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SAGASCO

EXPLORATORY DRILLING PROJECT

BASS BASIN

ENVIRONMENTAL ASSESSMENT

Dames & Moore
February 1992
23830\001

OR-403

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26 February 1992

SAGASCO Resources Ltd
60 Hindmarsh Square
ADELAIDE SA 5000

Attention: Mr Andrew Stock

Dear Sir

As discussed in Adelaide last week please find enclosed two (2) draft copies of the Environmental Section of the Environmental Assessment for the exploratory drilling programme in Bass Strait.

Today I have spoken with Ron Bell and we are providing the inputs to his oil spill contingency plan this week.

Any queries regarding this report, please contact Mr David Gwyther or the undersigned.

Yours faithfully
DAMES & MOORE PTY LTD

Russell Synnot
Manager
Victoria, South Australia and Tasmania

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TABLE OF CONTENTS

Page No.

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

* not recieved with this report

EXECUTIVE SUMMARY

The potential environmental impacts of exploratory offshore oil drilling have been assessed according to mode of interaction with the environment, including the physical aspects (eg. the presence of the rig), the operational activities and accidental oil spills. The major conclusions are summarised below.

- The proposed locations for the exploratory drilling are in the central region of Bass Strait. The proposed areas do not coincide with any of the more intensively harvested commercial fishing grounds. The southern shark fishery and, to a lesser extent, the south east trawl fishery and the Bass Strait scallop fishery do occasionally operate in the area but are also distributed throughout the Bass Strait region. Some temporary loss of access by fishermen to the area of the rig-exclusion zone will be incurred. Any prolonged interference with fishing will depend on the type of well capping at the completion of the exploration.

- There are some positive effects of the rig to the commercial fisheries in Bass Strait such as the provision of navigational assistance and weather information.

- Helicopter routes between Burnie and the rigs will not overfly any sensitive bird or seal rookeries.

- Impacts from the operation of supply vessels from Burnie or Barrys Beach during the period of exploration will be no greater than from the frequent shipping which passes through the region. Supply vessels will be subject to port operational procedures.

- If the supply site is at Barrys Beach (situated between the Corner Inlet and Nooramunga marine and coastal Parks), accidental spillages of fuel oil and other bulk materials such as drilling fluids could affect the adjacent seagrass and bird feeding areas. Spills would be handled under the Port Plan of the Port of Melbourne Authority.

- The discharge of drill cuttings and drilling fluids is expected to have a localised smothering effect on the sea bed in the immediate area of the rig. Existing benthic studies of the Bass Strait continental shelf indicate wide distribution of species present, so that the location of drilling is unlikely to have any particular significance. Given the volumes of cuttings and distances from shore, it is not likely that sediment and reduced water clarity could reach inshore reef areas or impact upon abalone divers or recreational divers.

- The return to shore of domestic and oily waste will remove any risk of impact to the marine environment.

- Discharge of macerated sewage from the rig to sea in an open oceanic high energy environment is not of concern. Nutrients will be rapidly dispersed and recycled by bacterial and phytoplankton activity.

- Species most likely to be in the vicinity of a spill of oil of any size are rafting birds (such as muttonbird. Marine mammals have a higher capability to swim to avoid spills but could accidentally become contaminated.

- The immediate toxic effects of a spill could affect fish eggs and larvae but this would be localised and in an area which does not correspond with the major fishing grounds.

- Similarly, any dispersed or submerged oil would not impair major fishing grounds if this were to occur in the vicinity of the rig.

- Of 22 oil spill scenarios modelled, only four resulted in oil impacting with the coastline. Two of the four cases occurred from a theoretical spill at the Flinders 1 site, with beaching on the coast near Stanley after 4.5 days. The wind conditions required to produce this trajectory occur with a frequency of 2%. Thus the risk of an uncontained blowout and landfall at either of the locations is extremely small.

- The other two examples occurred from oil theoretically spilled from the King 1 site. In this case, oil beached near Wilsons Promontory after approximately 3.5 days under wind conditions which occur with a frequency of 3%.

- The conditions used in the modelling were selected with the highest likelihood of achieving landfall. In most of the scenarios, oil was either carried away from the coastal areas or remained close to the original spill site.

- By combining the known risk of a major blow out with the probabilities of finding oil and the trajectories of spilled oil, the probability of beaching of an oil spill is approximately one in twenty million.

- The predicted landfall area on the Victorian coast includes the Shallow Inlet Marine and Coastal

Park and the Wilsons Promontory Marine Park, both of high conservation value as wildlife habitat and in the latter case, also of high tourism value.

- The predicted landfall area of the Tasmanian coast includes a number of sensitive areas such as the Port of Stanley, East Inlet, The Nut, mariculture sites around Duck Bay, mutton bird and penguin rookeries.

- There would be adequate time prior to the beaching of any spill to protect estuaries and inlets (eg. Shallow Inlet and East Inlet) with booms although such protection would not be possible for the exposed beaches and rocky headlands. The preferable treatment is to apply dispersants as soon as possible after any spill when dispersants will be most effective and while oil is located in open oceanic areas.

- The general perception of the community groups consulted was that there is unlikely to be any major environmental impact as a result of the proposed exploration in the Bass basin. It is understood that the risk of oil spills or blowouts during exploration is remote although the consequences may be high. The benefits of the possible discovery of an alternative energy supply to hydro-electricity were emphasised by many people.

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SAGASCO
EXPLORATORY DRILLING PROJECT
BASS BASIN
ENVIRONMENTAL ASSESSMENT

1.0 INTRODUCTION

SAGASCO Resources Ltd as operator on behalf of joint venturers is planning an exploratory drilling programme for oil reserves in western Bass Strait, in the TRL-1, TI8P and T25P leases, offshore from Tasmania during the latter part of 1992. The wells to be drilled are Yolla 2, King 1 and Flinders 1 respectively.

There is potentially a large number of environmental issues associated with such activities and it will be important to respond to these issues and to base oil spill contingency planning on sound technical information. SAGASCO Resources Ltd therefore commissioned Dames & Moore to provide this information with which to meet its internal and external environmental responsibilities in providing environmental management of the exploration project.

1.1 OBJECTIVES AND SCOPE OF REVIEW

The present report presents the technical supporting information for the SAGASCO Resources Draft Oil Spill Contingency Plan and contains:

- the identification of relevant marine environmental issues;
- an assessment of these issues in relation to interactions with oil exploration and drilling activities;
- the identification of community organisations and individuals likely to have a direct interest in SAGASCO's proposed exploratory drilling operations;
- oil spill trajectory predictions based on a worst-case blowout of 5 000 barrels for prevailing weather and current conditions typical of the May to December period, (Appendix A);
- an outline of cleanup procedures and the roles, objectives and responsibilities of the various regulatory agencies and key contact persons; and
- identification of acceptable sites for contaminated waste disposal.

2.0 ENVIRONMENTAL INTERACTIONS

2.1 INTRODUCTION

The major environmental issues which have been identified as having the potential to arise from offshore exploratory drilling activities have been summarised in relation to the mode of disturbance. The mechanisms of interaction with the environment are through the physical presence of the rig, the operational procedures and accidental spills or blow-outs. Each will require consideration during localised positioning and operation of the exploratory rig.

2.1.1 Physical Impacts

- Interference to offshore fisheries caused by the presence of the rig structure.

- Disturbance to sea bird and seal populations (feeding and breeding) by the supply helicopter and supply vessel traffic.

2.1.2 Operational Impacts

- The volume and disposal of cuttings and drilling fluids and any washdown introduced to the marine water column and sea bed, causing changes to water visibility and sea bed conditions.
- Spillage of any fuel and bulk materials during transfer to the supply vessel and to the rig.
- The level of toxicity or perceived toxicity of cuttings, drilling fluids and washdown that may enter the marine environment.
- Disposal of ballast water from the rig, if chartered from overseas;
- Ambient noise levels at the drilling location.

2.1.3 Accidental Blow-Out or Oil Spill

- Accidental blow-outs or oil spills have the potential to cause the most serious environmental impact because the offshore and coastal waters of Bass Strait support a diverse range of sea birds, mammals and fish as well as commercial and recreational fisheries. Highly sensitive coastal areas used for tourism or as penguin or seal breeding colonies, may arise as issues depending upon results from oil spill trajectory analysis.

- In the unlikely event of a major oil spill, trajectory modelling and clean up response mechanisms would be implemented to safeguard sensitive environments.

- The risk of an uncontained blow out has been estimated at 1.7×10^{-3} and 8.6×10^{-3} per well drilled in the North Sea and Gulf of Mexico respectively. Of these, one in fifty may be greater than 1000 barrels, giving a probability of a major blow out of 3.4×10^{-5} and 1.72×10^{-4} per well drilled in the North Sea and Gulf of Mexico (Langfield pers. comm.). Operating procedures and regulations in Australia correspond more closely to those of the North Sea and therefore, the North Sea figures are more applicable for the proposed operation. This risk is reduced further by a factor of approximately 20 (to 1.7×10^{-6}) since there is an accepted probability of a one in twenty chance of actually striking oil from a test well. The probabilities of minor oil spills relating to the proposed operating procedures are more difficult to assess.

- The risk of an oil spill reaching land is dependent on whether particular meteorological and hydrographic events take place and whether or not the spill can be cleaned up while it is still offshore. The modelling work conducted by the Victoria Institute of Marine Sciences (Appendix A) indicated a 3% chance of oil reaching the shore. By taking all of the above factors into consideration, the risk of an oil spill occurring and subsequently beaching onshore is much less than one in twenty million (5.1×10^{-8}), still assuming that there is no clean-up action undertaken offshore. The latter is also extremely unlikely.

2.2 REGIONAL SENSITIVITY TO OIL

The main regional sensitivities of western Bass Strait environments can be summarised into five categories which are:

- public perception and community concern;
- air and marine environment;
- birds and marine mammals;
- fisheries; and
- other commercial, recreational activities and cultural aspects.

A matrix of potential interactions between each mode of disturbance and each of the five environmental categories is given in Tables 2.1 to 2.5. These interactions have been subjectively assigned as positive or negative (Table 2.1) or low, medium and high impact potential (Tables 2.2 - 2.5).

2.2.1 Public Perception and Community Concerns (Table 2.1)

The appearance of the rig or the prior knowledge that SAGASCO intends to carry out exploratory drilling in the Bass Strait basin has raised public and media interest in potential environmental impacts of oil exploration.

Community concerns range widely from those based on technical information to those influenced by opinions and emotions. Perceived problems have required careful consultative management and Dames & Moore have sought to provide on-going information and explanation in an honest and forthright manner to avoid a polarisation of community views.

In excess of 45 groups were identified as having the potential to be affected, either positively or negatively if exploratory drilling did lead to full scale production.

For each of the major groups, their potential area of interest or concern was classified according to a number of major potential issues. For example, some groups were more concerned about impacts to marine fauna and flora. During the consultation process, the nature of these concerns was identified through discussion with the particular group and answered from a factual, technical basis. Consultation was with small groups rather than larger public meetings. The results of the community consultation programme are presented in section 4.0.

2.2.2 Air and Marine Environment (Table 2.2)

Physical impacts are likely to be restricted to the action of the rig's anchors on the sediment and benthic organisms, and thus only low impacts are expected.

Of the range of operational activities, flares will be of very low potential impact to air and water quality because of their infrequent occurrence and thus the potential problem to air quality is likely to be less than that caused by coastal shipping. The national air quality monitoring station is situated at Cape Grim on the north west tip of Tasmania. The probability that weather conditions could take gaseous emissions in that direction and for that distance is remote.

Discharges from the rigs and supply vessels such as drilling fluids and cuttings will have some localised effects on water and sediment quality. This could impact upon the plankton, through sedimentation, dispersion and possible toxic effects. The marine sediments and benthic organisms may be impacted through the settlement of these cuttings and used drilling fluids. These effects would be limited to the area of settlement of those sediments and is expected to be of short duration as re-colonisation would occur relatively quickly. Laboratory studies indicate that most of the water-based drilling muds now used in Australia have a relatively low acute toxicity to marine organisms. At present, the level of contaminated in the cuttings is not known and will be determined when samples can be obtained.

