- Waste management, which achieves more than 80 per cent diversion from landfill
- Waste water management, which sets high effluent performance standards for onsite treatment and disposal of waste water in order to protect and enhance public health and the state of the environment
- Renewable energy production, which aims to achieve over 70% renewable energy by 2017.
- Improved biosecurity arrangements, based on best practice (risk based, a shared responsibility) across the continuum of prevention, preparedness, response and ongoing management
- Responsible tourism which is capped at 400 beds under the Lord Howe Island Local Environment Plan (LEP)
- Limits on growth through the restriction on the number of dwellings (no more than a total of 25 dwellings during a period of 20 years).

The LHIB has previously submitted referrals under the EPBC Act for the following:

- *Lowering of Blinky Beach Sand Dune* (EPBC 2012/6599) - Not a Controlled Action if undertaken in a Particular Manner.
- Pilot Study for captive management of LHI Woodhen and LHI Currawong (EPBC 2013/6847) - Not a Controlled Action
- *Lord Howe Island Solar Photovoltaic Project* (EPBC 2015/7544) - Not a Controlled Action

The proposed eradication of rodents from LHI is identified in the following environmental legislation, plans and policy frameworks:

- Key Threatening Process and National Threat Abatement Plan for Predation by exotic rats on Australian offshore islands, under the EPBC Act.
- Key Threatening Process for Predation by the ship rat on LHI (2000) under the *Threatened Species Conservation Act*, 1995.
- Lord Howe Island Board Corporate Plan 2016-19
- Lord Howe Island Board Operations Plan 2016-17
- Lord Howe Island Biodiversity Management Plan (2007);
- Lord Howe Island Permanent Park Preserve Plan of Management (2010);
- Strategic Plan for the Lord Howe Island Group World Heritage Property (2010);
- Interim Recovery Actions for the Lord Howe Island Phasmid (2001);
- Recovery Plan for the Lord Howe Placostylus (2001).

10 Socio Economic Considerations

Potential impacts (or benefits) of the proposed REP including economic impacts and human health impacts are considered in the sections below.

10.1 Potential Economic Impacts

Potential economic impacts from the REP have been assessed through an Economic Evaluation (Gillespie Economics, 2016) of the project included in Appendix O.

The evaluation assessed the proposed REP ("With") scenario) against the baseline ("Without") of continuing the current rodent control program on the island. Costs spent to date were considered sunk costs and did not form part of the evaluation.

10.1.1 Key Points

- Investing in the Rodent Eradication Plan (REP) will create net benefits for Australia. It is justified on economic efficiency grounds.
- The REP will provide net benefits to the residents of Lord Howe Island and those living elsewhere in Australia.
- The REP will create net benefits by improving biodiversity, tourism opportunities and the profits of the Kentia Palm and fresh vegetable industry on Lord Howe Island.
- These results are robust to variations in assumptions that underpin the analysis.
- It is likely that there will be minimal or no reduction in visitation to Lord Howe island when the rodent baiting takes place. At worst, reductions will be off-set by intending tourists re-scheduling their visits.
- It is reasonable to expect that there will be minimal or no reduction in visitation at the time of the REP, or at least in the off-peak period overall (allowing for tourists rescheduling their visits in the off-peak period).
- The short term impacts of the REP on tourist demand for accommodation will be more than offset by the demand for accommodation of the REP workforce.
- Where the REP workers have similar spending patterns to tourists, then impacts on tour operators, food providers and shops will also be offset.
- Where the REP workers spending patterns are different to those of tourists, tour operators, and to a lesser extent food and shopping providers may be worse-off in the short term i.e. July 2017.
- These potential short term impacts would be offset if there was an increase in off-peak visitation by 0.4% (29 people) because of the eradication of rodents. Increases in visitor numbers due to the REP are likely to be considerably greater than this.
- Potential short term impacts of the REP on tourism operators, shops and food outlets could be reduced by:
    - promoting local purchases to the REP workers;
    - giving REP workers tour and restaurant vouchers; and,
    - mandating the use of tourist operators' vehicles and boats where required for REP operations.

10.1.2 Methodology

"With" and "Without" the Rodent Eradication Project

The LHI REP is considered the “With” scenario."Without" the REP, the current rodent control program would continue with ongoing control costs, continued presence of poison in the environment, continued impacts on the Kentia Palm and nursery industry, further degradation of World Heritage values (including endemic and threatened species) and the potential for the LHIG to be inscribed on the “World Heritage in Danger List”.

Cost Benefit Analysis

A Cost Benefit Analysis (CBA) was used to provide a comparison of the additional costs and benefits "with" the REP, relative to "without" the REP. Costs are measured in terms of reductions in producer surplus or consumer surplus while benefits are measured in terms of increases in producer or consumer surpluses.[1]

Provided the present value of additional benefits exceed the present value of additional costs (i.e. a net present value (NPV) of greater than zero or a benefit cost ratio (BCR) of greater than one), a project is considered to improve the well-being of society and hence is desirable from an economic efficiency perspective.

Additional Costs and Benefits of the REP

Relative to the "without" REP scenario of ongoing rodent control program, the REP would have the following additional costs and benefits to the Australian community.

Table 28 Potential Additional Costs and Benefits of the REP

Category	Costs	Benefits
Direct costs	REP direct implementation costs	Avoided ongoing rodent control costs - LHI and residents
Biodiversity	Potential for species extinction from REP Costs of returning extinct species to LHI	Biodiversity improvements - prevention of additional extinctions - increased abundance of species - return of extinct species to LHI
Tourism	Foregone tourism business during REP implementation	Additional demand for accommodation during REP implementation Additional tourism business after REP implementation
Palms and vegetables		Increased productivity for Kentia Palm industry and avoided direct costs Increased productivity of other vegetable gardens
Health and toxicity	Potential impacts on other species, water and human health	Reduced impacts to humans, livestock and pets from constant presence of rodent poison Elimination of health impacts from

[1] Consumer surplus is the difference between what an individual would be willing to pay (demand) for a good or service (the total benefit to the consumer) and what they have to pay (the cost to the consumer i.e. consumer expenditure or price times quantity). In the market model, it is the area between the demand curve and the price line. Producer surplus is the difference between the revenue (consumer expenditure) received for a good or service (total benefit to producer) and the costs (supply) of the inputs used in the provision of the good or service (economic cost to producer). In practical terms, it is the net revenue (before tax) that is earned by producer of goods and services (James and Gillespie 2002). In the market model, it is the area between the price line and the supply curve.

		rodents for residents and tourists
Wastage and amenity		Elimination of spoiled foodstuffs and the presence of rodent excrement on LHI
Research		Research benefits of the program

Quantification and Valuation of the Additional Costs and Benefits of the REP

Direct costs

The LHI REP has estimated capital costs of $10.6M, although approximately $1.5M of this is already spent and hence in accordance with NSW Treasury (2007) is excluded from the analysis. Incremental ongoing biodiversity monitoring costs associated with the REP are estimated at $50,000 per year for 10 years, with ongoing rodent detection (quarantine) costs of $30,000 per year. "With" the implementation of the REP, the LHIB would avoid ongoing rodent control costs of $85,000 per annum and residents would avoid private bait costs of $4,800 per annum.

Project Workforce

The REP is expected to create the following employment opportunities:

- 2 full time staff and 1 part time (0.5) staff member during Phase 2 (engaged)
- Approximately 5-10 (casual or contract) staff for aviary construction during Feb – Jun 2017
- Approximately 30-40 fulltime (casual or contract) staff between May –Sept 2017 for implementation of the REP and immediate follow up monitoring
- 1-2 full time staff for ongoing biosecurity post REP.

The project workforce will consist of a mix of LHI locals and mainland staff depending on actual skillsets required and resources available.

Biodiversity

The biodiversity benefits of the REP include:

- avoiding seven additional extinctions on LHI over the next 20 years;
- the ability to return four species that are extant from LHI due to the predation of rats and mice such as the Kermadec petrel, White-bellied storm petrel, phasmid and wood feeding cockroach; and
- an increase in abundance of plants, birds, reptiles and insects.

Based on benefit transfer from a choice modelling study of environmental improvements in three NSW catchments, including protection of species from extinction, a conservative value of $8M per species is adopted. Because of the uncertainty associated with future species outcomes, the benefit estimate was weighted by the probability of REP success (95%) and the probability of species extinctions or successful reestablishment (which ranged from 50% to 100% for the individual species). The cost of reestablishment of species, subject to successful eradication of rodents, was estimated at $50,000.

In addition to benefits from protection of species, a further benefit of the REP would be an increase in abundance of flora and fauna. This benefit remains unquantified in this analysis, although studies have found that the community are willing to pay for increases in species abundance. For example, Blamey et al (2000) found that Brisbane households on average were willing to pay $1.69 each to avoid each 1% decrease in the population size of non-threatened species in the Dessert Uplands of Queensland.

Toxikos (2010) and Pacific Environment Limited (2015) found that the potential risks of the REP to soil, water and the marine environment were negligible because of the physical chemical properties of the bait, Brodifacoum. While there are risks to a number of species from primary and secondary poisoning, with the implementation of a range of mitigation measures, the OEH found that the likelihood of species extinctions on LHI as a result of the EP would be extremely small i.e. $1*10^{-4}$ to $1*10^{-6}$.

Tourism

"Without" the REP, further degradation of World Heritage values of LHI would occur with this potentially resulting in the LHIG being inscribed on the “World Heritage in Danger List”. If this occurred, it would have the effect of 'signalling' a decline in the value of the LHI experience. This would be expected to result in a reduction in tourism demand in both the peak and off-peak periods. Whether LHIG is inscribed on the “World Heritage in Danger List”

or not, the Lord Howe Island Tourism Association (2015) has identified the "potential increase in negative consumer perception of degeneration of pristine environment" as a key threat to tourism.

While some decline in tourism demand is expected to be associated with further degeneration of the environment of LHI "without" the REP, for the purpose of the analysis it has conservatively been assumed that "without" the REP demand in the peak and off-peak periods would remain constant7 over the analysis period.

"With" the REP, two separate potential impacts were identified - short term effects during the REP and long term effects after the REP.

Short term effects include the potential for reduced tourist visitation during the REP and increased demand for accommodation from the non-local workforce.

The REP is proposed to be undertaken during the winter months when tourism is least and the group assumed to be most sensitive to knowledge of the REP i.e. families with children, visit less. Other groups are likely to be less sensitive and, in any case, have greater flexibility to adjust the time of their travel to other non-peak periods. Therefore, in the absence of any survey of prospective visitors to LHI, it is reasonable to expect that there will be minimal or no reduction in visitation at the time of the REP, or at least in the off-peak period overall (allowing for some substitution for an alternative off-peak times).

However, for the purpose of this analysis it is conservatively assumed that 50% of visitors who would otherwise have visited during the month of July (when the REP is likely to be implemented) i.e. 293 visits and 2,051 visitor nights, would not visit and would not alter the timing of their booking. This impact was represented by a reduction in off-peak demand resulting in an associated reduction in annual benefits to tourists and annual net revenues to tourism providers of $490,000 and $130,000, respectively. Offsetting this short term impact would be additional REP workforce demand for 3,050 bed nights and net revenues to accommodation providers of $122,000. If these workers have similar spending habits to tourists, then impacts on tour operators, food providers and shops will also be offset. However, to the extent that the REP workforce expenditure pattern is different to that of tourists, tour operators, and to a lesser extent food and shopping providers may be worse-off in the short term i.e. July 2017, if assumed reductions in tourists eventuate.

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Consultations with the LHI community elicited a range of views on the potential long term tourism impacts of the REP. However, evidence supports an increase in tourism demand post rodent eradication and economic principles indicate benefits to tourism providers from an increase in demand, even when constraints on visitor numbers apply. While a review of case studies suggests that, conservatively, predator free status may lead to a 50-75% increase in tourism numbers, this report adopts an even more conservative assumption of a 20%

increase in tourism demand, ramping up over five years. Sensitivity analysis is undertaken for different tourism demand assumptions.

In peak periods an increased demand results in no increase in visitation but an increase in the market price for accommodation on LHI with an estimated increase in the net revenue to accommodation providers8 of $6.0m per annum.

In off-peak periods an increase in demand, results in an increase in visits which can be accommodated within the capacity constraint, and an increase in price (or average spend) per visit. The result is an increase in annual net revenue to tourism providers on LHI and benefits to tourists of $720,000 and $2.7m, respectively.

Kentia Palm and Vegetables

Kentia Fresh has identified that a successful REP would result in the following benefits to its operations:

- avoided costs of $10,000 per year on rodent baiting;
- reduced seed collections costs from around $165/bushell to $50/bushell - wild seeds would be easier to collect in the absence of rodents;
- avoided loss of $50,000 worth of Kentia production per annum from current rodent predation;
- avoided loss of $25,000 of fruit and vegetable production per annum from current rodent predation..

Health and Toxicity

Toxikos (2010) and Pacific Environment Limited (2015) identified that many of the potential human exposure pathways to Brodifacoum will not occur due to the proposed management practices that are to be put in place during and after the REP e.g. removal of poultry and cattle from LHI, isolation of dairy cows from exposure. Other direct and indirect exposure pathways are concluded by Toxikos (2010) to pose negligible risk for human health.

Toxikos (2010) identified that the most important exposure pathway of Brodifacoum for humans is direct ingestion of bait pellets picked up off the ground. However, substantial quantities would need to be ingested to have any impact and with toxic signs apparent several days before the onset of any life threatening effects the toxicity of Brodifacoum is easily treated with Vitamin K.

With the implementation of the mitigation measures, the risk to dogs is considered by Toxikos (2010) and Pacific Environment Limited (2015) to be negligible.

10.1.3 Cost Benefit Analysis Results

The present value of the incremental costs and benefits of the REP[2], using a 7% discount rate and a 30 year evaluation period, consistent with NSW Treasury Guidelines, is provided in Table 29. The REP is estimated to have net social benefits of $142M and a benefit cost ratio of over 17 to 1. This indicates that the aggregate welfare of the community is improved by implementing the REP i.e. the incremental benefits of the REP exceed the incremental costs.

There are incremental biodiversity benefits, incremental tourism benefits and incremental benefits to the Kentia Palm and vegetable industry from implementation of the REP.

There are benefits that remain unquantified in the analysis i.e.:

- Increased species abundance
- increased productivity of private vegetable gardens;
- reduced risk to humans, livestock and pets from constant presence of rodent poison;
- elimination of health impact from rodents for residents and tourists;
- elimination of spoilt foodstuffs and presence of rodent excrement on LHI;
- research benefits from the REP.

If these were able to be quantified they would increase the net benefits of the REP. However, the magnitude of these benefits is unlikely to affect the central CBA result that the REP improves the well-being of the community.

