A FLORA and VEGETATION SURVEY of the COASTAL STRIP from FORREST BEACH - CAPE NATURALISTE - WOODLANDS

Prepared for the Department of
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1.0 INTRODUCTION

The study area is a coastal strip some 90 km long and 200 square km (20,000 ha) in area and lies in the far south-west corner of Western Australia. Starting from Forrest Beach just north of Busselton (233 km south of Perth) it runs south along Geographe Bay then north-west to Cape Naturaliste then south again to Cullen Road, which is just north of Cowaramup Point. The inland boundary follows the Bussell Highway and Caves Road (see Map 1).

While many of the features of the study area have been acknowledged for some time (eg. Valentine and Enright, 1975), the diversity of the vegetation has not been widely or fully appreciated. The current study highlights this diversity and the great need to improve the adequacy of conservation reserves in the area before it is lost. Regrettably, recommendations made ten years ago (Valentine and Enright, 1975) similar to some of those made in this report have not been acted upon. It is likely that in another ten years many of the areas of native vegetation concerned will no longer exist and lost with them will be the chance to retain a significant part of the natural environment.

The study area has a special attraction which results from a combination of many factors including the mild climate, the relatively unspoilt coastline with its variety of features and the natural vegetation with its range of species of different shapes, heights and colours. This is a fragile thing that can be destroyed a bit at a time, so that only those looking forward and appreciating the cumulative impact of all that is happening realise what the result will be.

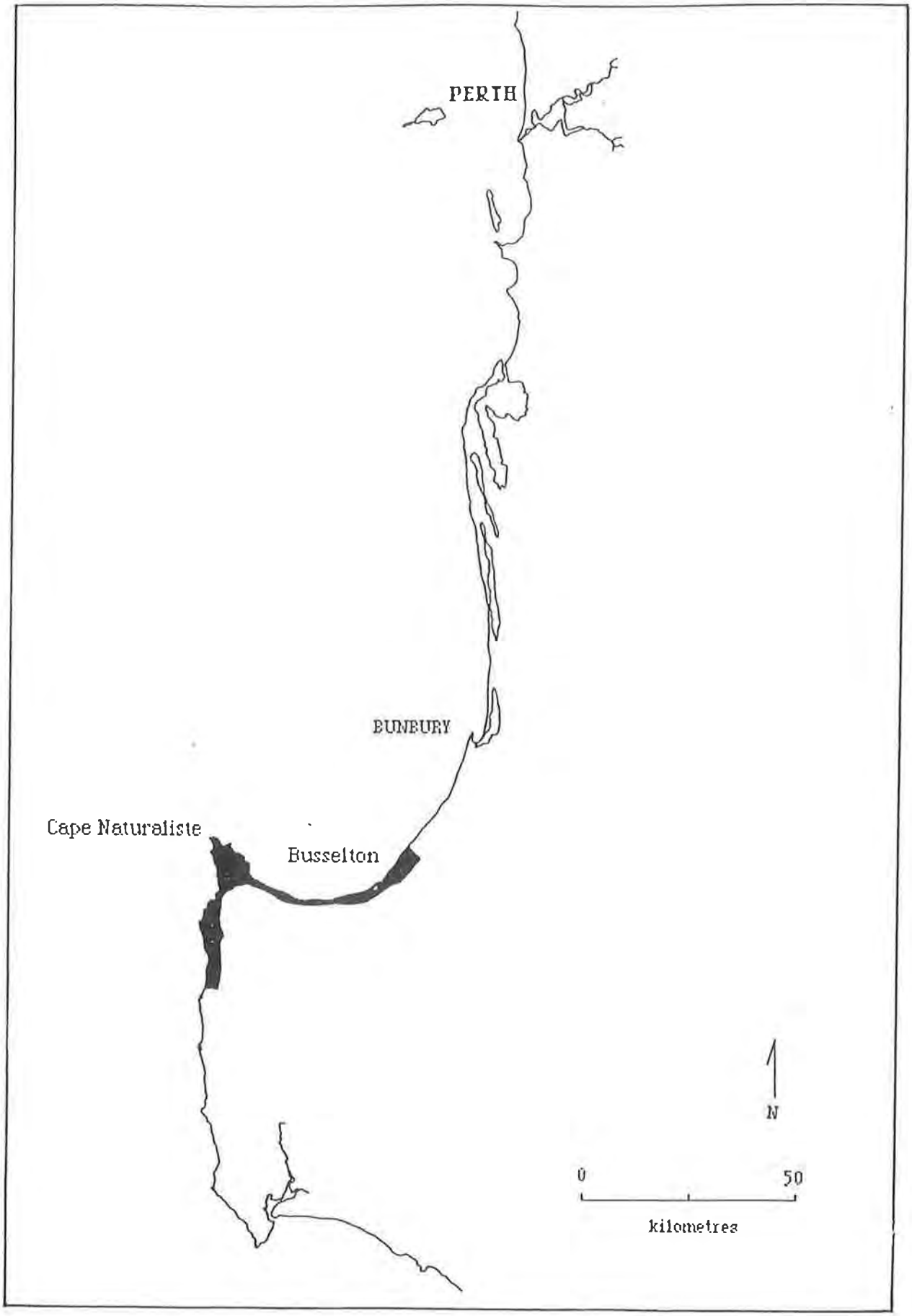
The far south-western corner of the state (which includes the study area) has been a popular holiday destination for West Australians for many years as well as having a

long agricultural history.

The demands of agriculture, the expanding populations of local towns and increased tourist and recreational pressures on the environment in this very accessible south-west corner of Western Australia need to be managed properly or they will result in the loss of many of the values that the area has for:-

- recreation
- tourism
- conservation of flora, fauna and landscapes
- scientific research and
- education.

In many parts of the south-west of Western Australia agriculture and to a lesser degree other development, has totally changed the environment, substituting a relatively simple, artificially maintained system in the place of the diverse native vegetation over very large areas with only inadequate conservation reserves. Until fairly recently the scale of such activities in the study area had not reached the point where the balance between the native vegetation and agriculture and other developments is threatened. However, this is undoubtedly the case now and if great care is not taken in its use and development then rather than maintaining all that makes it an outstanding area the study area will become commonplace and lose much of the special attraction that it has.



Map One **LOCATION OF THE STUDY AREA**

2.0 PHYSICAL ENVIRONMENT

2.1 CLIMATE

The climate of the Busselton-Cape Naturaliste study area is characterised by a cold, wet winter (April to September), and a warm to hot, dry summer (October to March). With these characteristics it falls into the "Mediterranean" climatic regime (Beard, 1981) or "csb", the equivalent in Köppen's climatic classification system (Gentilli, 1972).

Mediterranean climates are also further classified by Bagnouls and Gaussen (1957, quoted in Beard, 1981), on the length of the dry season. Using this method Beard has divided the study area into two climatic zones:-

(a) **Dry Mediterranean** with five to six dry months, from the northern boundary to Cape Naturaliste (including the Naturaliste Downs-Bannamah Wildlife Park area) and

(b) **Moderate Mediterranean** with three to four dry months, from Cape Naturaliste to the southern boundary of the study area (including Naturaliste Ridge).

Beard, using data collected up to 1962 puts Cape Naturaliste just inside the Dry Mediterranean zone. However, checking with data averaged to 1984 suggests Cape Naturaliste should be in the Moderate Mediterranean zone and it has been used here for rainfall and temperature data for that zone. However, it should be appreciated that there is a gradient in rainfall and temperature along the study area. Data from Busselton is used as an example for the Dry Mediterranean zone.

2.1.1 Rainfall

Rainfall for the study area is strongly seasonal, with a reliable wet season and a short summer dry season. The mean annual rainfall for Busselton is 828 mm of which 653 mm (> 75%) falls during the period May to September and 463 mm (> 50%) during the three winter months of May, June and July. The mean annual rainfall for Cape Naturaliste is very similar at 833 mm, with 647 mm (>75%) of this being received in May to September and 461 mm (> 50%) during the three winter months of May, June and July. The driest months are December to March with monthly averages at both localities ranging from 10 - 14 mm.

2.1.2 Temperature

The study area has a cold winter with a mean daily temperature at Busselton of 14.92°C (ranging from 7.9°C to 20.6°C) and at Cape Naturaliste of 14.96°C (ranging from 10°C to 19.1°C). Summer is mild to hot with a mean daily temperature at Busselton of 22.07°C, a mean maximum of 26.08°C and at Cape Naturaliste of 20.34°C, and a mean maximum of 23.7°C. February is the hottest month with a mean daily maximum at Busselton of 28.9°C and at Cape Naturaliste of 26.1°C.

2.2 GEOLOGY AND GEOMORPHOLOGY

The dominant structural features of the Busselton - Cape Naturaliste study area are the Leeuwin Block and the Perth Basin. The Leeuwin Block is composed of high grade igneous and metamorphic rocks of Precambrian age, including granite, granulite gneiss and pegmatite. Cape Naturaliste is the northern-most end of this block, the eastern boundary of which is the Dunsborough fault. To the east and north, between this fault and the Darling Scarp, is the southern part of the Perth Basin, a down faulted block filled with sediment (largely sands of marine origin at the surface in the study area). These two very different geological structures present as very different coastlines and topographies in the study area.

2.2.1 Leeuwin Block

Down the western third of the Leeuwin Block the granulite base rock is overlain by the younger Tamala limestone, but outcrops at a number of places on the coastline. To the east of the Tamala limestone the granulite has been lateritised but in many places is overlain by sands.

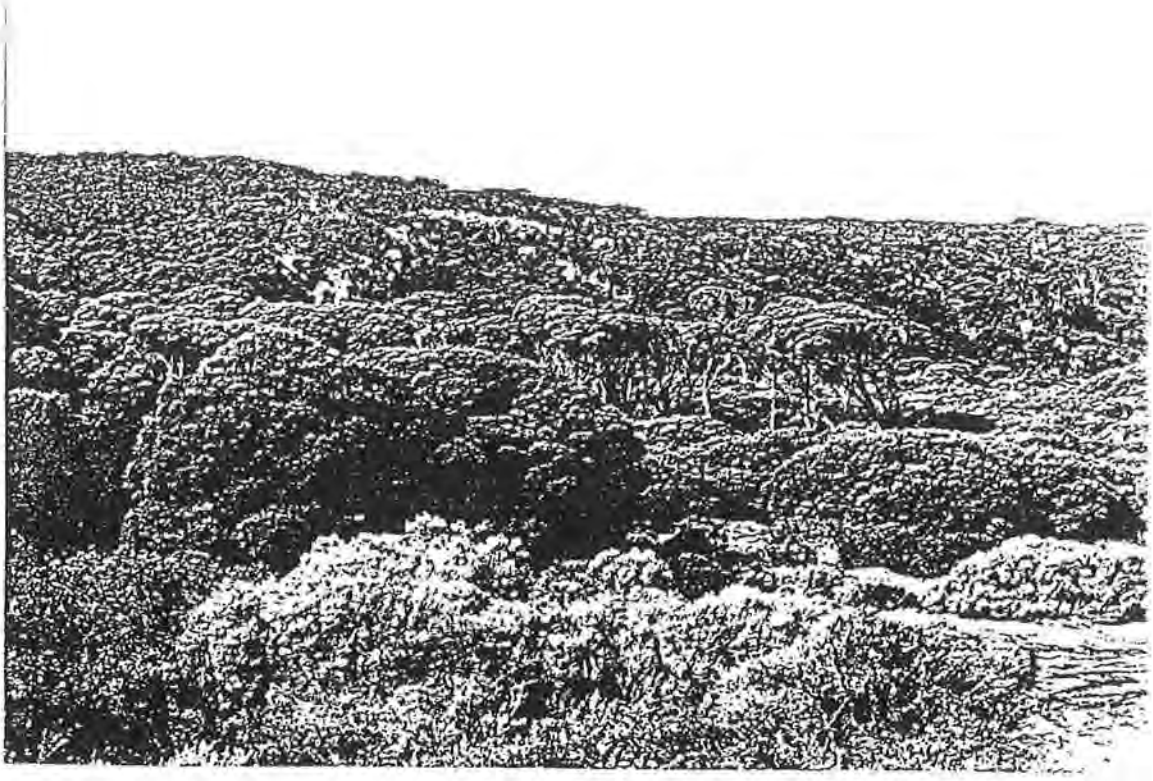
Due to the combination of granulite and limestone the coastline of the Leeuwin Block has a series of features which make this an area of outstanding beauty. These include exposed granulite and limestone headlands, indented sandy bays and steep limestone cliffs.

The geologic formations from Cape Naturaliste to Bunker Bay on the northern end of the Leeuwin Block are of particular importance and of high educational value because of their variety and degree of exposure. They include limestone cliffs with well developed sea caves (Photograph 1) and water seepage lines, granulitic

Photograph 1: Limestone Cliffs with sea-caves west of Bunker Bay.

headlands, conspicuously bedded aeolian limestone (where the layers of heavily calcified limestone are inter-bedded with softer, poorly cemented limestone and the latter has eroded leaving distinct gaps between the layers) and rounded gneiss boulders which are representative of the old landsurface before the aeolian limestone was laid down. This area is used often by both secondary and tertiary geology students.

Moving inland from the western shore of the Leeuwin Block the present land surface rises relatively steeply to the Naturaliste Ridge which parallels the coast and is overlain with limestone and limestone derived sands ranging from pale cream-coloured, through yellow and orange to dark brown, it has a high point of 220 metres. In areas the limestone forms steep cliffs (for example to the north of Yallingup) with dense *Melaleuca lanceolata* (Moonah or Rottnest Island Ti-tree) forests below them (Photograph 2). Limestone caves are also an attraction of this area



Photograph 2: *Melaleuca lanceolata* (Moonah or Rottnest Island Ti-tree) forests at the base of limestone cliffs north of Yallingup.

with their impressive features and high archaeological importance. Dolines or collapsed caves also occur on this ridge, the largest being near Mt. Duckworth. The water courses through the higher part of the Ridge (eg. Wilyabrup and Quininup Brooks) are well incised but become more open as they approach the ocean. From the crest of the Naturaliste Ridge the Leeuwin Block slopes gently down to the low-lying Perth Basin.

2.2.2 Perth Basin

The part of the Perth Basin in the study area has low, fairly flat topography reaching to only a few metres above sea level. This low-lying plain has extensive coastal-linked wetlands, for example the Deadwater, the Vasse and Wonnerup Estuaries north of Busselton and the Broadwater south of Busselton. In addition there are a number of smaller wetlands in low-lying areas. The soils range from the white of the recent calcareous beach sands through grey to creamy-yellow and brown sands.

In contrast to the rugged coastline of the Leeuwin Block the coastline of the Perth Basin (ie. northwards from Dunsborough) is a wide sandy bay, backed by a series of low dunes with some low rocky points.

3.0 CURRENT LAND USE

There are a diversity of land uses in the Busselton-Cape Naturaliste study area including: residential, commercial, light industrial, mineral tennements, forestry, recreation and tourism (incl. sightseeing, swimming, bushwalking, surfing, abseiling, caving, cycling, boating, sailboarding and wine tasting), agriculture (incl. grazing and viticulture) and conservation (incl. fauna, flora, habitat, landscape, caves and water).

3.1 RESIDENTIAL

Within the study area there are six defined residential or holiday areas:-

- **Busselton** this major south-west town occupies a strip contained by the coast and Vasse Estuary and has major commercial, civic, administrative, recreational, cultural and educational facilities and activities.

- **Quindalup** a ribbon shaped residential development west of Busselton, is bordered by Geographe Bay, the Bussell Highway, Caves Road and the Broadwater wetland system. Quindalup has expanded towards Dunsborough and the percentage of empty blocks is decreasing. Originally it supported mainly holiday homes, recently the trend for permanent residences has increased.

- **Dunsborough** is an expanding town at the entrance to Cape Naturaliste, it is a popular holiday spot, with caravan parks, holiday chalets, hotel/motel, and camping grounds to cater for seasonal influxes. Like many other towns in the south-west, Dunsborough's permanent residential population is increasing very rapidly with the development of new residential areas.

- **Eagle Bay** is a prestigious holiday and retirement village on the coast east of Cape Naturaliste and has expanded through the recent subdivision of cleared farming areas abutting the Meelup Reserve System and uncleared areas to the north-west. Eagle Bay is developing both a permanent working and a retired residential population as well as for holiday homes. The sweeping views of the ocean and Cape Naturaliste render this location very desirable and land values have escalated to match this.

- **Yallingup** is an important holiday centre on the coast south of Cape Naturaliste. In recent years it has developed a growing permanent population, yet still remains one of the major holiday and tourist centres of the south-west. The attraction of some of the world's best surf is responsible for a significant proportion of the holiday influx. Yallingup has a caravan park, a camping area, holiday chalets and a motel to cater for tourists and holiday makers.

- **Smiths Beach** is on the coast south of Yallingup and has a permanent caravan park with associated camping grounds to cater for holiday crowds. Smiths Beach also provides facilities for people using the nearby attractions of Canal Rocks.

3.2 LIGHT INDUSTRIAL

Within the study area there are numerous light industrial businesses servicing the needs of the agricultural and residential areas, the majority of these do not seriously conflict with other land use values. The only exception to this is at Busselton where the light industrial area on the south side of the Vasse Estuary conflicts with the conservation value of the Vasse Estuary and its adjoining vegetation (see Conservation Value, Section 6.1).

3.3 MINERAL TENNEMENTS

Mineral sands mining is the major mining interest in the study region with a number of mining and mineral exploration leases existing in the Ludlow Tuart Forest, Wonnerup and Vasse Wetlands and Geographe Bay. At present none of these leases are being operated however, immediately north of the study area in the Shire of Capel mineral sands mining is very active and the extension of mining into the study area would create serious land use conflicts.

3.4 FORESTRY

The Ludlow Tuart Forest, to the north of Busselton represents the only area of forestry activity whithin the the study area. At present extraction of the Tuarts (*Eucalyptus gomphocephala*) has ceased and the forest is currently managed as a Management Priority Area for conservation by the Department of Conservation and Land Management. As the pine plantations at Ludlow are harvested for timber production the extracted pines are replaced with the indigenous Tuart (see Conservation Value, Section 6.1).

3.5 RECREATION AND TOURISM

The natural environment of the study area provides the major basis for the very significant degree of recreational and tourist activities in the study area. A contrast to the natural areas is provided by the areas developed for agriculture, however it is probable that the area under native vegetation in the study area is already at or below the minimum desirable to provide a balance between the two.

A wide range of recreational activities are pursued in the study area:-

- The contrasting sheltered waters of Geographe Bay and the open surf, south of

the Cape accommodate a wide range of water-based activites such as swimming, surfing (board and body), boating (sail and power craft), windsurfing and fishing.

- Walking, caving and abseiling are popular activities from Cape Naturaliste southwards in association with the numerous limestone caves, coastal cliffs, the vegetation habitats, wildflowers and picturesque scenery. Bushwalking is also popular in the Ludlow Tuart Forest, in the north of the study area.

- Cycling is a popular activity in this area, with many people taking cycle touring trips in the south-west.

- Sightseeing and wildflower tours are a very substantial part of the recreational and tourist activity in this south-west area, both private and via organized commercial ventures. In recent years wine tasting and trips to cottage craft industries have become important.

3.6 AGRICULTURE

The agricultural areas in the study area produce a variety of products including beef, milk, sheep, grapes, wine and honey, with the major areas of agricultutral activity being located:-

- within the Wonnerup Wetland Area (between Bussell Highway and the coast),

- south of Bussell Highway and Caves Road, between Ludlow Tuart Forest (the northern boundary of the study area) and Dunsborough,

- Eagle Bay - Bunker Bay Area.

- vicinity of Caves road, between Dunsborough and Cullen Road (the southern boundary of the study area).

One of the most distinctive aspects of the pastoral and grazing areas in the study area is the practise of 'parkland clearing', a clearing method where a number of the larger trees are retained, while the understorey is cleared. This method of clearing is beneficial to the farmer in reducing soil erosion, helping to maintain the water table below the soil surface and providing shelter for livestock. It is also far more aesthetically pleasing than total clearing. However, it should be clearly understood that while it is preferable to total clearing for the reasons given above it is incompatible with conservation as the vast majority of the native fauna and flora are completely removed. It also needs to be understood that what remains is one age group of trees that continue to mature and die and therefore, if they are not progressively replaced the eventual result is the same as immediate total clearing.

3.7 CONSERVATION

Within the study area various reserves have been gazetted for a variety of conservation purposes, a synopsis of these is given here, their particular values are discussed in a later section (6.1):-

- a number of A-class reserves between Cape Naturaliste and the southern boundary of the study area, form part of the Leeuwin-Naturaliste National Park,

- a group of C-class reserves vested in the Busselton Shire are scattered from the townsite of Busselton to the southern boundary of the study area. Of these one particular group, situated in the Meelup - Eagle Bay coastal area (referred to as the Meelup Reserve System) has very high conservation value,

- an A-class reserve near Cape Naturaliste vested in the Busselton Shire which adjoins the Leeuwin-Naturaliste National Park.

- Ludlow Tuart Forest which is a Management Priority Area for conservation.

- the Vasse Estuary, parts of which are vested in the National Parks and Nature Conservation Authority.

3.8 UNCLEARED LAND

Within the study area there are many areas of private and public land which have not been cleared. Some of these have been gazetted for particular purposes, for example reserves for water or gravel, many of the others remain as uncleared land simply by chance. There are exceptions to this for a number have been maintained with limited disturbance by landowners who are aware of their conservation significance.

4.0 FLORA SURVEY

4.1 AIMS

The aims of the flora survey were as follows:-

- to list as much as possible of the flora of the study area,
- to provide plant identifications to assist in the vegetation survey,
- to document populations of rare and geographically restricted species encountered in the flora and vegetation surveys.

4.2 METHODS

Plant specimens were collected at the vegetation recording sites (Section 5.5) and also when time permitted at other locations. The specimens were identified by keying out and comparison to herbarium specimens at the Western Australian Herbarium.

The flora list presented as Appedix One is a compilation of data from the present survey and the flora lists from previous surveys within the study area (ie. Aplin et al., 1983; Tingay & Tingay, 1980; Valentine & Enright, 1975).

4.3 LIMITATIONS

The major limitations of the flora survey are:-

- the sampling is biased towards the vegetation recording sites due to the restricted time available and the size of the study area,
- species that were not in flower at the times that sites were visited were less likely to be collected,
- no attempt was made to collect fungi, lichens, liverworts, mosses or stoneworts due to the restricted time available in the field.

4.4 FLORA

The flora of the study area is very varied due to the wide range of ecotypes present and there are groups of species associated with the sandy coasts, rocky coasts, lower lying sandy areas, wetlands, limestone areas, lateritic uplands and granulite outcrops.

Photograph 3: Wildflower display in the understorey of Jarrah forest on lateritic uplands in the Meelup Reserve System.

The indigenous flora recorded for the study area (see Appendix One) is four hundred and thirty-two angiosperms, one gymnosperm and three fern species. Of the angiosperms, one hundred and twenty-three are monocotyledons (in fourteen families) and three hundred and nine are dicotyledons (in fifty-one families). The most abundant families are Proteaceae (32 species), Myrtaceae (39), Papilionaceae (41) and Liliaceae (33). Of the angiosperms three are gazzetted as rare species and six are geographically restricted.

Photograph 4: *Hovea elliptica* (Tree Hovea) a member of the Papilionaceae which has the largest number of species recorded for a plant family in the study area.

In addition to the native angiosperm flora there are ninety-five introduced angiosperm species (twenty-nine monocotyledons and sixty-six dicotyledons), mostly in Poaceae (23 species), Asteraceae (8) and Papilionaceae (13), the remainder are scattered through twenty three families, seven families were only represented by introduced species

While no attempt was made to collect lower plants (fungi, lichens, liverworts, mosses and stoneworts) many (particularly lichens and fungi) were observed during the survey. Sammy (1985) records the distribution of lichen species for 1:250,000 grid cells in Western Australia with the study area including parts of cell numbers 273 and 274. He records eleven and twenty-six species respectively for these cells, giving thirty-three species in total. It is unlikely that this is an exhaustive list.

4.5 SPECIES DIVERSITY OF VEGETATION TYPES

There is wide variation in the number of species present in the different vegetation types in the study area with some of the simpler units having less than ten species at a recording site and some of the more diverse having many more.

In general as the structure of the vegetation increased in complexity, ie. as the number of layers increased, the number of species at a recording site increased, however there were exceptions to this.

The coastal strand characteristically has low diversity with some of the foredune associations having only two to five species present, though the combinations of these may change. The wetland areas also often have only two to three species in the fringing vegetation. The heathlands have higher species diversity with three to seven species in the upper heath layer, over a number of lower shrubs and herbs. The Jarrah/Marri forests have even higher diversity with some sites having more than sixty species (up to five trees, ten tall shrubs, sixteen lower shrubs over twenty or more herbs with two or three creepers climbing through the upper layers). In contrast some of the *Melaleuca lanceolata* forests in the study area are so dense (thus reducing light infiltration) that some sites had only two to four species in the understorey.

4.6 SPECIES OF PARTICULAR INTEREST

A number of the species collected in the Busselton-Cape Naturaliste study area are of particular interest either because they:-

- are rare and / or geographically restricted,
- form disjunct populations from the main area of distribution of the species,
- are extensions to the known geographical range of the species,

- are poorly collected species,

(a) Rare and Geographically Restricted Species

Calothamnus graniticus ssp. *graniticus*.

This recently described species (Hawkeswood, 1984) is restricted to the study area. It occurs from Point Dalling (within Reserve No. 21629) west of Dunsborough to Eagle Bay, with smaller occurrences near Windmills (south-west of Cape Naturaliste Lighthouse) and Sugar Loaf Rock. It is of particular interest as it is the dominant shrub species of one of the major heath types in the study area ([GH1], see section 5.5) which occurs in a ribbon form along the outcropping coastal and near coastal granulite.

Dasypogon hookeri (pineapple bush)

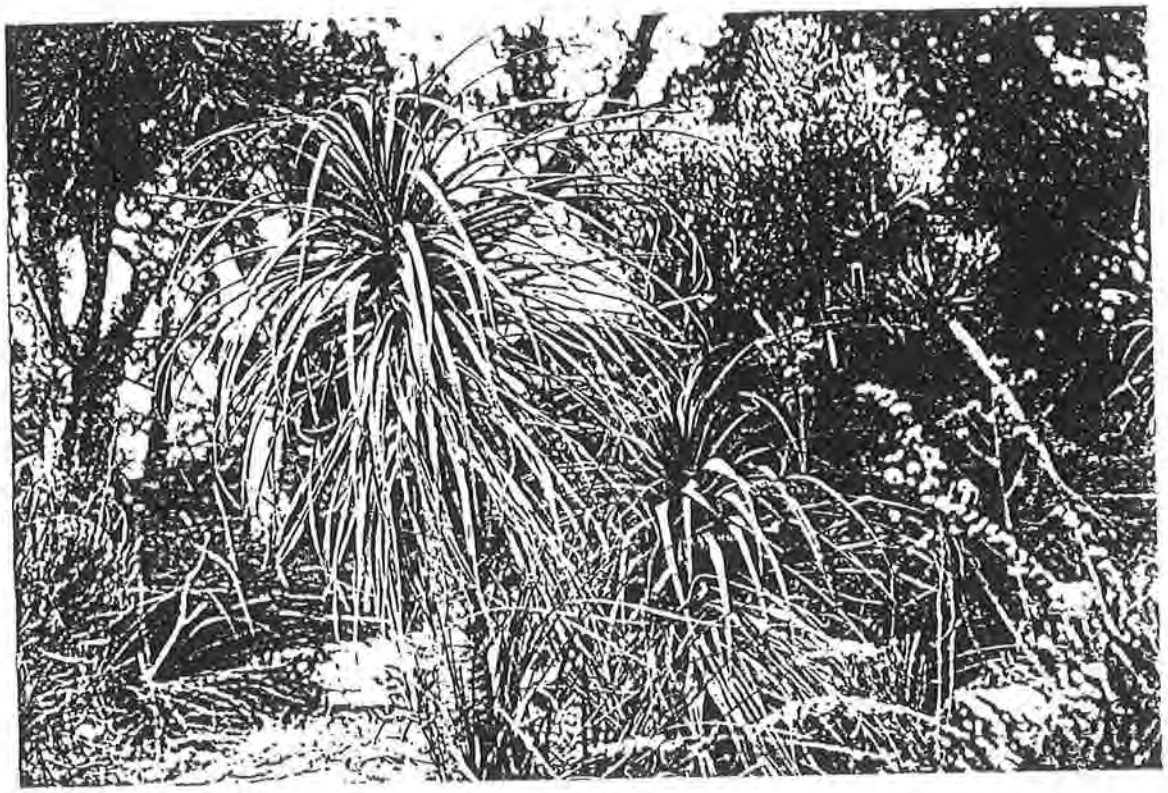
Dasypogon hookeri is a gazetted rare and geographically restricted species (Gillen, 1982) and has an unusual and eyecatching form reminiscent of the pineapple. The populations in the study area are the most north-eastern of its range.

Three populations of *Dasypogon hookeri* were observed in the study area between Dunsborough and Yallingup in areas adjacent to Caves Road:-

- The major occurrence in the study area is in a C-class Reserve, No. C28665, vested in the Busselton Shire for the purpose of 'caves and conservation of flora'. The current staus of this reserve does not reflect its value for the conservation of *Dasypogon hookeri* or for the vegetation types found there. The reserve adjoins a gravel reserve (No. C12493) used by the Local Shire, where the *Dasypogon* comes to the edges of the pit clearings.

- On the south-eastern corner of Reserve No. 8427, an A-class reserve that is part of the Leeuwin-Naturaliste National Park and has the vested purpose of 'protection and preservation of caves, flora and for health and pleasure resort',

- On private property, immediately north, north-east of the Bannamah Wildlife Park. This was the smaller of the three populations, it abutts cleared land.



Photograph 5: *Dasypogon hookeri*, showing its unusual form.

Acacia mooreana

This geographically restricted species was not collected during the present survey. It is known from two locations in the study area, both south of Yallingup, with its main area of distribution being from Donnybrook to Nannup and it has been recorded within a conservation reserve.

Acacia semitrullata

Within the study area this species has been recored in low-lying areas near Busselton, its restricted distribution extends from here in a thin strip to Harvey and it has been confirmed that it is within a conservation reserve. (Not collected during the present survey.)

Exocarpos odoratus

Only five collections of this very geographically restricted species have been made and two of the three known localities are within the study area on moist, low-lying areas of the Perth Basin sediments. There is doubt as to whether or not it occurs within a conservation reserve. (Not collected during the present survey.)

Frankiandia triaristata **(plumed lanoline bush)**

This gazetted rare and geographically restricted species occurs between Boyanup and Nannup on sandy soils. Nine locations are known for this species, only one of which is from within the study area and this location is the most western recorded occurrence of the species. It is not known if this species occurs in a conservation reserve. (Not collected during the present survey.)

Pterostylis barbata x *plumosa*

There have been no collections made of this very geographically restricted orchid species (which is thought to have a resticted range of less than 50 km), only an observation from near Busselton in the study area.

Pultaena drummondii

This geographically restricted species occurs between Busselton and Augusta, two of the nine known locations are from within the study area. The range of this species is believed to be less than 100 km and whether or not it grows in a conservation reserve

is not known. (Not collected during the present survey.)

Pultaena radiata

There has only been one collection made of this species, near Busselton. It is very geographically restricted and is also thought to be rare. Again, whether or not it grows in a conservation reserve is not known. (Not collected during the present survey.)

Boronia tenuis

During the current field work this species was collected near Rocky Point in Reserve No. 21751, west of Eagle Bay. This is a considerable range extension (some 100 km) for this gazetted rare species which was previously known from along the Darling Scarp with the most southerly collection from near Dwellingup.

(b) Species with Disjunct Distributions

These Eucalypt species are of interest for scientific study as their populations in the study area are seperated from the main area of their distribution by some distance and also have considerable aesthetic appeal with there pale, smooth trunks contrasting to the brown and grey, rough trunks of the more common trees. While they may represent areas that the species have spread to it is much more likely that they are remnants of former wider distributions.

Eucalyptus cornuta (Yate)

Within the study area the Yate was seen to 18-20 metres and is the co-dominant in one of the vegetation types (see section 5.5). It is restricted to the moist lower slopes and valleys in areas on the lee side of the Naturaliste Ridge, the best developed stand is on 'Naturaliste Downs'. The smooth white/grey upper branches of the Yate contrast with the darker trunks of *Eucalyptus calophylla*, *E. marginata* and *Agonis*

flexuosa. The main area of distribution of this species is from the Fitzgerald River to the Stirling Range.

An important aspect of this occurrence of *Eucalyptus cornuta* is that most of the population is on privately owned land and thus the security of this species in the study area depends on the goodwill of the landowners. It must be noted that the current land holders are aware of this and have taken protective steps.

***Eucalyptus diversicolor* (Karri)**

There is a small stand of Karri forest on protected slopes above Quininup Brook. The trees are "shorter stemmed with heavy branches and wide crowns" (Smith, 1973) when compared to trees in other populations inland from Cape Freycinet to near Cape Leeuwin that are also outliers from the main Karri belt which lies south-east of the study. It is the most north-westerly occurence of the species.

(c) Extensions to Geographical Range

A number of the specimens collected were of species that had not previously been recorded in the area of the current survey and represent extensions to the known ranges of the species concerned. This is a reflection of the still relatively poor state of knowledge of the flora of the south-west of Western Australia and it is probable that the species occur between the study area and their previously known range rather than their being species with disjunct populations.

Aotus cordifolia

This species was collected from Reseve No. C28683 in Dunsborough where it was one of the most abundant species in the lower shrub layer (20-60 cm). There is a proposal to build a civic and cultural centre on this reserve. The majority of the collections of *Aotus cordifolia* in the Western Australian Herbarium are from the Perth

metropolitan area, with the most southerly being from Dwellingup and the current collection is a large extension to the range of the species

Gompholobium preissii

This species was collected in Reserve No 21629 (which is vested in the Busselton Shire for parklands and recreation) on the gentle slope north of Castle Bay. It is very widespread with most collections coming from west of Quindanning and Collie.

Ptilotus stirlingii* var. *stirlingii

The known range of this species is from Boggy Lake in the Nornalup area to the Stirling Ranges and Perth and then north-east of these localities. The current collection was from the sandy, granulitic rock-strewn beach at Bunker Bay where it was growing with *Isolepis nodosus*, *Sporobolus virginicus*, *Frankenia pauciflora* and *Acanthocarpus preissii*.

Stylidium piliosum

Most of the previous collections of this *Stylidium* are from east of Bremer Bay with one collection from the Lowden River near Dardanup. The current collection is from the slopes above Castle Bay in the Meelup Reserve System (Reserve No. 21629).

Thomasia foliosa

This species has not previoulsy been collected from the far south-west corner, with the nearest collections being from Coolup, Mount Barker and Kojinup. It was collected on the valley slopes of the Meelup River, 2-300 metres inland from Meelup Beach.

Chorisema glycinifolium

Previous collections of this species have been from the Margaret River area. It was collected from near the gravel pit in Reserve No. C31368 in the Meelup Reserve

System and it was also observed at a number of locations in Reserve No. 21629.

Stipa elegantissima

Previous collections of this species have been from the Stirling Ranges to Perth, with no collections in the far south-west corner of the state. It was collected above Shelley Bay, growing to 1.6 m tall through the understorey shrubs and at the Bunker Bay car park.

Schoenus nanus

The nearest collection sites to the study area of this species are Byford and East Manjimup. It was collected on lateritised granulitic slopes in Reserve No. 21629 and is a small plant (2-5 cm) so it is probably often over-looked.

Petrophile striata

This species was collected in Reserve No. C28665 (This reserve is also important for the population there of the rare and geographically restricted *Desmpogon hookeri*.) on Caves Road south of Dunsborough. It had not previously been collected south of Perth where it is restricted to the Darling Scarp.

(d) Poorly Collected Species

Scaevola microphylla

There are only five collections of this species in the Western Australian Herbarium, three from Nornalup and one each from Lake Maringup and Hamel. The new collection is from the lateritised granulitic slopes above Castle Bay in Reserve No. 21629.

Patersonia pygmaea

There are only nine collections of this small *Patersonia* (Native Iris) in the Western Australian Herbarium, with Bridgetown and north-west of Collie being the nearest locations to the study area. It was collected on the moist slopes above Castle Bay and observed on protected slopes inland fom Meelup beach in Reserve 21629.

(e) Other Species of Interest

Eucalyptus gomphocephala (Tuart)

While this species is not rare or restricted it is of interest and concern, for it makes a major contribution to the landscape where it does occur and has suffered a gross reduction to both the extent and quality of the stands that it dominates. Many of the remaining stands are senescent, that is the trees that remain are ageing **and are not being replaced due to grazing.**

The occurrence of *Eucalyptus gomphocephala* in the study area is of particular interest for Ludlow Tuart Forest represents:-

- the most southern occurrence of the species and
- one of the most substantial remaining stands of Tuart in the world.

The importance of this forest for the conservation of Tuart and the associated plant species in the forest, as a habitat for fauna and for its contribution to landscape value is extremely high (see section 6.1 where further specific comments are made on this forest).

5.0 VEGETATION SURVEY OF THE BUSSELTON - CAPE NATURALISTE STUDY AREA

5.1 AIMS

The aims of the vegetation survey were to produce a 1: 25,000 scale vegetation map of the study area with accompanying descriptions of each of the vegetation types and comments on their distribution, relationships to environmental factors and value for conservation.

5.2 METHODS

The vegetation mapping was based on the interpretation of 1: 25,000 scale coloured aerial photographs of the study area. Areas of similar colour and texture were outlined on the photographs. This photo-interpretation was then assessed in the field and units defined and boundaries altered as necessary. Traverses were made by vechicle and foot (much of the study area was inaccessible by road). As new units were encountered detailed site descriptions of representative areas were recorded (species present, percentage cover, height, soil, aspect and slope).

The vegetation was mapped on the basis of a combination of its floristics and structure applying the system of Specht (1970) as modified by Aplin (1979), which uses divisions based on the height of the tallest stratum. This system of vegetation type classification was found to work well, with the variation observed in the field being reflected in the mapping units formed. There were exceptions to this where the visually and probably ecologically significant differences of the vegetation would not have been obvious if the system had been rigidly applied. For example a site with a very open tree cover (2%) of *Agonis flexuosa* over a very dense (80%) shrub

stratum of *Acacia rostellifera* is obviously ecologically and visually much closer to a similar shrubland without a tree layer and in such cases a lower limit for the tree layer of two percent was applied so that such stands were mapped with the vegetation that they most closely resembled. It was thought that this would make the map more useful for management and planning purposes.

Vegetation site descriptions using the system of Muir (1977) are given for representative sites to enable interpretation of the map and to enable appreciation of the variation of the vegetation in the study area.

5.3 LIMITATIONS

The vegetation mapping units each contain a range of plant communities with the same dominants in the upper stratum,where there were significant differences in the understories a further division was made. The at times, considerable range of vegetation within a unit needs to be borne in mind when using the map to ensure an over simplistic interpretation of the vegetation is not made. To avoid this, the map should be read in conjunction with the accompanying text descriptions.

The study area is quite large and time in the field was limited. Conseqently, even given the comment above, all of the variations of the vegetation could not be included in the mapping with some sites being allocated to the site type they are closest to and comments relating to theses variants noted in the text.

5.4 VEGETATION

The vegetation of the study area ranges from the strand vegetation of sandy beaches through dune heaths and scrublands, communities on rocky points, dense limestone heaths and Moonah (*Melaleuca lanceolata*) woodlands and forests on sand and limestone to *Banksia* woodlands on deep sands, Paperbarks (*Melaleuca*

preissiana, *M. rhaphiophylla*) woodlands fringing wetlands, samphire flats and reed banks to Peppermint (*Agonis flexuosa*) and Eucalypt woodlands and forests. There are strong relationships between the vegetation, both its species composition and stature, and the geology and landforms of the Busselton-Cape Naturaliste study area. The descriptions of the vegetation given below are grouped to follow these relationships.

For convenience in the text common names are often used for a number of the dominant species, these are: Moonah (*Melaleuca lanceolata*), Jarrah (*Eucalyptus marginata*), Marri (*Eucalyptus calophylla*), Flooded Gum (*Eucalyptus rudis*), Tuart (*Eucalyptus gomphocephala*), Yate (*Eucalyptus cornuta*), Karri (*Eucalyptus diversicolor*), Swamp Paperbark (*Melaleuca preissiana*), Peppermint (*Agonis flexuosa*), Bull Banksia (*Banksia grandis*), Swamp Banksia (*Banksia littoralis*) and Woody Pear (*Xylomelum occidentale*).

5.4.1 Relationship of the Vegetation to the Geology and Landforms

The study area can be divided into five main surface types reflecting their geology, three are associated with the Leeuwin Block, the others with the Perth Basin and the modern coastline:-

(a) The **Tamala limestone** (calcarenite) which overlies part of the granulitic base rock of the Leeuwin Block. In places this rock forms stable and unstable cliffs (both coastal and inland) and in other places is overlain by the cream-coloured to yellow, orange and brown sands derived from it.

The major vegetation types of this area include *Melaleuca lanceolata* (Moonah) Woodlands and Forests; *Melaleuca huegelii* (Chenille Honey-Myrtle) Thickets, mixed *M. huegelii*, *Agonis flexuosa*, *Spyridium*

globulosum, *Acacia decipiens* Closed Heaths and Mixed *Agonis flexuosa* (Peppermint) *Dryandra sessilis* (Parrot Bush) Low Woodlands.

(b) **Granulite** is the hard base rock of the Leeuwin Block which underlies the Naturaliste Ridge. This rock is exposed in places forming coastal headlands for example at Sugar Loaf Rock and Canal Rocks and inland as large outcrops and scattered surface rocks.

The major vegetation types of these granulitic areas include the geographically restricted *Calothamnus graniticus* ssp. *graniticus*, (the holotype comes from the study area) in Heaths with *Dodonaea ceratocarpa*, *Pimelea ferruginea*, *Hakea trifurcata* and *Daviesia horrida*.

(c) **Lateritised granulite**, over a broad area the granulitic base of the Leeuwin Block is capped by laterite, which in many places is overlain by creamy-yellow to yellow, orange, brown and grey sands. At high points and on some slopes the granulite outcrops.

The deeper soils of this zone support vegetation of increased stature and development such as woodlands and forests of *Eucalyptus marginata* (Jarrah), *E. calophylla* (Marri), *Allocasuarina fraseriana* (Sheoak), *Banksia grandis* (Bull Banksia), *B. attenuata* and *Nuytsia floribunda* (West Australian Christmas Tree). The understories of these woodlands and forests contain a diversity of shrub and herb species including *Dasypogon hookeri* (pineapple bush), *Kingia australis* (Black Gins), *Xanthorrhoea preissii*, *X. gracilis*, *Macrozamia riedlei* and *Hibbertia hypericoides*. The increased run-off on the lower slopes provides sufficient moisture for the development of *Eucalyptus megacarpa* (Bullich) and *Eucalyptus*

cornuta (Yate) woodlands.

The water courses support mixed woodlands and forests of *Eucalyptus rudis* (Flooded Gum) the paperbarks *Melaleuca preissiana* and *M. rhaphiophylla* and *Banksia littoralis* (Swamp Banksia) with *Logania vaginalis* and *Bossiaea linophylla* prominent in the understories.

(d) **The Perth Basin sediments** are deep, nutrient poor, calcareous aeolian sands in the low-lying area between Dunsborough and Forrest Beach (the northern boundary of the study area).

Agonis flexuosa (Peppermint) and *Eucalyptus gomphocephala* (Tuart) are the major trees of this surface type, with the Peppermint being the most widespread.

Hibbertia cuneiformis and the wattles *Acacia rostellifera*, *A. cochlearis* and *A. decipiens* are the most abundant understorey species in this area, they also form heaths. A variety of types of wetlands occur in low-lying areas, those with fresh water have *Melaleuca preissiana* and *M. rhaphiophylla* woodlands over understories of *Juncus krausii* and *Typha occidentalis*. The shallow saline wetlands have low shrublands of samphires (*H. ?pergranulata*, *Sarcocornia quinquiflora* and *Suaeda australis*) and *Juncus kraussii* sedgelands.

(e) **The coastal strip**, along the coastline of both the Leeuwin Block and the Perth Basin calcareous sand forms sandy beaches and dunes between the rocky headlands and along Geographe Bay.

The vegetation includes a strand of colonising species (**Arctotheca calendula*, *Cakile maritima* Low Shrublands) followed by an incipient foredune (*Spinifex longifolius*, *S. hirsutus* Open Grasslands, **Ammophila arenaria* (Marram Grass) Tussock Grasslands and mixed *Pelargonium capitatum*, *Tetragonia decumbens*, **Trachyandra divaricata* Low Shrublands) and then low dunes with intervening swales which have mixed *Acacia cochlearis*, *A. cyclops*, *Scaevola crassifolia* Open Heaths.

The vegetation types in each of these areas are described below and their distribution shown on the accompanying vegetation map.