In addition to any toxicity, the potential smothering effect of spent drilling fluids and cuttings on the benthos is an issue. The potential importance of this problem depend on the volume of cuttings produced during exploratory drilling. Approximately 200 - 300 tonnes of cuttings and a similar amount of drilling fluids will be produced from each well over a period of 30 days.

There have been a number of studies in the United States which suggest that the severity of impacts from drilling fluids or cuttings is related to the amount of material accumulating on the substrate, which in turn is related to the physical characteristics of the discharge and hydrographic conditions, (Neff 1987). In high energy environments, little drilling fluids or cuttings accumulate and impacts on the benthos are minimal and of short duration. In low energy environments, a reduction in the abundance of some benthic species due to burial has been reported to extend, in some cases, for distances of 100 - 150 m down current. Patchiness and seasonal variation of benthos also makes any vigorous statistical detection of changes very difficult.

The same studies referred to by Neff (1987) have shown that drilling fluids discharged to the ocean are diluted rapidly to very low concentrations within 1 000 m to 2 000 m down current and within 2-3 hours of the discharge. Dilutions of 1 000-fold are frequently reported within 1 - 3 m of the discharge. The effects of this material on water column organisms, including carval and fish eggs, depend on toxicity, dilution rate, proximity to the source of the discharge and duration of exposure. From studies of different examples in the United States, drilling fluids were diluted to within background levels for suspended solids within 4 hours, and suspended solid concentrations in drilling fluid plumes dropped below 1 mg/L within one hour of discharge. Post-drilling observations of the sea bed at the Carnarvon Basin (Leatherback and Caretta leases) showed that a mound of solids up to 1.5 m high and 8 m wide remained at the drilling site (Barker, 1991). These figures would clearly depend upon local hydrographic conditions.

Ballast water and any sediment taken on during ballasting of the rig may be of concern if exotic organisms are released into the local coastal waters. The issue of ballast water is treated as a quarantine matter by the Australian Quarantine and Inspection Service (AQIS) who have introduced a voluntary code of practice including re-ballasting at sea and screening of water and sediment for organisms. The release of ballast is expected to be a once-off event and the level of risk depends on the presence, for example, of toxic marine algae in the port of embarkation. Samples of ballast water and sediment could be screened for the presence of toxic algae.

All domestic and putrescible waste will be segregated and transferred into tanks on the supply vessel for disposal on land. Sewage will be either macerated and discharged to sea according to Petroleum (Submerged Lands) Acts (1990), or stored in tanks and disposed of onshore. Any contaminated waste material will be taken to a contaminated waste disposal depot in Smithton, Tasmania.

Anti-fouling procedures may cause problems to water and sediment quality and particularly shellfish species if tin-based, high leach rate paint is used and if hull scrapings are returned to the sea. The area most at risk will be around any port where any rig or vessel maintenance activities occur. Tin-based anti fouling paints are permitted on vessels greater than 25 m.

The impact of worst-case oil spills is expected to be least to offshore benthos and most to the intertidal areas. Intertidal mud flats and other low energy, fine sediment shorelines (eg. estuaries and saline wetlands) are ecologically very sensitive and oil is generally best left to naturally degrade. Estuaries are considered a high priority case for protection as they are low energy coastal habitats which are often species rich, highly productive breeding grounds for fish and popular feeding grounds for birds.

Intertidal sand flat habitats are considered to be moderately sensitive to oil pollution due to the ability of oil to penetrate and adhere to beach sediments. They are characterised by relatively simple plant and animal communities. Intertidal rock platforms, reef foreshores and gravel or pebble beaches are considered less ecologically sensitive, being relatively low in species abundance and diversity.

2.2.3 Birds and Marine Mammals (Table 2.3)

Potentially, impacts to coastal, island and pelagic (open sea) environments are possible. The drilling rig itself will affect only pelagic habitats and since the rig is relatively small, its presence, and the associated noise, is unlikely to cause significant changes in the behaviour of pelagic birds or to marine mammals beyond the immediate area of drilling. Information about the degree of disturbance to whales caused by shipping activity is inadequate (Brown & Richardson 1991), but some detection of approaching vessels by whales is apparent. There have been no studies of threshold responses of whales to drilling noise (Brown & Richardson 1991) and it is recommended that SAGASCO obtain values of ambient underwater noise levels using a hydrophone.

The supply vessel is not considered to be a significant source of impact and will cause less disturbance than the frequent shipping which passes through the region.

The supply helicopter has the potential to cause localised, short-term disturbance to feeding concentrations of sea-birds. This can be avoided by flying low only when taking off and landing. The potential for more serious disturbance arises when breeding colonies on islands are involved. Low flights by a helicopter over breeding islands can cause serious disturbance to breeding birds, resulting in egg and chick loss, thereby reducing breeding success. Similar disturbance to seal breeding colonies could cause major loss of pups if breeding adults are startled. All islands and coastal habitats supporting breeding colonies of sea-birds or significant concentrations of coastal birds should be avoided in the course of helicopter operations. A rule-of-thumb should apply whereby helicopters and other aircraft do not fly below 2 000 feet above mean sea-level in the vicinity of islands. This height is considered to be sufficient to prevent serious disturbance and it is based on operating guidelines for aircraft over sensitive areas, including bird breeding colonies, developed by the Great Barrier Reef Marine Park Authority.

Land supply sites will be required for operations. These are likely to be in the Burnie or Devonport area in Tasmania or the Geelong or Barry's Beach area in Victoria. Once the land supply site is selected, a brief survey of coastal habitats near the site should be all that is required to identify the issues of conservation significance which have the potential to be impacted on by supply site activities. Appropriate management procedures may then need to be implemented.

Of the operational impacts, cuttings and drilling fluids are unlikely to affect any birds. An accidental spillage of a large quantity of drilling fluids in the vicinity of a Little Penguin breeding site could disrupt normal feeding movements by affecting underwater visibility. However, the high wave energy of the south west Victorian coast is likely to result in rapid mixing and dilution and any impact would probably be short lived. Washdown of the rig, supply vessel and mainland supply site has the potential, if not properly contained, to result in small oil slicks which could harm small numbers of seals and pelagic birds, particularly penguins.

All domestic and putrescible waste will be segregated and returned to shore and will therefore not have any impact on birds.

Lights from the rig may attract numbers of migrating birds at night, as it will represent one of the few sources of light and resting areas in the open ocean. Some seabirds (e.g. White-faced Storm-Petrels) could be attracted to lights and flares although, with the low incidence of flaring, flares are not likely to be a serious issue. Bird migratory routes are predominantly in the eastern and western margins of Bass Strait; that is, across Flinders Island to Wilsons Promontory and across King Island to Cape Otway. Many land birds migrate between Tasmania and the mainland along these routes.

There is the potential for accidental spills of fuel and drilling fluid to occur during transfer to the rig and supply vessel. Spills at both the land supply site and at the rig potentially pose problems for both coastal and pelagic birds. A spill of fuel is more serious than one of mud since the fuel would form a slick which could contaminate coastal birds and habitats, as well as pelagic birds. However, the rapid evaporation rate of fuel oils would mean that any effects would be very localised and, as it has not been proposed to drill close to any offshore islands, such an accident is unlikely to affect islands directly.

A blow-out could potentially cause some damage to bird life, in all three habitat types (coastal, island and pelagic). This will obviously depend on the size of the spill, the weather conditions prevailing at the time, the type of oil involved and the spill trajectory.

Oil spills affect birds in a number of ways. Birds badly contaminated by oil loose the waterproofing and insulating capacity of their plumage. Hypothermia then becomes the principal cause of death. Birds can also ingest the various toxic substances in oil when they preen their plumage to remove even slight oil contamination. Poisoning then becomes the main cause of death.

The most vulnerable species to oil spillage is the Little Penguin, followed by other diving species. Although most other birds can fly away from a slick, Little Penguins must swim through it, surfacing regularly for air. In coastal areas, diving species such as cormorants could be affected. Other birds in coastal habitats may become slightly contaminated and be poisoned as they preen to clean oil off their plumage. The ecology of coastal habitats and island shores could also be seriously damaged should an oil slick wash ashore. Bird habitats may be damaged directly or feeding may be interrupted by disturbance to organisms lower in the food chain. Seals would be particularly vulnerable if slicks were to wash up on island or coastal breeding sites.

2.2.4 Fisheries (Table 2.4)

The physical presence of the rig and supply vessels will have most impact on those offshore fisheries which normally operate in the same area. The exploratory leases are not located in the major fishing grounds of the offshore fisheries in Bass Strait but some interactions with the scallop, trawl, shark and rock lobster fisheries are possible. Through discussions with various fishing groups, it was regarded that only shark fishermen would be immediately affected by the presence of the rig in the lease areas. However, the transient nature of the exploratory drilling reduces the risk of any major impacts. The rig and its anchors will prevent fishing activities in an area within and to a point beyond the immediate exclusion zone (1 500 m radius about the rig). The intricacies of setting and operating fishing gear restrict the vessel operator's ability to avoid any obstacles. Any well head or cap left after the rig has departed can also interfere with fishing gear particularly trawl nets.

Of the operational impacts, the disposal of cuttings and muds to the sea bed may be of higher localised impact to scallops and rock lobsters, due to smothering effects, than to other species such as shark which have a greater capacity to move away. Sharks also bear live young and, unlike scallops and lobsters, do not have larval stages vulnerable to the toxic effects of oil. However, given the widespread distribution of rock lobsters and scallops and their larvae, impacts from exploratory drilling are generally low. The risk of sediment affecting abalone reefs through smothering or reduction in visibility is low (depending on plumes) but may need to be considered. The nearest abalone reefs are on the Victorian coast, some 100 km from the King 1 lease area. It is most unlikely that sediment from the volumes of drilling from and cuttings generated could travel that far.

In the worst case scenario of an uncontained blow-out, the main impacts to offshore fisheries would be through:

- the temporary presence of a slick over fishing grounds;
- fouling of shark nets or lobster pot gear caught in a slick;
- localised toxic effects of the oil and any dispersants used (depending on the type) to the species and to their planktonic or larval stages;
- fouling of inshore fishing areas; and
- effects of dispersed oil on the sea bed, particularly rock lobster or abalone reefs.

The seriousness would depend on the volume of oil spilled and its trajectory. Other fisheries such as the abalone fishery, inshore netting, mariculture and recreational fisheries would be vulnerable to spills depending on the state of the oil upon reaching the coastal zone. By the time of landfall, oil would be less toxic but more of a physical problem. Dispersal of oil in shallow water could affect abalone reefs or fish nursery areas and therefore should be avoided.

2.2.5 Industry, Tourism and Cultural Aspects (Table 2.5)

The location of the rig and increased sea traffic by the supply vessels will affect coastal shipping activity. For the period of operation of the rigs at each area, notification to mariners would need to be provided some weeks in advance in order to allow ships' masters to adjust their routes between coastal ports.

The presence of rigs and support infrastructure may also interact with tourism, potentially positively in the viewing of the rig and helicopters. Daily operational activities would not be expected to interact with the list of activities in Table 2.5 but in the event of a blow-out or major oil spill, all would be affected to some degree. Tourism would be most affected, depending on the location of landfall of the oil. Any industrial sea water intakes (eg. for cooling or salt production) would also be a high priority for protection. Shipwrecks would be least affected, since they are predominantly subtidal. Cultural heritage areas around beaches and cliffs may be at more risk from the activities of clean-up machinery than any oil itself. Coast related recreational activities such as water sports, beachcombing, camping etc. may suffer some short-term disturbances but these could be rectified following clean-up.

