not in Endnote LS

DRAFT COASTAL MANAGEMENT PLAN
CAPE KERAUDREN

Department of Conservation and Environment
Perth, Western Australia

Bulletin 250 March 1986

DRAFT COASTAL MANAGEMENT PLAN

CAPE KERAUDREN

C E CHALMERS

Department of Conservation and Environment - Perth

Bulletin 250

March 1986

ACKNOWLEDGEMENTS

Information support and criticism were provided from a number of sources during this study, which must be acknowledged.

Councillors and staff from the Shire of East Pilbara gave advice about Council policy and local attitudes and extensive background information. People from a number of government authorities contributed helpful advice including staff from the Departments Marine and Harbours, Conservation and Land Management, Conservation and Environment, and Agriculture.

Ilona D'Souza undertook the proof reading and editing while Brian Stewart and Tony Berman prepared the report for publication.

ISBN 07309 0491 1
ISSN 0156 -2983

DRAFT COASTAL MANAGEMENT PLAN - CAPE KERAUDREN COASTAL RESERVE

		Page
Coastal Planning in Western Australia		
Summary		vi
1.0	**INTRODUCTION**	1
1.1	BACKGROUND	1
1.2	LOCATION	1
1.3	NAME OF RESERVE AND THE STATUS OF THE AREA	2
1.4	AIMS AND PURPOSE OF THE PLAN	2
2.0	**PLANNING DEVELOPMENT AND MANAGEMENT AIMS**	5
3.0	**THE CAPE KERAUDREN ENVIRONMENT**	5
3.1	PHYSICAL ENVIRONMENT	5
3.1.1	Geology	5
3.1.2	Landforms and physiography	5
3.1.3	Coastal processes	11
3.2	CLIMATE	11
3.3	BIOLOGICAL SYSTEMS	11
3.3.1	Mangroves	12
3.3.2	Salt marshes	15
3.3.3	Dune ridges	15
3.3.4	Central flat	16
3.3.5	Cape Bosut formation	16
3.3.6	Pindan	16
3.4	ABORIGINAL INTERESTS	16
3.5	EUROPEAN HISTORY	16
4.0	**DEVELOPMENT AND MANAGEMENT PLANNING**	18
4.1	LAND USE PLANNING	18
4.2	OPPORTUNITIES	18
4.3	CONSTRAINTS	18
4.4	MANAGEMENT OBJECTIVES	18
4.5	MANAGEMENT UNITS	19
5.0	**DEVELOPMENT PROPOSALS**	21
5.1	ACCESS	21
5.1.1	Main access road	21
5.1.2	Minor access tracks	21
5.2	CAMPING FACILITIES	25
5.2.1	Formal camping	25
5.2.2	Low-key camping	25

		Page
5.3	WATER SUPPLY	25
5.4	LANDSCAPING	30
5.5	SIGNS	30
5.6	BOAT RAMP	30
6.0	**MANAGEMENT ISSUES AND RECOMMENDATIONS**	33
6.1	ACCESS MANAGEMENT	33
6.2	LANDSCAPE PROTECTION	33
6.3	QUARRYING	34
6.4	EXOTIC FLORA AND NOXIOUS PLANT CONTROL	34
6.5	DIEBACK PREVENTION	34
6.6	GARBAGE DISPOSAL	35
6.7	FIRE MANGEMENT	35
6.8	WILDLIFE MANAGEMENT AND RESEARCH	35
6.9	SHELLFISH MANAGEMENT	36
6.10	PUBLIC EDUCATION	36
6.11	MANGROVES	36
6.12	ABORIGINAL SITES	37
6.13	PLACE NAMES	37
7.0	**IMPLEMENTATION**	38
7.1	ROLE OF THE STATE GOVERNMENT	38
7.2	ROLE OF THE LOCAL GOVERNMENT	38
7.3	FUNDING	38
7.4	CROWN LAND VESTING	39
8.0	**REFERENCES**	
	Appendices	

Maps

		Page
1.	Western Australia - Showing areas covered by coastal mangement plans	v
2.	Location	1
3.	Reserve boundary	2
4.	Geology and landforms	8
5.	Vegetation	14
6.	Management Units	20
7.	Existing and proposed roads, tracks and other developments	22
8.	Development concepts	32

Figures

1.	The mangrove food chain	13
2.	Typical toilet block	26
3.	Typical campsite	27
4.	Typical low key camping ground	28
5.	Prefabricated pit toilet for use in low key camping grounds	29
6.	Typical signs	31

Photographs

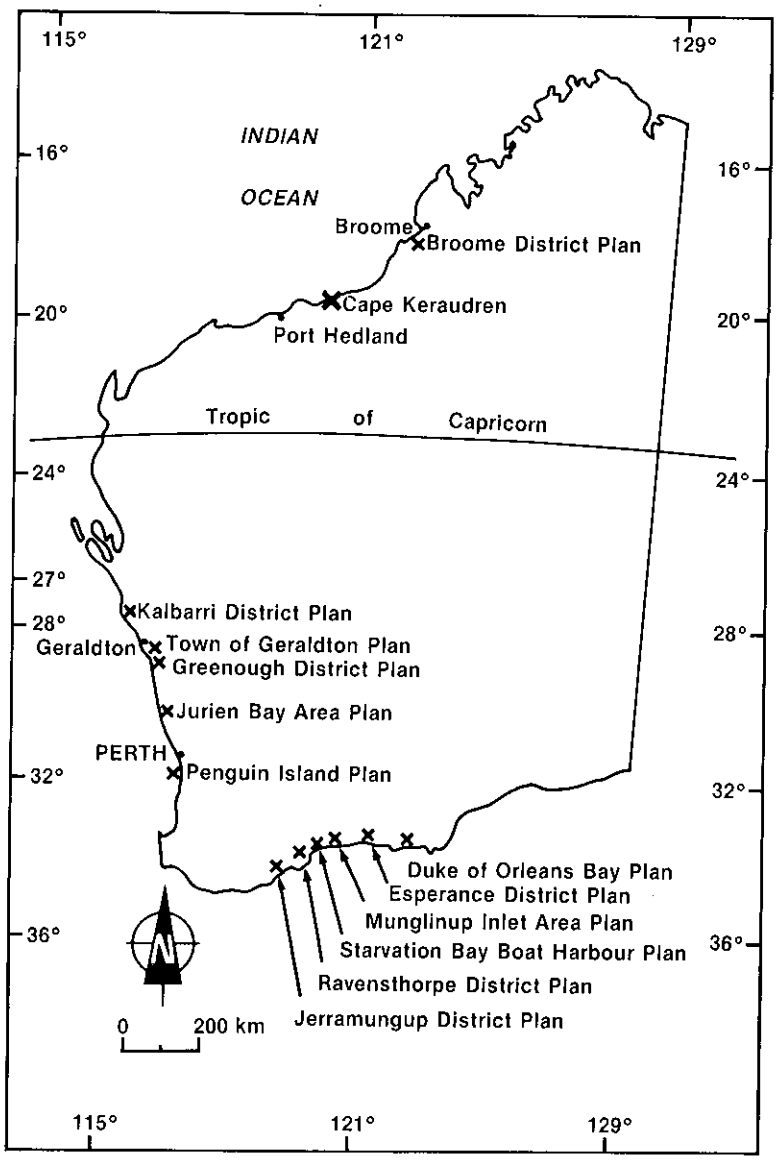
1.	Aerial photograph - Cape Keraudren area	6
2.	Northern end of Cape Keraudren	9
3.	Calcareous sand plain	9
4.	Northern end of the red sand plain	10
5.	Cootenbrand Creek	10
6.	Beach at Mosquito Creek	23
7.	Campers near the mouth of Cootenbrand Creek	24

COASTAL PLANNING IN WESTERN AUSTRALIA

In 1982 the Western Australian Government established a Coastal Management Coordinating Committee (CMCC) comprising representatives from a number of State authorities to:

- advise government about coastal management policies, legislation and administrative arrangements;
- coordinate departmental activities on the coast through the exchange of information and views, and review expenditure programmes and priorities;
- overview the preparation and implementation of the coastal management plans at regional and local levels for various locations on the coast of WA.

This is the sixteenth draft plan prepared under this programme and the locations covered by other plans are shown on Map 1.



Map 1 Western Australia — Showing areas covered by Coastal Management Plans.

SUMMARY

In 1981 the Shire of East Pilbara approached the Under Secretary for Lands seeking control of the portion of the Pardoo Station, which surrounds Cape Keraudren for recreation purposes. The Under Secretary agreed to the request in principle, but said that vesting of the land in council would be conditional upon the preparation of a Coastal Management Plan. In 1983 Shire Clerk, J M Read prepared an Interim Management Plan and Council approached the Department of Conservation and Environment (DCE) seeking assistance in the preparation of this Draft plan.

This plan has been prepared to guide Council in its long-term development and management of Cape Keraudren. It contains an investigation of the natural and man-made resources of the area and use pressures which are likely to be placed upon them. It determines the following development and management aims:-

- protect the natural systems in the area in co-operation with appropriate government authorities;
- provide for recreational demands on the area in a manner consistent with its protection;
- develop a public education and information system which will aid in the conservation of the area and promote public awareness and enjoyment of the region;
- preserve the landscape assets of the area;
- protect sites of interest to aboriginal people and historic sites.

The plan contains development and management proposals which have been prepared to assist Council in achieving those aims. Finally a chapter on implementation gives recommendations concerning priorities and procedures required to effect the plan.

This draft plan will be available for public comment until September 30.

1.0 INTRODUCTION

1.1 BACKGROUND

Cape Keraudren was part of the Pardoo Pastoral Lease and as road access to the area was limited it attracted little public interest until the 1970's. However, development of the townships of Goldsworthy and Shay Gap created populations of people seeking recreational outlets around the East Pilbara coast.

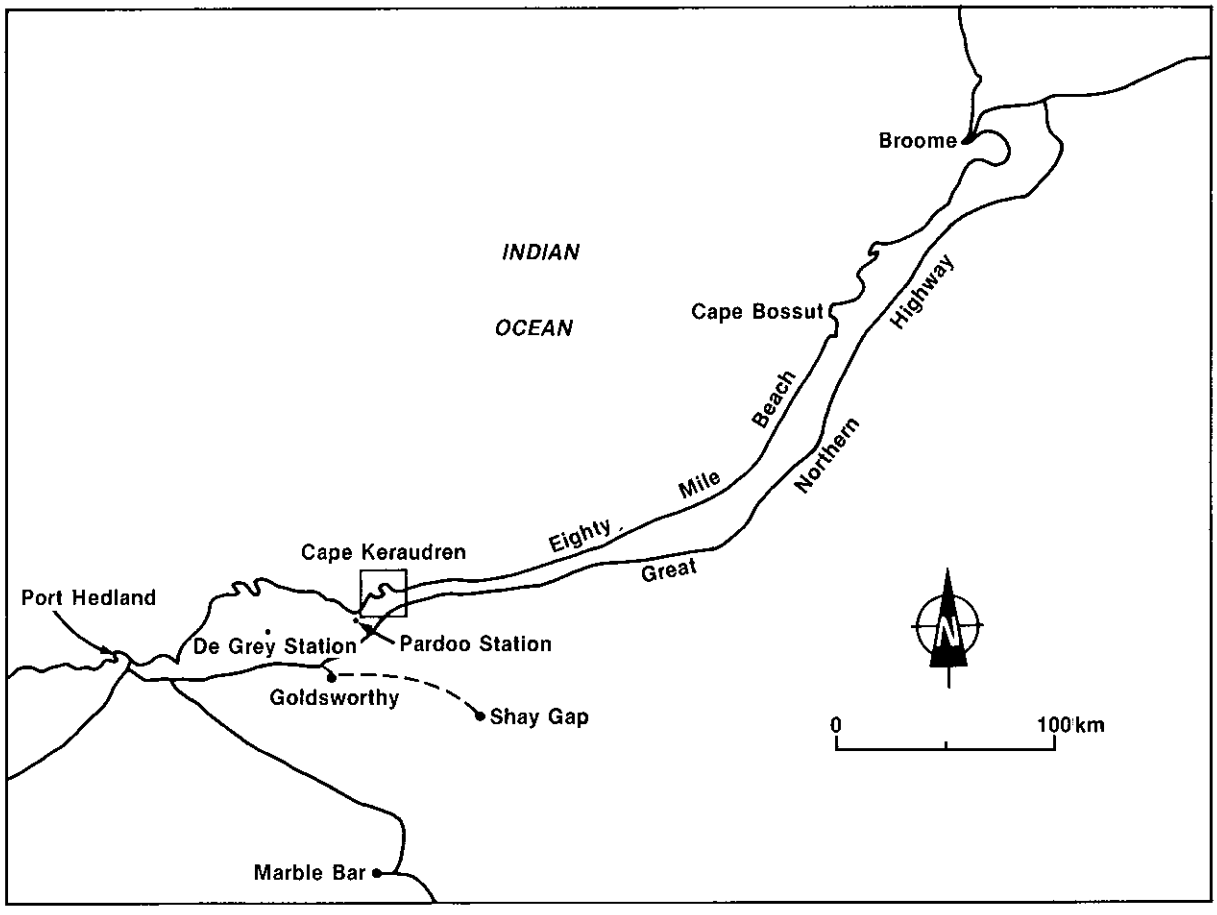
In 1981 the Shire of East Pilbara approached the Under Secretary for Lands asking that the area around the Cape be excised from the pastoral lease and vested in Council for recreational purposes. The Under Secretary for Lands sought the advice of the Departments of Fisheries and Wildlife, and Conservation and Environment, and the WA Museum all of which supported the proposal in principle but recommended that preparation of a management plan be a condition of vesting.

In 1983 the Shire of East Pilbara prepared an "Interim Management Plan" and approached the Department of Conservation and Environment seeking assistance in the preparation of this Draft Management Plan.

The area was vested in the Shire of East Pilbara on 12 July 1985 for the purpose of "Recreation."

