



Figure 4: Quaternary soil mapping in the Eastern Creek area and the 1:100 ARI

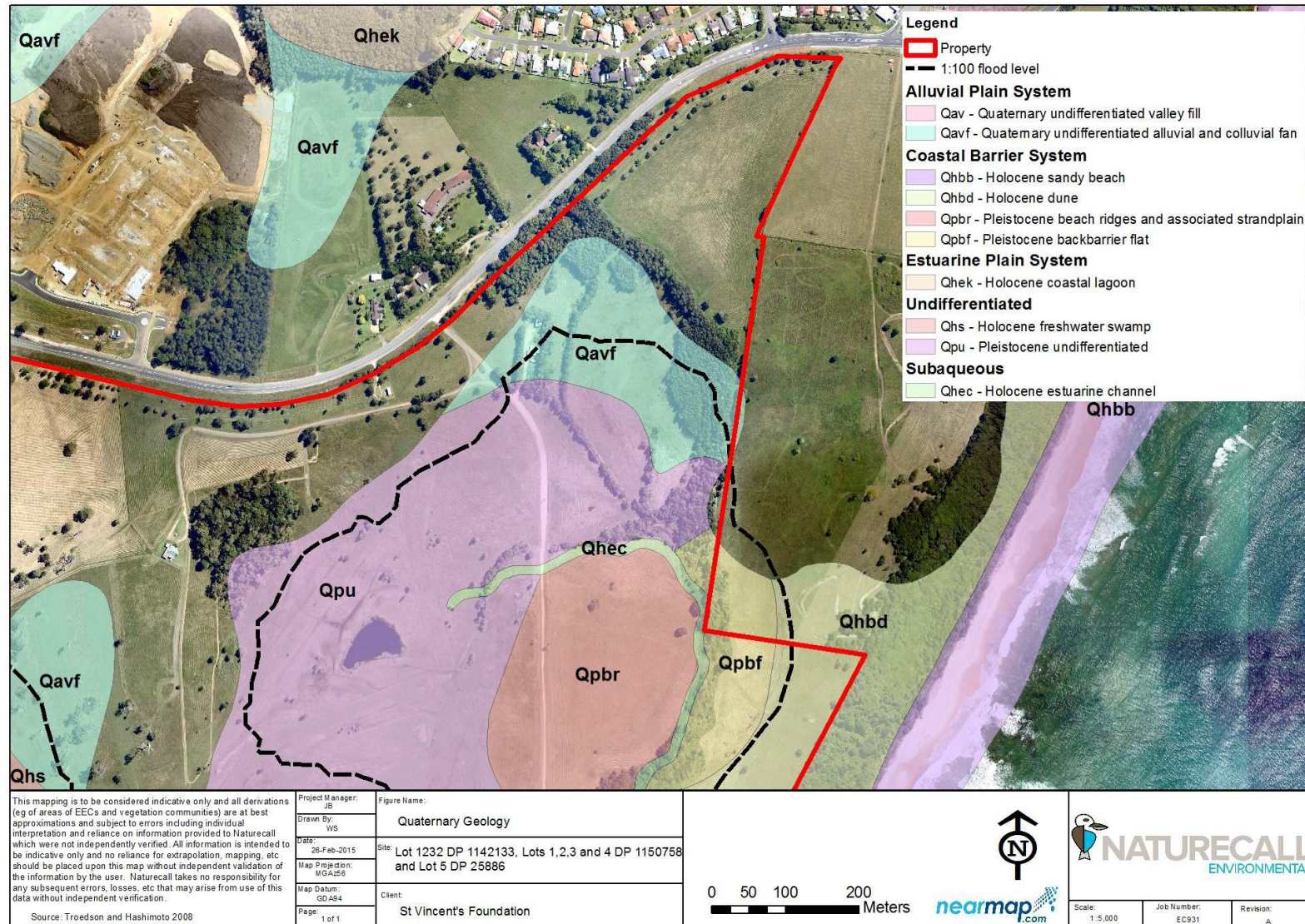
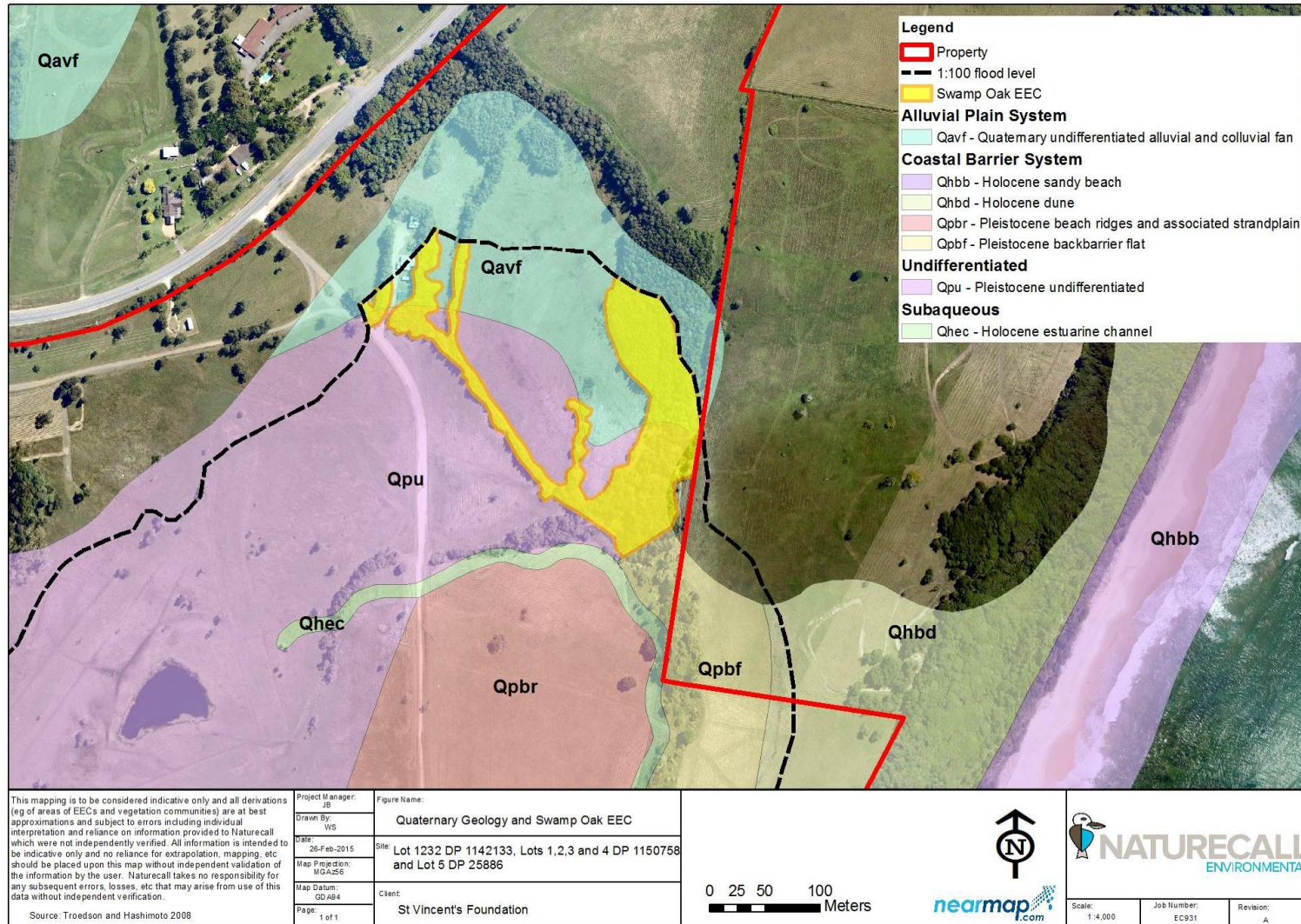