5 cm

TABLE 2.1
PUBLIC PERCEPTION AND COMMUNITY CONCERNS

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ISSUES / INTEREST GROUPS											
Conservation/Environment											
Australian Conservation Foundation	o	o	o		o				o		•
Greenpeace	o	o	o		o				o		•
Tasmanian Conservation Trust	o	o	o		o				o		•
Save Our Coast	o				o	x			o		•
Wilderness Society	o				o				o		•
Bird Observers Club	o				o				o	o	•
Royal Australiasian Ornithological Union	o				o				o	o	•
Dept of Environment and Planning											
• Parks, Wildlife and Heritage	x	x	x		o						•
• Environmental Management	x	x	x		o				o	o	•
Field Naturalists Club	o				o					•	•
Dept of Primary Industries	o	o	o		o	x					•
Dept Roads and Transport	o										•
CSIRO					x						•
Australian Heritage Council	o										•
Historical Societies	o										•
National Estate of Tasmania	o										•
Media	•				•						•
Primary Producers											
Fishermen	o	o	o	x	o	x					•
Divers	o	o			o						•
Mariculture	o	o			o						•
Local Communities											
Students/teachers	x				x						•
Residents	o				o		x		x		•
Local Business	x					x	x				•
Port Authorities	o			x		x			•		•
Tasmanian Development Authority	o				o					•	•
Recreational boating groups/individuals Chambers	o				o						•
of Commerce						x					•
State Emergency Service	x			•		x			•	•	•
Aborigines	o										•
Regional Development Boards					o					•	•
Tourism Tasmania	o				o	x					•
Royal Volunteer Coastal Patrol	o			•					•	•	•
Counter Disaster Committee	o				o				•	•	•
Local Councils	o				o	x					•
Marine Boards	o			x		•			•	•	•
Recreation/Tourism											
recreational fishermen	o			•	o						•
recreational divers	o				o						•
recreational sailors	o			•							•
tourists	o				o				x		•
tourism promotors	o				o	x			x		•
tour operators	o				o	x			x		•
Commercial/Industrial											
Shipping companies				x							
Unions							x				

o Negative impact • Positive impact x Positive and/or negative impact

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TABLE 2.2
POTENTIAL IMPACTS ON
AIR/MARINE ENVIRONMENT

		PROBABILITY	AIR Q	WATER Q	SEDIMENT Q	BENTHOS	PLANKTON	INTER TIDAL	SUB TIDAL	COASTAL RESERVES/PARKS
PHYSICAL IMPACT	RIG	1			o					
	Supply Vessel	1			o					
	Supply Helicopter	1								
	Supply Site	1								
	Well Capping	1								
OPERATIONAL IMPACT	Cuttings	1		x	x	●	●			
	Drilling fluids	1				●	●			
	Washdown	1		x	x	x	x			
	Domestic Waste	1		o	o	o	o			
	Formation Water	low		o			o			
	Flares	low	o	o			o			
	Ballast	initial		x	x	x	x	x	x	
	Fuel/Mud Transfer: To Rig	1		x	x	x	x			
	To Vessel	1		x		x	x	x	x	x
	Anti Fouling	1		x	x	x	x	x	x	
	Drilling Noise									
ACCIDENT	Blow Out	3.4×10^{-5}	x	x	x	o	x	●	x	●
	Oil Spill		x	x	x	o	x	●	x	●

o - Low
x - Moderate
● - High

5 cm

TABLE 2.3
POTENTIAL IMPACTS ON
BIRDS/MAMMALS

		PROBABILITY	OFFSHORE BIRDS	ISLAND BIRDS	COAST BIRDS	SEALS	WHALES	DOLPHINS
PHYSICAL IMPACT	RIG	1	o			o	o	o
	Supply Vessel	1	o	o	o	o		o
	Supply Helicopter	1	x	x	x	x		
	Supply Site	1			x			
	Well Capping	1						
OPERATIONAL IMPACT	Cuttings	1						
	Drilling fluids	1	x	x				
	Washdown	1	x	x	x	x		x
	Domestic Waste	1	x	x	x	x		x
	Formation Water	low	o	o	o			
	Flares	low	x					
	Ballast	initial						
	Fuel/Mud Transfer: To Rig	1	x	x		o	x	x
	To Vessel	1			x	o		
	Anti Fouling	1						
	Drilling Noise		o			o	o	o
ACCIDENT	Blow Out	3.4×10^{-5}	●	●	●	●	x	x
	Oil Spill		●	●	●	●	x	x

o - Low
x - Moderate
● - High

5 cm

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TABLE 2.4
POTENTIAL IMPACTS ON FISHERIES

		PROBABILITY	ROCK LOBSTER	SHARK	SET	SCALLOP	KING CRAB	ABALONE	COASTAL BAYS AND INLETS	MARI-CULTURE	RECREATIONAL FISHERIES
PHYSICAL IMPACT	RIG	1	o	x	o	o					
	Supply Vessel	1	o	o	o	o			o		
	Supply Helicopter	1									
	Supply Site	1									
	Well Capping	x	x	x	x	x					
OPERATIONAL IMPACT	Cuttings	1	o	o		x					
	Drilling fluids	1	o	o		x					
	Washdown	1	o	o	o	o					
	Domestic Waste	1	o	o	o	o					
	Formation Water	low									
	Flares	low									
	Ballast	initial								x	
	Fuel/Mud Transfer: To Rig	1	o	o	o	o					
	To Vessel	1	o	o	o	o	x	x	x	o	x
	Anti Fouling	1				o		x		x	
	Drilling Noise										
ACCIDENT	Blow Out	3.4×10^{-5}	x	x	x	o	x	●	●	●	●
	Oil Spill		x	x	x	o	x	●	●	●	●

o - Low
x - Moderate
● - High

5 cm

TABLE 2.5
POTENTIAL IMPACTS ON
OTHER COMMERCIAL AND RECREATIONAL ACTIVITIES/CULTURAL ASPECTS

		PROBABILITY	COASTAL SHIPPING	TOURISM	SEA WATER INTAKES	OTHER RRECREATIONAL ACTIVITIES	SHIPWRECKS	HERITAGE
PHYSICAL IMPACT	RIG	1	o					
	Supply Vessel	1	o					
	Supply Helicopter	1						
	Supply Site	1						
	Well Capping	1						
OPERATIONAL IMPACT	Cuttings	1						
	Drilling Fluids	1						
	Washdown	1						
	Domestic Waste	1						
	Formation Water	low						
	Flares	low						
	Ballast	initial						
	Fuel/Mud Transfer: To Rig	1						
	To Vessel	1						
	Anti Fouling	1						
	Drilling Noise	1						
ACCIDENT	Blow Out	3.4×10^{-5}	x	●	x	x	o	x
	Oil Spill		x	●	x	x	o	x

o - Low
x - Moderate
● - High

5 cm

3.0 EXISTING INFORMATION: COASTAL AND MARINE ENVIRONMENT

3.1 OCEANOGRAPHY

The study region incorporates the Bass Strait Basin, the Victorian coastline between Cape Otway and Corner Inlet, and the northern Tasmanian coastline between Cape Grim and Tamar River (figure 3.1.1).

The environment has been the subject of a limited number of investigations which form the base material from which this section is developed. However, a number of fundamental questions still remain to be addressed from a scientific viewpoint.

3.1.1 Data Sources

The following summary of the dynamics of the region is primarily drawn from the following investigations

i. Current meter and tide gauge measurements from the Victorian Institute of Marine Sciences (VIMS) database.
ii. Current meter deployments in the western Bass Strait cross-section passing through King Island, reported by Baines et al (1991).
iii. Seabed sediment descriptions of Jones and Davies (1983), and Blom and Alsop (1988).
iv. Weather patterns from the Bureau of meteorology, and analyses at VIMS.
v. Numerical model results of Black et al. (in prep.) and Greilach et al (1991).
vi. Wave measurements made by the CSIRO off Cape Sorell on Tasmania's west coast.

3.1.2 Bathymetry

The two regions of coastline that are of primary interest are the areas around Stanley and Waratah Bay. The shoreline near Stanley consists of irregular coastline with rocky outcrops and sandy beaches; whilst the Waratah Bay region is predominanly long sandy beaches, with sandy pocket beaches between rocky headlands along the western side of Wilson's Promontory. The general features of bottom topography to the east of King Island are shown on Australia Chart Nos. 4709 and 4601 (Hydrographic Service RAN, Sydney 1975). Bathymetry charts of the region are also available in the AUS Series and from National Mapping Service (Canberra).

3.1.3 Water Levels

The water levels and tidal regime of the southern coastline has been the subject of a number of investigations, as it is a challenging but basically tractable problem. The sea levels have been measured and analysed at various locations throughout the Bass Strait region. Hinwood and Wallis (in prep.) provided a comprehensive summary of the phase and sea level heights for the various tidal constituents.

The tidal sea level signal is mixed diurnal and semi-diurnal. The tides at King Island, Stanley and Waratah Bay are compared in Table 3.1. The comparison indicates that the amplitudes and phases change by only a small amount along this coastline. The M_2 constituent dominates the other main constituents (S2, K1 and O1), and this causes the neap/spring cycle to be understated. As such, the M_2 constituent was used, with a linear scaling function, to simulate the tidal currents in this region. Errors arising from this approximation will be most pronounced in shallow regions adjacent to the coastline. However, the approximation is acceptable over most of Bass Strait.

TABLE 3.1

Tidal sea level constituents (phases in degrees and amplitudes in metres) at King Island, Stanley, and Waratah Bay. (Taken from the Australian National Tide Tables, 1991, Australia Hydrographic Publication 11. Aust. Govt. Publ. Serv., Canberra).

	M_2	S_2	K_1	O_1
King Island	324 0.37	078 0.13	050 0.19	020 0.13
Stanley	339 1.14	130 0.14	097 0.15	060 0.11
Waratah Bay	326 0.84	119 0.19	065 0.22	045 0.14

Other influences on the water level include the direct effects of weather systems passing over the region. The most significant of these are wind stress, barometric pressure and coastal currents related to ocean circulation or coastal-trapped waves (figure 3.1.2).

The wind stress can cause set-up or set-down of water in coastal areas, as the sea level responds to the alongshore current induced by the wind. However, it has little effect on water levels further out to sea.
The combined effect of strong shore parallel winds and the Coriolis force cause the sea level to increase on

the southern Victorian coast when winds are from the westerly quadrant. On the northern Tasmanian coast, the westerly winds cause the water level to set-down. Thus, the water level in Bass Strait oscillates across the width of the Strait. The reverse applies with easterly winds. Coastal sea levels are reduced on the Victorian shoreline and increased along the northern Tasmania shoreline.

The changing barometric pressure systems passing over the region induce fluctuations in the water levels of the continental shelf and Bass Strait. Both of these phenomena have periodicities and amplitudes associated with the prevailing weather systems.

Less well understood influences on water levels include periodic upwelling of ocean waters, the large-scale ocean currents and the influence of coastal-trapped waves which come across the Great Australian Bight.

The water levels are therefore a complex interaction of local and oceanic influences, most of which are understood. For forecast purposes, the astronomical effects can be readily predicted without considering the meteorological factors/effects as well. The consequence is that workers in the nearshore areas should be advised to expect deviations from predicted water levels of the astronomical tides at times, particularly during strong easterly or westerly winds.

3.1.4 Currents

Tidal water currents in the Bass Strait Basin to the east of King Island and along the coast near Stanley are small, being less than 0.20 $m.s^{-1}$ (figure 3.1.3). In the Waratah Bay region, to the west of Wilson's Promontory the tidal currents are even smaller, being less than 0.10 $m.s^{-1}$ (figure 3.1.2).

However, currents exceeding 1 $m.s^{-1}$ pass through both the western and eastern entrances to Bass Strait (figure 3.1.3). Because the tidal circulation enters both sides of Bass Strait simultaneously, the flow is fastest in the entrance cross-sections and very small in central Bass Strait where the two opposing streams meet.

Circulation through the western cross-section was measured by VIMS and reported by Baines et al (1991). Analyses of the water current data indicated that very little of the nett flux was attributable to tidal influences. It was concluded that any nett flux identified was most likely to be caused by the prevailing winds, which most frequently come from the southwest and induce a northeasterly current or from the northeast and induce a southwesterly current.

3.1.5 Other Currents

Apart from tidal currents in the Bass Strait Basin, water movement may arise from currents induced by meteorological conditions (wind, temperature and barometric pressure) and coastal-trapped waves.