1.2 LOCATION

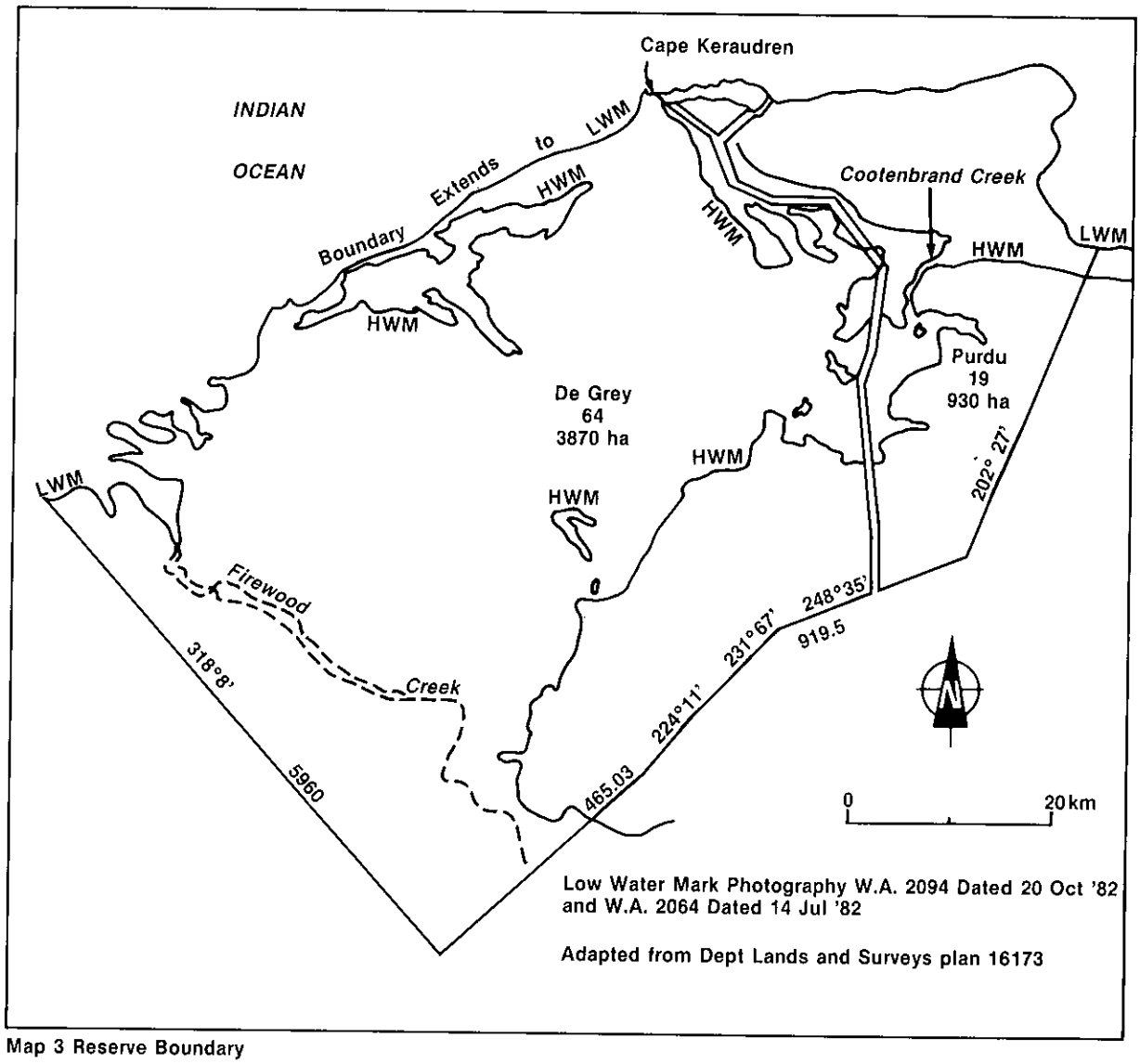
The area under consideration in this study is located on the north west coast of Western Australia at latitude 19 degrees 57' south and longitude 119 degrees 45 east. It lies 170 kilometres, by road, from Port Hedland and 13 kilometres from the Great Northern Highway (map 2).



Map 2 Location

1.3 NAME OF THE RESERVE AND CURRENT STATUS OF THE AREA

Until recently the area was part of the Pardoo pastoral lease as portions of the Grey Location 64 and Pardu Location 19. On 12 July notice was published in the government gazette that the Executive Council had issued an Order in Council directing that Reserve No 39135 be established as shown on map 3.



Map 3 Reserve Boundary

The reserve comprises an area of approximately 4800 hectares and is vested in the Shire of East Pilbara for the purpose of recreation.

The reserve will be publicly described as the Cape Keraudnen Coastal Reserve.

1.4 AIMS AND PURPOSE OF THE PLAN

In the past recreational use of the area has occurred on an 'ad hoc' and uncontrolled manner. In addition, the Shire of East Pilbarra has undertaken extensive works to provide access to the area, fence it out of the Pardoo pastoral lease and sought its vesting for recreational purposes.

A plan is needed to:

- satisfy the Hon Minister for Lands' requirement for a coastal management plan as a condition vesting the area in Council;
- guide orderly long term development and use of the area;
- ensure competing land uses and the capacity of the land to sustain those uses have been considered;
- outline authorities which may provide assistance in managing the area.

2.0 PLANNING, DEVELOPMENT AND MANAGEMENT AIMS

Councils planning, development and management aims for the reserve are to:

- protect the natural systems in the area in co-operation with appropriate government authorities;
- provide for recreational demands on the area in a manner consistent with its protection;
- develop a public education and information system which will aid in the conservation of the area and promote public awareness and enjoyment of the region;
- preserve the landscape assets of the area;
- protect sites of interest to Aboriginal people and historic sites.

3.0 THE CAPE KERAUDREN ENVIRONMENT

3.1 PHYSICAL ENVIRONMENT

3.1.1 GEOLOGY

The geology of the area is described by Hichman and Gibson (1982) and it is not proposed to repeat that work here, but to outline those geographical and physiographical features which significantly influence resource use planning.

The reserve contains portions of the aeolian sandplain and coastal flatlands described by Hichman and Gibson. The aeolian sand plain has longitudinal east-west trending dunes and rare rocky outcrops. This sandplain is the most western part of the Great Sandy Desert.

The coastal flat lands are a low lying tract of tidal creeks and mud flats lined by mangroves, and supratidal areas of calcareous sand and clay covered by samphire. In places the coast is backed by sand dunes and beach ridges of shelly sand built by on shore winds or wave action during storms.

3.1.2 LANDFORMS AND PHYSIOGRAPHY

Study of aerial photographs of the area (photograph 1) and field investigations indicates a number of landforms, each with associated biological, landscape and recreational values which are discussed later. Collectively these characteristics are used to classify the area and determine which parts of the reserve are suitable for particular purposes. The landforms are shown on map 4 and include:-

The Bossut formation as described by Hichman and Gibson, 1982, which is comprised of sandy calcarite (limestone) which crops out at the surface forming rocky hills or shelves (photograph 2).

The sand plain which comprises a calcareous oolitic sand plain which occurs immediately inland of the Bossut formation on Cape Keraudren and as an island about 3 kilometres to the west (photograph 3).

Storm ridges which contain sediments varying from fine sand to large limestone boulders which indicate past storm and cyclonic activity.

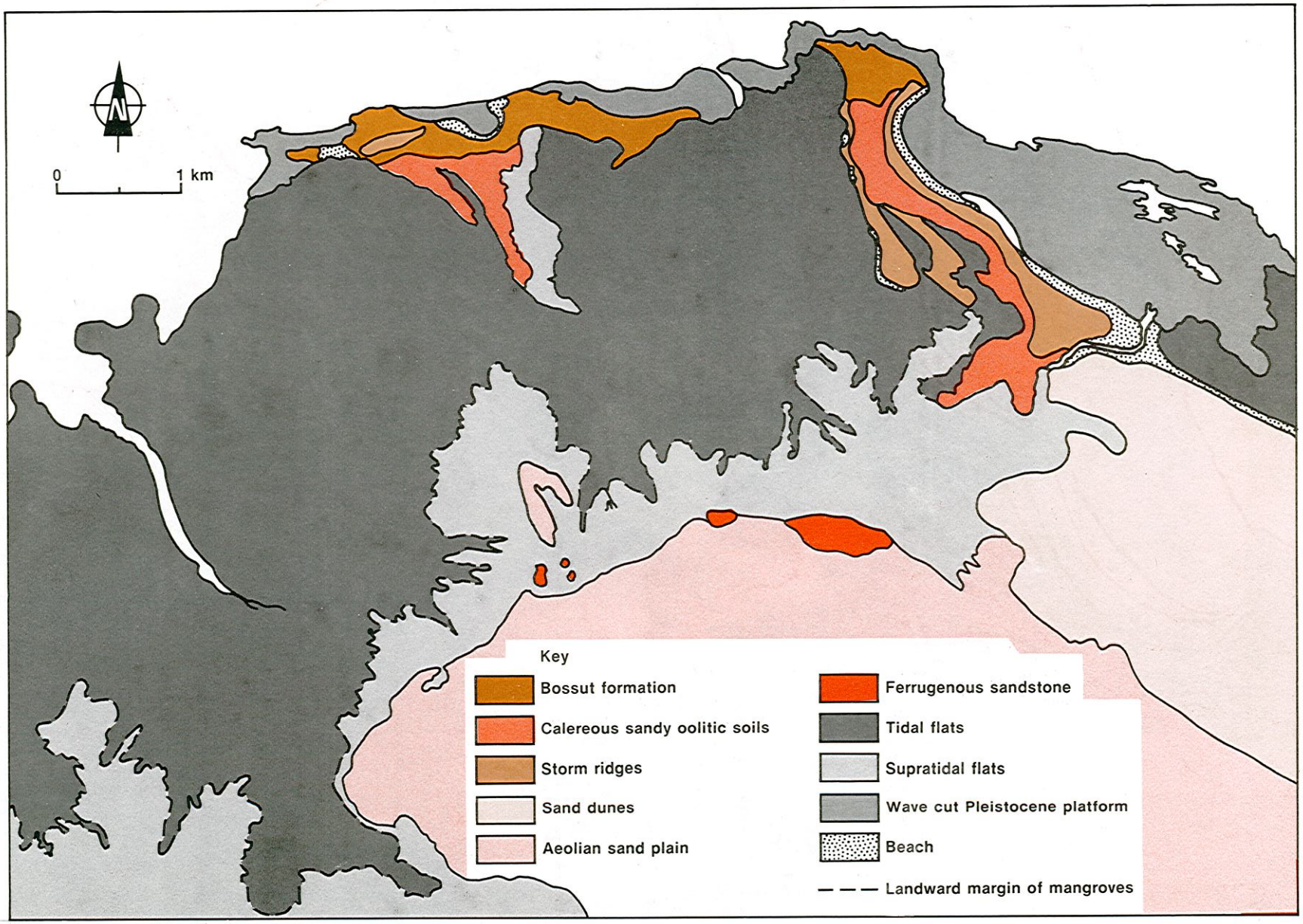
Sand dunes occurring in beach ridge plains of varying age which occur behind the beach east of Cootenbrand Creek. The dunes closest to the beach are relatively young probably formed during the Pleistocene period.

The southern end of the reserve is in the undluating red sand plain described by Hichman and Gibson and comprises fine red sand of Pleistocene origin. In addition there are outcrops of ferruginous sand stone on the margins of the plain (photograph 4).

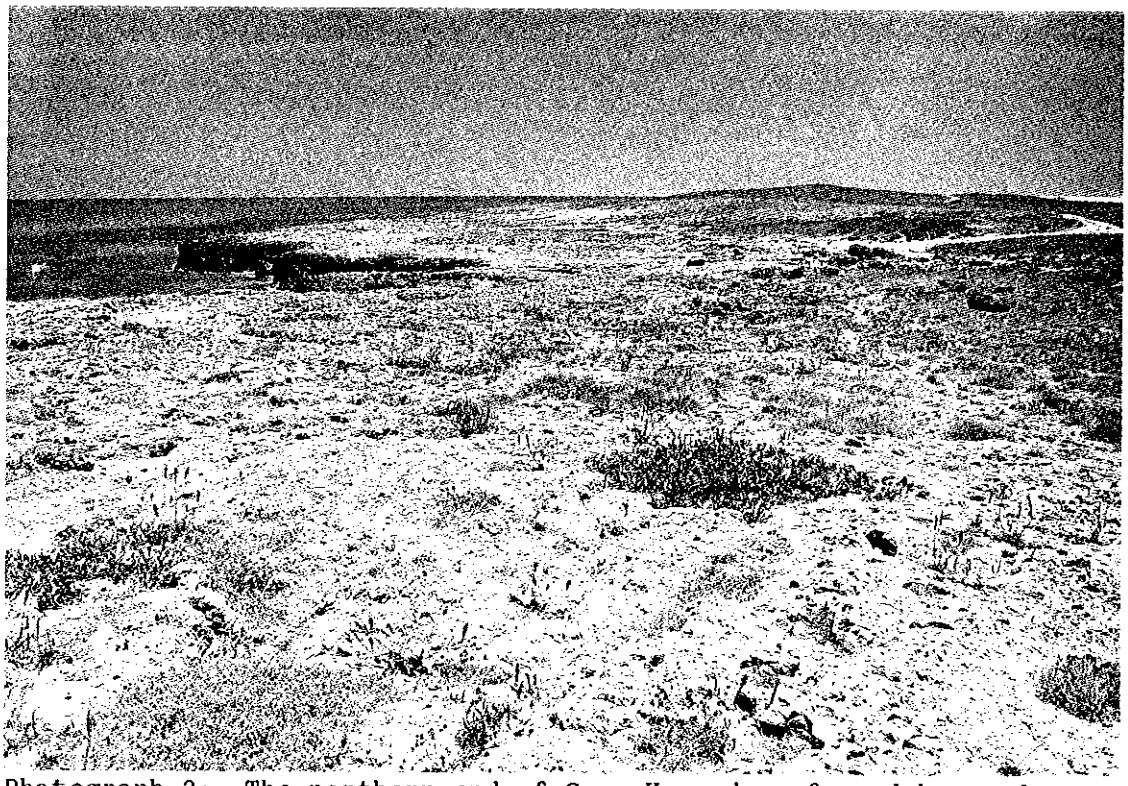
Creeks, supra-tidal flats and tidal flats occur in the area. The boundary between the tidal flats and supra-tidal flats can be identified by the upper margin of the mangrove community. Tidal flats are submerged by most diurnal tides while the supra-tidal flats are only submerged by spring tides (photograph 5).

Photograph 1 Aerial photograph – Cape Keraudren.