[2] With all costs and benefits that are contingent on successful eradication of rodents weighted by the probability of the REP being successful i.e. 95%.

Table 29 Present Value of Incremental Costs and Benefits (@7% discount rate)

Category	Costs	$	Benefits	$	Net Benefits
Direct costs	REP direct implementation costs		Avoided ongoing rodent control costs		
	Capital costs	$7,658,155	LHIB	$845,425	
	Ongoing costs	$620,823	Residents	$47,742	(-$7,385,812)
Biodiversity	Potential for species extinction from REP	$1,055	Prevention of additional extinctions	$40,599,970	
	Costs of returning extinct species to LHI	$38,774	Return of extinct species to LHI	$27,537,371	
			Increased abundance of species		$68,098,566
Tourism	Foregone tourism during REP implementation		Additional accommodation during REP implementation		
	Producer surplus	$113,686	Accommodation net revenue	$106,773	
	Consumer surplus	$427,457	Net revenue to tours, food outlets and shops	NQ	
			Tourist benefits	NA	
			Additional tourism business after REP implementation		
			Net Revenue	$57,175,022	
			Tourist Benefits	$23,153,099	$79,893,751
Palms and vegetables			Increased productivity for Kentia Palm industry and avoided direct costs	$982,682	
			Increased productivity of other vegetable gardens	NQ	$982,682
Health and toxicity	Any impacts to other species, water and human health	NQ	Reduced impact to humans, livestock and pets from constant presence of rodent poison	NQ	NQ
			Elimination of health impacts from rodents	NQ	NQ
Wastage and amenity			Elimination of spoiled foodstuffs, rodent excrement for residents	NQ	NQ
Research			Research benefits of the program	NQ	NQ
Total	Total costs	$9,676,248	Total benefits	$150,448,082	$141,588,132
			Net Present Value	**$141,558,132**	
			Benefit Cost Ratio	**17.0**	

Distribution of Costs and Benefits

The CBA was undertaken from an Australian perspective. Distributional analysis found that there are net benefits from the REP for the residents of LHI and those who do not live on LHI, with NPVs (BCRs) for these groups of $58 (80.5) and $83M (11.2), respectively. The BCR for LHI residents is considerable higher than the BCR for non-residents.

A particular focus of the distributional consideration is the impact of the REP on tourism and tourism providers i.e. net revenues.

If it assumed that there is a 50% decrease in tourists during July 2017 as a result of the REP then the reduction in net revenues to tourism providers10 is estimated at:

- $83,000 to $308,000 to accommodation;
- $18,000 to $68,000 to tours;
- $10,000 to 42,000 to shopping; and
- $20,000 to $111,000 to meals.

These economic costs would only accrue to those operators that are normally open during July.

However, increased demand for worker accommodation as a result of the REP would more than offset the assumed reduction in accommodation demand i.e. 50%, and hence there will be a net benefit to accommodation providers. If these workers have similar spending habits to tourists, then impacts on tour operators, food providers and shops will also be offset. However, to the extent that the REP workforce expenditure pattern is different to that of tourists, tour operators, and to a lesser extent food and shopping providers may be worse-off in the short term i.e. July 2017, if the assumed reductions in tourists eventuate. However, a number of measures could be implemented to mitigate these potential impacts including promotion of local purchases to the incoming workforce; provision of tour and food vouchers to workers; and rent of tourist operators vehicles and boats where required for implementation of the REP.

Accommodation providers (and airlines), who would be no worse-off in the short term as a result of the REP, would be the main beneficiaries of any increase in peak season tourism demand. This is because benefits would mainly accrue via price increases for accommodation (and airlines)11 rather than any increase in visitation.

An increase in off-peak tourism demand as a result of the REP would benefit all tourism service providers i.e. accommodation providers, tour operators, food outlets and shops, as it would result in both price increases and increases in visitation.

Sensitivity Testing

The sensitivity analysis indicates that the CBA results are not sensitive to substantive changes in key variables. The primary drivers of the CBA results are the estimated benefits from biodiversity improvements and the increased demand for tourism arising from these biodiversity improvements. Even under the extreme scenario of no increase in tourism demand, the REP would still have net benefits because of the biodiversity benefits it will provide.

Economic Activity Impacts

Any changes in expenditures (and revenue) impact economic activity on LHI. These are not measures of costs and benefits from an overall community and CBA perspective. However, changes in economic activity on LHI is of particular interest to stakeholders.

In the short term, there will be in the order of $400,000 spent on local labour to assist in the REP implementation and post REP monitoring. Reduced expenditure on tourism business is estimated at between zero and $527,000, depending on the impact of the REP implementation on visitation. The maximum estimate of reduced tourism expenditure on accommodation during the REP implementation ($307,000) is more than offset by the accommodation demand by nonlocal workers ($455,000) and if these workers have the same expenditure patterns as tourists then maximum assumed impacts on tour operators, food providers and shops will also be more than offset. Expenditure on tour operators is the expenditure category where worker expenditure is most likely to be different from tourist expenditure. Overall in the short run the REP implementation will result in an increase in expenditure in the local economy.

In the long run, there is expected to be increased expenditure on LHI from an increase in peak and off-peak tourism expenditure. There will also be increased profitability to the Kentia Palm Nursery. Local labour will experience some reduction in direct output as wages associated with the ongoing rodent control program will no longer be spent and there will be a reduction in expenditure on labour involved in Kentia Palm seed collection. However, overall in the long run the REP implementation is expected to result in a substantial increase in expenditure in the local economy.

Summary

CBA of the REP indicates that it will have net benefits to Australia and hence is justified on economic efficiency grounds. It will provide net biodiversity benefits, net tourism benefits and net benefits to the Kentia Palm and fresh vegetable industry. The REP will also have net benefits to residents of LHI and net benefits to residents in the rest of Australia.

It is reasonable to expect that there will be minimal or no reduction in visitation at the time of the REP, or at least in the off-peak period overall (allowing for some substitution for an alternative off-peak times). Nevertheless, the maximum assumed short term impacts to tour operators, food outlets and shops as a result of the REP implementation would be offset in present value terms if there was a sustained increase in off-peak visitation by 0.4% (29 people) because of the eradication of rodents.

10.2 Potential Human Health Impacts

10.2.1 Summary of Studies

Potential human health impacts from the proposed project have been considered through the following studies and reviews.

Author and Date	Description	Summary
Toxikos Pty Ltd 2010	Human Health Risk Assessment (HHRA)	Undertook hazard identification describing the properties of the proposed bait and the toxicological effects of Brodifacoum in humans. Identified exposure pathways and risks of the REP considering proposed mitigation. Also examined human health risks from current control baiting program. Recommended that all mitigation proposed be implemented. Concluded that although Brodifacoum is an acutely toxic substance that has the potential to cause toxicity and possibly death through internal bleeding, the human health risk to Lord Howe Islanders during the proposed eradication campaign is very low, indeed negligible.
New South Wales Health 2010	Independent Third Party Review of the Toxikos 2010 HHRA	NSW Health acknowledged the Toxikos report was undertaken by an independent and suitably qualified assessor and found that the report had explored and examined all potential exposure pathways, indirect exposure pathways and health risks from current practice. It was fully supportive of recommended mitigation.
South Australian Health 2010	Independent Third Party Review of the Toxikos 2010 HHRA	SA Health acknowledged that Toxikos had well summarised potential human health risks and exposure pathways. They suggested consideration of alternate methodologies for quantifying effect levels and safety factors used in the risk assessment. They provided several recommendations for mitigation of risks particularly to small children including: • Adding a taste bittering agent to reduce risk of ingestion by small children. • Consideration of differences in parenting skills and supervision levels

		• Additional mitigation for sensitive sub populations • Mitigation plan for accidental exposure
Toxikos 2010	Response to SA Health	Toxikos considered SA Health comments and provided additional supporting arguments for determining and quantifying effect levels and safety factors used in the risk assessment. After consideration of comments they concluded that there would be no material difference to the risk assessment outcome from using alternate methodologies, but agreed that a better overall conclusion would be that likelihood of health effects is low and likelihood of a serious outcome is negligible.
Pacific Environment Limited (formerly Toxikos) 2015	Reviewed the Toxikos 2010 report and included additional responses to a letter from a community member.	The review was undertaken by people not involved in the preparation of the original Toxikos report and the findings should be considered as independent. Some errors were found in the original Toxikos report; however they do not affect the overall findings. The findings of the 2015 review were that the proposed rodent eradication plan involving the use of Brodifacoum will not pose a risk to the health of the residents of Lord Howe Island. The risk management processes included in the plan would mitigate any possible risks posed by the use of Brodifacoum.

These documents are included in Appendix K – Human Health Package.

Additionally, as part of the ongoing community consultation process, the LHIB committed to having a second independent HHRA undertaken to allay concerns from a minority of residents regarding perceived independence of consultants engaged by the LHIB.

The NSW Office of Chief Scientist and Engineer (OCSE) were identified through community consultation as having a high level of independence. The OCSE were requested by the NSW Minister for the Environment to oversee an additional HHRA. The OCSE have commissioned an expert panel which is responsible for development of scope of the HHRA, selecting a preferred consultant to undertake the HHRA and for reviewing the draft and final HHRA. An Additional Selection Committee consisting of members of the Community Working Group will also assist the expert panel in defining scope and selecting the preferred consultant. Findings from this additional HHRA are expected in November 2016.

Impacts to Human Health from the proposed REP will also be considered as part of the APVMA in their decision to issue a “Minor Use” permit for the REP or not. The APVMA are the relevant agency responsible for assessing and permitting the use of agricultural and veterinary products in Australia. The APVMA “Minor use” permit application was submitted in April 2016 with a decision expected in December 2016. The APVMA have previously assessed Brodifacoum and have registered it for use in Australia.

10.2.2 Summary of the Human Health Risk Assessment

The effects of Brodifacoum

Brodifacoum is an anticoagulant that prevents blood clotting by blocking production of Vitamin K which is vital to the clotting process. As clotting factors are used by the body, more cannot be made if there is no Vitamin K. Hence Vitamin K is an effective antidote to the effects of Brodifacoum.

In humans signs of poisoning include: bleeding from the gums, nosebleeds, small red or purple spots on the skin, easy bruising after minor bumps and knocks of the skin and blood in the urine and faeces. These effects occur before the onset of life threatening internal bleeding. There are no other toxic effects, and Brodifacoum poisoning can be treated with Vitamin K. However, because Brodifacoum stays in the liver for a long time, oral treatment with Vitamin K may need to continue over a few to several months depending on the severity of poisoning. Death is very rare in situations of incidental ingestion (e.g. in young children mistaking rodent bait as candy), and even when Brodifacoum rodent bait is intentionally eaten for suicide death is uncommon if treatment is provided within a reasonable time frame. The onset of the clinical signs of poisoning listed above may be delayed several days after exposure to a single large dose or a few weeks after repeated ingestion of small doses.

The severity of poisoning is monitored by a simple test which measures how quickly blood clots. An increase in clotting time occurs before any signs of toxicity (i.e. before effects associated with increased bleeding occur). A

certain amount of Brodifacoum in the body is required to increase clotting time and the amount of Brodifacoum, in relation to body weight, it takes to affect clotting time is similar across different species. The No Observed Effect Level or NOEL is the dose of Brodifacoum that does not cause an increase in clotting time; that is the dose that has no effect on the body.

No observed effect levels (NOELs)

Because Brodifacoum can build up in the liver with continuous daily doses, the NOEL differs depending on the time period over which exposure to the poison occurs. For a large single dose (an ACUTE dose) the NOEL is 0.15 milligram (0.00015 g) per kilogram body weight (shortened to 0.15 mg/kg), if Brodifacoum is eaten daily for 42 days the NOEL is 0.005 mg/kg/d, and if eaten for 90 days it is 0.001 mg/kg/d. If Brodifacoum is eaten every day of your life, the acceptable daily intake (ADI) is 0.0000005 mg/kg/day.

Because the proposed LHI rodent eradication programme will occur over a clearly defined single time period and noting bait completely disintegrates with 100 days, the appropriate NOEL for judging the risk of human exposure to Brodifacoum is either the 42 or 90 day NOEL. For many of the assumed ways (exposure pathways) that contact could occur the 42 day value is appropriate. The ADI is inappropriate because this is a guideline intended for situations where exposure could be for every day of a person's lifetime of 70 years.

Potential exposure pathways

This health risk assessment for human exposure to Brodifacoum rodent bait is specific for the Lord Howe Island group and takes into account the particular bait intended to be used, the method of application, how long the bait lasts in the terrestrial and aquatic environments, and management practices to be undertaken to minimise human exposure to the broadcasted bait.

A number of possible theoretical exposure pathways have been considered. These include:

- Eating rodent bait.
- Breathing in dust from bait during aerial broadcasting.
- Eating soil contaminated by Brodifacoum from bait.
- Absorbing poison by touching bait and contaminated soil.
- Drinking water (ground water and tank water) that may become contaminated by bait.
- Eating of :
- vegetables and fruit,
- poultry produce,
- fish that may have ingested bait inadvertently distributed to shore waters,
- meat and dairy produce,
- goat produce,
- wild ducks.