Wind-driven currents in the region tend to be relatively weak in comparison to tidal currents in the entrances to Bass Strait, but are the predominant cuase of water movement in the Basin region. Typically, wind-driven currents are of the order of 2% of the wind speed, with the direction of these currents generally following the bottom topography.

Temperature induced currents show a clear seasonal cycle with vertically homogeneous conditions over the winter months and weak stratification over the summer period. The major dynamic mechanisms are surface cooling and advection in winter, with surface heating and ocean water intrusion below a weak thermocline in the summer.

The direct effect that changes in barometric pressure across the Bass Strait Basin have on currents in the region is not well understood. The work that has been done involving barometric pressures has looked at the more general problem of storm surges. This involves the study of weather patterns passing across the Strait (Noye and Arnold, 1984; Hubbert, et al. 1990), and thus both the effects of pressure changes and the corresponding winds on the Strait are treated rather than considering the effects of these elements separately. Even so, the work of Baines et al. (1991) indicates a high correlation between the North-South atmospheric pressure gradient across the Strait and the oceanic mass flux through the Strait. The opinion of Hubbert (pers. comm.) is that it is necessary that modelling of the region for wind-driven currents should contain barometric pressures in the model conditions.

Recent work by Black et al. (in prep.) indicates that coastal-trapped waves can also give rise to currents within the Bass Strait Basin of the order of 0.15 - 0.20 $m.s^{-1}$. These waves are the result of changes in wind strength within the Great Australian Bight setting oscillations in motion, which are trapped on the narrow shelf region due to the influence of the Coriolis force. (Coastal-trapped waves may even result from gradients originating Western Australian waters.) Once they reach the wider shelf region of Bass Strait, much of the wave energy enters the western entrance to the Strait, giving rise to complex current patterns in the Bass Strait Basin (including large-scale eddies). Flows arising from coastal-trapped waves tend to cause water movement away from Wilson's Promontory into the central region of the Bass Strait Basin, or around the Promontory and out through the eastern entrance to the Strait (figure 3.1.2). Arising as they do from changes in weather patterns, the temporal distribution of coastal-trapped waves is inherently unpredictable.

3.1.6 Water Temperatures and Density Stratification

On the continental shelf, the distribution of water temperature is determined by the fluxes of heat through the sea surface and exchanges of heat, by advection or eddy diffusion, with the water of adjacent regions. The main source of heat flux through the sea surface, solar radiation, is received either directly by reflection or by scattering from the clouds and atmosphere. This implies seasonal variation of water temperature at the surface layer.

Readings of sea surface temperature are predominantly taken directly from satellite. Numerical output of this data is available in real-time from the Bureau of Meteorology (Melbourne), whilst the CSIRO Division of Atmospheric Research in Aspendale can provide photographic output. Historical collections of readings taken by merchant vessels passing though the region are in existence (Edwards 1979: UK Meteorological Office 1990), although this source has been superseded by the increased availability of satellite information. Information from the cruise summaries for the CSIRO research vessel Franklin give the near-surface temperature (2 metre depth) for January 1991 as 16.9°C and 16.5°C (sites 11,
39° 33.98' S 146° 7.48' E and 12, 39° 32.52' S 145° 39.5' E), and that for May 1991 as 15.6°C (site 16, 40° 0.19' S 146° 0.0' E).

Density shows little variation over the year, changing from 1026.0 $kg.m^{-3}$ in January (sites 11 and 12, cruise F9101) to 1026.3 $kg.m^{-3}$ in May (site 16, cruise F9104). For the same period, there is no appreciable change in the salinity levels either (35.6 $kg.m^{-3}$ at sites 11 and 12 respectively in January, and 35.6^{-3} at site 16 in May).

3.1.7 Waves

The area west of Cape Otway and King Island is exposed to the prevailing westerly winds. Further, there are no land masses to the west to restrict the fetch for wave generation. This results in a high energy wave climate in this region. Wave rider buoy measurements from exposed locations near Portland and Cape Sorell have recorded median significant wave heights in the range of 2.5 to 3.0 m. Maximum individual wave heights associated with these conditions would be typically 4.5 to 5.5 m. Extreme wave conditions in this region are likely to be associated with an intense large scale low pressure system further to the south. It is expected that significant wave heights for design conditions are likely to be in excess of 10 m, with individual maximum wave heights of 20 m or more.

To the east of King Island, the predominant swell is out of the south-west quadrant, through the cross-section between King Island and Cape Grim. The westerly swells run up against King Island and are prevented from entering the Bass Strait Basin. There is significant attentuation of wave height due to the change of topography and the resulting current interaction, however some of the wave energy will enter the

Basin through the cross-section between King Island and Cape Grim. Attentuation of the wave energy will become more pronounced further towards the centre of Bass Strait Basin. Northern Tasmania, being in the shadow of Cape Grim, is a low energy environment due to its exposed position in the Strait. The amount of wave energy felt any any particular location in Bass Strait is highly dependent on its position within the Strait.

The wave measurements made by the CSIRO off Cape Sorell can be regarded as a 'worst case' indication of the western continental shelf region of Bass Strait. The Cape Sorell data is being recorded on a continuous basis and archived at the CSIRO, Division of Oceanography (Hobart) and at the Bureau of Meteorology (Melbourne).

3.1.8 Sediments

A number of studies of the sediment characteristics on the continental shelf have been conducted (figure 3.1.4; Black 1991). Initial studies of the sediments of Bass Strait by the Bureau of Mineral Resources (Canberra), as reported by Jones and Davies (1983), marked the beginning of active investigation into sea bed sediments in this region. Gaps in the original work have subsequently been filled by university groups such as the Sydney University team (Blom and Alsop 1988).

3.1.9 Weather

Since 1956, three-hourly weather observations have been routinely made at King Island by the Bureau of Meteorology. Wave observations are made from this station. The wind frequency diagram (seasonally adjusted for the May-December period) for King Island is shown in figure 3.1.5. The rose indicates that winds from the south-westerly and north-easterly quadrants are 'typical'. Winds from the southeasterly quadrant, whilst infrequent and thus not 'typical', can be produced by strong weather systems that occasionally occur in the Tasman Sea. When these easterlies arise, their effect in the Bass Strait Basin can be significant. Should real-time modelling be required of this region, the Bureau of Meteorology suggests that wind data be taken from Burnie (or one of the other northern Tasmanian weather stations) as well as King Island, since the recordings of easterly winds are more accurately measured on the mainland due to the placement of the weather station.

Monthly averaged air temperatures at King Island varied from about 11°C in Jul/Aug to 18°C in Jan/Feb.

3.1.10 Modelling the Continental Shelf Regions

The significant influence that astronomical tidal currents have on the water flows in Bass Strait and their inherent predictability have meant that a range of numerical models have been applied to Bass Strait and adjacent regions. The main Bass Strait model includes all of Victoria from the South Australian border to NSW. Thus, specific advice on the likely strength of tidal currents can be provided once the exact site locations are known.

In addition, models for oil spill simulations have been established over the major Australian ports, as well as covering the entire Bass Strait region using currents obtained from the VIMS hydrodynamic model. Figure 3.1.6 outlines the specific regions covered by the OSSM model.

3.2 MARINE OFFSHORE FISHERIES

The main offshore commercial fisheries within or adjacent to the proposed exploration area in Bass Strait are the southern rock lobster, the southern shark fishery, mostly for school and gummy sharks, the south east trawl fishery, and the scallop fishery.

3.2.1 The Southern Rock Lobster Fishery

The fishery

A commercial pot fishery for the southern rock lobster (*Jasus novaehollandiae*) yields around 500 - 600 tonnes annually in Victoria and 1500 tonnes in Tasmania, worth approximately $9 million and $27 million as landed price in the two states respectively. Most of the processed product is exported. In Victoria, there are 177 licensed rock lobster fishermen, with 81 restricted to the eastern zone and 94 restricted to the western zone, west of Apollo Bay. In Tasmania, there are approximately 340 entitlements which are not zoned. Vessels range in size from 10 to 25 metres and the method of fishing utilises baited pots placed on reef areas and hauled one or two times per day.

In Victoria, closed seasons are intended to protect rock lobsters by prohibiting the taking of females while in 'berry' (carrying fertilised eggs under their abdomens)-(between 1 May and 15 November) and by prohibiting all fishing while the males are moulting in spring (1 September to 15 November). A similar regime applies in Tasmania, although the season for both males and females starts on 1 November. Size limits of 105 mm (females) and 110 mm (males) apply in both states.

Distribution of the fishery

Victoria administers the fishery north of 39° 12'S and Tasmania administers the fishery south of this latitude. There are no rock lobster grounds on the central northern coast of Tasmania. The major fishing grounds are around the east Bass Strait islands, the east, south, west and north west Tasmanian coasts (around Three Hummock Island) and King Island. Approximately 10 - 20 % of the total Tasmanian catch comes from the area north of the north east and north west tip of the Tasmanian mainland, including Bass Strait islands. Most of that catch is from the west of King Island or the east of the Furneaux group (Kennedy pers. comm.). Rock lobster fishing has expanded into waters up to 180 metres in depth off the western continental slope off both western Tasmania and western Victoria. About 70% of the catch from the Victorian fishery is taken from grounds west of Cape Otway. The major fishing grounds occur on reef areas, where the grounds are extensive, but not continuous. In the Victorian eastern zone, up to 20 vessels operate between Wilsons Promontory and Port Phillip Bay. Up to half a dozen vessels operate from San Remo and most operators have their own preferred areas, or reefs for fishing. Rock lobsters also favour ledges on reefs which are thought to be geological fault lines. Pots are often set along the fault lines, according to many fishermen.

Life History

The size, age at first maturity and fecundity of female rock lobsters in Victoria is not known but in Tasmania, most females are mature at four years of age and reproduce annually producing up to 400 000 eggs depending on carapace length (Anon 1982 and Winstanley pers. comm.). Mature female rock lobsters moult and mate around April to May and are in berry, until hatching in October to November. After hatching they spend up to 8 - 10 months as planktonic larvae during which time they may be transported many hundreds of miles in the open ocean. It is also considered possible that some recruitment to the New Zealand rock lobster stocks may come from south eastern Australia. The final larval stage is known as the puerulus, which resembles a miniature adult which returns to coastal waters and adopts a bottom dwelling life. Settlement usually occurs from June to August each year, 8 - 9 months after hatching. Adults and juveniles occur on the same reefs in inshore waters but the occurrence of juveniles in offshore waters is not known.

Rock lobsters grow by a series of moults and reach the Victorian legal minimum catchable size for males (110 mm) and females (105 mm) at ages of around five and six years respectively. Few are thought to live more than 10 years. Although individual rock lobsters may move distances of up to 90 km, large scale migrations of this species are not known to occur.

3.2.2 The South East Trawl Fishery (SET)

The fishery

The south eastern trawl fishery (S.E.T.) is concentrated around the south east coasts of Australia. The fishery now covers the entire Bass Strait continental shelf and has more recently extended into the deeper oceanic waters of the eastern and western continental slope areas. The major demersal or bottom dwelling species caught in Bass Strait are the tiger flathead (*Neopatycephalus richardsoni*), school whiting (*Sillago bassensis*) and jackass morwong (*Nemadactylus macropterus*), although the latter species is taken mainly off the eastern shelf and slope. Gemfish (*Rexea solandri*), and orange roughy (*Hoplostethus atlanticus*) are the main species taken in deeper waters of the continental slope. Entry to the fishery has been limited since 1985 and 144 vessels fished in 1988 (Tilzey et al. 1990). Annual catches are around 2 000 tonnes of tiger flathead, 1 200 tonnes of school whiting and 1000 tonnes of jackass morwong for the entire fishery, although the total for all species exceeds 20 000 tonnes.