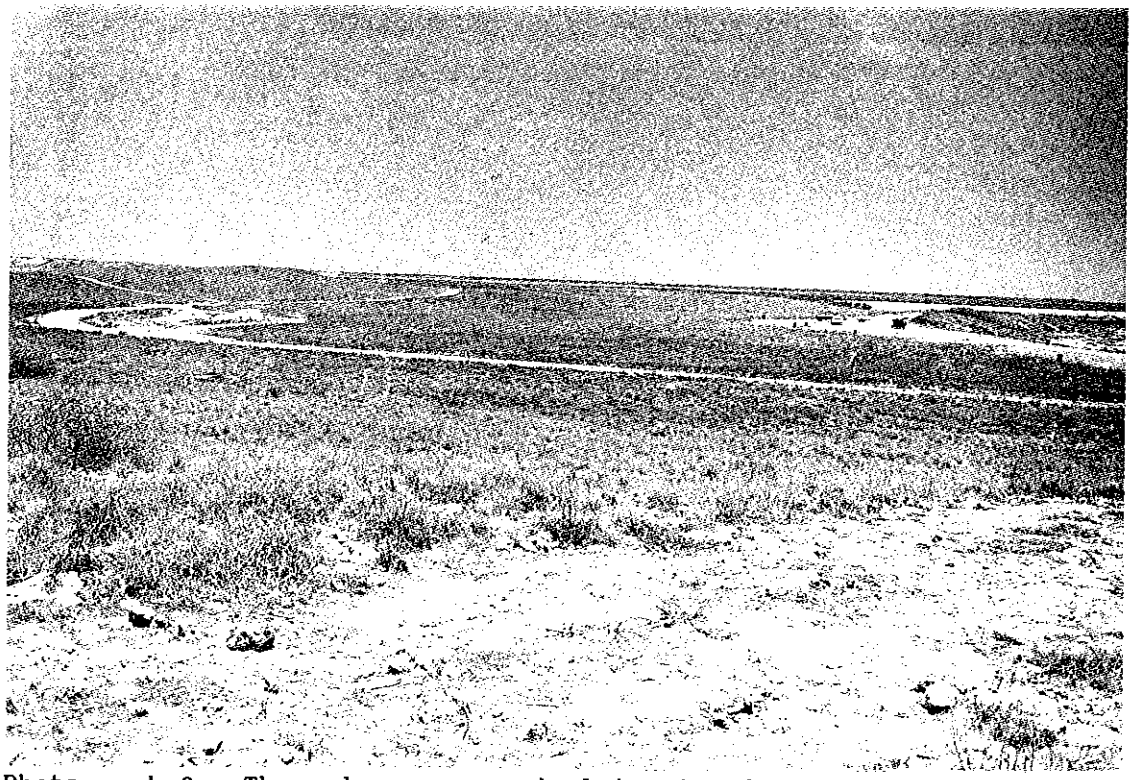

Cape Keraundren
Mosquito Creek
Eighty Mile Beach
Cootenbrand Creek
Existing quarry
Main access road
Cootenbrand well
fence
Key
1 Bossut formation
2 Calcareous oolitic sandplain
3 Storm ridge
4 Sand dune
5 Beach
6 Sand sheet
7 Undulating red sand plain with ferruginous sandstone outcrops
8 Tidal flats
9 Supra-tidal flats
10 Mangroves
11 Wave cut Pleistocene platform



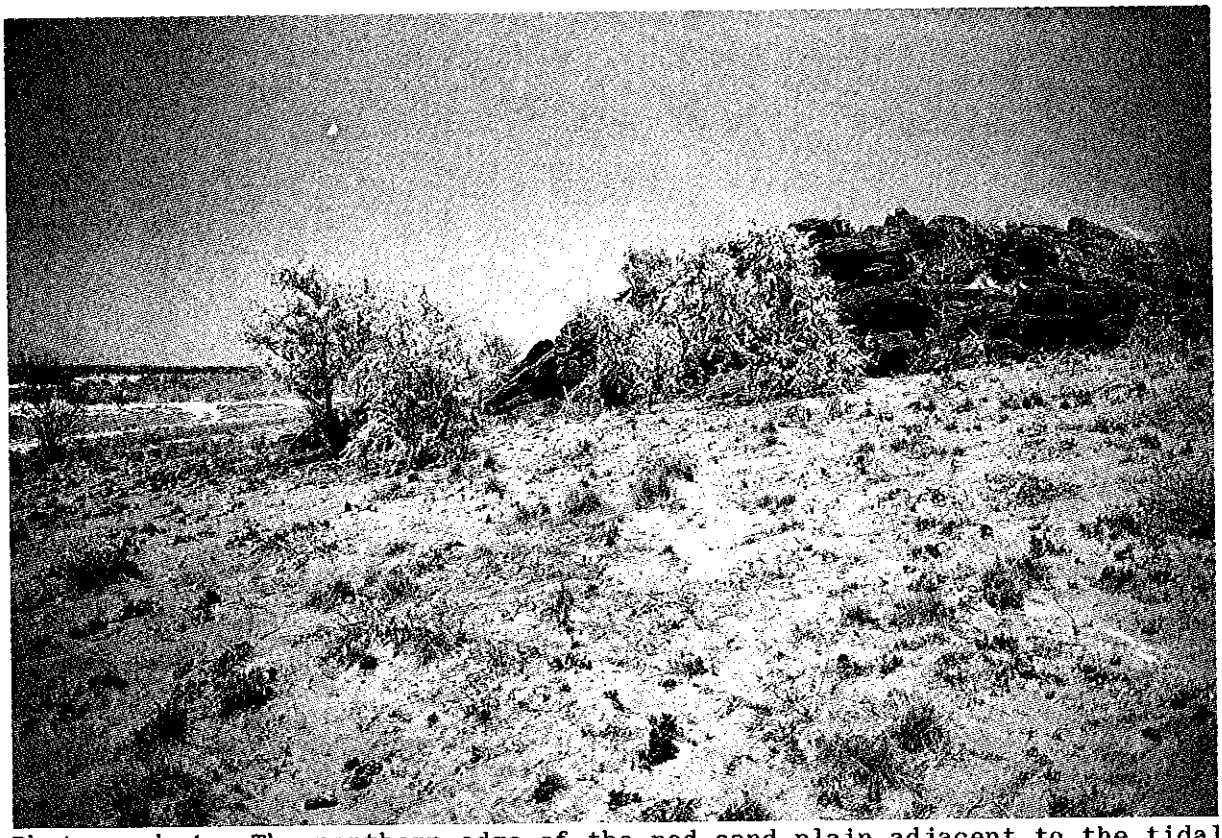
Map 4 Geology and landforms



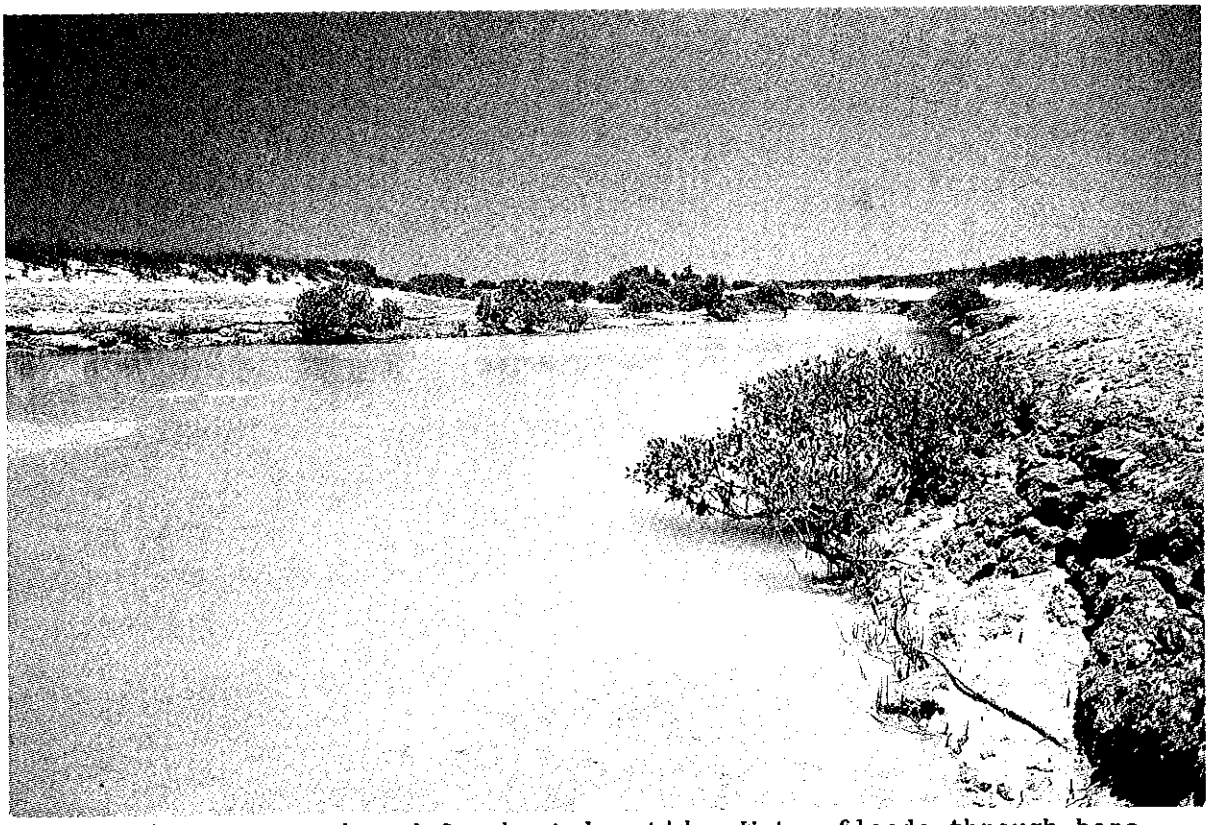
Photograph 2: The northern end of Cape Keraudren formed by sandy calcarite described as the Bossut formation.



Photograph 3: The calcareous sand plain viewed from the northern end of Cape Keraudren, showing the existing main access track. The existing tip is shown on the right hand side of the photograph.



Photograph 4: The northern edge of the red sand plain adjacent to the tidal flats. Note the ferrunenous sandstone outcrop which is typical of the area.



Photograph 5: Cootenbrand Creek at low tide. Water floods through here to submerge the tidal flats on the eastern side of the reserve.

3.1.3 COASTAL PROCESSES

Tides are macrotidal and diurnal. At Port Hedland the Mean High Water Spring Tide is 6.8m at Broome it is 8.5. (Australian Nation Tide Tables, 1982). Tidal currents are often bidirectional reaching velocities of up to 0.5 metres/second. (Australian Pilot 1972).

Westerly long period swell waves predominate with wave heights varying between 0.5-1.3 metres. Sea breeze, south easterly, westerly and cyclonic wind waves are superimposed on the swell. Storm surges may vary up to 2 metres, although because of the large tidal range, the chance of tides surpassing the height of the highest astronomical tide is low (Curry and Hesp 1985).

Beach deposits occur around Cape Keraudren on the landward margins of tidal flats. Cyclone and storm waves winnow out fine materials, and deposit more course material including gravel, small rocks and shell fragments to form beaches (photograph 5). On the eastern end of the Cape large limestone boulders have been swept ashore during a cyclone at some time in the past and demonstrate the potential forces associated with severe cyclones.

The tidal flats have been swept clean of course materials leaving extensive areas of sheltered mudflats which provide excellent habitat for mangrove communities.

3.2 CLIMATE

The only detailed meteorological information collected near Cape Keraudren are rainfall data from Pardoo Station. Consequently, this brief description of the climate of the area has been prepared using those figures and temperature and wind data collected at Port Hedland.

The climate of the region is arid with mean rainfall relatively high (151 mm) between January and March, with low falls in December (mean 19) and a mean of 78 mm for the April-June period. Practically no rain falls during the rest of the year and the mean annual rainfall is 287 mm.

Temperatures are high during the summer months at Port Hedland the average maximum value is $34^{o}C$-$35^{o}C$. The coldest months are June, July, August with maximum temperatures of about $26^{o}C$.

Summer mornings are characterised by easterly winds with afternoon sea breezes from the north west. Winter mornings are dominated by strong easterly winds with lighter and variable winds in the afternoon. The highest velocity winds occur during tropical cyclones which are most frequent from January to March.

3.3 BIOLOGICAL SYSTEMS

The Cape Keraudren areas displays a variety of beach, dune, mangrove and salt marsh systems which are found within various environmental settings, and which experience a range of wind wave and tidal energy conditions. Coastal beaches and dunes are formed wherever there is sufficient sand available and wind and wave energy to transport it. Plants in these environments are strongly influenced by the degree of surface instability (sand deposition and erosion), salt spray and wind blast. Mangroves grow on the mudflats within the range of tidal inundation, and are influenced by the degree of exposure, sediment and current movement and soil or substrate type. Salt marshes are intimately related to mangroves extending into areas flooded by only the highest tides. (Craig 1983). The following provides a

brief account of each of the major systems and discusses some of the processes operating within them.

3.3.1 MANGROVES

Mangroves usually grow between high spring tide and mean sea level. The term mangrove refers to individual tree or bush species, while a mangrove plant community is called a mangal.

Mangroves belong to a variety of plant families having common features such as pneumatophores, which are root outgrowths that function in aeration, and seeds which germinate while attached to the parent plant. These features almost certainly are adaptations which assist the plants to survive in a harsh environment (Semeniuk 1978).

Mangroves grow best in areas with warm climates, protected shores salt water, muddy substrates and a high tidal range. All of these attributes are found around Cape Keraudren. Mangroves are typically zoned (ie different species occur in various locations determined by the frequency of flooding by tidal waters, soil type, soil salinity, drainage, slope, plant interactions and animal interactions). Naturally many of these factors are interrelated. Where environmental factors are well differentiated along a shore with a gentle gradient there will be a tendency for development of distinct broad zones as has occurred in Firewood Creek (Semeniuk 1972).

In the last decade or so there has been a gradual realisation that many natural coastal resources may depend on the survival of the mangrove ecosystem. There is now a considerable body of scientific evidence that mangroves play an important role in supporting a wide range of marine life in the near shore waters, and in sustaining coastal fisheries.

Life in the mangrove community involves an interaction between plants, marine animals and terrestrial fauna. Mangroves provide the basis for the food chains involving various marine and terrestrial organisms in the form of leaf litter and other plant detritus on the ground, and for the insect, bird and bat populations in the form of leaves, flowers and fruits. Mangroves also provide the habitat for many other organisms such as algae and diatoms which are primary links in food chains as shown in figure 1 (Semeniuk et al. 1978).

The animals that are associated with mangroves span a wide range of invertebrate and vertebrate groups. This fauna is often distributed in distinct zones related to frequency of tidal flooding soils type, salinity, and the type of surrounding plant community. Many of the animals exploit the mangal as habitat, nursery grounds or a source of food.