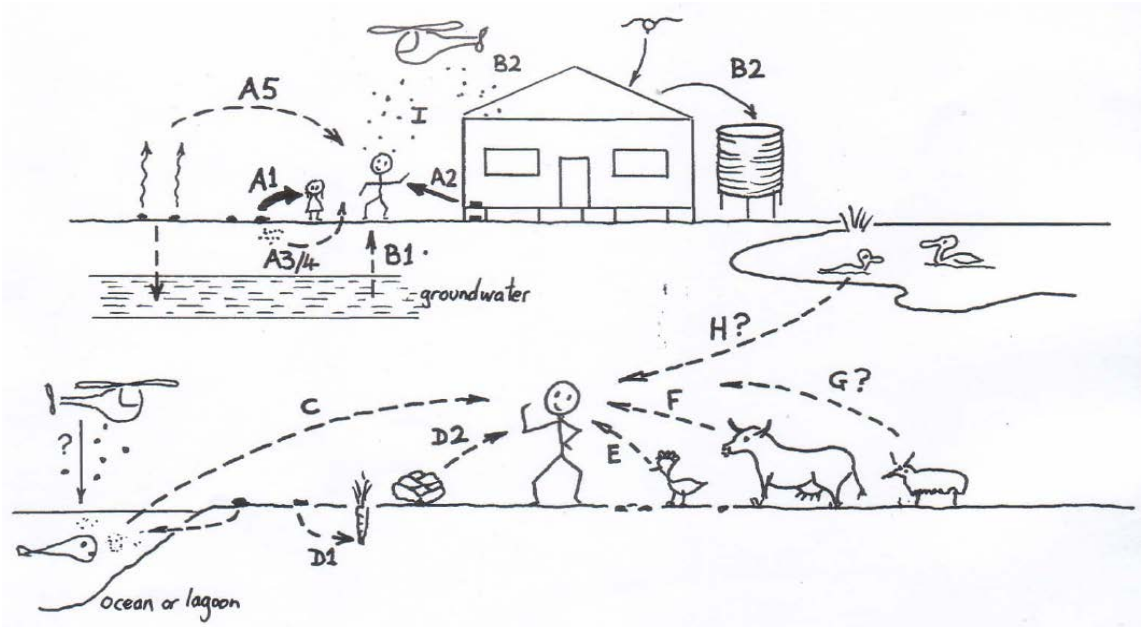

Figure 31 Possible Pathways by which LHI Residents can be Exposed to Brodifacoum during a Rodent Eradication

Table 30 Potential Human Routes of Contact with Poison and Likelihood

Potential human routes of contact with poison				**Likelihood**
	Route	**Media**	**Description**	
A1	Eat[n]	Bait	Picked up from soil surface	Possible [a]
A2			From bait station in, under or around house	
A3		Soil	Contaminated soil under where bait lay	Very low [b]
A4	Skin contact	Soil		
A5	Breath in[n]	Vapour	From broadcast bait or indoor bait stations	Incomplete pathway [c]
B1	Drink[n]	Water	Percolation into groundwater	Incomplete pathway [d]
B2			Bird droppings or bait dropped onto roof, washed into tank water	Low [e]
C	Eat[n]	Fish	Bait dropped or flushed into ocean/lagoon and eaten by fish	Very low [d, f]
D1		Garden vegs	Taken up from soil	Incomplete pathway [d, g]
D2			Dropped onto plants	Low [g]
E		Chicken	Chicken eats bait and transferred to flesh and eggs	Incomplete pathway [h]
F		Meat and dairy	Cattle/cows eat bait, Brodifacoum transferred to flesh and milk	
G			Goats eat bait and Brodifacoum transferred to flesh and milk	
H			Wild ducks eat bait and are shot	Incomplete pathway [j]
I	Breath in[n]	Dust	Fine dust from aerial dispersion	Very low [k]

Notes for above table

- [a] The most risky exposure to rodent bait is direct eating of bait picked up from the ground or from bait stations and eaten. Due to behaviour patterns young children are most at risk.
- [b] The probability of consuming soil from the exact spot under a bait pellet is low, the dose would be very low and furthermore Brodifacoum binds strongly to soil and so absorption into the body is significantly restricted. Absorption of Brodifacoum across the skin is low even without the strong binding to the soil.
- [c] Brodifacoum is a solid and so no gas is breathable.
- [d] Brodifacoum binds strongly to soil and does not leach into water, therefore groundwater, or the aquatic environment is not contaminated.
- [e] Birds may eat bait and leave contaminated droppings on roof, birds may also pick up bait pellet and drop onto roof. The amount of Brodifacoum washed off the roof will be very small, it is also poorly soluble in water so will be bound to tank sludge. It is unlikely aerial broadcasting will drop bait on roofs (if this is a possibility the management plan has a contingency action).
- [f] It is unlikely large amounts of bait will be dropped into the ocean. Bait rapidly disintegrates, the dose to fish should be low, the likelihood of catching a fish that has consumed bait is low, most Brodifacoum is in fish liver which is not consumed by humans.
- [g] Not taken up by vegetables from soil. If dropped onto plants washing vegetable during preparation will remove bait.
- [h] Chickens and cattle will be removed from the Island. Dairy cows are to be isolated from bait. Some goats will remain but these are pets not used for consumption or milk/cheese making.
- [j] There is no duck hunting on LHI.
- [k] Fine dust particles dispersed during aerial bait broadcasting are inhaled. Exposure is very low.

Many of these exposure pathways will not occur due to pre-emptive management practices that will be put in place during and after the proposed eradication campaign (e.g. poultry and beef cattle will be removed from the island, and dairy cows and goats will be isolated from exposure to rodent bait). It is believed that wild ducks are not eaten on the Island.

When estimating exposure to Brodifacoum by eating bait pellets, or indirectly via potentially contaminated water, soil, and seafood it is important to consider how long the bait lasts in the environment, because if it is not there it can't be eaten. The bait completely disintegrates into a few particles of grain within 100 days of being broadcast, and only remains in a form that can be picked up by children or birds for about 15 – 21 days. So with two baiting operations approximately two weeks apart, solid bait may be on the ground in such a 'pick-up-able' form for about 4 – 5 weeks. In water, bait pellets are reported to disintegrate within 15 minutes, sooner if there is wave action.

Direct Exposure Pathways:

The most important way that a young child may be exposed to rodent bait during the proposed eradication campaign is by picking the bait up and eating it. Pestoff®20R rodent bait contains a water soluble, non-toxic, green dye that will colour the tongue and mouth and thus assist to alert parents.

Even though Brodifacoum when eaten in a single (Acute) dose is very toxic to a range of species including humans, the amount of bait needed to be ingested by a child at one time to cause health effects is quite large. Small bait pellets (5.5 mm diameter) are intended to be hand distributed in the settlement and around dwellings. These are therefore the ones most likely to be picked up by a child. The number of pellets that a child would have to eat to reach the acute (one-off) NOEL (0.15 mg/kg) for increasing blood clotting time is approximately 200 which weigh about 100 g. This amount of bait is put into perspective by considering commercial rat bait Talon®, which is two-and-a-half times as poisonous as the Pestoff®20R baits, is sold in 150 g packets containing six prepacked pellet trays of 25 g each.

As there will be two bait operations about two weeks apart, the time that bait will be in a physical form able to be picked up by a child is 4 -5 weeks. It will require a small child to eat 6 -7 small pellets every day over this period to acquire a dose equivalent to the 42 day NOEL. This is unlikely to occur, even more so as parents will be alerted to consumption by the presence of green dye on the child's mouth.

It is a fact that unless it is consumed with the intention of self harm (e.g. suicide attempt) it is unusual for a person to suffer toxic effects (anticoagulant symptoms) from incidental ingestion of Brodifacoum rodent bait. Parents of children who have accidentally eaten rat bait understandably seek medical advice; however the majority of children do not require medical intervention. Even with intentional ingestion, with the aim of suicide, most people do not die. This is because there are several days between ingestion and the appearance of any toxic effects

which allows time to assess the severity of poisoning with the clotting time test, and if need be administer the antidotes which are very effective.

It is also theoretically possible that Island residents could be exposed to bait dust in the air during, or soon after broadcast by helicopters. A reasonable maximum estimate of the amount of Brodifacoum that might be inhaled during the proposed eradication is 5 million times less than the dose that would affect the body. This means that more than 200 million tonnes of bait would have to be dropped at LHI to expose a resident to a level of dust that might delay blood clotting time. It is planned to broadcast 42 tonnes.

Indirect Exposure Pathways:

Brodifacoum will not contaminate groundwater. It doesn't leach from soil. Similarly it does not contaminate vegetables and fruit because it is not transported from water or soil into the plant. The surface of a plant could be contaminated if the bait is physically broadcast onto the plant. While this should not occur (as bait be hand broadcast in the settlement area), if it does bait particles can be easily washed off during food preparation.

Contamination of soil, fish and seafood, and tank water are hypothetical but nonetheless plausible pathways through which LHI residents may become exposed to Brodifacoum. Even though it very unlikely such exposure will occur, possible intake of Brodifacoum by a 2 year old child has been estimated for these pathways. This is the population sector most at risk from exposure to chemicals in the environment. It is emphasised there is uncertainty associated with accurately calculating Brodifacoum intakes. Consequently very conservative 'high end' estimations have been undertaken so any error is more likely to be on the side of over-estimation of the risk rather than under-estimation.

The estimates of Brodifacoum dose by these exposure routes is less than the 42 day and 90 day NOELs, the daily amounts that would have to be encountered that would still not result in any increase in blood clotting times. For some of the indirect exposure routes the dose is many orders of magnitude (thousands to millions of times) lower.

Overall, it is concluded that the proposed eradication operation would pose negligible risk for human health, including young infant children, the most vulnerable group, from these exposure pathways.

It is unlikely fish will have much opportunity to eat bait that might fall into the ocean, it is also unlikely humans will catch such fish in numbers where it may become a health issue. In New Zealand there has been a very large accidental spill, (half of the total amount of bait that is proposed for use on the whole of Lord Howe Island) of Pestoff®20R into the sea (a small area about the size of the Lord Howe Island Oval); even so Brodifacoum was not measurable in fish flesh. It is estimated that a 2 year old child would have to consume around 68 kilograms of fish each day for 42 days before a change in blood clotting time might be expected.

Contamination of tank water may occur if aerial broadcasting of bait accidentally spreads pellets onto roofs. The draft eradication plan has management contingency for this event, baiting will not occur close enough to result in baits landing on roofs. Less obvious ways that Brodifacoum might get onto roofs is by birds eating bait and depositing droppings on roofs and gutters, or birds picking bait up and discarding it onto roofs. While these events appear plausible they are very unlikely to place significant amounts of Brodifacoum onto the roof, this is confirmed by the exposure calculations which indicate that any exposure would be at least 6,000 times lower than the NOEL. So a 2 year old child could drink at least 6000 litres (or 6 tonnes) daily without exhibiting Brodifacoum poisoning symptoms.

Eating Brodifacoum contaminated soil is a very minor pathway. It is unlikely all soil incidentally eaten (mostly by hand to mouth transfer) will be contaminated soil. Data collected in rodent eradications on soil residues when included in the eating calculations result in negligible doses of Brodifacoum. Furthermore, as Brodifacoum binds tightly to soil, even less poison is available to be absorbed. A 2 year old could eat more than 1.25 kg of soil daily without exhibiting poisoning symptoms.

Health Risk from Current Rodent Control

Relative to the health risk associated with current household practice of controlling rodents on LHI, the Pestoff®20R pellets present the same hazard and potential health risk as Ratsak. But as Pestoff®20R pellets are bigger, the health risk associated with eating a large number of pellets is greater than for the same number of Talon® pellets. However, this finding is put in context when you consider that incidental eating poses negligible risk to the health of infants of young children. For the same weight of bait ingested Pestoff®20R presents a lower risk because it has a lower concentration of Brodifacoum than products sold on the domestic market. This is however balanced by the absence of a taste deterrent which is in some, but not all commercial products. It is noted that with the current programme of rodent control there is an ongoing risk of inadvertent ingestion of rodent bait associated with that programme. This long term risk will be removed if rodents are eradicated from the Island.

HHRA Conclusions

1. Although Brodifacoum has the potential to cause poisoning and possibly death through internal bleeding, the human health risk to Lord Howe Islanders during the proposed eradication campaign is very low.
2. The most important exposure pathway is eating of bait pellets picked up off the ground or from bait stations.
    - While there will be an education campaign targeting children and parents of the dangers associated with eating the bait, parents will need to be especially watchful of their infant children during the 4 -5 weeks bait will be on the ground and in a form able to be picked up.
    - This vigilance is similar to that currently required given the ongoing use of rodenticides in the settlement area.
3. Indirect exposure pathways, where exposure is unlikely, are primarily managed during the eradication programme by removing or isolating human food sources that may theoretically become contaminated (e.g. poultry, beef meat and dairy produce).
    - Other human foods (e.g. seafood) are unlikely to be affected.
    - While water may become impacted if bait is strewn over roofs during aerial broadcasting, there are management contingencies to mitigate this. Theoretically tank water may also become contaminated with Brodifacoum if birds transport pellets onto roofs or after eating pellets leave their droppings on roofs. Both these scenarios are regarded as improbable but if they do occur are very unlikely to affect tank water to the extent it is unsafe to drink.
4. Exposure to Brodifacoum by indirect pathways (i.e. not direct ingestion of rodent bait) is negligible in comparison to the NOELs and human health effects are very unlikely.
5. The relative opportunity for exposure to Brodifacoum via Pestoff®20R is the same as current practise using commercially available rat bait. However:
    - for the same number of pellets ingested, the health risk may be higher depending on the constituents and pellet size of the commercial product.
    - Generally for the same weight of bait ingested Pestoff®20R presents a lower risk because it has a lower concentration of Brodifacoum.
    - This is balanced by the absence of a taste deterrent which is in some, but not all commercial products.
    - Notwithstanding the different relative risks associated with different bait products, the likelihood of health effects occurring in infants and young children from incidental ingestion of bait is **negligible**
6. The eradication campaign, if successful in removing rats and mice from LHI, will result in a smaller (**zero**) ongoing risk of exposure to rodent poisons.

HHRA Recommendations:

1. All mitigation measures as outlined in the *Draft Lord Howe Island Rodent Eradication Plan* should be implemented to minimise risks posed by use of rodent bait during the programme.
2. As a precautionary measure Islanders should not consume the livers of fish that have been caught within 200m of the shore line until 6 months after the last bait broadcast.
3. Although there is a negligible health risk from drinking tank water during the eradication campaign, for peace of Islander's mind, consideration could be given to a programme of strategic testing of tank water.
4. It would be prudent to advise those individuals involved with the control of non-native duck populations that they should not consume duck during the eradication programme, and not the liver for perhaps a year after the program has ceased

HHRA Specific Mitigation

The following measures will be implemented to reduce human health risks

- Bait choice. The Pestoff 20R bait pellets are chosen for their relatively low toxicity (20 ppm Brodifacoum) compared with commercially available rodenticides (generally 50 ppm Brodifacoum).
- Bait application methods. Bait will only be distributed by hand or bait station / trays in the settlement area, not aerially broadcast. The actual method on each property will be negotiated individually with

owners during the Property Management Plan process (see section 2.3). High risk areas such as the schools, and playgrounds will be treated with bait stations

- Temporary removal of livestock (beef cattle and chickens during the REP) to the extent possible. It is noted that the dairy herd and some pet cattle that are not for human consumption may remain but will be contained in small areas to restrict access to bait pellets. These containment areas will be baited with bait stations (see Section 2.1). Analysis of milk samples for Brodifacoum residues pre and post baiting will occur.
- Antidote. Vitamin K is an effective antidote for Brodifacoum poisoning. A supply of Vitamin K will kept at the hospital on LHI for treatment in the unlikely event of accidental ingestion of bait. Hospital staff will be made aware of diagnostic and treatment procedures prior to implementation of the REP.
- Detailed information of Brodifacoum (fact sheet) will be made available to the community prior to implementation of the REP. This sheet will include medical advisories of signs and symptoms of Brodifacoum poisoning, levels of risk, and what to do if ingestion of bait is suspected. Talks will also be given at the island's school to inform children of the operation and how they should behave around the toxic baits
- Residents and visitors will be kept informed of progress and notified of bait use in accordance with the LHIBs Pesticide Notification Policy
- Monitoring of bait breakdown, and Brodifacoum residues in soil and water will occur (see section 2.4)
- Walking tracks in the PPP may undergo temporary closure during the actual aerial bait drop. It is expected that these will be only for a day or two at a time.