5.4.2 Vegetation of the Busselton-Cape Naturaliste Study Area

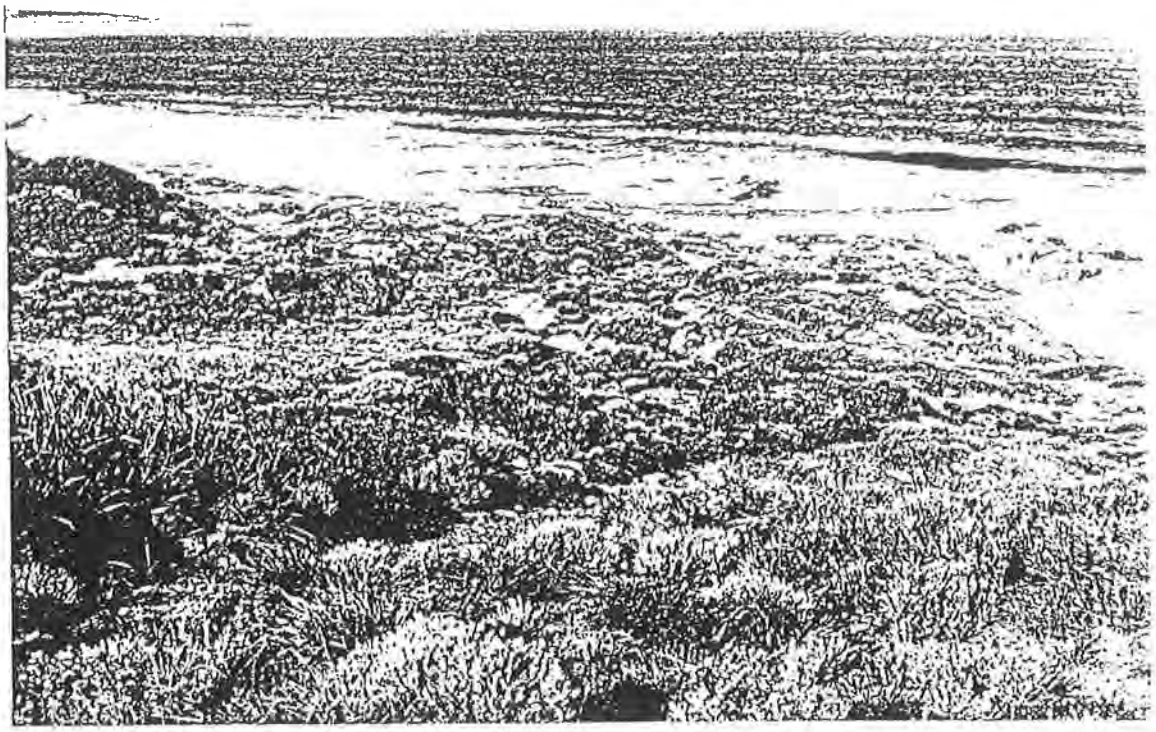
(a) Tamala Limestone (Calcarenite)

Olearia axillaris*, *Scaevola crassifolia*, *Acanthocarpus preissii*, *Rhagodia baccata*, *Calocephalus browniI*, *Acacia decipiens

LOW OPEN HEATH [SH3]

This vegetation type occurs on steep slopes with shallow caves and exposed grey-white limestone above narrow sandy coastal strips. The low height of the vegetation type (30-50 cm) is a reflection of the combined effects of wind-pruning and the shallow grey sandy soils. Other species include shrubs of *Pimelea ferruginea*, *Boronia alata*, *Templetonia retusa* and *Melaleuca huegelii* and the herb *Lomandra nitida*.

Distribution: This community is common on the steep slopes down to the either sandy or rocky coastlines from Cape Naturaliste to the southern end of the study area.



Photograph 6: *Olearia axillaris, Scaevola crassifolia, Acanthocarpus preissii, Rhagodia baccata, Calocephalus brownii, Acacia decipiens* LOW OPEN HEATH [SH3]

Comments: This is an extremely fragile vegetation type which plays a very important role in stabilizing the steep slopes on which it occurs and which are exposed to strong on-shore winds. Because of their fragility the careful management of these areas is very important as they are easily accessible from the coastal track and easily damaged by trampling due to their low nature.

Spyridium globulosum, Olearia axillaris, Acacia rostellifera **CLOSED HEATH [SH1]**

This vegetation type occurs on coastal dunes and on areas of grey sands upslope from near-coastal limestone cliffs. It is the common heath on coastal sand areas in the

study area and has a height range of 1.2-1.5 m. Other species found in this vegetation type are shrubs of *Acanthocarpus preissii*, *Rhagodia baccata*, *Acacia cochlearis*, *Acacia littorea*, *Hibbertia cuneiformis*, *Melaleuca acerosa*, *Phyllanthus calycinus*, *Diplolaena dampieri*, *Scaevola crassifolia*, herbs of *Conostylis setigera* and the sedges *Lepidosperma gladiatum* and *Loxocarya fasciculata*.

Muir Descriptions:

Site 358

Mixed *Olearia axillaris* (dominant) *Scaevola crassifolia*, *Acacia cyclops*, *Melaleuca huegelii* Dense Low Heath C, with occasional low shrubs of *Boronia alata*, *Calocephalus brownii*, *Acanthocarpus preissii*, *Leucopogon propinquus*, over very low shrubs of *Suaeda australis*, *Arctotheca Calendula*, *Carprobotus* sp. (CK 47) and tussock grasses of *Spinifex hirsutus*.

Site 366 (a)

Mixed *Acacia rostellifera*, *Olearia axillaris*, *Spyridium globulosum*, *Hibbertia cuneiformis* Heath B over occasional shrubs of *Diplolaena dampieri*, *Rhagodia baccata*, *Acacia littorea* over occasional low shrubs of *Pelargonium capitatum* with occasional emergent shrubs of *Dryandra sessilis*.

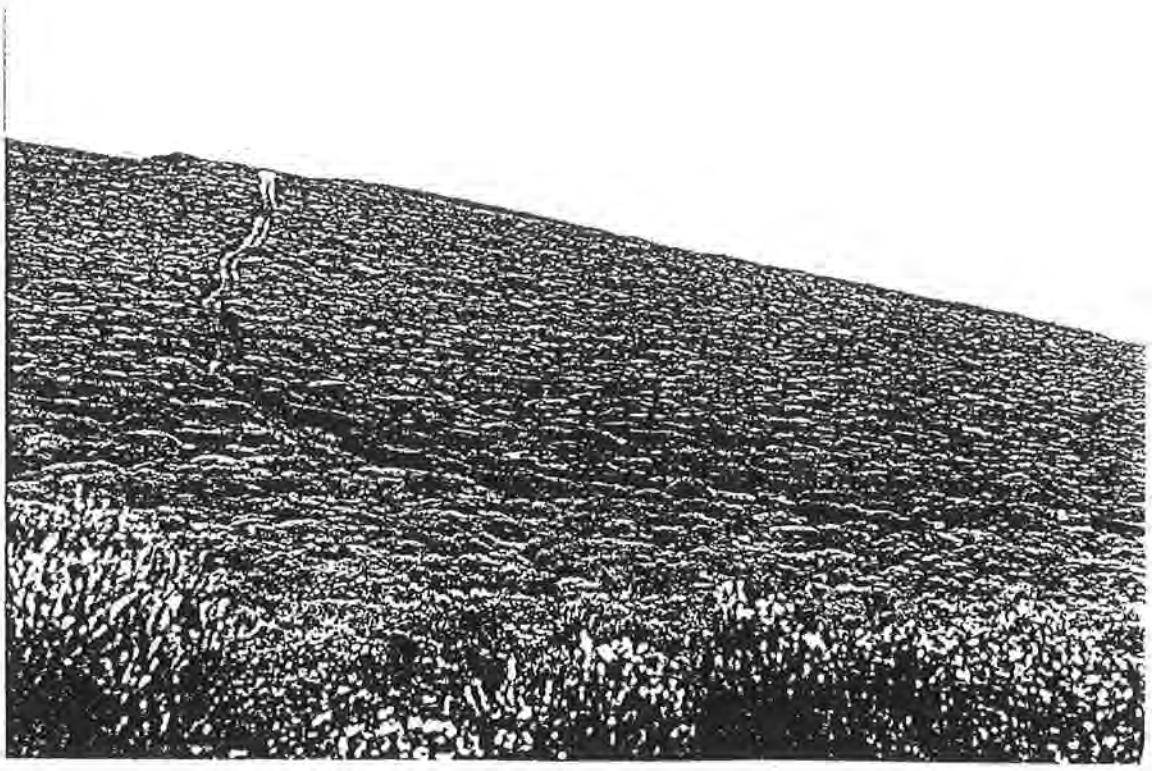
Site 337 (b)

Mixed *Olearia axillaris*, *Acacia rostellifera*, *Hibbertia cuneiformis*, *Spyridium globulosum*, Dense Heath A, with occasional emergent *Agonis flexuosa* (2-3 m), with occasional shrubs of *Diplolaena*

dampieri, *Leucopogon propinquus*, *Dryandra sessilis* over low shrubs of *Rhagodia baccata*, *Acacia littorea*, *Acanthocarpus preissii*, *Phyllanthus calycinus* and *Sueeda australis* and the herb *Patersonia occidentalis*.

Site 332

Mixed *Templetonia retusa*, *Spyridium globulosum*, *Olearia axillaris*, Heath B, with occasional shrubs of *Melaleuca huegelii* (increases in height with proximity to cliff face, ie. with protection from wind and salt spray), *Acacia littorea*, *Thryptomene saxicola* and *Leucopogon propinquus*, over low shrubs of *Acanthocarpus preissii* and *Melaleuca acerosa* over occasional herbs of *Loxocarya fasciculata* and *Patersonia occidentalis*.



Photograph 7: *Spyridium globulosum*, *Olearia axillaris*, *Acacia rostellifera*

Closed Heath [SH1]

Distribution: Patches of this vegetation type occur in a strip south-wards from near the Cape Naturaliste Lighthouse to the end of the study area.

Comments: This vegetation type is relatively undisturbed except for four-wheel drive tracks, fire-breaks and a low degree of weed invasion.

Occasional shrubs of *Melaleuca huegelii*, the dominant species of heath type LH4, occur through this unit reflecting the effect of the underlying limestone.

The grey-white appearance of *Olearia axillaris* enables easy visual separation of this heath type from surrounding heath types.

Boronia alata, Spyridium globulosum, Olearia axillaris **CLOSED HEATH [SH2]**

This community occurs in sandy lowlands between rocky headlands, as a narrow strip, usually about 60 m from the high water-mark, it is very dense and varies in height from 0.8-1.2 metres. The leaves of the *Boronia* give a shiny appearance to this vegetation type, their pinnate form and pungent odour are quite distinctive. The *Boronia* shares dominance with *Spyridium globulosum* and *Olearia axillaris* but is more abundant than either. Other species in this community include shrubs of *Acacia rostellifera, Acacia cochlearis, Hibbertia cuneiformis, Rhagodia baccata, Exocarpus sparteus*, scramblers of *Tetragonia amplexicoma* and the sedges *Lepidosperma gladiatum* and *Isolepis nodosus*.

Distribution: The main occurrence of this community in the study area is between the area of *Acacia* Heath [SH1] south of Cape Naturaliste and the area of *Calothamnus* heath [GH1] north of Sugarloaf Rock. There are also a number of smaller patches in this area.

Comments: The area of this vegetation type in the study area is quite limited, it does not seem to occur north of the study area, but may occur further south.

Although *Boronia alata* is also found scattered through a number of the *Acacia* Heath [SH1] areas, it is not common or widespread in the study area.

Scaevola nitida, Exocarpos sparteus LOW TO MEDIUM CLOSED HEATH [SH6]

This community is found on grey and yellow sands some 500 m from the beach. The *Scaevola* has a cover of 80-90% and a height range of 0.5-1.2 metres. While the *Exocarpos* is much less abundant, it is visually very prominent due to its unusual yellow-green colour. Other species in the community include shrubs of *Olearia axillaris, Acacia divergens, Pimelea ferruginea, Rhagodia baccata, Templetonia retusa, Hibbertia serrata, Hibbertia racemosa, Hibbertia cuneiformis, Acanthocarpus preissii, Boronia alata, Hakea prostrata, Daviesia horrida* and *Melaleuca acerosa*, creepers of *Hardenbergia comptoniana* and the sedges *Lepidosperma gladiatum* and *Juncus krausii*.

Muir Descriptions:

Site 326

Scaevola nitida Dense Low Heath B with occasional shrubs of *Spyridium globulosum, Olearia axillaris, Acacia rostellifera, Acacia cochlearis, Hibbertia cuneiformis, Rhagodia baccata* and *Templetonia retusa*.

Site 338 (a)

Mixed *Scaevola nitida, Olearia axillaris, Hibbertia cuneiformis, Spyridium globulosum, Acacia rostellifera* Dense Heath A with

occasional *Lepidosperma gladiatum* and *Exocarpus sparteus* over occasional shrubs of *Diplolaena dampieri*, *Suaeda australis*, *Leucopogon propinquus*, *Acanthocarpus preissii* and *Rhagodia baccata*.

Site 338 (b)

Scaevola nitida Dense Heath A with occasional *Exocarpus sparteus* and *Lepidosperma gladiatum*.

Site 339(b)

Mixed *Scaevola nitida*, *Acacia rostellifera* Dense Heath B with occasional shrubs of *Spyridium globulosum*, *Diplolaena dampieri*, *Hakea prostrata*, *Hibbertia cuneiformis* and *Daviesia horrida*, over occasional low shrubs of *Melaleuca acerosa*, *Hibbertia racemosa*, occasional sedges of *Juncus krausii*, *Lepidosperma gladiatum*, and occasional creepers of *Hardenbergia comptoniana*.

Distribution: The two main occurrences of this vegetation type in the study area are near the Cape Naturaliste Lighthouse and abutting the car park one km south-south-west of the Lighthouse. The minor occurrences are also in this area.

***Acacia rostellifera*, *Spyridium globulosum*, *Thryptomene saxicola* OPEN HEATH [SHO]**

This vegetation type occurs upslope from coastal limestone cliffs, on yellow sand. The height of the heath is approximately 1.2-1.5 m with occasional emergents of *Banksia attenuata* (2.5 m), *Agonis flexuosa* and *Eucalyptus calophylla* (to 4 m). Other species include shrubs of *Melaleuca acerosa*, *Grevillea vestita*, *Daviesia divaricata*, *Hibbertia hypericoides*, *Allocasuarina humilis*, *Hakea*

prostrata, *Acacia cochlearis* and the sedge *Loxocarya fasciculata*.

Muir Descriptions:

Site 325

Acacia rostellifera, *Acacia cochlearis*, *Thryptomene saxicola* Mixed Heath B, with occasional shrubs of *Spyridium globulosum*, *Olearia axillaris*, *Santalum acuminatum* and occasional sedges of *Lepidosperma gladiatum* over Mixed *Melaleuca acerosa*, *Templetonia retusa*, *Rhagodia baccata*, *Scaevola crassifolia*, *Hakea prostrata* Open Dwarf Scrub C, over Mixed *Allocasuarina humilis*, *Hibbertia hypericoides*, *Calothamnus sanguineus* Low Heath D, over low herbs of *Loxocarya fasciculata*, *Hybanthus calycinus* and *Patersonia occidentalis*, with occasional emergent shrubs of *Dryandra sessilis* (1.8m) and stunted tree forms of *Eucalyptus calophylla* (2.5m), in pockets.

Site 327

Acacia rostellifera, *Acacia cochlearis*, *Thryptomene saxicola* Mixed Heath B with occasional shrubs of *Spyridium globulosum*, *Olearia axillaris*, *Santalum acuminatum* and occasional sedges of *Lepidosperma gladiatum* over Mixed *Melaleuca acerosa*, *Templetonia retusa*, *Rhagodia baccata*, *Scaevola crassifolia*, *Hakea prostrata*, Open Dwarf Scrub C over Mixed *Allocasuarina humilis*, *Hibbertia hypericoides*, *Calothamnus sanguineus* Low Heath D, over sedges of *Loxocarya fasciculata* and low herbs of *Hybanthus calycinus* and *Patersonia occidentalis*, with occasional emergent shrubs of *Dryandra sessilis* (1.8m) and stunted tree forms of *Eucalyptus calophylla* (2.5 m) and *Agonis flexuosa* (2.5m) in pockets.

Site 329

Acacia rostellifera, *Scaevola crassifolia*, *Templetonia retusa* Heath E, with occasional shrubs of *Melaleuca acerosa*, *Thryptomene saxicola*, *Spyridium globulosum* and *Olearia axillaris* over *Allocasuarina humilis* Open Dwarf Scrub C with occasional low shrubs of *Hibbertia hypericoides*, *Hakea prostrata* and occasional emergent stunted tree forms of *Agonis flexuosa* (2.5m).

Distribution: Within the study area this vegetation type is restricted to the vicinity of Cape Naturaliste, it is not known whether it occurs outside the study area.

Comments: This vegetation type is one of the more important of several heath types that were only observed in the vicinity of Cape Naturaliste. In places it abuts *Banksia attenuata* woodland and it is in these areas that *Banksia attenuata* occurs as an occasional emergent.

Allocasuarina humilis*, *Melaleuca acerosa*, *Olearia axillaris

LOW CLOSED HEATH [SH9]

This vegetation type occurs on gentle slopes below *Banksia attenuata*, *Banksia grandis* and *Agonis flexuosa* woodlands and upslope from stabilised dunes on grey-white sands and has a height range of 0.8-1.2 m. Occasional stunted Peppermints (*Agonis flexuosa*, 2.0-2.5 m) occur. Other prominent species include shrubs of *Acacia cochlearis*, *Cryptandra arbutiflora*, *Hibbertia hypericoides* and *Jacksonia* sp. (CK139) with herbs of *Loxocarya fasciculata*.

Distribution: One area of this vegetation type was found, it is situated about 0.5 km south of the Cape Naturaliste Lighthouse.

Comments: As only one area of this unit was found care should be taken to avoid disturbing it, especially given its close proximity to the Lighthouse.

The area is easily accessible by two-wheel drive vehicles and also supports a few walk tracks, one of which is an over-grown old water-line, which originally linked with a pumping station at the top of the coastal cliffs, south of the Cape Naturaliste Lighthouse.

Acacia rostellifera, Agonis flexuosa, Thryptomene saxicola **CLOSED SCRUB [SH8]**

This vegetation type is closely related to the *Acacia rostellifera, Spyridium globulosum, Thryptomene saxicola* Open Heath and also occurs upslope from coastal limestone outcrops on yellow sand, it is very dense and has a height range of 2.2-5.0 m. Other species in this community include shrubs of *Spyridium globulosum, Olearia axillaris, Acacia cochlearis, Phyllanthus calycinus* and *Hakea prostrata* (which is also recorded as an occasional emergent). The herb layer includes *Patersonia occidentalis*.

Distribution: The only patches of this vegetation type observed occur approximately one kilometre south-south-west of the Cape Naturaliste Lighthouse.

Comments: As this vegetation type is of limited distribution care needs to be taken in management programmes to ensure that not all of it is burnt at one time, or that it is not adversely affected by roads or fire breaks.

Hibbertia cuneiformis, Thryptomene saxicola, Allocasuarina humilis **LOW OPEN HEATH [SH7]**

This vegetation type occurs on yellow sand upslope from limestone cliffs. It is about

30-40 cm tall and has occasional emergents of *Spyridium globulosum*, *Olearia axillaris*, *Agonis flexuosa* to 2m tall. Associated species include shrubs of *Acacia cochlearis*, *A. rostellifera*, *A. divergens*, *Acanthocarpos preissii*, *Hibbertia hypericoides*, *Scaevola crassifolia* and *Melaleuca acerosa*. *Loxocarya fasciculata* occurs under the shrub layer.

Distribution: The only area of this vegetation type in the study area is approximately 200 metres north of the Cape Naturaliste Lighthouse.

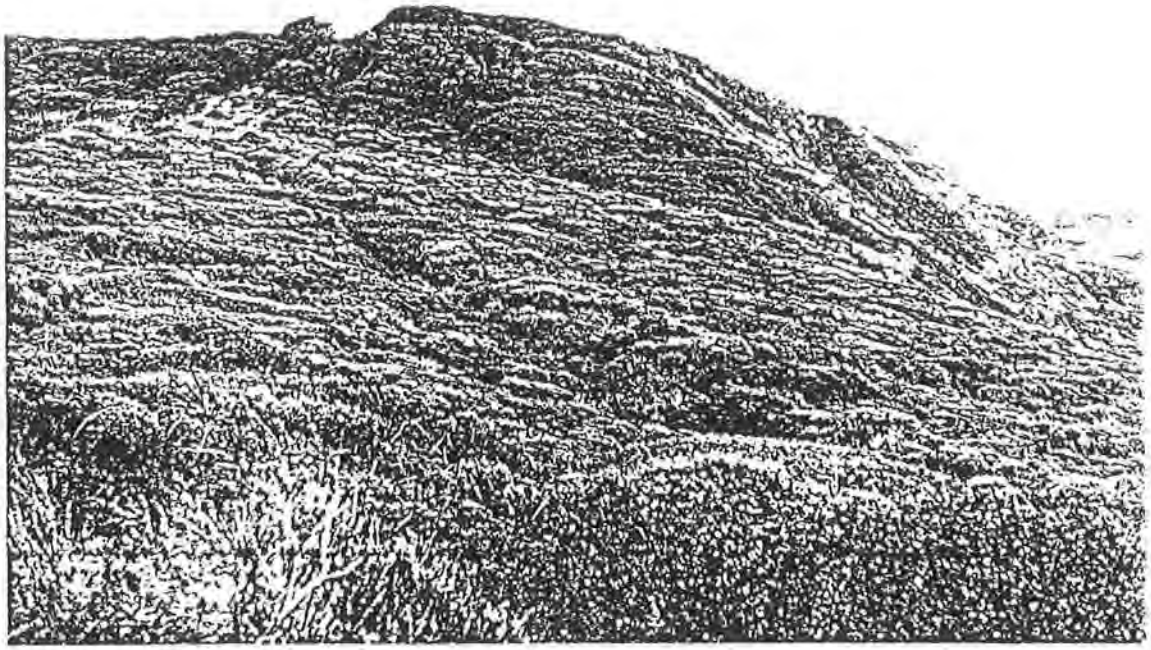
Comments: As this vegetation type is surrounded by taller heath types and is much lower, the area presumably has rock close to the surface.

***Melaleuca lanceolata*, *M. huegelii* CLOSED HEATH [LH1]**

This heath is an intergrade between *Melaleuca lanceolata* [LH2] and *M. huegelii* [LH4] heaths, where the dominance is shared. This stand occurs on creamy-yellow to creamy-brown sands and has a height range of 1.5-2.5 metres. Other species present in the upper stratum include *Leucopogon propinquus*, *Hibbertia cuneiformis*, *Spyridium globulosum* and *Olearia axillaris*. The understorey includes *Templetonia retusa*, *Diplolaena dampieri*, *Rhagodia baccata*, *Tetragonia implexicoma* and *Acanthocarpus preissii*. Occasionally *Boronia alata* is present in the understorey.

Distribution: This stand occurs in patches on the lower windward slopes of the Naturaliste Ridge between Sugar Loaf Rock and the southern boundary of the study area.

Comments: These stands usually have a linear shape, paralleling the coast.



Photograph 6: *Melaleuca lanceolata, M. huegelii* Closed Heath [LH1]

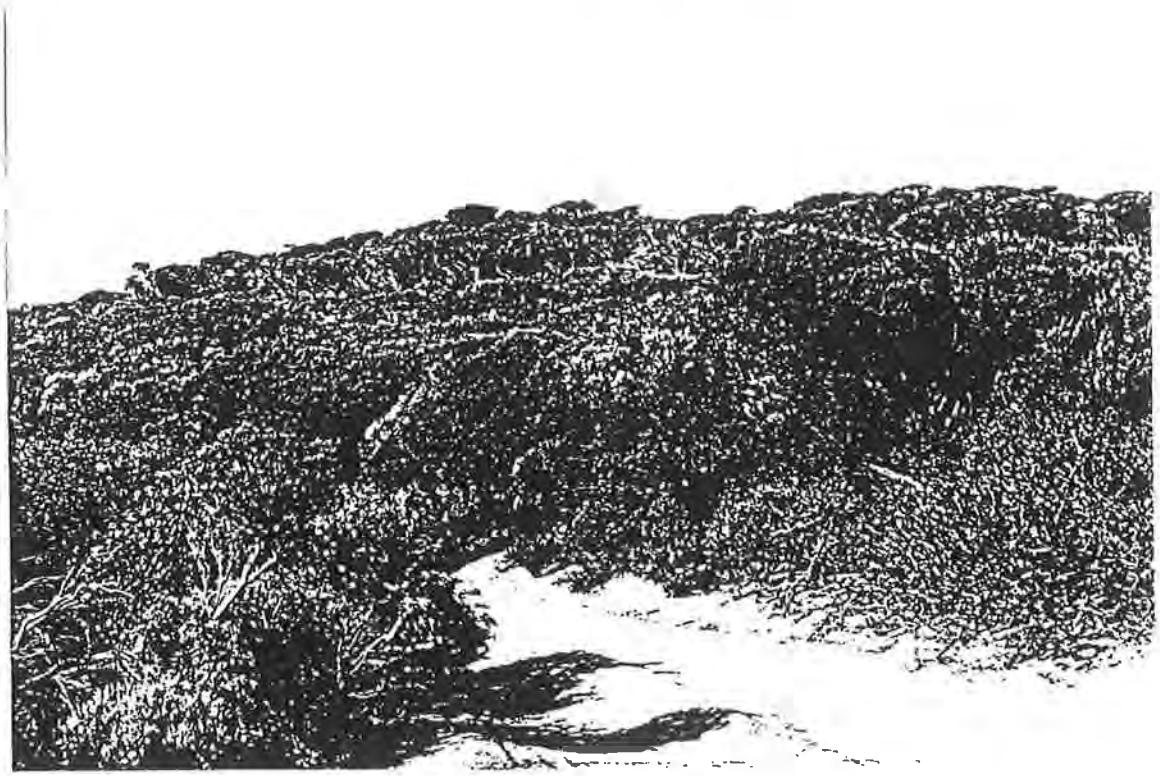
***Melaleuca lanceolata* CLOSED HEATH [LH2]**

This vegetation type occurs on the exposed slopes of the Naturaliste Ridge, on creamy-yellow to yellow coloured sands, often with out-cropping limestone and has a height range of 1.5-2.5 m. *Templetonia retusa, Diplolaena dampieri, Leucopogon propinquus* and *Acacia divergens* reach the same height as the dominant. Occasional lower shrubs of *Rhagodia baccata, Acanthocarpus preissii* and *Tetragonia implexicoma* occur under the dense heath.

Distribution: This unit occurs on the lower windward slopes of the Naturaliste Ridge, from south of Sugar Loaf Rock to the southern end of the study area.

Comments: The dominant of this important limestone heath is often much taller than in this unit and its lower stature here is probably due to a combination of shallow

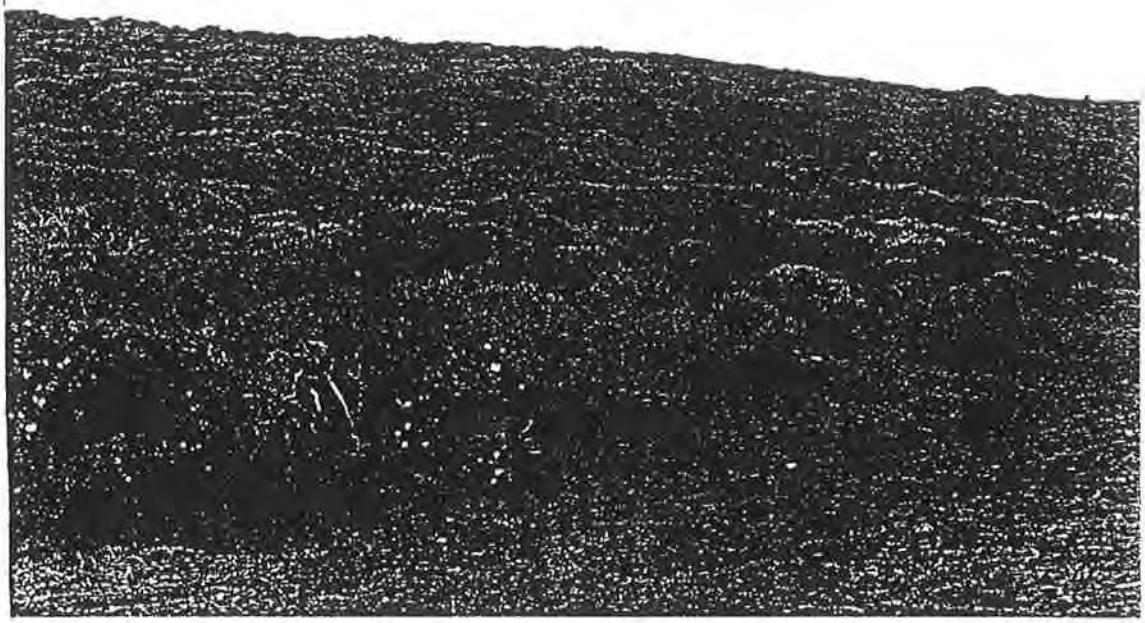
soils and wind pruning



Photograph 9: Foreground *Melaleuca lanceolata* Closed Heath, background *Melaleuca lanceolata* Low Closed Forest [LH2]

***Melaleuca huegelii* CLOSED HEATH [LH4]**

This vegetation type, with a height range of 1-1.8 m tall, is one of the more widespread and continuous within the study area. It occurs upslope from the *Acacia* heaths on shallow yellow sands (with cream coloured or brown surfaces) over limestone. Although *Melaleuca heugelii* dominates, shrubs such as *Olearia axillaris*, *Spyridium globulosum* and *Acacia littorea* are important secondary species. *Diplolaena dampieri*, *Templetonia retusa* and *Thomasia triphylla* are other species present in lower numbers. Low shrubs of *Acanthocarpus preissii*, *Pimelea ferruginea*, *Phyllanthus calycinus*, herbs of *Loxocarya fasciculata* and the sedge *Lepidosperma gladiatum* form the understorey.



Photograph 10: *Melaleuca huegelii* Closed Heath [LH4]

Muir Description:

Site 339

Mixed *Melaleuca huegelii* [dominant]. *Spyridium globulosum*, *Scaevola crassifolia*, *Acacia littorea*, *Olearia axillaris* Heath B, with occasional shrubs of *Diplolaena dampieri*, *Acanthocarpus preissii*, *Templetonia retusa* and *Leucopogon propinquus* and occasional sedges of *Lepidosperma gladiatum*.

Distribution: Areas of this heath type are found from near Cape Naturaliste Lighthouse to Moses Rock and it is one of the major heaths on this stretch of coastline.

Comments: On the coastline where this heath type occurs its density and continuous canopy contribute significantly to the high landscape value of the area, with its distinctive windswept appearance.

This vegetation type is relatively undisturbed, with the major disturbances being 4-wheel drive tracks and firebreaks.

***Dryandra sessilis* (Parrot Bush) CLOSED HEATH [DH3]**

This community occurs above a limestone cliff on shallow yellow-orange sand with outcropping limestone. The dominant is approximately 1.4 metres tall with an understorey including shrubs of *Acacia cyclops*, *Acacia littorea*, *Spyridium globulosum*, *Olearia axillaris*, *Pelargonium capitatum*, *Templetonia retusa* and *Leucopogon propinquus*, the sedge *Isolepis nodosus* and the creeper *Kennedia prostrata*.

Muir Description:

> Site 335
>
> *Dryandra sessilis* Thicket, over mixed *Acacia cyclops*, *Acacia littorea*, *Spyridium globulosum* Low Heath C, with occasional sedges of *Isolepis nodosus*, and low shrubs of *Pelargonium capitatum*, *Leucopogon propinquus* and *Templetonia retusa* over herbs of *Patersonia occidentalis* and the ground cover *Kennedia prostrata*.

Distribution: This community was noted at only one location, about one km north to north-west of the Cape Naturaliste Lighthouse.

Acacia divergens, Melaleuca huegelii, Dryandra sessilis CLOSED SCRUB [LH3]

This dense scrub occurs on gentle slopes with creamy-brown over yellow sandy soils with outcropping limestone. Other species in the upper layer (1.4-2.5 m) include *Acacia rostellifera, Agonis flexuosa, Viminaria juncea, Melaleuca lanceolata, Spyridium globulosum, Scaevola nitida* and *Olearia axillaris*, under these there are *Acacia cochlearis, Melaleuca scerosa* and *Acanthocarpus preisii*.

Distribution: There is only one occurrence of this vegetation unit in the study area in the Canal Rocks area on both sides of Canal Rocks Road (west of Smiths Beach intersection) on a gentle slope.

Comments: While the majority of the stand occurs within the Leeuwin-Naturaliste National Park the remainder of the stand is part of the vegetation on a very important and largely uncleared privately owned block (Sussex loc. 413) at Smiths Beach. This block is important because with the adjoining narrow strip of Vacant Crown Land it provides a link along the coast between otherwise disjunct parts of the Park. It is also important for a restricted vegetation type (see Recommendations, 7.0).

Acacia divergens CLOSED SCRUB [Ad]

This dense vegetation type has an upper stratum height range of 2-3 m with occasional emergents of *Hakea oleifolia*. It occurs on gentle slopes with creamy-brown sandy soils. Other prominent species include *Acacia cochlearis, Scaevola nitida, Melaleuca huegelii, Agonis flexuosa* and *Spyridium globulosum*.

Distribution: The only stand in the study area occurs on both sides of Smiths Beach

Road at the T-junction with Canal Rocks Road.

Comments: The conservation value of this closed scrub is high as it is the only stand in the study area. It is within the Leeuwin-Naturaliste National Park, unfortunately however it adjoins cleared land to the east.

Melaleuca huegelii **CLOSED SCRUB 1 [LH6]**

This dense vegetation type occurs on exposed limestone areas, with pale-grey to yellow sandy soils. The dominant varies from 1.5-2.5 m tall. Other species in the upper stratum are *Spyridium globulosum*, *Acacia rostellifera*, *Agonis flexuosa*, *Olearia axillaris* and *Dryandra sessilis*. Understorey shrubs include *Diplolaena dampieri*, *Hibbertia cuneiformis* and *Adriana quadripartita*.

Photograph 11: *Melaleuca huegelii* Closed Scrub [LH6]

Muir Description:

Site 371

Melaleuca huegelii Dense Thicket over *Acacia rostellifera, Spyridium globulosum, Olearia axillaris, Agonis flexuosa, Diplolaena dampieri* Low Scrub B with occasional shrubs of *Hibbertia cuneiformis, Adriana quadripartita, Leucopogon propinquus,* over ocasional *Acacia littorea* and herbs of *Phyllanthus calycinus* with occasional emergent shrubs of *Dryandra sessilis.*

Distribution: This vegetation type covers large areas in a strip parallel to the coast from the point about one km south of Cape Naturaliste Lighthouse to the southern end of the study area.

Comments: Due to the combined effect of increasing soil depth and decreasing wind pruning the height of this unit increases away from the beaches.

***Dryandra sessilis, Agonis flexuosa* CLOSED SCRUB [DH2]**

This vegetation type occurs in strips parallel to the coast upland from *Acacia* Heaths [SH1] and *Melaleuca huegelii* Heaths [LH4] on creamy yellow sands with outcropping limestone. The light-green of the *Agonis*, the dark-green of the *Dryandra* and its distinctive erect form help to distinguish this unit from the surrounding vegetation types. Other species include *Acacia littorea, A. saligna, A. cochlearis, A. pulchella, A. rostellifera, Melaleuca huegelii, Spyridium globulosum, Hibbertia* sp. (CK8), *Xanthorrhoea preissii, Macrozamia riedlei* and *Olearia axillaris*. There are occasional emergents of *Banksia attenuata* and stunted Jarrah (*Eucalyptus marginata*) and Marri (*Eucalyptus calophylla*).

Distribution: Patches of this scrub type occur between Sugar Loaf Rock and the southern boundary of the study area.

Comments: *Dryandra sessilis* is an important nectar source for birds and small marsupials, care should be taken in the management of this vegetation type to maintain this food resource, and the shelter resource also provided by this species.

Melaleuca huegelii CLOSED SCRUB 2 [M2]

This vegetation type occurs on grey sands inland from the coast. The dominant ranges from 2.0-3.5 metres high and in the large stand it has a foliage cover of some 90%. Other stands of this species in the study area are not as tall presumably because they occur closer to the ocean, and are classified as heaths. Other shrubs present include *Hakea oleifolia*, *Leucopogon propinquus* and *Hibbertia* sp. (CK159).

Photograph 12: *Melaleuca huegelii* Closed Scrub 2 [LH6]

Distribution: Only one substantial, undisturbed, area of this vegetation type occurs in the study area one km inland south, south-east of Moses Rock, as well there are small, disturbed stands lining the roads to Canal Rock and Sugarloaf Rock.

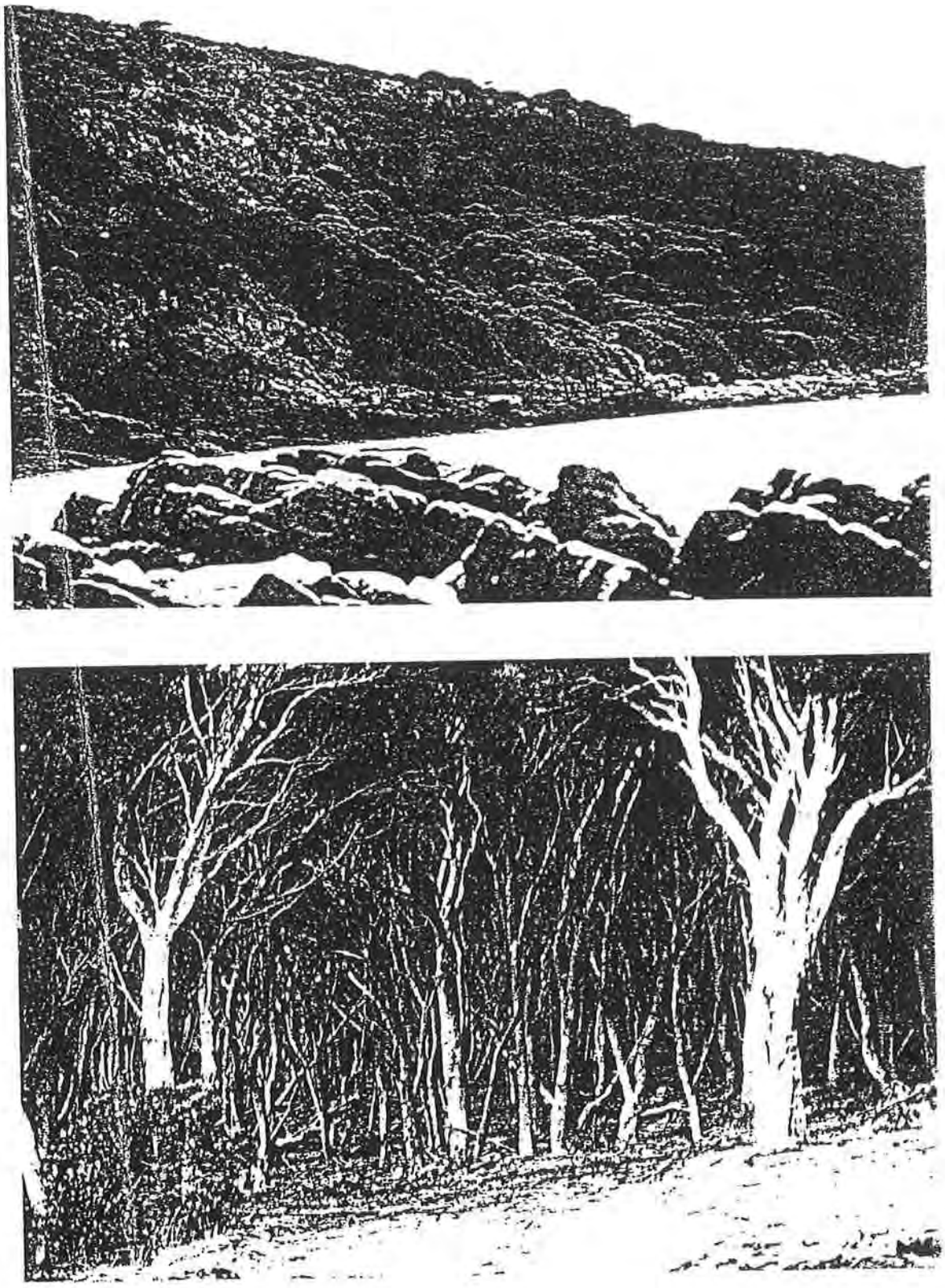
Comments: Due to the density of the dominant there is very little understorey. The eastern edge of the major stand abuts cleared land, over which it may once have partially extended.

Management of the major stand should recognise that it has not been burnt for some time and should include exclusion of fire for all or a significant part, as it may have important habitat value as well as being of interest because of its age.

***Melaleuca lanceolata* (Moonah or Rottnest Island Ti-tree) LOW CLOSED FOREST to CLOSED FOREST [M1]**

This unit includes two of the height classes given by Aplin (1979). It was not practicable to seperate them in the field due to lack of time. It occurs near the beach, below cliffs, above cliffs and down steeply sloping rock slopes on dark-grey to brown often with outcropping limestone or less commonly pale-grey sands. The Moonah varies in height from 2 to 15 metres reflecting the effects of soil depth and wind pruning. The understorey has shrubs of *Tetragonia amplexicoma*, *Rhagodia baccata*, *Leucopogon propinquus*, *Suaeda australis* and occasionally *Pittosporum phylliraeoides* var. *phylliraeoides* and the grass CK104.

Distribution: This unit occurs at a number of places from Dunsborough to the southern end of the study area. Good stands occur between Bunker Bay and the tip of Cape Naturaliste, near Sugarloaf Rock and at Yallingup. Disturbed stands occur at Bunker Bay, Cape Clairault and Gannet Rock.



Photograph13 & 14 : *Melaleuca lanceolata* Low Closed Forest to Closed Forest [M1].

Note the closeness to the beach and the lack of an understorey

Comments: Presumably because of the shade value of the Moonah and its open understorey this unit has been favoured as a site for carparks, this has resulted in a significant impact at a number of locations. Future management should take into account this problem to minimise further disturbance of this type.

The conservation value of the remaining stands is very high, especially those that have escaped disturbance. Most of these are in areas not easily accessible, eg. on the coastal edge or below limestone cliffs. A large stand in good condition occurs inland and slightly north fron the townsite of Yallingup.

Because of the density of the overstorey the understorey in these woodlands and forests is very open, this adds to the recreational value as they are easy options for picnic areas, but implies that they could be overexploited if not managed properly.

Agonis flexuosa **(Peppermint),** ***Dryandra sessilis, Eucalyptus calophylla*** **(Marri),** ***E. marginata*** **(Jarrah) SCRUB [AgDsMJ]**

This unit occurs on the upper windward slopes of the Naturaliste Ridge on creamy-yellow to orange sandy soils with outcropping limestone. The dense scrub reaches a height of (1.5-3.0 m) other species in the upper layer include *Eucalyptus megacarpa, Acacia decipiens, Melaleuca huegelii, Hakea oleifolia, Spyridium globulosum* and *Olearia axillaris* with lower shrubs of *Acacia cochlearis, Melaleuca acerosa* and *Xanthorrhoea preissii*.

Distribution: This unit occurs on the exposed (western) slope of the Naturaliste Ridge, south of Canal Rocks.

Comments: The majority of this unit is within the National Park.

Agonis flexuosa, Eucalyptus calophylla, E. marginata

LOW WOODLAND [AW2]

This vegetation unit occurs on the gentle, exposed upper slopes of the Naturaliste Ridge on pale grey sands. The dominants reach a height of 4-5 m. There are two strata in the understorey, *Xanthorrhoea preissii, Hakea oleifolia, Acacia divergens* and *Melaleuca huegelii* form the upper layer (2.5-3 m) and *Melaleuca acerosa, Macrosamia riedlei* and *Hakea prostrata* form the lower layer. Mallees of *Eucalyptus megacarpa* (Bullich) occur scattered through the unit but do not reach to the upper storey.

Photograph 15: *Agonis flexuosa, Eucalyptus calophylla, E. marginata* Low Woodland

Distribution: This vegetation type occurs in patches near the crest of the Naturaliste ridge to the north of Yallingup and south of Cape Clairault.

Comments: The largest occurrence of this vegetation type is on privately owned land near Cape Clairault.

Agonis flexuosa **(Peppermint),** ***Banksia attenuata, Melaleuca huegelii*** **WOODLAND [AgBaM2]**

This vegetation unit occurs on gentle slopes with caramel-brown over creamy-yellow coloured sandy soils with outcropping limestone. The Peppermint, *Banksia* and *Melaleuca* (3-7 m) occur over *Hakea oleifolia* and *Dryandra sessilis* with lower shrubs of *Hibbertia cuneiformis, Leucopogon parviflorus, Templetonia retusa, Xanthorrhoea preissii* and the sedge *Lepidosperma gladiatum*.

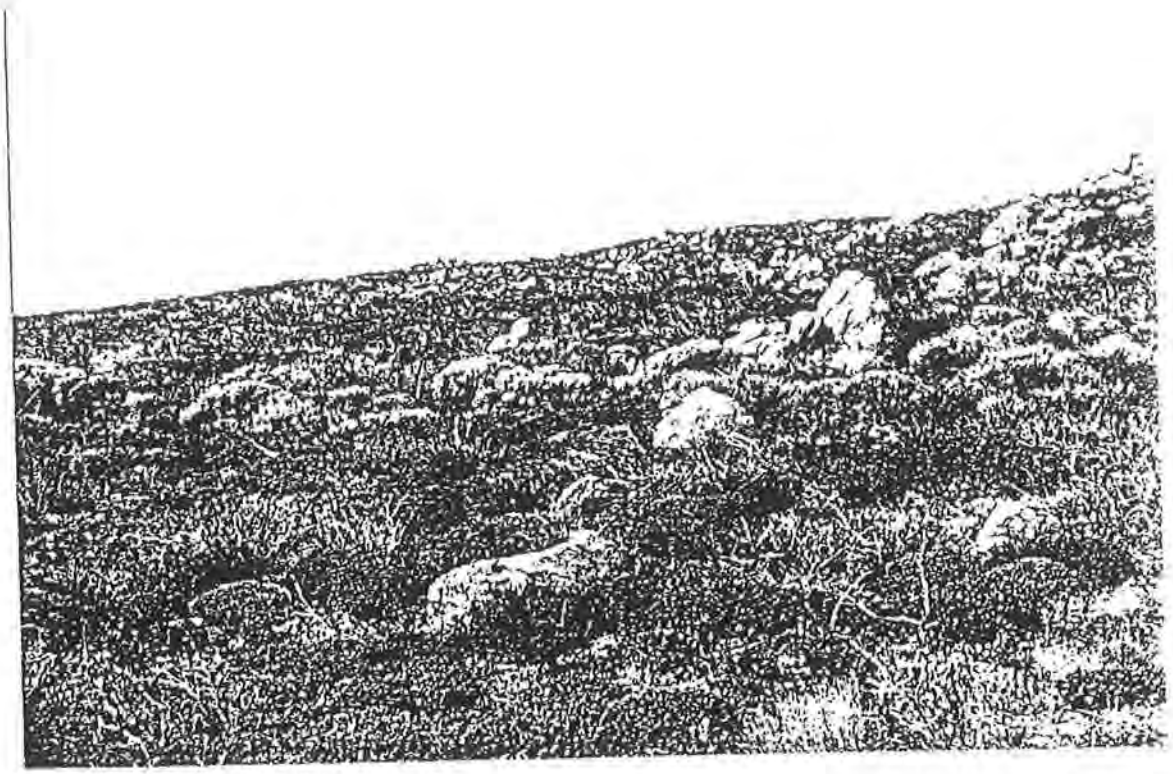
Distribution: The only occurrence of this unit is within the Leeuwin-Naturaliste National Park, on the gentle leeward slope south of Moses Rock Road, unfortunately it adjoins cleared land on two sides.