Fauna in mangroves may be distinguished as either resident or temporary. Resident fauna includes ground-dwelling surface animals such as crabs, shrimps and worms; tree-dwellers such as encrusting oysters and barnacles, wandering snails, boring Teredo ("ship worm"), and a host of insects, birds and bats which use mangrove foliage as habitat and derive food from leaves, flowers and fruit. Mangroves provide vital feeding grounds for the temporary fauna which is made up of free-swimming animals such as fish and crustaceans that invade the mangal environment at high tide, and of terrestrial animals such as birds, reptiles and mammals that invade the areas at low tide. Additionally, numerous fish and crustacean species (notably banana prawns) use the mangrove environment as a nursery.

Thus, in terms of plant primary production, feeding grounds and nursery beds, mangroves are a vital resource. It has been shown that the destruction

Supply of mangrove material to the food chain.

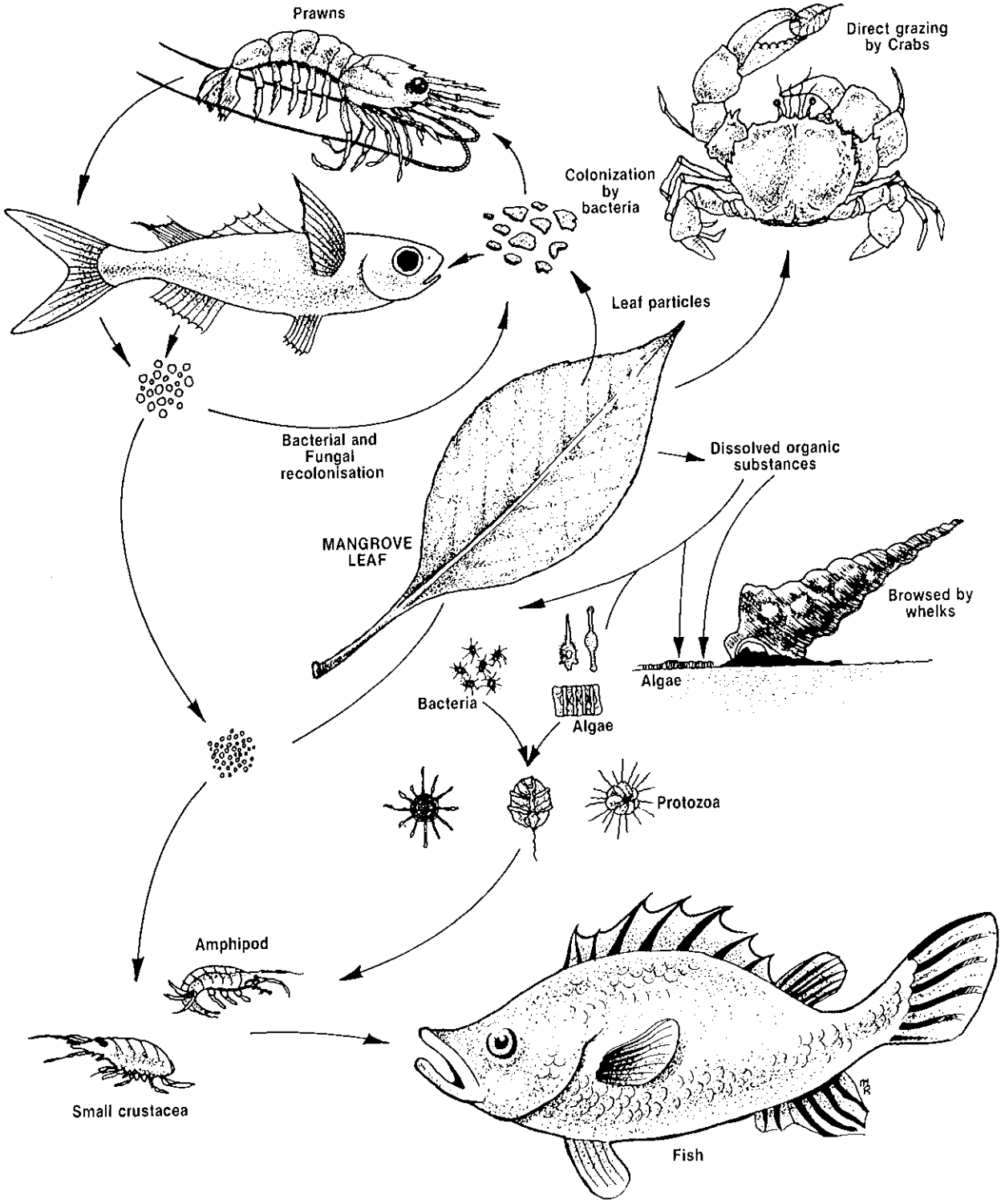
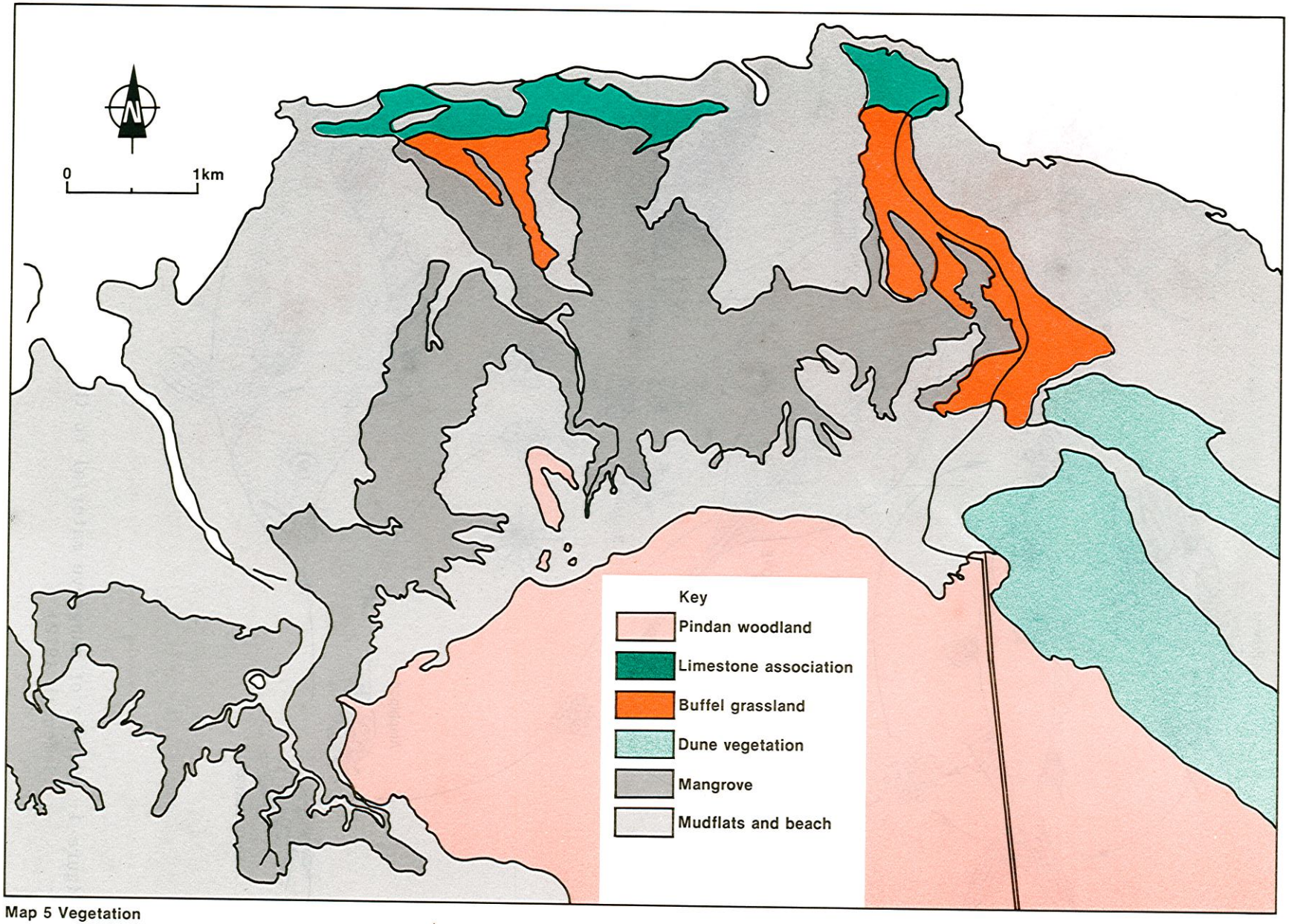


Figure 1: Supply of mangrove material to the food chain. (Adapted from Semenuik 1972)



Map 5 Vegetation

of mangroves can lead to a major change in near shore ecology with the subsequent decline of commercial fishing. Studies have shown that in some coastal waters most fish caught commercially were linked to food chains that depended on mangroves. Consequently on mangrove loss is the dislocation of the food chain accompanied by the inevitable loss or severe depletion of organisms within the chain. Destruction of mangroves also results in loss of habitats for a large range of terrestrial organsims such as insects, birds and bats. Removal of even part, such as a particular zone, has detrimental effects on the ecosystem since those birds and insects that are very selective in their feeding are lost (Semeniuk et al. 1978).

Mangroves also help to stablise coast lines and protect them from storm attack by absorbing wave energy, slowing down currents and protecting the substrate against erosion. Where mangroves have been removed, coastlines that once experienced moderate shore erosion have undergone greater erosion (Semeniuk et al. 1978).

For preservation of natural habitats, protection from coastal erosion, and sustenance of offshore fisheries, careful management of the mangrove habitats is essential. It must be recognised that the tidal flats in front, and the supratidal flats behind, are important to the mangrove system.

In WA protection of tidal wetlands is covered by three acts: the Fisheries Act, the Conservation and Land Management Act and the Rights in Water and Irrigation Act. These acts prohibit deposition of filth and refuse, discharge of wastes into waters where fish or fishing grounds are likely to be, and removal or disturbance of the ecosystem as well as interference with water supply. At this stage rather than declare the mangroves sanctuaries or marine parks as is required under the various Acts, Council should recognised the importance of the mangroves and through planning policy implement a strategy to preserve them by avoiding incompabtible land use of adjacent areas.

3.3.2 SALT MARSHES

Salt marshes exist in low energy environments around the Cape between the mangroves and the upper reaches of tidal influence. These areas support low shrubby glass works (popularly brown samphires) and in some places there are wide expanses of bare mud. (Graig 1983). In addition, these flats support algal mats which are an important component of the mangrove system.

Sediments are introduced onto the salt marshes during normal tidal inundations and during storms, and are deposited from suspension and trapped by plants. (Graig 1983).

3.3.3 DUNE RIDGES

The dunes in this areas have generally been formed by wind blown sand which has accumulated with sand trapping vegetation and include incipient foredunes established foredunes and hind dunes.

Foredunes are the foremost vegetated sand dune occurring immediately landward of the unvegetated beach. They are initially colonised by beach spinifex (Spinifex longifolius) soft roly-poly (Salsola kali) and beach morning glory (Ipomoea brasiliensis) (Graig, 1983).

Hind dunes are behind the foredunes and separated from them by swales. They support a more diverse vegetation including spinifex (Triodia) buffel grass (Cenchrus ciliaris) and occasional shrubs.

3.3.4 CENTRAL FLAT

The Cape Keraudren peninsula is bounded by storm ridges and sand dunes. Between these ridges is a relatively flat and stable area of calcareous oolitic sand. This area supports a dense stand of buffel grass with occasional shrubs including green bird flower (Crotalaria cunninghamii) and creepers such as wild Jack bean (Canavalia rosea).

3.3.5 CAPE BOSSUT FORMATION

The rubbly outcrop of limestone at the end of the Cape supports a variety of vegetation characterised by soft spinifex (Triodia pungens) with occasional thickets and isolated shrubs including sandpaper fig (Ficus opposita), Acacia bivenosa, Acacia ampliceps, Melaleuca leucadendron and kapok (Aerva javanica).

3.3.6 PINDAN

The other major botanical community existing in the reserve is the Pindan which occurs on the red sand plain on the southern portion of the study area. This is a low open woodland with an understorey of Spinifex (Triodia sp.), buffel grass, Acacia translucens, Cockroach Bush (Cassia notabilis) and Birdflower. The scattered low trees include Ghost Gum (Eucalyptus papuana).

3.4 ABORIGINAL INTERESTS

In 1983 consultants R O'Connor and P M Veth undertook a period of field research in the vacinity of Cape Keraudren on behalf of the East Pilbara Shire. The survey was carried out with the specific aim of locating the traditional owners of the area or their successors and consulting them to ensure that any improvement of access roads or any other development which may occur in the future does not interfere with sites of mythological or ritual significance to Aborigines.

Researchers agree that Cape Keraudren and surrounding areas lie within the traditional lands of the Narla people. Neighbouring groups included the Kariera to the west, Nangamada to the east, and the Namal and Junna to the south, although the precise boundaries between these neighbours appear uncertain.

The name "Cape Keraudren" is not well known to the Aboriginal people who continue to use the area but call it Cootenbran or Cootenbrand, a corruption of the original Narla name Kurtumburran Kurtumburrana was the name of the freshwater soak (or orrlya in Narla) which is on the Cape. This soak and nearby Mangroves are still used by Aborigines as sources of water and food.

There are a number of sites of significance to Aborigines within the study area.

3.5 EUROPEAN HISTORY

Cape Keraudren was named during the French expedition undertaken to explore Western Australia in 1803 and the vessels involved were the "Geographe" commanded by Commodore Nicolas Baudin and the "Casuarina" under Lieutenant Louis Claude Desaulses de Freycinet.

The survey was conducted from February 1803 to July 1803, and the ships left South Australia on 11 February sailing across the Bight to King George

Sound, then sailed along the Western Australian coast to the Bonaparte Archipelago from where they sailed to Timor.

Cape Keraudren was named by Francois Peron, the naturalist on the "Geographe" after Pierre Francois Keraudren, 1769-1857, physician in charge of Naval Medical Services at Brest.

4. DEVELOPMENT AND MANAGEMENT PLANNING

4.1 LAND USE PLANNING

Land use planning is a process involving the consideration of an areas resources, the land's ability to support likely uses, constraint on use, and likely use pressures. The allocation of appropriate uses to areas capable of sustaining those uses is an essential step in management planning. If this step is not taken environmental degradation may occur resulting in the loss of amenity and increased management costs. Recognising constraints as well as opportunites is a major philosophical step and an essential part of effective resource management planning.