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11 Information Sources

11.1 Reliability and date of information

References and studies cited above include a broad range of:

- peer reviewed and published scientific literature
- Commonwealth and State government reports and website references
- unpublished reports prepared specifically for the proposed LHI REP undertaken by appropriately qualified and experienced LHIB, NSW OEH staff or consultants
- unpublished reports from a range of similar eradication projects undertaken around the world.

Of 196 references cited, 160 (81%) are from peer reviewed scientific journals, government documents and PhD thesis (92, 64 and 4 respectively). An additional nine are published books. The majority of these studies are considered to be very recent (within the last 5 years) or recent (within the last 15 years). Older studies are used where the information was considered still relevant. Studies from the scientific literature and Australian and State government reports and references were considered to be extremely reliable and credible. Studies undertaken for the LHIB by qualified and experienced staff or consultants and other global eradication projects (mostly undertaken by reputable foreign governments) were also considered reliable and credible. Uncertainties in any of the sources were noted and where relevant considered in this proposal.

11.1.1 Lord Howe Studies

The ecology and biodiversity of LHI has been extensively studied and documented over a long period of time providing an excellent baseline. The island has fascinated scientists since discovery in 1788 (Hutton, 1990) and a broad range of anecdotal accounts of sightings, collections and research projects relevant to the REP have been undertaken including rare plant surveys, breeding ecology of seabirds and invertebrate surveys (DECC, 2007).

Distribution and abundance, particularly of threatened and endemic species is comparatively well understood. Surveys have helped contribute to flora and fauna records for the island and the listing of many threatened species under both the EPBC Act and the NSW *Threatened Species Act 1995 (*TSC Act).

Several surveys for rare plants have been undertaken by OEH (formerly DECC) to determine the distribution, population size and threats to a number of plant species (Hutton 2005 and Hutton 2001b). Outcomes of these surveys have resulted in the listing of several plant species on the TSC Act.

The Australian Museum has been collecting systematic terrestrial invertebrate data since 1977 with results collated over time Cassis *et al.* (2003).

The bird life in particular has been extensively studied by scientists, locals and visitors. Records are kept on bird sightings and several ecological studies of the threatened seabirds on Lord Howe Island have been completed. These studies have focussed on breeding productivity and foraging ecology as a means of evaluating conservation status and threats.

Individual species such as the Lord Howe Woodhen, the LHI Currawong, and phasmid have all been well studied as part of recovery actions.

Studies, trials and baseline monitoring specifically undertaken on LHI (see sections 1.6 and 2.8) for the REP have been undertaken either by specialised consultants with expertise in the relevant area, employees of the NSW OEH or past or present LHIB employees with appropriate qualifications for their roles.

A summary of relevant studies undertaken included in Appendix L – LHI Ecological Studies Summary.

11.1.2 Eradication

Globally there is considerable research undertaken on invasive mammal and particularly rodent eradications prior to, during and post operations. Government organisations like the Island Eradication Advisory Group (NZ Department of Conservation and the United States Fish and Wildlife Service, together with not for profits organisations such as Island Conservation have extensive collections of recent and historical peer reviewed and grey literature relating to assessment of risks, operational impacts and long term recovery of ecosystems following eradication. Access to this knowledge bank for the LHI REP has been facilitated through contact with global eradication experts including the Chairman of the IEAG being on the LHI REP Steering Committee.

12 Conclusion

This Public Environment Report provides a demonstrated need for the REP based on documented evidence of significant impacts of rodents both globally and on LHI. It demonstrates compliance with the objectives of the EPBC Act and the principles of Ecologically Sustainable Design. It presents evidence of ongoing impacts at the species and ecosystem level on LHI even in the presence of ongoing rodent control. It demonstrates support for the REP through a range of legislative instruments, recovery plans and the like and outlines the unacceptable consequences of failing to proceed. It also provides evidence of expected benefits.

Detailed consideration of alternatives assessed is provided together with justification of why continuing with the current control program is unacceptable. It provides evidence of why other methods were considered unsuitable for an eradication on LHI and why the toxin, bait and delivery methods were selected based on over 30 years of lessons and experience globally.

It outlines the project details and mitigation and considers in detail, potential risks to matters of NES based on results from numerous similar eradications around the world.

It concludes that significant impacts are highly unlikely for most matters of NES. Species considered most at risk are the LH Woodhen and the LH Pied Currawong. In the absence of mitigation, a significant impact to woodhens is likely to occur from the LHI REP. However with the mitigation proposed in place, it is considered unlikely that either long term population decrease or major disruption to a breeding cycle will occur. Impacts are likely to be temporary. It is therefore considered unlikely that the REP will have a significant impact on woodhens

In the absence of mitigation, a significant impact to LHPC is likely to occur from the LHI REP. With the proposed mitigation in place, it is considered possible that the REP will still have a significant impact on LHPC through the temporary disruption of a breeding cycle, although it is unlikely that a long-term population decrease will occur. Any potential impacts will be temporary. This temporary potential impact, will be substantially offset by the improvement in biodiversity if impacts of rodents are removed as a result of the REP. No other offsets are proposed.

Socio –economic considerations are discussed. Economic benefits of the REP far outweigh costs indicating that the aggregate welfare of the community is significantly improved by implementing the REP. Potential short term impacts from a potential reduction in tourism numbers during the REP are offset by the project workforce and long term tourism benefits arising from ecological improvements. Human health impacts were assessed considering the proposed use of the toxin and mitigation measures proposed. Human health risks are considered to be very low with the mitigation in place

The REP is essential and beneficial. Risks have been addressed through proposed mitigation to the point where they are considered to be very low. Any potential impacts are localised and short term and far exceeded and offset by the benefits that will be provided by implementation of the REP. Potential impacts of the REP are also considerably less than the ongoing impact of failing to proceed.

A summary of risks and benefits of the REP compared to the current control program is provided below.

Table 31 Summary Conclusions

Impact	Continue Current rodent Control Program as current	Rodent Eradication
Ecological impacts including matters of NES	Continued deterioration of ecosystems through predation of fauna and flora at all but the selected control sites. Varied response of species depending on the selected protection sites, some species likely to continue to decline and some at high risk of extinction. Ongoing risk of invasion by rodents of predator free islands from the main island with subsequent loss of species. Continued impact to matters of NES; 10 bird species, two reptile species, six invertebrate species and two plants species (see Table 4).	Recovery of ecosystems Recovery of endemic and threatened species. Enhanced recruitment of flora species with consequent benefits to wider ecosystem. Potential for the reintroduction of extirpated species confined to offshore islands Potential recolonisation Possible increase in weeds due to reduced seed predation, - allowed for in the Lord Howe weed management planning. Greatly reduces the risk of invasion by rodents of predator free islands Temporary impact to one matters of NES species (Currawong) offset by overall biodiversity improvement.

World Heritage Values	Ongoing deterioration away from selected control sites continues to negatively impact WHS values Potential for listing on the "World Heritage in Danger" list	Remove a major threat to World Heritage values Australia gets recorded as actively protecting a WH site.
Human Health risks	Risks and impacts remain as present. Uncontrolled use of poison by residents. Ongoing use of poison in the environment and ongoing exposure risk especially for children	Temporary risk profile, (but still low with mitigation) during REP offset by removal of poison use permanently eliminating human health risks from rodenticides.
Impact on tourism	Continues status quo. Tourists continue to have exposure to rodents and control program. Potential downturn in tourism from further degradation of World Heritage values.	Potential short term impact to tourism offset by project workforce and expected long term increase in tourism from improved biodiversity and enhanced World Heritage values.
Impact on Palm Industry	Continued losses of seeds and seedlings	Removal of rodent impacts to Kentia Palm Industry
Use of toxicants	Amount of rodenticide used likely to remain the same, or increase is resistance develops, with ongoing cumulative impacts and risk to human and environmental health including ongoing poisoning of threatened fauna i.e. woodhens.	After initial major use of toxicant, under tightly controlled conditions, very limited requirement for rodenticide for biosecurity removing human and environmental health risks.

13 References

AECOM Australia Pty Ltd (2016). Lord Howe Island Biosecurity Strategy 2016. Unpublished Report for the Lord Howe Island Board

Alifano A, Wegmann A. (2010). The ecotoxicology and palatability of two rodenticide products: Field-based assessment at Palmyra Atoll. Island Conservation report prepared for the Palmyra Atoll Rainforest Restoration Project. 51 p.

Angel, A., Wanless, R. and Cooper, J. (2009). Review of impacts of the introduced house mouse on islands in the Southern Ocean: are mice equivalent to rats? *Biological Invasions* **11**, 1743-1754.

Athens, J. (2009). Rattus exulans and the catastrophic disappearance of Hawaii's native lowland forest. *Biological Invasions* **11.** 1489-1501.

Auld, T.D., Hutton, I., Ooi, M.K.J. and Denham, A.J. (2010) Disruption of recruitment in two endemic palms on Lord Howe Island by invasive rats. *Biological Invasions* **12**, 3351-3361

Birlife Australia (2016). Macquarie Island celebrates 5 years of being rabbit-free. Accessed 21 Dec 2016 http://birdlife.org.au/media/macquarie-island-celebrates-5-years-of-being-rabbit-free/

Beeton, R.J.S. (2008a). *Gudeoconcha sophiae magnifica* ms (a snail) Listing Advice. Advice to the Minister for the Environment, Water, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on Amendment to the List of Threatened Species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Threatened Species Scientific Committee, Canberra.

Beeton, R.J.S. (2008b). *Mystivagor mastersi* (Masters' Charopid Land Snail) Listing Advice; Advice to the Minister for the Environment, Water, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on Amendment to the List of Threatened Species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Threatened Species Scientific Committee, Canberra.

Beeton, R.J.S. (2008c). *Pseudocharopa lidgbirdi* (Mount Lidgbird Charopid Snail) Listing Advice; Advice to the Minister for the Environment, Water, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on Amendment to the List of Threatened Species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Threatened Species Scientific Committee, Canberra.

Beeton, R.J.S. (2008d). *Pseudocharopa whiteleggei* (Whitelegge's Land Snail) Listing Advice; Advice to the Minister for the Environment, Water, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on Amendment to the List of Threatened Species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Threatened Species Scientific Committee, Canberra.

Bester, A. 2003. The breeding, foraging ecology and conservation of the Providence Petrel *Pterodroma solandri* on Lord Howe Island, Australia. Unpubl. PhD Thesis, Charles Sturt University, Albury.

Billing, J. (1999). The management of introduced rodents on Lord Howe Island. Unpublished report. Lord Howe Island Board, Lord Howe Island.

Bollmer J. L., Hull J. M., Ernest H. B., Sarasola J. H. and Parker P. G. (2011) Reduced MHC and neutral variation in the Galapagos hawk, an island endemic. *BMC Evolutionary Biology* **11**.

Booth, L.H., Eason, C.T. and Spur, E.B. (2001). Literature review of the acute toxicity and persistence of Brodifacoum to invertebrates. Pp. 1-9 in *Department of Conservation 2001: Literature Review of the Acute Toxicity and Persistence of Brodifacoum to Invertebrates and Studies of Residue Risks to Wildlife and People* (eds J. Jasperse and L. Clelland). Department of Conservation, Wellington.

Booth, L.H., Fisher, P., Heppelthwaite, V. and Eason, C.T. (2003). Toxicity and residues of Brodifacoum in snails and earthworms. DOC Science Internal Series, No. 143. Department of Conservation, Wellington, New Zealand.

Bowie, M.H. and Ross, J.G. (2006). Identification of weta foraging on Brodifacoum bait and the risk of secondary poisoning for birds on Quail Island, Canterbury, New Zealand. *New Zealand Journal of Ecology* **30**, 219-228.

Brooke MdL, Cuthbert RJ, Mateo R, Taggart MA. (2011). An experimental test of the toxicity of cereal pellets containing Brodifacoum to the snails of Henderson Island, South Pacific. *Wildlife Research* **38**: 34-38.

Brooke MdL, Cuthbert RJ, Harrison, G Gordon, Taggart MJ. (2013). Persistence of Brodifacoum in cockroach and woodlice: Implications for secondary poisoning during rodent eradications. *Ecotoxicology and Environmental Safety* **97** 183-188.

Broome, K.G.; Fairweather, A.A.C.; Fisher, P. (2016). Brodifacoum Pesticide Information Review. Version 2016/1. Unpublished report docdm-25436, Department of Conservation, Hamilton, NZ. 137p

Brown, D. A. (1997a). Chetwode Island kiore and weka eradication project. *Ecological Management* **5**, 11-20.

Brown, D., Wylie, M. and McClelland, P. (2006). Assessment of environmental effects for the eradication of: Ship Rats (*Rattus rattus*) from Taukihepa, Pukeweka and Solomon (Rerewhakaupoko) Islands; and Kiore (*Rattus exulans*) from Big Moggy (Mokonui) Island. Unpublished Report. Department of Conservation, New Zealand.

Buckelew S, Howald G, MacLean S, Byrd V, Daniel L, Ebbert S, Meeks W. (2009). Rat Island Habitat Restoration Project: Operational Report. Report to USFWS. Island Conservation, Santa Cruz, CA. 44 p.

Burger, J. and Gochfeld. M. (1993). Tourism and short-term behavioural responses of nesting Masked, Red-footed, and Blue-footed Boobies in the Galapagos. *Environmental Conservation* 20: 255-259.

Buxton, R., Taylor, G., Jones, C., Lyver, P. O., Moller, H., Cree, A. and Towns, D. (2016). Spatio-temporal changes in density and distribution of burrow-nesting seabird colonies after rat eradication. *New Zealand Journal of Ecology* 40: 88-99

Carlile , N., Priddel, D. (2006). Population size and distribution of the Lord Howe Currawong *Stepera graulina crissalis.* Unpublished Report prepared for the Lord Howe Island Board. Department of Environment and Conservation, NSW

Carlile , N., Priddel, D. (2013). Abundance and occurrence of the Lord Howe Island Wood-feeding Cockroach *Panesthia lata.* Unpublished Report prepared for the Lord Howe Island Board. Office of Environment and Heritage, NSW.