Figure 5: Revised extent of Swamp Oak Floodplain Forest EEC in the eastern creek area

Note: Southeast boundary nominal allows for gradation of soil landscape.





5.0 Review Of Buffer Requirements

Condition B2 of the Concept Approval (DPI 2012a) required a 25m wide buffer to the SOFF EEC.

The linear parts of this EEC (comprising regrowth along fencelines and drains) mostly fall under the development footprint, hence the buffer zone will only apply to the intact remnant within the Eastern Creek area mapped as this EEC in Figure 5.

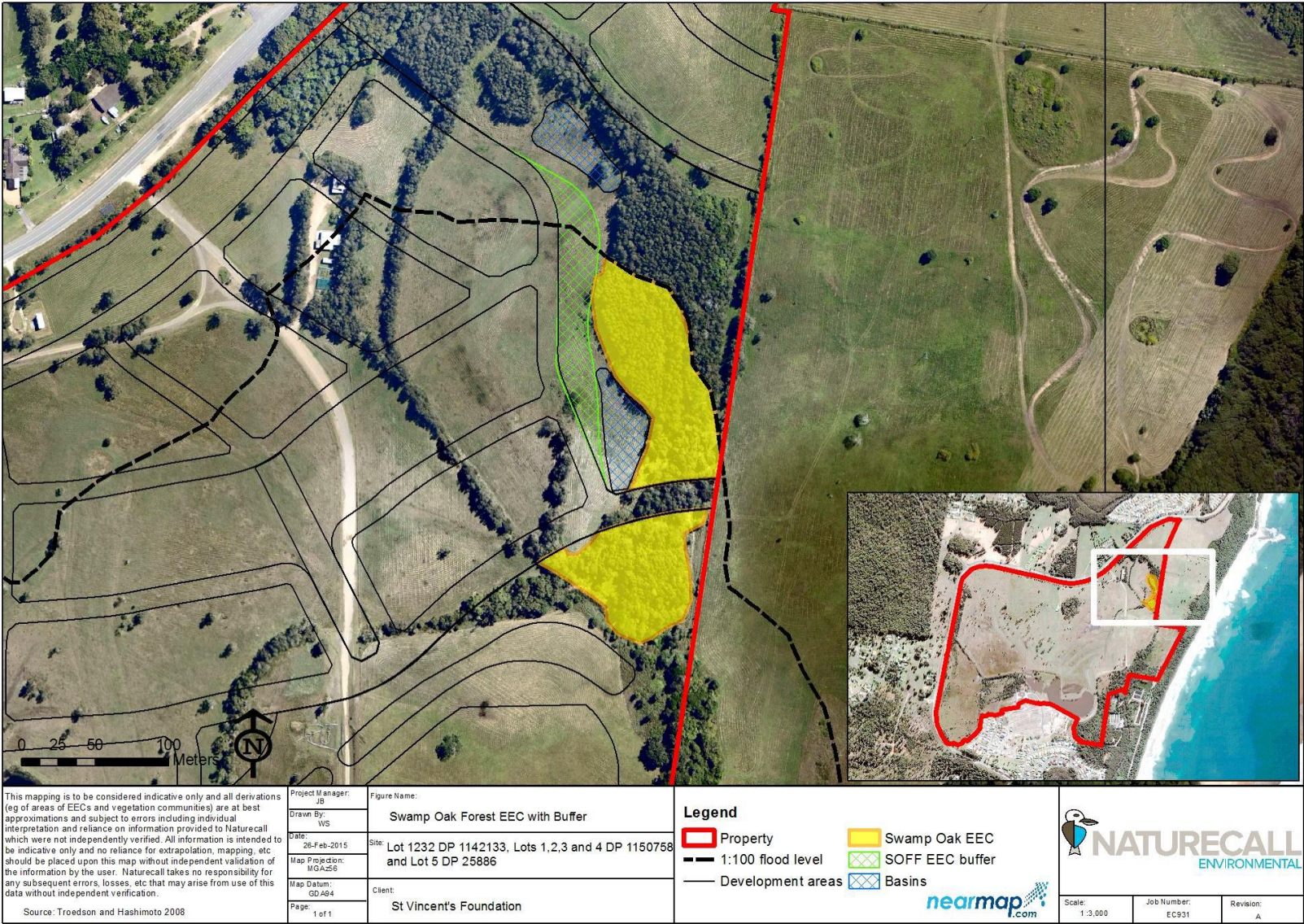
Consequently, it is recommended:

- The maximum width of the required buffer vegetation adjacent to the residential zone is to be 25m, as shown in Figure 6. As an existing buffer occurs on the northern side, the new buffer only needs to be applied on the southwest. The concept development layout is to be adjusted accordingly to allow for this buffer. This buffer excludes Asset Protection Zones and road reserves, as per Condition B2.
- Where existing vegetation is absent in this buffer zone, ecotonal species (currently present in the northeast corner) typical of the locality and the edaphic position are to be planted. Example species include *Callistemon saligna*, *Syzygium australe*, *Melaleuca quinquenervia*, *M. stypheloides*, *M. linariifolia*, *Eucalyptus robusta*, *E. tereticornis*, *Glochidion ferdinandi*, *Ficus coronata*, *Gahnia clarkei*, *Lomandra longifolia*, *Elaeocarpus reticulatus* and *Acmena smithii*. These will not only close the edge but improve the habitability of the northwest drainage line, given Swamp Oak offers very limited habitat resources, i.e. lacks nectar producing capabilities and rarely produces hollows.
- The edge is to be closed along the urban fringe by planting with pungent plants such as *Lomandra longifolia* and *Gahnia* spp. on the outermost fringe.
- Weeds (generally consisted of *Paspalum* spp., Winter Senna, and Lantana) are to be controlled by standard bush regeneration techniques.



Figure 6: Buffer zone between residential zone and Swamp Oak Floodplain Forest EEC

(Source: Aecom 2013)





Part B: Crown Reserve Interface

The objectives of this Section are:

- Identify and map the vegetation communities in the section of Crown Reserve R754444 adjacent to Lot 5.
- Determine if any of the vegetation meets the criteria to qualify as *Littoral Rainforest and Coastal Vine Thickets of Eastern Australia*, which is a Critically Endangered Ecological Community (CEEC) listed under the *EPBC Act 1999* (DSEWPC 2012b).
- Identify potential threats to the integrity of the *Littoral Rainforest* EEC/CEEC within the study site on the Crown Reserve directly adjacent Lot 5.
- Identify the appropriate buffers and other options that may achieve an equivalent or greater ecological benefit.

