Photo 13: Approximately 70m from gate viewing east into Banksia Woodland in 2013

The Banksia woodland in the immediate vicinity of the track was previously heavily infested with Bitou. Major works funded by the proponent in this area has eliminated the main infestation and significantly opened up this community. The dead vegetation on the right is the remains of a Lantana infestation.

Follow-up treatment is required to prevent re-infestation and dense infill planting to create a buffer to maritime stresses on the Littoral Rainforest behind this community. Exotic grasses and common pastoral weeds are now the main weed in this area.

Photo 14: View east down to and west from beach access approximately 70m from gate in 2015.

Photo 15: View east down to beach access approximately 75m from gate in 2013.

The open nature of the vegetation at the beach access point allows deep penetration of maritime stresses, hence infill planting here will also add to the buffer zone to the Littoral Rainforest. This area was formerly heavily infested with Bitou.

Photo 16: View east down to beach access approximately 75m from gate in 2015.

Photo 17: View west of existing beach access from the beach in 2013

Active beach erosion processes will require an access design that can cope with a variable berm, as shown in the photo.

Weed cover is low in this area due to extensive Bitou control by Landcare along the Reserve (note dead plants). The proponent has funded planting of *Casuarina equisetifolia* on the berm to enhance stabilisation at and adjacent to the access exit (indicated by arrows).