Carlile, N. and Priddel, D. (2013a). Seabird Islands – Roach Island, Lord Howe Group, New South Wales. *Corella* 37: 82-85

Carlile, N. and Priddel, D. (2013b). Seabird Islands – South Island, Lord Howe Group, New South Wales. *Corella* 37: 82-85

Carlile, N. and Priddel, D. (2013c). Seabird Islands – Sugarloaf Island, Lord Howe Group, New South Wales. *Corella* 37: 90-91

Carlile, N. and Priddel, D. (2013d). Seabird Islands – Mutton Bird Island, Lord Howe Group, New South Wales. *Corella* 37: 94-96

Carlile, N. (2015). Monitoring, evaluating and reporting the biodiversity benefits of eradicating exotic rodents from Lord Howe Island. Unpublished report for the LHIB. Office of Environment and Heritage, NSW

Christmas, E. (1995). Interactions between Duvaucel's Gecko (*Hoplodactylus duvaucelii*) and Kiore (*Rattus exulans*). MSc. Thesis (unpublished thesis), Department of Zoology, University of Otago, Dunedin, New Zealand. Cited in Hoare, J.M. and Hare, K.M. (2006). The impact of Brodifacoum on non-target wildlife: gaps in knowledge. *New Zealand Journal of Ecology* **30**(2), 157-167.

Cleghorn, M. and Griffiths, R. (2002). Palatability and efficacy of Pestoff 20R bait on mice from Mokoia Island, Rotorua. SCIENCE INTERNAL SERIES 25. Department of Conservation, New Zealand.

Cogger, H. G. (1971). The reptiles of Lord Howe Island. *Proceedings of the Linnean Society of New South Wales* **96**, 23-38

Commonwealth of Australia. (2001). Background information for the Abbott's Booby, *Papsasula abbotti* Recovery Plan. Department of the Environment and Heritage, Canberra.

Craddock, P. (2003). Aspects of the Ecology of Forest Invertebrates and the Use of Brodifacoum. PhD Thesis University of Auckland.

Craddock, P. (2004). Environmental breakdown of Pest-Off poison bait (20ppm Brodifacoum) at Täwharanui Regional Park, North of Auckland. Unpublished report prepared for Northern Regional Parks, Auckland Regional Council. Entomologica Consulting, Auckland.

Croll D. A., Newton K. M., McKown M., Holmes N., Williams J. C., Young H. S., Buckelew S., Wolf C. A., Howald G., Bock M., Curl J. A. and Tershy B. R. (2016) Passive recovery of an island bird community after rodent eradication. *Biological Invasions* **18**, 703-15.

Cuthbert, R. and Hilton, G. (2004). Introduced house mice Mus musculus: a significant predator of threatened and endemic birds on Gough Island, South Atlantic Ocean. *Biological Conservation* **117**, 483-489.

Cuthbert, R., Broome, K., Bradley, J. and Ryan, P. (2014). Evaluating the effectiveness of aerial baiting operations for rodent eradications on cliffs on Gough Island, Tristan da Cunha. *Conservation Evidence* **11**, 25-28

Curran, Dr J. (2007). *Health assessment of the Lord Howe Woodhen (Gallirallus sylvestris) population on Lord Howe Island NSW, and assessment of disease risks from resident and migratory avian species.* Unpublished report for the Lord Howe Island Board.

Day, T.D. (2004). Withholding period from pasture for sheep exposed to hand-broadcast Pestoff 20R Rodent Bait. Report prepared as part of a code of practice for the aerial application of Pestoff 20R Rodent bait on mainland New Zealand (unpublished). XcluderTM Pest Proof Fencing Company, Cambridge, New Zealand. 13pp

DECC. (2007) Lord Howe Island Biodiversity Management Plan. Department of Environment and Climate Change, Hurstville.

DECC (2007a). Report on non-toxic bait trials Lord Howe Island – August 2007. Department of Environment and Climate Change. Unpublished report for the Lord Howe Island Board.

DECC (2008). *Measuring uptake of non-toxic baits by ship rats (*Rattus rattus*) and house mice (*Mus musculus*): essential information for planning a rodent eradication programme on Lord Howe Island.* Department of Environment and Climate Change. Unpublished report for the Lord Howe Island Board.

DECC (2010). *Lord Howe Island Permanent Park Preserve Plan of Management*. Department of Environment and Climate Change

Department of the Environment. (2016). Australian Heritage Database - Place details Lord Howe Island Group. Accessed April 2016. http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;search=list_code%3DNHL%3Blegal_status%3D65%3Bkeyword_PD%3D0%3Bkeyword_SS%3D0%3Bkeyword_PH%3D0;place_id=105694

DEWR. (2007). A national strategy for the management of vertebrate pest animals in Australia. Department of the Environment and Water Resources, Canberra

DEWHA, (2009). THREAT ABATEMENT PLAN to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100 000 hectares. Department of Environment Water, Heritage and the Arts, Canberra.

DEWHA. (2009b). Species profile and Threats Database: *Strepera graculina crissalis* – Lord Howe Island Currawong, Pied Currawong (Lord Howe Island). Date accessed: 31/8/2009. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25994

Dowding, J.E., Lovegrove, T.G., Ritchie, J., Kast, S.N. and Puckett, M. (2006).Mortality of northern New Zealand dotterels (*Charadrius obscurus aquilonius*) following an aerial poisoning operation. *Notornis* 53: 235-239.

DSEWPaC, (2012), Marine bioregional plan for the Temperate East Marine Region. Department of Sustainability, Environment, Water, Populations and Communities, Canberra.

DIISE (2015): Database for Island Invasive Species Eradications accessed December 2015: http://diise.islandconservation.org

Eason, C. T. and Ogilvie, S. (2009). A re-evaluation of potential rodenticides for aerial control of rodents. DOC Research and Development Series 312. Department of Conservation, Wellington, New Zealand.

Eason C, Wickstrom M. (2001). Vertebrate Pesticide Toxicology Manual (Poisons). Department of Conservation, PO Box 10-420, Wellington, New Zealand. 122 p.

Eason, C. T., Hix, S., MacMorran, D. and Murphy, E. C. (2009). The first stage of preliminary screening of candidate MtHb inducers as potential rodenticides including PAPP and sodium nitrite by oral gavage and in bait. Unpublished Connovation Contract Report. Landcare Research, New Zealand.

Ebbert, S.E., and Byrd, G. V. Eradications on an Alaskan Wildlife Refuge. In: Veitch CR, Clout MN eds. *Turning the tide: the eradication of invasive species*, IUCN SSC Invasive Species Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. Pp. 102-109.

Empson, R.A. (1996). Application for resource consent application of anticoagulant toxic baits for rat eradication (Kapiti Island): Background information and assessment of effects. Unpublished report. Department of Conservation, Wellington, New Zealand.

Empson, R.A. and Miskelly, C.A. (1999). The risks, costs and benefits of using Brodifacoum to eradicate rats from Kapiti Island, New Zealand. *New Zealand Journal of Ecology* **23**(2), 241–254.

Environment Australia (2002). Lord Howe Island Marine Park (Commonwealth Waters) Management Plan. 2002, Environment Australia, Canberra

Fenn, M.G.P, Tew, T.E. and McDonald,D.W.(1987). Rat movements and control on an Oxfordshire farm. *Journal of Zoology* London **213** 745-79

Fisher, P. (2005). Review of house mouse (*Mus musculus*) susceptibility to anticoagulant poisons. *DOC Science Internal Series* **198**, 1-18.

Fisher, P. (2013). Environmental residues of anticoagulants used for pest animal control. Landcare Research New Zealand.

Fisher P, Funnell E, Fairweather A, Brown LE, Campion M. (2012). Accidental discharge of Brodifacoum baits into a freshwater lake: A case study. *Bulletin of Environmental Contamination and Toxicology* **88**: 226-228.

Fisher P, Griffiths R, Speedy C, Broome KG. (2011). Environmental monitoring for Brodifacoum residues after aerial application of baits for rodent eradication. In: Veitch CR, Clout MN, Towns DR eds. Island Invasives: Eradication and Management. *Proceedings of the International Conference on Island Invasives*, IUCN, Gland, Switzerland, Auckland, New Zealand. Pp. 300-304.

Fisher PM. (2009). Residual concentrations and persistence of the anticoagulant rodenticides Brodifacoum and diphacinone in fauna. Unpublished PhD thesis. Lincoln University, Lincoln, NZ. 155 p.

Freeman, A.B., Hickling, G.J., and Bannock, C.A. (1996). Response of the skink *Oligosoma maccanni* (Reptilia: Lacertilia) to two vertebrate pest-control baits. *Wildlife Research* **23,** 511-516.

Frith, C. B. (2013). *The Woodhen: A flightless island bird defying extinction*. CSIRO Publishing, Victoria Australia.

Fullagar, P., Davey, C., Nicholls, A. O., and Hutton, I. (2014). Landbirds on Lord Howe Island, NSW Survey report 1, September 2013. Unpublished Report to the Lord Howe Island Board prepared by the Canberra Ornithologists Group.

Fullagar, P., Davey, C., Nicholls, A. O., and Hutton, I. (2015). Landbirds on Lord Howe Island, NSW Survey report 2, September 2014. Unpublished Report to the Lord Howe Island Board prepared by the Canberra Ornithologists Group.

Garnett, S. and Crowley, G.M. (2000). The action plan for Australian birds 2000. Environment Australia, Canberra.

Garcia MA, Diez CE, Alvarez AO (2002). The eradication of Rattus rattus from Monito Island, West Indies. In: Veitch CR, Clout MN eds. *Turning the tide: the eradication of invasive species*, IUCN SSC Invasive Species Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. Pp. 116-119.

Gerlach, J. and Florens, V. (2000). Considering molluscs in rodent eradication projects. *Tentacle - The Newsletter of the IUCN/SSC Mollusc Specialist Group* **9**, 7-8.

Gillespie, J. (1993). Avian husbandry notes; guidelines; the Lord Howe Island Woodhen *Tricholimnas sylvestris*. Taronga Zoo, Sydney.

Gillespie Economics Pty Ltd. (2016). Economic Evaluation of LHI Rodent Eradication Project. Final Report Unpublished report for the Lord Howe Island Board

Godfrey, M.E.R. (1985). Non-target and secondary poisoning hazards of 'second generation' anticoagulants. Acta Zool. Fennici 173, 209–212.

Green C. (2002): Recovery of invertebrate populations on Tirtiri Matangi Island New Zealand following eradication of Pacific rats (*Rattus exulans*). In: Veitch CR, Clout MN eds. Turning the tide: the eradication of invasive species, IUCN SSC Invasive Species Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. Pp. 407.

Green C J, Gibbs G W, Barrett P A. (2011). Wetapunga (*Deinacrida heteracantha)* population changes following Pacific rat (Rattus exulans) eradication on Little Barrier Island. In: Veitch CR, Clout MN, Towns DR eds. Island Invasives: Eradication and Management. *Proceedings of the International Conference on Island Invasives*, IUCN, Gland, Switzerland, Auckland, New Zealand. Pp. 305-308

Griffiths R. (2004). Little Barrier Island Kiore Eradication Monitoring Report. Unpublished, Hamro-100283 Warkworth Area Office, Department of Conservation, Warkworth

Groombridge, B. (1992). Global biodiversity: status of the earth's living resources: a report. Report prepared for the World Conservation Monitoring Centre, British Museum (Natural History), and International Union for Conservation of Nature and Natural Resources. Chapman and Hall, London.

Hansen, B.D., Fuller, R.A., Watkins, D., Rogers, D.I., Clemens, R.S., Newman, M., Woehler, E.J. and Weller, D.R. (2016) Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species. Unpublished report for the Department of the Environment. BirdLife Australia, Melbourne.

Harden, R. (1999). Methods Used in the Census of Lord Howe Island Woodhen Population 1985-1988. University of New England, Armidale.

Harden, B. (2001). Recent trends in the number of woodhen recorded during surveys. Unpublished report to the Lord Howe Island Board. NSW National Parks and Wildlife Service, Armidale.

Harden, R.H. and Robertshaw, J.D. (1988). Lord Howe Island Woodhen Census, 1987. Unpublished report to the NSW National Parks and Wildlife Service, Sydney. NSW National Parks and Wildlife Service, Armidale.

Harden, R. and Robertshaw, J. (1989). Lord Howe Island Woodhen census 1988. Unpublished report. Environmental Survey and Research Branch, National Parks and Wildlife Service.

Harrison, E.G., Porter, A.J. and Forbes, S. _1988. Development of methods to assess the hazards of a rodenticide to non-target vertebrates. In M.P Greaves, B.D. Smith and P.W. Greig-Smith _eds. *Environmental effects of Pesticides*, pp. 89]96. British Crop Protection Council Monograph No. 40. Thornton Heath, UK.

Hayman, P., Marchant, J. and Prater, T. (1986). Shorebirds: An identification guide to the waders of the world. Houghton Mifflin, Boston.

Higgins, P.J., Peter, J.M. and Cowling, S.J. (2006). Handbook of Australian, New Zealand and Antarctic Birds. Volume 7: boatbill to starlings. Oxford University Press, Melbourne.

Higgins, P.J. and Davies, S.J.J.F. (eds) (1996). *Handbook of Australian, New Zealand and Antarctic Birds. Volume 3: Snipe to Pigeons*. Oxford University Press, Melbourne. Hindwood, K. A. (1940). The birds of Lord Howe Island. *Emu* **40**, 1-86.

Hoare, J.M. and Hare, K.M. (2006). The impact of Brodifacoum on non-target wildlife: gaps in knowledge. *New Zealand Journal of Ecology* **30**(2), 157-167.

Holdaway, R. N., Hawke, D. J., Hyatt, O. M. and Wood, G. C. (2007). Stable isotopic (□15N, □13C) an wood in trees growing in past and present colonies of burrow-nesting seabirds in New Zealand. I. □15N in two species of conifer (Podocarpaceae) from a mainland colony of Westland petrels (Procellaria westlandica), Punakaiki, South Island. *Journal of the Royal Society of New Zealand* **37**, 75-84.

Hone, J. and Mulligan, H. (1982). Vertebrate pesticides. *Science Bulletin 89*. New South Wales Department of Agriculture, Orange.

Hogan, F., Campbell, C. Harrison, K., Milledge, D., and Cooke, R. (2013). Molecular data contradicts historical records and cautions translocation of the Lord Howe Island masked owl. *Biological Conservation* **159** 313-320

Howald GR, Mineau P, Elliott JE, Cheng KM. (1999). Brodifacoum poisoning of avian scavengers during rat control on a seabird colony. *Ecotoxicology* **8**: 431-447.

Howald, G.R., Faulkner, K.R., Tershy, B., Keitt, B., Gellerman, H., Creel, E.M., Grinnell, M., Ortega, S.T. and Croll, D.A. (2005). Eradication of Black Rats from Anacapa Island: biological and social considerations. In *Proceedings of the Sixth California Islands Symposium.* (eds D. K. Garcelon and C. A. Schwemm). National Park Service Technical Publication CHIS-05-01, Institute for Wildlife Studies, Arcata, California.

Howald, G., Donlan, C.J., Galvan, J.P., Russell, J.C., Parkes, J., Samaniego, A., Wang, Y., Veitch, D., Genovesi, P., Pascal, M., Saunders, A. and Tershy, B. (2007). Invasive rodent eradication on islands. *Conservation Biology* **21**, 1258-1268.