6.0 Current Vegetation on Lot 5

Lot 5's vegetation consists of:

- **Brushbox Wet Sclerophyll Forest**, forming a narrow ribbon upstream of the creek crossing. This community, while very narrow, is in good condition with a light level of weed infestation.
- **Blackbutt Dry Sclerophyll Forest**, comprising a remnant along the edges of Duchess Gully. This community is more expansive and also includes ecotones to the downstream swamp forest. Condition overall is good, with some light infestations of Lantana.
- **Dune Scrub**, comprising a seral stage of Coastal Sands Blackbutt forest. This community lies at the southern end of Lot 5, forming a link (broken by the overhead powerline easement) to the Crown Reserve vegetation to the east and Duchess Gully. This community is in a natural condition and has minimal weeds.
- **Pasture**: Dominates a flat area over Lot 5. Dominated by a mixture of Carpet Grass, Bladey Grass, Spiney-Headed Matrush and Bracken Fern with some Kangaroo Grass and patches of *Gahnia clarkei*. *Gahnia clarkei*, Bracken Fern, Pouched Coral Fern, *Selaginella uliginosa* and Cord Rush dominated the drainage line with Sphagnum Moss, with scattered White Banksia (*Banksia integrifolia*) and small clump in the northeast.

The pasture on Lot 5 is used for grazing cattle as part of the primary grazing land on the property. This portion of the property has been maintained in a consistent manner, from time to time, for the period since St Vincent's Foundation purchased the property.

7.0 Crown Reserve Vegetation Survey

It should be noted that Crown Reserve R754444 extends for some kilometres north and south of the subject site. This section of the report only assesses the portion of the Reserve immediately adjacent to Lot 5 and does not address any part of Crown Reserve R754444 east of the neighbouring PMHC (STP) property or Milland-Seawide properties (King and Campbell 2010).



7.1. Survey Methods

7.1.1. Vegetation Mapping and Species Identification

A quadrat based survey was undertaken on 3-4 July 2012. The study site consisted of the land within the Crown Reserve bound by Rainbow Beach to the east; the eastern boundary of Lot 5 to the west; the Reserve, including the SEPP 26 Littoral Rainforest north to the “boundary” of Lot 5; and south to the “boundary” of the Bonny Hills Sewerage Treatment Plant (north and south boundaries measured parallel across the Reserve from the cadastral boundaries).

In general, the vegetation mapping consisted of initial community stratification from aerial photos into structural types with reference to such diagnostic features as colour, texture, crown architecture, aspect and topographic position (DECC 2004, McDonald *et al* 1990). A process of selective field sampling and interpretation adjustment was continued until a satisfactory level of confidence in type recognition was reached. The boundaries of each type initially mapped from aerial imagery of the site were checked by groundtruthing.

The stratification of sites for plot-based sampling was determined using aerial imagery patterns and preliminary site investigation. Quadrats were assigned to sample the range of different vegetation types within the study site, supplemented with random meanders to sample boundaries and ensure a representative description was made. Floristic data was collected for quadrats of fixed size of 20 x 20 metres (400m²). The following attributes were measured or estimated at each site:

- Australian Map Grid Reference (GDA-94. GPS measurement).
- Vegetation structure, including the height and foliage cover of each stratum.
- Location, aspect, elevation and slope.
- Geology and general soil characteristics.
- Topographic position.
- Approximate time since last fire and characterisation of intensity (ground cover burnt, shrubs burnt, tree tops burnt).
- Forms of disturbance other than fire.
- Presence of environmental weed species and severity of infestation.

A total of 9 quadrats were carried out. The location of the quadrats is given in Table 2 and mapped in Figure 7. The map coordinates given in the table were obtained by GPS at the centre of each quadrat and are expected to be generally accurate to between 5-8m given canopy cover was a common limitation.



Table 2: Flora survey sampling results

(GPS settings were: Position format UTM/UPS and Map Datum WGS 84)

Quadrat Number	Location	
	Easting	Northing
1	485199	6506996
2	485221	6506929
3	485166	6506938
4	485198	6506893
5	485176	6506860
6	485115	6506858
7	485138	6506772
8	485077	6506757
9	485110	6506728

Each quadrat survey was completed in 30 minutes. Within the quadrats all trees, shrubs and dominant groundcover plants were identified and recorded. Species identification was made with the assistance of Bale (1993), Beadle (1982), Chippendale (1981), Harden (1993, 2000), Williams and Harden (1980), Robinson (1994) and Brooker and Kleinig (1999). Plant species were identified to species or subspecies level and nomenclature conforms to that currently recognized by the Royal Botanic Gardens and follows Harden (1990-2000) and PlantNET for changes since Harden.