Comments: Care needs to be taken in the management of this area to ensure this vegetation type is not degraded.

(b) GRANULITE

Spyridium globulosum, Pimelea ferruginea, Acacia divergens, Scaevola crassifolia **LOW HEATH [GH4]**

This vegetation type occurs on exposed granulite headlands which are overlain by cream-coloured sands. It reaches a height of 50-60 cm. Other species found in the unit include *Acacia nervosa* and *Melaleuca lanceolata*.



Photograph 16: *Spyridium globulosum. Acacia divergens. Pimelea ferruginea. Scaevola crassifolia* Low Heath [GH4]

Distribution: This type occurs on the shallow sand covered granulitic headlands at Smiths Beach, Canal Rocks, Yallingup and North of Cape Clairault.

Comments: The occurrence of this unit at Smiths Beach is on Vacant Crown Land and adjoining uncleared privately owned land (Sussex loc. 413).

The low height of this vegetation type is a reflection of the shallow soils it grows on and its exposure to strong salt-laden winds.

***Calothamnus graniticus* ssp. *graniticus* OPEN TO CLOSED HEATH [GH1]**

This vegetation type occurs on granulite outcrops in localised patches as strips paralleling and in close proximity to the coast, usually near headlands The dominant

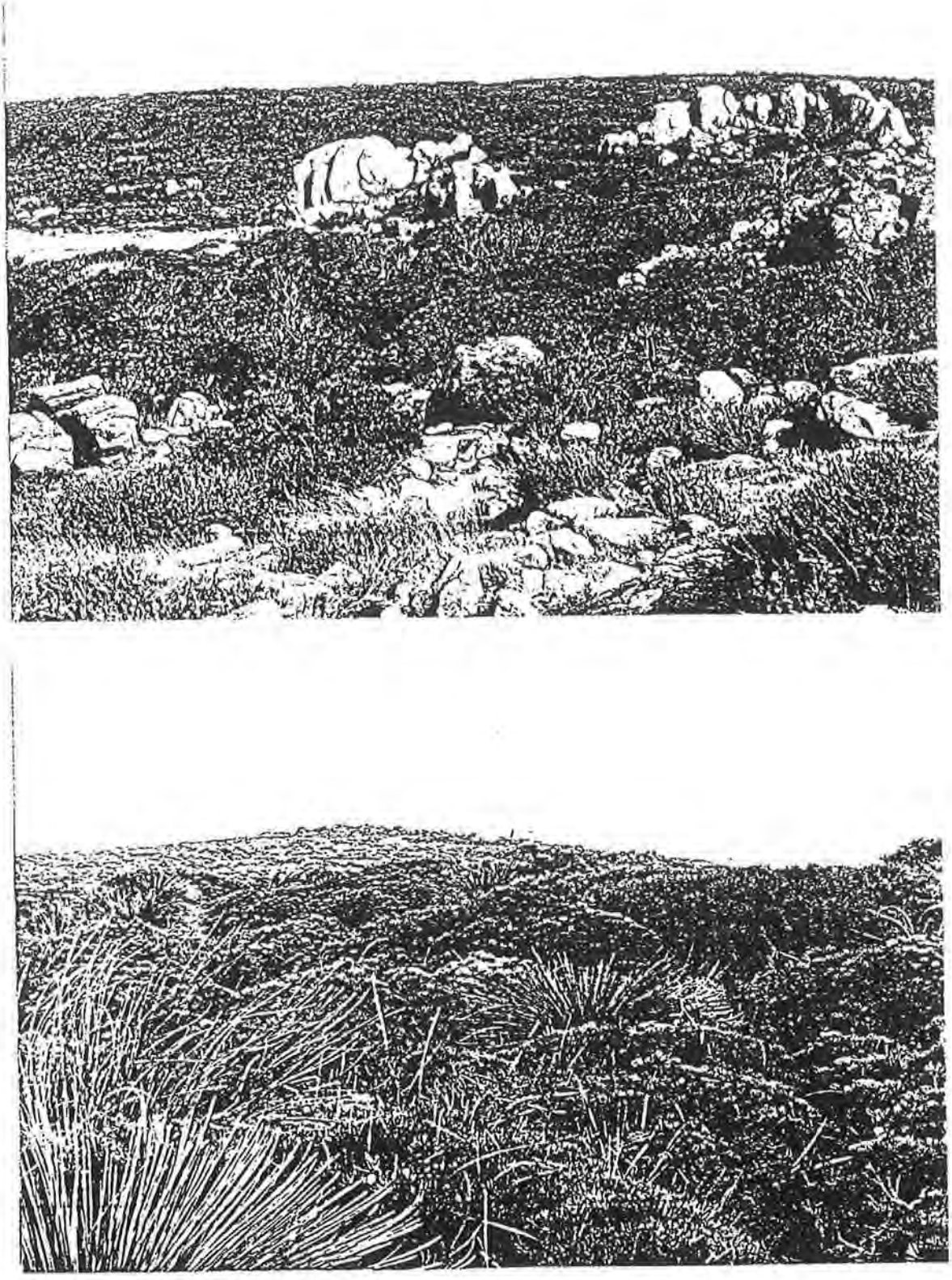
is a shrub varying from approximately 1.2-2.0 metres tall and is often wind-pruned as it grows to within 15 m of the shore. The dark green colour of the *Calothamnus* and the granite boulders give a distinctive appearance to the community. Other prominent shrub species are *Dodonaea ceratocarpa*, *Spyridium globulosum*, *Hakea trifurcata*, *Viminaria juncea*, *Acacia pulchella*, *Melaleuca acerosa* and *Xanthorrhoea preissii*. Smaller shrubs include *Darwinia citriodora*, *Pimelea angustifolia*, *Pimelea ferruginea*, *Hibbertia hypericoides*, *Hibbertia cunninghamii*, *Phyllanthus calycinus* and *Cryptandra arbutiflora*. The herb layer is diverse and includes *Conostylis setigera*, *Lomandra nigricans*, *Haemodorum laxum*, *Haemodorum simplex*, *Caladenia latifolia*, *Caladenia paterson*ii var. *longicauda*, *Loxocarya fasciculata*, *Drosera mensiesii*, *Drosera erythrorrhiza*, *Laxmannia sessiliflora*, *Kennedia prostrata* (red runner) and the ferns *Cheilanthes austro-tenuifolia* and *Cheilanthes* sp. (CK 24).

Distribution: Within the study area this community occurs in a discontinuous strip between Dunsborough and Eagle Bay with smaller occurrences at Sugarloaf Rock. At the latter location there is a very small pocket south of the carpark and a larger occurrence north of the carpark below *Melaleuca lanceolata* thickets and almost down to the ocean.

Comments: There is only a relatively small area of this vegetation type in the study area and it does not occur to the north as there is no suitable habitat, it is not known whether or not there are other locations south of the study area, but suitable habitat does occur there. All the areas of this vegetation type in the study area are in reserves.

A significant portion of the comparatively large area of this vegetation type north of

Meelup Road has been recently burnt, consequently the only well developed stands,



Photographs 17 & 18: *Calothamnus graniticus* ssp. *graniticus* Open to Closed Heath [GH1] (in foreground only in both Photographs).

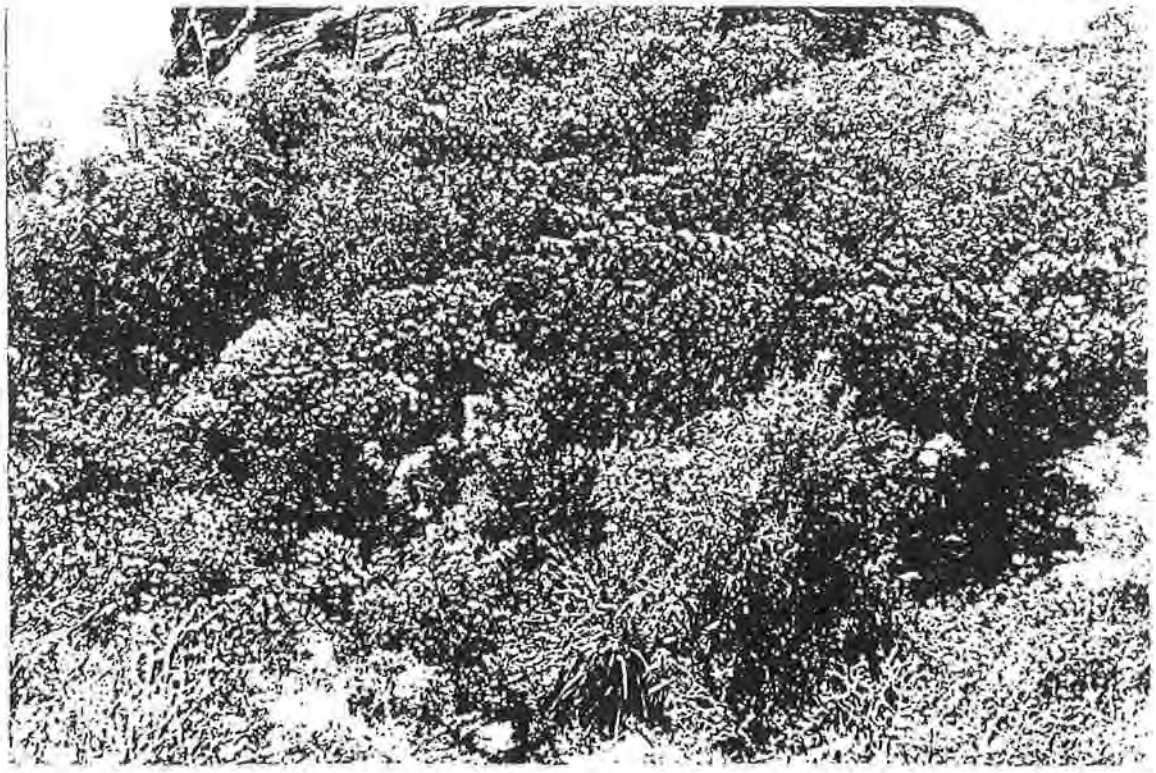
in the sense of age, are the smaller ones and management of them should include exclusion of fire. Both the *Calothamnus* and *Melaleuca acerosa* are regenerating from the base.

It should be noted that the distribution of this vegetation type (close to the beaches) means that it occurs in areas of high recreational use and that management plans should take potential conflicts of conservation and recreation into account.

In "The Cape Naturaliste Area, W.A. - An Environmental Resource Evaluation" [Valentine and Enright, 1975] *Calothamnus graniticus* ssp. *graniticus* is Referred to as *Calothamnus* sp., as it was at that time undescribed.

Agonis flexuosa, Calothamnus graniticus* ssp. *graniticus

CLOSED SCRUB [AgCg]



Photograph 19: *Agonis flexuosa, Calothamnus graniticus* ssp. *graniticus* Closed Scrub [AgCg].

This vegetation type occurs in near-coastal situations on granulite overlain by creamy-brown to mid-brown sandy soils. The height of the dominants is 1.5-2.5 m, with other prominent shrubs in the upper layer including *Hakea trifurcata*, *Dodonaea ceratocarpa*, *Macrosamia riedlei* and *Xanthorrhoea preissii*. The understorey layer is fairly simple with shrubs (0.5-1.0 m) of *Hibbertia hypericoides*, the lily *Dianella revoluta*, the fern *Cheilanthes austro-tenuifolia* and the herb *Stylidium adnatum*. *Hardenbergia comptoniana* climbs through the shrubs.

Distribution: This unit occurs along the coast from Dunsborough to Rocky Point, largely within the Meelup Reserve System.

Comments: Occurs as small linear shaped patches, often next to St4 and GH1.

***Agonis flexuosa*, *Eucalyptus calophylla*, *E. marginata* LOW WOODLAND [St4]**

This vegetation unit occurs on lower slopes (just above the beach) on pale brown to dark brown sandy soils with granulite pebbles and boulders. The height of the dominants is 1.8-3.0 metres. Prominent in the understorey are *Xanthorrhoea preissii*, *Macrosamia riedlei*, *Calothamnus sanguineus*, *Daviesia divaricata*, *Melaleuca acerosa*, *Pimelea ferruginea* and the creepers *Hardenbergia comptoniana* and *Kennedia coccinea*. *Calothamnus graniticus* ssp. *graniticus*, *Dodonaea ceratocarpa* and *Hakea trifurcata* can also occur in the understorey.

Distribution: In the study area this unit occurs along the coastal strip from Dunsborough to Rocky Point.

Comments: This unit occurs as linear-shaped strips parallel to the coast. It is in this unit and in AgM and M1Er that *Eucalyptus calophylla* and E. *marginata* grow down to the foreshore.

***Agonis flexuosa, Eucalyptus calophylla* LOW WOODLAND [AgM]**

This unit occurs at the edges of the granulitic coast where the granulite is overlain by creamy-brown coloured sandy soils. These woodlands have a height range of 4-9 m with an understorey of various combinations of the shrubs *Viminaria juncea, Xanthorrhoea preissii, Macrozamia riedlei, Hibbertia cuneiformis, Olearia axillaris, Spyridium globulosum, Calothamnus graniticus* ssp. *graniticus, Acacia rostellifera A. saligna, A. cochlearis* over *Pimelea ferruginea, Pteridium esculentum* (Bracken Fern), *Acanthocarpus preissii, Lepidosperma gladiatum* and *Stylidium adnatum*.

Photograph 20: *Agonis flexuosa, Eucalyptus calophylla* Low Woodland [AgM]

Distribution: This unit occurs along the the coastline from Meelup to Eagle Bay in the Meelup Reserve System.

Comments: This unit differs mainly in height from stands referred to St4, and the Marri in it are the tallest close to the coast.

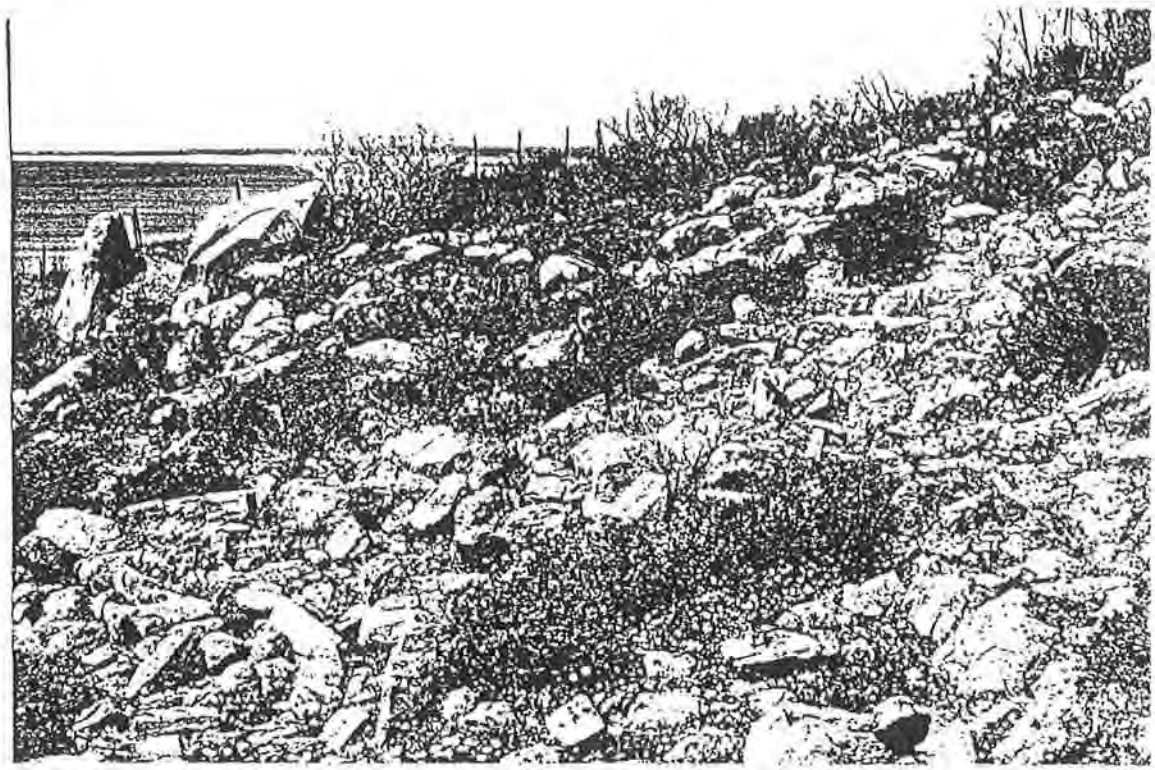
***Eucalyptus calophylla* (Marri) LOW OPEN WOODLAND [GH6]**

This vegetation unit occurs on slopes with caramel-coloured sandy soils with scattered surface laterite and outcropping granulitic pebbles and boulders. Under the Marri (2-2.5 m) there is a dense low heath (0.5-1.2 m) of *Xanthorrhoea preissii*, *Melaleuca acerosa*, *Allocasuarina humilis*, *Daviesia divaricata*, *Hakea trifurcata*, *Pimelea ferruginea*, *Cryptandra arbutiflora*, *Hibbertia hypericoides*, *Dodonaea ceratocarpa* and *Hypocalymma angustifolium* with *Cheilanthes austro-tenuifolia*, *Loxocarya flexuosa* and *Stylidium bulbiferum* in the herb layer.

Distribution: This vegetation unit occurs at Eagle Bay on a gentle slope in the north-westen end of the Meelup Reserve System.

***Thryptomene saxicola*, *Melaleuca acerosa*, *Pimelea ferruginea* LOW HEATH [GH5]**

This vegetation type occurs between boulders on exposed upper granulitic slopes with pale to mid-brown sandy soils. The height of the dominants is 30-60 cm, they occur over the herbs *Brachycome iberidifolia*, *Millotia myosotifolia*, *Podolepis lessonii*, *Helipterum cotula*, *Stylidium bulbiferum*, *Haemodorum umbellatum*, *Conostylis setigera*, *Levenhookia pusilla*, the fern *Cheilanthes austro-tenuifolia* and lichens.



Photograph 21: *Thryptomene saxicola. Melaleuca acerosa. Pimelea ferruginea* Low Heath [GH5].

Distribution: This unit occurs on some of the granulite outcrops within the Meelup Reserve System.

Comments: These low heaths and hebrfields are very fragile and disturbance can easily destroy them.

The lichen encrusted granulite boulders within this unit enhance its visual appeal.

Allocasuarina humilis. Thryptomene saxicola Dodonaea ceratocarpa. Calothamnus graniticus **LOW SHRUBLAND [Ah]**

This vegetation type occurs on granulite outcrops upslope from the coast. The shrubs

are stunted in comparison to the height they attain in other habitats and vary from 0.4-1.0 m. Other shrub species include *Darwinia citriodora*, *Melaleuca acerosa*, *Hibbertia hypericoides*, *Hibbertia cunninghamii* and *Calothamnus sanguineus*. The herb layer is very well developed and includes species of *Brachycome imberidifolia*, *Helipterum coluta*, *Podolepsis lessonii*, **Tunica prolifera*, *Millotia myosotidifolia*, *Stylidium bulbiferum*, *Stylidium* sp. CK269, *Stylidium pilosum*, *Burchardia umbellata*, *Thysanotus patersonii*, *Logania serpyllifolia*, *Cheilanthes austro-tenuifolia*, *Levenhookia pusilla*, *Stypandra grandiflora* and *Thelymitra crinita*.

Distribution: This vegetation types occurs on most of the granulite rock outcrops in the reserves adjacent to Dunsborough, but was not seen elsewhere in the study area.

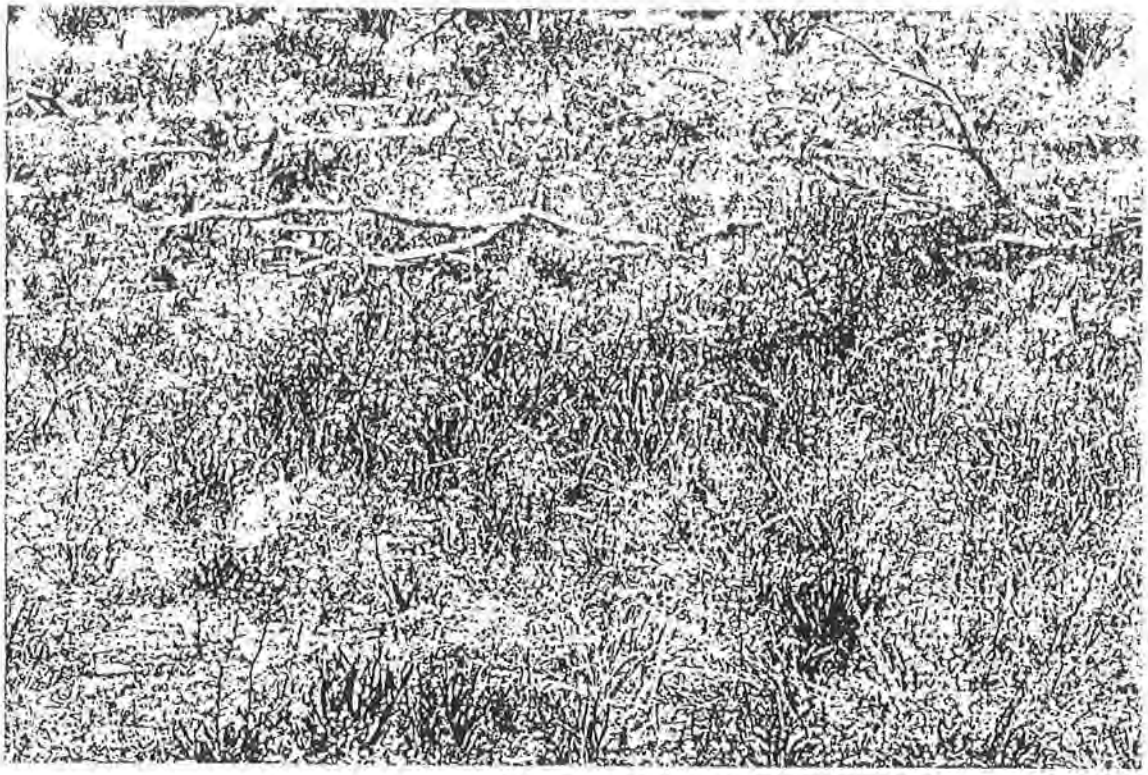
Comments: As the habitat of this vegetation type is highly specific the conservation value of the reserves near Dunsborough is high for the protection of this vegetation type.

(c) LATERITIZED GRANULITE

***Drosera gigantea* (Giant Sundew), *Stylidium crassifolium* (Thick-leaved Triggerplant) CLOSED HERBLAND [Dr]**

This vegetation unit occurs on very gentle slopes with caramel-brown to dark-brown damp sandy soils. The height range of the dominants is 15-30 cm and they form a dense herbland with *Patersonia pygmaea*, *P. umbrosa* var. *xanthina*, *P. occidentalis*, *Levenhookia pusilla*, *Trymalium ledifolium*, *Dampiera linearis* and *Loxocarya fasciculata*. There are occasional emergents of *Viminaria juncea*, *Eucalyptus calophylla*, *Daviesia divaricata*, *Xanthorrhoea preissii*, *X. gracilis*, *Hakea lissocarpha*, *Melaleuca*

lanceolata and *Acacia saligna* from surrounding vegetation units, mostly near the edges of the unit



Photograph 22: *Drosera gigantea* (Giant Sundew), *Stylidium crassifolium* (Thick-leaved Triggerplant) Closed Herbland [Dr]

Distribution: This vegetation unit occurs on a gentle slope into a flow line near the southern boundary of the Meelup Reserve system

Comments: There is only one occurence of this vegetation type in the study area and as such it is obviously of high conservation value, it is visually quite different to the bulk of the vegetation types in the study area because of its low stature.

Hakea trifurcata, Allocasuarina humilis **LOW CLOSED HEATH. [Htr2]**

This vegetation unit occurs on a hill-crest with pale brown sandy soils with scattered surface lateritic pebbles and exposed granulite. The dominants reach 40-80 cm, other

shrubs include *Dodonaea ceratocarpa*, *Melaleuca acerosa*, *Gompholobium spinosa*, *Darwinea citriodora* and *Daviesia divaricata* over lower shrubs of *Hibbertia hypericoides*, *H. cunninghamii* and *Cryptandra arbutiflora*; there are occasional emergent trees of *Nuytsia floribunda*. The herb layer includes *Loxocarya fasciculata*, *Stylidium bulbiferum*, *S. diversifolium*, *Leventhookia pusilla*, *Thysanotus multiflorus* and *Cheilanthes austro-tenuifolia*.

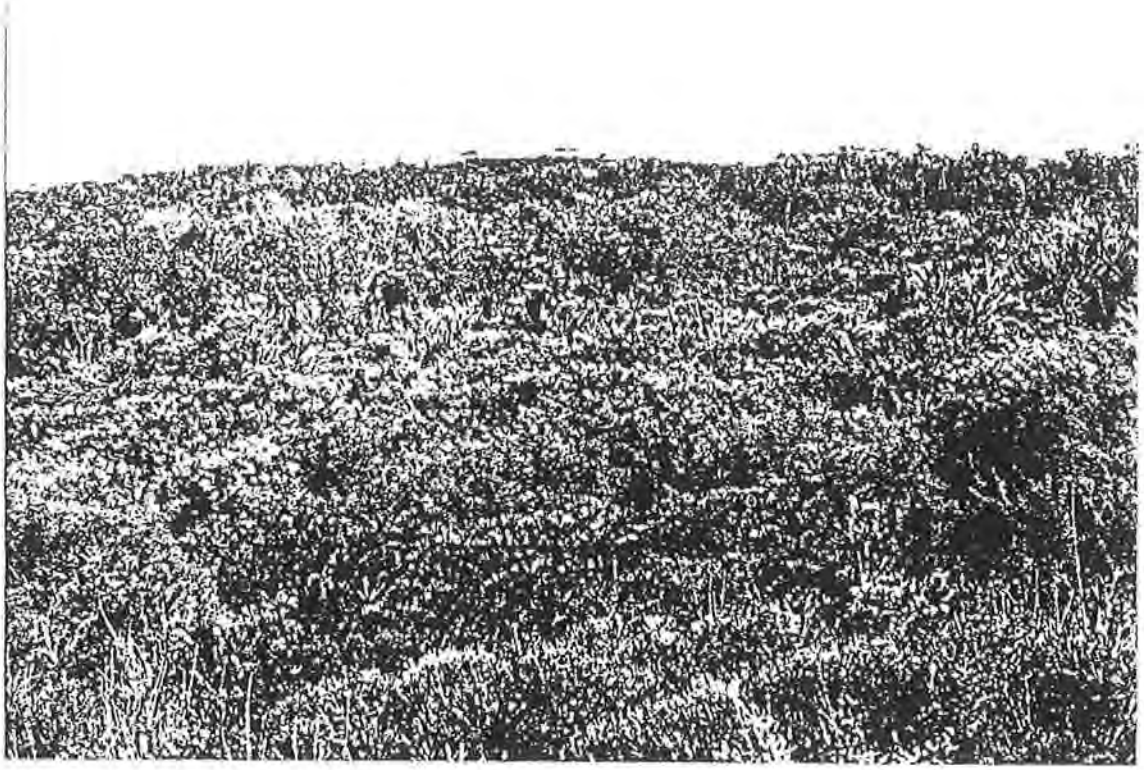
Distribution: This unit occurs on the crest of the hill inland from Point Picquet, in the Meelup reserve system.

***Hakea trifurcata* CLOSED SCRUB [Htr]**

This vegetation type is found on hilltops and lower slopes with cream-coloured to orange or brown sands over laterite, sometimes with some outcropping granulite. This dense heath has a distinctive soft yellow-green appearance, caused by its slender spikey phyllodes and which belies its true nature! It has occcasional emergents of *Eucalyptus marginata*, *E. calophylla*, *Persoonia longifolia*, *Nuytsia floribunda* and *Xylomelum occidentale*. Other species in the shrub layer include *Xanthorrhea preissii* and *Viminaria juncea*. The lower shrub layer includes shrubs of *Allocasuarina humilis*, *Hibbertia hypericoides*, *Melaleuca acerosa*, *Calothamnus sanguineus*, *Cryptandra arbutiflora*, *Dryandra nivea*, *Xanthorrhoea gracilis*, *Phyllanthus calycinus*, *Trymalium ledifolium*, *Acacia nervosa* and *Acacia pulchella*. Species in the herb layer include *Drosera erythrorrhiza*, *Thelymitra crinita*, *Elythranthera brunonis*, *Stylidium piliosum*, *Stylidium scaposeratum*, *Burchardia umbellata* and *Gompholobium nightianum*.

Distribution: This vegetation type was only observed from just south of Meelup to a

short distance south of Eagle Bay



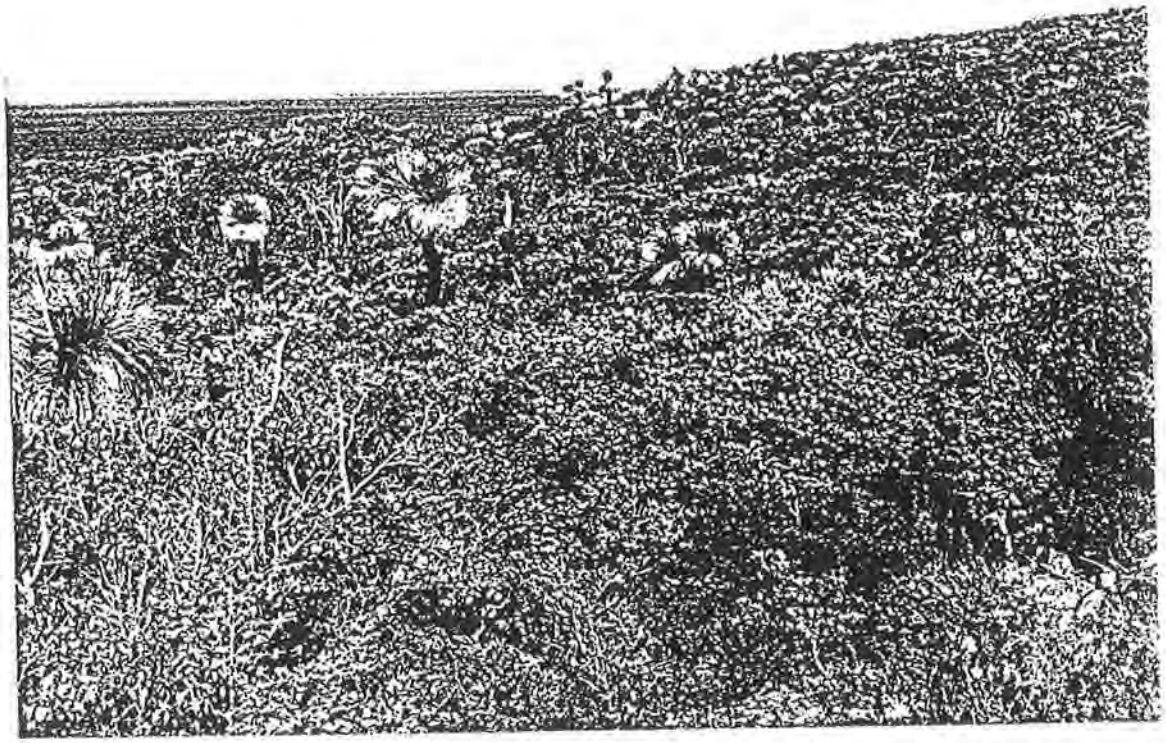
Photograph 23: *Hakea trifurcata* Closed Scrub [Htr]

Comments: Variants of this closed scrub with *Allocasuarina* or *Gastrolobium spinosum* as co-dominants have been mapped separately.

In reserve 21629 there are areas that have been burnt and have dead stems of *Hakea trifurcata* over regeneration of *Melaleuca acerosa*, *Allocasuarina humilis* and *Calothamnus sanguineus*. It appears that fire has caused a change in the vegetation type at these places. It is not known how long it would take, or if these areas will, revert to *Hakea trifurcata*. Given this, fire should be excluded from the remaining areas of *Hakea trifurcata* closed scrub until its fire ecology is better known.

***Hakea trifurcata*, *Gompholobium spinosa* CLOSED HEATH [GH2]**

This vegetation type occurs on exposed granulitic slopes with mid-brown sandy soils. Other species in the upper stratum (1.2-1.8 m) include *Dodonaea ceratocarpa*, *Xanthorrhoea preissii* and *Macrozamia riedlei* with occasional shrubs of *Calothamnus graniticus* ssp. *graniticus*.



Photograph 24: *Hakea trifurcata*, *Gompholobium spinosa* Closed Heath [GH2].

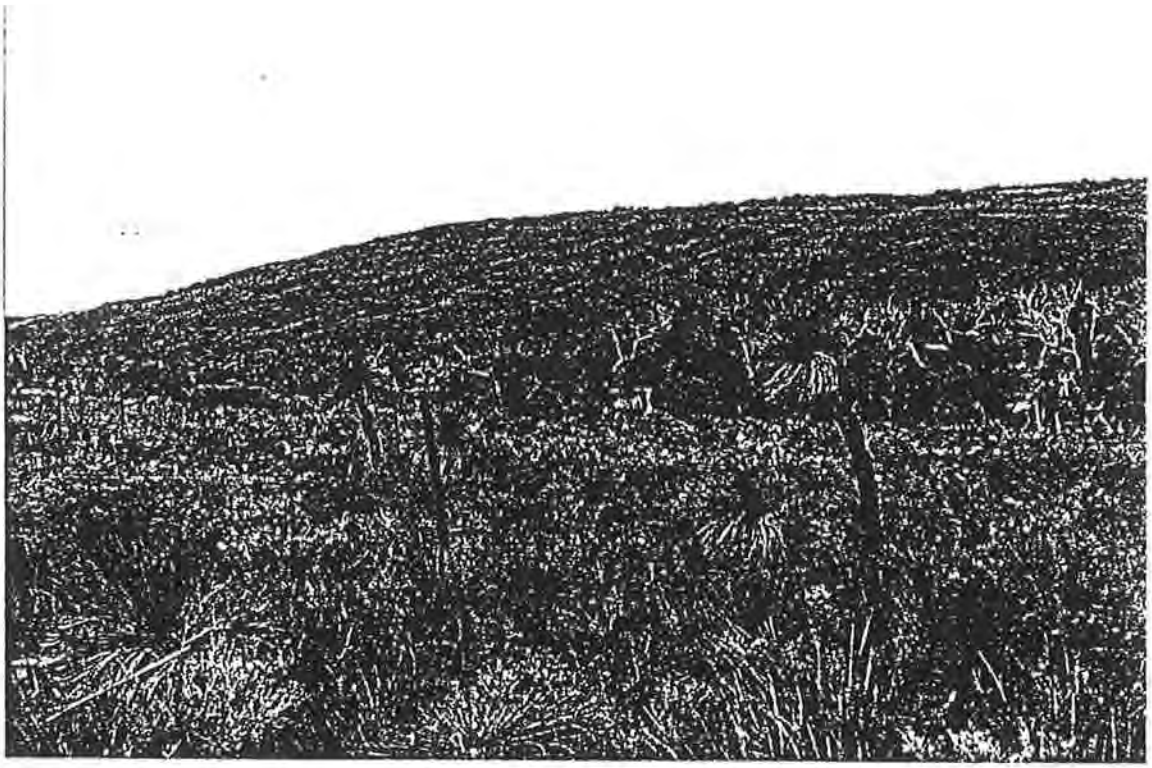
Distribution: This vegetation type occurs in the Meelup Reserve System, just south-west of Point Picquet.

Comments: *Gompholobium spinosa* also occurs as a scattered shrub in the understorey of adjoining vegetation types.

Xanthorrhoea preissii. Hakea trifurcata. Allocasuarina humilis

CLOSED HEATH [XH]

This unit occurs on upper slopes with creamy-brown to mid-brown sandy soils with surface laterite and outcropping granulitic pebbles and boulders. The height range of the dominants is 0.8-1.2 with the *Xanthorrhoea* occasionally reaching 3 m. Other prominent species in this dense low heath include the shrubs *Calothamnus sanguineus. Daviesia divaricata. Hakea amplexicaulis. Xanthorrhoea gracilis. Adenanthos meisneri* and the sedge *Mesomolaena stygia* over the herbs *Loxocarya flexuosa. Thelymitra crinita. Burchadia umbellata* and *Synaphea petiolaris.*

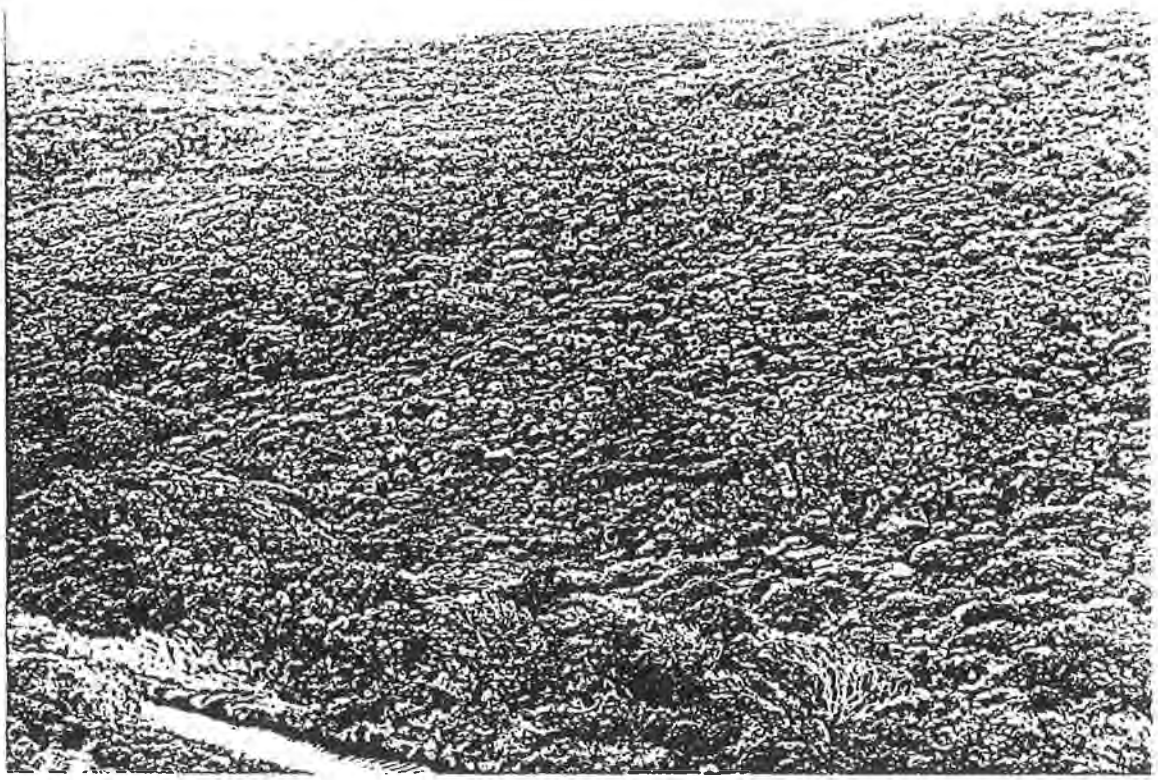


Photograph 25: *Xanthorrhoea preissii. Hakea trifurcata. Allocasuarina humilis* Closed Heath [XH]

Distribution: Within the study area this unit occurs only in the Meelup Reserve System on upper slopes near Meelup Road.

Xanthorrhoea preissii HEATH [XH2]

This vegetation unit occurs on a moderate slope with pale brown to dark grey sandy soils with outcropping granulite. This dense heath is 0.8-1.5 m tall, as well as the *Xanthorrhoea* this heath has the shrubs *Daviesia divaricata*, *Macrosamia riedlei*, *Allocasuarina humilis*, *Calothamnus sanguineus* and *Hakea lissocarpha* over lower shrubs of *Darwinia citriodora* and *Phyllanthus calycinus* with occasional emergents of *Agonis flexuosa* and *Spyridium globulosum*.



Photograph 26: *Xanthorrhoea preissii* Heath [XH2].

Distribution: The only occurrence of this vegetation unit in the study area was on the southern (north facing) slope leading down to the Wilyabrup Brook, approximately 300 m inland from its mouth in the Woodlands area..

Comments: The stand is on uncleared, privately owned land adjoining the

Leeuwin-Naturaliste National Park and is one of a number of vegetation units associated with Wilyabrup Brook, all of which are on uncleared privately owned land and are of high conservation value. Addition of these areas to the National Park would rationalise its boundaries allowing more effective management and give greater protection to the very narrow strip in the park at this location, as well as protecting the areas of high conservation value currently on private land and which have vegetation types not represented in the park.

The form of the *Xanthorrhoea preissii* and the outcropping granulite make this a very visually attractive vegetation unit, especially when looking down from the opposite bank. Lack of time prevented more detailed recording of this vegetation type.

Acacia saligna CLOSED HEATH [P2]

Small patches of this vegetation type occur on grey-white sands along the coast. The height range of the dominant is 1.5-2.0 metres. The large (seen to 17 cm long), light to mid-green, pendant phyllodes of the *Acacia* are a noticeable feature of this vegetation type.

Distribution: There are two major occurrences of this vegetation type in the study area. One is on the coastal edge of the Castle Bay car park, and the other is just north of Canal Rocks and is upslope from the Smiths Beach Caravan Park Road. Smaller patches occur between Dunsborough and the southern end of the study area.

Comments: While this vegetation type is undoubtedly natural, in places *Acacia saligna* appears to take advantage of disturbed conditions. *Acacia saligna* is also present in other vegetation types including some of the damper *Agonis flexuosa*, *Eucalyptus calophylla* woodlands, it often has fungal galls.

Melaleuca lanceolata, Viminaria juncea **CLOSED SCRUB [MiVj]**

A strip of this vegetation type was found along the bottom of a small valley, the soils are dark grey sands with some scattered surface granulite rocks. The dominants were both 2.5-3.5 m tall, with the *Melaleuca* having a 'drumstick' form.

Muir Description:

> **Site 148**
>
> *Melaleuca lanceolata, Viminaria juncea* Dense Thicket with occasional trees of *Banksia grandis* over occasional shrubs of *Acacia saligna, Acacia pulchella* over *Isolepis nodosus* Open Tall Sedgeland over Mixed *Stylidium crassifolium, Patersonia occidentalis* Herbfield.

Distribution: The area of this unit is located near Eagle Bay on the southern boundary of reserve no. 21629.

Comments: This community is obviously a response to the moist conditions at the site, and has high value because of its limited occurence.

Eucalyptus calophylla **[Marri],** ***Eucalyptus marginata*** **[Jarrah]**

LOW WOODLAND [St1]

This vegetation type occurs on areas between the granulitic outcrops and lateritic uplands, the soil is dark grey sand with some laterite. There are small outcrops of granulite within the unit. The Jarrah and Marri occur in discrete groups with a height range of 2.0-4.0 metres which are surrounded by a low [0.5-1.2 m] heath. The shrub layer includes *Hibbertia hypericoides, H. cunninghamii, Hypocalymma angustifolium, H. robustum, Eriostemon spicatus, Xanthorrhoea preissii, Daviesia divaricata, Hakea lissocarpha, H.*

amplexicaulis, *Calothamnus sanguineus*, *Adenanthos meisneri*, *Dodonaea cersiocarpa*, *Synaphea petiolaris* and *Dryandra nivea*. Species prominent in the herb layer include *Drosera* sp. (CK252), *Drosera erythrorrhiza*, *Loxocarya fasciculata*, *Burchardia umbellata*, *Dampiera linearis*, *D.* sp. (CK 218), *Patersonia occidentalis* and the orchids *Thelymitra crinita*, *Caladenia macrostylis* and *Elythranthera brunonis*.

Photograph 27: *Eucalyptus calophylla*, *E. marginata* Low Woodland [St1].

Distribution: The major occurrences of this vegetation type are upslope from the *Calothamnus* Heath [GH1] between the Dunsborough Golf Course and Eagle Bay.

Comments: As this vegetation type is of limited distribution in the study area the individual occurrences have high conservation value.

The stunted form of the Jarrah and Marri is caused by the shallow soils which are

underlain by granulite (which outcrops occassionally in this vegetation type and extensively in the heaths downslope). The slender trunks of the stunted eucalypts add to the aesthetic appeal of this vegetation type.

***Eucalyptus calophylla, E. marginata* LOW WOODLAND [St2]**

This vegetation type occurs on the gentle exposed (windward) slopes of the Naturaliste Ridge on pale grey to brown sandy soils. Other species which share the dominance wih the Marri and Jarrah are *Agonis flexuosa*, *Melaleuca huegelii*, *Acacia rostellifera* and *Acacia decipiens* with less prominent shrubs of *Dryandra sessilis* and *Hakea oleifolia* (2.0-4.0 m). The understorey includes shrubs of *Xanthorrhoea preissii*, *Macrozamia riedlei*, *Melaleuca acerosa*, *Hakea prostrata* and *Calothamnus sanguineus* and the herb *Conostylis setigera*.

Distribution: This unit occurs in a number of areas between Cape Clairault and the southern boundary of the study area.