Photo 18: View west of existing beach access from the beach in 2015

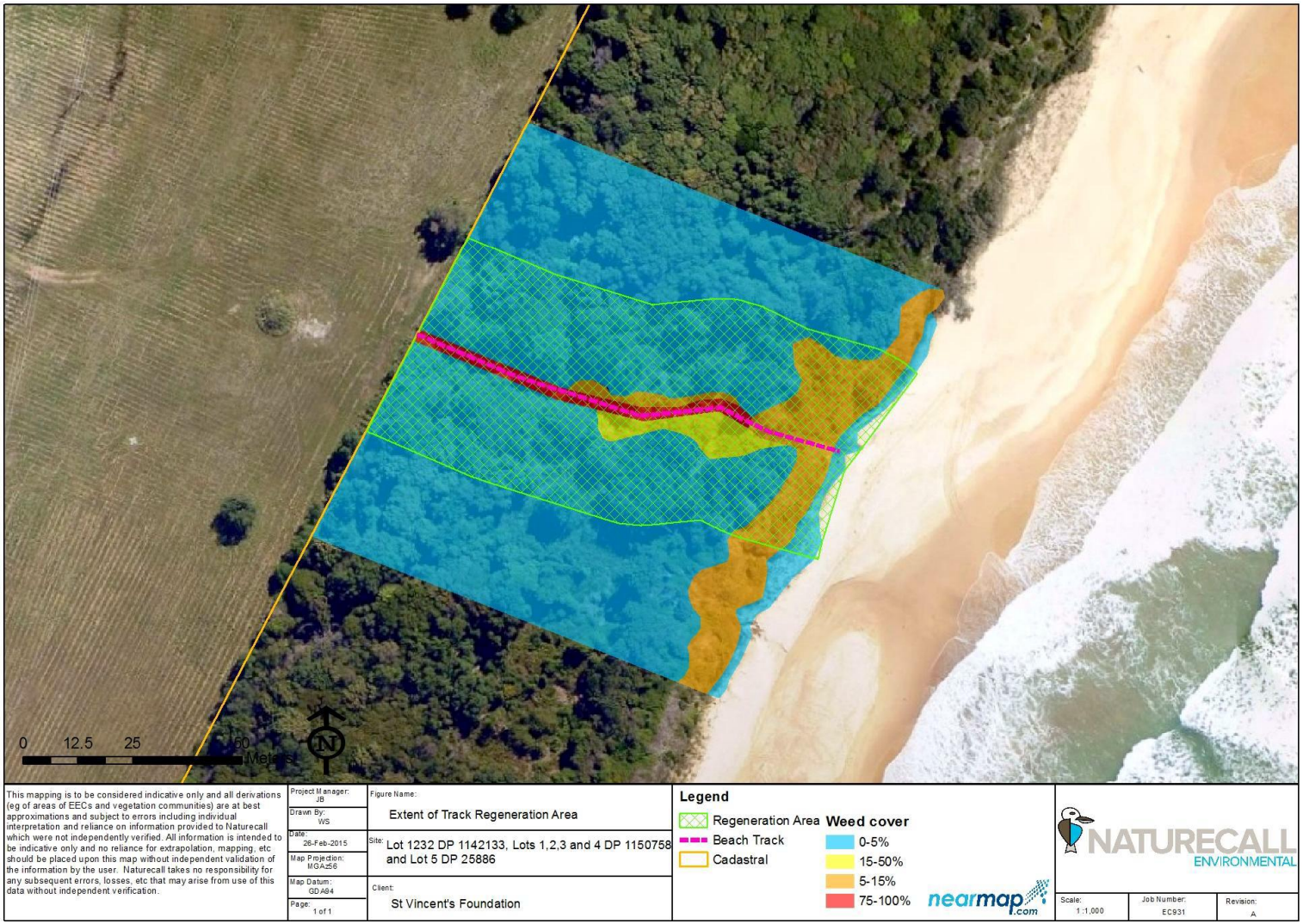
10.2.2. Results and Discussion

Figure 10 reflects the above series of photos, i.e. the highest density of weeds is now only along the edges of the track itself. This is due to the fact that previously severe weed infestations adjacent to the track have been largely removed by works undertaken by both Landcare and a bush regenerator funded by the proponent. This has significantly opened up the forest edges (especially the Banksia woodland) and created some canopy gaps as shown by the area mapped as yellow. These areas were previously highly infested with Bitou Bush and Lantana, and occur on or just behind the foredune (pers. obs.). Weeds in these areas are now primarily young plants regenerating from seed stock and pending follow-up treatment. Plantings of native tree species have been made to infill these gaps.

This Figure and the photos illustrates that the immediate sections of forest adjacent to the track are the most vulnerable to re-invasion and hence dominance by weeds (e.g. due to greater access to solar radiation and less competition with native plants), and hence require the most intensive level of treatment. In general, the forest beyond this area is in very good condition following bush regeneration over several years, and limited active treatment is needed (eg follow-up weeding and infill planting). The remainder of the Reserve is under ongoing management by Landcare and, as detailed in the following table, is not likely to be significantly affected by the formalisation of the track.

Hence the nominated vegetation management area for the purposes of Concept Approval Condition C23 is considered sufficient to be 25m north and south of the track, with works aiming to effectively enclose the track within closed forest to buffer effects associated with the track's formalisation (see Section 12.

Figure 10: Weed mapping within 50m of the beach access and recommended treatment zone



11.0 Threats Associated with formalising the beach access

Table 10 reviews and assesses the threats associated with formalising the existing access.

Table 10: Potential threats/impacts associated with the formalisation of the beach access

THREAT/IMPACTS	LITERATURE REVIEW	CURRENT THREAT STATUS	FUTURE THREAT STATUS/MITIGATION
Direct Clearing	Littoral Rainforest is listed as an EEC at the NSW and Federal level. ERM (1996) reviewed aerial photos of the area between Bonny Hills and Lake Cathie, documenting the contraction of native vegetation to the west. Sand mining is also known to have occurred north of Bonny Hills and most of the vegetation east of the site indicates this, as well as the modified dune topography.	A current beach access exists forming a break between the main local occurrence of Littoral Rainforest to the north and a patchy distribution of recovering Littoral Rainforest to the south within the remainder of the Crown Reserve adjacent to Lot 5.	The existing beach access is simply proposed to be formalised via implementing fencing and soil protection measures and signage. Route will follow existing track hence no new track created. No other clearing or intrusion into the Crown Land proposed.
Weed Invasion	Bitou Bush is the main weed threat to Littoral Rainforest due to its ability to penetrate closed canopies and overwhelm existing communities as well as out-compete native regrowth (Buchanan 1989, ERM 1996, NSWSC 1999, Hamilton *et al* 2008). Lantana is also a threat as it dominates the edges and suppresses establishment of native species (ERM 1996, Lamb 1982, NSWSC 2006a). Other weeds, such as Winter Senna, also compete with native species especially at the edge. Disturbance of soil provides the opportunity for weed invasion. Weeds may also be transported into Littoral Rainforest via informal tracks made by people, as well as grazing stock, e.g. cattle and horses.	Bitou Bush previously heavily infested the foredune but has all but been eliminated by recent bush regeneration work and is no longer a key threat. This and also previously dense Lantana infestations south of the beach access was hampering regeneration/succession in the Banksia woodland by rainforest species via smothering rainforest regeneration and development of protective shrubland to the east. This heavy infestation was removed over the last few years by works partially funded by the proponent and with replanting works also undertaken to close the gaps. Ongoing works aim to eliminate the weed from regeneration area	Limited soil disturbance is likely to occur during the formalisation of the walking track and this will be limited to the footprint of the track, hence no new habitat for weeds will be created. Sand may overlay footing at the beach end but will be too dry and heavily trafficked to support weeds. Current weed infestations on the edge of track boundary with the Crown Land vegetation from the beach front to the site will be removed and replaced with native species to form a closed edge and encourage the continuation of ecological processes and re-development of rainforest vegetation.