Distribution

Annual landings and distribution of effort have been collated by one-degree grid squares (Tilzey et al. 1990). Distribution of fishing methods, distribution of effort, distribution of catches of all species and species representation by region are given in figures 3.2.1 to 3.2.3. Otter trawling is most widespread in the eastern and western continental shelf and slope, although Danish seining predominates in the shallower inshore areas of northern and eastern Bass Strait, where there is a specific, year round Danish seine fishery for whiting and flathead. There is a small amount of trawling effort for flathead around 20 nautical miles offshore from Stanley (Zacharin pers. comm.) but this does not form a major contribution to the overall SET catch and for the 1986 and 1987 period, no catch or fishing effort was recorded from central Bass Strait between the central north coast of Tasmania and south of 40° S (Tilzey et al. 1990). Between 39° and 40° S, a small amount of catch and effort was recorded in the area immediately south of Wilsons Promontory. Between the Victorian coastline and 39° S, average annual catches of up to 25 tonnes of tiger flathead and up to 100 tonnes of school whiting are taken, mostly by Danish seiners, from the area between Cape Schanck and Wilsons Promontory. Higher catches are taken in the area to the east of the Promontory but relatively few boats operate from ports to the west of the Promontory, (mostly San Remo) compared with those to the east particularly Lakes Entrance.

Methods

The fishery principally operates two types of gear; otter trawl and Danish seine. Otter trawling involves towing a trawl net over the seabed for up to several hours. The net is strongly constructed and is kept open while being towed by two otter boards which act as deflectors. Between the otter boards and the net are wire sweeps which herd the fish towards the net. The net has a weighted ground rope and buoyed head rope. The net lightly skims the sea floor and this is maintained by the functioning of the otter boards. Most demersal trawling requires a clean sea floor free from snags, although rollers can be fitted to the ground rope for a coarser sea floor. The length and configuration of nets used in the trawl fishery varies considerably depending on size of vessel and area of fishing. Bass Strait trawlers are usually 12 - 23 metres and use nets of between 22 - 36 metres headrope and sweeps of between 120 - 300 m (Wankowski 1983).

Danish seiners are 11 to 19 m in overall length. The Danish seine is used in quite a different way from the otter trawl, as it sweeps an area and is not towed over a long distance. The spread of the ropes effectively herds the fish towards the net. The vessel sets out a marker buoy and anchors one end of the seine rope to it. The boat then travels in an arc, paying out the appropriate amount of rope (a little under two kilometres) which lies on the sea floor. The net is then released and the boat pays out coils of rope as it completes a triangular course back to the buoy. The ropes are then hauled so that they act as ticklers to herd the fish inwards into the path of the net. Diagrams of otter trawling and Danish seining are shown in figures 3.2.4 and 3.2.5 (from Adams 1967 and Garner 1977).

3.2.3 Shark Fishery

The fishery

The shark fishery began in the 1920s and extended throughout the continental shelf areas of Victoria, Tasmania and South Australia. It is based upon several species of temperate water sharks but mainly the school shark (*Galeorhinus galeus*) and the gummy shark (*Mustelus antarcticus*). In recent years, catches have been consistently over 5 000 tonnes live weight (Walker 1989), valued at more than $20 million to fishermen.

Until the late 1960s and early 1970s, most fishermen used long lines but most have now switched to monofilament gill nets. Jurisdictional responsibility for management of the southern shark fishery is shared by the Commonwealth Government (from 3 nautical miles to the 200 nautical mile limit of the Australian Fishing Zone) and the State Governments of Victoria, Tasmania and South Australia (to 3 nautical miles from the respective coastlines or enclosed waters). There are limits on the number of entitlements, the number of nets that can be held on each vessel, minimum sizes and gill net mesh size. Sharks are generally long lived, slow growing and produce only a small number of offspring and therefore have a low capacity for recovery in the event of overfishing. Present concerns over the state of exploitation of shark stocks and decline in catch rates are likely to result in further reductions in net entitlements and allowable catches until there are signs of recovery.

As of May 1991, there were 88 Tasmanian state gill net endorsements of which 32 were owned by Victorian-based fishermen and 3 were owned by South Australian fishermen. The net limit for gill netting in Tasmanian waters is 3 nets. There were also 144 Tasmanian long line vessels recorded to have utilised their entitlement to hook for shark mainly in state waters. In general, Tasmanian coastal rivers, estuaries and lagoons are closed to commercial net fishing for shark. The prohibition of all onshore fish netting was considered in Victoria to protect juvenile shark nursery areas but was dropped because prevention of taking incidental catches of shark adversely affected net fishermen targeting other species. Gill netting has been prohibited in Victorian state waters since December 1990, although there are about 31 Victorian master-fishermen who were known to have exercised their entitlements to long line for shark in Victorian and/or Commonwealth waters (Dec 1990 figures - Brown pers. comm.).

In the commonwealth gill-net fishery, the number of nets carried varies from 4 - 7 for A-class vessels and from 1 - 3 for B-class endorsements (Walker & Gason 1991). According to 1991 figures, there were 34 A-class and 15 B-class Victorian vessels as well as 4 A-class and 7 B-class Tasmanian vessels operating in the commonwealth fishery (Brown pers. comm.).

Methods

Long line fishing is the traditional method of fishing and still comprises 20 - 25% of the fishery. The long line consists of a main line constructed of 6 - 8 mm diameter rope with 1 m long snoods attached at intervals of 6 - 10 m. Each long line 'set' may have up to 300 hooks, each baited with fish or squid. The hooks, together with the main line and an anchor weight at each end are placed on the sea bed. A buoy and dahnpole with flag are attached to each end of the gear for retrieval when it is hauled from one end over a roller mounted on the gunwale. Long lines can be set in deeper water and in waters of stronger current where gill nets cannot be used effectively.

The gill net method is considered more effective than long line fishing. The gill net consists of a stationary monofilament net, usually six inch (152 mm) mesh size, anchored and buoyed (with dahnpoles) at each end. Average length of the net is about 550 m long, although several may be joined and set together. The nets rest vertically with the bottom rope or lead line resting on the sea bed. The gear is retrieved by hauling it from one end over a roller which is normally mounted near the bow. Nets may be left for several hours but not for extended periods such as overnight because of possible spoilage from sea lice. The attachment of flashing lights to dahnpoles allows for fishing and net retrieval at night.

Distribution of effort

Gill netting and long lining occurs throughout Bass Strait. A spatial analysis of school and gummy shark has been collated for one-degree grid squares (Klaer et al. 1989) and is shown in figures 3.2.6 and 3.2.9. While both gummy and school shark catches are generally concentrated in the eastern and western parts of the continental shelf and slope of Bass Strait, some are taken from the central Bass Strait region.

Life history

Sharks are long-lived, slow growing animals which produce only a small number of offspring. Because of this, they have a low capacity to recover in the event of overfishing and the southern shark fishery is presently facing severe reductions in fishing effort imposed by the commonwealth and state managing agencies, in an effort to stabilise this fishery.

3.2.4 The Scallop Fishery

The fishery

The fishery for the commercial scallop (Pecten fumatus) is centred mainly in eastern Bass Strait, Port Phillip Bay, and Tasmania, off the Furneaux Island group and off north western Tasmania and King Island. Annual catches of scallops are very variable (100 - 4 000 tonnes flesh weight; Young et al. 1989) and the scallop resource is intermittently one of Tasmania's and Victoria's most valuable fisheries, worth in excess of $30 million.

The Bass Strait fishery is jointly managed by the Commonwealth, Victoria and Tasmania under offshore constitutional settlement and there are three management zones; the coastal zones twenty nautical miles off shore from the southern Victorian and northern Tasmanian coasts respectively, and the central zone. In Victoria, there are 94 vessels licensed to fish in the Victorian 20-mile zone and central Bass Strait and approximately 121 Tasmanian vessels can also fish in the central zone and the Tasmania 20-mile zone. The timing of the seasonal opening in Bass Strait depends on the condition of the scallops but is normally takes place in June.

Methods

Scallops are caught from the sea bed using single "box dredges" towed behind each boat. The dredges are constructed with a steel frame, to which weld mesh is attached (figure 3.2.8). They are up to 3.3 m wide, mounted on runners with a depressor plate so that the dredge maintains contact with the sea bed and with a tooth bar or scraper bar to lift the scallops into the cage. The dredges are towed at about 3 - 6 knots and skim across the surface of the sea bed sometimes, penetrating a few centimetres while collecting the scallops. Each tow may be from 2 to 10 minutes depending on the density of the scallops.

Distribution of fishing effort

The major scallop grounds in Victoria are in Port Phillip Bay and in the twenty-mile zone east of Wilsons Promontory (Gwyther, 1988). Most Bass Strait vessels operate from Lakes Entrance, Port Welshpool or ports in Port Phillip Bay. The Tasmanian Bass Strait fishery occurs in the north west, from Stanley, around Three Hummock Islands to King Island, extending up to 40 nautical miles to the north and east of King Island. There has been no scallop fishing since 1972 off the central north coast of Tasmania but scallop grounds occur off the north east coast from Bridport, Furneaux Group, Deal Island and the Kent group (figure 3.2.9 - Zacharin 1988). There are no productive scallop grounds in the central area of Bass Strait, nor in Victorian coastal waters between Cape Schanck and Wilsons Promontory, although a few patches have been fished off the Glennies.

Life history

Scallops are hermaphrodites and shed eggs and sperm into the sea usually during winter to early summer. Scallop larvae swim in the plankton for 2 - 3 weeks before settling on the sea bed. They take between 1.5 and 2.5 years to grow to commercially harvestable size and are capable of limited swimming if disturbed.

3.2.5 Deepwater Crab Fishery

A small fishery exists for the giant king crab which is caught in rock lobster pots as a by-catch to the rock lobster fishery. Most are caught off the northwest coast of Tasmania and west coast of King Island on the edge of the continental slope. A small amount is processed for crab meat but it is not a major fishery.

3.3 MARINE INSHORE FISHERIES

3.3.1 Bay And Inlet Fisheries

In Victoria, commercial inshore fishing is permitted in 9 bays and inlets: Port Phillip Bay, Western Port Bay, Andersons Inlet, Shallow Inlet, Corner Inlet, Gippsland Lakes, Lake Tyers, Tamboon Inlet and Mallacoota Inlet. There is a separate limited entry for each area, with 5, 7 and 42 licences held at Andersons Inlet, Shallow Inlet and Corner Inlet respectively. The major target species are snapper, King George whiting, black bream, flathead, garfish, pilchards, anchovy, squid and flounder.

The major methods are haul seine netting and mesh netting in Corner Inlet and Andersons Inlet and haul netting only in Shallow Inlet. Gear is set from small trailered vessels usually less than 7 metres in length. In addition, there is a considerable amount of recreational line fishing, particularly during the summer months.

Other fishing activities conducted in open coastal waters (within three nautical miles) of Victoria are undertaken by up to 1 300 unendorsed master fishermen who may use a variety of nets, long lines, squid jigs, pots and traps. There is no current information of the actual number operating in the study area nor on the frequency of their activities, however the incidence of these fishing methods is likely to be less than of Danish seining and shark fishing.

In Tasmania, the central north coast is sparsely fished compared with the remainder of the coastline. There is a very small coastal fishery equivalent to that in Victoria, targeting mainly on Australian salmon and mullet using gill nets and purse nets.

3.3.2 Abalone

The fishery

Abalone, mainly the blacklip (*Haliotis rubra*), are taken by licensed divers from coastal reefs around Victoria and Tasmania and the fishery also extends into New South Wales and South Australia. Divers work from small boats using Hookah diving equipment and operate in waters of depths usually less than 20 metres. Calm conditions are required.

In Tasmania, there are 125, non-zoned entitlements to fish for abalone and the total quota amounts to an annual catch of 2 100 tonnes, worth approximately $35 million at a landed price of $17 per kg. In Victoria, there are 73 entitlements divided into three zones. Each Victorian diver has an annual quota of 20 tonnes, worth $340 000. Quota may be taken during any time of year and up to half can be transferred to other divers.