Comments: This unit is somewhat similar to AW2 except that *Melaleuca huegelii*, *Acacia rostellifera* and *A. decipiens* are important in this unit.

***Eucalyptus calophylla, E. marginata* LOW WOODLAND [St3]**

This vegetation type occurs on gentle slopes with dark-brown loamy soil with scattered surface laterite. The upper tree stratum has a height range of 5-7 m with occasional lower trees of *Persoonia longifolia*. The dense understorey has taller shrubs (0.6-1.0 m) of *Allocasuarina humulis*, *Calothamnus sanguineus*, *Melaleuca acerosa* with other less prominent shrubs of *Hakea lissocarpha*, *H. amplexicaulis* and *Xanthorrhoea preissii* and smaller shrubs of *Hibbertia cunninghamii*, *Hypocalymma angustifolium*, *Adenanthos meisneri* and

Dryandra nivea. The sedges *Lepidosperma angustatum* and *Mesomelaena stygia* and the herbs *Thysanotus multiflorus*. *Thelymitra crinita* and *Stylidium calcaratum* form a ground layer.

Distribution: This vegetation type occurs within the Meelup Reserve System, on the south side of the Meelup Road.

***Agonis flexuosa* (Peppermint), *Eucalyptus marginata* (Jarrah), *E. calophylla* (Marri) LOW WOODLAND [AW8]**

This vegetation unit occurs on moderate to gentle slopes with creamy-brown to brown sandy soils. The tree stratum (3-5 m) is dominated by the Peppermint but also has stunted Eucalypts. The understorey is mid-dense (0.6-1.2 m) with *Xanthorrhoea preissii*. *Calothamnus sanguineus*. *Daviesia divaricata*. *Hibbertia cuneiformis*. *Melaleuca acerosa*. *Hakea ruscifolia*. *H. prostrata* and *Olearia axillaris* over *Loxocarya fasciculata*.

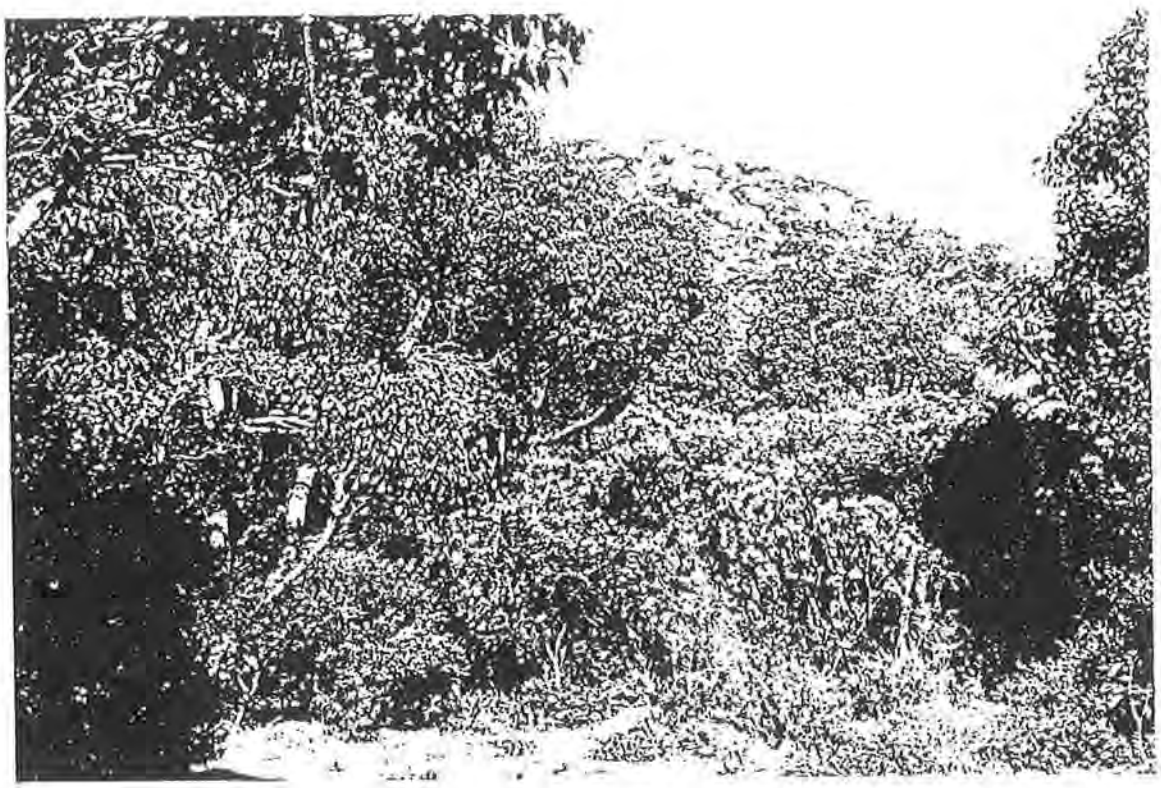
Distribution: The areas of this unit are in the broad valley floor south of the Woodlands area.

Comments: The majority of this unit is outside the park in uncleared areas which are on privately owned land and are grazed, this has thinned out the understorey. The inclusion of the Woodlands area, including the stands of this vegetation type, in the National Park is extremely important to protect a variety of vegetation types and to add to the thin strip currently in the Park.

***Eucalyptus calophylla* (Marri) WOODLAND [MGr]**

This vegetation unit occurs on moderate to gentle slopes with creamy-yellow to yellow-orange-brown lateritic sandy soils. The Marri (6-8 m) grows over a dense tall

heath dominated by *Calothamnus graniticus* ssp. *graniticus*. *Hakea trifurcata*. *Dodonaea ·eratocarpa* with other shrubs including *Melaleuca scerosa*. *Acacia saligna*. *A. cyclops*. *Macrosamia riedlei*. *Bossiaea linophylla* and *Darwinia citriodora* over lower shrubs of *Thomasia triphylla*, and herbs of *Burchardia umbellata*. *Stylidium adnatum*. *Drosera giganteum*. *Loxocarya flexuosa* and *Elythranthera brunonis*.



Photograph 28: *Eucalyptus calophylla* (Marri) Woodland [MGr]

Distribution: This unit occurs on the lower slopes just inland from the coast at Point Picquet.

Eucalyptus calophylla (Marri), *Agonis flexuosa*, *Banksia attenuata* CLOSED WOODLAND [MBaAg+J]

This vegetation unit occurs on gentle slopes with creamy-grey over yellow sandy soils. The upper stratum has a height range of 5-8 m, and also has occasional trees of *Nuytsia floribunda* and *Banksia grandis*. The understorey is a low heath of *Allocasuarina humilis*, *Acacia pulchella*, *Xanthorrhoea preissii*, *Macrozamia riedlei*, *Melaleuca scerosa* and *Hibbertia hypericoides*.

Distribution: Occurs on the crest and gentle leeward slopes of the Naturaliste Ridge just south of the Sugar Loaf Road.

Agonis flexuosa, *Eucalyptus calophylla* WOODLAND [AgM/meg]

This vegetation type occurs on moist, grey sandy soils on gentle leeward slopes. The upper stratum has a height range of 7-10 metres and occurs over a dense scrub layer of *Viminaria juncea* and *Eucalyptus megacarpa* and a dense understorey of *Spyridium globulosum*, *Acacia cyclops*, *Beyeria viscosa*, *Olearia axillaris*, *Xanthorrhoea preissii*, *Macrozamia riedlei* and *Gahnia trifida* and moss.

Distribution: The only stand of this vegetation type in the study area adjoins the south side of the Naturaliste Road, at the Bunker Bay turn-off.

Comments: A seasonal water course crosses the site this unit occurs on, providing the damp conditions for the Bullich, *Beyeria viscosa*, *Viminaria juncea*, *Gahnia trifida* and the moss. This stand is of high conservation value (see Recommendations, sect. 7.0), the private property it is on was previously offered to the Government for inclusion in the Leeuwin-Naturaliste National Park (Valentine & Enright, 1975).

***Eucalyptus calophylla* (Marri), *E. marginata* WOODLAND [MJ/Bg]**

This unit occurs on moderate inland slopes with pale-grey sandy soils. There are two distinct tree strata, the upper (10-14 m) with Marri more abundant than Jarrah over *Banksia grandis*, *Banksia attenuata* and *Agonis flexuosa* (all 3-4 m). The understorey also has two distinct layers with an upper layer (1.2-3.0 m) of scattered shrubs of *Jacksonia furcellata*, *Daviesia divaricata*, *Macrosamia riedlei* and *Xanthorrhoea preissii* over a dense lower layer (0.4-1.1 m) dominated by the shrubs *Stirlingia latifolia*, *Calothamnus sanguineus*, *Melaleuca scerosa*, *Hibbertia hypericoides* with occasional shrubs of *Phyllanthus calycinus*, *Pimelea rosea* and *Hibbertia cunninghamii* and herbs of *Lobelia serpyllifolia* and *Elythranthera brunonis*.

Distribution: Within the study area there is only one stand of this vegetation unit, on the southern boundary of the Meelup Reserve System, adjoining cleared land where it may once have also occurred.

***Eucalyptus calophylla* (Marri) WOODLAND [AJM1 / AW5]**

This community is located on valley slopes or next to creeks, with moist soils of grey sand over brown sand. This vegetation type has two tree strata, the Marri and the dense lower stratum of *Eucalyptus cornuta* (Yate) and *Agonis flexuosa* (Peppermint). Other species include *Acacia saligna*, *A. pulchella*, *Hibbertia hypericoides*, *H. cuneiformis*, *H. cunninghamii*, *Macrosamia riedlei*, *Pteridium aquilinum*, and creepers of *Hardenbergia comptoniana*.

Distribution: There are three areas of this vegetation type in the study area, one is approximately two and half kilometres east from the coast at Canal Rocks, the second is about one and a half km west of Naturaliste Downs homestead and the third is about three km south-east of Moses Rock.

Comments: The areas of this unit are all fairly small, and need attention to ensure their preservation, for example the area near Moses Rock is being grazed.

Eucalyptus calophylla (Marri) WOODLAND [Marri]

This vegetation unit occurs on gentle slopes with mid to dark brown sandy soils with scattered lateritic surface pebbles and exposed granulitic pebbles and boulders. Under the dominant (10-15 m) there is a dense low heath (0.5-1.2 m) of the shrubs *Hakea lissocarpha*, *H. amplexicaulis*, *Calothamnus sanguineus*, *Hibbertia hypericoides*, *Daviesia divaricata*, *Xanthorrhoea preissii* (occasionally to 2.8 m), *Macrosamia riedlei*, *Cryptandra arbutiflora* and *Acacia nervosa* with the sedges *Mesomelaena stygia*, *Lepidosperma angustatum* and the herbs *Conostylis setigera*, *Patersonia occidentalis*, *P. umbrosa* var. *xanthina* and *Stylidium calcaratum*.

Photograph 29: *Eucalyptus calophylla* (Marri) Woodland [M1]

Distribution: This vegetation unit occurs on the gentle inland slope to the west of Meelup Road, a few hundred metres from its junction with the Naturaliste Road.

Comments: The understorey of this unit is similar to some of the Jarrah and Jarrah-Marri units, but this is one of the few stands in the study area where Marri occurs without Jarrah.

***Eucalyptus calophylla* (Marri), *Eucalyptus marginata* (Jarrah) WOODLAND [MJ/Xp1]**

This vegetation unit occurs on shallow wide valley floors with pale brown sandy soils with scattered lateritic pebbles on the surface and has three distinct layers. The upper stratum of Marri and Jarrah has a height range of 8-12 m, below this *Xanthorrhoea preissii* (1.8-3.0 m) and scattered *Persoonia longifolia* form a lower tree stratum (usually *X. preissi* is referred to a shrub layer, but in this case its height and form makes it appropriate to refer it to a tree layer). *Xanthorrhoea gracilis* (0.4-0.9 m) dominates the lower layer with other species including shrubs of juvenile *X. preissii*, *Allocasuarina humilis*, *Hakea lissocarpha*, *H. prostrata*, *Hibbertia hypericoides* and *Daviesia divaricata* over the herbs *Dryandra nivea*, *D. bipinnatifida*, *Conostylis setigera* and *Drosera menziesii*. The creeper *Kennedia coccinea* climbs within the lower stratum.

Distribution: Within the study area this unit occurs on inland facing gentle slopes in the Meelup Reserve system.

Comments: This unit is somewhat similar to the next [JM/Xp2] but differs in the following repects; it has a lower, more open overstorey (ie. it is a woodland not a forest) with Marri twice as abundant as Jarrah, rather than both being equal and has *Persoonia longifolia* and *Xanthorrhoea preissii* forming a lower tree stratum

whereas JM/Xp2 has only a shrub layer below the upper-storey.

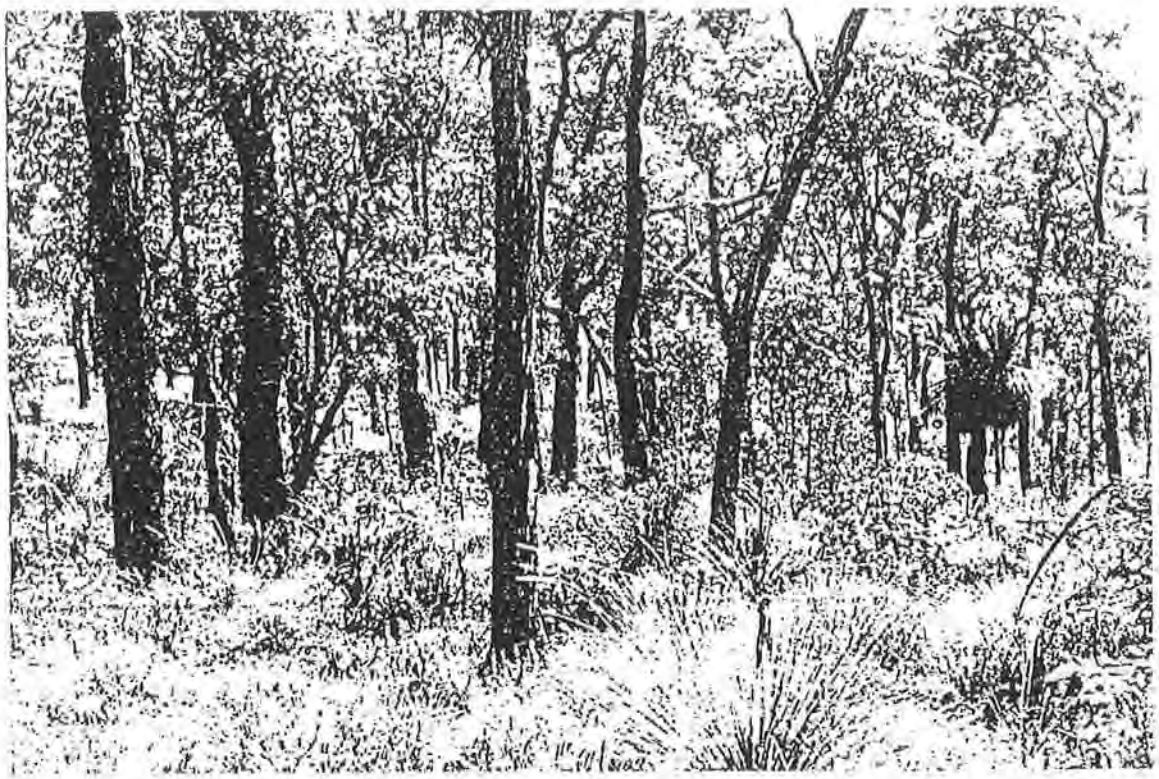
Photograph 30: *Eucalyptus calophylla* (Marri), *Eucalyptus marginata* (Jarrah) Woodland [MJ/Xp1]

It is also somewhat similar to JM3, but differs in that JM3 is a forest not a woodland and in JM3 *Calothamnus sanguineus* and *Hibbertia hypericoides* dominate the understorey rather than *Xanthorrhoea gracilis*.

***Eucalyptus marginata* (Jarrah), *E. calophylla* (Marri) OPEN FOREST [JM/Xp2]**

This vegetation unit occurs on low slopes leading into a flow line on mid-brown to dark brown sandy soils with scattered surface laterite. The height range of the upper stratum is 14-16 m over a dense low shrub layer dominated by *Xanthorrhoea preissii* and *X. gracilis* with other species including the shrubs *Pimelea angustatum*, *Hibbertia hypericoides* and *H. cunninghamii* and the herbs

Stylidium crassifolium and *Drosera gigenteum*.



Photograph 31: *Eucalyptus marginata* (Jarrah), *E. calophylla* (Marri) Open Forest [JM/Xp2]

Distribution: This unit occurs on a gentle slope into a flow line on the inland side of the Meelup Reserve System on the southern boundary of the reserve (adjoining cleared land).

Comment: There is only one area of this vegetation type in the study area.

***Eucalyptus marginata* (Jarrah), *Xylomelum occidentale* (Woody Pear) LOW FOREST [JLo]**

This vegetation type occurs on a slope about 300 m from the beach, with deep-orange sandy soils. The upper stratum is 8-9 metres tall, occasional *Eucalyptus calophylla* (Marri), *Banksia grandis*, *Persoonia longifolia*, *Myrsine floribunda* and

Agonis flexuosa are scattered amongst the dominants. The *Xylomelum* gives this community a distinctive appearance with its 'holly-like' leaves and pear-shaped fruit

Photograph 32: *Eucalyptus marginata. Xylomelum occidentale* (Woody Pear) Low Forest [JKo]

Muir Description:

Site 58

Mixed *Eucalyptus marginata. Eucalyptus calophylla. Xylomelum occidentale* Low Forest A over Mixed *Banksia grandis. Persoonia longifolia. Nuytsia floribunda. Agonis flexuosa* Low Woodland B over *Hakea trifurcata* Dense Thicket with occasional shrubs of *Viminaria juncea, Xanthorrhoea preissii* and *Macrozamia riedlei* over Mixed *Hibbertia hypericoides* (dominant). *Phyllanthus calycinus. Hakea lissocarpha. Trymalium ledifolium. Acacia*

pulchella, *Pimelea ferruginea*, *Melaleuca acerosa*, *Hypocalymma robustum*. Low Heath C with occasional low shrubs of *Adenanthos meisneri*, *Hibbertia cunninghamii*, *Cryptandra arbutiflora*, *Pryandra nivea*, *Logania serpyllifolia*, *Darwinea citriodora*, *Tetratheca hirsuta*, *Allocasuarina humilis*, *Gompholobium preissii* and *Eriostemon spicatus* over occasional herbs of, *Burchadia umbellata*, *Anigosanthos manglesii*, *Patersonia occidentalis*, *Stylidium calcaratum*, *S. bulbiferum*, *S. piliosum*, *Elythranthera brunonis* and *Caladenia flava* and occassional sedges of *Loxocarya fasciculata* with creepers of *Hardenbergia comptoniana* and *Thysanotus patersonii*.

Distribution: The only location recorded for this vegetation type is slightly south, south-west of the formal car park at Meelup beach, at the base of the laterite slopes.

Comments: Although *Xylomelum occidentale* is not a restricted species this is the only substantial stand noted within the Meelup Reserve System.

Melaleuca lanceolata*, *Agonis flexuosa **LOW OPEN FOREST [M1Ag]**

This vegetation type occurs in near coastal locations on areas of light-mid brown sands with outcropping granulite. The tree stratum ranges in height from 6-9 metres. Shrub species present in the understorey include *Scaevola nitida*, *Thryptomene saxicola*, *Spyridium globulosum*, *Rhagodia baccata*, *Acacia cyclops*, *A. saligna*, *Boronia alata*, *Macrozamia riedlei*, *Tetragonia amplexicoma* and *Phyllanthus calycinus*. Where this vegetation type occurs near disturbed areas, such as the occurrence at Bunker Bay, there is a high percentage of invading exotics in the herb and grass layers such as **Briza maxima*, **Trifolium* sp. and **Lagurus*

ovatus. This vegetation type occurs just above the beach at Bunker Bay

Muir Description: BB1

> Mixed *Melaleuca lanceolata*, *Agonis flexuosa* Low Forest A, over mixed *Spyridium globulosum*, *Scaevola nitida*, *Rhagodia baccata* Low Scrub A, over *Thryptomene saxicola* Low Scrub B with occasional shrubs of *Acacia saligna* and *A. cyclops*, over occasional low shrubs of *Macrosamia riedlei*, *Boronia alata* and *Phyllanthus calycinus*, over mixed **Briza maxima*, **Lagrus ovatus* Dense Low Grassland, with mixed **Trifolium* sp., *Orobanche minor* Open Herbland.

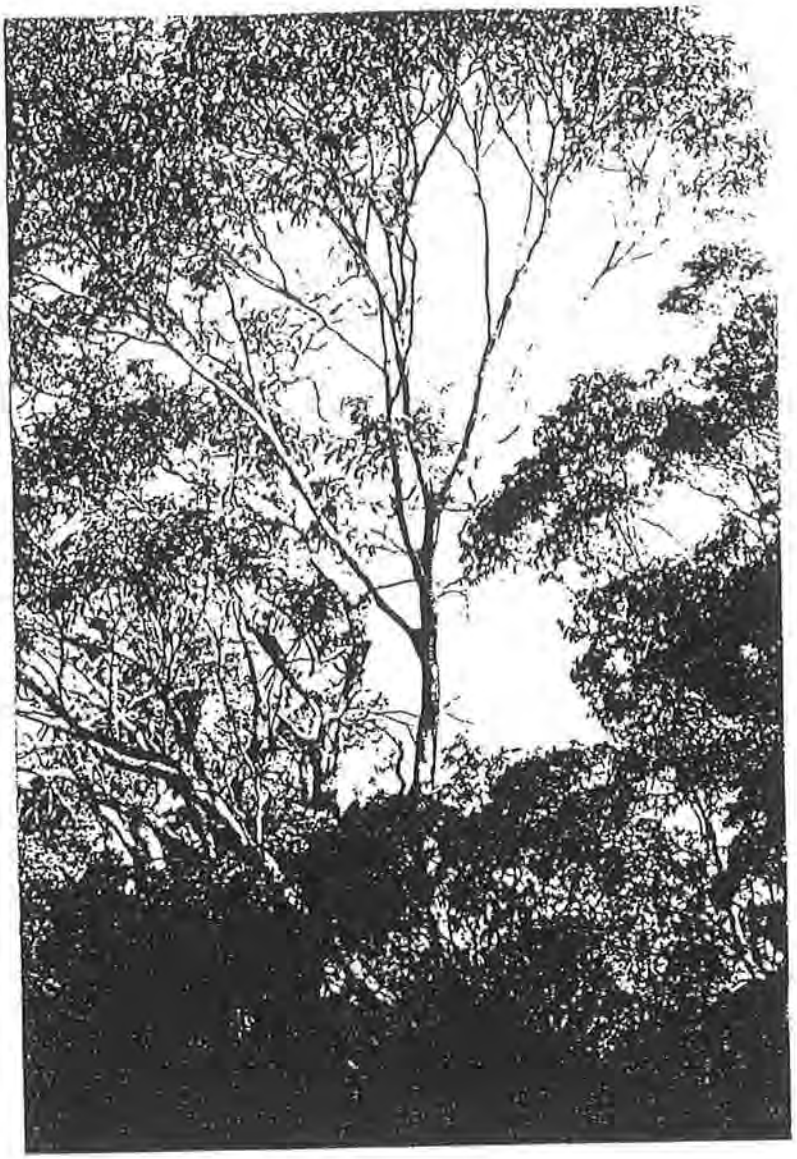
Distribution: The main occurrence of this unit is in the vicinity of Bunker Bay.

Comments: The area of this vegetation unit to the east of Bunker Bay has been more highly disturbed than the occurrence to the west, above the limestone cliff.

***Eucalyptus megacarpa*, *E. calophylla* WOODLAND [MegM]**

This vegetation unit occurs on protected slopes on creamy-yellow to pale-brown sands with areas of outcropping limestone. The height of the upper stratum is 12-16 m, there is a lower tree stratum of *Agonis flexuosa* to 10 m tall. The understorey is relatively open with prominent species including *Xanthorrhoea preissii*, *Bossiaea linophylla* and *Hibbertia cuneiformis*, there are also many juvenile Peppermints present in the understorey. The creepers *Billardiera variifolia* and *Kennedia coccinea* also occur here.

Distribution: The only stand present in the study area is on the lower slopes of the Naturaliste Ridge on privately owned land (part of Sussex location 1049).



Photograph 33: *Eucalyptus megacarpa* (Bullich), *E. calophylla* (Marri) Woodland [MegM]

Comments: This is the only stand with *Eucalyptus megacarpa* (Bullich) in the study area where this species is the dominant rather than a secondary species and therefore has high conservation value (see Recommendations, sect. 7.0).

Eucalyptus calophylla **(Marri),** ***Eucalyptus marginata*** **(Jarrah),** ***Banksia grandis*** **(Bull Banksia),** ***Nuytsia floribunda*** **(W. Aust. Christmas tree) LOW OPEN FOREST [MJ/Ki]**

This vegetation unit occurs on moderate slopes with creamy-brown to mid-brown sandy soils, scattered surface laterite and scattered pebbles and small boulders of granulite. The dominants (4-8 m) occur over a distinct two-layered understorey with the grass trees *Xanthorrhoea preissii* and *Kingia australis* dominating the upper layer (mostly 2-4 m but Kingia was seen to 6 m) over the lower (0.8-1.5 m) layer, which is dominated by the shrubs *Calothamnus sanguineus* and *Hakea trifurcata* with lesser amounts of *Acacia pulchella*, *Pimelea angustifolium*, *Adenanthos meisneri* and Hibbertia hypericoides over the herbs *Thelymitra crinita*, *Tyrantheria brunonis* and *Conostylis setigera*. The creepers

Photograph34: *Eucalyptus calophylla* (Marri), *Eucalyptus marginata* (Jarrah), *Banksia grandis* (Bull Banksia), *Nuytsia floribunda* (W. Aust. Christmas tree) Low Open Forest [MJ/Ki]

Hardenbergia complonians and *Kennedia coccinea* climb through all the layers.

Distribution: This unit occurs on the western slope above the Castle Bay Road (ie. off the Meelup Road).

***Banksia attenuata, Agonis flexuosa, Eucalyptus marginata, Eucalyptus calophylla* LOW OPEN FOREST [BaAgJM]**

This vegetation type occurs adjacent to the heath areas at Cape Naturaliste in areas with deep, grey sandy soil and its grey appearance and greater height offers a marked visual contrast to the heaths. Occasional trees of *Persoonia elliptlcum* occur in the upper stratum which has a cover of 55-60%, the eucalypts vary in height from 3.5-5 m. The understorey is quite dense, with a height range of 0.8-2.0 m and includes shrubs of *Bossiaea linophylla, Allocasuarina humilis, Calothamnus sanguineus, Hakea lissocarpha, H. ruscifolia, H. trifurcata H. prostrata, Acacia pulchella, A. cochlearis, Xanthorrhoea preissii, Macrosamia riedlei, Melaleuca acerosa, Olearia axillaris, Spyridium globulosum, Leucopogon propinquus, Hibbertia hypericoides* and *Phyllanthus calycinus* with sedges of *Lyginia barbata,* herbs of *Conostylis setigera* and creepers of *Billardiera varifolia* and *Hardenbergia complonlana.*

Distribution: This vegetation type occurs at a number of of sites within 0.5-1.0 km south-east from the Cape Naturalista Lighthouse, on the both sides of the Cape Road, which cuts through one stand.

Comments: This vegetation type falls into a group of forest and woodland vegetation types growing on the deeper, grey sands found back from the coast in the Cape Naturaliste area, where it is exposed to the wind the dominants are reduced in height

by wind-pruning

***Allocasuarina fraseriana* (Sheoak), *Banksia grandis*, *B. attenuata* LOW OPEN FOREST [A11o 4]**

This vegetation type occurs on leeward or eastern slopes on creamy-yellow coloured sandy soils. The understorey of this vegetation type is very sparse and both grazing and the deep litter layer of *Allocasuarina* needles may be responsible for this Occasional trees of *Eucalyptus marginata* are present in the upper stratum and a second tree statum of *Agonis flexuosa*, *Persoonia elliptica* and *Xylomelum occidentale* is present.

Photograph 35: *Allocasuarina fraseriana*, *Banksia grandis*, *B. attenuata* Low Open Forest [A11o4]

Distribution: This vegetation type occurs approximately 1.5 km inland of Kabbijgup, near Gutherie Road.

Comments: The majority of this vegetation type is on privately owned land, except for a small area which has recently been aquired by the Busselton Shire Council as the future site for the amalgamated Yallingup-Dunsborough Rubbish Tip. The location of such an activity in this area is unfortunate due to the potentially disastrous impact of fires escaping from the rubbish tip and burning into the National Park. Except to the east, the proposed tip site is surrounded by virtually undisturbed tracts of natural vegetation and in the case of a fire escaping from the tip (a regular occurrence at other tips) it could be very difficult to protect the fragile coastal heaths and other vegetation types of the Naturaliste Ridge. Unfortunately the Council has already cleared a large section of this proposed Tip site.

***Banksia littoralis* (Swamp Banksia), *Banksia grandis*, *Agonis flexuosa* LOW OPEN FOREST [Blitt]**

This vegetation type occurs upslope from the beach on grey sands, near a semi-permanent soak. The height of the forest is 4-7 metres and there are also occasional trees of *Nuytsia floribunda* in the upper statum. Other species in this vegetation include shrubs of *Melaleuca lanceolata*, *Viminaria juncea*, *Xanthorrhoea preissii*, *Trymalium ledifolium*, *Logania vaginalis*, *Dodonaea ceratocarpa*, *Acacia divergens*, *A. pulchella*, *Hibbertia hypericoides*, *Phyllanthus calycinus* and *Thomasia pauciflora* and sedges of *Lepidosperma angustatum* and *Loxocarya flexuosa*.

Distribution: Only one location of this vegetation type was found in the study area, upslope from the beach at Eagle Bay.

Comments: As there is only one location of this vegetation type in the study area and the spring in it provides a natural source of drinking water for the native fauna (as is evident from tracks) its conservation value is high.

It is in close proximity to a popular recreation beach (Eagle Bay), and to residential development, but unfortunately is being used as a water source by some of the private residences, which may be responsible for the death of some of the large *Banksia littoralis* (Swamp Banksia).

Eucalyptus marginata, E. calophylla FOREST [JM2]

This vegetation unit occurs on gentle slopes with caramel-brown to dark-brown coloured sands with surface lateritic pebbles and occasional surface granulitic pebbles and boulders. Under the marri and jarrah (12-15 m) there is a second tree layer of *Banksia grandis* and *Agonis flexuosa* (3-6 m) with occasional *Persoonia longifolia* and *Viminaria juncea*. The understorey is a dense low heath (0.6-1.2 m) with *Xanthorrhoea preissii, Calothamnus sanguineus, Acacia divergens, Acacia pulchella, Melaleuca scerosa, Daviesia cordata* and *Hakea lissocarpha* with sedges and herbs of *Loxocarya fasciculata, Patersonia occidentalis, Mesomeleana stygia, Logania serpyllifolia, Stylidium calcaratum, Drosera menziesii, Caladenia flava* and *Conostylis setigera*.

Distribution: This unit occurs around the water tanks in Meelup Reserve No. 21629.

Comments: This unit has been disturbed with the siting of a rubbish tip, a gravel pit, water tanks and a golf course, however the remainder of this unit and the reserve are still of high conservation value even taking into account this disturbance.

Eucalyptus marginata (Jarrah), *E. calophylla* (Marri) OPEN FOREST [JM3]

This vegetation unit occurs on lower gentle slopes with pale brown to mid-brown loamy soils. The height range of the dominants is 8-12 m over an understorey of two

distinct strata. The upper (1.5-3.0 m) has scattered *Hakea amplexicaulis*, *Xanthorrhoea preissii* and *Persoonia longifolia* over a low (0.4-0.9 m) dense heath of the shrubs *Calothamnus sanguineus*, *Hibbertia hypericoides*, *Xanthorrhoea gracilis*, *Adenanthos meisneri*, *Dryandra nivea*, *Hakea lissocarpha* and *Hypocalymma angustifolium* with ocassional low shrubs including *Acacia pulchella*, *Tetratheca hirsuta*, *Hibbertia cunninghamii*, *Scaevola* sp. (CK 214), *Pimelea angustifolium*, over the herbs *Drosera menziesii*, *Conostylis setigera*, *Stylidium amoenum* and *Thelymitra crinita*.

Distribution: There is only one area of this vegetation unit in the study area, it occurs on the inland slopes of the Meelup Reserve System.

Comments: While the middle stratum of this unit is similar to that of MJ/Xp1 the upper stratum is denser and has more Jarrah than Marri and the understorey is different (see note unde MJ/Xp1).

***Eucalyptus calophylla* (Marri), *E. marginata* (Jarrah) OPEN FOREST [MJ/Ag1]**

This vegetation unit occurs on gentle slopes with pale to dark grey sandy soils. There is more Marri than Jarrah (both 8-12 m), below them there is a second tree layer of *Banksia grandis*, *B. attenuata*, *Nuytsia floribunda*, *Agonis flexuosa* and scattered *Xylomelum occidentale* (all 4-8 m). The understorey (0.8-1.4 m) is mid-dense with the most abundant shrubs being *Xanthorrhoea preissii*, *Hakea lissocarpha*, *Macrosamia riedlei*, *Jacksonia furcellata* and *Acacia pulchella*.

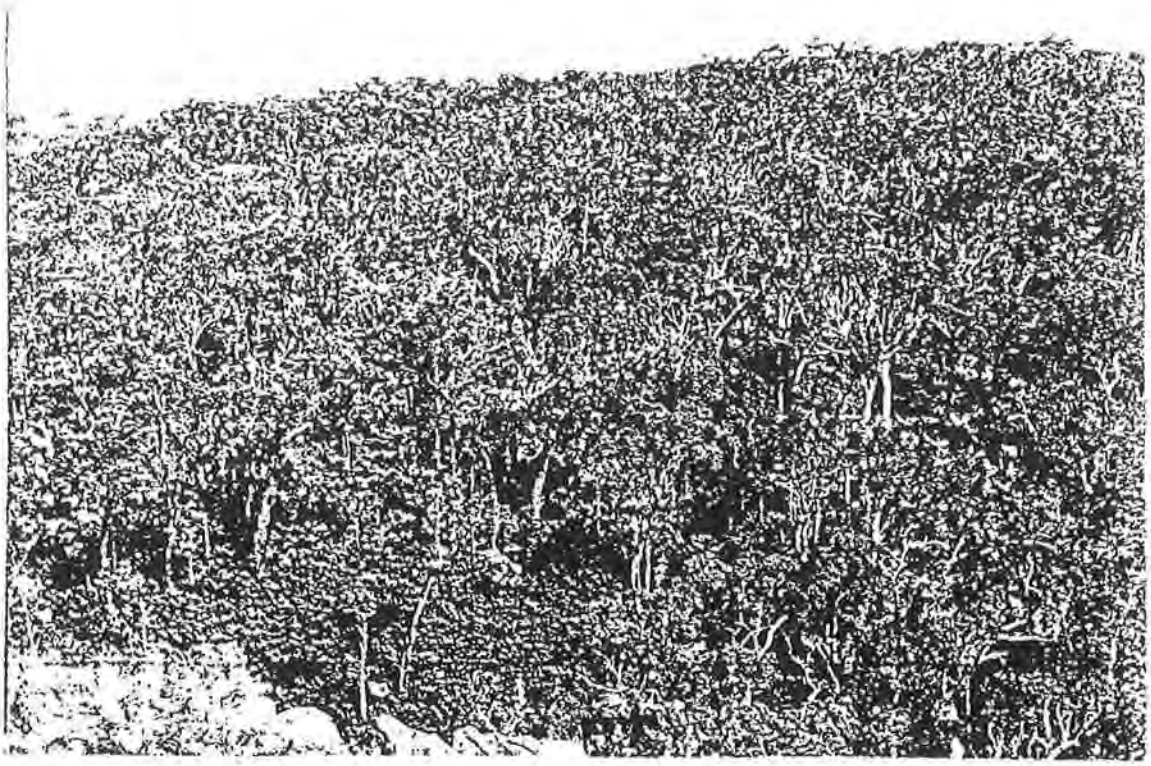
Distribution: This vegetation unit occurs on the gentle slopes inland from Eagle Bay

on privately owned land.

Comments: The area of this vegetation unit is being grazed and in the absence of this pressure the understorey would probably be denser

Eucalyptus calophylla, E. marginata, Agonis flexuosa FOREST [MJ/Ag2]

This vegetation unit occurs on moderate to steep valley slopes with mid to dark brown sandy soils with some surface lateritic pebbles and outcropping granulite. The upper stratum reaches 12-16 m. The upper layer of the understorey (0.6-1.8 m) has the shrubs *Xanthorrhoea preissii, Hakea lissocarpha, Calothamnus sanguineus, Macrozamia riedlei* and *Acacia pulchella* with less *Bossiaea linophylla* and *Logania vaginalis*. In the lower layer (30-70 cm) the shrubs



Photograph36: *Eucalyptus calophylla, E. marginata, Agonis flexuosa* Forest [MJ/Ag2]

Hibbertia hypericoides, *Dryandra nivea*, *Pimelea rosea*, *Astroloma drummondii* and *Trymalium ledifolium* occur over the herbs *Burchardia umbellata*, *Conostylis setigera* and *Logania serpyllifolia*.

Distribution: This vegetation unit occurs on the lower valley slopes of the Meelup River.

Eucalyptus marginata (Jarrah) FOREST [J1]

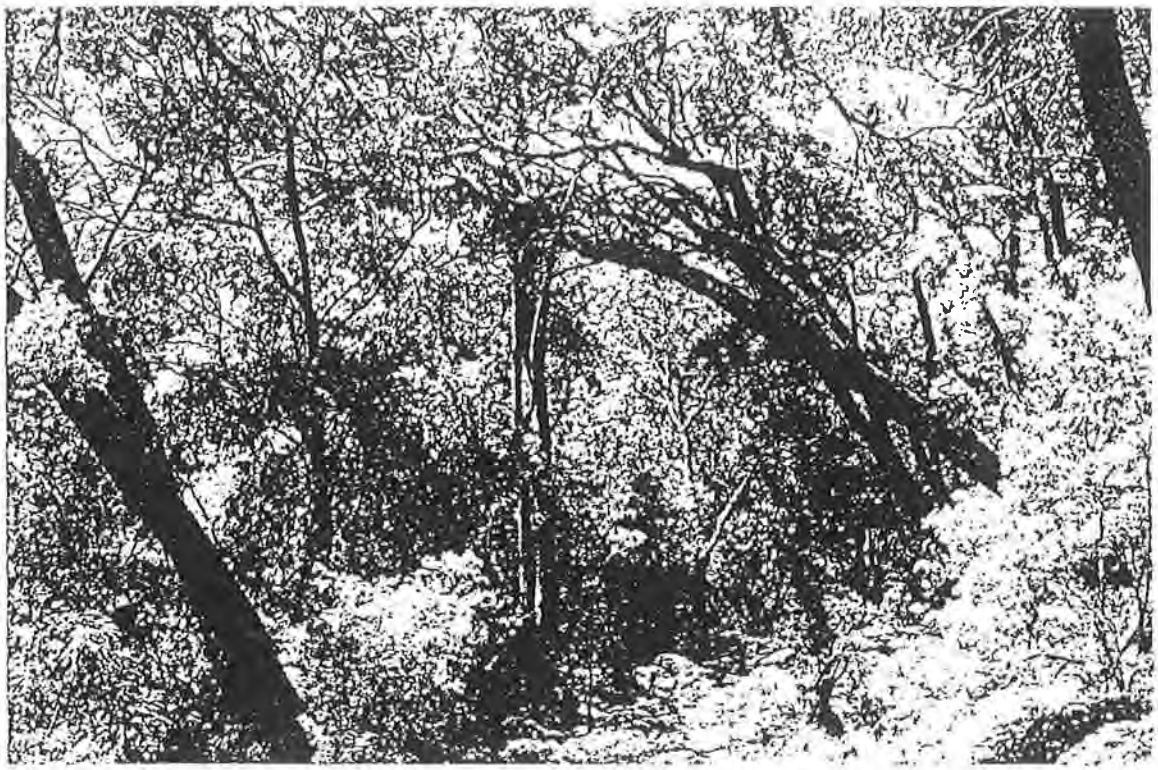
This vegetation type occurs on moderate slopes with dark brown soil with scattered lateritic surface pebbles. The upper stratum has a height range of 8-14 m and has very small amounts of Marri (*Eucalyptus calophylla*) with the Jarrah. The upper layer of the understorey (0.6-1.4 m) is dominated by the shrubs *Xanthorrhoea preissii*, *X. gracilis* and *Hakea amplexicaulis*. The lower storey (25-50 cm) is a dense heath of *Calothamnus sanguineus*, *Hibbertia hypericoides*, *H. cunninghamii*, *Acacia alata* and *Tetratheca hirsuta* with herbs including *Patersonia occidentalis*, *P. umbrosa* var. *xanthina*, *Logania serpyllifolia*, *Stylidium calcaratum*, *Burchardia umbellata* and *Elythranthera brunonis*.

Distribution: This vegetation unit occurs on the western slopes below the Meelup and Castle Bay roads.

Eucalyptus cornuta (Yate), *E. calophylla*, *E. marginata* OPEN FOREST [Y]

This vegetation type occurs on the protected slope of the Naturaliste Ridge on grey to creamy-brown coloured sandy soils. The upper stratum has a height of 10-14 metres over a second tree stratum of *Agonis flexuosa* (6-10 m). Prominent species in the understorey include *Dryandra sessilis*, *Jacksonia furcellata* (seen to 4m and 5m respectively), *Acacia littorea*, *A. cochlearis*, *Hibbertia cuneiformis*, *Hakea*

prostrata, *H. amplexicaulis* and *Xanthorrhoea preissii* over lower shrubs including *Hibbertia hypericoides* and *H. grossularia*. Herbs include *Patersonia occidentalis* and *Thysanotus multiflorus*.



Photograph 37: *Eucalyptus cornuta* (Yate), *E. calophylla*, *E. marginata* Open Forest [Y]

Distribution: The only stand in the study area occurs on the mid-lower leeward slopes of the Naturaliste Ridge, on privately owned land (part of Sussex loc. 660).

Comments: This stand is part of a population of Yate that is disjunct from the major area of that species (the main occurrence of this species is from the Fitzgerald River to the Stirling Range), as such it is of high conservation value (see Recommendations, 7.0). It is the only place in the study area where Yate has reached such development. The inclusion of this important stand in the Leeuwin-Naturaliste National Park is most desirable.

Eucalyptus marginata **(Jarrah) OPEN FOREST [J2]**

This vegetation type occurs on granulite upland areas where there are grey sandy soils over laterite. The dominant ranges in height from 12-17 metres, there is a small proportion of *Eucalyptus calophylla* with the dominant and *Persoonia longifolia* is comparatively common as a lower stratum. The understorey is relatively dense and has a height range of 0.5-1.5 m with prominent species including *Daviesia cordata*, *Pimelea rosea*, *Hakea lissocarpha*, *H. amplexicaulis*, *Hibbertia hypericoides*, *Xanthorrhoea preissii*, *Acacia pulchella*, *A. nervosa*, *A. decipiens*, *Daviesia preissii*, *Calothamnus sanguineus*, *Adenanthos meisneri*, *Dryandra nivea* and *D. bipinnatifida*. *Conostylis setigera*, *Synaphea petiolaris*, *Patersonia occidentalis*, *Stylidium diversifolium* and *Stackhousia huegelii* are present in the herb layer. *Hovea trisperma*, *Brachyscme praemorsum* and *Xanthosia candida* forming a localized dense ground cover.

Muir Desription: site d

> *Eucalyptus marginata*, *E. calophylla* Low Forest A over mixed *Leucopogon verticillatus*, *Daviesia cordata*, *Pimelea rosea*, *Xanthorrhoea preissii*, *Hakea amplexicaulis* Low Scrub A, over mixed *Hakea lissocarpha*, *Acacia pulchella*, *A. divergens* swamp Open Dwarf Scrub C over mixed *Hibbertia hypericoides*, *Adenanthos meisneri*, *Calothamnus sanguineus*, *Acacia nervosa*, *Dryandra nivea*, *Daviesia preissii* Low Heath D, over mixed *Conostylis setigera*, *Stylidium diversifolium*, *Synaphea petiolaris* Open Herbland.

Distribution: This unit occurs on private land on the north side of Caves Road in the vicinity of the Bannamah Wildlife Park. It is bordered by the Road to the South and by cleared farming areas to the north and west.

Comments: This unit has a similar upper stratum to the *Eucalyptus marginata* Open Forest [J1], which occurs in the Meelup Reserve System (Reserves No. C21629, C31367 and C31368). It has been separated on the basis of the differing understorey. *Daviesia cordata*, *Leucopogon verticillatus* and *Acacia alata* are prominent species in this unit [J2], which do not occur in the Meelup Reserve System.