THREAT/IMPACTS	LITERATURE REVIEW	CURRENT THREAT STATUS	FUTURE THREAT STATUS/MITIGATION
	Dumping of green wastes may also introduce plant propagules or introduce nutrients which advantage such species (ERM 1996, Buchanan 1989). Some ornamental plants also have the potential to escape and become weeds (Bennet *et al* 2000), though restrictions on the sale of such plants under the *Noxious Weeds Act 1993* reduce this threat.	and establish a closed edge and close canopy gaps. Lantana formerly dominated a large patch on the immediately southern side of the beach access and lined most of the beach access track. Again this was removed by recent bush regeneration works and now only occurs as small plants awaiting removal in the next round of works. Winter Senna (*Senna pendula*) occurs sporadically mostly along the southern edge of the track in the canopy gaps in the rainforest and sporadically under the mosaic of rainforest, Banksia woodland and tall *Leptospermum* spp. shrubland which constitutes the dune vegetation south of the beach access. This weed is also being targeted for removal as part of ongoing bush regeneration works. Other problem weeds such as Coastal Morning Glory (*Ipomoea cairica)*, Morning Glory (*I. indica*) and Turkey Rhubarb (*Acetosa sagittata*) are also present in low abundance and are being progressively removed. Pasture grasses (e.g. Rhodes Grass) and weeds (e.g. Crofton Weed) dominate the beach access. A few Native Tobacco also occur. These will also be eliminated by the formalisation of the track and ongoing regeneration works.	Development envelope on Lot 5 centred on pasture with positive impact of removing primary invasive weed source and mowing to form lawns will minimise propagule production and dispersal. Setback of any dwelling from reserve should minimise risk of garden or other significant waste dumping.

THREAT/IMPACTS	LITERATURE REVIEW	CURRENT THREAT STATUS	FUTURE THREAT STATUS/MITIGATION
Fencing	Fences have potential to obstruct the movement of threatened fauna across the subject site. Some threatened fauna can be injured by collision with wire fences, particularly barbed wire, e.g. the Yellow-Bellied Glider, owls and Squirrel Glider have been recorded being injured by barbed wire fences (Lindenmayer 2002, Berrigan 2001c, Woodford 1999).	Eastern boundary of Reserve is currently fenced with strand boundary fence. South of the beach access, the fence is largely overgrown with native species. North of the access, the fence stands out from the forest. This poses a minor (compared to barbed wire) potential injury risk to birds and, perhaps, Microbats at dusk and dawn and at night during times of limited visibility. No fencing along access track.	Fence to be placed along Crown Reserve boundary to act as impediment to human penetration and minimise soil disturbance. Plain wire fencing as used for beach accesses in NSW will be placed along length of beach access and the adjacent forest edge planted with a dense band of Spiny Matrush and *Gahnia* spp. as a deterrent to people from crossing through the fence and making tracks in the regenerating dune vegetation. Plastic coated plain wire will be used to minimise potential threats to fauna and enhance visibility.
Noise and Physical Disturbance	Noise effects on fauna in Australia are relatively poorly studied (Clancy 2001, Berrigan 2001d). Most evidence presented is anecdotal but suggests most fauna have a fair degree of tolerance and adaptation at least to residential noise depending on species, situation, habitat/lifecycle stage affected, habitat significance, etc. Generally as noise is accompanied with a physical disturbance it has a greater negative effect (ERM 1996, Clancy 2001, Radle *undated*).	Background noise dominated by ocean. No proximate roads and limited vehicle and pedestrian activity on beach.	Noise will increase due to: • Public using beach access as primary access to beach. • Establishment of a tourist facility adjacent. • Establishment of carpark. This elevated level of anthropogenic activity may deter use of habitat in close proximity to the beach access by diurnal birds. Limited activity is expected at night (eg fishermen) with consequentially limited impacts.