Distribution

In Victoria, the coast is divided into east, west and central zones (figure 3.2.10), where in the latter, there are 36 licensed divers. There are commercially productive reefs at Cape Schanck/Bushrangers Bay (60 - 140 tonnes per year), Flinders (0 - 20 tonnes), Phillip Island and Cape Woolamai (5 - 40 tonnes), San Remo (5 - 50 tonnes), Cape Patterson (5 tonnes), Inverloch (> 5 tonnes), Cape Liptrap (10 - 20 tonnes), and on the west coast of Wilsons Promontory at Waratah Bay, Norman Island, the Glennies, the Anser Group and South West Point (> 30 tonnes at each), (McShane et al. 1986). These are show in figures 3.2.11 - 3.2.13. Size limits for taking abalone in Victoria vary from 100 to 120 mm depending on the area of operation.

In Tasmania most of the productive reefs are on the west, east and south coasts, with the central north coast between Rocky Cape and the Tamar estuary containing few commercially productive reefs, (Nash pers. comm.). About 10% of the total catch is taken from the area between the north east and north west tip of Tasmania, including the islands. The size limit in Tasmania is 132 mm, and many of the north coast stocks do not reach this size. The fishery in Bass Strait is managed by permitting special 'fish-down' seasons. During 1991, 110 tonnes of 'stunted' stock was taken from the Tasmanian-managed fishery in the north eastern islands from Wilsons Promontory to the Furneaux group during the month of May. The area and timing of these fish-down permits is re-considered each year.

Life history

Abalone are marine gastropods, (snails) which live on rock subtidal reefs and feed on seaweeds. They take between 4 and 10 years to grow to commercially harvestable size. Eggs tend to sink and remain in the waters around the parent reef. The larval development time is very short, about three days, and settle on reefs close to the parent stock (McShane 1989). Those that get washed away from the reef are unlikely to survive.

3.4 MARICULTURE

Mariculture is an important and blossoming primary industry in Tasmania. Species subjected to cultivation in north west Tasmania currently include the pacific oyster (*Crassostrea gigas*), the flat oyster (*Ostrea angasi*) and bull kelp (*Durvillea potatorum*). The locations of current oyster leases and permits registered with the Marine Farming Branch of the Division of Sea Fisheries are identified in figure 3.4.1 a-c. Oyster farms within the study area include one on the east coast of King Island, six in Robbins Passage, six in Big Bay and three in Duck Bay. Kelp harvesters are at present active only on the west coast of King Island (figure 3.5.1a), transporting their storm cast bull kelp all the way to Scotland for further processing.

Most of the Victorian coast is too exposed for the successful development of aquaculture. Due to the marine park and/or coastal park status of the majority of the South Gippsland coastline (figure 3.4.2), commercial mariculture has been discouraged from this part of the state. However, the Victorian Department of Conservation and Environment have been conducting oyster culture trials in the Corner Inlet Marine and Coastal Park and the Nooramunga Marine and Coastal Park, but the long term future of this venture is uncertain.

3.5 MARINE FAUNA AND FLORA

3.5.1 Marine Benthic Communities

Between 1979 and 1984 the Museum of Victoria conducted a systematic investigation of the benthic fauna of Bass Strait to analyse species abundance, distribution, and diversity of species and classification of sediments (Poore et al. 1985). This represents one of the most detailed studies of any southern hemisphere continental shelf fauna. Samples from over 200 stations in eastern, western and south western Bass Strait were analysed. More than 2 000 species of invertebrates and fish were recognised, although not all have been identified. In eastern Bass Strait, some species with warmer water affinities were observed but many species appeared to be widely distributed across the Strait, suggesting that each sampling site was taken from a heterogenous sediment with as many microhabitats found in a small area as found in the whole strait, thus the location of the drilling rig is unlikely to have any particular significance. The Bass Strait benthic fauna is representative of an endemic warm-temperate faunal element, widespread along Australia's southern coast. Many taxonomic groups exhibit higher species diversity than other continental shelf faunas, although the reasons for this are not known.

Sediments of the southern Australian coast, (where Bass Strait has been most studied) are predominantly biogenic in origin, that is derived from mollusc and bryozoan decay, with terrigenous sands confined to the marginal areas. It is considered likely that the stable, shelly sediment favours high numbers and diversity of many of the infaunal groups such as sponges, brachiopods, bryozoans, polychaetes, molluscs crustaceans and echinoderms.

3.5.2 Marine Intertidal Communities

Productivity and species diversity increase as substrate stability increases in more sheltered environments. Intertidal sand or mud flat habitiats are characterised by relatively simple plant and animal communities.

Intertidal rock platforms, reef foreshores and gravel or pebble beaches are considered less ecologically sensitive, being relatively low in species abundance and diversity. Rocky foreshores are characterised by a tide influenced gradation of seaweeds, inhabited by barnacles, chitons, mussels, limpets and other invertebrates. Cobble and gravel beaches are characterised by a micro-fauna of amphipods, isopods, crabs, chitons and snails.

3.5.3 Marine and Coastal Flora

Seagrasses are true flowering plants which have become secondarily adapted to living in the shallow marine environment. They are ecologically important because they provide nursery habitat for juvenile fish. They also support a rich variety of marine life and help to stabilise shifting sea bed sediments. Seagrass meadows are also popular areas for recreational fishing activities. Seagrass meadows are vulnerable to oil spills because they occur in shallow waters where the mixing zone is small and oil may quickly reach the sea bed. Oil pollution can kill plants by smothering and preventing gaseous exchange, or by being chemically toxic.

Seagrass areas in north west Tasmania are identified in the map series from "Coastal Resources Atlas - Tasmania" (figures 3.5.1 a-g). Although they generally grow in pure stands seagrass is widespread along the tidal flats of Shallow Inlet and four species of seagrasses have been recorded from the vicinity of Wilsons Promontory although they generally grow in pure stands (anon, 1991).

Saline wetlands (or saltmarshes) consist of a particular suite of plant species which grow in areas subject to regular inundation by the sea. These wetlands are usually species poor and occur on low energy coasts, usually in the shelter of estuaries, sand bars, and open lagoons. Saltmarsh plants vary in their susceptibility to damage from oil. Several species have been shown to recover well from an oil spill incident while others do not recover at all.

Saltmarsh distribution has been comprehensively surveyed in Tasmania and is indicated in figures 3.5.1 a-g. Saltmarshes in Shallow Inlet are most extensive on the sheltered, muddy western shores.

Marine seaweeds, or macroalgae are confined predominantly to the areas of reef or hard substratum. The large brown seaweeds commonly known as kelp most evident around the Tasmanian coastline include the string and giant kelp, *Macrocystis pyrifera* and *Macrocystis angustifolia*, and the bull kelp, *Durvillaea potatorum*. Ecologically, kelp forests are a highly productive and important habitat for a large number of species. The structural diversity of kelp forests gives a wide variety of habitats for many fish and crustaceans, molluscs, algae and sponges, and provides a refuge for larval and juvenile fish.

In north west Tasmania, their distribution is restricted to areas around the mouth of the Tamar River and along the west coast of King Island. In Victoria, more than 120 species of benthic algae has been identified from the marine environment of Wilsons Promontory. The variety of forms range from large kelps to cryptic species such as the encrusting coralline red algae or epiphytic species.

3.5.4 Avifauna

The bird-frequented coastal areas of Tasmania most sensitive to oil pollution (i.e. major rookeries and feeding grounds) have been identified by the Department of Parks, Wildlife and Heritage and have been indicated in figures 3.5.1 a-g.

Penguins are considered the species of bird most at risk in Tasmania. Concentrated in the vicinity of rookeries, they dive to feed and risk contamination by surfacing in an oil slick. The little penguin *(Eudyptula minor)* is the only species which breeds in Tasmania. The colonies are widespread and numerous. Nevertheless, several major colonies should be protected in the breeding season (October to January).

The fairy tern *(Sterna nereis)* has a limited number of nesting sites in Tasmania. These are susceptible to oil spills and need to be protected as they are located on sand spits just above high tide mark.

The short-tailed shearwater or muttonbird *(Puffinus tenuirostris)* is a diving bird which is at risk when surfacing in an oil slick. The species is widespread and is not threatened as a whole. Fledgling chicks form the basis of the muttonbird industry and the effect of large scale mortalities caused by an oil slick contacting a feeding congregation of the birds could be locally severe in economic terms.

The black-faced cormorant *(Phalacrocorax fuscescens)* has a breeding distribution limited to western and southern Australia but is widely distributed within this region and is not an endangered species. Individual colonies are vulnerable to oil splashed above the high tide mark where the nests are located. The birds are thought to concentrate feeding fairly close to a rookery.

The Australasian gannet *(Morus serrator)* also has a feeding habit which puts individuals, but not the species, at risk. This is due to its wide distribution throughout New Zealand and Southeast Australia.

Other species of diving birds which are prone to oil contamination because of their feeding and diving habits are either widely distributed or otherwise insulated from the effects of oil pollution.

Gulls cannot be considered threatened by oil spills as they all have either a wide distribution or a feeding ecology that permits individuals to avoid oil.

The birds of Wilsons Promontory and adjacent islands have been studied extensively. The islands provide important breeding habitats for seabirds such as the fairy prion, pacific gull, fairy penguin, diving petrel, silver gull, short-tailed shearwater and the Cape Barren goose. Other seabird species which breed on the coast or islands adjacent to Wilsons Promontory include the black-faced cormorant, crested tern, sooty oystercatcher and the white-breasted sea eagle.

In regional terms, Shallow Inlet has been described as one of the most important mudflat habitats for migratory wading birds. Major species include the lesser golden plover, double-banded plover, eastern curlew, red-necked stint, sanderling, curlew sandpiper and sooty oyster catcher. Breeding shorebirds of Shallow Inlet and adjacent ocean beaches include pied oystercatchers, red-capped plovers, gull-billed terns and hooded plovers. Other waterbirds found on the inlet include the black swan, yellow-billed and royal spoonbill, Australian pelican, white-faced heron, pacific gull, chestnut teal, egrets, terns and cormorants.

3.5.5 Marine Mammals

There are nine major Australian fur seal (*Arctocephalus pusillus*) colonies in Southern Australia (Kirkwood pers. comm.). One of these occurs on Reide Rocks south of King Island. The size of the colony is estimated at 6 000 with 1 500 pups produced every year. There have been irregular sightings of elephant seals in the Cape Grim area (Copson pers. comm.). A breeding colony of elephant seals which once existed on King Island was wiped out in 1810. Leopard seals and sea lions have rarely been sighted.

Adult male fur seals leave their territorial sites at the end of the breeding season and it is assumed that they spend most time out at sea. Immature seals do not generally move further than 150 kms from their birthplace. Seals feed on squid, octopus and many species of fish. From the types of fish taken, it is apparent that the whole continental shelf area is available to the seal as feeding area as it can dive to at least 120 m (King 1983).

Seals are the mammals of concern in relation to oil spills in Tasmanian waters being especially vulnerable during the breeding season (spring). Seal habitats are given a high priority status for protection from oil pollution by the Tasmanian Department of Parks, Wildlife and Heritage.

Two species of dolphins roam throughout Bass strait. These are the bottlenose dolphin (*Tursiops truncatus*), which occurs in more inshore areas, and the common dolphin (*Delphinus delphis*), which is smaller and occasionally occurs in large schools further offshore. These species are sighted frequently in Tasmanian waters and they regularly school between King Island and Tasmania.

Whales are not sighted regularly in northern Tasmanian waters and there are no known calving grounds off the coast of north west Tasmania or eastern Victoria. Whales sighted in Northwest Tasmania include the southern right whale, sperm, fin, and pilot whales (Copson, pers. comm.).

Despite the lack of research into the sensitivity of whales and dolphins to contact with oil, it is known that they are highly mobile and intelligent animals so contact with oil is likely to be avoided.

A number of marine mammals have been recorded in the vicinity of Wilsons Promontory. The Australian Fur Seal forms colonies on some of the islands including Kanowna Island and Andersons Islets. Other marine mammals which have recently been beached or observed near Wilsons Promontory include the Humpback Whale, Andrews beaked Whale, Pilot Whale, Common Dolphin, Bottle-nosed Dolphin and Sperm Whale.