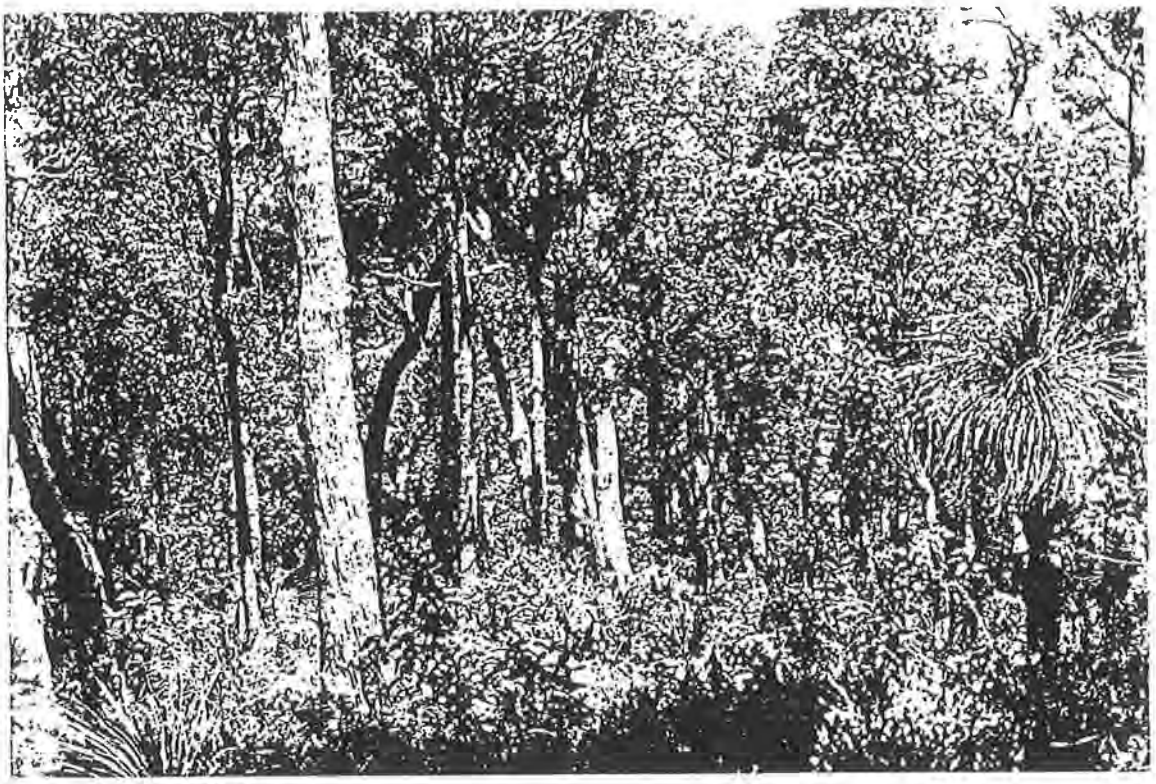
The restricted occurrence of *Eucalyptus marginata* Forests and Woodlands within the study area and the disturbance of a number of these through clearing and gravel extraction means the remaining undisturbed stands have a high conservation value. Therefore it would be desirable for this specific area to be aquired for conservation purposes.

***Eucalyptus marginata* (Jarrah) OPEN FOREST [J5]**

This vegetation type occurs on lateritised granulite upland areas with pale brown sandy soils over laterite. The relatively open upper stratum has a height range of 10-15 metres, over a mid-dense stratum of *Banksia grandis*, *B. attenuata*, *Allocasuarina fraseriana*, *Nuytsia floribunda*, *Agonis flexuosa* and *Persoonia longifolia*. The understorey is also mid-dense with a height range of 0.5-1.6 m, and includes the shrub species *Xanthorrhoea preissii*, *X. gracilis*, *Macrosamia riedlei*, *Stirlingia latifolia*, *Calothamnus sanguineus*, *Lysinema ciliatum*, *Acacia pulchella*, *Calytrix flavescens* and the prostrate shrub *Hemiandra pungens*; sedges of *Mesomelaena stygia* and *Lepidosperma angustatum*, the fern *Asplenium* aff. *flabellifolium*, with herbs of *Anigozanthos rufus*, *Patersonia occidentalis*, *Logania serpyllifolia*, *Dasypogon bromeliifolius*, and the rare and geographically restricted caulescent monocotyledon, *Dasypogon hookeri* (pineapple bush).

Muir Description:

Eucalyptus marginata, *E. calophylla* Woodland over mixed *Banksia grandis*, *B. attenuata* Low Woodland A over mixed *Xylomelum occidentale*, *Persoonia longifolia* Open Low Woodland B over mixed *Xanthorrhoea preissii*, *Desypogon hookeri*, *Macrosamia riedlei* Heath E over mixed *Xanthorrhoea gracilis*, *Stirlingia latifolia*, *Calothamnus sanguineus*, *Hibbertia hypericoides*, *Lysinema ciliatum* Dwarf Scrub D.



Photograph 38: *Eucalyptus marginata* (Jarrah) Open Forest [J]

Distribution: This vegetation unit is restricted (within the study area) to Reserve No. 28665, a C-class reserve vested in the Busselton Shire Council for the purpose of 'conservation of caves and flora'.

Comments: The restricted occurrence of this unit which has the gazetted rare and geographically restricted *Dasypogon hookeri* (see Section 3.6) present in it, means it is of very high conservational value. This vegetation unit is currently within a C-class conservation reserve however, there is a need to increase the status to A-class and as discussed above, in relation to the high conservation value of the combined vegetation units within Reserve No. 28665, accompanying such an upgrading is the need to vest this conservation reserve with an appropriate authority having the requisite skills for management for conservation.

This occurrence of *Dasypogon hookeri* is the most north-westerly of its range which adds to its conservation value.

***Allocasuarina fraseriana, Eucalyptus calophylla, E. marginata* OPEN FOREST [Allo MJ1]**

This vegetation type occurs on protected slopes with pale orange-brown sands. *Allocasuarina fraseriana, Eucalyptus calophylla* and *E. marginata* share equal dominance in the upper tree stratum over the lower tree stratum of *Banksia grandis, B. attenuata, Persoonia longifolia, Xylomelum occidentale* and *Agonis flexuosa*. Occasional trees of *Eucalyptus megacarpa* (Bullich) are present but are outliers of the neighbouring vegetation type. The understorey is moderately dense, with juvenile *Agonis flexuosa* and shrubs of *Hibbertia cuneiformis, Bossiaea linophylla, Hakea ruscifolia, Acacia pulchella* and *Macrozamia riedlei*. Creepers include *Clematis microphylla* (Old Man's Beard) and *Hardenbergia comptoniana* (Native Wisteria) and *Billardiera variifolia*. The exotic *Zantedeschia aethiopica* (Arum lily) occurs as a dense herbland in localised damper patches. Characteristic of this vegetation type is the well developed litter layer of *Allocasuarina* needles.

Muir Desription:

> Mixed *Allocasuarina fraseriana, Eucalyptus calophylla, E. marginata, Agonis flexuosa, Banksia grandis, B. attenuata* Dense Low Forest A, over mixed *Xylomelum occidentale, Persoonia longifolia* Open Low Woodland B, over *Hibbertia cuneiformis, Acacia pulchella, Leucopogon australis, Macrozamia riedlei* Low Scrub B, over localized *Zantedeschia aethiopica* Dense Herbs with occasional herbs of *Hibbertia grossulariifolia* and occasional creepers of *Clematis microphylla*.

Ditribution: This unit occurs on the leeward slopes of the Naturaliste Ridge, approximately 1.5 km inland from Kabbijup Beach (Three Bears).

Comments: This vegetation type is of limited occurrence and the only occurrence in the study area is on privately owned land and while its conservation would be desirable the stand is small and is surrounded by cleared land.

Eucalyptus calophylla, Eucalyptus marginata **OPEN FOREST [JM1]**

This vegetation community occurs on lateritic upland areas, and has an overstorey of about 15 m tall, over a low (0.6-1.0 metres), mixed understorey. The location of such a well developed stand of Jarrah and Marri in such close proximity to the coast is very significant. The extent of cleared and disturbed land within the region only serves to impress the need to conserve and manage such unique areas. Other species in this community include, the 'grass trees' *Xanthorrhoea preissii* and *X. gracilis, Hibbertia hypericoides, H. cunninghamii, Conostylis setigera, Caladenia flava, Patersonia umbrosa* var. *xanthina, Calothamnus sanguineus, Kennedia coccinea, Daviesia cordata, Tetratheca hirsuta, Dampiera linearis, Scaevola* sp. (CK214), *Thelymitra crinita, Stylidium calceratum,*

Stylidium amoenum, *Logania serpyllifolia* and *Burchardia umbellata*.

Photograph 39: *Eucalyptus marginata*, *E. calophylla* Open Forest [JM1]

Muir Descriptions:

Site B1

Eucalyptus calophylla, *Eucalyptus marginata* Low Forest A, over Mixed *Xanthorrhoea preissii*, *Xanthorrhoea gracilis*, *Hakea amplexicaulis*, *Daviesia cordata* Low Scrub B with occasional shrubs of *Hakea lissocarpha* over Mixed *Calothamnus sanguineus*, *Hibbertia hypericoides*, *Hibbertia cunninghamii*, *Acacia nervosa*, *Dryandra nivea*, *Hypocalymma robustum*, *Tetratheca hirsuta*, *Daviesia longifolia* Dwarf Scrub D, with occasional low shrubs of *Sphaerolobium medium*, *Logania serpyllifolia*, *Pimelea suaveolens*, *Bossiaea ornata*, *Leptospermum* sp. (CK198), *Eriostemon spicatus*, *Daviesia* sp. (CK216), *Adenanthos meisneri* and *Dryandra bipinnatifida*, with a

Mesomelaena stygia Very Open Tall Sedgeland over Mixed *Dampiera linearis*, *Scaevola* sp. (CK214), *Thelymitra crinita*, *Caladenia paterson*ii var. *longicauda*, *Burchardia umbellata*, *Apiaceae* sp. (CK191), *Lomandra* sp. (CK205), *Drosera erythorrhiza*, *D. menziesii*, *Stylidium diversifolium*, *S. calcaratum*, *S. amoenum* and *Lechenaultia biloba*.

Distribution: The only occurrences of this vegetation type in the study area are found above Curtis Bay in reserves C21629, C31368 (Gravel Pit) and C31367 (Rubbish Dump) except for a significant stand on private property abutting reserve No. 21629.

Comments: This vegetation type is of very limited occurrence in the study area and this combined with its aesthetic appeal gives it a very high conservation value. Given this (and the other restricted vegetation types that occur there) it is obvious that the level of protection of reserve no. 21629 should be increased from C to A-class. It is also obvious that the areas of this vegetation type in reserve nos. 31367 and 31368 are being used for purposes that significantly underate the conservation and recreational values of the vegetation resource found on them.

The areas of this vegetation type on the reserves have all been recently burnt, it would be desirable to burn them in rotation (but not more freqently than 15-20 years) rather than all at the same time.

***Eucalyptus rudis* (Flooded Gum), *E. calophylla* (Marri) OPEN FOREST [ErlM]**

This vegetation type occurs in the moist river or creek valleys. Its density and height are a marked contrast to the surrounding vegetation. The Flooded Gum and Marri are 12-16 metres over a dense second stratum of *Agonis flexuosa* (6-8 m). Understorey

species include shrubs of *Loganio reginalis*, *Bossiaea linophylla*, *Acacia alata*, *A. pulchella*, *A. divergens*, *A. nervosa*, *Trymalium ledifolium*, *Hibbertia cuneiformis*, *H. racemosa*, *Dodonaea ceratocarpa*, *Macrozamia riedlei*, *Xanthorrhoea preissii*, *Phyllanthus calycinus*, *Thomasia*, *Leptospermum* sp. (CK196), with sedges of *Lepidosperma tetraquetrum*, *Juncus pallidus*, *Ghania trifida*, *Lepidosperma gladiatum*, creepers of *Clematis microphylla*, *Billardieria variifolia*, *B. floribunda*, *Kennedia coccinea* and *Hardenbergia comptoniana*, herbs of *Conostylis setigera* and *Loganio serpyllifolia* and *Loxocarya fasciculata*.

Photograph 40: *Eucalyptus rudis*, *E. calophylla* Open Forest [Er1M]

Distribution: The three locations where this vegetation type occurs in the study area are in the valleys at Meelup, Woodlands and about one km north of Canal Rocks.

Comments: This vegetation type is of limited occurrence in the study area, the Meelup

stand is in the C-Class Reseve (No.21629) south of Dunsborough, most of the other major stand (Woodlands) is on private land abutting Leeuwin-Naturaliste National Park. Its inclusion in the Park is highly desirable.

***Eucalyptus rudis, Eucalyptus calophylla* OPEN FOREST [Er2M]**

This vegetation type occurs in moist valley areas (particularly where there is a permanent water course) on pale brown to a very dark brown, loamy soils. The upper stratum has a height range of 9-14 metres over a lower tree stratum of the Peppermint, (*Agonis flexuosa*). The mid-dense to dense understorey (often a reflection of disturbance) includes the shrub species *Viminaria juncea, Xanthorrhoea preissii, Hibbertia cuneiformis, H. hypericoides, H. cunninghamii, Acacia saligna, A. nervosa, Cryptandra arbutiflora* and *Phyllanthus calycinus* the ferns *Pteridium esculentum* (Bracken fern) and the Maiden Hair Fern *Adiantum aethiopicum*, the creepers *Hardenbergia comptoniana* and the coral vine *Kennedia coccinea* and the exotics **Zantedeschia aethiopica* (arum lily), **Anagallis arvensis* and **Briza maxima*.

Muir Description: SITE 26D

> *Eucalyptus rudis, E. calophylla* Dense Low Forest A, over *Agonis flexuosa* Low Forest B, with occasional trees of *Melaleuca preissiana*, over mixed *Viminaria juncea, Hibbertia cuneiformis, Xanthorrhoea preissii* Heath A, over *Lepidosperma gladiatum* Open Tall Sedges with mixed *Pteridium esculentum, Phyllanthus calycinus, Cryptandra arbutiflora, Acacia nervosa*. Dwarf scrub D, over **Zantedeschia aethiopica, *Anagallis arvensis* localized Dense Herbland.

Photograph 41: *Eucalyptus rudis, E. calophylla* Open Forest [Er2M]

Distribution: This vegetation unit occurs in narrow strips along the majority of the drainage lines in:-

- the low lying area bounded by Busselton, Caves Road and the Naturaliste Ridge, and
- the area south of Yallingup, bounded on the east by Caves road (the eastern boundary of the study area).

Comments: A number of the occurrences of this unit which are on private land are highly disturbed, through clearing and the general grazing and trampling of vegetation, muddying of the water courses and subsequent introduction of weeds as a result of grazing.

Allocasuarina fraseriana, Banksia grandis, Banksia attenuata, Eucalyptus marginata, E. calophylla **OPEN FOREST [A1101]**

This distinctive *Allocasuarina* vegetation type with *Eucalyptus calophylla* (Marri), *E. marginata* (Jarrah), *Banksia grandis* (Bull-banksia), *Banksia attenuata* and *Agonis flexuosa* with the geographically restricted *Desypogon hookeri* occurs on upland areas of grey sand. Other species in this community are trees of *Persoonia elliptica, Nuytsia floribunda* and shrubs of *Hibbertia hypericoides, Calothamnus sanguineus, Xanthorrhoea preissii* and *Acacia pulchella*.

Distribution: The larger area of this vegetation type in the study area is near Yallingup on the east side of Caves Road, stretching from Yallingup to five kms from Dunsborough, the second occurrence is west of Caves Road near Canal Rocks.

Comments: Areas of this vegetation type are protected within the Leeuwin-Naturaliste National Park, near Yallingup and in Reserves No. C28665 and C12494 (adjoining Caves Road opposite the Bannamah Wildlife Park) vested in the Busselton Shire for the purpose of 'preservation of caves and conservation of flora'.

Allocasuarina fraseriana, Eucalyptus marginata, E. calophylla, Nuytsia floribunda, Banksia grandis **LOW CLOSED FOREST [A1102]**

This vegetation type has a dense canopy, a very open understorey and occurs on exposed, moderate upland slopes, approximately 500m from the beach. The soils are very dark grey on the surface over orange-brown sands. Understorey species include shrubs of *Xanthorrhoea preissii, Calothamnus sanguineus, Melaleuca acerosa, Hypocalymma robustum, Eriostemon spicatus, Hibbertia hypericoides, H. cunninghamii, Acacia pulchella, Hemigena incana* and *Synaphea petiolaris*, herbs of *Podolepsis lessonii, Burchardia umbellata*,

Helipterum cotula, *Styllidium calcaratum*, *Stackhousia huegelii*, **Anagallis arvensis* and *Loxocarya fasciculata*.

Photograph 42: *Allocasuarina fraseriana*, *Eucalyptus marginata*, *E. calophylla*, *Nuytsia floribunda*, *Banksia grandis* Low Closed Forest [A1o2].

Muir Description:

Site 36

Mixed *Allocasuarina fraseriana*, *Eucalyptus marginata*, *Eucalyptus calophylla*, *Nuytsia floribunda*, *Banksia grandis* Dense Low Forest A over *Xanthorrhoea preissii* Open Dwarf Scrub C over Mixed *Acacia pulchella*, *Hibbertia cunninghamii* Open Dwarf Scrub D with occasional low shrubs of *Calothamnus sanguineus*, *Hypocalymma robustum*, *Hibbertia hypericoides*, *Eriostemon spicatus*, *Melaleuca acerosa*, *Hemigenia incana*, over mixed *Burchardia umbellata*, *Styllidium calcaratum*, *Helipterum cotula*, *Stackhousia huegelii*,

* *Anagallis arvensis* Open Herbfield.

Distribution: One area of this vegetation type was observed 500 m west of Castle Bay.

Comments: The very open understorey of this vegetation type is probably due to a combination of a dense overstorey and the presence of the *Allocasuarina fraseriana* which inhibits understorey growth. The area had been burnt fairly recently.

As there is only one area of this unit in the study area it must be given a high conservation value and care taken to see that it is not disturbed or degraded.

Eucalyptus calophylla **(Marri)** ***E. marginata*** **(Jarrah) OPEN FOREST [MJ/BgBa]**

This unit occurs on upper slopes with pale grey to mid-grey sandy soils. Marri and Jarrah (10-15 m) form the upper layer tree layer over *Banksia grandis*, *B. attenuata*, *B. littoralis* and *Nuytsia floribunda* (all 3-5 m) with occasional scattered lower trees of *Persoonia longifolia*. The upper shrub layer (1.5-3 m) has scattered *Xanthorrhoea preissi* and *Kingia australis* over a medium to dense lower layer (0.5-1.5 m) of *Xanthorrhoea preissii*, *X. gracilis*, *Hakea lissocarpha*, *Acacia nervosa*, *Hypocalymma angustifolium*, *Daviesia divaricata*, *Calothamnus sanguineus*, *Hibbertia hypericoides* and *H. cunninghamii* with the herbs *Anigosanthos manglesii*, *Caladenia flava*, *Conostylis setigera* and the sedges *Mesomelaena stygia* and *Lepidosperma angustatum*. *Kennedia coccinea* climbs through the understorey.

Distribution: This vegetation unit occurs on the southern slopes in the Meelup Reserve System on the coastal side of the golf club.

Eucalyptus calophylla (Marri) OPEN FOREST [M/Ag]

This unit occurs on moderate slopes with brown to dark grey loamy soils with some surface laterite and outcropping granulite. Under the Marri (15-20 m) is a dense layer (6-8 m) of *Agonis flexuosa* and *Banksia grandis* with scattered *Eucalyptus megacarpa*. The understorey (0.8-1.6 m) is fairly open with the shrubs *Hibbertia hypericoides*, *Xanthorrhoea preissii*, *Acacia saligna*, *A. pulchella*, *Macrozamia riedlei* and bracken, *Pteridium esculentum*.

Distribution: This unit occurs on uncleared, privately owned land in the Woodlands area, upslope from Wilyabrup Brook, there is only one, moderate sized, stand of this unit in the study area.

Comments: This is one of the few units in the study area with a pure Marri overstorey, usually it is mixed with Jarrah, and thus the stand has a high conservation value.

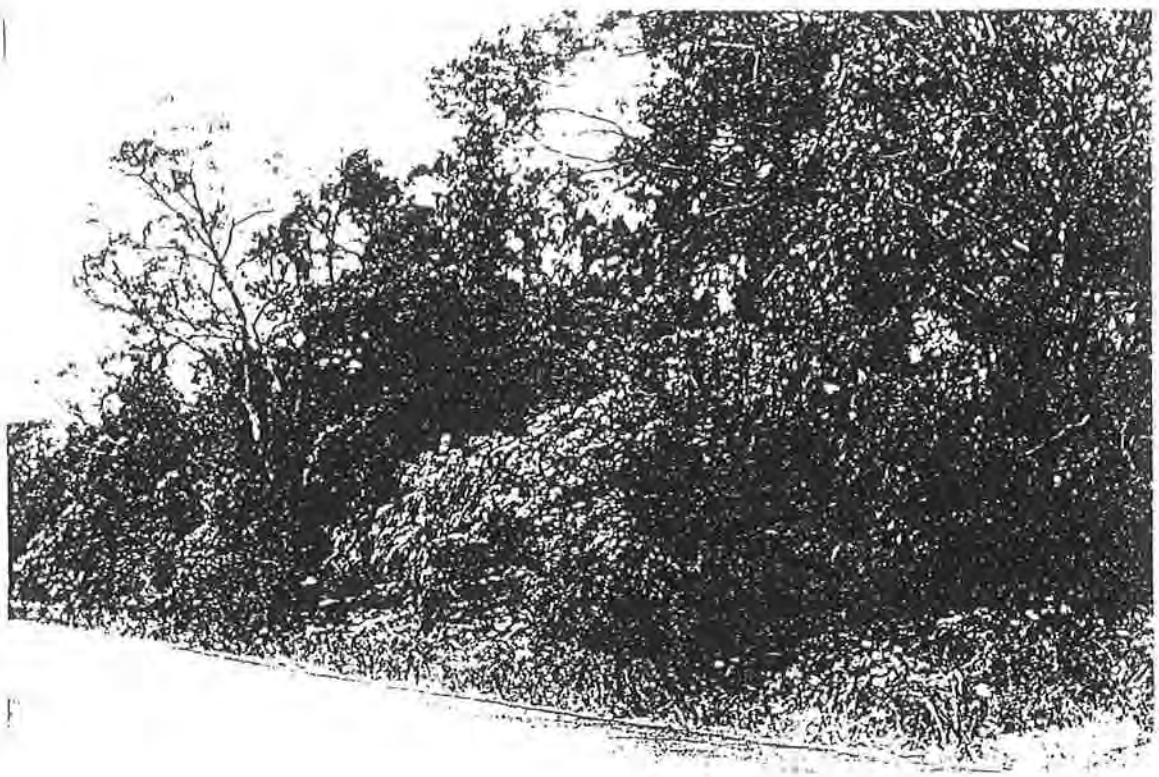
Eucalyptus megacarpa has developed to a height of 8-10 m in this unit but in most of the units that itwas observed in it was not this tall.

Grazing of this unit has caused degradation of the understorey, and a small dam has meant the south east corner has received excessive trampling pressures.

Agonis flexuosa, *Eucalyptus calophylla* (Marri), *E. rudis* (Flooded Gum) CLOSED FOREST [AgMEr]

This vegetation unit occurs on damp, low-lying areas close to the beach with cream-coloured to grey and mid-brown sandy soils and has a height range of 5-9 m. This unit has a dense two-layered understorey with an upper (1.5-4.0 m) stratum of *Viminaria juncea*, *Acacia saligna* and *A. pulchella* over the lower (1.0-2.0 m) stratum of *Xanthorrhoea preissii*, *Beyeria viscosa*, *Olearia axillaris* and

Sporadium globulosum



Photograph 43: *Agonis flexuosa*, *Eucalyptus calophylla* (Marri), *E. rudis* (Flooded Gum) Closed Forest [AgMEr]

Distribution: This vegetation unit occurs at the eastern tip of the Meelup Reserve System (ie. at Eagle Bay) and forms a wedge between the beach and cleared land

Comments: There is only one stand of this vegetation type in the study area, it is somewhat disturbed with moderate weed invasion.

Eucalyptus marginata FOREST [J3]

This vegetation type occurs on laterilised upland areas with orange-brown lateritic gravel soils. The upper stratum has a height range of 12-20 metres with a moderate proportion of Marri (*Eucalyptus calophylla*) amongst the dominant *Hakea amplexicaulis* and *Persoonia elliptica* form a low open upper shrub stratum

over a mid-dense (0.5-1.5 m) understorey including shrubs of *Xanthorrhoea preissii*, *Hakea lissocarpha*, *Calothamnus sanguineus*, *Hibbertia hypericoides*, *Hypocalymma robustum*, *Isopogon sphaerocephalus*, *Adenanthos meisneri* and *Daviesia horrida* over lower shrubs of *Acacia nervosa*, *Dryandra nivea*, *D. bipinnatifida*, *Pseudanthus virgatus*, *Hibbertia cunninghamii*, *Synaphea reticulata*, *Tetratheca hirsuta* and *Daviesia preissii*. Herbs include *Isotoma hypocrateriformis* (wooodbridge poison), *Stylidium amoenum* and *Patersonia occidentalis*. *Mesomelaena stygia* and *Lepidosperma angustatum* are sedges present in this vegetation type.

Photograph 44: *Eucalyptus marginata* Forest [J3]

Muir Description:

SITE E Mixed *Eucalyptus marginata*, *E. calophylla* Low Forest A over *Persoonia longifolia*, *Hakea amplexicaulis* Open Scrub, over

Xanthorrhoea preissii Open Low Scrub A over mixed *Hibbertia hypericoides*, *Hakea lissocarpha*, *Calothamnus sanguineus*, *Hypocalymma angustifolium* Low Heath C over mixed *Hibbertia cunninghamii*, *Pseudanthus virgatus*, *Synaphea reticulata*, *Tetratheca hirsuta*, *Adenanthos meisneri*, *Dryandra nivea*, *D. bipinnatifida*, *Daviesia preissii* Dwarf Scrub D.

Distribution: This vegetation type is localized to the lateritic upland areas between Dunsborough and Yallingup, ie. to parts of Reserve No. 28665 which is currently vested in the Shire of Busselton and has a C-class status for 'preservation of caves and conservation of flora'.

Comments: This unit is of restricted occurrence in the study area. It occurs in Reserve No. 28665 with other restricted vegetation types which have the rare and geographically restricted species *Dasypogon hookeri* in their understoreys (see flora section 3.4). The high conservational value of these combined vegetation units should be secured by the upgrading of the status of this Reserve to A-class. Accompanying such an upgrading is the need to vest this conservation reserve with an appropriate authority having the requisite skills of management for conservation. Similarly, consideration should be given to upgrading the status and purpose of the adjoining gravel reserves which also have vegetation types of importance for conservation.

A few of the areas mapped as this vegetation unit have a dense shrub layer of *Hakea trifurcata* on their lower slopes and due to their thin, strip-like shape, mapping of this as a separate unit was not practical.

Eucalyptus marginata **(Jarrah),** ***E. calophylla*** **(Marri) CLOSED FOREST [JM/BaBg2]**

This vegetation unit occurs on upper slopes with pale to dark brown sandy soils with scattered surface laterite and exposed granulitic pebbles and boulders. There are two tree strata, the Marri and Jarrah (10-15 m) over *Banksia grandis, B. attenuata, B. littoralis, Nuytsia floribunda* (all 5-7 m) and scattered *Agonis flexuosa*. The understorey is also two layered, the upper layer (0.8-1.5 m) is a heath of *Xanthorrhoea preissii, Daviesia divaricata* and *Macrozamia riedlei* over a dense lower layer (0.4-0.9 m) of the shrubs *Baeckea camphorosmae, Hakea lissocarpha, Calothamnus sanguineus, Phyllanthus calycinus, Hibbertia racemosa* and *H. hypericoides*. Herbs include *Anigozanthos manglesii, Thelymitra crinita, Conostylis setigera, Patersonia occidentalis, Patersonia umbrosa* var. *xanthina, Burchardia umbellata* and *Drosera erythrorhiza*.

Distribution: This unit occurs to the east of the Dunsborough Golf Club.

Comments: A number of the *Banksia littoralis* in this unit are dead or dying. This is possibly a response to disturbance upslope, either by interference with water flow or by the introduction of *Phytophthora cinnamomi* (Dieback) on machinery or in gravel used in the development

Eucalyptus calophylla **(Marri),** ***E. marginata*** **(Jarrah) FORREST [MJP1]**

This unit occurs on moderate to steep valley slopes with brown to dark brown loamy sands with scattered surface laterite. The upper stratum (10-16 m) has Marri twice as abundant as the Jarrah and occasional *Eucalyptus rudis* there is also a lower tree layer (6-10 m) of *Agonis flexuosa* with occasional *Banksia grandis*. With the

Eucalypts this gives the unit a very dense overstorey. The understorey (0.8-1.6 m) is open with the shrubs *Xanthorrhoea preissii*, *Macrosamia riedlei*, *Hibbertia hypericoides*, *Lepidosperma gladiatum* and occasional *Dryandra sessilis*. At the edges of this vegetation type there is a strip of *Melaleuca preissiana* over *Lepidosperma tetraquetrum* and *Juncus pallidus* associated with the water course.

Distribution: This vegetation unit occurs in three patches on the moist valley slopes on the leeward side of the Naturaliste Ridge inthe vicinity of Woodlands.

Comments: All three areas of this vegetation type have high conservation value for its protection as well as for flora and landscape, unfortunately they are on privately owned land (see Recommendations, 7.0).

Allocasuarina fraseriana **(Sheoak),** ***Banksia attenuata, Eucalyptus marginata*** **(Jarrah) FOREST [Allo 5]**

This unit occurs on gentle, upper slopes with pale-brown to grey sandy soils. In the upper tree stratum (8-15 m) the Sheoak forms half the canopy and the *Banksia attenuata* and *Eucalyptus marginata* are about equal. There is a lower, medium-dense tree layer of *Agonis flexuosa* with occasional *Banksia grandis*. The understorey (0.6-1.7 m) has the shrubs *Acacia pulchella*, *Xanthorrhoea preissii*, *Phyllanthus calycinus*, *Hibbertia cuneiformis*, *H. hypericoides* and *Macrosamia riedlei* over *Loxocarya fasciculata*, the creeper *Hardenbergia comptoniana* climbs through to the lower tree layer.

Distribution: The one area of this unit occurs to the north of the Woodlands area on the upper, leeward slopes of the Naturaliste Ridge on uncleared privately owned land.

Photograph45: *Allocasuarina fraseriana* (Sheoak), *Banksia attenuata*, *Eucalyptus marginata* (Jarrah) Forest [Allo 5]

Comments: This stand is of interest as it has a high cover of the *Allocasuarina* which is also quite tall. It is of high conservation value for the vegetation type and for its aesthetically pleasing nature.

Agonis flexuosa (Peppermint) CLOSED FOREST [AFO]

This vegetation type parallels the coast on leeward (ie. away from the coast) slopes on very dark brown sandy soils with occasional outcropping limestone. The dominant ranges in height from 10-17 metres and has a sperse admixture of *Eucalyptus calophylla* (12-14 m), below this there are *Banksia grandis* (8 m), and *Persoonia elliptica* (3-4 m) forming a very open lower tree stratum. The understorey is relatively open, and has an average height of 1-1.5 m. Prominent species include *Hibbertia cuneiformis*, *Leucopogon propinquus*, *Acacia*

saligna, *Hakea amplexicaulis*, *Xanthorrhoea preissii*, *Adriana quadripartita*, *Macrosamia riedlei*, *Rhagodia baccata*, *Lepidosperma gladiatum*, *Pteridium esculentum* (Bracken Fern), *Phyllanthus calycinus*, *Stackhousia huegelii*, *Pimelea rosea* and the low, ground-spreading *Hibbertia grossulariifolia*. Creepers of *Clematis microphylla* (Old Man's Beard) and *Hardenbergia comptoniana* (Native Wisteria) are present climbing to 2.5 metres.

Muir Description:

> *Agonis flexuosa* Dense Forest over mixed *Eucalyptus calophylla*, *Banksia grandis*, Open Low Woodland A, over *Hibbertia cuneiformis* Open Low Scrub B, over mixed *Leucopogon propinquus*, *Acacia saligna*, *Pteridium esculentum*, *Rhagodia baccata*, *Hakea amplexicaulis*, *Xanthorrhoea preissii*, *Macrosamia riedlei* Dwarf Scrub C, with *Lepidosperma gladiatum* Very Open Tall Sedges, over mixed *Phyllanthus calycinus*, *Pimelea rosea* Open Dwarf Scrub D

Distribution: This vegetation type occurs on the leeward slope of the Naturaliste ridge, east of Yallingup, and abutting Hemsley Road.

Comments: This vegetation unit is the tallest and densest of the *Agonis flexuosa* units. These forests are particularly aesthetically appealing due to the stature of the trees, which separates these areas from units with similar floristic composition. The protection from the prevailing winds afforded by the Naturaliste Ridge combined with run-off from it provide the better conditions that enable this good development of the dominant.

At present the land on which these forests occur is privately owned but its sale has previously been offered to the government for inclusion in the adjoining National

Photograph 46: *Agonis flexuosa* (Peppermint) Closed Forest (AWO)

Photograph 47: Trunk of a large *Agonis flexuosa* in AWO, showing the particularly good development of Peppermint in this unit, of which there was only one area

Park (Valentine and Enright, 1975), this is highly desirable as this vegetation type is not adequately represented in conservation areas, they are relatively undisturbed and their inclusion would afford greater protection to the National Park, particularly to the Yallingup Caves area which they lie close to.

The exotic *Zantedeschia aethiopica* (Arum Lily) is well established in some areas of this moist environment, inclusion in the park would enable control measures to be implemented.

Eucalyptus diversicolor (Karri) [K]

There is one stand of Karri in the study area, it was not visited due to lack of time however, it is mentioned by Smith (1973). It is a disjunct stand at some distance from the main area of Karri's distribution and is therefore of great interest and conservation value (see also Section 4.4).

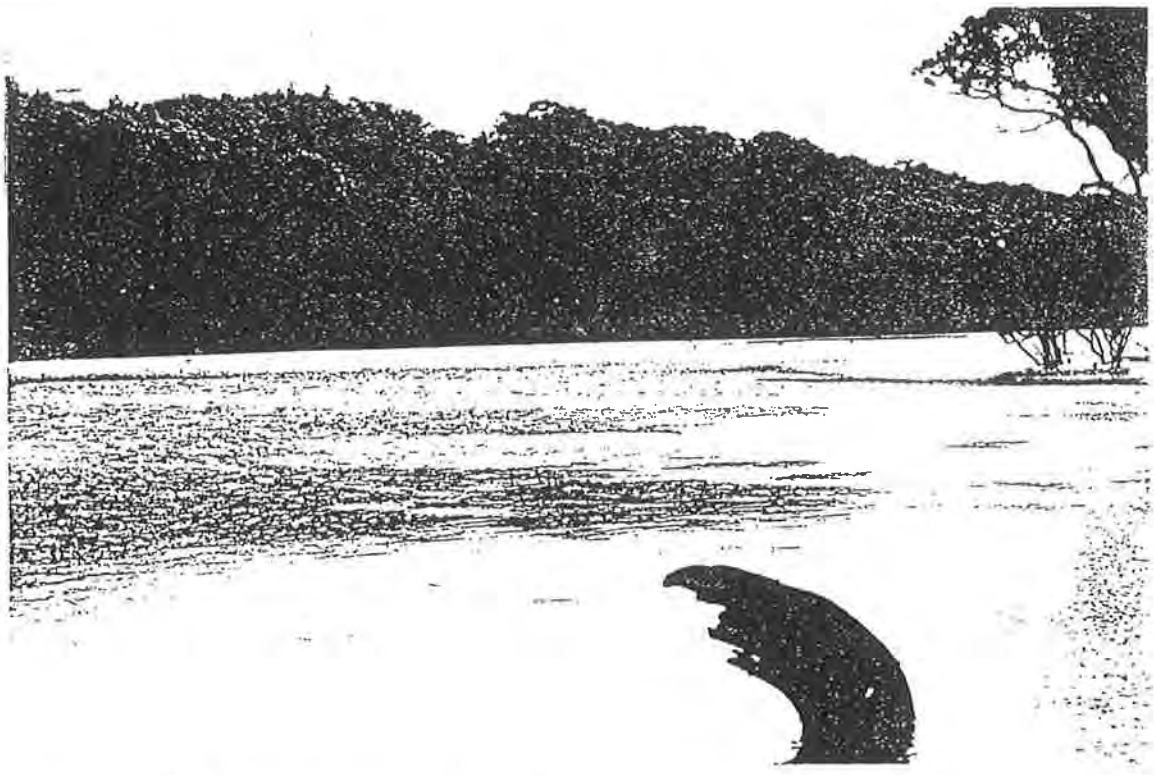
Distribution: The stand is near Quininup Brook in the Leeuwin-Naturaliste Park.

(d) PERTH BASIN SEDIMENTS

Myriophyllum salsugineum AQUATIC HERBFIELD [My]

This vegetation type occurs in an apparently permanent water body with pale-cream coloured to pale-grey sand. The dominant has an even distribution across the surface of the water body. The vegetation on the periphery of this water body is *Melaleuca preissiana, Eucalyptus rudis* Closed Forest (MpEr, see below).

Muir Description. *Myriophyllum salsugineum* Dense Aquatic Herbfield.



Photograph 42. *Myriophyllum salsugineum* Aquatic Herbfield (My)

Distribution: This vegetation unit is restricted to the apparently permanent lake behind the sand dunes at Boulder Bay.

Comments: The limited occurrence of wetlands in the study area (the nearest open water body to this location is the Broadwater complex east of Busselton, which has a different vegetation type and has been highly disturbed by residential development) coupled with the restricted occurrence of this particular vegetation type and its importance as a water resource for water fowl means it is of high conservation value. This value is in addition to that of the surrounding *Melaleuca preissiana Eucalyptus rudis* Woodland, with its high habitat value this adds to the food resource value of the lake.

The northern boundary of this wetland complex adjoins part of the thin coastal,

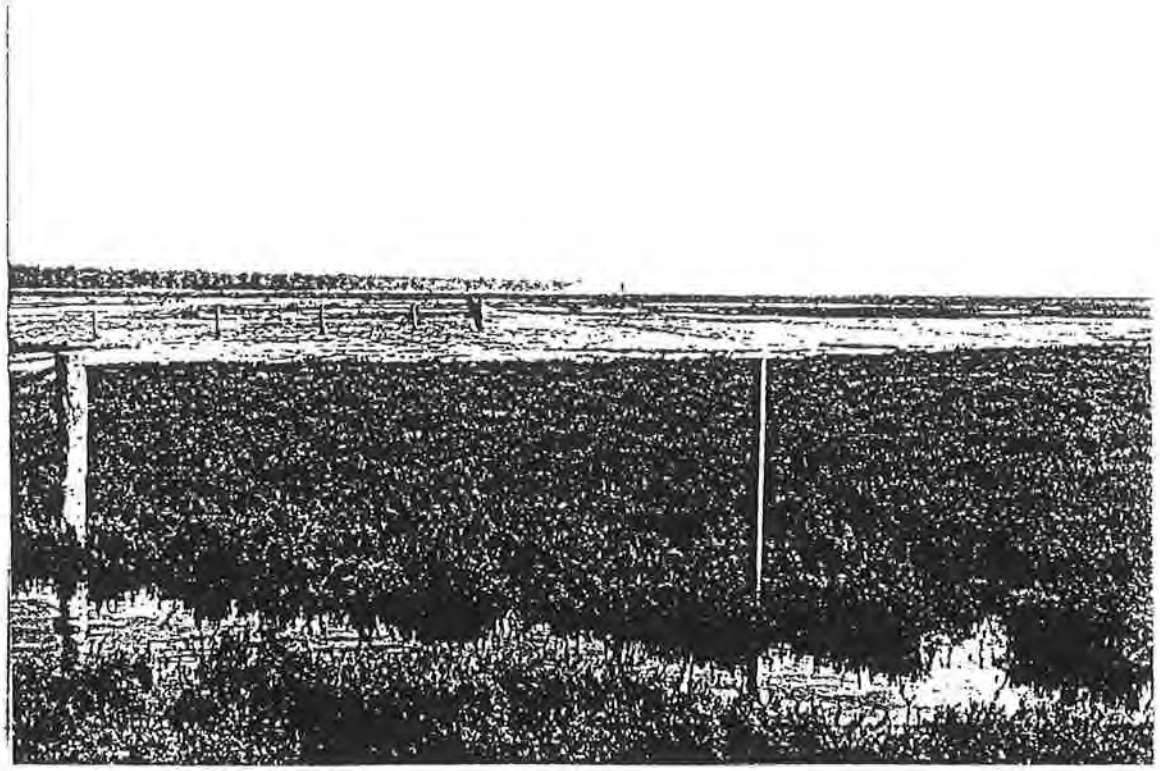
ribbon-section of A-class Reserve, No. 21751. To secure the conservation of this interesting wetland complex and to provide a buffer for the A-class reserve, aquistion of the private property on which this vegetation type occurs is highly desirable so that appropriate management can be implemented.

Sarcocornia quinqueflora, Halosarcia indica, H. pergranulata

LOW OPEN HEATH - LOW SHRUBLAND [Hal]

This vegetation unit occurs on inundated flats with very dark-grey, organic-rich sandy soils. The dominants (40-70 cm) occur over a dense herbfield of *Cotula coronifolia* and there is a dense mat of algae on the soil surface.

Distribution: This unit occurs as a fringing vegetation of the Wonnerup Estuary.



Photograph 49: ***Sarcocornia quinqueflora, Halosarcia indica, H. pergranulata*** Low Open Heath- Low Shrubland [Hal] note the Black Swans nests.

Comments: There is considerable variation within the *Halosarcia* shrublands that form this unit, and it would be reasonable to divide them into several units; without going into more detail than has been done with other vegetation types such as the woodlands and heaths. This was not done because of lack of time and the fact that the individual units produced would not have been mapable at the scale of the present study.

The Wonnerup Estuary with its associated vegetation has very high habitat value for water fowl, for example it is a major breeding site for the black swan (*Cygnus atratus*). Their permanent nesting mounds are constructed from fragments of *Halosarcia* spp. (see Recommendations, sect.7.0).

Halosarcia ?halocnemoides, Threlkeldia diffusa **LOW CLOSED HEATH [HhTd]**

Photograph 50: *Halosarcia ?halocnemoides, Threlkeldia diffusa* Low Closed Heath [HhTd]

This unit occurs on the margins of coastal-linked, inter-dunal wetlands with mid to dark-grey sandy soils. The dominants reach 40-70 cm and occur on the water side of *Juncus kraussii* sedgelands.

Distribution: Fringing the Deadwater north of Busselton and Quindalup Broadwater between Busselton and Dunsborough

Comments: *Halosarcia* units are generally very fragile

These wetlands are important for fauna (particularly water fowl) and there value for flora and landscape conservation is also high.

Juncus kraussii, Isolepis nodosus **CLOSED SEDGELAND [Jk]**

Photograph 51: *Juncus kraussii, Isolepis nodosus* Closed Sedgeland [Jk] in midground, with *Lepidosperma gladiatum* in the foreground.

This vegetation unit fringes coastal linked, inter-dunal wetlands, on pale-grey to brown sandy soils. The height of this dense sedgeland is 0.4-1.2 m with occasional emergent sedges of *Lepidosperma gladiatum* and occasional shrubs of *Halosarcia ?halocnemoides* and *Threlkeldia diffusa*.

Distribution: This unit ocurs on the fringes of the Deadwater and Quindalup Broadwater.

Comments: These units have important habitat for water fowl (food and nesting) and have conservation value for flora and landscape.

Typha orientalisis, Juncus krausii TALL SEDGELAND [TyJk]

This unit fringes the semi-saline water bodies in the Perth Basin section of the study area on dark grey to dark brown sandy soils. The height of the sedgeland is 0.6-1.8 m and they are so dense that there are very few other species, except where Halosarcias creep in from surrounding vegetation units or where *Juncus pallidus* occurs in scattered patches amongst the *Juncus krausii*.

Distribution: This unit occurs on the margins of the deeper parts of the Vasse Estuary.

Comments: These sedgelands are important habitat areas and feeding grounds for water-birds.

Melaleuca cuticularis, M.hamulosa OPEN WOODLAND [S5]

This unit occurs close to the coast on low-lying areas with pale-grey through pale-brown and dark grey sandy soils. The Paperbarks (1.4-3.5 m) occur as isolated clumps in a shrubland of the samphires *Halosarcia ?pergranulata, H. indica* ssp. *bidens* and *Sarcocornia quinqueflora* which are fringed by *Juncus*

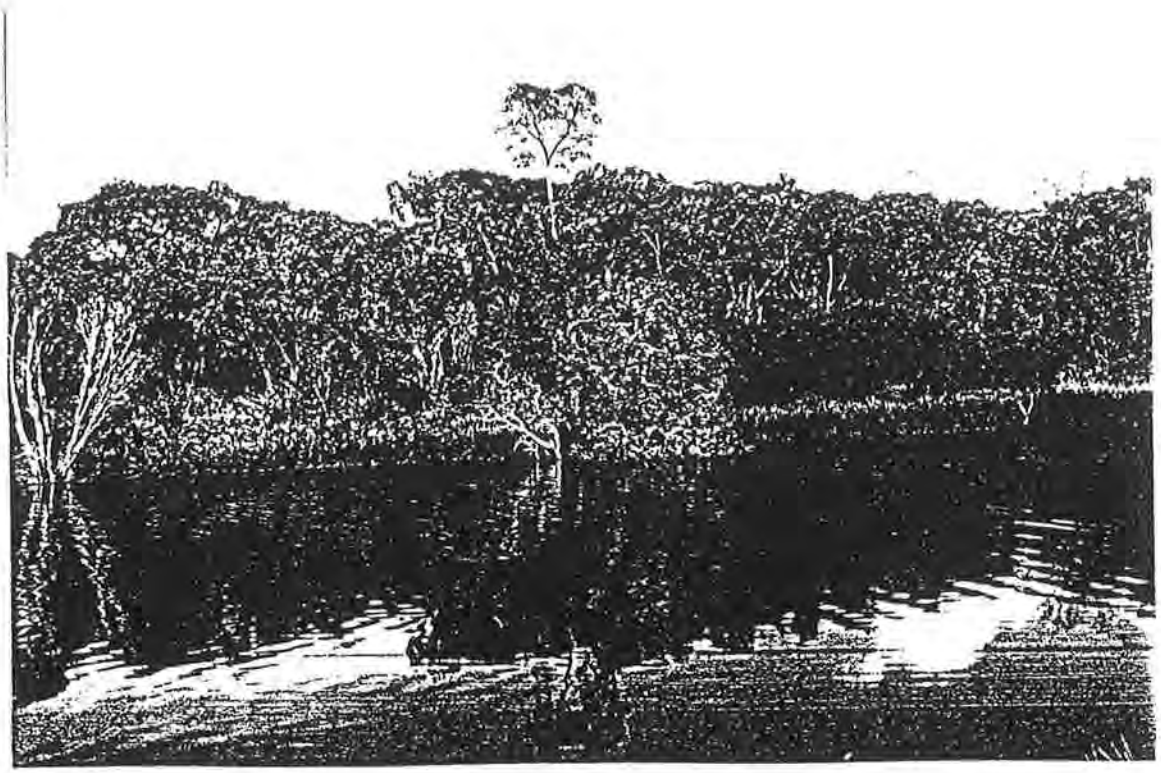
krausii sedgelands.