4.2 OPPORTUNITIES

Factors which may provide opportunities to meet human needs in the Cape Keraudren coastal environment include:

- unspoilt coastal scenery, including islands headlands and a clean blue sea;
- sheltered beaches and bays which can be used for boating and fishing;
- significant groundwater resources of reasonable quality;
- relatively undisturbed physical and biological features which, together with adjacent areas form an ecosystem of significant value;
- sites suitable for limited tourist development;
- a system of access roads and tracks;
- a limited management infrastructure provided by the Shire of East Pilbarra;

4.3 CONSTRAINTS

The constraints on use which influence planning of the area are:

- some area of highly erodible sandy soils which depend upon vegetation cover for their stability;
- a seasonal climate with unreliable rainfall and occasional hurricane force winds;
- a large tidal range which creates problems for coastal engineering;
- a great distance from population centres and the Shire management infrastructure;
- limited development and management funding;

4.4 MANAGEMENT OBJECTIVES

After considering the planning, management and development aims, the reserve environment, the communties existing use and aspirations for the area, and opportunites and constraints the following planning objectives have been determined:

- council will seek the advice of appropriate government authorities and institutions about the most appropriate methods of caring for and protecting the reserves natural ecosystems and where possible implement their recommendations;

- will rationalise and upgrade the existing road and track system to ensure appropriate public access to various parts of the reserve as funds become available;

- provide a range of camping facilites within planning units capable of sustaining this type of use;

- ensure that all development in the reserve is undertal n in a manner which minimises its impact on the environment;

- provide for the proper disposal of garbage and other waste products;

- develop a public information system which assists in the management of the area, orientates visitors and helps them appreciate and enjoy the reserve environment.

4.5 MANAGEMENT UNITS

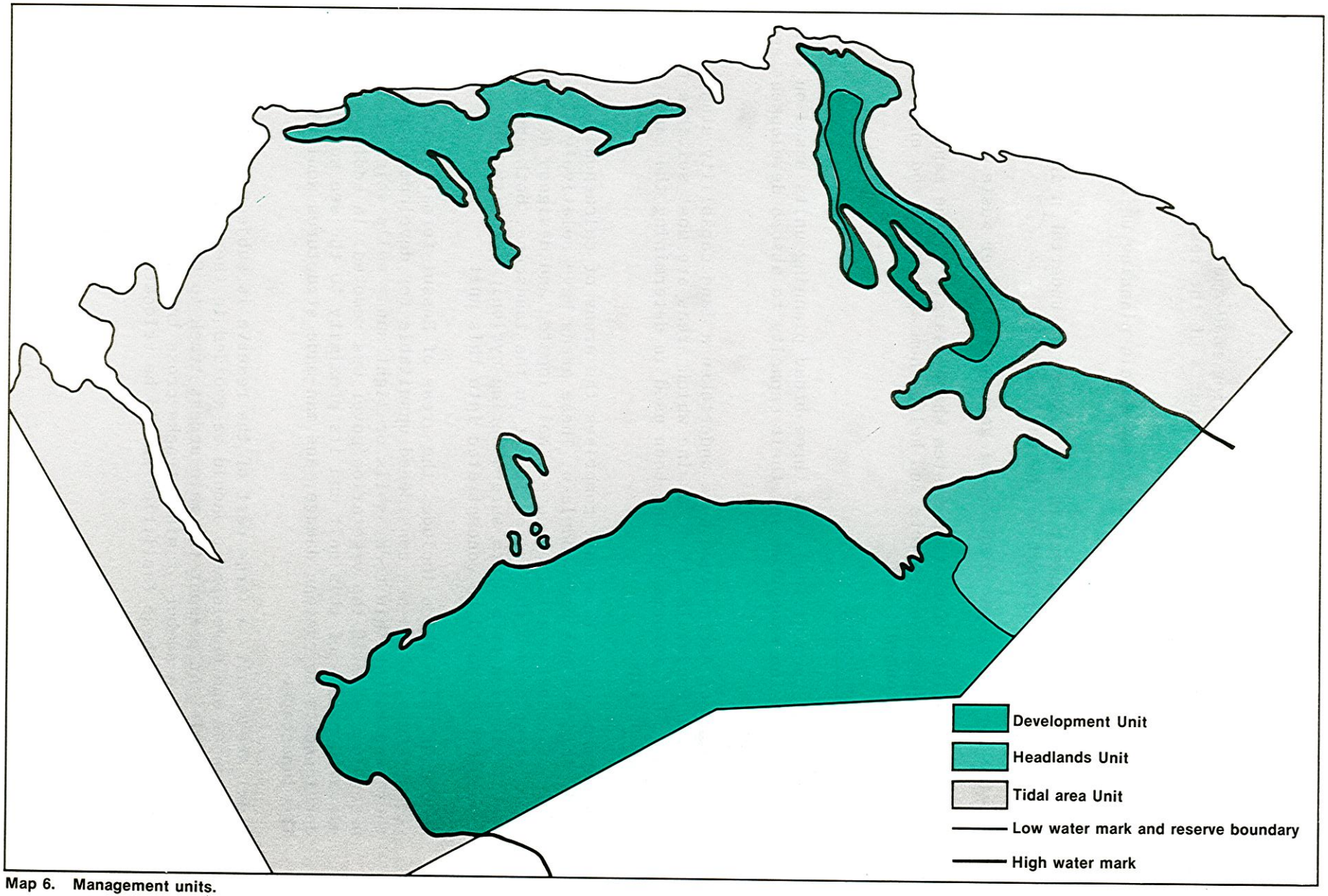
The reserve has been divided into three broad planning units based on their relationship to the ecosystem and their capacity to absorb development and use.

The Department of Agriculture have undertaken a land capability study of the Cape Keraudren Peninsula, to determine which areas are most suitable for development. This information has been used in determining the management units shown on map 6.

Development Unit. This unit comprises the areas of calcaenous oolitic sand plain and the red sandplain. These areas have relatively stable soils, a robust vegetation cover. Well located and designed developments could occur here with limited impact on the landscape. Both areas enjoy some protection from storm surges during cyclonic activity. Any developments should be concentrated into this unit.

Headlands Unit. Which includes the areas of Bossut formation and the storm ridges, which are considered unsuitable for development because they have either thin rocky soils or light sandy soils which would become unstable if the vegetation cover was removed. In addition, the elevated nature of this unit and its proximity to the sea would expose developments to cyclone damage, and man-made structures would dominate the landscape.

Tidal Areas Unit. A large part of the reserve is subject to tidal influences and development should be avoided in these areas where practicable. At present the main access track to Cape Keraudren crosses the flat and a number of minor tracks cross the upper edges of the flat. Where possible these facilities should be relocated.



Map 6. Management units.

5. DEVELOPMENT PROPOSALS

A number of development proposals have been prepared to assist in achieving the management objectives outlined above.

5.1 ACCESS

Upgrading of the access system in the area will be an integral part of the development and management of the reserve. Road standards in reserves of this type need not be the same as in surrounding rural areas, as high traffic speeds are neither required or desirable. Roads should be aligned so that they fit into the landscape.

5.1.1 MAIN ACCESS ROAD

The Shire of East Pilbara has already constructed a road from the Great Northern Highway to the southern boundary of the reserve as shown on maps 3 and 7.

The other major access to be constructed is a crossing of the tidal flats between the northern end of the new access road and the high ground forming Cape Keraudren.

The preliminary management plan considered two possible routes for the tidal flat crossing namely, an alignment which follows the old rabbit proof fence and an alignment on the western end of the sand dune unit involving the bridging of Cootenbrand Creek. The preliminary plan recommended the fence alignment be adopted and this plan supports that recommendation. The proposal is to construct a limestone causeway across the highest part of the mudflats which will contain culverts to enable the free movement of water during storms.

Towards the northern end of the tidal flats the alignment will travel west across a small sandhill, which is an island in the mud flat, to avoid crossing the final section of the mud flat which drains to the west. This corner of the mud flats supports a stable samphire vegetation and is a fresh water catchment area which becomes boggy after rain.

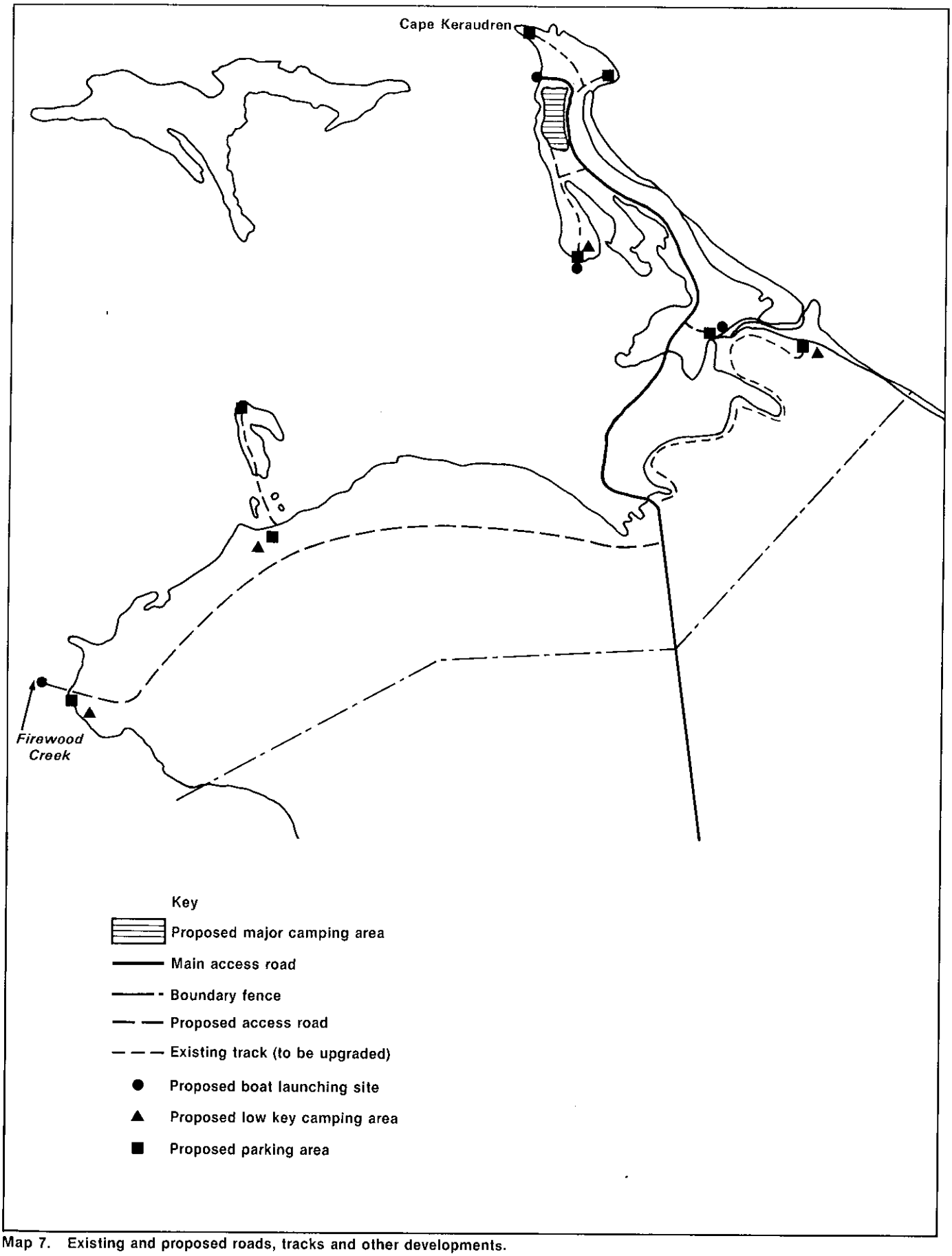
From the tidal flat area to the Cape, the road alignment will follow the existing access track with minor realignments to avoid close proximity to the mangrove swamps where the road is presently subject to spring tide inundation. This final road section is higher, in stable sand dune country with minimal drainage problems and well vegetated with spinifex and buffel grass. Redundant sections of the existing track will be ripped and sheeted with top soils from the new alignment to promote revegetation.

5.1.2 Minor access tracks

Minor tracks provide access to a variety of features within the reserve including beaches, camping and fishing spots. These are shown on Maps 7 and 8 and include:

- Cape Keraudren

  There are a number of rough tracks which cross the Bossut formation to points on the northern tip of Cape Keraudren. These tracks are short and their rough surface limits vehicle speeds, and the rocky nature of the terrain precludes any erosion risk, and consequently it is not considered necessary to upgrade them.



Map 7. Existing and proposed roads, tracks and other developments.

Mosquito Creek

Mosquito Creek (photograph 6) is a relatively popular camping and fishing spot but access is difficult because this area is only marginally accessible to two wheel drive vehicles. It could be hazardous to the unwary traveller because of the sandy conditions and limited vehicle turnaround facilities.

Photograph 6: The beach on Mosquito Creek, composed of sediments deposited during storms. This is a popular camping and fishing spot.

At present, 4 wheel drive vehicles occasionally travel west along a narrow sandy beach behind the mangroves. This activity should be curtailed by signposting or physical barriers.

It is proposed that the access track not be upgraded and that the situation be monitored. It is further recommended that the track be signposted "Four Wheel Drive Vehicles Only".