The vegetation communities were described from data collected during transect studies. Classification was based on the *Forest Types Classification Research Note 17* (1989) with sub-formation names for vegetation types adapted from the classification proposed by Beadle and Costin (1952) and Keith (2004) eg 'Dry Sclerophyll Forest' to assist the fauna habitat evaluation, and the structural classification used by Walker and Hopkins (1990). Crown cover classes are defined by the following:

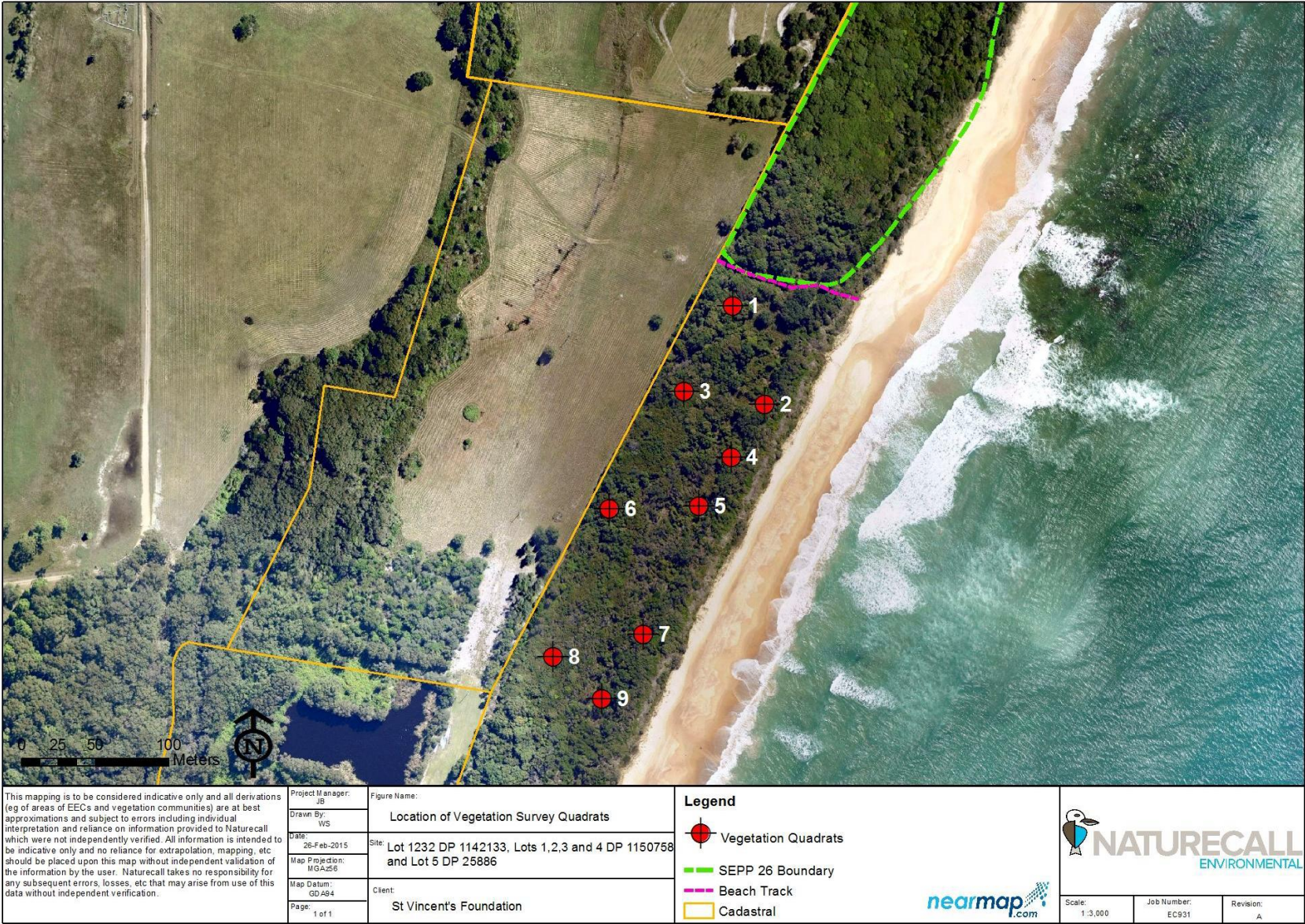
- **Closed or dense:** crowns touching to overlapping (crown separation ratio <0).
- **Mid-dense:** crowns touching or slightly separated (crown separation ratio 0– 0.25).
- **Sparse:** crowns clearly separated (crown separation 0.25–1).
- **Very Sparse:** crowns well separated (crown separation 1–20).
- **Isolated plants:** trees greater than 100 m apart, shrubs about 25m apart (crown separation >20).
- **Isolated clumps:** clump of two to five woody plants 200 metres apart (crown separation >20)

Identification of Threatened Ecological Communities (TECs) was based on the data collected by the survey and review of the relevant listings on the OEH website (www.environment.nsw.gov.au) and Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) website (<http://www.environment.gov.au/epbc/index.html>).