Distribution: This unit occurs over parts of the Wonnerup Estuary and the shallower sections of the Vasse Estuary.

Comments: The distribution of this unit has been reduced by the development of Busselton townsite and agricultural clearing. The remaining parts are important food and nesting areas for water-birds.

***Melaleuca cuticularis, M. hamulosa, Agonis flexuosa* LOW OPEN WOODLAND [S4]**

This unit occurs as a strip along the edges of inter-dunal, coastal-linked wetlands on pale to very dark grey sands. This unit is a mosaic of patches of the Paperbarks and



Photograph 46: *Melaleuca cuticularis* (saltwater paperbark), *M. hamulosa*, *Agonis flexuosa* Low Open Woodland [S4]

Peppermint over *Acacia divergens*, *Adriana quadripartita* and dense sedgelands of *Juncus kraussii* and *Isolepis nodosus* with occasional *Lepidosperma gladiatum*.

Distribution: This mosaic unit fringes the margins of the inter-dunal lakes near Quindalup.

Comments: This unit has conservation value for its habitat value for water-birds and its aesthetic appeal, however it has been somewhat disturbed by weed invasion.

***Agonis flexuosa* Low Open Woodland [S6]**

This vegetation type occurs as a discontinuous strip around the periphery of the Broadwater wetlands. The understorey sedges fringe the edges of the water body, and the availability of water encourages a dense development of *Agonis flexuosa* and tall shrubs of *Acacia divergens* and *Anthocercis littorea* over shrubs of the 'coastal geranium', **Pelargonium capitatum* to 1.1 metres tall.

Muir Descriptions:

> **Site 387(f)**
>
> *Agonis flexuosa* Low Woodland A, over Mixed *Anthocercis littorea*, *Acacia divergens*, *Hibbertia* sp. (CK145) Heath A with occasional shrubs of *Exocarpus sparteus*, over *Pelargonium capitatum* Dwarf Scrub C, with occasional creepers of *Hardenbergia comptoniana*.

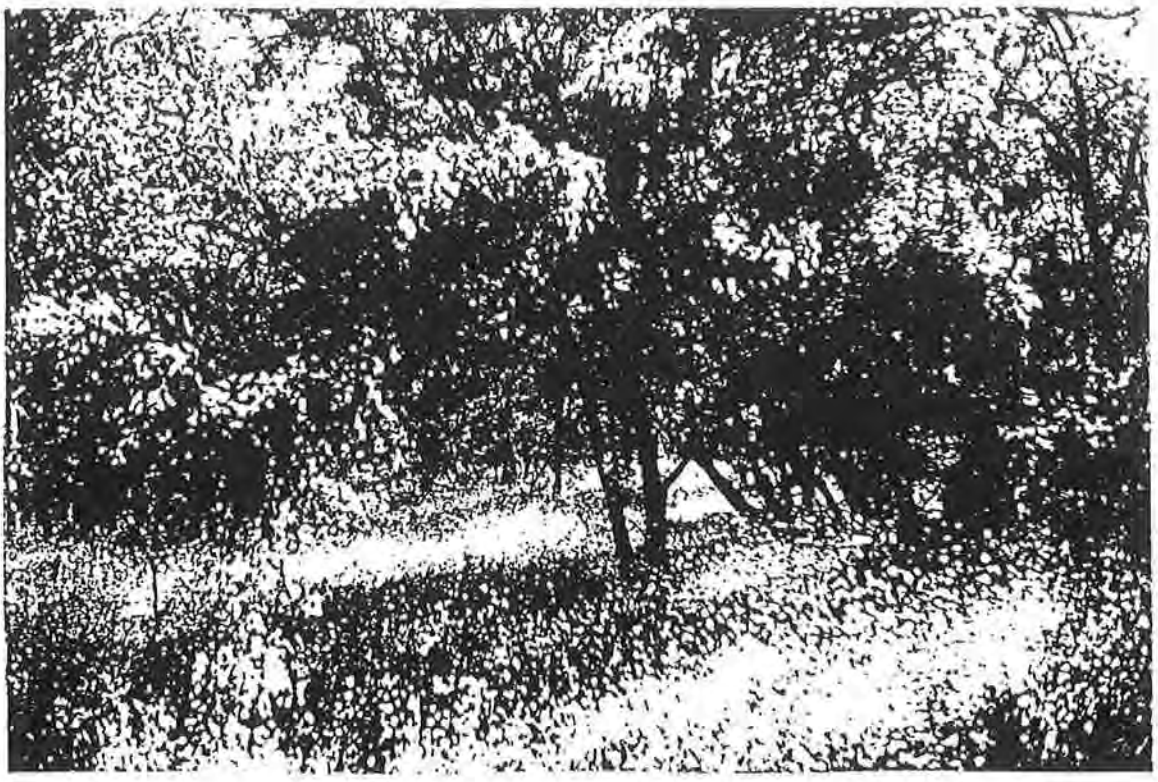
Distribution: Surrounding the southern side of the (Quindalup) Broadwater.

Comments: This vegetation type only occurs around the Broadwater wetlands and has

been somewhat disturbed by residential development

***Agonis flexuosa* (Peppermint) LOW OPEN FOREST [AW]**

This vegetation unit occurs on gentle inland slopes away from the low coastal dune complexes, on pale to dark brown over yellow sandy soils. Under the Peppermint (3-5 m) there is a two layered understorey. The upper of theses layers (1.6-2.2 m) has the shrubs *Hakea oleifolia, Leucopogon parviflorus, Spyridium globulosum Jacksonia furcellata and Exocarpus sparteus*. The lower shrub layer (0.8-1.5 m) has *Diplolaena dampieri, Templetonia retusa, Acacia cochlearis* and *Rhagodia baccata* over lower shrubs of *Acanthocarpus preissii* and *Phyllanthus calycinus*. The herb layer of *Dianella revoluta, Dichondra repens, Stipa flavescens* and the sedge *Lepidosperma gladiatum* has been badly invaded by weeds including **Trifolium* sp. (CK21), **Lagurus ovatus* **Vulpia membranacea* and **Trachyandra divaricatum*.



Photograph 53: *Agonis flexuosa* Low Open Forest [AW] note the weeds.

Distribution: This unit occurs from north of Busselton to Forrest Beach on the gentle inland slopes leading down to the Wonnerup Estuary from the coastal sand dunes.

Comments: This vegetation type would have had a much larger distribution in the study area but much of it has been cleared and those areas remaining are being grazed, which has caused degradation of the unit.

Agonis flexuosa WOODLAND with *Acacia divergens* [AWAd]

This vegetation type is distinguished from other *Agonis flexuosa* woodlands on the understorey of *Acacia divergens* and occurs behind the dune sequences on grey-white sands. The *Agonis flexuosa* ranges in height from 3-8 m. Other species present in this community are shrubs of *Spyridium globulosum*, *Olearia axillaris*, *Exocarpus sparteus*, *Acacia cochlearis*, *A. saligna*, *Hibbertia cuneiformis*, *Adriana quadripartita*, *Rhagodia baccata* and *Phyllanthus calycinus* with creepers of *Hardenbergia comptoniana*.

Muir Descriptions:

Site 383 (a)

Disturbed *Agonis flexuosa* Low Forest A over occasional tall shrubs of *Acacia divergens*, *Acacia cochlearis*, *Acacia Saligna*, and *Adriana quadripartita* over occasional shrubs of *Hibbertia* sp. (CK145) over occasional tall sedges of *Lepidosperma gladiatum*, over occasional herbs of *Phyllanthus calycinus* and with occasional creepers of *Hardenbergia comptoniana*.

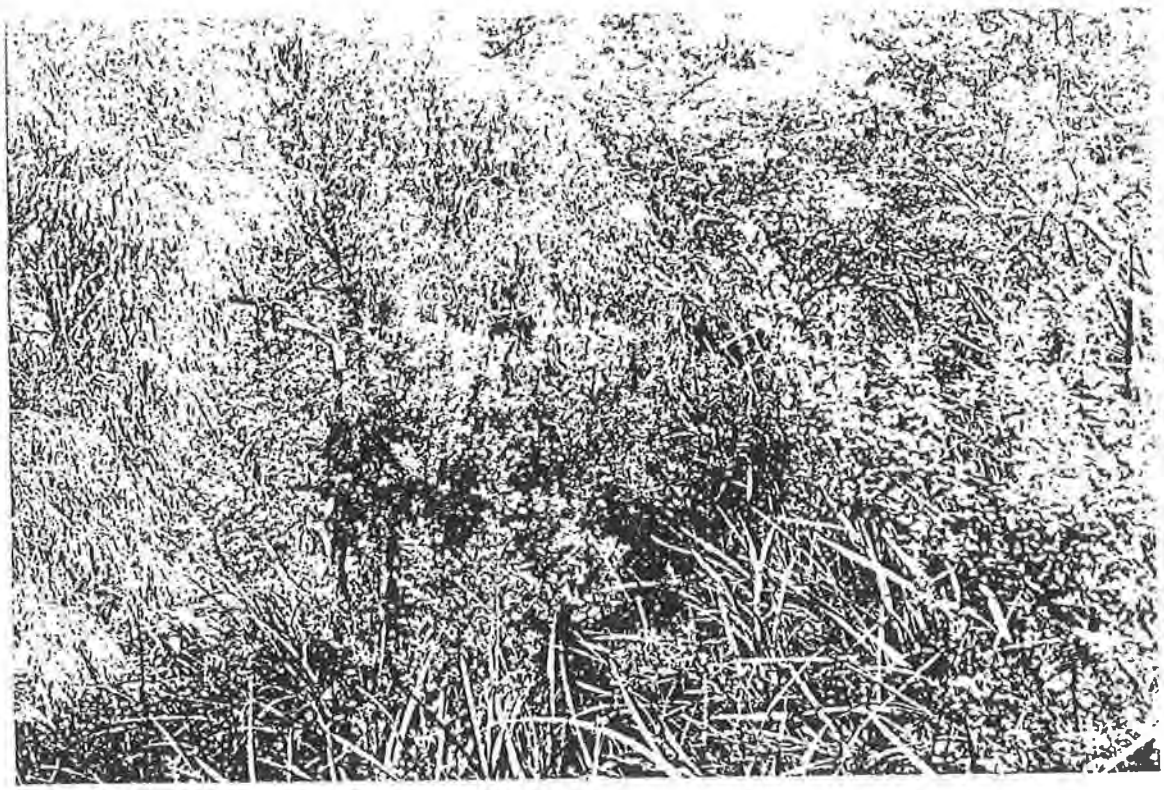
Site 386

Agonis flexuosa Dense Low Forest A over *Acacia divergens* Scrub over occasional shrubs of *Rhagodia baccata* with occasional creepers of

Hardenbergia complioniana.

Site 389 (This site is transitional to a wetland type, see comments.)

Agonis flexuosa Low Forest A over mixed *Acacia divergens* *Spyridium globulosum* Low Scrub A with occasional shrubs of *Exocarpus sparteus* over *Lepidosperma gladiatum*. *Juncus krausii* Tall Sedgeland near water body with occasional creepers of *Hardenbergia complioniana*. Over occasional *Styllidium schoenoides*.



Photograph 54: *Agonis flexuosa* Woodland with *Acacia divergens*. [AWAd]

Distribution: This vegetation type was observed only between Busselton and Broadwater on both sides of the Bussell Highway.

Comments: Much of the area of this vegetation type has been disturbed, on the inland side of the Highway by grazing and resultant weed invasion and on the coastal side of

the Highway by residential development. There is a need for management of the remnants of this vegetation type to ensure that it does not entirely disappear.

The dominant has a high visual appeal and is an important component of the Busselton environment and dominates the scenery as one drives along the Bussel Highway and Caves Road, with its fresh green foliage and strings of white flowers.

Within this vegetation type there are small wetlands, where the paperbarks, *Melaleuca cuticularis* and *Melaleuca rhaphiophylla* dominate with an understorey of the sedge *Lepidosperma gladiatum*. The larger examples of these wetlands have been mapped separately, but there are many that are too small to map, some are intermediate between the *Agonis* woodland and the *Melaleuca* woodland, for example site 369 which is described in the Muir descriptions above.

***Melaleuca cuticularis, Melaleuca hamulosa* WOODLAND [**

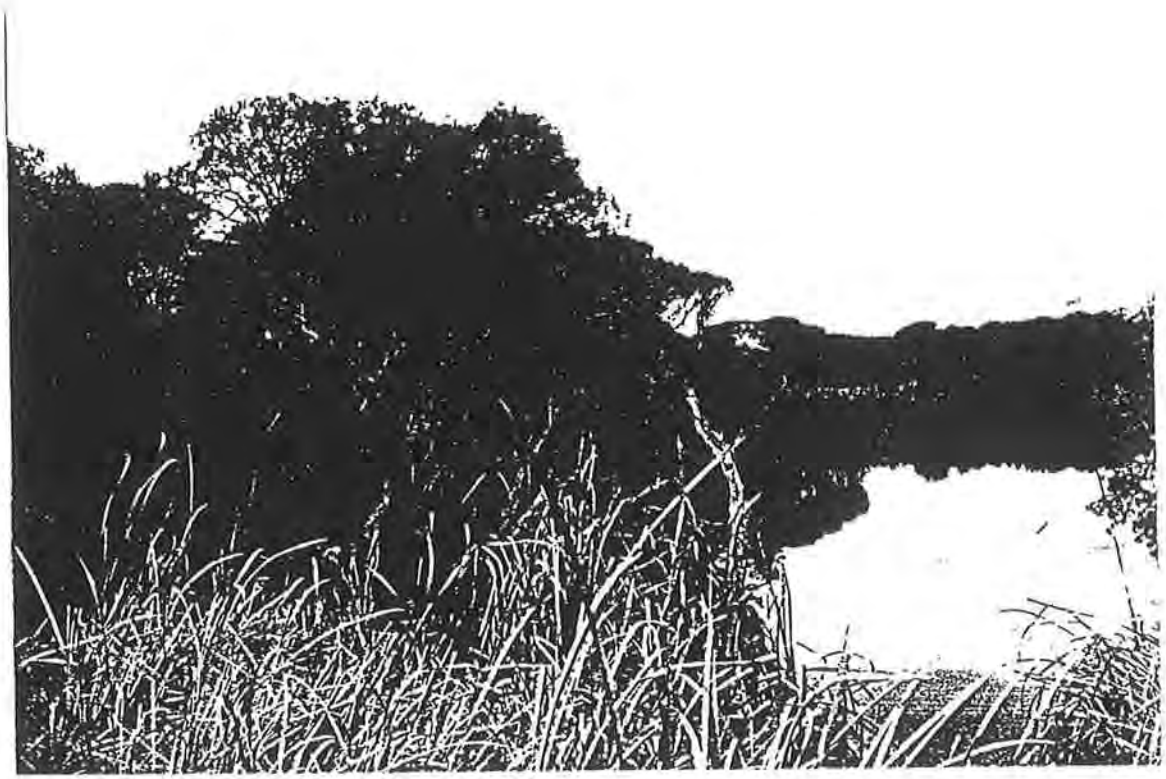
This unit occurs on the margins of deep estuaries on dark grey to dark brown sandy soils. The upper-storey varies from 1.8-3.5 m over shrubs of *Acacia saligna* and *Viminaria juncea* and the sedges *Typha orientalis, Juncus kraussii* and *J. pallidus*.

Distribution: This unit occurs along the margins of the Vasse and Butterfactory swamp areas.

Comments: Much of the original extension of this vegetation unit has been removed and the remainder is under threat from encroaching development. The Vasse Estuary is a very important habitat for water fowl, especially during times of drought when other water-bodies are dry, so it has very high value for the conservation of water fowl.

***Melaleuca cuticularis, M. rhaphiophylla, M. preissiana* LOW CLOSED FOREST [S2]**

This unit fringes the deeper water bodies of the Vasse Estaury system often interspersed with the fringing sedgelands. The *Melaleuca cuticularis* is usually on the water side with the other paperbarks slighty away from the saline water. Shrubs include *Agonis flexuosa, Melaleuca hamulosa* and *Acacia saligna*. There is little understorey except where some of the sedges from adjoinoing units stray under the *Melaleucas*.



Photograph 55: *Melaleuca cuticularis, M. rhaphiophylla, M. preissiana* Low Closed Forest [S2]

Distribution & Comments: This unit occurs along the margins and on the islands in the Vase Estuary system and is of very high value for the beauty of the paperbarks.

Melaleuca preissiana **(Swamp Paperbark), *Eucalyptus rudis* (Flooded Gum) LOW CLOSED FOREST [MpEr]**

This vegetation type occurs on cream-coloured to pale grey sandy soils around the periphery of an apparently permanent lake. The upper stratum (6-12 metres) is dominated by th Swamp Paperbark and the Flooded Gum. The understorey is very low and sparse and has been highly disturbed through grazing and trampling by livestock and the subsequent introduction of weeds, species present include *Acacia rostellifera*, *Hibbertia cuneiformis*, *Rhagodia baccata*, *Lepidosperma gladiatum*, **Zantedeschia aethiopica*, **Anagallis arvensis*, **Nicotiana* (deadly night shade), **Solanum sodomaeum*, **Carduus pycnocephalus*, **Verbascum virgatum* and **Lotus suaveolens*.

Muir Description:

> Mixed *Melaleuca preissiana*, *M. lanceolata*, *Eucalyptus rudis* Dense Low Forest A, over *Agonis flexuosa* Open Low Woodland A, over *Rhagodia baccata* Open Dwarf Scrub C, with *Lepidosperma gladiatum* Open Tall Sedgeland, over mixed **Zantedeschia aethiopica*, **Anagallis arvensis*, **Nicotiana* sp. (deadly night shade), **Solanum sodomaeum*, **Carduus pycnocephalus*, **Verbascum virgatum* and **Lotus suaveolens* Open Herbland.

Distribution: This vegetation unit occurs in the depression, immediately inland from the Bunker Bay coastal sand dunes (in some sections the sand dunes are moving inland towards the swamp complex).

Comments: Within this unit there are stands of *Melaleuca lanceolata* (too small to map) which represent an interesting occurrence of this species associated with wetland areas, most of the stands of this species in the study area are associated with

coastal limestone and sand dunes rather than wetlands.

This wetland complex is on private land and as a consequence has been degraded by the impact of grazing. Fences have been erected around the water body, presumably in relation to property boundaries, and the fencing at the eastern end of the swamp in particular is in need of repair. The 'Cape Farm' property boundary runs across the western end of this water body and unfortunately this segment of the peripheral vegetation has been totally cleared for agriculture.

Photograph 56: *Melaleuca preissiana, Eucalyptus rudis* Low Closed Forest [MpEr].

The water body which this vegetation type surrounds has an aquatic herbfield of *Myriophyllum salsugineum* (see above) and in contrast to others in the study area, this particular wetland does not have any peripheral sedges, reeds or *Halosarcia*, whereas other water bodies within the study area have a fringe of

Juncus krausii Tall Sedgeland, or in the case of saline water bodies, *Isolepis nodosus* or *Halosarcia* spp. on the edge of the water body.

Melaleuca preissiana, M. rhaphiophylla (Swamp Paperbark)

OPEN FOREST [S1]

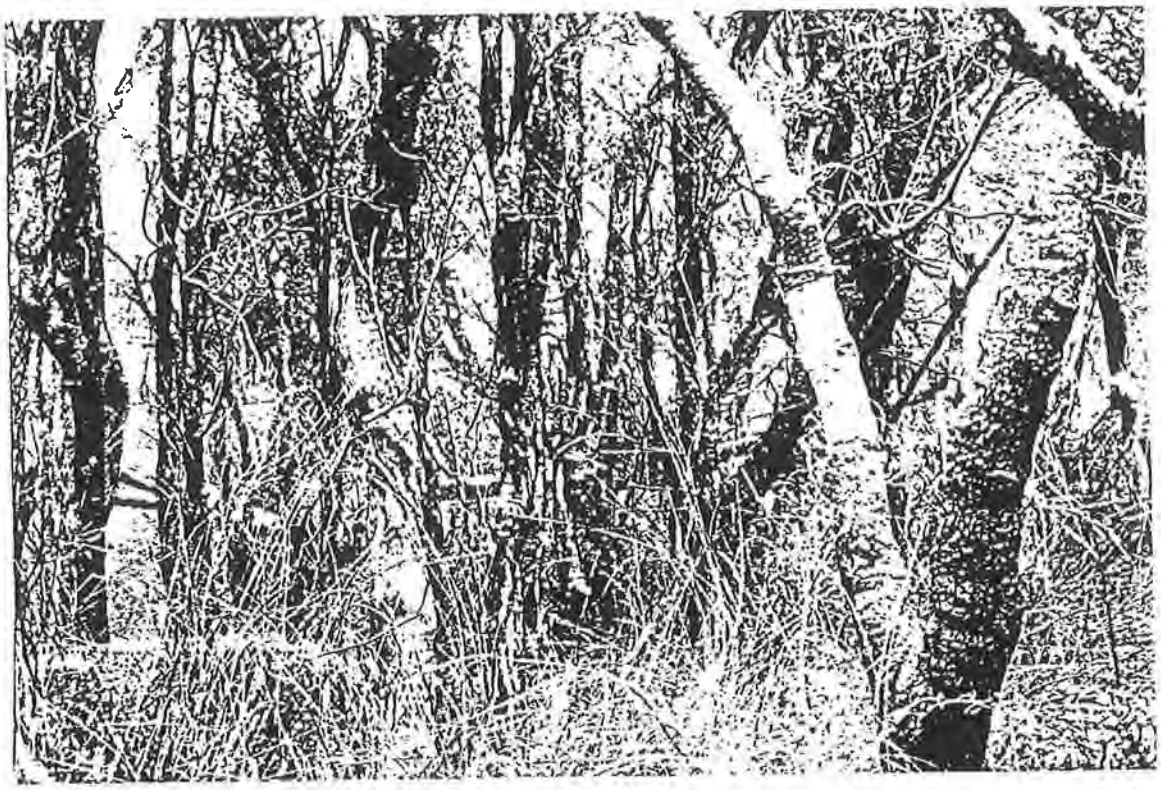
This vegetation type is restricted to seasonal swamps and low lying areas of high soil moisture, on cream-coloured to light-grey sandy soils. The paperbarks range in height from 6-12 metres and are concentrated in the areas of highest soil moisture. Swamp Banksia (*Banksia littoralis*), Marri (*Eucalyptus calophylla*) and Jarrah (*E. marginata* on the slightly higher ground) form a second tree stratum. The understorey is mid-dense and the occurrence of sedges *Lepidosperma tetraquetrum* and *Cyathochaeta clandestina* and fern *Asplenium* aff. *flabellifolium* again indicate the high soil moisture of the area. Other prominent indicators of moisture include shrubs of *Boronia mollyae, Astartea fascicularis, Pteridium esculentum, Hibbertia perfoliata* and *Pimelea rosea*, with the matted ground-covers *Acitus cordifolia* and *Empodisma gracillimum*.

Muir Description: Mixed *Melaleuca rhaphiophylla, M. preissiana, Banksia littoralis* Low Forest A, with occasional trees of *Eucalyptus calophylla* and *E. marginata* over *Cyathochaeta clandestina* Tall Sedgeland, with *Pteridium esculentum, Boronia mollyae, Astartea fascicularis* Low Scrub B over *Hibbertia perfoliata, Acitus cordifolia* Open Dwarf Scrub D over *Empodisma gracillimum* Herbland.

Distribution: This vegetation unit occurs in swampy areas in the vicinity of the Dunsborough Townsite and some of the moist depressions in the Eagle Bay area and where not disturbed is encircled by vegetation type MErMp1.

Comments: The least disturbed occurrences of this vegetation unit are in Reserve No. 28683 (bordered by Naturaliste Road) vested in the Busselton Shire and on privately owned land between Gifford and Naturaliste Roads. The occurrences in the Eagle Bay area are on cleared land where only the water course and its immediate vegetation have been retained. The present trend to reclaim similar habitats in the Dunsborough Townsite area (eg. the residential development as one enters Dunsborough, and the Redgum Park Development which is bounded by Naturaliste, Greenacre and Gifford Roads) adds to the conservation importance of this reserve.

The habitat value of this restricted vegetation type is further increased by the presence of water, a resource for native fauna.



Photograph 57: *Melaleuca preissiana*, *M. rhaphiophylla* (Swamp Paperbark) Open Forest [S1] showing the density of *M. rhaphiophylla* and *B. littoralis* trunks over dense sedges.

The vesting purpose of Reserve No. 28683 has recently been changed to 'Community, Cultural and Recreation' (from 'recreation') to accommodate a proposal to site the 'Dunsborough Cultural and Civic Centre' there. Such a development at this site would mean the partial or total destruction of this undisturbed example of this important habitat, with areas that were not destroyed suffering significant disturbance.

Eucalyptus calophylla, E. rudis, Melaleuca preissiana

LOW WOODLAND [MErMp1]

This vegetation type occurs in low lying areas of Perth Basin sediments on very pale-brown to white-grey sandy soils. The mixed upper stratum (in which the white paperbark and clustered foliage of the *Melaleuca* is prominent) has a height range of 10-14 metres. There is a lower tree stratum of *Banksia littoralis, B. grandis* and *Agonis flexuosa* with a height range of 3.5-9.0 metres. Under these tree strata there is a dense and layered understorey. Shrub species in the upper layer (1.8-3.5 metres) of the understorey include *Agonis linearifolia, Kunsea recurva, Astartea fascicularis, Homalospermum firmum, Oxylobium lanceolatum, Xanthorrhoea preissii* and juvenile *Melaleuca raphiophylla, M. preissiana* and *M. thymoides*. The lower shrubs include *Eutaxia virgata, Macrosamia riedlei, Boronia dichotoma* and *Dampiera hederacea* with sedges of *Lepidosperma angustatum* and Herbs including *Anigosanthos rufus, A. manglesii, Thysanotus multiflorus* and *Johnsonia lupulina* (Hooded Lily) over the fern *Asplenium* aff. *flabellifolium*.

Distribution: This vegetation type occurs in the townsite area of Dunsborough, in a Reserve and on private land between Gifford and Caves Roads. This main occurrence was continuous but has been dissected by Cape Naturaliste Road and residential development. A significant portion of this area lies within the C-class Reserve (No. 28663) vested in the Busselton Shire Council for the purpose of 'Civic Centre and

Recreation'

Comments: This vegetation type encircles a more restricted damper unit (*Melaleuca rhaphiophylla*, *M. preissiana* Woodland MrMp1), the comments and recommendations made for this latter unit are also applicable to this vegetation type.

Photograph 58: *Eucalyptus calophylla*, *E. rudis*, *Melaleuca preissiana* Low Woodland [MErMp1] with bracken fern, Xanthorrhoea preissii (foreground), *Homalospermum firmum* (mid-ground) and *Melaleuca preissiana* (background).

Eucalyptus rudis (Flooded Gum), ***E. calophylla*** (Marri), ***Melaleuca rhaphiophylla*** (Swamp Paperbark) **WOODLAND**

This unit occurs on low-lying areas with pale to dark brown sandy soils. Under the Flooded Gum, Marri and Swamp Paperbark is a second tree layer of *Agonis flexuosa* with occasional *Banksia grandis*. The understorey has *Xanthorrhoea preissii*,

Melaleuca acerosa, *Hibbertia cuneiformis*, *Viminaria juncea*, *Macrosamia riedlei* and *Hibbertia hypericoides*.

Distribution & Comments: This unit is on privately owned land on the south side of the Vasse Estuary and has been badly degraded through grazing, so it only has a low conservation value.

Eucalyptus calophylla (Marri) WOODLAND [MAg]

This vegetation unit occurs on low-lying areas with grey to mid-brown sandy soils. There are two tree strata, the upper Marri (10-12 m) with occasional *Eucalyptus rudis* (Flooded Gum) over a second dense stratum (4-8 m) of *Agonis flexuosa*, *Melaleuca preissiana*, *Banksia attenuata* and occasional *Banksia littoralis* and *Nuytsia floribunda*. Under these tree strata there is a mid-dense heath (0.6-1.5 m) of *Jacksonia furcellata*, *Melaleuca acerosa*, *Calothamnus sanguineus*, *Adenanthos meisneri*, *Xanthorrhoea preissii*, *Macrosmia riedlei* and the fern *Pteridium esculentum*.

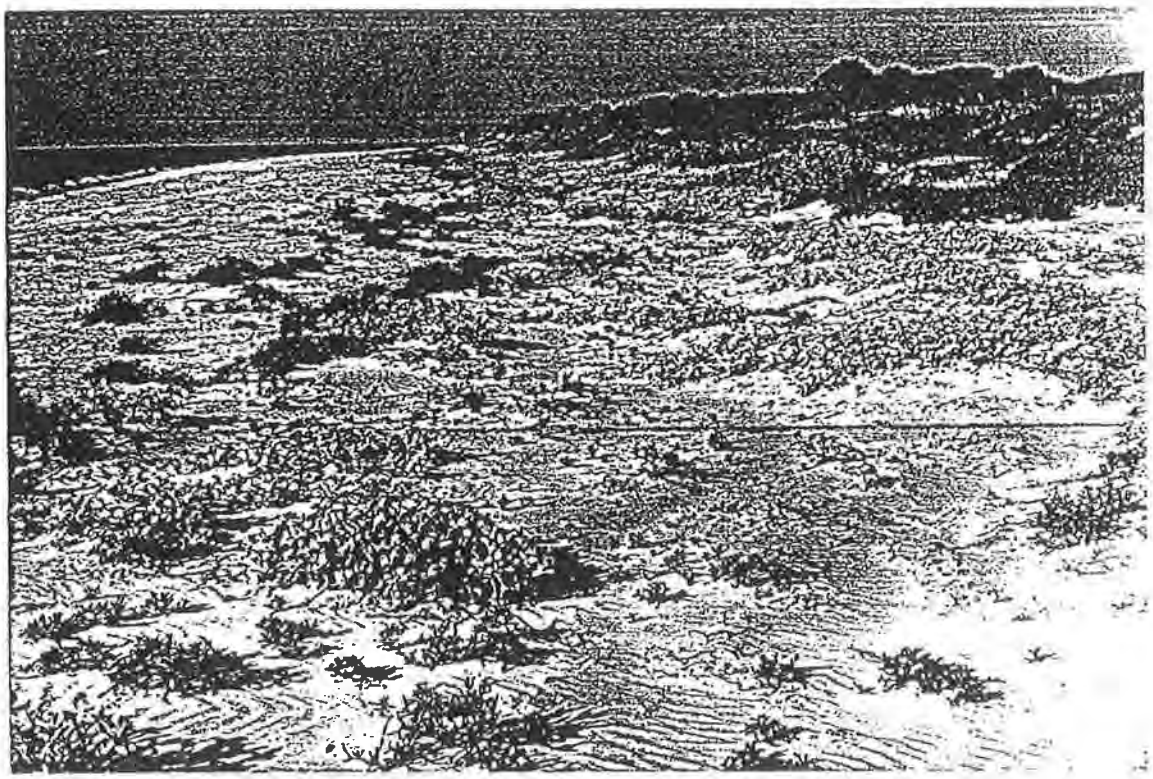
Distribution: This vegetation unit occurs on the damp, low-lying areas south of the deeper sections of the Vasse Estuary.

Comments: The areas of this vegetation type are currently being grazed by cattle, this has the potential to severely degrade the vegetation through trampling, changing the balance of the flora by selective grazing of palatable species and through the introduction of weeds.

(e) THE MODERN COASTLINE

**Cakile maritima*, **Arctotheca calendula* OPEN HERBLAND [D1]

This unit has a height range of 5-50 cm and occurs as a narrow, irregular strip on the beaches of sandy bays. Other species which may occur in this unit include *Carpobrotus* sp (CK47), *Salsola kali*, *Euphorbia paralias* and *Spinifex hirsutus*.



Photograph 59: *Cakile maritima* (dark green), *Arctotheca calendula* (silver-grey) Open Herbland [D1]

Distribution: This unit occurs on the majority of sandy beach strips and bays within the study area.

Comments: Obviously any species occurring this close to the ocean must be extremely tolerant to salt spray and saline ground water. It is interesting that the dominants are

both introduced as is *Euphorbia paralias*.

Spinifex hirsutus, *Spinifex longifolius* OPEN GRASSLAND [D2]

This vegetation type is the second in the sequence of the sand stabilizers on sandy beaches. Low, hummocky dunes are created in response to the dynamic sand trapping abilities of these tussock and rhizomatous grasses. Similarly to D1, this community is present on the majority of sandy beach stretches in the study area, if only in a very open or localized form. In unstable areas, such as blowouts, these grasses become more widespread, thus tending to cover a larger area than on a 'normal' or less disturbed coastal stretch where they are notably limited to the upper beach. Other species present include *Carpobrotus* sp. (CK47), *Tetragona decumbens*, *Isolepis nodosus* and the introduced species **Cakile maritima*, **Euphorbia paralias* and **Ammophila arenaria* (marram grass).

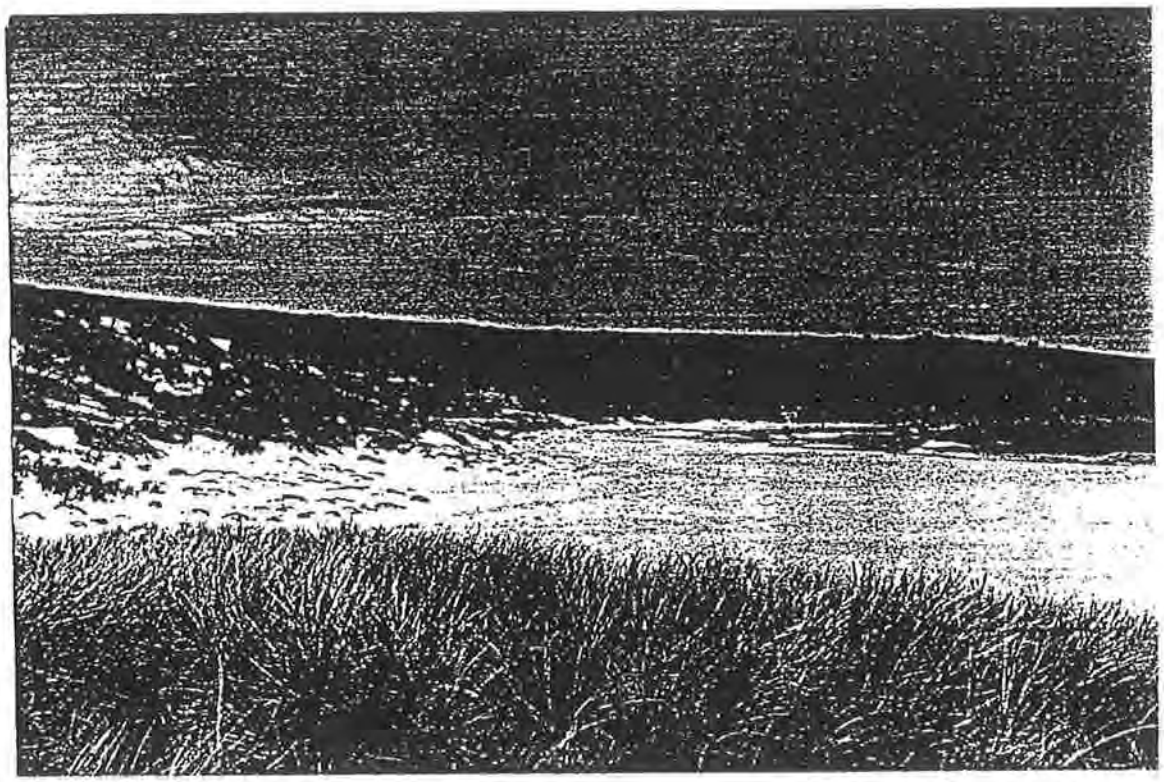
Distribution: As noted above, this vegetation type is represented to some degree along the numerous sandy pockets along the coastline in the study area, being more developed at the river mouths and in the sandy beaches from the northern boundary of the study region, south to Dunsborough.

Comments: Blow-out areas, where this community covers 'abnormally' large areas and also extends further inland than usual, are present at the disturbed points of Cape Naturaliste and Cape Clairault.

**Ammophila arenaria* (marram grass) Tussock Grassland [D3]

Marram grass has been deliberately introduced to the West Australian coast as a sand stabilizer on disturbed coastal areas because of its ability to stabilise coastal sands even after almost complete burial. It has now spread to many areas and successfully competes with the native species. It grows to 0.6-1.0 metres tall and is usually just

landward of the stabilizing D1 and D2 or replacing D2. Other species growing in the **Ammophila arenaria* grassland, are low shrubs of *Pelargonium capitatum*, the sedge *Isolepis nodosus* and the small grass *Sporobolus virginicus*. The introduced species **Trachyandra divaricata* and **Cakile maritima* also occur.



Photograph 60: **Ammophila arenaria* (marram grass) Tussock Grassland [D3] in foreground and along the base of the dune.

Muir Descriptions:

Site 397

ii) *Ammophila arenaria* Tall Grassland.

Site 387 Dead-end of Broadwater coastal road

B) *Ammophila arenaria* Tall Grassland over Mixed *Cakile maritima* *Tetragonia decumbens* Dwarf Scrub C.

Distribution: This vegetation type is relatively common on the stretches of sandy beach between Forrest Beach and Broadwater and also occurs on major blowouts between the tip of Cape Naturaliste and the southern end of the study area.

Comments: On the blowouts *_Ammophila arenaria_* is taking advantage of the large areas of mobile sands which it needs for survival, as it dies out in areas where sand is not deposited on it, at these locations its colour makes it very obvious from a distance.

With time, the sand trapping ability of Marram Grass (*_Ammophila arenaria_*) generally produces a flat ground surface, unlike the hummocky topography produced by the native species _Spinifex hirsutus_ and _S. longifolius_.

*_Ammophila arenaria_ also occurs as a secondary species within other sandy vegetation types, eg D2 and D4.

Acacia cochlearis, Acacia cyclops, Scaevola crassifolia

OPEN HEATH. [D4]

This vegetation type occurs in inter-dunal swales along the more developed sandy beaches on white sand and has a height range of 0.8-1.4 metres. The protection given to the swale zone from wind and salt spray is reflected by the increase in overall canopy height of this vegetation type in contrast to the more seaward types. Other species in this vegetation type include shrubs of _Acanthocarpus preissii_, _Pelargonium capitatum_, _Tetragonia decumbens_, _Spyridium globulosum_, and _Olearia axillaris_, the sedges _Isolepis nodosus_ and _Lepidosperma gladiatum_ and the weed *_Trachyandra divaricata_.

Distribution: Major areas of this vegetation type occur from Forrest Beach south to Busselton, Broadwater south along the coast to the southern end of the study area.

Comments: Much of the original area of this vegetation type has already been cleared for roads and carparks and only small areas remain next to residential areas. The remaining areas need careful management to minimise the impact of recreational use.

Photograph 61: *Acacia cochlearis, Acacia cyclops, Scaevola crassifolia* Open Heath. [D4]

***Agonis flexuosa* OPEN SCRUB to LOW OPEN WOODLAND. [D5]**

This unit contains two of the structural types of Aplin (1979), which it would have been impracticable to seperate in the field. It occurs on and between the stabilised dunes behind sandy beaches. *Spyridium globulosum* and *Acacia cochlearis* are the two most abundant shrubs growing under the *Agonis*, other shrubs are *Exocarpos sparteus, Pelargonium capitatum, cuneiformis, Hibbertia* sp. (CK145), *Rhagodia baccata* and *Phyllanthus calycinus* and the sedges *Lepidosperma gladiatum, Isolepis nodosus*, the creeper *Hardenbergia*

compioniana and *Loxocarya fasciculata*.

Muir Descriptions:

Site 387 E

Agonis flexuosa Low Woodland A over *Juncus krausii*, *Lepidosperma gladiatum* Open Tall Sedgeland over shrubs of *Acacia divergens*, *Anthocercis littorea*, *Hibbertia* sp. (CK145), *Pelargonium capitatum* over low shrubs of *Phyllanthus calycinus* with occasional creepers of *Hardenbergia compioniana*.

Site 397 B

iv) *Agonis flexuosa* Low Woodland B over mixed *Sporidium globulosum*, *Hibbertia cuneiformis*, *Acacia littorea*, *Acacia cochlearis*, *Leucopogon propinquus* Heath A.

Distribution: This unit is found from Forrest Beach south to Broadwater.

Comments: The remaining examples of this unit are very close to residential areas and are under pressure from the recreational use of the adjacent beaches. As a result of this, and possibly of grazing there is a high degree of weed invasion (including **Trachyandra divaricata*) and disturbance. Even so they still have value for the conservation of the type and as a landscape and recreation resource.

6.0 CONSERVATION VALUE OF THE VEGETATION

6.1 EXISTING CONSERVATION RESERVES

LUDLOW TUART FOREST

Tuart (*Eucalyptus gomphocephala*) was described in 1828 by de Candolle, from a specimen collected in Geographe Bay by Leschenault in 1803, the type locality is thought to be Ludlow (CTRC 1974). The species is restricted to the coastal limestone, between Busselton and Moore River and the Ludlow Forest is the most southerly limit of the range of the species. It has suffered a great reduction in the extent and quality of its stands through clearing for agricultural, residential and commercial development. Remnant stands are located between Ludlow and Moore River, with many having suffered degredation from logging (the wood was prized by the early settlers for its strenght and durability) and the grazing of sheep and cattle.

Ludlow is the most significant remaining stand of Tuart and the individual trees in it include the largest remaining individuals of this species which reaches its optimum development as a species and vegetation type in this area. It needs to be recognised however, that the conservation value of the area is not just in the individual species alone but in the ecosystem of which Tuart is the dominant. The ecosystem contains many other species of plants and animals each of which is equally worthy of preservation as the dominant, even though some may be inconspicuous. The extremely high value of this State Forest for the conservation of flora, vegetation types, natural landscapes and fauna and should be more widely recognised.

Ludlow Tuart Forest is currently a Management Priority Area (M.P.A.) for conservation, however there is still cause for concern both for the security of the vesting purpose of the area and for the actual management of the area. In the past

the conservation value of the area and the detrimental impact of in-appropriate management practises were not recognised. This led to the then Forests Department not only clearing parts of the area for pine plantations but also condoning the grazing of cattle in the area, a practice with disastrous effects not only on the understorey (and the animals it provides food and shelter for) but also on the replacement of the overstorey. It can only be concluded that those resposible for the management of the area did not have the appropriate management skills or concern for the environment in their control. In this context it should be noted that they are still grazing cattle there!

Currently as existing areas of the pine plantations are cut down they are being progressively replaced by Tuart. There is a need to ensure that attention is also being given to the restoration of the understorey.

Currently there are a number of mineral and exploration leases for mineral sands within the Ludlow Tuart Forest, if these were to be mined this would have a very severe impact on the ecosystem as it would change the structure of the soil and consequently make replacement of the existing vegetation extemely difficult. It would also have a severe impact on the populations of the species presently in the area and add to the already existing problem of weed invasion.

WONNERUP ESTUARY

The entire Wonnerup Estuary is freehold land and is recognized as an important bird refuge and winter nesting site for the black swan (*Cygnus atratus*. Tingay, 1980), various duck species, white egrets (*Egretta alba*), white-faced herons (*Ardea novaehollandiae*), pacific herons (*Ardea pacifica*) and other wading birds (C.T.R.C. 1974).

The most prominent visual impact of this wetland area is its shallow water body and flat topography. The raised permanent nesting sites of the Black Swan are also of high importance ecologically.

The estuary with its tidal link, experiences cyclic inundation which renders it generally unsuitable for intensive commercial cropping or grazing. With increased efficiecy of drainage in cleared areas which drain on to the Wonnerup wetland, and the use of lock-gates to prevent the "natural tidal encroachment of sea-water" (C.T.R.C., 1974) an unnatural drier period during the summer months has resulted.

Cropping and grazing activities are pursued on the privately owned parts of the wetland system and there is a need to ensure that this is not adversely affecting the ability of the wetland to act as a wildlife refuge. Mining and mineral exploration permits are currently held over parts of the Wonnerup system, it should be recognised that the system is extremely fragile and that mining would have a severe impact by affecting the depths of water and water quality by increasing turbidity (which would affect the survival of food species).

VASSE ESTUARY

The Vasse is a very important bird refuge and nesting site, particularly during drought periods for when other swamps dry out it remains wet. It is a deeper and more permanent water body than the adjacent Wonnerup System with a dense woodland of the paperbarks *Melaleuca cuticularis*, *M. rhaphiophylla* and *M. preissiana* and a well developed sedge band on the margins and a number of substantial islands within the wetland complex.

At present there are land-use conflicts within the Vasse Estuary Wetland System, between the value of this fragile ecostystem and the continued development of

Busselton and its associated service industries. The Estuary is being adversely affected by residential, commercial, educational, recreational, light industrial and farming development with many developments coming to within metres of the waters edge.

LEEUWIN - NATURALISTE NATIONAL PARK

The Leeuwin-Naturaliste National Park consists of a number of reserves along the coastal strip from Cape Naturaliste to Augusta. It is continuous along the coast in the study area, with the exceptions of a small section of vacant crown land in the Smiths Beach locality and a reserve near Yallingup vested in the Busselton Shire. The width of the Park is very eratic, varying within the study area from an inadequate 50 m at a steeply cliffed bay, between Canal and Wyadup Rocks to 2.5 km at Sugar Loaf Rock. One part of the park, Reserve No. A8428 (68.39ha) near Quininup Brook, does not adjoin the coastal strip. Details of the individual reserves which make up the park are given in Table One below.