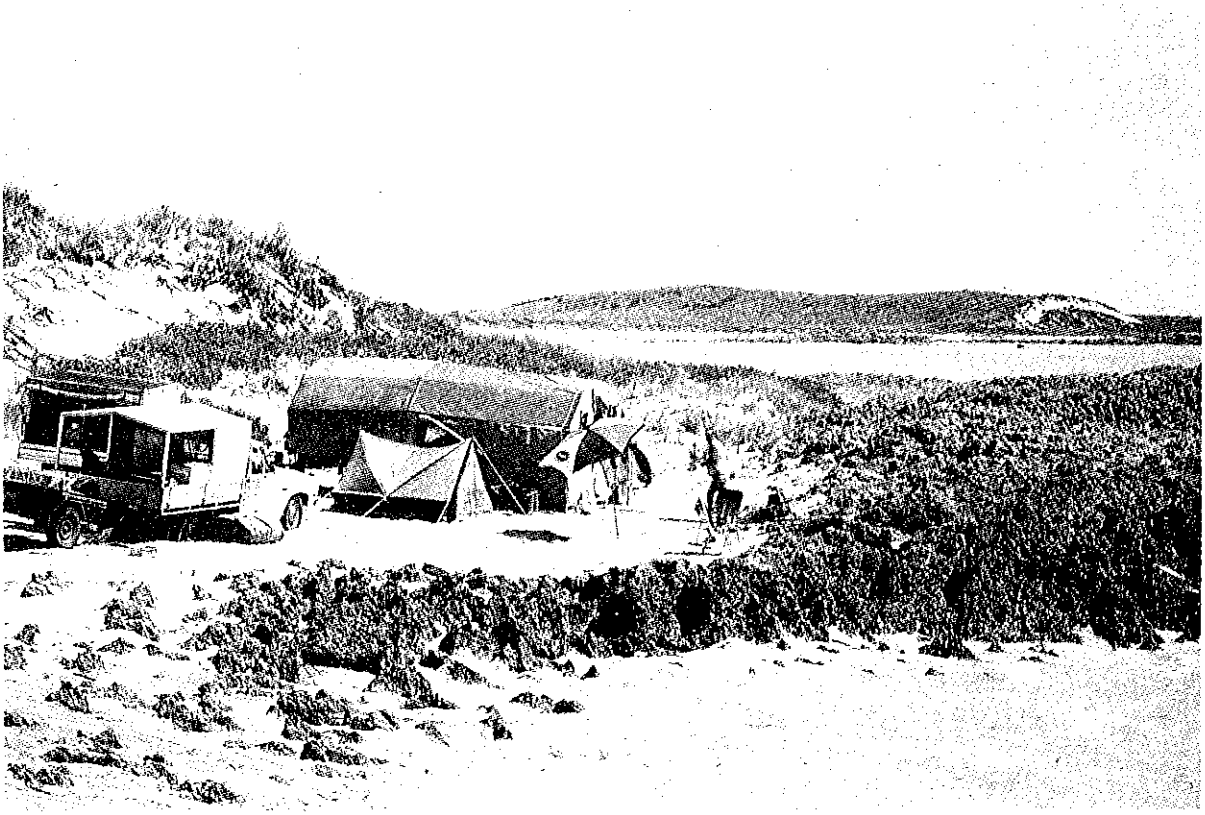
. Sandy Beach

Presently a 4 wheel drive access track off the road leading to the main camping area gives access to the bay to the east. This track which is used by net fishermen continues along the dune crest to rejoin the main Cape Keraudren access road by a steep descent down the hindside of the dune, has caused a blowout. For this reason it is recommended this part of the track be closed and a short track with a turnaround could be developed to enable public access to the bay.

. Cootenbrand Creek mouth

On neap tide, many 4 wheel drive vehicles continue beyond Cootenbrand Creek to the beach and to an area protected by exposed reef where they camp (photograph 7). From there some vehicles travel west along the beach

front behind here the rock outcrop and gain access to a sandy beach with occasional forays into the dune system.



Photograph 7: Campers near the mouth of Cootenbrand Creek.

As the dunes in this area are soft and higly unstable, and as blowouts exist, this activity must be curtailed by way of signposting and/or barricading.

Site 1

This site is a small camping/vehicle turnaround area on the eastern side of Cootenbrand Creek, situated on the dune forming the south western end of the 80 Mile Beach. Access is by a track which skirts the samphire flats and is flooded at spring tides. Possible relocation of the track to high ground will require consideration.

This area has potential for upgrading as a camping/parking area because of its proximity to the sandy beach. However the unstable nature of the frontal dunes in the area indicates that detailed attention will need to be paid to siting of the campsite and the beach access.

A track leading from Site 1 provides access to the New Cootenbrand Well which is outside the proposed reserve boundary.

It is recommended that provision of facilities at Site 1 be postponed until proper access is provided.

Site 2 (Firewood Creek)

This area is known as Firewood Creek and is situated approximately 5.5 kms south west of the Cape Keraudren Access Road. It is a popular spot for canoeing, small boating, and camping. Vehicle access is along the samphire flats which are flooded at spring tides. The existing tracks intercept the

tidal drainage and is causing erosion. A planning priority should be to relocate the existing track to higher ground.

A formal parking area is required at Site 2.

5.2 CAMPING FACILITIES

Camping is a most popular activity at Cape Keraudren providing a valuable recreational outlet for residents of the Pilbara, and it is anticipated that this will continue. In the past, camping has occurred on a casual and low key basis with people stopping in favourite locations around the reserve. While this approach has provided some of the charm associated with the Cape some rationalisation is desirable. Rationalisation is required because there is a need to stop camping in environmentally sensitive areas and because the uncontrolled activities of increasing visitor populations is creating difficulties in more robust locations. In addition, Council wishes to provided more sophisticated facilities for tourists.

5.2.1 FORMAL CAMPING AREA

A formal camping area will be established by Council in the Development Unit south of the Cape. This will include a system of roads, camping bays, toilets and eventually a water supply system which will enable the provision of showers and a tree planting programme. It is anticipated that the Shire will provide a caretaker for the camping area who would also act as manager for the rest of the reserve. Conceptual plans and specifications for the facility are shown in map 8 and figures 2 and 3.

5.2.2 LOW KEY CAMPING AREAS

Low key camping areas will be established at various locations around the reserve to ensure the traditional use of the area can continue. However, this type of facility will only be developed in relatively stable areas and such use will be restricted to prepared sites. A nominal charge will be made for the use of the sites which will be located at:-

Mosquito Creek
the eastern side of Cootenbrand Creek
Firewood Creek

The location of these sites is shown on map 7 and concept designs for the camping areas are illustrated in figures 4 and 5.

The Department of Conservation and Land Management has had considerable experience in development of camping facilities in the arid zone and the Shire of East Pilbara will seek their advice concerning development details before starting work on camping areas.

5.3 WATER SUPPLY

The existing lack of fresh water at Cape Keraudren limits development and is the factor which most restricts the amount of time visitors spend there. As past management of the area has been limited it has been appropriate that visitor use be restricted but as the area becomes developed a reliable water supply will be required.

The Department of Mines advises that it is reasonable to expect that a water supply could be established at Cape Keraudren based on deep ground water. While this water is likely to have relatively high salt levels it should be suitable for low key development.