In addition to the above, the previous mapping by Bill Peel (2010) was ground-truthed to compare this mapping with this survey.



Figure 7: Vegetation quadrat locations





7.2. Crown Reserve Vegetation Communities

Refer to vegetation map in Figure 8.

Vegetation communities were broadly identified according to structural form and dominant canopy species. Four distinct, though variable and at times interblended communities, were identified and are described below.

7.2.1. Simple Notophyll Mid-High Closed to Mid-Dense Forest (Littoral Rainforest)

A

Distribution: This community occurs as a patch in the northeast and is continuous with the SEPP 26 mapped Littoral Rainforest extending north to Middle Head.

Structure and Species Composition:

(a) Canopy:

Features a closed to mid dense canopy ranging from 50-80% Projected Foliage Cover (PFC). Height is generally between 8-12m and most trees were approximately 20cm Diameter at Breast Height (DBH) or less. Dominated by Corkwood (*Endiandra sieberi*) with Lilly Pilly (*Syzygium smithii*), Blueberry Ash (*Elaeocarpus reticulatus*) and Coast Banksia (*Banksia integrifolia*) as canopy associates.

(b) Understorey:

Sparse understorey with cover rarely exceeding 15% PFC. Typically contained canopy recruits and rainforest shrubs such as Veiny Wilkiea (*Wilkiea huegeliana*), Tuckeroo (*Cupaniopsis anacardioides*), Guioa (*Guioa semiglauc*) and Narrow-Leaved Palm Lily (*Cordyline stricta*) from 1-4m in height.

(d) Groundcover:

Generally dense and between 0.05-1m in height. Saw Sedge (*Gahnia clarkei*) and Spiny-Headed Matrush (*Lomandra longifolia*) were dominant across the entire association, almost exclusively in some areas. Where these species were absent, a low cover of Native Violet (*Viola hederacea*) and Creeping Beard Grass (*Oplismenus imbecillis*) was present.

(e) Climbers and Scramblers:

Vines were common in all layers and smothered canopy trees in some areas. Monkey Rope (*Parsonsia straminea*) and Lawyer Vine (*Smilax australis*) were the most widespread species. Other occasionally occurring species included *Cassytha pubescens* and Water Vine (*Cissus antarctica*).

(f) Epiphytes:

Mistletoes, e.g. *Amyema congener*, were fairly common throughout this association.

Comments: Poor drainage in some areas as a result of historical sand mining. Low weed cover throughout with only a few Senna (*Senna pendula* var. *glabrata**) shrubs observed.

Equivalent Biometric community is Brushbox – Tuckeroo littoral rainforest on coastal headlands of the North Coast.



7.2.2. Disturbed Simple Notophyll Low to Mid-Dense Forest (Littoral Rainforest) B

Distribution: Occurs in the east behind the foredune where *Banksia* cover is absent or sparse. The approximate area of the mapped community is 0.7ha.

Structure and Species Composition:

(a) Canopy:

The canopy is patchy and irregular and is recovering from past clearing and significant weed invasion which has recently been controlled. Height is generally between 4-6m. Dominant species recorded were Beach Acronychia (*Acronychia imperforata*), Native Guava (*Rhodomyrtus psidioides*), Lilly Pilly and Large Mock-Olive (*Notelaea longifolia*). Other common canopy species included Guioa, Tuckeroo and Ribbonwood (*Euroschinus falcatus*). Emergent Coast Banksia were a common feature in some areas.

(b) Understorey:

Understorey absent in areas with a dense canopy and otherwise sparse to open. Height ranged from 1-3m and was generally comprised of canopy recruits and various shrubs such as Veiny Wilkiea, Breynia (*Breynia oblongifolia*) and Senna (*Senna pendula**).

(d) Groundcover:

Cover varies from dense to open and ranges from 0.1-1m in height. Saw Sedge and Spiny-Headed Matrush were the dominant species recorded along with occasional Bracken Fern (*Pteridium esculentum*), Bladey Grass (*Imperata cylindrica*), Creeping Beard Grass and Native Violet.

(e) Climbers and Scramblers:

Vines were a dominant feature, especially in the eastern edge of the community where Water Vine formed pure thickets. This species along with *Cassytha pubescens*, Lawyer Vine and Monkey Rope (*Parsonsia straminea*) completely smothered the low canopy in several areas. Other occasionally occurring species included Dusky Coral Pea (*Kennedia rubicunda*), Sweet Sarsaparilla (*Smilax glycyphylla*) and Milk Vine (*Marsdenia rostrata*).