The Leeuwin-Naturaliste National Park is an extremely important conservation reserve because of the variety of vegetation types it contains and their value as habitat for fauna and flora, the areas of scenic beauty it contains, its value as an area for scientific research and education, the diversity of geological types found there and its value as a tourist and recreation destination.

The variety of different vegetation types in the park can be seen from examination of the accompanying vegetation map, with reference to the section on vegetation (5.0) for discussion of the importance of the park for the conservation of the different vegetation types. Hammond (1974) commented on the value of Cape Naturaliste as a field study area for educational purposes, especially for; botany, zoology, geologic history and formations and coastal dynamics.

TABLE ONE **Individual reserves comprising Leeuwin-Naturaliste National Park.**

RESERVE	AREA	PURPOSE	LOCATION	VESTING
A15633	(707.28 ha)	parklands & recreation	Cape Naturaliste to Sugar Loaf Rock	
A31634	(1,000 m2)	faun-	Sugar Loaf and Gull Rocks	(WAWA)
A20455	(524.47 ha)	tourist resort	Kabbejup to Mt. Duckworth (north of Yallingup)	
A13404		recreation, ocean frontage	coastal strips:- Cape Naturaliste to Mt Duckworth (ie. fronts A15633 and A20455); Injidup Springs; south of Cape Clairault to Quininup Brook and south of Moses Rock Road to Cullen Road, the southern boundary of the Study Area. (partially fronts A8249)	
9041		water pipe track,	Cape Naturaliste, within A15633, Willanup Spring	Leased to Commonwealth
A8768		protection & preservation of caves & for health & pleasure resort	Mt Duckworth,	
A8427	(686.10 ha)	protection & preservation of caves & for health & pleasure resort	from sand drift north of Yallingup, surrounding the Townsite and extending south (Smiths Beach) and east (junction of Caves and Biddle Roads)	
A10922	(139.20 ha)	preservation of caves & conservation of flora		
A12507	(33.99 ha)	prevention of soil erosion & ocean frontage	Cape Clairault	
A8428	(68.39 ha)		isolated from the rest of the Park, (the south-east corner is crossed by both Quininup Brook and Road).	
A8429	(622 00 ha)		Moses Rock to Woodlands Road (includes some coastal frontage)	

Leeuwin-Naturaliste National Park follows its major aesthetic feature; the coast, and was largely created to protect this outstanding feature. However, lack of appreciation, in the past, of the value of the vegetation, flora and fauna has led to parts of the park being undesirably narrow, with some vegetation types being poorly represented or not represented at all. In the future this will lead to management problems with the control of weed invasion, fire and the conflict between people and the environment that would be less serious if a better boundary to area ratio existed. Specific recommendations for additions to the park to deal with these problems are made in section 7.0.

MEELUP RESERVE SYSTEM

A group of C-class reserves near Meelup, Nos. 21629, 28933, 31367 and 31368 vested in the Busselton Shire ("Meelup Reserve System") cover the uncleared tract of land along the coast from Dunsborough Townsite to Eagle Bay.

This reserve system contains vegetation types that reach their best development here and are poorly represented elsewhere and a significant variety of vegetation types with well developed examples in good condition. These include the *Calothamnus graniticus* Heaths, near coastal Jarrah/Marri Woodlands and Forests (see section 5.5 for details). The only other undisturbed, sizable areas of Jarrah/Marri Woodlands and Forests in reserves within the study area are in Reserve No. 28665, a C-class reserve also vested in the Shire of Busselton. Although they have similar tree strata the understorey species compositions of these reserves differ significantly. For example there is no *Dasypogon hookeri* and less *Xylomelum occidentale, Persoonia longifolia, Banksia grandis, B. attenuata, B. littoralis, Allocasuarina fraseriana* and *Nuytsia floribunda* in the Meelup Reserve System.

The diversity of vegetation types present, their habitat value for flora and fauna

coupled with its aesthetic value means the Meelup Reserve System has a very high conservation value and needs greater protection (see Recommendations, sect. 7.0) even though the area has been somewhat disturbed through the location there of a rubbish tip and gravel pit and also by fire. It is important to realise that though parts of the reserve system are not pristine, it still has great conservation, recreation and tourism value. The area east of Meelup Road was burnt both by a fire which escaped from the rubbish tip approximately 10 years ago, and by a planned 'management burn' by the Regional Volunteer Fire Brigade approximately two years ago. Local reaction to this latter burn was so great that the planned management burn for the remainder of the Meelup Reserve System was intelligently aborted.

The significant aesthetic, conservation, recreation and tourism value of this reserve system would be seriously degraded by the presence of developments such as boat harbours or caravan parks, both of which have been proposed at various times for the Meelup Beach - Point Picquet area. The presence of such developments in the

TABLE TWO **Individual reserves in the "Meelup Reserve System".**

RESERVE	AREA	PURPOSE	LOCATION	VESTING
C31368		gravel extraction	above Castle Bay	Busselton Shire
C31367		rubbish disposal	above Castle Bay	" "
C21629		parklands and recreation	north, north-east of Dunsborough Townsite, north-west to Eagle Bay	" "
C32026		recreation	Eagle Bay, (adjoins A21629)	nil
C28933		recreation	Meelup Beach	" "

centre of the coastline would greatly reduce the appeal of the unspoilt coastline and would create management problems that currently do not exist. It would be

appropriate for such developments to be built on areas that have already been cleared (see recommendations, sect. 7.0).

RESERVES C28665 and C12494

These adjoining reserves are vested in the Busselton Shire for the purpose of caves and conservation of flora (C28665) and gravel extraction (C12494) and are located on the south side of Caves Road, opposite the Bannamah Wildlife Park. Reserve No. C28665 supports some of the main undisturbed stands of Jarrah and Marri in the study area, with a significant population of the rare and geographically restricted *Dasypogon hookeri* (pineapple bush, see section 4.6) which occurs in localized areas throughout this reserve. The unusual form of *Dasypogon hookeri* and the different understorey compared to the Jarrah/Marri Woodlands and Forests of the Meelup Reserve System gives these reserves a very distinctive appearance which is of great aesthetic appeal.

The high conservation value of these reserves with their variety of vegetation types, high habitat value for flora and fauna and their unique aesthetic value needs to be given greater protection through the uprading of their status (see recommendations, sect. 7.0).

RESERVE A21751

This reserve is located in the Bunker-Eagle Bay area and vested in the Busselton Shire for 'parklands and recreation', with A-class status. It has an awkward shape, with a narrow strip along the coast and a six-sided wedge within the Leeuwin-Naturaliste National Park and bordered on one side by Bunker Bay Road. The narrow coastal strip joins the Leeuwin-Naturaliste National Park to the Meelup Reserve System .

The section wedged within the National Park has a variety of vegetation types which

are poorly represented in the the Park, for example mixed *Melaleuca huegelii*. *M. lanceolata* Woodlands, *Thryptomene saxicola* and *Acacia rostellifera* Coastal Heaths, and Mixed Jarrah, Marri and Banksia Woodlands. The conservation importance of these examples of these vegetation types needs to be protected by the changing of the purpose of the reserve to 'conservation of flora, fauna landscape and coastline'. To ensure appropriate management the reserve should be managed as part of the Leeuwin-Naturaliste National Park (see recommendations, sect.7.0) and recreation activities within the reserve should be restricted to those compatible with the protection of flora and fauna.

The narrow coastal section adjoins both totally cleared agricultural areas and lands which have been moderately disturbed through grazing, the latter areas are discussed in the following section (6.2).

RESERVE C28683

This reserve on Naturaliste Road in Dunsborough, it is vested in the Shire of Bussselton for the purpose of 'civic centre and recreation'. The dense *Melaleuaca preissiana*. *M. rhaphiophylla* [S1] Woodland and the *Eucalyptus calophylla*. *E. rudis*. *Melaleuca preissiana* [S3] Woodland on this reserve are of high conservation value for within the study area they are only represented here and on the private land on the oppposite side of the road. This reserve as well as having high conservation for these vegetation types and habitat value for flora and fauna has a potential for educational value for local students. However, this area is threatened by the proposed development of the Dunsborough Cultural and Civic Centre and consequent increased activity (see Recommendations, sect 7.0).

RESERVE No. C24622

This C-class reserve vested in the Busselton Shire for the purpose of 'public

recreation' adjoins the south-western boundary of the Yallingup Townsite, the coastal strip and the Leeuwin-Naturaliste National Park. The western part of the Yallingup Brook runs just inside thenorth-east boundary of this reserve. Reserve No. C24622 has a number of vegetation types including *Melaleuca huegelii* Heath, *Melaleuca lanceolata* Woodlands, *Pimelea ferruginea*, *Darwinea citriodora* Low Heath as well as sandy coastal communites of *Arctotheca calendula*, *Cakile maritima* Low Heaths, *Spinifex hirsutus*, *S. longifolius* Grassland and mixed *Acacia rostellifera*, *Agonis flexuosa*, *Spyridium globulosum* Heath. The high conservation value of this reserve for vegetation, flora, fauna and landscape need to be secured by its inclusion into the Leeuwin-Naturaliste National Park which would simplify management of theses adjoining areas.

RESERVES NO. 27062, 27063 and 27064

These reserves are somewhat triangular in shape and adjoin the Leeuwin-Naturaliste National Park at the south-east, north-east and north-west corners respectively of the Yallingup Townsite. All three reserves have well developed *Melaleuca lanceolata* Woodlands. Reserve No. 27062 has mixed *Agonis flexuosa* nad Marri Woodland associated with the Yallingup Brook.

GEOGRAPHE BAY

For convenience Geographe Bay has been treated here as a whole (ie. including both the reserves and the area outside reserves). It has a number of small reserves which are vested in the Busselton Shire for a variety of purposes.

Within the study area most of the bay has been developed for residential and commercial purposes, often to within metres of the fragile foreshore. Much of the *Agonis flexuosa* woodland behind the dunes has either been removed or extensively disturbed and stands of *Agonis* woodland in the Wonnerup Estuary area

have also been disturbed by grazing, although they do not have great conservation value due to the high degree of disturbance, these areas are still of aesthetic and recreation value. The thin strip of coastal dunes and the wetland areas (see above) are all that remain of any conservation significance.

6.2 AREAS OF CONSERVATION VALUE NOT IN RESERVES

Conservation value is to a limited degree a subjective value, those who have no appreciation of the worth of native species and landscapes for their quality of life, or who have no feeling that other life-forms have a right to exist will put no value on them. However, if a more reasonable stance is taken then criteria can be established for making a judgement on the value of a paricular area. In the following section areas are considered to be of high value if:-

- they contain vegetation types which are not, or are only poorly represented in the Leeuwin-Naturaliste National Park,

- their inclusion would rationalize the boundaries of the Park, facilitating management and providing better protection for the areas currently in the Park (this applies particularly to places where the Park is very narrow),

- they bridge gaps between parts of the Park, allowing animals to pass from one part to another, through vegetated rather than cleared land (this includes instances where a gap exists but would become wider if the block concerned was cleared),

- they are part of a view-scape with aesthetic appeal,which would be significantly reduced if the use of the area changed (essentially in this survey this means areas were the coastline has a wild, windswept

appearance that would be reduced in value by the intrusion of clearing into the viewscape),

- they contain populations of rare or geographically restricted plant species, or stands of species that are well outside their main area of occurrence (ie. disjunct populations),

- they contain stands that are of an excellent quality or development.

Obviously some areas would have more than one of these characteristics.

6.2.1 Vacant Crown Land

SMITHS BEACH, LOTS 1409 & 1410

These adjacent coastal frontage blocks are at the Smiths Beach locality (approx. 0.6 km south of Yallingup) and includes a sandy stretch of beach where Gunyulgup Brook flows into the ocean continuing south around the granulitic headland. They are currently unvested and form one of two sections of coastline in the study area on the west side of the Leeuwin Block, which are not included in the Leeuwin-Naturaliste National Park, breaking its continuity. Smiths Beach is a popular recreational area with a permanent caravan park. While they are not large these blocks are important as they form a bridge of native vegetation between otherwise seperated areas of the park. Inclusion of these blocks in the park would allow management consistent with the purpose of the adjoining areas of native vegetation and would also provide protection for their flora and fauna.

The sandy beach has typical strand and heath vegetation with *Spinifex hirsutus*, *Arctotheca calendula*, *Cakile maritima* and **Ammophila arenaria* on the

strand, while the dunes have heath dominated by shrubs of *Acacia rostellifera*, *Olearia axillaris* and *Spyridium globulosum*. On the granulitic headland there is a low heath with *Pimelea ferruginea*, *Spyridium globulosum*, *Acacia divergens* and *Scaevola crassifolia*.

CANAL ROCKS AND WINJEE SAM ROCK

These small islands of granulitic rock close to the coast are currently unvested. They are of geologic importance, illustrating the erosion (by the sea) of the softer hornebiende and plagioclase bands which run parallel to the present coastline through the hard granulitic base rock of the Leeuwin Block. They are also prominent well known features of great scenic value. Because of their importance they should be transferred into the Leeuwin-National Park (see Recommendations, sect. 7.0)

6.2.3 Freehold Land

SUSSEX LOCS. 829 and 885, near Yallingup

These adjoining blocks are located on Hemsley Road and abut the Leeuwin-Naturaliste National Park on two sides, slightly east of the Yallingup Cave on the protected side of the Naturaliste Ridge. The *Agonis flexuosa* Woodland developed is the densest and tallest occurrence of this species in the study area and shows the impressive stature that this species can attain under good conditions (see Vegetation, section 5.5). No similar stand is represented in any of the conservation reserves in the study area, the stand is relatively undisturbed and its inclusion in the park as well as protecting the vegetation developed would protect an example of the change in vegetation across the ridge.

These blocks was apparently previously offered for purchase to the Government for such an inclusion (Valentine & Enright 1975).

NATURALISTE RIDGE, SUSSEX LOCATIONS 1044 & 1046

These blocks of land are mostly on the windward or exposed slope of the Naturaliste Ridge, immediately south of Sugar Loaf Rock Road with part of the inland lot on the leeward slope. At this locality for a length of some 2.3 km the National Park consists of only a narrow coastal strip varying from 100 to 250 metres wide and Lots 1044 and 1046 form a break in the continuity of the park, which to the north and south is 2.0-2.2 km wide.

A variety of vegetation types including Mixed *Acacia cochlearis, Olearia axillaris, Spyridium globulosum* Heath, *Melaleuca huegelii* Heath, Mixed *Agonis flexuosa, Melaleuca huegelii, Dryandra sessilis* Scrub, Mixed Marri, Jarrah, *Agonis flexuosa* Low Woodland and *Eucalyptus cornuta* Open Woodland occur on these lots. While these types are reasonably well represented in the Park the lots would be a valuable addition to the park for two reasons:-

Firstly their addition would rationalise the boundary of the park at this locality, making management of the park simpler in the future, and making the park more continuous (as well as improving considerably its boundary to area ratio), thus increasing its value for conservation by reducing the impact of surrounding land-uses on the flora and fauna in the park.

Secondly they are an important part of the landscape of the area as they are visible for some distance and contribute significantly to the continuity of the windswept heath viewscape. This is an important point, for this is a significant part of the attraction of the area to visitors and at the moment the continued existence of the native vegetation on these blocks depends entirely on the goodwill of the landowner. The two blocks are parallel to each other and the coast, the block closest to the coast (Loc. 1044) has suffered very little disturbance, and while the

other (Loc. 1046), has been somewhat disturbed, most of it remains in quite good condition. These blocks also lie between the park and part of block Sussex Loc. 660 which is of high conservation value and is discussed below.

SUSSEX LOCATION 517

This block of land is bordered on three sides by the Leeuwin-Naturaliste National Park and on the fourth by Cape Naturaliste Road just south of the Bunker Bay turn-off. It has some disturbance from clearing, sand extraction, tracks and homestead buildings, but most of it is in good condition.

The vegetation of the block includes the only occurrence within the study area of *Agonis flexuosa, Eucalyptus calophylla* woodland [AgM/meg] This vegetation type has scattered trees of *Eucalyptus megacarpa* (Bullich) in the *Viminaria juncea, Acacia cyclops, Xanthorrhoea preissii* scrub layer and, has high conservation value as it is not represented in the Park. There is also an extension from the park of a *Banksia*, Peppermint, Jarrah woodland [BaAgJ] and a low *Marri, Agonis, Melaleuca* closed scrub [AW8].

While the area of the block is not extremely large it is a potential problem from a management point of view. It extends over the crest of the Naturaliste Ridge so that if it were cleared an intrusion into the uncleared viewscape along the ridge would be produced and also if dieback (*Phytophthora cinnamomi*) were introduced onto the property it could spread downslope into the park. Otherwise it presents the usual problems associated with properties which protrude into a national park, problems such as the increased likelihood of fires and weeds escaping from the property into the park.

This property was previously offered for purchase to the Government for the

purposes of inclusion in the Park (Valentine & Enright 1975).

Eucalyptus cornuta **(Yate) OPEN FOREST, SUSSEX LOCATION 660,**

This relatively undisturbed *Eucalyptus cornuta* Woodland is on the eastern or protected flank of the Naturaliste Ridge It covers about two-thirds of Loc. 660 which adjoins Loc. 1046 (see above) and the Leeuwin-Naturaliste National Park. Most of the stand is separated from the park by Locs. 1044 and 1046, both of which have conservation value which is discussed above.

This is the only occurrence of this vegetation type (see Vegetation, sectn. 5.5) in the study area; there is none in the park.

Eucalyptus megacarpa **(Bullich) Woodland on SUSSEX LOCATION 1049**

This stand of Bullich Woodland occurs on the eastern or protected flank of the Naturaliste Ridge on Loc. 1049. While there are areas in the Leeuwin-Naturaliste National Park where this species occurs as scattered mallees or trees (in some of the exposed coastal scrubs of the Naturaliste Ridge and in Marri/Peppermint Woodlands on lower slopes in the southern section of the study area) this is the only site in the study area where it shares dominance in a woodland (see Vegetation, sectn. 5.5) and so the stand has conservation value as an example of this vegetation type at one extreme of the species distribution.

Loc. 1049 adjoins cleared land downslope, upslope it is connected to the park by uncleared privately owned land, some of which has high conservation value (see Loc. 829 above).

BUNKER BAY, SUSSEX LOCATIONS d (?) and 302

An apparently permanent lake and its associated vegetation in the depression behind

the sand dunes at Bunker Bay on land adjoining part of the southern boundary of Reserve A21751 are of high conservation value.

The vegetation types present are a *Myriophyllum salsugineum* Aquatic Herbfield and a Mixed *Eucalyptus rudis, Melaleuca preissiana* Woodland which has localised pockets of *Melaleuca lanceolata* (see Vegetation, sect. 5.5). This was the only wetland in the study area where *Myriophyllum salsugineum* was observed. The other *Eucalyptus rudis / Melaleuca preissiana* woodlands in the study area differ from the one found here in that they also include Marri and Jarrah in the overstorey, have a different lower tree stratum (including *Banksia grandis, B. littoralis* and *Nuytsia floribunda* rather than just *Agonis flexuosa*) and an understorey of *Xanthorrhoea preissii* and *Macrozamia riedlei* rather than an open *Acacia rostellifera, Hibbertia cuneiformis* heath over *Lepidosperma gladiatum* and *Acanthocarpus preissii*. The absence of a reedy margin is also unusual in comparison to other wetlands in the study area. The combination of the value of these different vegetation types coupled with the habitat value of the water body gives this area a high conservation value.

SUSSEX LOCATION 413, SMITHS BEACH

This partially disturbed, privately owned land near Smiths Beach is adjoined in parts by Vacant Crown Land (Locs. 1409 and 1410), cleared land (Locs. 364 and 85) and the Leeuwin-Naturaliste National Park. The vegetation types present include low heath on granulite with *Pimelea ferruginea, Scaevola crassifolia, Acacia divergens* and *Spyridium globulosum* and part of the only occurrence of an *Acacia divergens, Melaleuca huegelii, Bryandra sessilis* closed scrub [LH3] in the study area. It also has a small area of stunted *Agonis flexuosa, Eucalyptus calophylla* and *E. marginata* low woodland. One of the most important aspects of this block is that, together with the adjoinining Vacant Crown Land, it forms the

largest gap in the continuity of the Leeuwin-Naturaliste National Park (see comments above for Vacant Crown Land)

SUSSEX LOCATION 480, CANAL ROCKS

This block of land adjoins the Leeuwin-Naturaliste National Park south of Canal Rocks Road and uncleared privately owned land. A portion of the only stand of *Acacia divergens. Melaleuca huegelii. Dryandra sessilis* closed scrub [LH3] in the study area and referred to immediately above occurs on this block, this unit, which is represented by only a small area in the park with the rest of the stand on private land, is of high conservation value. The remainder of the block is *Agonis flexuosa.* Marri, Jarrah low woodland with a *Dryandra sessilis* understorey [AgDsMJ] (which is represented in the Park to the north and on other areas of privately owned land to the south) and *Agonis flexuosa.* Marri woodland surrounding the water course (partially cleared) which crosses the block.

SUSSEX LOCATION 589, CANAL ROCKS

This block is partially cleared and has cleared land on the eastern, southern and western boundaries and uncleared private land on the northern boundary. It lies next to Sussex location 480 (see directly above) which abuts the Park to the north, to the south it is seperated by a fairly narrow gap of cleared land from a group of privately owned, uncleared bocks which abut the narrow strip of land in the park at that location. Its major value for conservation is that while it remains uncleared the gap that fauna would have to cross between the areas of uncleared vegetation is relatively small. It also has value for the vegetation type present [*Agonis flexuosa. Eucalyptus calophylla. Banksia attenuata* woodland, MBaAg+J.] which is of restricted distribution, occurring here and on the uncleared blocks to the south, all on private land.

SUSSEX LOCATIONS 1351, 931, 1051, 935, 777, 1325, 936, 4082, 440

These blocks (which are discussed individually below) form a large area of uncleared privately owned land near Cape Clairault. Together they are extremely important for conservation because:

- of the many vegetation types on them which are not represented in the Park, these individually are of significance and together are very important,
- only a very narrow strip of the costal vegetation is in the Park along this stretch of coast,
- the area has significance for its landscape that would be reduced if these blocks were cleared,
- with the narrow coastal strip they include the transition from the beach through the coastal heaths to the woodlands and forests of the eastern slopes of the Naturaliste Ridge which are poorly represented in the National Park,
- they connect the coastal strip of the Park to a very important outlying block of the Park which has the most north-westerly stand of Karri on it.

SUSSEX LOCATION 1351, CAPE CLAIRAULT

This uncleared land adjoins the Leeuwin-Naturaliste National Park and uncleared privately owned land on the west, south and parts of the east sides and cleared land to the east and north. The Cape Clairault and Wyadup Roads run through the block. The vegetation includes the most southerly occurrence in the study area of *Dryandra sessilis*, *Agonis flexuosa* closed scrub (other stands are north of Yallingup). Where this block extends onto the coastal side of Cape Clairault Road dense thickets of *Melaleuca huegelii* and *M. lanceolata* dominate and are a very important part of the visual landscape of this popular section of the coastline. Other vegetation types include tall stands of coastal heath with *Spyridium globulosum*, *Acacia littorea*

and *Olearia axillaris*, a stand of *Agonis flexuosa*, *Eucalyptus calophylla*, *E. marginata* low woodland with *Xanthorrhoea preissii*, *Hakea oleifolia* and *M. huegelii* in the understorey and good stands of *Banksia attenuata* and *Allocasuarina fraseriana* woodlands, both of which have Marri, Jarrah, Peppermint and *Banksia grandis* present.

SUSSEX LOCATION 931, CAPE CLAIRAULT

Cape Clairault Road runs through this block, on the western side it adjoins the Leeuwin-Naturaliste National Park and on the other three side it adjoins uncleared privately owned land. The vegetation of this block is a mixture of *Melaleuca huegelii* and *M. lanceolata* tall scrubs and woodlands.

SUSSEX LOCATION 1051, CAPE CLAIRAULT

This block adjoins adjoins cleared land on part of its northern and on its eastern boundary and uncleared private land. The vegetation on this block is a woodland of *Allocasuarina fraseriana*, *Banksia attenuata*, Marri and Jarrah of a type [Ba Ag JM] that is not represented in the Leeuwin-Naturaliste National Park and is part of a stand that extends into the adjoining blocks.

SUSSEX LOCATION 935, CAPE CLAIRAULT

This block is surrounded by uncleared privately owned land. It has some of the best *Agonis flexuosa*, *Melaleuca lanceolata* low forests [M1Ag] and *Melaleuca huegelii* closed scrub [LH4 and LH6] stands in the study area.

SUSSEX LOCATION 777, CAPE CLAIRAULT

This block is almost totally surrounded by uncleared privately owned land and has a dense vegetation cover of three vegetation units. These are an *Agonis flexuosa*, Marri, Jarrah low woodland over a shrubs of *Xanthorrhoea preissii*, *Hakea*

prostrata, *Acacia divergens* and *Melaleuca acerosa* [St2] part of the *Banksia attenuata*, *Agonis flexuosa*, Marri woodland [BaAg+M] referred to above and an *Agonis flexuosa*, Marri and Jarrah [AW2].

SUSSEX LOCATION 1325, CAPE CLAIRAULT

This long block parallels the coast south from Point Clairault, on its northern, western and parts of its southern and eastern boundaries it abuts the Leeuwin-Naturaliste National Park with the remainder abutting uncleared privately owned land. The vegetation is largely dominated by *Melaleuca lanceolata* woodlands [M1] and closed scrubs of *Melaleuca lanceolata* [LH1] and *M. huegelii* [LH6] towards the coast and an *Agonis flexuosa*, Marri, Jarrah low woodland [AgM2] further upslope.

This block has very high conservation value as along this stretch of coastline only the immediate coast and the cliffs above it are within the National Park and if it were cleared only this narrow strip would remain.

SUSSEX LOCATION 936, CAPE CLAIRAULT

This block lies next to a section of the Park that is not connected to the coastal strip. It has one of the largest areas of *Agonis flexuosa*, Marri, Jarrah low woodland [AW2] in the study area and also has a stand of *Agonis flexuosa*, Jarrah, Marri woodland [JMP1] which is the only one in the study area, ie. it is not represented in the Park.

SUSSEX LOCATION 4082, QUININUP BROOK

This triangular-shaped block adjoins the eastern side of the outlying block of the Leeuwin-Naturaliste National Park. It has a small part of the Karri stand and the rest is covered by Jarrah Marri forest [JM1] and is important as a buffer to the Karri in the Park.

SUSSEX LOCATION 440, QUININUP BROOK

This block has native vegetation remaining on only the northern section where it adjoins the Leeuwin-Naturaliste National Park near the mouth of the Quininup Brook. It is important for the Falls the Quininup Brook forms as it passes down the low cliffs. The vegetation is a series of *Melaleuca* heaths with *Agonis flexuosa* and coastal heaths with *Spyridium globulosum, Olearia axillaris, Diplolaena dampieri* and *Acacia rostellifera* where the Brook reaches the ocean.

SUSSEX LOCATION 494, WOODLANDS

This block is separated from the Leeuwin-Naturaliste National Park by a narrow area of cleared land. It has an *Allocasuarina fraseriana, Banksia attenuata, Eucalyptus marginata* forest (Allo5), the only occurrence of this vegetation type in the study area.

SUSSEX LOCATION 346, WOODLANDS

This unit is also separated from the Park by a narrow strip of cleared land and has a *Eucalyptus calophylla* open forest [M/Ag] with a dense understorey of *Agonis flexuosa, Banksia grandis* and occasional trees of *Eucalyptus megacarpa* (Bullich). The vegetation of this block is important as it adjoins the vegetation associated with Wilyabrup Brook (see below).

SUSSEX LOCATION 350, WOODLANDS

This block in the Woodlands area has two arms of the Wilyabrup Brook dissecting it, with the associated vegetation of Marri, *Eucalyptus rudis* (flooded gum) and *Agonis flexuosa* forest [Er2M] and *Melaleuca preissiana, Lepidosperma tetraqueirum*. There are also Jarrah, Marri and *Agonis flexuosa* woodlands on the valley slopes leading down to the water course [AW2 and MJP1].

Wilyabrup Brook is one of the two large water courses in the study area which have not been cleared and the vegetation along it is in excellent condition and includes types not represented in the Park.

SUSSEX LOCATION 593, WOODLANDS

The lower reaches of the Wilyabrup Brook cross this block which adjoins cleared land to the north. The vegetation includes Marri, *Agonis flexuosa* forests [AW8] associated with the water course, Marri, Jarrah, *Agonis flexuosa* forests [M/Ag] upslope and *Allocasuarina fraseriana*, *Eucalyptus calophylla* woodlands [Allo5]. These are not represented in the Park but do occur on the two blocks discussed immediately above.

SUSSEX LOCATION 731, WOODLANDS

This unusual shaped block covers a large area of land the majority of which is cleared. Sections 2 and 7 of this block which constitute the major uncleared areas are adjoined by both cleared and uncleared privately owned land. Although it is partially cleared, the vegetation that remains is only marginally disturbed and is associated with Wilyabrup Brook, a major water course.

Section 2, has an important stand of Marri, *Eucalyptus rudis*, *Agonis flexuosa* forest [Er2M] and *Melaleuca preissiana* associated with the water course, a *Xanthorrhoea preissii* [XH2] heath on the slopes into the brook that is not represented anywhere else in the study area, an *Agonis flexuosa* Marri low woodland and a *Melaleuca huegelii* closed scrub near the coast.

Section 7 has a Marri, Jarrah woodland [MJP1] and an *Agonis flexuosa*, *Banksia attenuata* and *B. grandis* woodland.

The importance of the vegetation on this block is the types not represented in the Park and the presence of the Wilyabrup Brook, which is protected by the surrounding vegetation.

7.0 RECOMMENDATIONS

The recommendations made below are based on the flora and vegetation surveys presented in sections 4.0 and 5.0, where the vegetation makes an obvious contribution to the landscape this value has also been taken into account. In some cases recommendations made in previous studies (Valentine & Enright, 1975; Conservation Through Reserves Committee, 1974; Environmental Protection Authority Review of the C.T.R.C. recommendations, 1976) are still appropriate and have been endorsed. It is hoped that these recommendations will lead to the protection and conservation of natural resource areas of high vegetation, flora and landscape value within the study area.

Individual recommendations are made for reserves which already exist for conservation purposes (see also sectn. 6.1) but need changes to ensure better protection and management and for areas of conservation value outside reserve systems (see also section. 6.2).

7.1 LEEUWIN-NATURALISTE NATIONAL PARK

To give the park a uniform purpose and better protection the vesting purposes of the individual parts of the park should be changed to:- The conservation of flora, fauna, coastline, landscape and caves (where present), with A-class status.

The boundaries of the Leeuwin-Naturaliste National Park should be changed to:-

(1) include adjacent areas of high conservation value,

(2) improve the boundary to area ratio by addition of suitable areas and thus reduce management problems associated with:-

(a) the invasion of weeds into the park,

(b) the control of fires:- both management fires and wildfires (from inside

or outside the park),

(c) reduce the likelihood of the introduction of dieback (*Phytophthora cinnamomi*) into the park,

(d) simplify the management of other reserves in or adjacent to the park by including them in one entity.

By specifically :-

(1) Aquisition and addition to the Leeuwin-Naturaliste National Park of private land on:-

(a) Lots 1044 and 1046, on the Naturaliste Ridge south of Sugar Loaf Road.

(b) Lots 829 and 885, east of Yallingup Cave.

(c) Lot 660, on the leeward side of the Naturaliste ridge.

(d) Lot 517, north of Sugar Loaf Road.

(e) Lot 1049 to the west of Gutherie Road.

(f) Lot 413, Smiths Beach.

(g) Lot 480, Canal Rocks.

(h) Lot 589, Canal Rocks.

(i) Lot 1351, Canal Rocks.

(j) Lot 931, Canal Rocks.

(k) Lot 1051, Canal Rocks.

(l) Lot 935, Canal Rocks.

(m) Lot 777, Canal Rocks.

(n) Lot 1325, Canal Rocks.

(o) Lot 936, Canal Rocks.

(p) Lot 4082, Quininup Brook.

(q) Lot 440, Quininup Brook.

(r) Lot 494, Woodlands.

(s) Lot 346, Woodlands.

(t) Lot 350, Woodlands.

(u) Lot 393, Woodlands.

(v) parts of Lot 731, Woodlands.

(2) Transfer to the Leeuwin-Naturaliste National Park of Vacant Crown Land on:-

(a) Lots 1409 and 1410, adjacent coastal frontage blocks at Smiths Beach.

(b) Canal Rocks and Winjee Sam Rock.

(3) Transfer to the Leeuwin-Naturaliste National Park the following reserves:-

(a) The 'Meelup Reserve System', Reserve Nos. 21269, 31367, 31368, 32026 & 35685.

(b) Reserve No. 21751, on Bunker Bay, with the addition of adjoining privately owned land (parts of lots 302 and 595, refer to sections 6.1 & 6.2).

(c) Reserve Nos. 27062, 27063 and 27064, coastal frontage blocks at Yallingup.

This is an endorsement of the recommendation by Valentine and Enright (1975) that "all conservation reserves in the Cape Naturaliste area be vested in the National Parks Authority (substitute: National Parks and Nature Conservation Authority), a single authority with expertise and finance to manage the areas as conservation reserves".

The continuity in the management of the coastline by a single authority is seen as having particular advantage. If agreement between the authorities involved cannot be reached, another way of ensuring the security of these important conservation areas is to:-

(1) upgrade the status of the reserves from C-class to A-class,

(2) change the vesting purpose to the 'conservation of flora, fauna, landscape

and coastline (the latter where present).

7.2 LUDLOW TUART FOREST

This very significant area should be upgraded to a National Park with A-class status for the conservation of flora and fauna.

The grazing of cattle in the forest should be stopped as quickly as possible.

Mining should not be allowed in the reserve due to its extreme importance for the conservation of *Eucalyptus gomphocephala* (Tuart).

7.3 WONNERUP ESTUARY

The impact of the grazing of cattle on the value of this wetland for fauna conservation should be reviewed. If a deliterious impact is occurring then agreement should be sought with the landowners to allow only activities compatible with conservation of water fowl.

Mining for the extraction of mineral sands should not be allowed.

7.4 VASSE ESTUARY

The recommendations of the C.T.R.C. (1974) that the Vasse Estuary be upgraded from C-class to A-class status maintaining its purpose as the conservation of fauna is endorsed.

The impact of competing land-uses on the wetland should be investigated to ensure that the value of the estuary for fauna conservation is not being eroded.

Mining for the extraction of mineral sands should not be allowed.

7.5 RESERVES No. C28665 & C12493

It is recommended that the high conservation value of the combined natural resources (fauna, flora and landscape) of these adjoining reserves should be secured by:-

(1) the upgrading of the status of this reserve from C-class to A-class,

(2) changing its vesting purpose to the 'conservation of flora, fauna and caves'.

7.6 RESERVE No. C28683

The high conservation value of this rerserve should be secured by:-

(1) upgrading the status from C-class to A-class,

(2) changing the vesting purpose to 'conservation of flora and fauna'.

8.0 OBJECTIVES FOR MANAGEMENT OF THE RESERVES IN THE STUDY AREA WITH PARTICULAR EMPHASIS ON THE LEEUWIN-NATURALISTE NATIONAL PARK

Simply stated the objectives of management of the reserves in the study area should be to maintain the the diversity of the flora and fauna found in them and, particularly for the Leeuwin-Naturaliste National Park to maintain the natural viewscapes that they contain. This is simplistic and the **quality** of the populations of plants and animals present, that is their size and age structures, and the quality of the viewscapes, need to be considered if the reserves are going to maintain their integrity as representations of the natural environment over long periods of time. That is, if they are not to be degraded by poor management and inapropriate development.

There are obviously conflicts between this view of the proper objectives of management for the reserves in the study area and the view that national parks (particularly) and reserves should have as a primary role, or simply be available for, developments whose aim is based on the encouragement of economic activity. This conflict should be resolved for the positive good of the continuation of the reserves as reservoirs of the populations of native flora and fauna that they were set up to protect, or where appropriate for the positive protection of the other natural attributes (landscapes, geological formations) present. The paradox is that, in the long run, giving this positive protection will also bring stable economic activity because the resource will not be squandered for short term gain.

8.1 ROADS

The road system into the Leeuwin-Naturaliste National Park is quite good from the point of view that there is access to many of the coastal attractions via roads that run

directly into the park accross its short axis. Such roads have the advantages that there construction involves the minimum loss of vegetation and impact on the landscape, they also expose smaller areas to the risk of the introduction of dieback, weeds and accidentally or deliberately lit wildfires.

Unfortunately there is a coastal track that runs from near Cape Naturaliste to Yallingup and similar tracks in parts of the Park further south. These tracks are undesirable from several points of view. They have the potential to have a high impact on the landscape as they become more and more used and particularly if their "defacto" presence is used as an argument for their "up-grading" into formal roads. If this was done there would be a substantial loss of the landscape value of the coast and the amenity value as well, rather than being relatively undisturbed it would start to approach Cottesloe in its appeal. The other problems with these tracks are that they cut accross sensitive and restricted vegetation types that are only found along this coast and they expose comparitively large sections of the park to the introduction of weeds and the lighting of "wildfires" by vandals.

8.2 USE OF FIRE

The management use of fires in the South-West of Western Australia tends to be on fairly short rotations, in the order of 4-10 years, usually with the major aim of reducing the likelihood of intense wildfires.

There is a conflict between such short periods between fires and their effect on the vegetation, flora and landscapes if the management objectives outlined above are accepted. Gill (1977) notes that the flora responds to fire regimes (a combination of type, intensity, frequency and season of occurrence) and not fire *per se*.

The deleterious effects of frequent fires are:-

- the loss of a diverse range of different aged stands and their replacement by young stands of lesser stature and aesthetic appeal.

- the loss of substantial amounts of nutrients through volatilisation and as particles in smoke during the fire and subsequently through solution and wind action (Raison, 1979).

- opening up of the vegetation by fire allows the easier invasion of weeds and subsequent fires make nutrients available in the ash which can allow the weeds to compete against the native flora.

- loss of dense overstoreys and litter layers changes the surface soil temperatures and moisture levels and this may effect the establishment and pathogenicity of dieback (*Phytophthora cinnamomi*).

- changes to the balance of the flora through the elimination of species dependant on reproduction by seed (rather than from rootstocks) and which have not set seed between fires as they have not had sufficient time to flower and set seed.

It is obvious from the above that the use of fire in reserves needs to be carefully considered and that the possibilities of the effect of intense fires on **other** property should be one of a number of considerations which should include the deleterious impacts of frequent fires on the public property of reserves and national parks.

8.3 CONTROL OF WILDFIRES

The control of wildfires should be carefully considered for each reserve and for the Leeuwin-Naturaliste National Park, there needs to be a well thought out strategy for handling wildfires including access and consideration of the suitability of different fire-fighting techniques for use in conservation reserves. Included in this strategy should be an assessment of when the impact of fighting a wildfire would be more damaging than letting the fire burn through a particular reserve or part of a reserve.

Some other points which should be considered are:-

- Some fire retardants may act as fertilizers encouraging the spread of weeds. Fire retardants which are high in nitrogen and phosphorous may also prove to be toxic to some species of native plants (Heddle and Specht, 1975, in Gill, 1977).

- Fire-fighting trails bulldozed in haste may lead to erosion, the introduction of weeds and dieback, the death of plants that would otherwise have regenerated after the fire and the opening of areas to vehicular traffic.

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ACKNOWLEDGEMENTS

Grateful acknowledgement is made of the help given in this study by the following people:-

Dr Libby Mattiske, who read the vegetation section and made useful comments on the vegetation units.

Ms Anna Napier, who assisted with plant identifications and word processing.

Mr Tom Suffling, for assistence in the field and for compilation of the flora list.

Mr Nick and Mrs Kitty Keating, for companionship and assistance in the field.

Mr Geoff Sutcliffe and Miss Sybil Sutcliffe for the kind use of their holiday cottage in Dunsborough.

Dr John Green, curator of the Western Australian Herbarium, for permission to consult the public collections under his care and whose stseff assisted with identifications in specialist areas.

Ms Anne Gisborne, for assistance with wordprocessing.

Mr Vivian Forbes, Curator of the Geography Department Library, University of Western Australia, for assistance with maps and references.

Mrs Diane Johns, Information Officer, Dept. Conservation & Land Management, who assisted with references and maps.

Mrs Denise Pope, Librarian, Dept. Conservation & Environment, who assisted with references.

Property owners in the study area for permission to enter and survey their properties.

Mr Craig Ashley, Parks Manager, Busselton Shire and and Mr Wilson, Foreman Busselton Shire, who assisted with information on fire histories of particular reserves.

All photographs taken by Colma Keating.