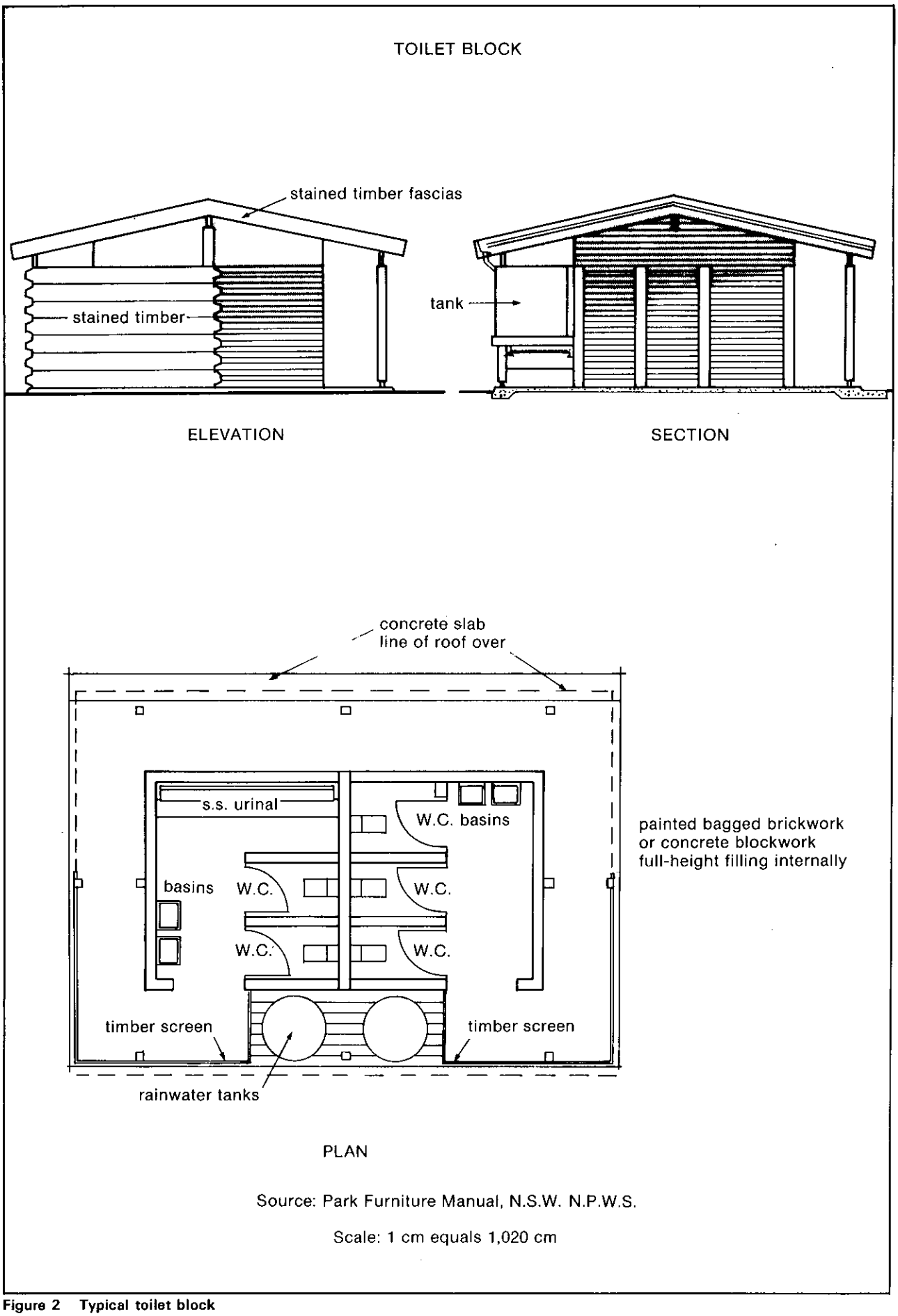


Figure 2 Typical toilet block

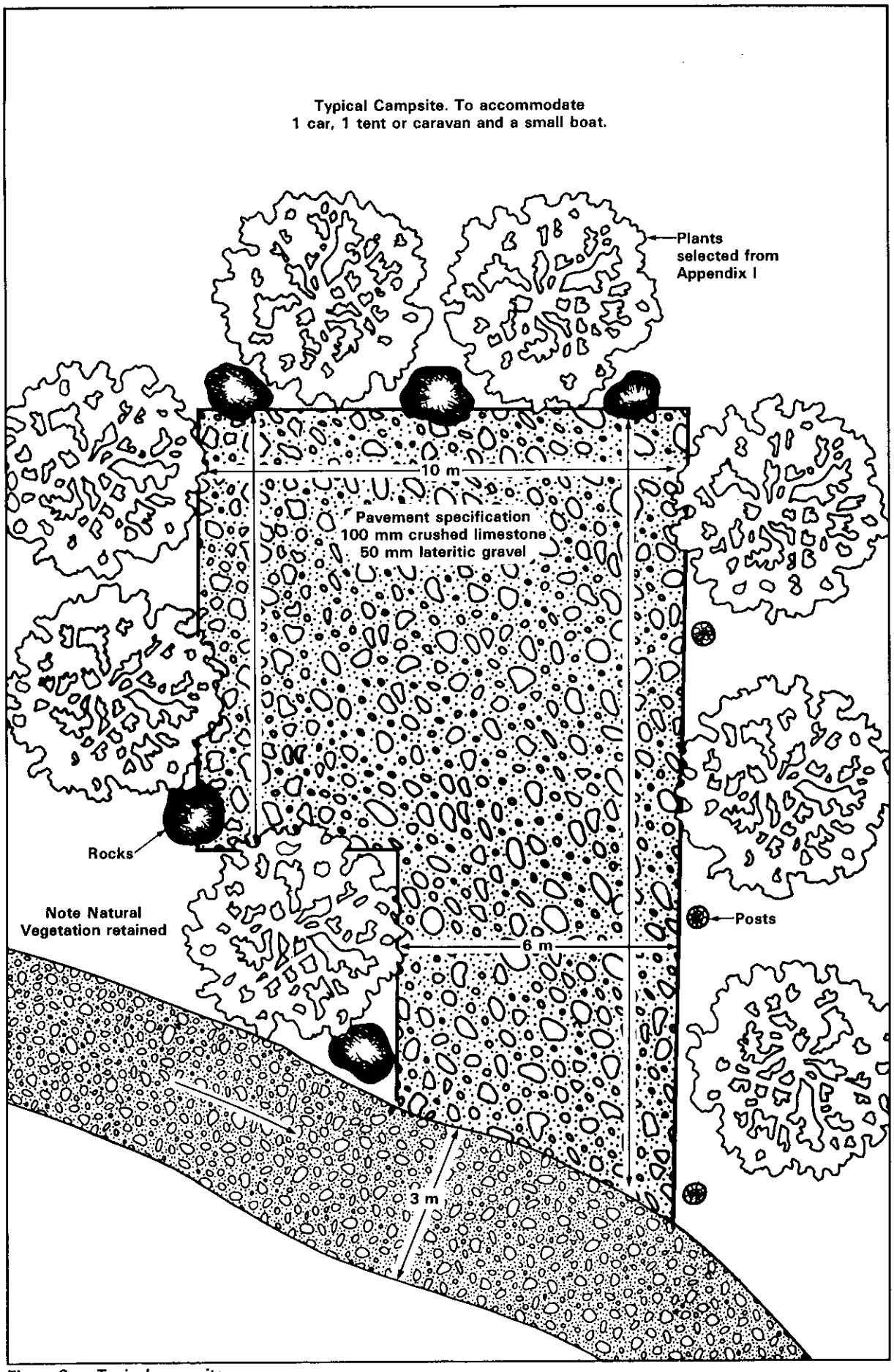


Figure 3 Typical campsite

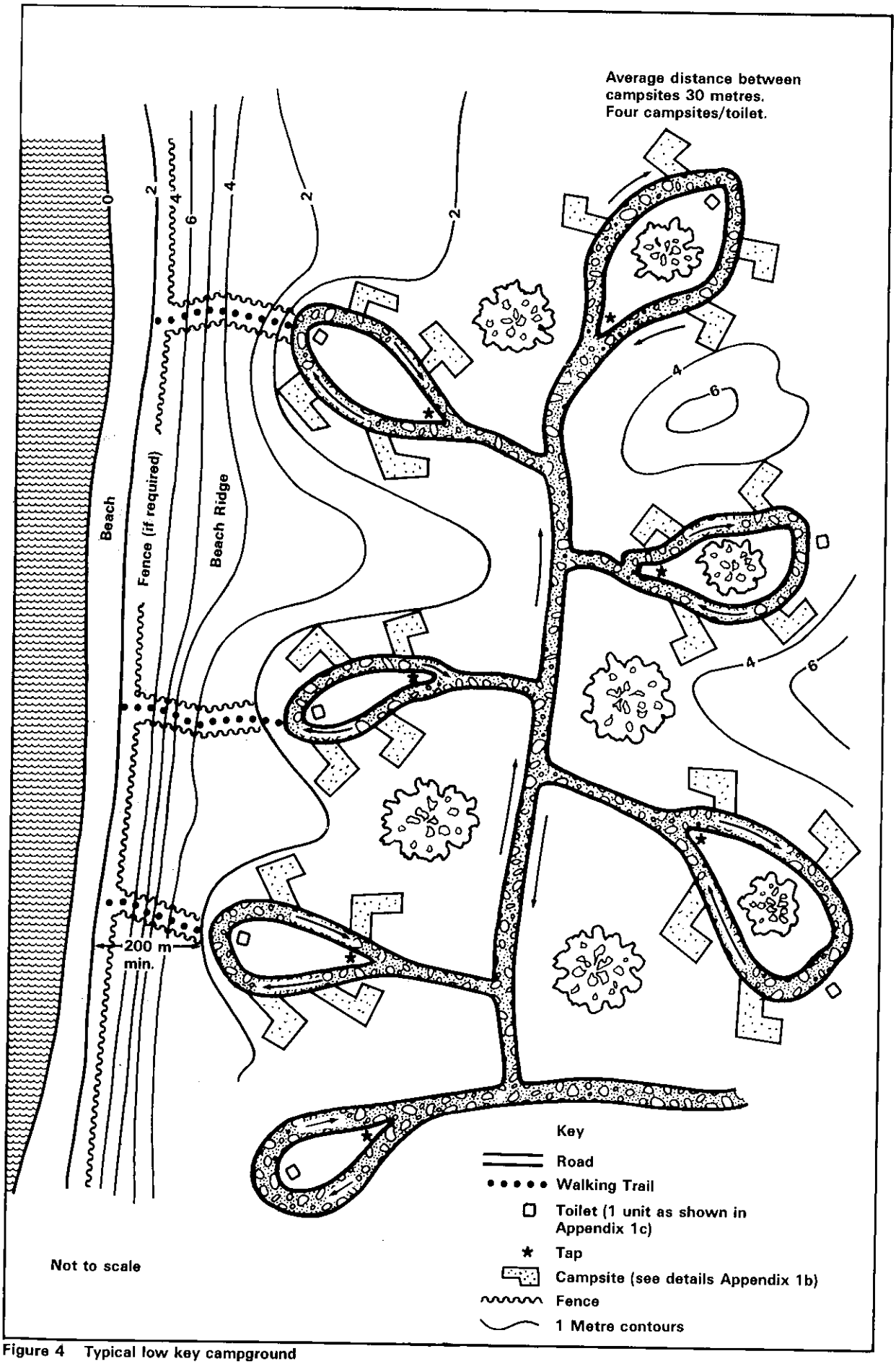


Figure 4 Typical low key campground

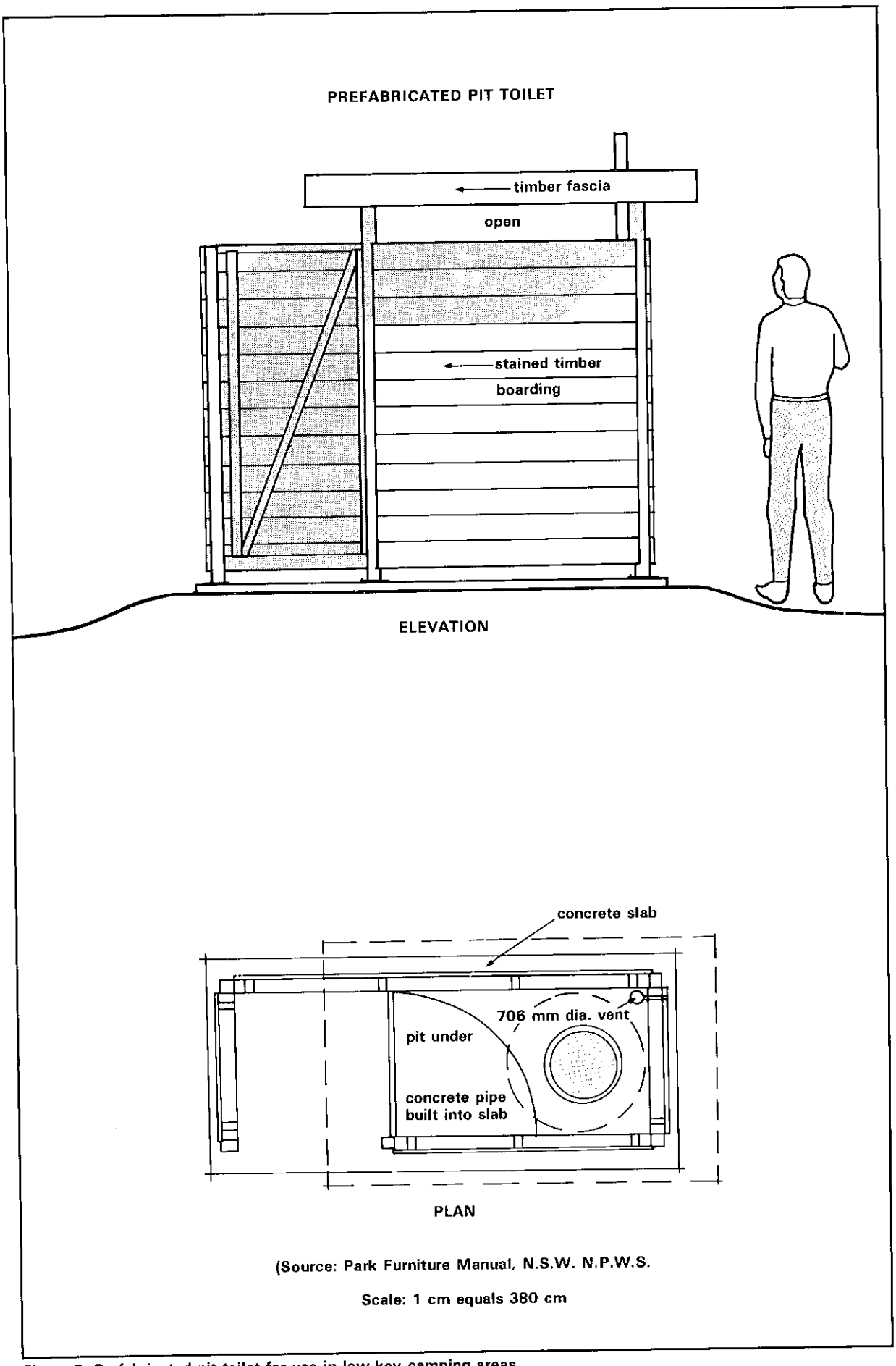


Figure 5 Prefabricated pit toilet for use in low key camping areas.

A production bore drilled to a depth of 250 metres screened between 175-250 metres should yield between 500-2 000 cubic metres per day. Such a bore would cost between $52-61 000 is constructed in 1985.

When the bore is constructed it should be located close to the major camping area to minimise reticulation costs.

5.4 LANDSCAPING

While the existing landscape of the Cape is attractive and should be retained and protected, some tree and shrubs plantings will be required to screen the camping area, and provide shade and protection from the wind.

Generally trees endemic to nearby areas of the Pilbara and Kimberley should be selected and a recommended plant list is shown in Appendix I. Plantings will be limited until the water supply has been developed and Council will seek advice from the Department of Conservation and Land Management nurseries at Karratha and Broome before undertaking plantings.

5.5 SIGNS

Limited signs will be required at the entrance at the Reserve at major facilities, points of interest and at intersections. Some restrictive signs will be required to influence visitor behaviour and examples of such signs are shown in Figure 6.

As public education and interpretation is a major management aim at Cape Keraudren, nature trails will be developed to assist people's understanding and appreciate this unique arid coastal ecosystem. The trails will be defined by low posts and should require little construction. They will guide people to areas of interest demonstrating geological features and mangrove and marine ecosystems. The location of possible trails is shown on map 8.

5.6 BOAT RAMP

A boat launching ramp exists at high tide level in the location marked on Map 7 but this facility has been damaged by storm activity and requires some repair. Council will approach the Department of Marine and Harbours and seek advice about this work. In addition, an area close to the boat ramp will be put aside to provide parking for vehicles and trailers using the ramp.

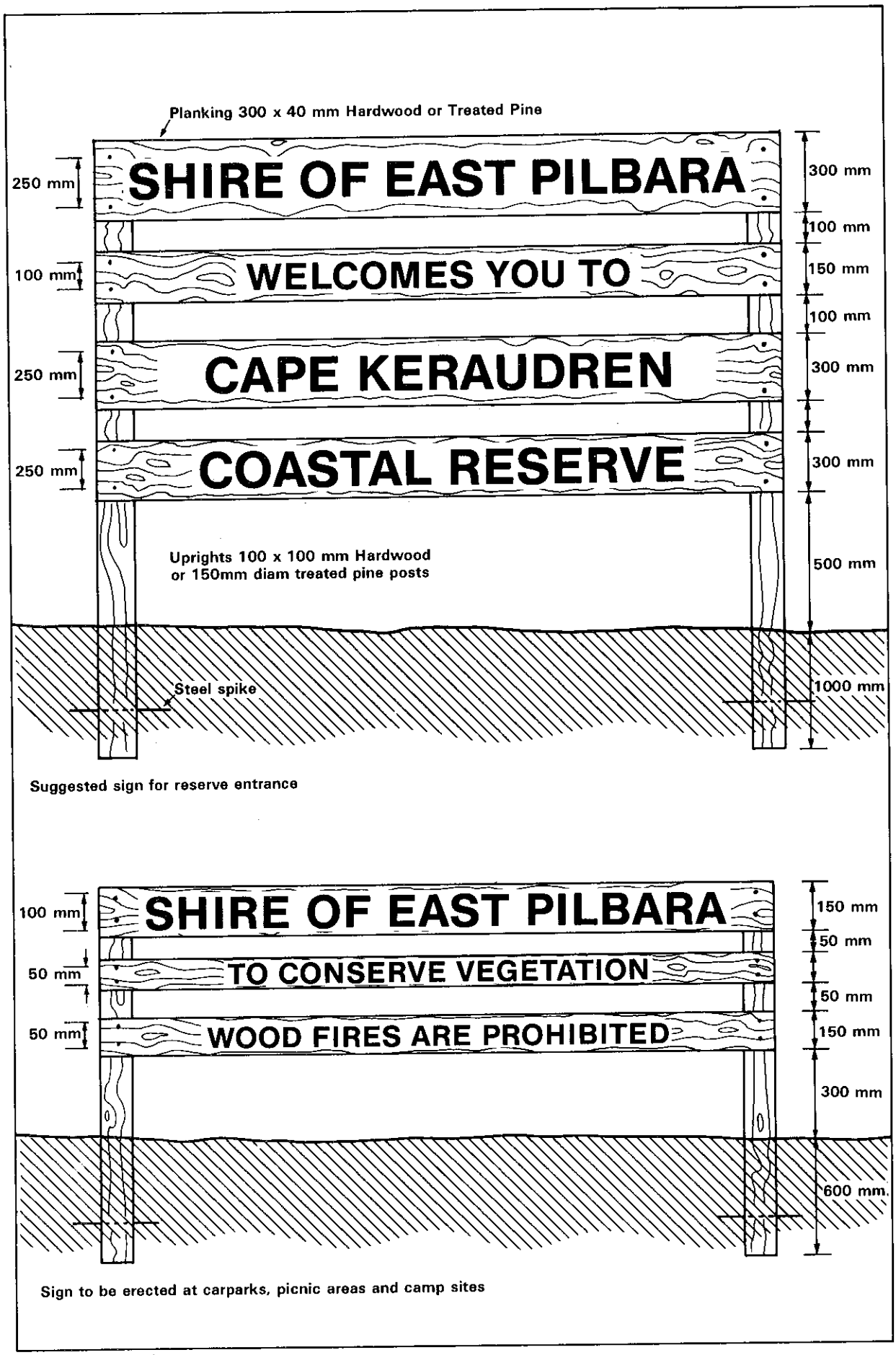
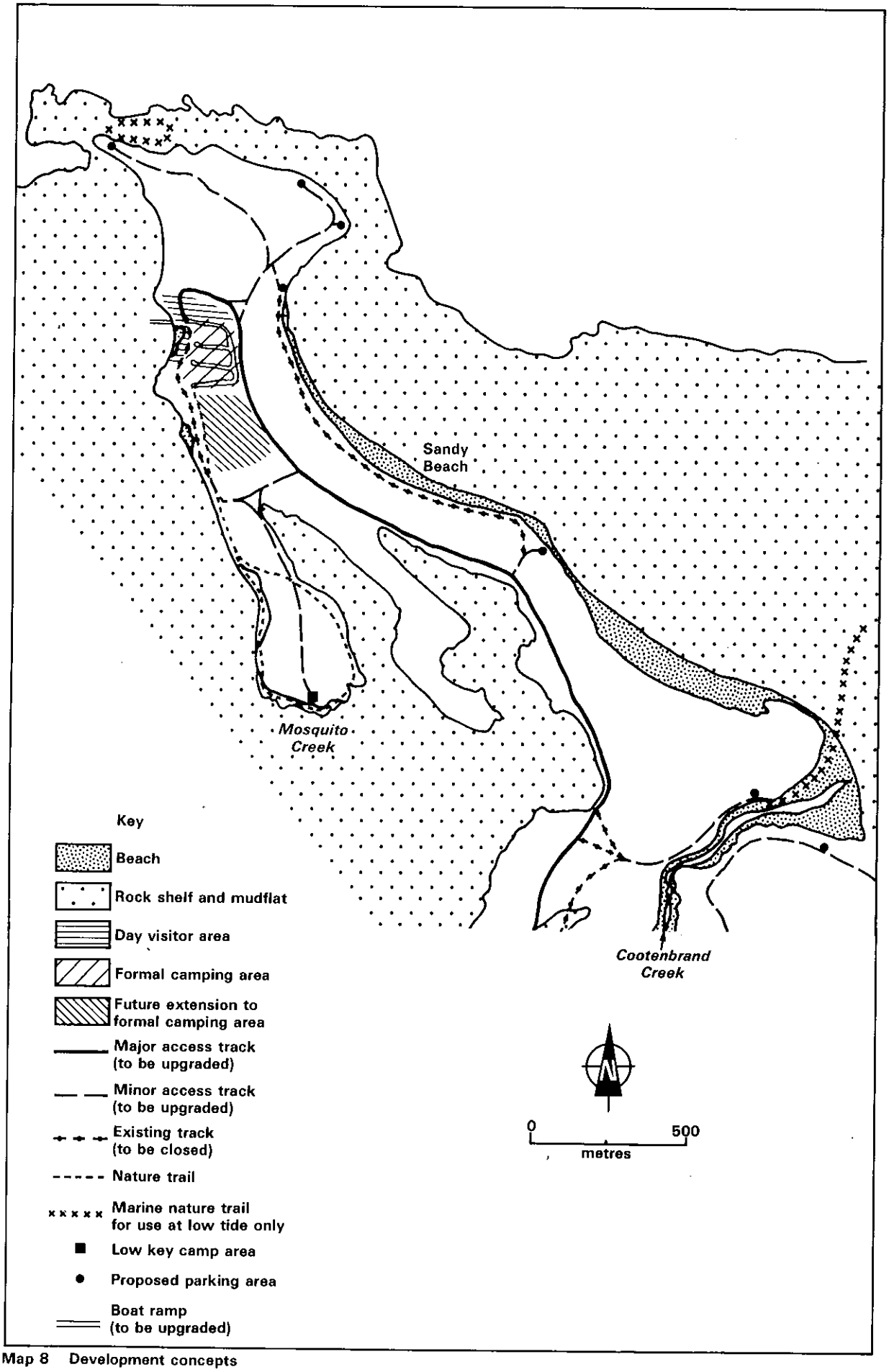


Figure 6 Typical signs.