(f) Epiphytes:

Mistletoes, e.g. *Amyema congener*, were fairly common in senescent canopy trees and occasional Elkhorns (*Platynerium bifurcatum*) were observed.

Comments: Weed invasion and maritime stresses have significantly modified this community and it is currently in a state of regeneration following extensive weed control of Lantana (*Lantana camara**) and Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata**).

Equivalent Biometric community is Brush Box – Tuckeroo littoral rainforest on coastal headlands of the North Coast.

Photo 1: Littoral rainforest A



Photo 2: Littoral Rainforest B





7.2.3. Mid-High Closed Shrubland

Distribution: Occupies most of the western half of the area investigated, totalling approximately 1.2ha.

Structure and Species Composition:

(a) Canopy:

This community has a dense canopy exceeding 70% PFC in most areas. The height was approximately 8m in the north, decreasing to around 6m in the south. Prickly-Leaved Paperbark (*Melaleuca nodosa*) and Tautoon (*Leptospermum polygalifolium* subsp. *cismontanum*) were co-dominant throughout. Other frequently occurring species included Satinwood (*Nematolepis squamea*), Sydney Golden Wattle (*Acacia longifolia* subsp. *longifolia*), Blueberry Ash and Coast Banksia.

(b) Understorey/Shrub Layer:

Generally a sparse understorey throughout ranging from 1-3m in height. Canopy juveniles were most common with Wallum Banksia (*Banksia aemula*) and various heathy shrubs, e.g. Tree Broom-Heath (*Monotoca elliptica*) and Wallum Heath (*Epacris pulchella*), occurring in the south.

(d) Groundcover:

Dense in most situations and dominated by Saw Sedge and Spiny-Headed Matrush with occasional *Baloskion tetraphyllum* and Bracken Fern to a height of 1.5m. A low cover of grasses, herbs and seedlings was also present in some areas.

(e) Climbers and Scramblers:

Climbers were common to rare in this community and were found in all layers. Monkey Rope and *Cassytha pubescens* were most frequent and other species such as Sweet Sarsaparilla, Wonga Wonga Vine (*Pandorea pandorana*) and Lawyer Vine were occasional to uncommon occurrences.

(f) Epiphytes:

Generally absent.

Comments: Considered to be a derived community following historical sand mining of the area. Drainage was generally poor with standing water present in some areas. Low weed cover throughout.

Equivalent Biometric community is Paperbark swamp forest of the coastal lowlands of the North Coast.



7.2.4. Disturbed Mid-High Open Woodland (Banksia Woodland)

Distribution: Occurs mainly in the northeast with other linear patches behind the foredune further south with an overall area of 0.6ha.

Structure and Species Composition:

(a) Canopy:

Open canopy of Coast Banksia (20-30% PFC) ranging from 8m high in exposed areas to approximately 10-12m in sheltered situations. Wind shear, salt burn and natural attrition were evident in exposed areas.

(b) Understorey:

The understorey was generally open although some areas contained pioneer rainforest species such as Brush Kurrajong (*Commersonia fraseri*) and thickets of Water Vine and Lawyer Vine to 5m in height.

(c) Groundcover:

Cover averaged 50% PFC and was dominated by Saw Sedge and Spiny-Headed Matrush. Bladey Grass, Carpet Grass (*Axonopus fissifolius**), Common Paspalum (*Paspalum dilatatum**) and Bracken Fern were also dominant in some areas

(d) Climbers and Scramblers:

Dense thickets of vines comprising Water Vine and Lawyer Vine were occasionally present in the community along with Wild Yam (*Dioscorea transversa*), *Cassytha pubescens*, Milk Vine, Monkey Rope, Appleberry (*Billardiera scandens*) and Climbing Guinea Flower (*Hibbertia scandens*).

(e) Epiphytes:

Mistletoes, e.g. *Amyema congener*, were fairly common in senescent canopy trees.

Comments: This community is likely to have originally covered a larger area of the dunal system as evidenced by the many fallen dead Banksia and large canopy gaps being colonised by vine, weeds and pioneer rainforest trees. Recruitment was very low due to the extensive Bitou Bush and Lantana infestations which have only been recently controlled. This community is currently in a seral stage of recovery with maritime stresses being a limitation to the open structure and exposure to on-shore winds.

Equivalent Biometric community is Banksia dry shrubland on coastal sands of the North Coast.