THREAT/IMPACTS	LITERATURE REVIEW	CURRENT THREAT STATUS	FUTURE THREAT STATUS/MITIGATION
			Planting of dense and closed edge along track is expected to buffer impacts via reducing noise penetration and sight lines.
Erosion and Sedimentation	Sedimentation and erosion impacts can occur at both the construction and establishment phases. Erosion/sedimentation may occur via erosion of fill material and disturbed soils, scouring of exposed soil, earthen banks and habitats adjacent to the development area via directed flow (e.g. stormwater) or where runoff is concentrated.	Local topography is generally flat hence erosion by water flow is a very minor risk. Beach access is highly eroded (gully formation) at eastern end. Requires rehabilitation to prevent penetration by large seas.	Beach access to be completely reconstructed to be erosion resistant, mitigate penetration of maritime stresses and passable when wet (to avoid people detouring through adjacent vegetation to avoid mud and puddles). Fencing along side of beach access and planting of appropriate species (e.g. Spiny-Headed Matrush) will deter creation of informal tracks. Construction adjacent to Crown Land on flat land with all construction activity confined to designated areas to avoid compaction in the vegetated screen areas. Standard erosion and sedimentation controls will also apply.
Introduction of feral/introduced species	Urban and rural developments are often associated with the introduction of non-native species, i.e. rodents, cats and dogs. Cats are significant predators of native species (NSWSC 2000a, Dickman 1996) and domestic dogs are significant threats to species such as the Koala (Wilkes and Snowden 1998, Port Stephens Council 2001, Connell Wagner 2000b, DECC 2009b). Rodents compete with native species but also form component of native species prey (DECC 2009b, Debus 1993). Foxes may also be	Berrigan and Bray (2004) and Parker (2002) have in total surveyed almost all of SEPP 26 #116. Both surveys recorded a high abundance of native species. House Mouse and Black Rat have been detected on the property as well as deer, foxes and wild dogs (Darkheart 2008a). Deer tracks are evident in the rainforest and dune vegetation and control measures implemented. Deer are particularly	Domestic dogs currently allowed on the adjacent beach and local residents may walk their dogs along this beach via the beach access. It is expected these would be required by Council statute to be leashed when entering or leaving the beach. Dogs will be allowed within the residential area to the west and could roam to the beach access. Signage will be provided advising dogs must be leashed and appropriate fines will be issued by PMHC Ordinance Officer.

THREAT/IMPACTS	LITERATURE REVIEW	CURRENT THREAT STATUS	FUTURE THREAT STATUS/MITIGATION
	attracted to urbanised and rural areas by opening up forest to open woodland (NPWS 2001, NSWSC 2000b) and food scraps (NPWS 2001, NSWSC 2000b).	problematic as they may graze plantings and damage regeneration areas.	Foxes, deer and feral cats may currently use the vegetated Crown land and other remnant vegetation for refuge. Deer may be deterred by high human presence but foxes and cats may not. Bins stationed at the beach access will be provided with lids and mounted to ensure spillage cannot occur. Exotic rodents have limited if any potential to establish in the Reserve given current dominance by native species and lack of disturbance benefiting these species. Ongoing deer control to be undertaken and plantings to be protected, e.g. via tree guards.
Artificial Lighting	Lighting may potentially discourage particularly nocturnal native species from foraging near areas of development (e.g. Squirrel Gliders), especially given light may travel significant distances and it can have a similar effect to a full moon on the hunting success of predators such as owls, or a behavioural avoidance impact by potential prey species (DEC 2004a, Andrews 1990, Grayson and Calver 2004, ERM 1996). Artificial lighting also shown to affect Yangochiropteran bat assemblages positively and negatively (Scanlon and Petit 2008). Conversely, wallabies, kangaroos, Tawny Frogmouth Owls, Kookaburras, Magpies and possums have	Currently no artificial light source in any proximity to Crown Land.	Artificial lighting will exist in close proximity to the Crown Land beach access from: • Street and path lighting. • Lighting in any carpark. • Lighting around and in any building. • Vehicle headlights. Light spillage dissipates with distance (ERM 1996), but in general ambient light levels are expected to significantly increase. This may affect nocturnal fauna in the adjacent Crown Land.