FLORA OF THE BUSSELTON - CAPE NATURALISTE COASTAL REGION

scientific name	common name
PTERIDOPHYTA (ferns)	
DENNSTAEDIACEAE	
Asplenium aff. flabellifolium	
Pteridium esculentum	'bracken fern'
ADIANTACEAE	
Adiantum aethiopicum	'maiden hair fern'
Cheilanthes austro-tennuifolia	'rock fern'
Cheilanthes sp. CK12	
GYMNOPHYTA (cycads)	
ZAMIACEAE	
Macrozamia riedlei	'zamia palm'
ANGIOSPERMAE (flowering plants)	
MONOCOTYLEDONS	
TYPHACEAE	
Typha orientalis	'bullrush'
RUPPIACEAE	
Ruppia megacarpa	
JUNCAGINACEAE	
Triglochin calcitrapa	'spurred arrowgrass'
Triglochin mucronata	
Triglochin trichophora	
POACEAE	
Agrostis avenacea	'blown grass'
* Aira cal ophylla	'silvery hair grass'
* Ammophila arenaria	'marram grass'
* Avellinia michelii	
* Avena barbata	'bearded oat'
* Avena ?fatua	'wild oat'
* Briza maxima	'large quaking grass'
* Briza minor	'shivery grass / lesser quaking grass
* Bromus diandrus	
* Bromus hordeaceus	
* Bromus madridensis	'madrid brome'
Danthonia caespitosa	
Dichelachne crinita	'long hair plume grass'
* Ehrharta longiflora	'annual veldt grass'
* Hordeum glaucum	
* Hordeum leporinum	
* Lagurus ovatus	'harestail grass'
* Lolium perenne	'perennial rye grass'
* Lolium rigidum	'wimmera rye grass'

CENTROLEPIDACEAE

	Aphelia drummondii	

JUNCACEAE

	Juncus caespititious	
	Juncus ?holoschoenus	'joint leaf rush
	Juncus kraussii	
	Juncus kraussii ssp. australiensis	
	Juncus pallidus	'giant rush'
	Luzula meridionalis	'woodrush'

LILIACEAE (Sensu latu)

	Acanthocarpus preissi	'prickle lily'
	Agrostocrinium scabrum	
	Borya nitida	'pincushion plant'
	Bulbine semibarbata	'leek lily'
	Burchardia umbellata	'milk maids'
	Caesia parviflora	
	Chamaescilla corymbosa	'blue squill'
	Dasypogon bromeliifolius	
	Dasypogon hookeri	'pineapple bush'
	Dianella revoluta	'flax lily'
	Kingia australis	'black gin'
	Johnsonia lupulina	'hooded lilly'
	Laxmania sessiliflora	'nodding lily'
	Lomandra caespitosa	'tufted mat-rush'
	Lomandra endlicheri	
	Lomandra ? maritima	
	Lomandra micrantha	'small flower mat-rush'
	Lomandra nigricans	
	Lomandra pauciflora	
	Lomandra preissii	
	Lomandra sericea	
	Lomandra suaveolens	
	Phlebocarya ciliata	
	Sowerbaea laxiflora	'purple tassles / vanilla lily'
	Stypandra grandiflora	'candyup poison'
	Thysanotus arenarius	
	Thysanotus multiflorus	'many flowered fringe lily'
	Thysanotus patersonii	'common twining fringe lily'
	Thysanotus sparteus	
*	Trachyandra divaricata	
	Tricoryne elatior	'yellow autumn lily'
	Wurmbea dioica	'early nancy'
	Xanthorrhoea gracile	'slender blackboy'
	Xanthorrhoea preissii	'common blackboy'

HAEMODORACEAE

	Anigozanthos manglesii	'common / Mangle's kangaroo paw'
	Anigozanthos rufus	
	Conostylis aculeata	
	Conostylis setigera	'bristly conostylis'
	Haemodorum laxum	
	Haemodorum simplex	
	Haemodorum spicatum	

	Microlaena stipoides	'weeping / rice grass'
	Neurachne alopecuroidea	
*	Paspalidium paspalodes	
*	Poa annua	'annual poa / winter grass'
	Poa drummondiana	'shaking grass'
*	Polypogon monspeliensis	'beard grass'
	Spinifex hirsutus	'hairy spinifex'
	Spinifex longifolius	'long-leaved spinifex'
	Sporobolus virginicus	'sand couch'
*	Stenotaphrum secundatum	'buffalo grass'
	Stipa compressa	
	Stipa elegantissima	
	Stipa flavescens	
	Stipa hemipogon	
*	Vulpia bromoides	'sqirrel tail fescue'
*	Vulpia membranacea	
*	Vulpia myuros	'rats tail fescue'

CYPERACEAE

	Anarthria prolifera	
	Baumea articulata	'jointed twig rush'
	Baumea vaginalis	'sheath twig rush'
	Carex divisa	
	Carex inversa	'knob sedge'
	Cyperus ?alterniflorus	
	Cyperus tenuiflorus	
	Cyathochaeta clandestina	
	Empodisma gracillima	
	Gahnia trifida	'coast saw sedge'
	Isolepis nodsus	'knotted club rush'
	Lepidosperma angustatum	
	Lepisosperma gladiatum	'coast sword sedge'
	Lepidosperma gracile	'slender sword sedge'
	Lepidosperma cf. leptostachyum	
	Lepidosperma longitudinale	'common sword sedge'
	Lepidosperma pubisquameum	
	Lepidosperma tetraquetrum	
	Mesomelaena stygia	'semaphore sedge'
	Schoenus curvifolius	
	Schoenus grandiflorus	'large flowered bog-rush'
	Schoenus ?lanatus	
	Schoenus nanus	
	Scirpus margintaus	
	Scirpus maritimus	'marsh club rush'
*	Scirpus prolifer	'budding club rush'
	Tetrariopsis octandra	

ARACEAE

*	Zantedeschia aethiopica	'arum lily'

RESTIONACEAE

	Leptocarpus ?canus	
	Loxocarya cinerea	
	Loxocarya fasciculata	
	Loxocarya flexuosa	
	Loxocarya pubescens	
	Loxocarya sp. B (Metro Region Key) CK317	
	Lyginia barbata	

IRIDACEAE		
	Orthrosanthus laxus	'morning iris'
	Patersonia ?juncea	'rush-leaved patersonia'
	Patersonia occidentalis	'purple flags' / 'native iris'
	Patersonia pygmaea	
	Patersonia umbrosa var. xanthina	'yellow flags' / 'wild iris'
*	Romulea rosea	'onion / Guildford grass'
*	Romulea rosea var australis	" " "
*	Sparaxis grandiflora	
ORCHIDACEAE		
	Caladenia filamentosa	
	Caladenia flava	'cowslip orchid'
	Caladenia huegelii	
	Caladenia latifolia	'pink fairy orchid'
	Caladenia macrostylis	'leaping spider orchid'
	Caladenis marginata	
	Caladenia patersonii var. longicauda	'white spider orchid'
	Caladenia pectinata	
	Diuris longifolia	'common donkey orchid'
	Erythranthera brunonis	'purple enamel orchid'
	Eriochilus dilatatus	'white bunny orchid'
	Lyperanthus serratus	
	Prasophyllum sp.	'leek orchid' TINGAY (1980)
	Pterostylis barbata x plumosa	
	Pterostylis nana	'dwarf greenhood orchid'
	Pterostylis scabra	
	Pterostylis vittata	'banded greenhood orchid'
	Thelymitra crinita	'blue lady orchid'
	Thelymitra villosa	'custard orchid'
CASUARINACEAE		
	Allocasuarina fraseriana	'sheoak'
	Allocasuarina humilis	'scrub sheoak'

DICOTYLEDONS

URTICACEAE		
	Parietaria debilis	'forest pellitory'
PROTEACEAE		
	Adenanthos barbigerus	
	Adenanthos meisneri	'hairy jug flower'
	Banksia attenuata	
	Banksia grandis	'bull banksia'
	Banksia littoralis	'swamp banksia'
	Conospermum petiolare	
	Conospermum stoechadis	'smoke grass'
	Dryandra bipinnatifida	
	Dryandra nivea	'couch honeypot'
	Dryandra sessilis	'parrot bush'
	Franklandia triaristata	
	Grevillea ? flexuosa	
	Grevillea thelemanniana	'spider net grevillea'
	Grevillea vestita	

	Hakea amplexicaulis	'prickly hakea'
	Hakea ceratophylla	
	Hakea lissocarpha	'honey bush'
	Hakea oleifolia	
	Hakea prostrata	'harsh hakea'
	Hakea ruscifolia	'candle / spike hakea'
	Hakea trifurcata	
	Hakea ?varia	'variable leafed hakea'
	Isopogon sphaerocephalus	
	Persoonia elliptica	
	Persoonia graminea	
	Persoonia longifolia	'long leaf persoonia'
	Petrophile linearis	'narrow-leaved conebush'
	Petrophile striata	
	Stirlingia latifolia	'blue boy'
	Synaphea linearis	
	Synaphea petiolaris	
	Xylomelum occidentale	'woody pear'
SANTALACEAE		
	Exocarpus sparteus	'broom ballart'
	Exocarpos odoratus	
	Leptomeria sp. (possibly nov. sp.)	TINGAY & TINGAY (1980)
	Santalum acuminatum	'pale quandong' / 'sandalwood'
LORANTHACEAE		
	Nuytsia floribunda	'West Australian Christmas tree'
POLYGONACEAE		
*	Emex australis	'double gee'
	Muehlenbeckia adpressa	'climbing lignum'
*	Rumex acetosella	'sheep sorrel'
*	Rumex conglomeratus	'clustered dock'
*	Rumex obrusifolia	
CHENOPODIACEAE		
	Atriplex cinereum	'coast salt bush'
	Atriplex isatidea	
	Atriplex paludosa	
*	Chenopodium glaucum	'pale goosefoot'
*	Chemopodium murale	
	Halosarcia ? halocnemoides	
	Halosarcia indica ssp. bidens	
	Halosarcia pergranulata	
	Halosarcia syncarpa	
	Rhagodia baccata	'berry saltbush'
	Rhagodia radiata V & E	
	Sarcocornia blackiana	
	Sarcocornia quinquiflora	
	Suaeda australis	'sea blite'
	Threlkeldia diffusa	
AMARANTACEAE		
	Ptilotus drummondii	
	Ptilotus stirligii var. stirlingii	
AIZOACEAE		
	Carprobrotus sp. CK104	'pigface'

	Tetragonia decumbens	'sea spinach'
	Tetragonia implexicoma	'bower spinach'
	PORTULACACEAE	
	Calandrinia brevipedata	
	Calandrinia calyptrata	'pink purselane'
	Calandrinia liniflora	
	CARYOPHYLLACEAE	
*	Cerastium glomeratum	'mouse ear chickweed'
*	Petrorhagia nanteuilii	
*	Polycarpon tetraphyllum	'four-leaved all seed'
*	Silene gallica	'Frenh cath fly'
*	Stellaria media	'chickweed'
*	Tunica prolifera	
	RANUNCULACEAE	
	Clematis microphylla	'old man's beard / small leaved clematis'
	Clematis pubescens	
	Ranunculus colonorum	
*	Ranunculus sessiliflorus	
	LAURACEAE	
	Cassytha ? glabella	'dodder'
	FUMARIACEAE	
*	Fumaria officinalis	
	BRASSICACEAE	
*	Brassica rapa	
*	Brassica tournefortii	
*	Cakile maritima	'sea rocket'
*	Heliophila pusilla	
*	Raphanus raphanistrum	'wild radish'
	Stenopetalum robustum	
	DROSERACEAE	
	Drosera erythorhiza	'red-ink sundew'
	Drosera gigantea	'giant sundew'
	Drosera glanduligera	'scarlet sundew'
	Drosera menziesii	
	Drosera pallida	'pale sundew'
	Drosera stolonifera	
	Drosera stricticaulis	
	CRASSULACEAE	
	Crassula colorarta	'dense stone crop'
*	Crassula glomerata 319	
	Crassula pedicellosa	
	PITTOSPORACEAE	
	Billardiera candida	
	Billardiera erubescens	
	Billardiera floribunda	
	Billardiera variifolia	
	Pittosporum phillyraeoides var. phillyraeoides	'weeping pittosporum'

ROSACEAE

*	Acaena agnipila	

MIMOSACEAE

	Acacia alata	'winged wattle'
	Acacia cochlearis	'rigid wattle'
	Acacia cyclops	
	Acacia decipiens	
	Acacia divergens	
	Acacia extensa	
	Acacia leioderma	
	Acacia littorea	
	Acacia mooreana	
	Acacia nervosa	'rib wattles'
	Acacia pulchella var. pulchella	'prickly moses'
	Acacia rostellifera	
	Acacia saligna	
	Acacia semitrullata	
	Acacia stenoptera	

Hnatiuk and Maslin (1980) record 24 species of Acacia for 1: 25.000 Grid cell NO. 273 and 33 species for Grid Cell No. 274. The study area includes parts of these two grid cells and it is probable that some of thees species they record are in parts of the study area.

CESALPINACEAE

	Labichea punctata	

PAPILIONACEAE

	Aotus cordifolia	
	Bossiaea eriocarpa	
	Bossiaea linophylla	
	Bossiaea ornata	
	Brachysema praemorsum	
	Chorizema apiculare	
	Chorizema diversifolium	
	Chorizema glycinifolium	
	Chorizema ilicifolium	'holly flame pea'
	Chorizema rhombeum	
	Daviesia cordata	'bookleaf pea'
	Daviesia divaricata	
	Daviesia longifolia	
	Daviesia pectinata	'thorny bitter-pea'
	Daviesia ?preissii	
	Daviesia sp. CK56	
	Dillwynia cinerascens	
	Eutaxia virgata	
	Gastrolobium spinosum	
	Gastrolobium sp. CK175	
	Gompholobium ?capitatum	
	Gompholobium knightianum	
	Gompholobium ovatum	
	Gompholobium polymorphum	
	Gompholobium preissii	
	Gompholobium tomentosum	
	Hardenbergia comptoniana	'native wisteria'
	Hovea chorizemifolia	'holly leaved hovea'
	Hovea elliptica	'tree hovea'
	Hovea trisperma	'common hovea'

	Jacksonia furcellata	
	Jacksonia horrida	
	Kennedia carinata	
	Kennedia coccinea	'coral vine'
	Kennedia prostrata	'red-runner / running postman'
*	Lotus suaveolens	
*	Lotus subbiflorus	
*	Lupinus cosentinii	
*	Medicago polymorpha	'burr medick'
*	Medicago sp.	'medick'
*	Melilotus alba	
*	Melilotus indica	'common melilot'
	Mirbelia dilatata	
*	Ornithopus compressus	
	Oxylobium lanceolatum	
	Pultaena drummondii	
	Pultaena radiata	
	Pultenaea reticulata	
	Sphaerolobium medium	
	Templetonia retusa	'cockies tongue'
*	Trifolium campestre	'hop clover'
*	Trifolium fragiferum	'strawberry clover'
*	Trifolium glomeratum	'clustered clover'
*	Trifolium subterraneum	'subterraneum clover'
*	Vicia sativa	'common vetch'
	Viminaria juncea	'golden spray'

GERANIACEAE

*	Erodium botrys	'long stork's bill'
*	Erodium cicutarium	'commmon crow foot'
*	Erodium moschatum	'musky crow foot'
*	Geranium molle	'crane's bill gearanium'
*	Pelargonium capitatum	'beach geranium'
	Pelargonium littorale	

OXALIDACEAE

	Oxalis corniculata	'creeping wood-sorrel'

RUTACEAE

	Boronia alata	
	Boronia dichotoma 68	
	Boronia molloyae 97	
	Boronia tenuis 60 (GAZETTED RARE)	
	Diplolaena dampieri	'southern diplolaena'
	Eriostemon spicatus	

TREMANDRACEAE

	Tertatheca hirsuta	

POLYGALACEAE

	Comesperma ciliatum	
	Comesperma confertum	
	Comesperma virgatum	

EUPHORBIACEAE

	Adriana quadripartita	
	Beyeria viscosa	
*	Euphorbia paralias	

* Euphorbia peplus
* Euphorbia terracina
Phyllanthus calycinus
Phyllanthus ciccoides
Phyllanthus crassifolius
Poranthera microphylla
Pseudanthus virgatus

STACKHOUSIACEAE
Stackhousia huegelii

SAPINDACEAE
Dodonaea aptera
Dodonaea ceratocarpa

RHAMNACEAE
Cryptandra arbutiflora

STERCULIACEAE
Rulingia cygnorum
Thomasia foliosa
Thomasia ? pauciflora

DILLENIACEAE
Hibbertia commutata
Hibbertia cuneiformis 'cut-leaf hibbertia'
Hibbertia cunninghamii
Hibbertia grossularifolia
Hibbertia hypericoides 'yellow buttercups'
Hibbertia perfoliata
Hibbertia racemosa
Hibbertia serrata
Hibbertia sp. CK159
Hibbertia sp. CK162

FRANKENIACEAE
Frankenia pauciflora

VIOLACEAE
Hybanthus calycinus

THYMELACEAE
Pimelea angustifolia
Pimelea ferruginea
Pimelea imbricata var. piligera
Pimelea rosea
Pimelea suaveolens
Pimelea cf. suaveolens
Pimelea sylvestris

MYRTACEAE
Agonis flexuosa 'coastal peppermint'
Agonis linearifolia
Astartea fascicularis
Beaufortia sparsa
Calothamnus graniticus ssp. graniticus
Calothamnus sanguineus

	Calytrix flavescens	
	Darwinia citriodora	
	Darwinia vestita	
	Eucalyptus calophylla	'marri' / 'redgum'
	Eucalyptus cornuta	'yate'
	Eucalyptus decipiens	'redheart'
	Eucalyptus diversicolor	'karri'
	Eucalyptus gomphocephala	'tuart'
	Eucalyptus marginata	'jarrah' / 'stringybark'
	Eucalyptus patens	
	Eucalyptus rudis	'flooded gum'
	Eucalyptus xylomelum	
	Homalospermum firmum	
	Hypocalymma angustifolium	
	Hypocalymma ?angustifolium	'white myrtle'
	Hypocalymma robustum	'Swan River myrtle'
	Kunzea preissiana	
	Kunzea recurva	
*	Leptospermum laevigatum	
	Melaleuca acerosa	
	Melaleuca cuticularis	'salt water paperbark'
	Melaleuca hamulosa	
	Melaleuca huegelii	'chenille honeypot'
	Melaleuca incana	'grey honey-myrtle'
	Melaleuca lanceolata	'Rottnest Ti-tree' / 'Moonah'
	Meleleuca laterita	'robin red-breast bush'
	Melaleuca preissiana	'swamp paperbark'
	Melaleuca rhaphiophylla	
	Melaleuca thymoides	
	Melaleuca uncinata	'broom honey myrtle'
	Thryptomone saxicola	
	Verticordia plumosa	
ONAGRACEAE		
	Epilobium billardierianum billardierianum	'glabrous willow herb'
	Epilobium billardierianum cinereum	'glabrous willow herb'
	Epilobium hirtegerum	'willow herb'
HALORAGACEAE		
	Myriophyllum salsugineum	
APIACEAE		
	Apium annuum	
	Apium prostratum ssp. prostratum	
	Centella asiatica	
*	Centella cordifolia	
	Daucus glochidiatus	
	Eryngium pinnatifidum	
	Eryngium rostratum	
	Homalosciadium homalocarpum	
	Hydrocotyle callicarpa	
	Hydrocotyle diantha	
	Hydrocotyle tetragonocarpa	
	Pentapeltis peltigera	
	Trachymene pilosa	
	Xanthosia candida	
	Xanthosia pusilla	

EPACRIDACEAE
- Andersonia caerulea
- Andersonia involucrata
- Astroloma ciliatum
- Astroloma drummmondii
- Astroloma pallidum
- Leucaopogon australis
- Leucopogon capitellatus
- Leucopogon parviflorus
- Leucopogon propinquus
- Leucopogon tenuis
- Lysinema ciliatum
- Styphelia tennuifolia

PRIMULACEAE
- Samolus junceus

LOGANIACEAE
- Logania serpyllifolia
- Logania vaginalis
- Mitrasacme paradoxa

GENTIANACEAE
- * Centaurian erytheraea

MENYANTHACEAE
- Villarsia albiflora
- Villarsia ? latifolia
- Villarisa parnassifolia

APOCYNACEAE
- Alyxia buxifolia

CONVOLVULACEAE
- * Calystegia sepium — 'milk convolvulus'
- Dichondra repens
- Wilsonia humilis

LAMIACEAE
- Hemiandra pungens
- Hemigenia incana
- * Menthapulegium sp. — 'penny royal'

SOLANACEAE
- * Solanum nigrum — 'deadly nightshade'
- * Solanum sodomeum

SCROPHULARIACEAE
- * Bellardia trixago
- * Dischisma arenarium
- * Parentucellia latifolia
- * Parentucellia viscosa
- * Verbascum virgatum

OROBANCHACEAE
- Orobanche minor

MYOPORACEAE
Eremophila glabra
Myoporum tetrandrum

PLANTAGINACEAE
* Plantago debilis
* Plantage lanceolata

RUBIACEAE
* Galium murale
Opercularia hispidula
Opercularia vaginata
* Sherardia arvensis

CUCURBITACEAE
* Citrullus lanatus 'wild watermelon'

LOBELIACEAE
Isotoma hypocrateriformis 'Woodbridge poison'
Lobelia alata 'lesser loose trife'
Lobelia rhytidosperma
Lobelia tenuior

GOODENIACEAE
Dampiera alata 'winged-stem dampiera'
Dampiera linearis 'narrow leaved dampiera'
Dampiera hederacea
Lechenaultia biloba
Scaevola crassifolia
Scaevola microphylla
Scaevola nitida
Scaevola sp. CK214

STYLIDIACEAE
Levenhookia pusilla
Levenhookia stipitata
Stylidium adnatum
Stylidium amoenum
Stylidium breviscapum
Stylidium bulbiferum
Stylidium calcaratum
Stylidium crassifolium
Stylidium diversifolium
Stylidium junceum
Stylidium pilosum
Stylidium ?repens
Stylidium striatum

ASTERACEAE
Actites megalocarpa
* Arctotheca calendula
Athrixia pulverulena
Brachycome goniocarpa
Brachycome iberidifolia
Calocephalus brownii
* Carduus pycnocephalus
* Carduus tenuiflorus
Cotula australis

	Cotula coronopifolia	'water buttons'
*	Cotula turbinata	
	Cotula uniflora	
	Craspedia uniflora	
*	Dittrichia graveolens	
	Helichrysum filifolium	
	Helychrysum sp. CK139	
	Helipterum cotula	
*	Hypochoeris glabra	
	Lagenifera heugelii	
*	Leontodon taraxacoides	
	Leptorhynchos elongatus	
	Millotia myosotidifolia	
	Millotia tenuifolia	
	Olearia axillaris	
	Olearia ciliata	
	Podolepis lessonii	
	Podotheca angustifolia	
	Senecio lautus	
*	Sonchus oleraceus	'common sow-thistle'
	Waitzia citrina	

APPENDIX TWO VEGETATION TYPES:- FORREST BEACH - CAPE NATURALISTE - WOODLANDS VEGETATION SURVEY

(a) TAMALA LIMESTONE / CALCARENITE

SH3 Olearia axillaris, Scaevola crassifolia, Acanthocarpus preissii, Rhagodia baccata, Acacia decipiens, Calocephalus browmii LOW OPEN HEATH

SH1 Spyridium globulosum, Olearia axillaris, Acacia rostellifera CLOSED HEATH

SH2 Boronia alata, Spyridium globulosum, Olearia axillaris CLOSED HEATH

SH6 Scaevola nitida, Exocarpos sparteus LOW-MEDIUM CLOSED HEATH

SH0 Acacia rostellifera, Spyridium globulosum, Thryptomene saxicola OPEN HEATH

SH9 Allocasuarina humilis, Melaleuca acerosa, Olearia axillaris LOW CLOSED HEATH

SH8 Acacia rostellifera, Agonis flexuosa, Thryptomene saxicola CLOSED SCRUB

SH7 Hibbertia cuneiformis, Thryptomene saxicola, Allocasuarina humilis LOW OPEN HEATH

LH1 Melaleuca lanceolata, M. huegelii CLOSED HEATH - CLOSED SCRUB

LH2 Melaleuca lanceolata CLOSED HEATH

LH4 Melaleuca huegelii CLOSED HEATH

DH3 Dryandra sessilis CLOSED HEATH

LH3 Acacia divergens, Melaleuca huegelii, Dryandra sessilis CLOSED SCRUB

Ad Acacia divergens CLOSED SCRUB

LH6 Melaleuca huegelii CLOSED SCRUB

DH2 Dryandra sessilis, Agonis flexuosa CLOSED SCRUB

M2 Melaleuca huegelii CLOSED SCRUB

M1 Melaleuca lanceolata LOW CLOSED FOREST - CLOSED FOREST

AgDaMJ Agonis flexuosa, Dryandra sessilis, Eucalyptus calophylla, E. marginata SCRUB

AW2 Agonis flexuosa, Eucalyptus calophylla, E. Marginata LOW WOODLAND

AgBaM2 Agonis flexuosa, Banksia attenuata, Melaleuca huegelii WOODLAND

(b) GRANULITE

GH4 Spyridium globulosum, Pimelea ferruginea, Acacia decipiens, Scaevola crassifolia LOW HEATH

GH1 Calothamnus graniticus ssp. graniticus OPEN - CLOSED HEATH

AgCg Agonis flexuosa, Calothamnus graniticus ssp. graniticus CLOSED SCRUB

St4 Agonis flexuosa, Eucalyptus calophylla, E. marginata LOW WOODLAND

AgM Agonis flexuosa, Eucalyptus calophylla LOW WOODLAND

GH5 Thryptomene saxicola, Melaleuca acerosa, Pimelea ferruginea LOW OPEN HEATH

Ah Allocasuarina humilis, Thryptomene saxicola, Dodonaea ceratocarpa, Calothamnus graniticus ssp. graniticus LOW SHRUBLAND

(c) LATERITIZED GRANULITE

Dr Drosera gigantea, Stylidium crassifolium CLOSED HERBLAND

Htr2 Hakea trifurcata, Allocasuarina humilis LOW CLOSED HEATH

Htr Hakea trifurcata CLOSED SCRUB

GH2 Hakea trifurcata, Gompholobium spinosa CLOSED HEATH

XH Xanthorrhoea preissii, Hakea trifurcata, Allocasuarina humilis CLOSED HEATH

XH2 Xanthorrhoea preissii HEATH

P2 Acacia saligna CLOSED HEATH

M1Vj Melaleuca lasceolata, Viminaria juncea CLOSED SCRUB

St1 Eucalyptus calophylla, E. marginata LOW WOODLAND

St2 Eucalyptus calophylla, E. marginata LOW WOODLAND

St3 Eucalyptus calophylla, E. marginata LOW WOODLAND

AW8 Agonis flexuosa, Eucalyptus calophylla, E. marginata LOW WOODLAND

MGr Eucalyptus calophylla WOODLAND

MBaAg+J Eucalyptus calophylla, Agonis flexuosa, Banksia attenuata CLOSED WOODLAND

AgM/meg Agonis flexuosa, Eucalyptus calophyllla WOODLAND

MJ/Bg Eucalyptus calophylla, E. marginata WOODLAND

AJM1/AW1 Eucalyptus calophylla WOODLAND

Marri 1 Eucalyptus calophylla WOODLAND

MJ/Xp1 Eucalyptus calophylla, E. marginata WOODLAND

JM/Xp2 Eucalyptus marginata, E. calophylla OPEN FOREST

JXo Eucalyptus marginata, Xylomelum occidentale LOW FOREST

M1/Ag Melaleuca lanceolata, Agonis flexuosa LOW OPEN FOREST - FOREST

MegM Eucalyptus megacarpa, E. calophylla WOODLAND

MJ/Ki Eucalyptus calophylla, E. marginata, Banksia grandis, Nuytsia floribunda LOW OPEN FOREST

BaAgJM Banksia attenuata, Agonis flexuosa, Euc. marginata, E. calophylla LOW OPEN FOREST

Allo4 Allocasuarina fraseriana, Banksia grandis, B. attenuata LOW OPEN FOREST

Blitt Banksia littoralis, B. grandis, Agonis flexuosa LOW OPEN FOREST

JM2 Eucalyptus marginata, E. calophylla FOREST

JM3 Eucalyptus marginata, E. calophylla OPEN FOREST

MJ/Ag1 Eucalyptus calophylla, E. marginata, Agonis flexuosa FOREST

MJAg2 Eucalyptus calophylla, E. marginata, Agonis flexuosa FOREST

J1 Eucalyptus marginata FOREST

Y Eucalypta calophylla, E. cornuta, E. marginata OPEN FOREST

J2 Eucalyptus marginata OPEN FOREST

J5 Eucalyptus marginata OPEN FOREST

AlloMJ1 Allocasuarina fraseriana, Eucalyptus calophylla, E. marginata OPEN FOREST

JM1 Eucalyptus marginata, E. calophylla OPEN FOREST

Er1M Eucalyptus rudis, E. calophylla OPEN FOREST

Er2M Eucalyptus rudis, E. Calophylla OPEN FOREST

Allo 1 Allocasuarina fraseriana, Banksia grandis, B. attenuata, Eucalyptus marginata, E. calophylla OPEN FOREST

Allo2 Allocasuarina fraseriana, Euc. marginata, E. calophylla, Nuytsia floribunda, Banksia grandis LOW CLOSED FOREST

MJ/BgBa Eucalyptus calophylla, E. marginata OPEN FOREST

M/Ag Eucalyptus calophylla OPEN FOREST

AgMEr Agonis flexuosa, Eucalptus calophylla, E. rudis CLOSED FOREST

J3 Eucalyptus marginata FOREST

(e) MODERN COAST

D1 Cakile maritima, Arctotheca calendula OPEN HERBLAND

D2 Spinifex hirsutus, S. longifolius OPEN GRASSLAND

D3 *Ammophila arenaria TUSSOCK GRASSLAND

D4 Acacia cochlearis, A. cyclops, Scaevola crassifolia OPEN HEATH

D5 Agonis flexuosa OPEN SCRUB to LOW OPEN WOODLAND

JM/BaBg2 Eucalyptus marginata, E. calophylla CLOSED FOREST

MJP1 Eucalyptus calophylla, E. marginata FOREST

Allo5 Allocasuarina fraseriana, Banksia attenuata, Eucalyptus marginata FOREST

AW0 Agonis flexuosa CLOSED FOREST

K Eucalyptus diversicolor CLOSED FOREST

(d) PERTH BASIN SEDIMENTS

My Myriophyllum salsugineum AQUATIC HERBFIELD

Hal Sarcocornia quinqueflora, Halosarcia indica ?bidens, Halosarcia pergranulata LOW OPEN HEATH - LOW SHRUBLAND

HhTd Halosarcia halocnemoides, Threlkeldia diffusa LOW CLOSED HEATH

Jk Juncus kraussii, Isolepis nodosus CLOSED SEDGELAND

TyJk Typha orientalis, Juncus kraussii CLOSED SEDGELAND

S5 Melaleuca cuticularis, M. hamulosa OPEN WOODLAND

S4 Melaleuca cuticularis, M. hamulosa, Agonis flexuosa LOW OPEN WOODLAND

S6 Agonis flexuosa LOW OPEN WOODLAND

AW Agonis flexuosa LOW OPEN FOREST

AwAd Agonis flexuosa WOODLAND with Acacia divergens

McMh Melaleuca cuticularis, M. hamulosa WOODLAND

S2 Melaleuca cuticularis, M. rhaphiophylla, M. preissiana LOW CLOSED FOREST

MpEr Melaleuca preissiana, Eucalyptus rudis CLOSED FOREST

S1 Melaleuca preissiana, M. rhaphiophylla OPEN FOREST

MErMp1 Eucalyptus calophylla, E. rudis, M. preissiana LOW WOODLAND

ErMMr Eucalyptus rudis, E. calophylla, Melaleuca rhaphiophylla WOODLAND

MAg Eucalyptus calophylla WOODLAND

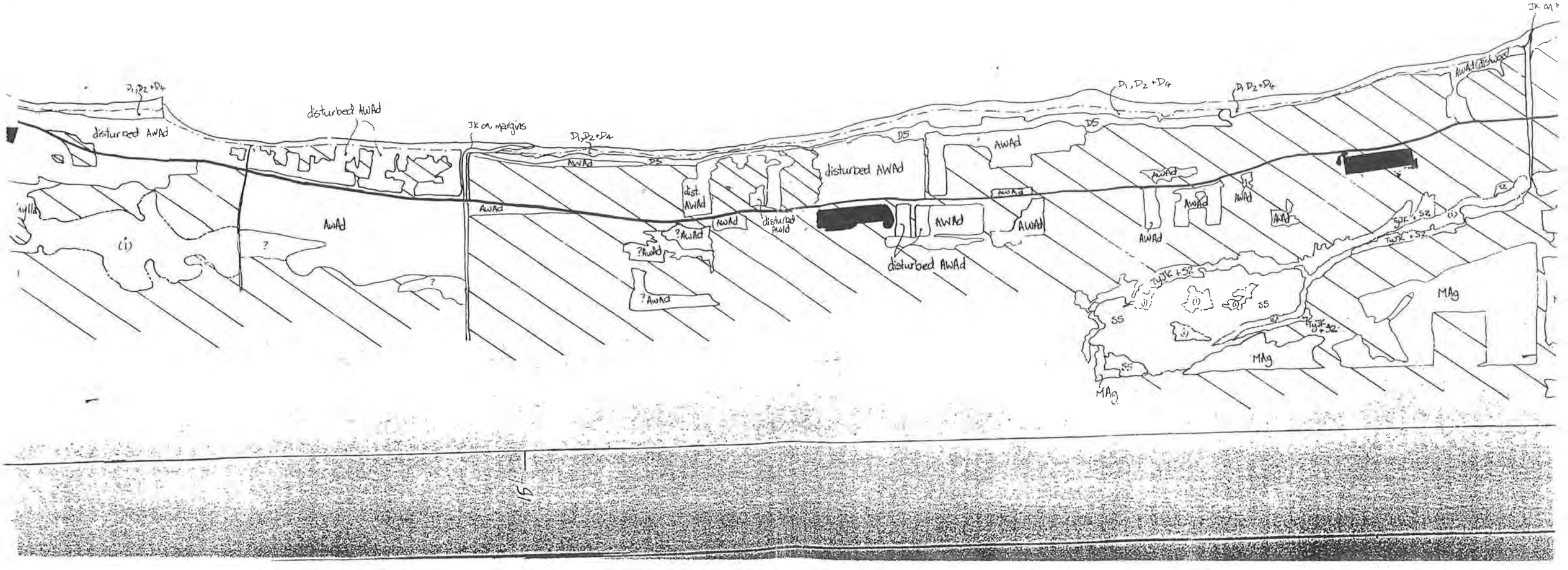
Tuart Eucalyptus gomphocephala HIGH CLOSED FOREST

GB2/5

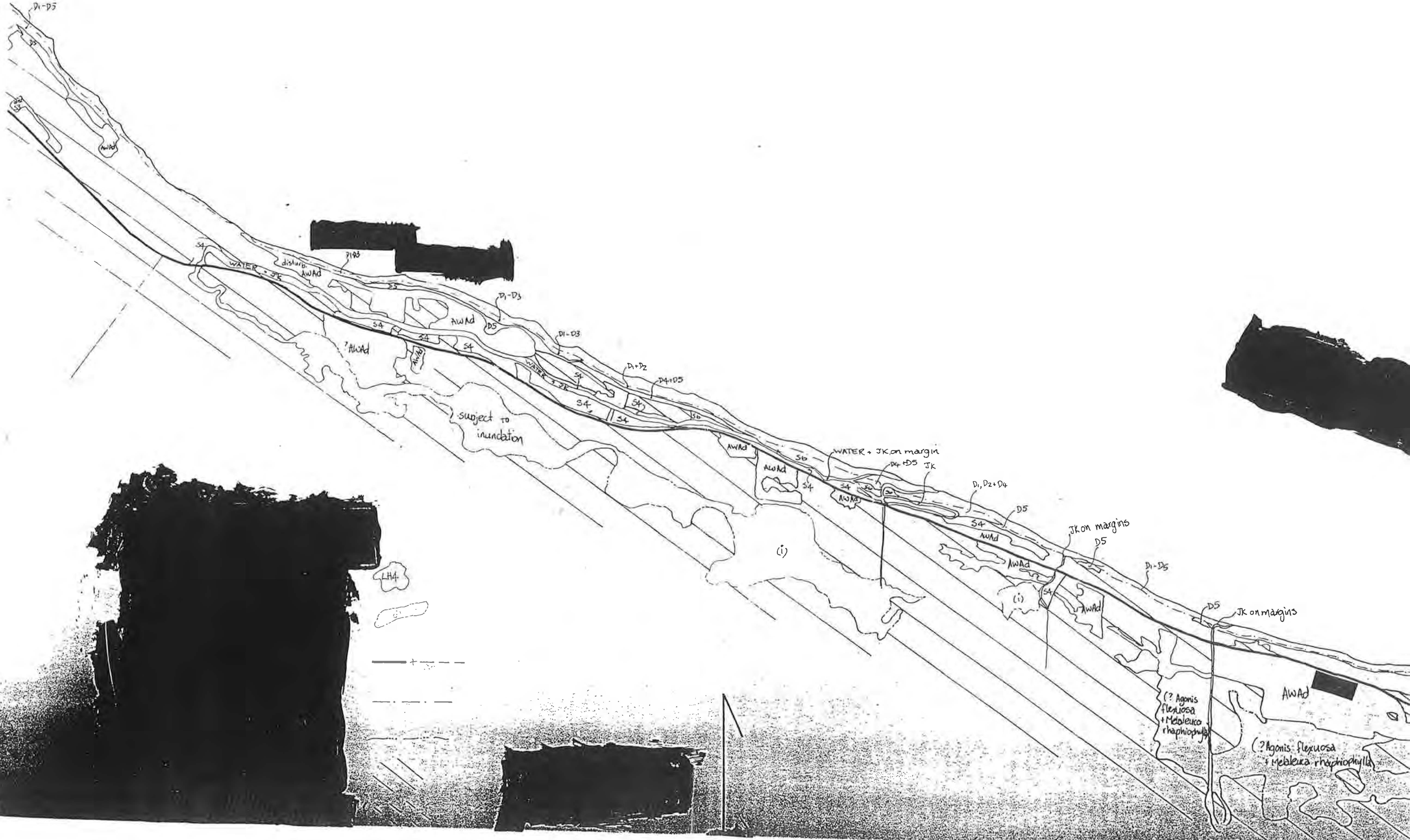
[redacted]

[redacted]

[redacted]

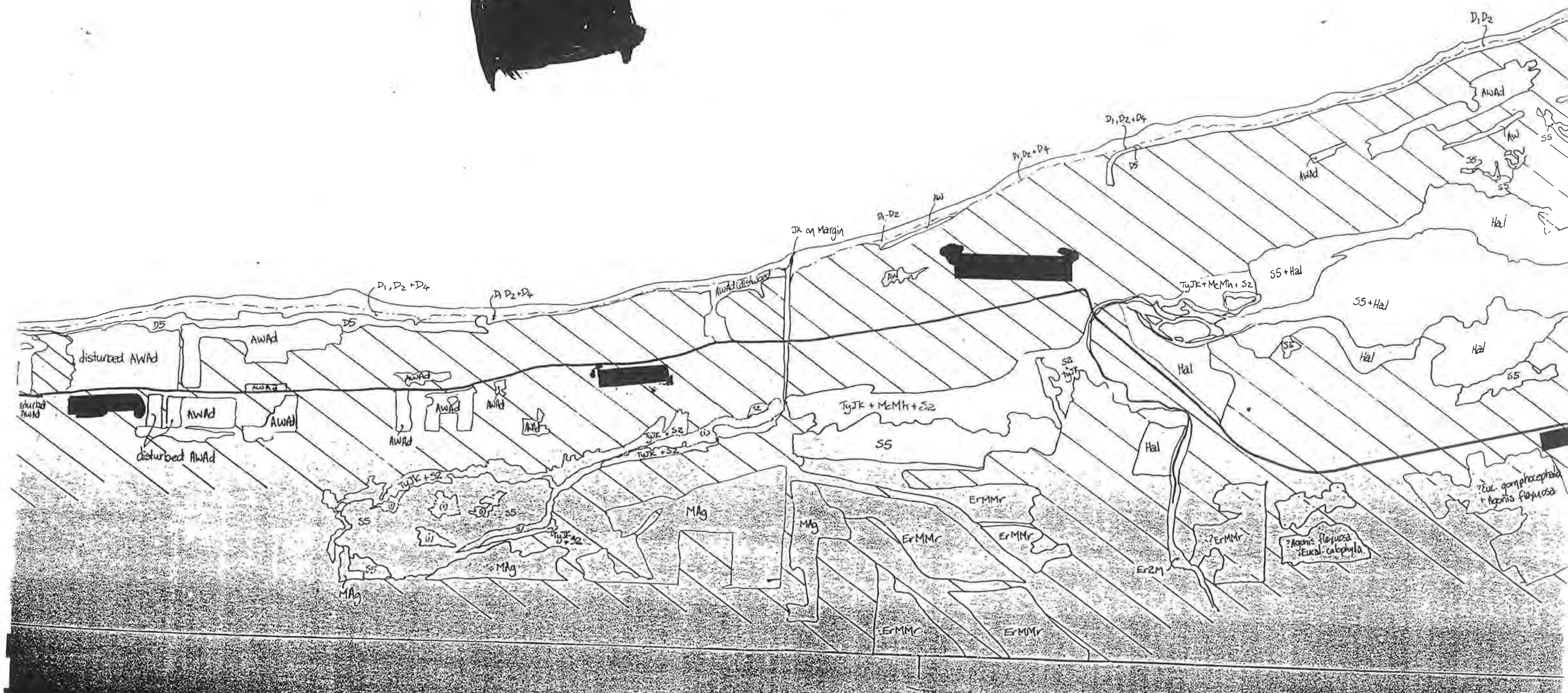


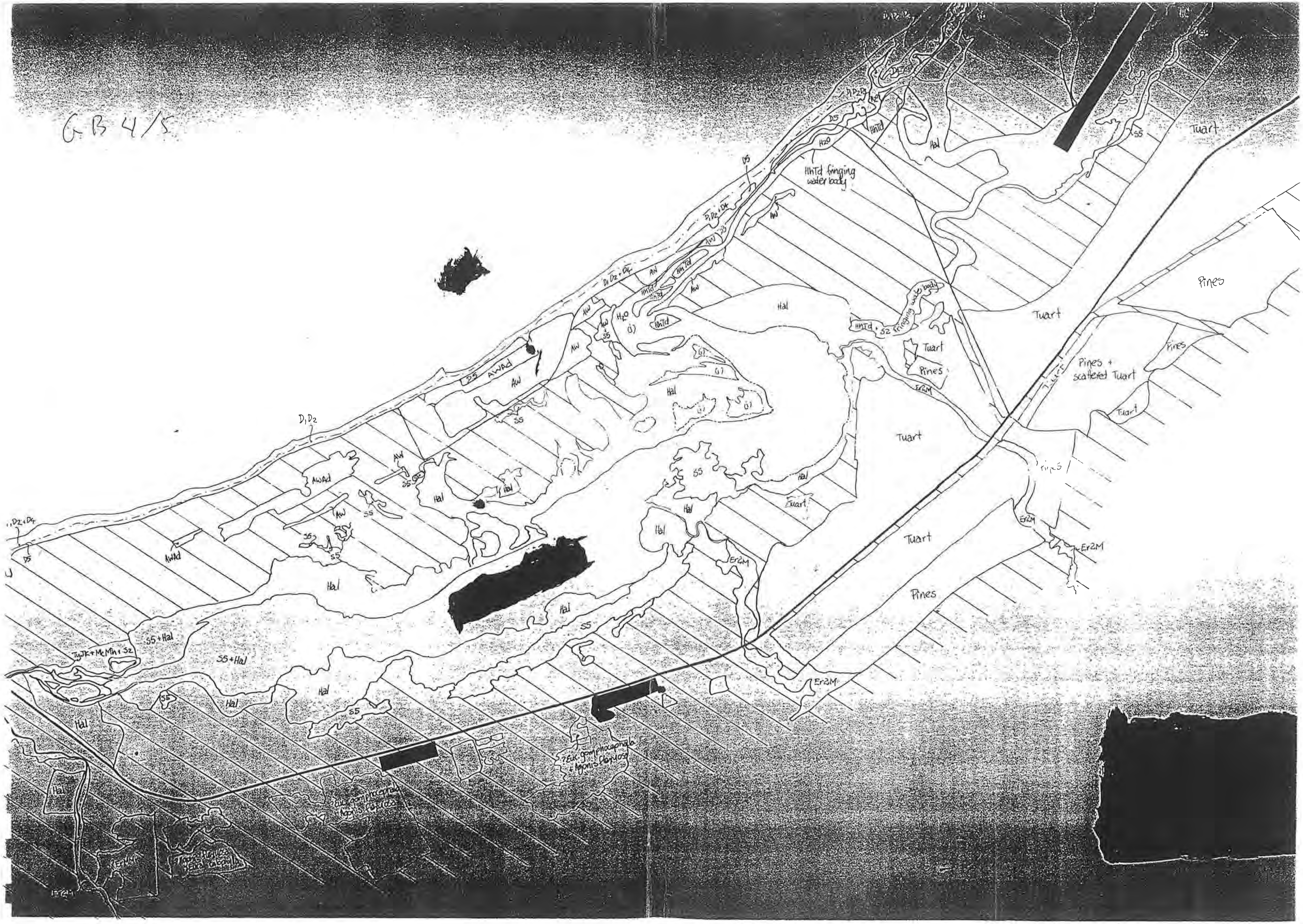
GBY/5

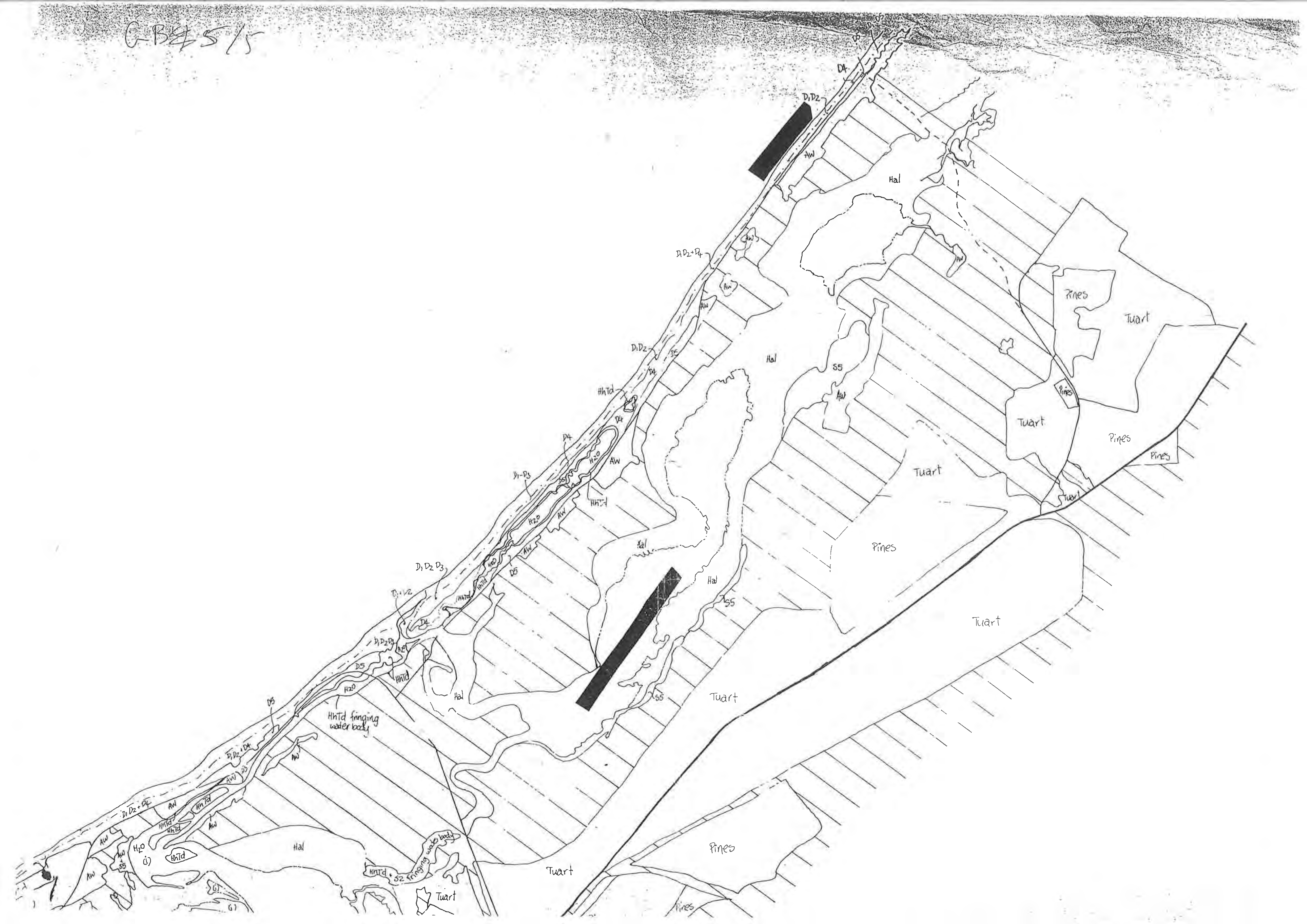

D1-D5
D5
AWAd
S4
WATER + JK
disturb. AWAd
D1-D3
AWAd
D5
?AWAd
D1+D2
D4+D5
subject to inundation
S6
WATER + JK on margin
JK
D1, D2 + D4
JK on margins
(i)
LH4
(? Agonis flexuosa + Melaleuca rhaphiophylla)
[redacted]

GB 3/5

[redacted]


D1,D2
AWAd
AW
S5
D1,D2+D4
D5
AWAd
D1,D2+D4
AW
D1-D2
Hal
JK on Margin
AWAd (disturbed)
S5+Hal
TyJK+McMh+S2
S5+Hal
D1,D2+D4
D1 D2+D4
D5
D5
AWAd
disturbed AWAd
S2
TyJK
Hal
Hal
Hal
S5
disturbed AWAd
AWAd
AWAd
AWAd
AWAd
AWAd
AWAd
TyJK+McMh+S2
S5
Hal
AWAd
TyJK+S2
disturbed AWAd
TyJK+S2
TyJK+S2
?Euc. gomphocephala
+Agonis flexuosa
ErMMr
MAg
S5
S5
MAg
ErMMr
ErMMr
TyJK+S2
?ErMMr
?Agonis flexuosa
+Eucal. calophylla
MAg
S5
Er2M
MAg
ErMMr
ErMMr
1000


GB 4/5
Tuart
Pines
Pines + scattered Tuart
Hal
HhTd fringing water body
HhTd + S2 fringing water body
AW
AWAd
D5
D1 D2
D1 D2 + D4
S5
S5 + Hal
Er2M
H2O
HhTd
TyJk + McMh + S2
?Euc. gomphocephala + Agonis flexuosa



D4
D5
D1D2
AW
Hal
D1D2+D4
S5
Pines
Tuart
HhTd
D1-D3
H2O
D1D2D3
HhTd fringing water body
D1D2+D4
HhTd + S2 fringing water body