3.6 COASTAL PARKS AND RESERVES: SENSITIVE COASTAL HABITATS

Most of the coastline of Northwest Tasmania is private land with the exception of some areas set aside as public parks and reserves. The locations of parks and reserves included in the study area are presented in the Tasmania Land Map (figure 3.6.1 a&b). Public recreational land in Tasmania is administered under one of three pieces of legislation. Land administered by the Forestry Commission includes State Forests, Timber Reserves and Forest Reserves. Land administered under the Crown Lands Act 1976 includes Protected Areas, Coastal Reserves, Crown reserves, Lakeside Reserves, River Reserves and State Recreation Areas; and land administered under the National Parks and Wildlife Act include National Parks, State Reserves, Historic Sites, Nature Reserves, Conservation Areas, Wildlife Sanctuaries, Game reserves, Muttonbird Reserves and Aboriginal Sites.

Wilsons Promontory is a high granite peninsula which forms the most southerly point of the Australian mainland. Eighteen of the many islands around Wilsons Promontory are included in the Wilsons Promontory National Park. The Wilsons Promontory Marine reserve and Marine Park extends 300 metres or more from the coast of the Promontory and adjacent islands (figure 3.4.2). It was established primarily to protect significant marine ecosystems and to provide for education and recreation.

Shallow Inlet is a large tidal embayment whose connection to the sea is partly enclosed by a sand barrier complex of spits, bars and mobile dunes (anon 1990). The Shallow Inlet Marine and Coastal Reserve (figure

3.6.2) is located at Waratah Bay, adjoining Wilsons Promontory Marine Park to the west. It was established primarily in recognition of its high value as wildlife habitat, particularly for migratory wading birds and other shorebirds. Seagrass beds in the inlet provide impotant nursery grounds for fish and the area is also very popular for fishing, boating and sailboarding.

Wilsons Promontory is an extensively exposed area of granitic rock and carries the significance of being the largest continuous region of granite on the Victorian coast. A review of the of the geology and geomorphology of the Wilsons Promontory Marine Park was undertaken by Rosengren (1989) as part of the coastal management planning project conducted by the Victorian Department of Conservation, Forests and Lands.

The sand spit at the entrance to Shallow Inlet is a geomorphological feature of state significance (anon 1990). Rosengren (1989) documented 13 sites of geological and geomorphological significance (state, regional or local) for the Shallow Inlet Marine and Coastal Park.

3.7 TOURISM AND RECREATION

The northwest coast of Tasmania and King Island offer many popular tourist destinations. Places of particular interest include the Asbestos Range and Rocky Cape National Parks, Devonport, Burnie, Stanley, Smithton and Currie on King Island. According to the 1990 Tasmania Visitors Survey, visitor numbers to these towns were as follows:

Devonport		181 748
Burnie		138 320
Stanley		67 673
Smithton	41 536	
Currie		3 328

Coastal tourist activities in the area include sightseeing/touring, camping, walking, swimming, boating and fishing. Launching ramps and other popular recreation areas are marked in the Coastal Resources Atlas maps included in figures 3.5.1 a-g.

Since being declared a National Park in 1905, Wilsons Promontory has become an extremely popular area for nature lovers and holiday makers. Wilsons Promontory is now one of the most heavily visited parks in Victoria, with the highest level of camping use. Most visitors stay at Tidal River which provides flats, lodges and camping facilities.

Water-based activities are popular at Wilsons Promontory and include swimming, surfing, windsurfing, sunbathing, diving and snorkelling, fishing and boating. Visitors to the marine park may also gain access from outside the park, launching boats from Shallow Inlet to the north-west or from Port Welshpool or Yanakie to the north east.

Shallow Inlet offers a variety of activities including fishing, sailboarding, swimming, camping and picnicing. Recreational facilities include car parking areas, boat launching areas, toilets and fireplace barbeques. There are no jetties moorings or anchorages. Sailboarding is becoming increasingly popular at Shallow Inlet; the Australian Sailboarding Championships were held there in November 1988 and October 1989.

3.8 CULTURAL HERITAGE SITES

The Department of Parks, Wildlife and Heritage in Tasmania keeps a register of sites located through limited investigations and research surveys.

3.8.1 European Sites

There are few, if any, sites along the north west Tasmanian or south central Gippsland coastlines that would be affected by marine pollution. The historic port of Stanley on the north coast of Tasmania might fall into this category (Nash pers. comm.).

3.8.2 Shipwrecks

From the Tamar River to Cape Grim and including the Hunter Group and King Island a total of approximately 150 shipwrecks have occurred since 1810. The locations of only 11 of these wrecks are presently known and of these, two have been protected under the Commonwealth Historic Shipwrecks Act. These are the Cataraqui and the Brahmin, both located at King Island (figure 3.8.1 b - Nash pers. comm.). Other identified wrecks and their locations are indicated in figures 3.8.1 a&b.

Shipwrecks in Victoria are protected by the Commonwealth Government's Historic Shipwrecks Act 1981. Shipwrecks located within the Wilsons Promontory Marine Park are also protected under the National Parks Act. The Victorian Archaeological Survey carried out an investigation of four shipwreck sites around Wilsons Promontory in 1983. These included; the Seagull near the south west corner of Anser Island, the Lady Mildred about 10 meters south of Waterloo Point, the Miranda in Miranda Bay near Rabbit Island

and, an unidentified wreck (possibly the Favourite) off South point. The remains of a number of other unidentified shipwrecks in the water off the Promontory are described by Staniforth (1985).

There have been at least 10 vessels which are known to have wrecked in Waratah Bay. These include the Drumblair off Sandy Point and the Morosa which ran aground on the Yanakie surf beach.

3.8.3 Aboriginal Sites

In north west Tasamania, approximately 190 coastal midden sites and 7 coastal stone carving and quarry sites have been recorded. The distribution of the midden sites is; King Island = 15, Hunter Group = 120, and northwest coast from Cape Grim to Mt. Cameron = 55 (Nash, pers comm.).

Detailed archaeological surveys of Wilsons promontory indicate that the richest sites are on the west coast between Shallow Inlet and Darby River, although sites are also found at other locations including Whiskey Bay, Oberon Bay, Waterloo Bay and on the Singapore Peninsula. Many middens containing charcoal, stones and the remains of shellfish have been found at these sites.

3.9 SHIPPING

The reporting system at the Maritime Rescue Coordination Centre in Canberra receives regular reports from all commercial vessels travelling through Australian waters. Actual records of shipping traffic in these areas are not instantly available but could be obtained from relevant port authorities if required. However, this issue would simply be handled by means of notification to mariners of the location and period of operation of the drilling rig. In the event of more permanent location, more formal shipping lane arrangements would need to be implemented, as in eastern Bass Strait.

Tank ship routes into Tasmania and King Island have been mapped in the Coastal Resources Atlas of Tasmania, a copy of which has been included in figure 3.9.1.

Shipping lanes around Wilsons Promontory and within Corner Inlet are mapped on Admiralty Charts #801 and #181, respectively.

4.0 COMMUNITY CONSULTATION

A community consultation programme was undertaken in Tasmania from 22-28 January 1992. Meetings were held with local council representatives, State government departments, fishery groups and local conservation groups. These meetings were held in Devonport, Burnie, Smithton, Currie (King Island) and Hobart. A total of 52 people representing the various groups listed below were present at the meetings.

Devonport Chamber of Commerce
Port of Devonport Authority
Tourism Tasmania
Department of Environment and Planning
Royal Volunteer Coastal Patrol
Wynyard Council
Devonport Council
Burnie Chamber of Commerce
Ulverstone Council
Burnie Port Authority
Burnie Council
Counter Disaster Committee
State Emergency Service
Department of Parks, Wildlife and Heritage
Burnie Field Naturalists
Devonport Field Naturalists
Wilderness Society
Tasmania Conservation Trust
Save Our Coast
Circular Head Marine Board
Circular Head Council
King Island Field Naturalists
King Island Fishermen
Kelp Industries
King Island Marine Board
King Island Council
Department of Primary Industry
CSIRO
Marine Board of Hobart

4.1 MAIN ISSUES

The main issues raised in the community meetings are summarised below.

4.1.1 General Perceptions and Concerns

- There were many questions regarding the relationship between this proposed exploration programme and the recent publicity regarding a pipeline from the Yolla 2 gasfield to the north west coast. Most people believed that it was a pre-election publicity stunt and were aware that the introduction of a gas supply was not certain, despite views expressed in the press.

- There was some confusion about possible relationships between the SAGASCO Bass Strait exploration programme and other petroleum industry activity in the area, including BHPP and the issue of impacts on whales.

- The timetable for the exploration programme was often asked about.

- The location of on-shore facilities such as a supply base or helicopter base was discussed, with various councils indicating the advantages of using their facilities. Many questions were raised regarding helicopters, the number of flights per day, distances involved, preferred airports, noise impacts, etc.

- Questions were asked regarding the logistics and operation of the drilling rig including issues such as size, location, use and type of drilling muds, volume of cuttings, restrictions to navigation routes, etc. It was considered that the rig, because of its size, position and lighting would present an advantage for navigation, rather than an obstacle. It was noted that the possibility of interference with recreational boats would pose more of a concern.

- A number of people disputed the claim (based on VIMS modelling) that winds do not blow north easterly toward the north west coast of Tasmania.

- It was considered that there would be greater threat to Flinders and Lady Baron Islands and the Kent Group than the coasts of King Island or north west Tasmania.

- 'Save the Coast' have warned that there will be a "wall of protest" if gas/oil discovered in the Bass field is used for production of electricity rather than as a direct energy source.

- A number of people warned that conservation/environment groups would be very concerned and negative toward the exploration. However, representatives from 'Save our Cost', Burnie, Devonport and King Island Field Naturalist Clubs, the Wilderness Society and the Tasmanian Conservation Trust were all present at meetings and not only determined that there were few environmental issues related to the exploration, but were very positive regarding being given the opportunity to discuss the project.

4.1.2 Conservation Issues

- The 'Save our Coast' group was interested in the mechanics and methods of clean-up, including appropriate use of dispersants, access to coastal areas and availability of clean-up equipment and expertise.

- Mention was made of the nomination of the Rocky Cape Marine Park to the Register of the

National Estate. It was not confirmed whether this remains a nomination or a listing at present, but it and 'The Nut' were considered vulnerable and contentious sites in relation to possible oil spills.

- There is expected to be little if any impact on bird colonies along the north west coast and in Bass Strait. Rafting muttonbirds were identified as potentially suceptible to oil spills or collision from supply vessels.

4.1.3 Fisheries Issues

- Fishermen on King Island indicated that the lease areas were not used by local fishermen, but that shark fisheries operated in the area out of San Remo and Apollo Bay in Victoria. These groups should also be consulted. The cray fishing and kelp industries were not likely to be affected by an oil spill, because of their location on the island. Mariculture operations at Circular Head could be affected by an oil spill if it reached the NW coast.

4.1.4 Councils and Coastal Agencies

- Many of the people consulted, particularly representatives from marine boards and local councils, with experience in OSCPs requested information on co-ordination and documentation of the OSCP for the Bass Basin exploration programme. A number of agencies requested further consultation when the OSCP was in draft form so that they could add anything to it and/or ensure that their individual OSCPs included all the relevant information necessary.

- Burnie Mayor, Sandra French, indicated that they were interested in continued consultation so they could include various developments and organisation for production into their current planning programme. Other authorities, such as the State Emergency Service and the Marine Board of Hobart, as well as conservation groups, also indicated their interest in the project and their desire for further consultation - particularly if the project reached the production phase.

4.1.5 Suggestions and Requests

- 'Save the Coast' are interested in obtaining some of the information to be included in the environmental assessment report, for their own use.

- The 'Save our Coast' group would like SAGASCO to undertake a study to determine what marine life is present in the vicinity of the drill sites and to ensure that no rare or endangered species are located there.

- Sources of information - including studies undertaken by industry, government departments and interest groups, - as well as key contacts to consult with, were provided by many of the people at the meetings.