Howald,G.,Donlan,C.J.,Faulkner,K.R.,Ortega,S.,Gellerman,H.,Croll,D.A.,Tershy, B.R., (2010). Eradication of black rats Rattus rattus from Anacapa Island. *Oryx* **44** (01), 30–40.

Hutton, I. (1991). *Birds of* Lord Howe Island*: Past and present*. The Author Coffs Harbour

Igual, J. M., Forero, M. G., Gómez, T., Orueta, J. F., and Oro, D. (2006). Rat control and breeding performance in Cory's shearwater (*Calonectris diomedea*): Effects of poisoning effort and habitat features. *Animal Conservation* 9: 59-65

IUCN. (2016). World Heritage Outlook – Lord Howe Island Group. Accessed Aug 2016. http://www.worldheritageoutlook.iucn.org/search-sites/-/wdpaid/en/5001?p_p_auth=9fJebPKY

IUCN. (2012). IUCN Red List Categories and Criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN. iv + 32pp.

Jacobs. (2016) *LHI Renewable Energy Project - Q*and*A - May 2016*. Accessed 14 Sept 2016. http://www.lhib.nsw.gov.au/infrastructure/renewable-energy

Jones H. P., Holmes N. D., Butchart S. H., Tershy B. R., Kappes P. J., Corkery I., Aguirre-Monoz A., Armstrong D. P., Bonnaud E., Burbidge A. A., Campbell K., Courchamp F., Cowan P. E., Cuthbert R. J., Ebbert S., Genovesi P., Howald G. R., Keitt B. S., Kress S. W., Miskelly C. M., Oppel S., Poncet S., Rauzon M. J., Rocamora G., Russell J. C., Samaniego-Herrera A., Seddon P. J., Spatz D. R., Towns D. R. and Croll D. A. (2016) Invasive mammal eradication on islands results in substantial conservation gains. *PNAS* **113**, 4033-8

Jones, A. G., Chown, S. L., Ryan, P. G., Gremmen, N. J. M. and Gaston, K. J. (2003). A review of conservation threats on Gough Island: a case study for terrestrial conservation in the Southern Oceans. *Biological Conservation* **113**, 75-87.

Jones, H. P., Tershy, B. R., Zavaleta, E. S., Croll, D. A., Keitt, B. S., Finkelstein, M. E. and Howald, G. R. (2008). Severity of the effects of invasive rats on seabirds: a global review. *Conservation Biology* **22**, 16-26.

Kaukeinen, D.E. and Buckle, A.P. (1992): Evaluations of aversive agents to increase the selectivity of rodenticides, with emphasis on denatonium benzoate (Bitrex®) bittering agent. In:Borecco, J.E.; Marsh, R.E. (eds) *Proceedings of the 15th Vertebrate Pest Conference*. University of California, Davis.

Köhler, F., Hyman, I. and Moussalli, A. (2016). Lord Howe Island Rodent Eradication Project: Assessment of potential impacts on land snails. Unpublished report for th Lord Howe Island Board. Australian Museum, Sydney.

Lane, B.A. (1987). Shorebirds in Australia. Nelson Publishers, Melbourne.

Lavoie, C., Donlan, C. J., Campbell, K., Cruz, F. and Carrion, V. G. (2007). Geographic tools for eradication programs of insular non-native mammals. *Biological Invasions* 9, 139-148.

Le Corre M., Danckwerts D. K., Ringler D., Bastien M., Orlowski S., Morey Rubio C., Pinaud D. and Micol T. (2015) Seabird recovery and vegetation dynamics after Norway rat eradication at Tromelin Island, western Indian Ocean. *Biological Conservation* **185**, 85-94.

LHIB (2009). Draft Lord Howe Island Rodent Eradication Plan. Lord Howe Island Board, NSW.

LHIB (2010a). Lord Howe Island Permanent Park Preserve Plan of Management. Lord Howe Island Board NSW

LHIB (2010). Strategic Plan for the Lord Howe Island Group World Heritage Property. Lord Howe Island Board NSW

Machovsky-Capuska, G.E., Priddel, D., Leong, P.H.W., Jones, P., Carlile, N., Shannon, L., Portelli, D., McEwan, A., Chaves, A.V., and Raubenheimer, D. (2016) Coupling bio-logging with nutritional geometry to reveal novel insights into the foraging behaviour of a plunge-diving marine predator. New Zealand Journal of Marine and Freshwater Research

MacKay, J. W. B., Russell, J. C. and Murphy, E. C. (2007). Eradicating house mice from islands: successes, failures and the way forward. In 'Managing Vertebrate Invasive Species: *Proceedings of an International Symposium* '. Eds G. W. Witmer, W. C. Pitt and K. A. Fagerstone. pp. 64-66. (USDA/Aphis/WS, National Wildlife Research Center: Fort Collins.)

Maitland MJ. (2012). Shakespear Open Sanctuary animal pest eradication monitoring report #1. Auckland Council, Auckland, New Zealand. 69 p.

Marchant, S. and Higgins, P.J. (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: raptors to lapwings. Oxford University Press, Melbourne.

Marchant, S. and Higgins, P. J. (eds) (1990). Handbook of Australian, New Zealand and Antarctic Birds. Volume 1: Ratites to Ducks. Oxford University Press, Melbourne.

Marie, A., VanderWerf, E.A., Young, L.C., Smith, D.G., Eijzenga, J., and Lohr, M.T. (2014) Response of wedge-tailed shearwaters (*Puffinus pacificus*) to eradication of black rats (*Rattus rattus*) from Moku'auia Island after reinvasion. *Pacific Science* 68(4), 547-553.

McCreless, E., Huff, D., Croll, D., Tershy, B., Spatz, D., Holmes, N., Butchart, S., and Wilcox, C. (2016). Past and estimated future impact of invasive alien mammals on insular threatened vertebrate populations. Nature Communications. 7:12488 doi: 10.1038/ncomms12488.

Marie, A., VanderWerf, E.A., Young, L.C., Smith, D.G., Eijzenga, J., and Lohr, M.T. (2014) Response of wedge-tailed shearwaters (*Puffinus pacificus*) to eradication of black rats (*Rattus rattus*) from Moku'auia Island after reinvasion. *Pacific Science* 68(4), 547-553.

Marris, J. W. M. (2000). The beetle (Coleoptera) fauna of the Antipodes Islands, with comments on the impact of mice: and an annotated checklist of the insect and arachnid fauna. *Journal of the Royal Society of New Zealand* **30**, 169-195.

Masuda BM, Fisher P, Beaven B. (2015). Residue profiles of Brodifacoum in coastal marine species following an island rodent eradication. *Ecotoxicology and Environmental Safety* **113**: 1-8

McAllan, I.A.W., Curtis, B.R., Hutton, I. and Cooper, R.M. (2004). The birds of the Lord Howe Island Group: a review of records. *Australian Filed Ornithology* **21** (Supplement**)**, 1-82.

Merton, D. (1987). Eradication of rabbits from Round Island, Mauritius: a conservation success story. *Dodo* **24**, 19-43.

Merton, D., Climo, G., Laboudallon, V., Robert, S. and Mander, C. (2002). Alien mammal eradication and quarantine on inhabited islands in the Seychelles. Pp. 182-198 In *Turning the Tide: the Eradication of Invasive Species* (eds C. R. Veitch and M. N. Clout). IUCN; Gland, Switzerland.

Meyer, J-Y and Butaud, J-F. (2009). The impacts of rats on the endangered native flora of French Polynesia (Pacific Islands): drivers of plant extinction or coup de grace species? *Biological Invasions* **11,** 1569-1585.

Milledge, D. (2010). Research to Inform the Eradication of the Introduced Masked Owl Population on Lord Howe Island. Landmark Ecological Services

Miller, B. and Mullette, K. J. (1985). Rehabilitation of an endangered Australian bird: the Lord Howe Island Woodhen (Sclater). *Biological Conservation* **34**, 55-95.

Moore Jr, H. E. (1966). Palm hunting around the world. IV Lord Howe Island. *Principes* **10**, 12-21.

Moors, P. J. (1985). Eradication campaign against *Rattus norvegicus* on the Noises Islands, New Zealand, using Brodifacoum and 1080. In ' Conservation of Island Birds: Case Studies for the Management of Threatened Island Species. Technical Publication No. 3'. pp. 143-155. (International Council for Bird Preservation: Cambridge.)

Morgan DR, Wright GR, Ogilvie SC. (1996). Assessment of the environmental impact of Brodifacoum during rodent eradication operations in New Zealand. In: Timm RM, Crabb AC eds., University of California, Davis, USA. Pp. 213-218.

Murphy EC, Clapperton BK, Bradfield PMF, Speed HJ. (1998). Brodifacoum residues in target and non-target animals following large scale poison operations in New Zealand podocarp-hardwood forests. *New Zealand Journal of Zoology* 25: 307-314.

NGH Environmental Pty Ltd. (2016) Biodiversity assessment Lord Howe Island Hybrid Renewable Energy Project Stage 2: Wind Turbines. Unpublished report for the Lord Howe Island Board.

NRMMC, (2010). Australia's Biodiversity Conservation Strategy 2010-2030. Natural Resource Management Ministerial Council. Australian Government, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

NSW Marine Parks Authority (2010a). Lord Howe Island Marine Park: zoning plan review report

NSW Marine Parks Authority (2010b). Natural Values of Lord Howe Island Marine Park

National Parks and Wildlife Service. (2001). Lord Howe *Placostylus Placostylus bivaricosus* (Gaskoin, 1855) Recovery Plan. NSW National Parks and Wildlife Service: Hurstville, NSW.

NSW National Parks and Wildlife Service (2002). *Approved Recovery Plan for the Lord Howe Woodhen*. NSW National Parks and Wildlife Service, Hurstville NSW.

Nevill, J. (2004). Eco-tourism as a source of funding to control invasive species: The case of the Seychelles. *International Journal of Island Affairs*. **February,** 99 – 102.

Newman, D. G. (1994). Effects of a mouse, Mus musculus, eradication program and habitat change on a lizard population on Mana Island, New Zealand, with special reference to McGregor's skink, Cyclodina macgregori. *New Zealand Journal of Zoology* **21**, 443-456.

North, S.G., Bullock, D.J., Dulloo, M.E. (1994). Changes in vegetation and reptile populations on Round Island, Mauritius, following eradication of rabbits. *Biological Conservation* **67**, 21-28.

O'Dwyer, T., Carlile, N., Portelli, D., Wheeler, R and Wilkinson, I (2016). Testing the efficacy of brodifacoum to kill House Mice *Mus musculus* on Lord Howe Island. Unpublished Report prepared for the Lord Howe Island Board. Office of Environment and Heritage, NSW. Produced in May 2016.

Ogilvie, S. C., Pierce, R. J., Wright, G. R. G., Booth, L. H. and Eason, C. T. (1997). Brodifacoum residue analysis in water, soil, invertebrates, and birds after rat eradication on Lady Alice Island. *New Zealand Journal of Ecology* **21**, 195-197.

Onley, D. and Scofield, P. (2007). *Albatrosses, Petrels, and Shearwaters of the World*. Princeton: Princeton University Press

(Pain, D.J., Brooke, M.D., Finnie, J.K. and Jackson, A. (2000). Affects of Brodifacoum on the land crab of Ascension Island. *Journal of Wildlife Management* **64**: 380-387.)

Palmer, R. (2014). Eradication of the Pacific Rat (Rattus exulans) from Adele Island Nature Reserve, Western Australia APVMA permit number – PER13966. Unpublished report. Department of Parks and Wildlife, Western Australia.

Parkes, J., Ruscoe, W., Fisher, P. and Thomas, B. (2004). Benefits, constraints, risks and costs of rodent control options on Lord Howe Island. Unpublished report to the Lord Howe Island Board. Landcare Research, Lincoln, New Zealand.

Pickard, J. (1983). Vegetation of Lord Howe Island. *Cunninghamii* **1,** 133-265.

Pierce, R. and Brown, D. (2011). Summary of restoration work undertaken on the Phoenix Islands Atolls, Kiribati in July 2011. Eco Oceania Pty Ltd Report for Government of Kiribati, CI - CEPF, and Packard Foundation.

Pierce, R., Anterea, N., Anterea, U., Broome, K., Browns, D., Cooper, L., Edmonds, H., Muckle, F., Nagle, B., Oakes, G., Thorsen, M. and Wragg, G. (2008). Operational work undertaken to eradicate rats and rabbits in the Phoenix Islands, Kiribati, May-June 2008. Pacific Expeditions Ltd report for Government of Kiribati, NZ Department of Conservation, NZAID and Pacific Invasives Initiative.

Pitt WC, Berentsen AR, Volker SF, Eisemann JD. (2012). Palmyra Rainforest Restoration Project: Monitoring Results for the Application of Broadcast of Brodifacoum 25W. USDA, APHIS, National Wildlife Research Center, Hilo Hawaii.

Pitt WC, Berentsen AR, Shiels AB, Volker SF, Eisemann JD, Wegmann AS, Howald GR (2015). Non-target species mortality and the measurement of Brodifacoum rodenticide residues after a rat (Rattus rattus) eradication on Palmyra Atoll, tropical Pacific. *Biological Conservation* **185**.

Ponder, W.F. (1997). Conservation status, threats and habitat requirements of Australian terrestrial and freshwater mollusca. *Memoirs of the Museum of Victoria* **56**, 421-430.

Priddel, D., Carlile, N., Humphrey, M., Fellenberg, S. and Hiscox, D. (2003). Rediscovery of the 'extinct' Lord Howe Island stick-insect (*Dryococelus australis* (Montrouzier)) (Phasmatodea) and recommendations for its conservation. *Biodiversity and Conservation* **12**, 1391-1403.

Primus, T., Wright, G. and Fisher, P. (2005). Accidental discharge of Brodifacoum baits in a tidal marine environment: a case study. *Bulletin of Environmental Contamination and Toxicology* **74**, 913–919.

Rance, B. (2001). Titi Islands expedition, March 2001. Unpublished Report RI 6418. Department of Conservation, Invercargill.

Russell, J., Binnie, H., Oh, J., Anderson, D., Samaniego-Herrera, (2016) Optimising eradication confirmation with rapid eradication assessment. (unpublished report)

Russel, J., and Broome, K. (2016) Fifty years of rodent eradications in New Zealand: another decade of advances. *New Zealand Journal of Ecology Volume **40**(2),* 197

Samaniego-Herrera, A., Aguirre-Muñoz, A., Howald, G.R., Félix-Lizárraga, M., Valdez-Villavicencio, J., González-Gómez, R., Méndez-Sánchez, F., Torresgarcía, F., Rodríguez-Malagón, M. and. Tershy, B.R. (2009). Eradication of Black Rats from Farallón de San Ignacio and San Pedro Mártir islands, Gulf of California, Mexico. Pp. 337–347 in *Proceedings of the 7th California Islands Symposium*. (eds C.C. Damiani, and D.K. Garcelon). Institute for Wildlife Studies, Arcata, CA.