Map 8 Development concepts

6.0 MANAGEMENT ISSUES AND RECOMMENDATIONS

Management is a series of activities undertaken to assist in the achieving the reserves purpose and conserve the environment. The management objectives provide a framework for conserving the areas resources, integrating the reserve into the regions environment and accommodating environmentally compatible public use.

6.1 ACCESS MANAGEMENT

The provision and maintenance of effective access to appropriate areas in an integral part of the development of the area and this is the responsibility of the Shire of East Pilbara.

Vehicle use of the area must be confined to designated roads and tracks to prevent damage to the vegetation and associated erosion, and to provide reasonable safety for pedestrians in the area.

Recommendations

The control of vehicles can best be achieved by implementing the following recommendations. Council will:-

- provide good access to popular points by the staged development of tracks and car parks as shown on Map 4;

- inform the public about the access system and the need to remain on the roads to conserve the environment;

- implement the provisions of the Control of Vehicles Off Road Areas Act 1978. The entire area should be declared a prohibited area for all motor vehicles with the exception of designated vehicle access roads and car parks;

- monitor use of the access system.

6.2 LANDSCAPE PROTECTION

The landscape of Cape Keraudren is a valuable resource which could be degraded by unplanned development and management. The absence of large trees and the open nature of the country would allow man-made structures to intrude on the landscape.

Recommendations

- Structure and roads will comprise materials and colours which harmonize with the landscape.

- When possible developments will occur on the edge of spaces which are defined by sand hills and tall vegetation.

- Toilets and similar structures will not occupy the central or highest point in any area. They are best located away from the foreshore and screened by clumps of vegetation.

- Caravan parks or camping areas will be screened with trees and shrubs. If these plantings are undertaken correctly they will assist in landscape protection and provide shade.

- Roads in the reserve will be designed so they harmonize with the landscape through which they pass. It is not necessary for them to meet the technical standards of other rural roads in the Shire, as vehicle speeds need not be high. Where possible roads will follow contours and avoid mud flats, and the width of road pavements and shoulders will be minimal.

- The visual impact of car parks will be minimised by careful siting and design.

6.3 QUARRYING

There may be a need to continue quarrying road base material for construction purposes in the reserve. This operation should take place on a site, producing good quality material which is not readily visible from the roadside, camping areas or coastal viewing points. Borrow pits resulting from quarrying will remain free of vegetation for long periods unless proper rehabilitation techniques are adopted.

Recommendations

- The sides of pits will be reshaped with slopes of less than 1 in 3.

- The bottom and sides of pits will be ripped to a depth of 0.5 metres.

- Top soils and plant material from the surface of the pit will be returned and spread over the site to a depth of 100 mm. Top soil used for this purpose will not be stored for more than 3 months.

6.4 EXOTIC FLORA AND NOXIOUS PLANT CONTROL

With the exception of some Australian trees and shrubs which may be brought into the reserve, to form windbreaks and visual screens, introduced plants should be discouraged. The low nutrient status of the soil in the reserve makes invasion of the area difficult for most plant species, providing bare areas which are suited the establishment of introduced species are kept to a minimum.

RECOMMENDATIONS

- Noxious weeds should be eliminated immediately they occur. Advice concerning the control of noxious plants is available from the Agricultural Protection Board.

6.5 DIEBACK PREVENTION

Dieback is a plant disease caused by the fungus Phytophthora cinnamomi, commonly known in this State as Jarrah dieback. Introduced into Western Australia early in the century, the disease was not identified until the 1960's. By that time it had spread unwittingly throughout much of the forest near Perth, particularly by the heavy machinery used after World War II to build roads, clear the way for powerlines or for logging operations.

At the time this plan was prepared there had been no report of dieback in the reserve, and little is known about the likely spread or effects of the disease in this type of environment, but it should be considered a significant threat.

Recommendation

As there is no known cure for the disease on a broad scale it is important that the organism responsible is not introduced to the reserve. Infection is mostly likely to occur if soil or road building materials are imported from affected districts. Plant seedlings used for landscaping in the reserve will come from a nursery using sterilized materials.

6.6 GARBAGE DISPOSAL

The presence of garbage and litter reduces the amenity of coastal areas and may create a health hazard. The location of the existing tip is not ideal because it affects the landscape and may reduce the long-term development potential of the site, and another site should be selected.

Recommendation

A new tip will be established on the site shown on map and this area will be fenced and managed in accordance with proper tip management procedures.

6.7 FIRE MANAGEMENT

The vegetation of Australia has evolved in the presence of fire and plants use a variety of strategies to survive burning. Some plants regenerate vegetatively from parts of their roots and stems, while others recover by means of seeds stored on the plant or in the soil. However, and dune communities recover slowly after fire and the erosion risk is high until the vegetation recovers, which may take several years. The danger of erosion is higher if the area is subject to intensive public use. As a result it is considered that management should attempt to exclude bushfire from the dune areas and if fire does occur it should be confined.

Recommendations

The following programme is recommended to reduce the risk of widespread damage by fire.

- The lighting of fires in the reserve should be prohibited except in properly constructed fire places.

- The public education programme should include information concerning the danger of fire in the area, and the responsibility of people in relation to the lighting of fires.

- The roads, tracks and carparks in the area can be used as fire breaks, and the appropriate location of fire breaks should be considered when locating roads.

6.8 WILDLIFE MANAGEMENT AND RESEARCH

As outlined in Section 3.0 the reserve supports wildlife habitats of international, national and regional significancne and significant fish stocks. Further research is required before the life history and requirements of these animals can be identified properly.

However, it is known that the important wading bird populations which use the district each year benefit if disturbance by people is avoided. This can be achieved by limiting public access to areas frequently inhabited by the birds.

Recommendations

. That Council develop the coastal access system which will minimise the disturbance of wading birds.

6.9 SHELLFISH MANAGEMENT

The status of shellfish populations is of concern, and more information is required before positive management proposals can be made.

Recommendation

. Advice will be sought from the WA Museum and Fisheries and Wildlife Department about the feasibility of establishing marine reserves.

6.10 PUBLIC EDUCATION

The Council's public education programme could be part of a wider proposal for the region, the objectives being to guide visitors, interpret the natural features and to influence the behaviour of people.

Recommendations

. That with assistance from DCE, Council will inform visitors about the natural attractions of the district, where to find them and how to used them in an appropriate manner, by -

. Preparing a pamphlet containing details of roads, paths, boat launching areas, fishing spots, beaches, wildlife and picnic areas, cultural and natural attractions; the pamphlet should also contain information about the proper use of vehicles and boats in the district;

. Erection of well designed signs at appropriate locations;

. Continuing contact between Shire staff and the public.

6.11 MANGROVES

As outlined earlier mangroves form a vital component of the natural system at Cape Keraudren however they are sensitive to disturbance. Signficant physical factors influencing the occurrence of mangrove communities include tidal regimes, sedimentation (accretion and erosion), fresh and salt ground water and exposure to wave energy. In addition, tidal mud flats on the seaward side, and salt flats on the landward side are important parts of the mangrove system (McKenzie 1982).

Care will be required during the development of the Cape if the mangrove system is not to be degraded.

Recommendations

The use of mangroves for fire wood will be prohibited. Camping areas will be located away from mangroves. The planning and development of roads and tracks will be used to discourage people from driving on the salt flats.

. Disposal of wastes (liquid and solid), quarrying and clearing of vegetation will be avoided in the mangals and adjacent tidal flats.

. Where possible increased discharge of stormwater into creeks and the tidal flat will also be avoided.

- Care will be taken to ensure that land uses adjacent to mangrove communities will not be incompatible with the mangrove environment.

- Care will be taken to ensure that engineering structures do not inhibit natural water flows in the reserve.

6.12 ABORIGINAL SITES

Cape Keraudren has a number of sites of interest to Aboriginal people and careful planning and management will be require to protect them.

Recommendations

- All developments will be undertaken to avoid significant aboriginal sites which are identified in the consultants report.

- Generally specific site locations will not be identified in this plan or on the ground to avoid publicity and possible site disturbance. The only exception to this policy is the flying fox increase site which the traditional owners feel should be marked with a sign.

6.13 PLACE NAMES

Currently many of the attractive areas and features around Cape Keraudren are not named, and as use and management operations increase this will create problems.

Recommendations

- Council will identify and name places and features of interest in accordance with the Nomenclature Committees policies.

- Care will be taken to ensure that features which have Aboriginal names are identified, and their traditional names used.

7.0 IMPLEMENTATION

Implementation of this Coastal Management Plan, which will enable a co-ordinated approach to planning and management, is primarily the responsibility of the East Pilbara Shire Council. The first step in implementation is to consider this Draft Plan. The second is to process comments from Council, residents and other interested bodies involved in planning and management at the Cape, so that a final Management Plan can be prepared. The third step is to adopt the final Management Plan and any recommendations and proposals it may contain.

7.1 ROLE OF THE STATE GOVERNMENT

As set out in the Government Position Paper on Coastal Management, the State Government is committed to sound planning and management of the WA coast. A Coastal Management Co-ordinating Committee has been set up and its functions are outlined on page vi

Various government authorities can provide advice and financial assistance for management of the coast.

7.2 ROLE OF LOCAL GOVERNMENT

Coastal management plans are generally prepared by or in conjunction with the local authority who can provide and co-ordinate local public participation. Local authorities can fulfil an important role in the management of coastal lands provided that they are given technical assistance and financial incentives. In many cases this is advantageous as the local authority has local knowledge, equipment on site, an existing land management role, and an established liaison with State Government departments. One of the important aims of this Management Plan has been to provide a guide to potential uses of various land areas and to recommend management strategies in the coastal zone so that the East Pilbara Shire Council can become involved in management of lands under its jurisdiction.

7.3 FUNDING

Finance is required to implement land management programmes. Currently much of this cost is being borne by the Shire, with occasional assistance from State Government departments. Hopefully the Coastal Management Co-ordinating Committee will be able to co-ordinate applications for finance through various government departments so that adequate and long term funding can be ensured.

As the question of funding is difficult, proposals that require only administrative changes (ie reserve vestings) can be addressed immediately.

As for proposals that do require funding, the existing system of shire management funding, supplemented by grants from appropriate government departments in the context of a long term plan, should prove sufficient to initiate management and development proposals for areas under most pressure.

In the present climate of tourist promotion and unemployment relief, the two bodies that should be approached immediately are the State Tourist Commission and the Commonwealth Department of Labour and Industry. Other State Government departments that do provide grants include: the Department of Youth, Sport and Recreation (community sport and recreation facilities fund); Main Roads Department (tourist road grants); DCE (beach management grants); Department of Agriculture (soil conservation grants); PWD

(foreshore and erosion repair grants). As mentioned in the introduction to this report, experience indicates that applications for funding are likely to be more successful if presented in the context of a long term management plan. The fact that a Coastal Management Plan has been prepared and accepted by Council should assist these agencies in making funds available.

7.4 CROWN LAND VESTING

The implementation of this plan would require changes to the vesting of many areas of Crown land. These will be outlined in the final report after comments in the draft have been considered.

REFERENCES

Craig, G.F. 1983. Pilbara Coastal Flora Department of Agriculture, Western Australia.

Curry, P and Hesp, P.A. 1985. A Land Resource Survey of the Fall Point Coastline - Broome WA. Technical Report 38, Division of Resource Management. WA Department of Agriculture, Perth WA.

Hickman, A.H. and Gibson, D.L. 1982. Port Hedland - Bedout Island - Western Australia 1:250 000 Geological Series - Explanatory Notes. Australian Government Printing Service. Canberra.

McKenzie, N. 1982 and 85. Personal communications made in interdepartmental letters dated 16 March 1982 and 3 October 1985.

O'Connor, R. and Veth, P.M. 1983. Report of the Ethnographical and Archaeological Survey of Cape Keraudren and adjacent areas of Pardoo Station. Western Australia. Shire of East Pilbara, Marble Bar, WA.

Read, J.M., 1983, Cape Keraudren - Interim Management Plan. Shire of East Pilbarra, Marble Bar, WA.

Semeniuk, V., Kenneally, K.F. and Wilson, P.G. 1978 Mangroves of Western Australia.

APPENDIX I

APPENDIX I (prepared by D McMillan, Department of Conservation and Land Management, Karratha)

Groundcovers

Sesuvuim portulacastrun
Enchylaena tomentosa
Ipomoea brasiliensis
Ipomoea costata
Diplopeltis eriocarpa
Scaevola crassifolia
Scaevola globulifera
Clianthus formosus
Canavalia rosea

Small Shrubs

Gomphrena canescens
Lepidium strongylophyllum
Capparis spinosa
Rhagodia eremaea
Scaevola spineceus
Acacea Transluceus
Tephrosia rosea
Cassia glutinosa
Cassia helmsii
Cassia oligophylla
Crotalaria cunninghamii
Indigofera monophylla
Swainsonia pterostylis
Solanum phlomoides

Larger Shrubs/Small Trees

Acacia bivenosa
Acacia ampliceps
Acacia coriacea
Acacia trachycarpa
Myoporum acuminatum
Melaleuca lasiandra
Gordenia sp

Larger Trees

Lysiphyllum cunninghamii
Thespesia populneoidea
Euc papuana
Owenia reticulata
Ficus virens
Ficus platypoda

Other Native Species Worth Considering

Adonsonii gregorii
Ficus racemosa
Brachychiton gregorii
Terminalia supranitifolia
Terminalia ferdinandiona
Terminalia petiolaris
Canarium australia
Timonius Timon
Celtis phillipinensis
Minuoops elengi
Erythrina verspittillio
Pittosporum philliarioides
Melaleuca acacioides