THREAT/IMPACTS	LITERATURE REVIEW	CURRENT THREAT STATUS	FUTURE THREAT STATUS/MITIGATION
	been noted foraging under artificial lighting in residential areas, e.g. around Lake Innes, Port Macquarie and Kendall (personal observations). Artificial lighting may also be beneficial to Yangochiropteran bats by localised aggregation of insects, with these animals being observed foraging under streetlights, floodlights and even landing on fully lit footpaths in Horton St, Port Macquarie, to scamper for insects (personal observations). Artificial lighting can also have the positive impact of increasing sight detection of fauna on roads thus reducing risk of road kills, e.g. Koalas (Wilkes and Snowden 1998, AKF 2003, Connell Wagner 2000, Port Stephens Council 2001, Lunney *et al* 1999, DECC 2008d).		Recommended for future development applications that at most only bollard lighting be placed along the track if deemed necessary, and suitable designed pole lighting at the western end of the access to minimise light spillage into the Crown Reserve.
Bushfire	Bushfire is an extinction threat to the ecological integrity of Littoral Rainforest (ERM 1996, Keith 2004, NSWSC 2004a, DEWHA 2009). Small fires only burning the edges can also open up closed canopies, altering microclimates, resulting in lower humidity and drying out. This also prevents extension of the community and provides an edge for weeds to establish (ERM 1996, DEWHA 2009, NSWSC 2004a).	There is no evidence of recent fire in the Crown Land but extensive fire could readily lead to local extinction of the local occurrence of the EECs. Adjacent land to west is grassland with a high component of Bladey Grass, hence risk of grass fire burning into rainforest, though periodic slashing and minimum arson risk as no proximate residential area.	Pasture will be removed/maintained by development, hence this threat will be eliminated. However, dune scrub to south and Area 2 will pose an ongoing bushfire risk (regardless of whether it is grassy woodland or forest). Higher human presence especially due to increased beach access use may increase risk of arson but also high vigilance due to high human presence.

THREAT/IMPACTS	LITERATURE REVIEW	CURRENT THREAT STATUS	FUTURE THREAT STATUS/MITIGATION
			Enhancement of edge to maintain high moisture levels would also reduce fire risk. Appropriate signage may also be erected, i.e. banning fires.
Maritime Stresses	On-shore salt laden winds are a primary environmental factor responsible for the character of this community (NSWSC 2004a, DEWHA 2009, ERM 1996, Keith 2004, Floyd 1990). The wind and salt content is a prime influence in the dune vegetation succession but also provides nutrients to otherwise poor soils. Clearing or modification of seafront vegetation can allow salt-laden winds to penetrate into the closed rainforest, affecting humidity and moisture content, as well as toxic effects resulting in die off of sensitive species and invasion by weeds or seral natives, e.g. Banksia and Leptospermums.	Prior to recent major weed control works, the foredune vegetation in the adjacent section of Crown Reserve contained at times high infestations of Bitou Bush which hampered development of a tall Banksia woodland which is required to protect the Littoral rainforest. Much of this weed content has been removed however this has allowed salt spray to penetrate deep into the remaining dune vegetation, which has produced the disturbed Littoral Rainforest B. The current access also cuts to just above mean high tide level in the foredune and forms a wind funnel to and from the beach. Despite this, the generally dense edge vegetation along the track appears to limit salt damage.	Beach access will be formalised with design to minimise penetration of wind funnel effect ie retaining the bend at the eastern end. Fencing will formalise boundaries to the track, with up to 1m on the outside edge of the fence to be planted with pungent leaved vegetation to discourage people making tracks in the vegetation. Coupled with the above, ongoing bush regeneration works, partially funded by the proponent, will include weed removal/suppression and planting to create a buffer to the east from maritime stresses, close canopy gaps and create a closed edge along the access track. This will ultimately negate the current adverse penetration of maritime stresses.
Rubbish Dumping	Rubbish dumping can assist the introduction of some weeds via transport of propagules and crushing of native vegetation during access or by dumped materials.	Several piles of old concrete lie on the eastern boundary of the site. Possibly a relic of former sandmining activities. These will be removed as part of future development.	Formal beach access will be one of two new accesses between Bonny Hills and Middle Head, hence expect heavy use. Potential for little to accumulate but litter can be controlled by Council fines advertised on signage with sufficient bins provided.