Samaniego-Herrera, A., M. Rodríguez Malagón, A. Aguirre Muñoz, R. González Gómez, F. Torres García, M. Latofski Robles, F. Méndez Sánchez, E. Soqui Gómez y N. Silva Estudillo. (2010). Erradicación de rata negra en isla Isabel, México. Reporte Técnico. Grupo de Ecología y Conservación de Islas, A.C., Ensenada, B.C., México.

Saunders, A. and Brown, D. (2001). An Assessment of the Feasibility of Eradicating Rodents from the Lord Howe Island Group. Unpublished report to the Lord Howe Island Board.

Shaw, J. D., Hovenden, M. and Bergstrom, D. M. (2005). The impact of introduced ship rats (*Rattus rattus*) on seedling recruitment and distribution of a subantarctic megaherb (*Pleurophyllum hookeri*). *Austral Ecology* **30**, 118-125.

Shirer, M. (1992). In poison's defence. *Terra Nova* **17**, 3.

Smith, V. R. and Steenkamp, M. (1990). Climatic change and its ecological implications at a subantarctic island. *Oecologia* **85**, 1424.

Springer, K. (2016). Methodology and challenges of a complex multi-species eradication in the sub-Antarctic and immediate effects of invasive species *New Zealand Journal of Ecology* 40(2), 273-278.

Springer, K. and Carmichael, N. (2012). Non-target species management for the Macquarie Island pest eradication project. In: Timm, R. M. (ed.). Proceedings of the 25th Vertebrate Pest Conference, University of California, Davis. Pp. 38–47

Spurr, E.B. and Drew, K.W. (1999). Invertebrates feeding on baits used for vertebrate pest control in New Zealand. *New Zealand Journal of Ecology* **23**, 167-173.

Spurr, E.B. (1996). Environmental effects of rodent Talon baiting. Part II: Impacts on invertebrate populations. *Science for Conservation* **38**. Department of Conservation, Wellington, Pp 12-27)

Taronga Conservation Society Australia, (2014). Captive management for Woodhen and LHI Currawong associated with the Lord Howe Island Rodent Eradication project. An unpublished report for the Lord Howe Island Board.

Taylor, R. H., Kaiser. G.W., and Drever, M.C. (2000) Eradication of Norway Rats for Seabird Recovery Langara Island British Columbia*. Restoration Ecology,* Vol 8 No 2 pp 151-160.

Taylor, R. H. and Thomas, B. W. (1989). Eradication of Norway rats (Rattus norvegicus) from Hawea Island, Fiordland, using Brodifacoum. *New Zealand Journal of Ecology* **12**, 23-32.

Taylor, R. H. and Thomas, B. W. (1993). Rats eradicated from rugged Breaksea Island (170 ha), Fiordland, New Zealand. *Biological Conservation* **65**, 191-198.

Tomlin, C. (2009) The Pesticide Manual: A World Compendium. BCPC

Torr N. (2002). Eradication of rabbits and mice from subantarctic Enderby and Rose Islands. In: Veitch CR, Clout MN eds. Turning the tide: the eradication of invasive species, IUCN SSC Invasive Species Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. Pp. 319-328

Torr, N. and Agnew, D.(2007).Trial to determine differences in bait fragmentation in various spreader bucket designs used during aerial application of toxic bait. Department of Conservation, New Zealand Government. February 2007.

Towns, D.R. (1991). Response of lizard assemblages in the Mercury Islands, New Zealand, to removal of an introduced rodent: the kiore (*Rattus exulans*). *Journal of the Royal Society of New Zealand* **21**, 119-136.

Towns, D.R. (1994). The role of ecological restoration in the conservation of Whitaker's skink (*Cyclodina whitakeri*), a rare New Zealand lizard (Lacertilia: Scincidae). *New Zealand Journal of Zoology* **21**, 457-471.

Towns, D. R. and Broome, K. G. (2003). From small Maria to massive Campbell: forty years of rat eradications from New Zealand islands. *New Zealand Journal of Zoology* **30**, 377-398.

Towns, R. T., Atkinson, I. A. E. and Daugherty, C. H. (2006). Have the harmful effects of introduced rats on islands been exaggerated? *Biological Invasions* **8**, 863-891

Toxikos (2010). Human Health Risk Assessment for the use of Brodifacoum for the Lord Howe Island Rodent Eradication Plan. Unpublished Report for the Lord Howe Island Board. Toxikos Pty Ltd

Traveset, A., Nogales, M., Alcover, J., Delgado, J., Lopez-Darias, M., Godoy, D., Igual, J., and Bover, P. (2009). A review on the effects of alien rodents in the Balearic (Western Mediterranean Sea) and Canary Islands (Eastern Atlantic Ocean). *Biological Invasions* **11,** 1653-1670.

TSSC (2006) Commonwealth Listing Advice on Predation by exotic rats on Australian offshore islands of less than 1000 km2 (100,000 ha). Threatened Species Scientific Committee. Australian Government Department of the Environment

TSSC, (2013). Guidelines for Nominating and Assessing the Eligibility for Listing of Ecological Communities as Threatened according to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *EPBC Regulations 2000* (EPBC Regulations). Threatened Species Scientific Committee. Australian Government Department of the Environment

TSSC, (2014). Guidelines for assessing the conservation status of native species according to the Environment Protection and Biodiversity Conservation Act 1999 and Environment Protection and Biodiversity Conservation Regulations 2000. Threatened Species Scientific Committee. Australian Government Department of the Environment

UNESCO. (2016) Lord Howe Island Group - Outstanding Universal Value. Accessed April 2016. http://whc.unesco.org/en/list/186

UNESCO. (2009) World Heritage in Danger Compendium II - A compendium of key decisions on the conservation of cultural heritage properties on the UNESCO List of World Heritage in Danger

U.S. Environmental Protection Agency. (1998). Reregistration Eligibility Decision (RED): Rodenticide Cluster. EPA 738-R-98-007. 319 pp.

U.S. Fish and Wildlife Service and Hawai'i Department of Land and Natural Resources. (2008). Final supplemental environmental assessment Lehua Island ecosystem restoration project October 2008. Honolulu, Hawaii

Vercauteren K, Pipas, M., and Bourassa, J. (2002). A camera and hook system for viewing and retrieving rodent carcasses from burrows. *Wildlife Society Bulletin*, 2002, 30 (4):1057-1061

Vestena C, Walker A. (2010). Ipipiri Rodent Eradication 2009 Post Operational Monitoring Report. Unpublished, Docdm-483696 Bay of Islands Area Office, Department of Conservation, Kerikeri

Walker, C.S.; Shetty, R.P.; Kazuko, S.G.; Letsou, A.; Olivera, B.M.; P.K., Bandyopadhyay. 2001: On a potential global route for vitamin K-dependent carboxylation in animal systems - evidence for glutamyl carboxylase in *Drosophila. Journal of Biological Chemistry 276*: 7769-7774.

Warham, J. (1990). The Petrels: Their ecology and breeding systems. Academic Press: London.

Wedding CJ. (2007). Aspects of the Impacts of Mouse (Mus musculus) Control on Skinks in Auckland, New Zealand. Unpublished MSc thesis. Massey University, Auckland. 133 p.

Weeks A. R., Sgro C. M., Young A. G., Frankham R., Mitchell N. J., Miller K. A., Byrne M., Coates D. J., Eldridge M. D. B., Sunnucks P., Breed M. F., James E. A. and Hoffman A. A. (2011) Assessing the benefits and risks of translocations in changing environments: a genetic perspective. *Evolutionary Applications* **4**, 709-25.

Wegmann, A., E. Flint, S. White, M. Fox, G. Howald, P. McClelland, A. Alifano, and R. Griffiths. 2012. Pushing the envelope in paradise: A novel approach to rat eradication at Palmyra Atoll. *Proc. Vertebr. Pest Conf*. 25:48-53.

Wheeler, R. and Carlile, N. (2013). Testing for Brodifacoum resistance in invasive rodents on Lord Howe Island: Summary of Work Undertaken by the Office of Environment and Heritage in 2013. Unpublished report for the Lord Howe Island Board

Wilkinson, I .and Hutton, I. (2013). Assessing the risk of Pestoff® 20R Brodifacoum baits to the Lord Howe Island flax snail (*Placostylus bivaricosus*). Unpublished Report for the Lord Howe Island Board

Wright, G.R. and Eason, C.T. (1991). Residue analysis of invertebrate samples for Brodifacoum (Talon). Forest Research Institute contract report, FWE 91/94)

Wright, G., Booth, L., Morriss, G., Potts, M., Brown, L. and Eason, C. (2002) Assessing potential environmental contamination from compound 1080 (sodium monofluoroacetate) in bait dust during possum control operations, *New Zealand Journal of Agricultural Research*, **45**:1, 57-65.

WHO (1995). Anticoagulant rodenticides. International Programme on Chemical Safety. Environmental Health Criteria 175. World Health Organisation, Geneva, Switzerland.

14 Appendices

Appendix A – Guidelines for the Content of the Draft Public Environment Report

Appendix B – Guidelines Cross Reference

Appendix C – Author Names and Qualifications

Appendix D – LHI Trials Package

Appendix E – Captive Management Package

Appendix F – Non-target Impact Management Plan

Appendix G – Masked Owl Package

Appendix H – Biodiversity Benefits Monitoring Package

Appendix I – Marine Hypothetical Scenario

Appendix J – Stakeholder Engagement Package

Appendix K – Human Health Package

Appendix L – LHI Ecological Studies Summary

Appendix M – Island Eradications Using Pestoff

Appendix N – Land Snail Survey 2016

Appendix O – Economic Evaluation

Appendix P – Submissions Report

EPBC Ref: 2016/7703

Ms Penny Holloway
Chief Executive Officer
Lord Howe Island Board
PO Box 5
LORD HOWE ISLAND NSW 2898

Dear Ms Holloway

Invitation to comment on proposed approval decision
Lord Howe Island Rodent Eradication Project, NSW

I am writing to you in relation to your proposal to eradicate introduced rodents on Lord Howe Island and its associated islands and rocky islets and to capture and house Lord Howe Woodhens (*Gallirallus sylvestris*) and Lord Howe Island Currawongs (*Strepera graculina crissali*). The Proposed Action was referred and assessed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for its impacts on:

- World Heritage properties (sections 12 & 15A)
- National Heritage places (sections 15B & 15C)
- Listed threatened species and communities (sections 18 & 18A)
- Listed migratory species (sections 20 & 20A)

I am proposing to approve the Proposed Action subject to conditions.

My proposed decision of approval is attached. In accordance with the EPBC Act, I invite you to provide comments on my proposed decision of approval, including the conditions which I propose to attach, within 10 business days of the date of this letter.

Please quote the title of the action and EPBC reference, as shown at the beginning of this letter, in any correspondence. You can send comments to:

by letter s22
Assessments (NSW, ACT) and Fuel Branch
Department of the Environment and Energy
GPO Box 787
CANBERRA ACT 2601

by email s22

If you have any questions about this decision, please contact the project manager, s22, by email to s22 t.gov.au, or telephone s22 and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely

Kim Farrant
Assistant Secretary
Assessments (NSW, ACT) and Fuel Branch
3 August 2017

Australian Government
Department of the Environment and Energy

Approval

Lord Howe Island Rodent Eradication Project, NSW (EPBC 2016/7703)

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*.

Proposed action

person to whom the approval is granted	Lord Howe Island Board
proponent's ABCN (if applicable)	~~ABN:~~ 33 280 968 043
proposed action	To eradicate introduced rodents on Lord Howe Island and its associated islands and rocky islets and to capture and house Lord Howe Woodhens (*Gallirallus sylvestris*) and Lord Howe Island Currawongs (*Strepera graculina crissali*) ~~during the eradication period~~ (see EPBC Act referral 2016/7703).

Approval decision

Controlling Provision	Decision
World Heritage properties (sections 12 & 15A)	Approved
National Heritage places (sections 15B & 15C)	Approved
Listed threatened species and communities (sections 18 & 18A)	Approved
Listed migratory species (sections 20 & 20A)	Approved

conditions of approval

This approval is subject to the conditions specified below.

expiry date of approval

This approval has effect until 31 December 2022.

Decision-maker

name and position	Kim Farrant Assistant Secretary Assessments (NSW, ACT) and Fuel Branch
signature	DO NOT SIGN
date of decision	DO NOT DATE

Conditions attached to the approval

1. To avoid and minimise impacts on the **Lord Howe Island World Heritage Area and National Heritage place** (as identified at Schedule 1) and listed threatened species and communities and listed migratory species, the action must be undertaken in accordance with the final Lord Howe *Island Rodent Eradication Public Environment Report* dated 10 February 2017.

2. To avoid, minimise and mitigate impacts from the aerial baiting on **non-target species** and the World Heritage values of the **Lord Howe Island Group**.

(a) aerial baiting can only be undertaken between 1 June 2018 and 30 August 2018 or 1 June 2019 and 30 August 2019;

(b) aerial baiting in the southern mountains must not occur after midday each baiting day to minimise the ~~possibility~~ risk of helicopters colliding with Providence Petrels and Masked Boobies;

(c) during aerial baiting, **observers** must be at a location with clear line of sight to the Providence Petrel and Masked Booby breeding grounds (as identified at Schedule 2). Trained **observers** must also be located ~~in a boat to have visibility of the southern face of Mount Gower relative to helicopter movements. The~~ **observers** within the boat observation zone (as identified at Schedule 2) and must provide commentary to the helicopter pilot via radio regarding **unusual behaviour** of Petrels and Boobies to supplement the pilot's observations;

(d) should either species display **unusual behaviour** or become agitated during baiting flights, the pilot must take action to minimise impacts on Providence Petrels and Masked Boobies;

(e) aerial baiting in the vicinity of the Providence Petrel and Masked Booby breeding grounds must be undertaken at a bait dispersal altitude that minimises **unusual behaviour** by Providence Petrels and Masked Boobies;

Commented [GH1]: The conditions don't restrict the baiting to any particular pesticide (unless there is a clear recommendation in the report cited in Condition 1). There should be a sub-condition under condition 2 that states that aerial baiting must use brodifacoum along with other bait details, e.g. colour, matrix.

Commented [GH2]: What action could be taken? Perhaps increase altitude, but this is covered under 2(e). It is too vague at present and reads as: To minimise impacts, is unusual behaviour is observed, the pilot must take action to minimise impacts.