Photo 3: Shrubland

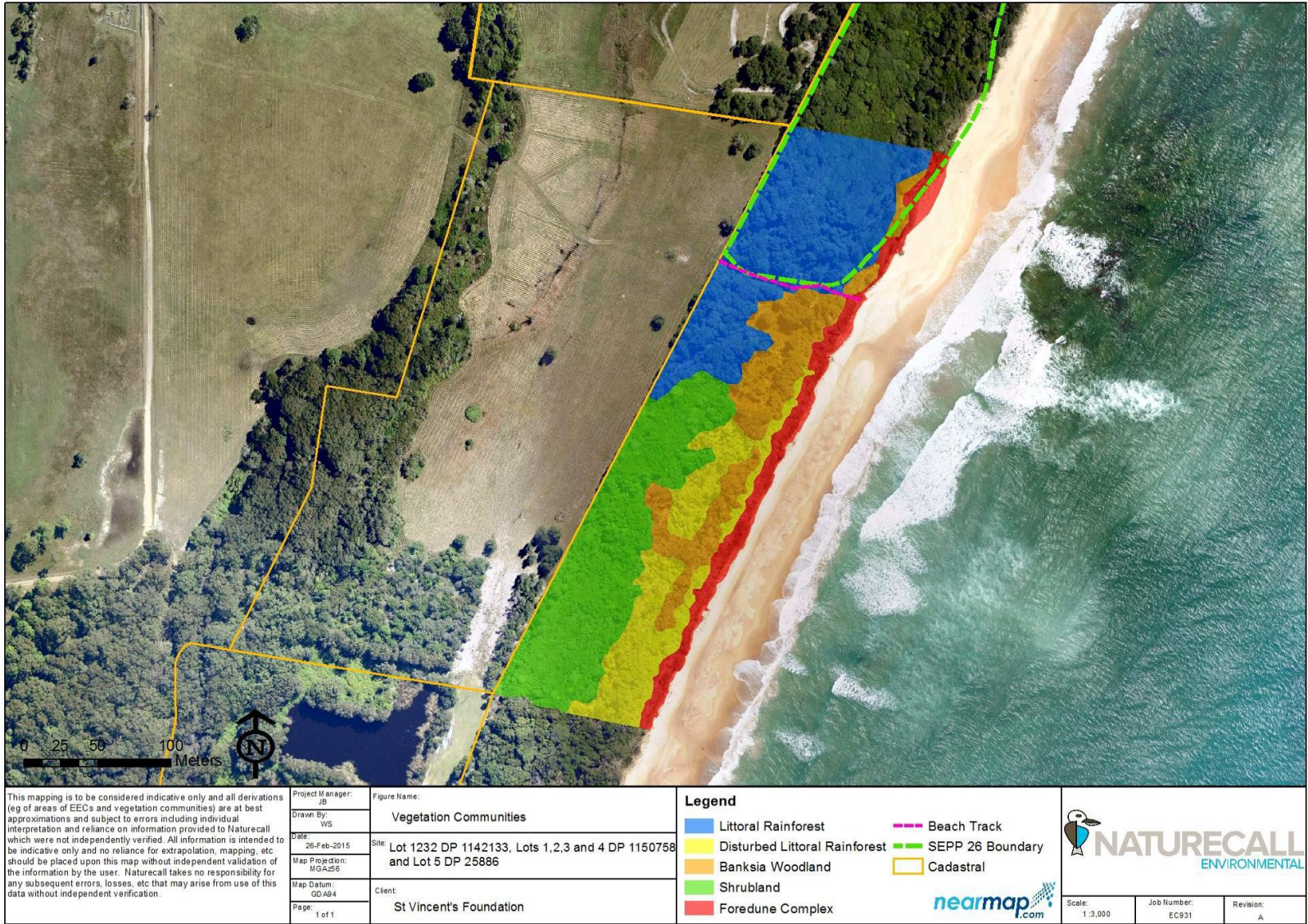


Photo 4: Banksia woodland





Figure 8: Crown Reserve vegetation community map





7.2.5. Foredune Complex

Distribution: A linear community colonising the foredune along the entire length of the Reserve with a total area of 0.4ha. Extends onto adjacent land to the north and south along Rainbow Beach.

Structure and Species Composition:

(a) Canopy/Understorey/Shrub Layer:

Scattered to clumped stunted Coast Banksia about 2m high with a few Horsetail She-Oak (*Casuarina equisetifolia*) in the Northern end.

(b) Groundcover:

Varies from absent due to recent control of Bitou Bush, to clumps or scattered *Lomandra longifolia*. Berm and some steep slopes dominated by Coast Spinifex (*Spinifex sericeus*) to a height of approximately 30cm. *Hydrocotyle bonariensis* was also common.

Comments: This community is evidently regenerating following recent removal of previously dense infestations of Bitou Bush along the foredune. Species diversity is low and the main species present represent salt and wind tolerant pioneer species.

Equivalent Biometric community is Banksia dry shrubland on coastal sands of the North Coast

Photo 5: Foredune complex