Commented [OC3R2]: Action needs to be defined

Commented [GH4]: This is not realy enforcebale unless a specific height is specified. If the height is not presently known then the conditions should specify that this be determined.

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(f) handling, transport, clean-up and disposal of the pesticide **Brodifacoum** must be undertaken in accordance with the Pestoff 20R label requirements and the Australian Pesticides and Veterinary Medicines Authority minor use permit.

Commented [OC5]: If this is already regulated under the APVMA Permit; do we need to condition it as well?

3. Within one month of the date of this approval, the person taking the action must submit to the **Department** draft terms of reference for the **Minister's** approval for the establishment of a **Technical Advisory Group (TAG).**

Baiting must not commence until ~~T~~the membership of the **TAG** ~~is~~must be approved by the **Department.** The TAG and must consist of at least five members. The members must include, but not be limited to, an environmental toxicologist, human toxicologist, a pelagic bird expert and an island ecologist each with relevant tertiary qualifications and suitable experience in their field of expertise.

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Commented [OC6]: This is conditioning the Department… Would suggest changing it to 'cannot commence baiting until approved by the Department' or such.

Commented [GH7]: Four experts noted in the next sentence. Any requirements for the 5th member?

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The TAG will provide technical advice to the **Rodent Eradication Steering Committee** and be responsible for providing advice and recommendations for the development and implementation of the Monitoring and Mitigation Plan required at Condition 4.

4. To minimise impacts from aerial baiting on **non-target species**, the person taking the action must establish a **Monitoring and Mitigation Plan** based on advice from the **Technical Advisory Group**. The **Monitoring and Mitigation Plan** must be approved by the **Department** prior to **commencement** of aerial baiting on the **Lord Howe Island Group**. The **Monitoring and Mitigation Plan** must:

Commented [OC8]: As above

(a) Describe a strategy to monitor for the presence of **target species** on **rocky islets** prior to commencing aerial baiting (detailed at Condition 7).

(b) provide for the monitoring of mortality and cause of death of **non-target species**, for a period of at least 4 months after the **commencement** of aerial baiting.

(c) establish a **Mitigation Team** Manager responsible for collection of qualitative and quantitative information on **non-target species** mortality, documenting and reporting this information and using this information to coordinate and adapt carcass search and removal operations. The **Mitigation Team** Manager must provide weekly reports to the **Department** and the **Technical Advisory Group** regarding **non-target species** mortality and efficacy of carcass search and removal operations. More regular reports must be provided if requested by the **Technical Advisory Group**. The **Mitigation Team** Manager must continuously undertake these tasks for a period of at least 4 months after the **commencement** of aerial baiting.

Commented [OC9]: Are we needing to read these? This is a fairly onerous requirement. Would suggest that issues are reported to the Department only on an exceptional basis I.e. in the event that something goes wrong and requires our attention.

(d) include protocols and impact thresholds to stop any further baiting where the **TAG** determines that unacceptable impacts on **non-target species** are observed between the first and second aerial baiting events.

(e) include protocols to ensure systematic, targeted and effective carcass search, collection and disposal in the vicinity of the **Settlement** and other accessible areas; (to avoid secondary poisoning of **non-target species**, but recognising that ~~Masked Owl~~ eradication depends on sufficient carcasses remaining uncollected) and specify appropriate resourcing.

Commented [GH10]: Rodent carcass searched should also be timely. Rodents can rapidly consume multiple lethal doses of brodifacoum and become 'supertoxic'. The protocol should provide detail on the conflicting priorities of reducing the risk of secondary poisoning and ensuring adequate doses for owls, particularly if owl habitat overlap habitat for species likely to be at risk of secondary poisoning.

(f) include clear contingency planning and adaptive management measures where mortality of **non-target species** is recorded, with the aim of reducing further mortalities.

(g) provide for ongoing whole-of-island census, and breeding success monitoring of Lord Howe Woodhens, Lord Howe Island Currawongs, Providence Petrel and Masked Booby populations for a period of at least 5 years following completion of aerial baiting with

particular focus on Lord Howe Woodhens and Lord Howe Island Currawongs following release from captivity.

A report summarising the monitoring results collected on **non-target species** mortality in accordance with Condition 4(b&c) must be provided to the **Department** within 5 months following the completion of aerial baiting.

The results of the whole-of-island census and breeding success monitoring conducted in accordance with Condition 4(g) must be provided to the **Department** annually until otherwise advised.

5. To ensure the success of the rodent eradication program. The person taking the action must establish a rodent detection team. Following the decay or removal of rodent carcasses, and no more than 30 days after the second baiting event, the rodent detection team must initiate intensive rodent detection activities across the entire **Lord Howe Island Group** to identify and kill remaining **target species**, as detailed in section 2.6 Rodent Detection Monitoring in the **PER**.

   To avoid and mitigate impacts from rodent detection operations on **non-target species** and the environment of **Lord Howe Island Group**:
   (a) all detecting team members must be trained in the location of the colonies of EPBC Act listed bird species and methods for minimising impacts on these colonies, vegetation and soils;
   (b) all dogs used to aid detection of rodent species on the **Lord Howe Island Group** must have previously undergone project-specific training and be currently accredited by the Canine Detection Certification Council after passing the Council's practical accreditation test, prior to detection operations starting;
   (c) each handler must have a Statement of Attainment in Dog Training from the Certificate IV, Companion Animal Care and Management Course (ACM40310) from TAFE NSW or equivalent as approved in advance by the **Department**.
   (d) when rodents are detected appropriate action must be taken to ensure rodents are eradicated at that location.
   (e) rodent detection using dogs must begin 30 days after the last aerial baiting event and occur continuously across the island until no rodents are detected.

6. The person taking the action must submit an **integrated quarantine/biosecurity management plan** for the airport and shipping port to prevent the reintroduction of rodents to the **Lord Howe Island Group** for the **Minister's** approval, prior to **commencement** of the action. ~~, an **integrated quarantine/biosecurity management plan** for the airport and shipping port to prevent the reintroduction of rodents to the **Lord Howe Island Group**.~~

   The plan ~~should~~ must prescribe quarantine/biosecurity management protocols regarding visiting yachts, cruise ships, other vessels and shipwrecks and maintaining rodent free status on islets including the long-term use of rodent detection dogs.

   In developing and implementing the plan the person taking the action must seek and act on advice and recommendations from an independent biosecurity expert.

7. The person taking the action must ascertain if rodents are present on the **rocky islets** and small islands in the **Lord Howe Island Group** prior to **commencement** of the action.

   The results of these surveys are to be provided to the **Department** prior to commencement of the action. ~~within 10 days of their completion.~~

Commented [GH11]: Perhaps an additional sub-condition to specify that woodhens and currawongs will be housed separately during the baiting period or whatever the time period is, and why they are housed; Is it for the protection of these species from primary poisoning (secondary for currawong)?

Commented [OC12]: What is 'appropriate'?

Commented [GH13]: Will dogs be used to detect remaining rodents, or also kill them? If alternative strategies are used (fumigation?) will the potential impact on non-target species be considered?

Commented [OC14]: Is this timeframe necessary? Or can we just leave it at prior to the commencement of the action?

Aerial baiting must only take place on those rocky islets and small islands where these surveys identify the presence of rodents.

Commented [OC15]: It seems like these are baselines surveys – if so would suggest moving them up to the front of the notice.

8. The person taking the action must ensure that rodent baiting is conducted on all properties on LHI.

Commented [OC16]: Is this appropriate for us to condition?

9. Within 30 days after the **commencement** of the action, the person taking the action must advise the **Department** in writing of the actual date of **commencement**.

10. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement plans required by this approval, and make them available upon request to the **Department**. Such records may be subject to audit by the **Department** or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the **Department's** website. The results of audits may also be publicised through the general media.

11. Upon the direction of the **Minister**, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the **Minister**. The independent auditor must be approved by the **Minister** prior to the commencement of the audit. Audit criteria must be agreed to by the **Minister** and the audit report must address the criteria to the satisfaction of the **Minister**.

12. If, any time after 5 years from the date of this approval, the person taking the action has not substantially commenced the action, then the person taking the action must not substantially commence the action without the written agreement of the **Minister**.

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13. ACR?

~~12.~~14. Publish plans and reports?

Definitions

Brodifacoum baits means either 5.5 mm or 10 mm cereal-based bait pellets of Pestoff 20R containing 0.02g/kg (20 parts per million) of the toxin Brodifacoum.

Commencement (where bolded in the text) means the commencement of the aerial distribution of Brodifacoum baits across the LHIG using helicopters.

Department means the Australian Government Department responsible for administering the *Environment Protection and Biodiversity Conservation Act 1999*.

Lord Howe Island World Heritage Area and National Heritage place means the area identified at Schedule 1 of the approval.

Integrated quarantine/biosecurity management plan means a quarantine/biosecurity management plan for the airport and wharf to prevent the reintroduction of rodents should the rodent eradication be successful.

Lord Howe Island Group means Lord Howe Island and its associated islands and **rocky islets** (excluding Balls Pyramid).

Minister means the Australian Government Minister responsible for administering the *Environment Protection and Biodiversity Conservation Act 1999*.

Mitigation Team means the team, including the **Mitigation Team** Manager, responsible for implementing relevant mitigation and monitoring activities on LHI under the **Monitoring and Mitigation Plan.**

Monitoring and Mitigation Plan means the plan to be prepared by the proponent that will guide mitigation and monitoring activities on the **Lord Howe Island Group** with the aim of minimising **non-target species** mortality from the aerial baiting as well as monitoring **non-target species** mortality, impacts on populations and population responses.

Non-target species means native flora and fauna species on the **Lord Howe Island Group**.

Observers means bird experts approved by the Lord Howe Island Board (LHIB) as being suitably qualified and/or experienced to observe and interpret the response of birds to the helicopter baiting flights.

PER means the final Public Environment Report dated 21 December 2016.

Rocky islets means any body of land of the **Lord Howe Island Group** excluding Lord Howe Island and Balls Pyramid that has permanent land above the mean high water mark and that can be safely accessed by a suitably trained person (boat or helicopter) for the purpose of setting and retrieving presence and absence monitoring equipment for **target species**.

Rodent Eradication Steering Committee means the Rodent Eradication Steering Committee established in October 2012, consisting of one representative from each of the following organisations, the Commonwealth Department of the Environment and Energy and the NSW Office of Environment and Heritage. The CEO of the ~~Lord Howe Island Board (~~LHIB~~)~~, an elected LHIB member and a rodent eradication expert.

Settlement means the area identified at Schedule 1 as the Settlement.

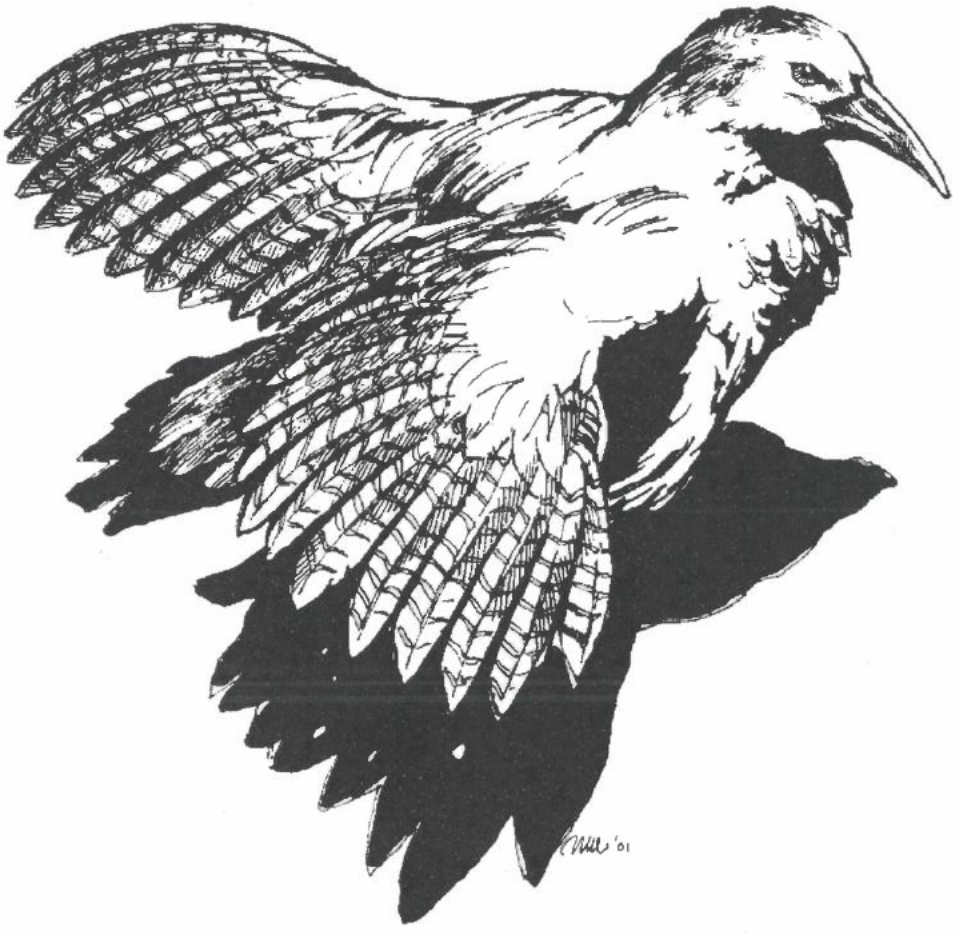
Target species means *Rattus rattus*, *Mus musculus* and *Tyto novaehollandiae castanops* (the Masked Owl Tasmanian population).

Technical Advisory Group means a group of experts with operational and ecological experience, independent of the person taking the action to provide advice and recommendations on the mitigation and monitoring of **non-target species** mortality and recovery.

Unusual behaviour in relation to Providence Petrels and Masked Boobies means abnormal behaviour relative to an agreed baseline as defined by the pelagic seabird expert on the **Technical Advisory Group**.

Approved NSW & National Recovery Plan

Recovery Plan for the Lord Howe Woodhen (*Gallirallus sylvestris*)



NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

NSW National Parks and Wildlife Service
43 Bridge Street
(PO Box 1967)
Hurstville NSW 2220
Tel: 02 95856444
www.npws.nsw.gov.au

Requests for information or comments regarding the recovery program for Lord Howe Woodhen are best directed to:

The Lord Howe Woodhen Recovery Coordinator
Threatened Species Unit, Northern Directorate
NSW National Parks and Wildlife Service
Locked Bag 914 Coffs Harbour NSW 2450
Tel 02 66515946

Cover illustration: Margaret Murray

This plan should be cited as follows:
NSW National Parks and Wildlife Service (2002). *Approved Recovery Plan for the Lord Howe Woodhen*. NSW National Parks and Wildlife Service, Hurstville NSW.