- Dames & Moore were made aware of the various Oil Spill Contingency Plans which have been completed (or are in the process of review); including the State Plan and various local harbour plans. Dames & Moore has or are receiving copies of these. Other sources of information were also indicated. These included the Counter-Disaster Plan produced by the City of Burnie, the Coastal Resources Atlas for Tasmania, Footprints in the Sand; Tasmania's Coastline - A Discussion Paper by the Department of Environment and Planning and data collected by various local industries on the NW coast, the HEC and CSIRO.

- King Island representatives indicated a desire to be more involved in any exploration or production, especially the supply of materials/equipment etc to boost the suffering economy of the island.

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502056

APPENDIX A

SIMULATION OF POSSIBLE OIL SPILL TRAJECTORIES FROM THE BASS STRAIT OIL FIELDS EAST OF KING ISLAND

502057

Simulation of possible oil spill trajectories from the Bass Strait oil fields east of King Island

A report to

Dames and Moore

on behalf of

SAGASCO Resources Ltd.

by the

Victorian Institute of Marine Sciences

Peter Greilach
January 1992

Victorian Institute of Marine Sciences

1. Project Description

As part of SAGASCO's oil spill contingency planning and the improvement of their capability to respond to oil spills that might derive from oil-field operations in Bass Strait, a pilot project to assess areas of possible spill impact was commissioned by Dames and Moore to provide oil spill trajectories for a possible oil spill incident originating from the area east of King Island. The Victorian Institute of Marine Sciences undertook this work and this report summarizes the pilot project.

The Bureau of Meteorology provided VIMS with wind speed and direction data from King Island for the period January 1957 to September 1991. This data was analysed by VIMS to determine meteorological conditions 'typical' of the months May to July. (Subsequently, the window was enlarged to the May-December period. The affects of this change are discussed in section 2.)

Trajectory modelling of the spill path was undertaken using the OSSM model by combining the selected spill event originating from sites specified by Dames and Moore with the defined wind conditions input to the model, along with astronomical M_2 tidal currents for the area derived from verified hydrodynamic modelling of Bass Strait.

The modelling results permitted the identification of the areas of the Victorian and Tasmanian coasts that would be impacted in the selected meteorological conditions in the event of a spill to the east of King Island. The modelling also gives indications of the time of travel for the oil to reach the coast.

The results of simulations such as these are a necessary first step in the development of soundly based oil spill contingency plans for SAGASCO's Bass Strait operations.

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2. Assessment of the Bass Strait wind climate

The Bureau of Meteorology provided wind speed and direction data at three hourly intervals covering all years of record at King Island (1957 to 1991). From this data set VIMS extracted the records for the months May to July and analysed the extracted data for percentages of wind speeds occurring at each of the sixteen compass points (Appendix 3).

'Typical' conditions, as inferred by the data analysis, were regarded to be those conditions that occurred with the highest percentage frequency, and which were most likely to bring oil ashore. Where combinations of wind speeds and directions were considered, the speeds and directions were chosen such that they lay along "ridges" on the contoured wind rose (Appendix 3). These "ridges" correspond to meteorological conditions of most likely probability.

Based on this analysis of wind speed and direction, the following conditions were assessed as those appropriate for this criteria.

- a north-westerly wind of 15 knots gradually moving through to a 15 knot northerly.
- a constant medium strength (15 knot) north-westerly wind.
- a 13 knot north-easterly wind decreasing to a light north-easterly of 9 knots.
- a constant 13 knot south-westerly wind.
- a 24 knot south-westerly shifting around to the south-south-west at the same strength.

Having selected the conditions above as being representative of those arising in the King Island region of Bass Strait, each site was then considered separately. The conditions applied at the individual sites were selected on the basis of the increased likelihood of a spill impacting with the coast due to the choice of wind speed and direction.

Following the decision to enlarge the window, the records for the months May to December were extracted and analysed as previously (Appendix 3). These were then compared to the analysis of the May-July period. The predominant differences between the two analyses can be summarized as:-

- a decreased probability of north and north-westerly winds; with those winds occurring more likely to be in the 6-10 knot category.
- a greater general emphasis on winds from the south through to the west.
- very light (0-6 knot) north-easterly winds become less likely, whilst the chances of light to medium strength winds remain approximately the same.
- a decreased likelihood of winds from the east.

In the light of the new analysis, the wind conditions chosen as 'typical' of the original May-July period can be regarded as 'typical' of the larger May-December period.

3. Description of the spill event

The spill event to be modelled was defined as a point discharge of 5,000 barrels of oil. The simulated discharge was to be located at three sites within the Bass Strait Basin east of King Island.

Change names for new well names.

- Yolla site ------- 39°52'S, 145°47'E
- Pipipa site 40°22S, 145°50'E
- Cormorant site 39°37'S, 145°24'E

Given the resolution of the maps used for the trajectory modelling, there was little point served in simulating a more complex spill phenomenon, unless the period over which the discharge was likely to occur was greater than the length of the M_2 tidal cycle. Even if the spill event was a continuous discharge of oil over several M_2 tidal cycles (that is, a discharge lasting several days), the time at which oil first impacts with the coast would not be affected. Since a spill in the region of interest is predominantly influenced by the prevailing wind conditions rather than the tidal currents, the trajectory of the spill, and thus the site at which impaction occurs, would not be affected either.

Four sets of wind conditions were applied to the spills originating from the Yolla and Pipipa sites, and three sets of wind conditions were applied to those originating from the Cormorant site.

The specific time in the M_2 tidal cycle that the spill could begin, and its subsequent effect on the future path of a trajectory, was considered by modelling two separate spills; the first initiated at approximately mid-ebb at the sites, and the second at approximately mid-flood.

4. Trajectory modelling

The trajectory modelling was conducted using the OSSM model, originally developed by the National Oceanographic and Atmospheric Administration (Torgrimson 1984), but with data input and output software developed by VIMS. The OSSM model has been adopted as the Australian national standard for oil spill trajectory modelling by the Federal Department of Transport (now the Australian Maritime Safety Authority) and VIMS was the nominated agency supervising its implementation.
The basic features of OSSM can be summarized as follows:-

- OSSM is two dimensional in space, modelling a layer of oil. (Separated layers may be modelled).

- A square grid of 48x80 rectangular cells is used to define the coverage of an OSSM map (which may be any selected size) with planimetric corrections being made within OSSM to account for any spheroid induced distortions.

- Oil is modelled as point masses with the following parameters - location (lat/long), release time, age (for evaporation), oil type, tide height (for intertidal areas), and status (eg. evaporated, beached, off map)

- Evaporation of oil is accounted for as a three component substance, each component with independent evaporation characteristics.

- Water currents are input to the model as a grid (40x24) of current vectors. For Bass Strait, this current grid derives from the VIMS numerical model of Bass Strait, which has been calibrated against current meter data from the Strait collected by VIMS in the early 1980's, this being the most complete data set of water currents available for Bass Strait.

- Water currents used in the trajectory modelling are based on an M_2 tidal range (ie. approximately mean range). For modelling at specific times, these M_2 tidal currents can be factored up or down depending on the time within the spring/neap cycle being modelled.

- Wind fields are specified over the entire OSSM map grid and can be specified as varying in time and space, although for this exercise only time-varying winds were used.

- Diffusion and spreading of the oil is treated within OSSM by a specifiable stochastic algorithm, intended to account for the buoyant spreading and surface tension effects. The accuracy of this approach has been assessed in comparison to Fay's (1971) description of the spreading of oil on calm water in the absence of wind. At the scale of OSSM output used for these simulations, accurate assessment of the spread of oil was not a critical factor.

- The altered characteristics of oil that might result from formation of oil/water emulsions ('mousse') are not automatically simulated by OSSM.

- OSSM accounts for the beaching and refloating of oil but does not attempt to simulate the movement of oil into the water column or into the beach and seabed sediments.

- OSSM has been used by the Institute in both forecast and hindcast modes on a number of actual oil spill trajectories with good results (Easton et al. 1991). As with all numerical models the accuracy of the model output is inherently dependent on the quality of input environmental data.

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5. Comments on the results

In assessing the results of the trajectory modelling, the following general comments are made.

- The trajectories of oil discharged to Bass Strait are the result of a complex set of interactions between the water currents and the winds prevailing at the time of the spill. The strength and direction of the water currents are generally predictable in this area with astronomical tidal currents prevailing most of the time. For short periods (12-72 hrs) the water currents can be influenced by the major eddies moving into Bass Strait from the Tasman Sea, or perhaps coastal trapped waves. If such currents are present and are of sufficient strength they may influence the trajectory of the oil.
  For the purposes of this exercise, these intermittent currents have not been considered because -

  a) there is little point in incorporating an intermittent current in a scenario of 'typical' conditions, and

  b) the specified winds are of sufficient strength to be the dominant influence on the trajectory.

- The tidal current strengths upon which the modelling is based are for an M_2 tide. The strength of the tidal currents obviously varies with the spring/neap cycle of the lunar month, which may also slightly modify the trajectory from the simulation presented. The selection of the time of the spill in relation to the time of tide is arbitrary. The distance of the spill area from the shore and the consequent time of travel of the oil over several tidal cycles means that the time of oil release in relation to the time of tide is not critical to the result, (ie. the location and timing of the oil beaching).

- The OSSM trajectory simulations set up for Bass Strait are of such a scale that little definition of the spread of the oil is possible. The main purpose of the Bass Strait trajectory simulations are seen to be prediction of the time and location of oil beaching, rather than to predict the dynamics of the spreading of the oil in transit. A more detailed set of OSSM charts could be utilized to provide more definition of spreading but for most requirements, including this one, such definition is unnecessary.

- Oil floating on the surface of the sea in calm conditions with low currents will spread until such time that the buoyant forces spreading the oil are balanced by the surface tension of the oil, the rate of spread being determined by the viscosity of the oil. Wind and water currents will continue to cause spreading beyond this time. Partly to avoid excessive processor loads and to allow real-time predictions, OSSM uses a stochastic algorithm to simulate the buoyant spreading of oil, and allows for varying spreading rates with an adjustable coefficient in the spreading algorithm. This technique is basic but generally provides an adequate means of simulating the buoyant spread of oil (which depends on the oil type, the air and water temperatures, and the prevailing wind and current conditions). The oil spreading as simulated by OSSM has been compared by VIMS with an analytical estimate of Fay (1971). Results of this comparison were good, with OSSM simulating about 94% of the spread calculated using the Fay algorithm. (Both methods are subject to substantial limitations).

- The modelling results are considered to give accurate indications of the fate of oil under the specified conditions. However, it is recommended that these results be used for their intended purpose of contingency planning only. These simulations are likely to give no more than an indicative result in the event of an actual spill, due to the fact that the combination of initial conditions will almost certainly differ from those modelled here.

Real-time trajectory simulations using conditions prevailing at the actual time of the spill are recommended in all instances; the initial conditions can make a large difference to the resulting trajectory.

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6. Comments on the use of models to simulate oil spill trajectories

The following information is provided as routine advice to users of oil spill trajectory simulations for real-time predictions. Not all of the advice is relevant to Bass Strait, or to this mode of use of the model as a contingency planning aid, nonetheless it is worthwhile noting the points below.

Models work

The OSSM model (and some other trajectory models) have been demonstrated to give accurate results if properly set up and operated, and accurate environmental data are entered (especially winds). This confidence is justified by the sound track record OSSM has in actual spills and hindcasting simulations.

Models are only as good as the data input to them

It is unrealistic to expect a model to provide accurate output if the data upon which it is running do not accurately reflect the prevailing conditions of wind and tide. For trajectory predictions in real-time this is a particularly important issue; to the extent that uncertainty exists in the weather forecast this uncertainty will be transferred to the modelling results.

Models are a tool for advice and should be used as such

The bounds of the uncertainties as to oil trajectories induced by forecast errors can be usefully defined if a number of simulations are run covering a range of possible weather conditions. The results from such a series of simulations can be used to circumscribe the possible spill trajectories and aid in spill response planning. In some instances the forecast errors will have only a small effect on the trajectory outcome, in other cases the differences to the trajectory can be major; this is all useful information for spill response coordination.

Models have limits to their resolution

By their nature, numerical models are usually designed to run on a spatial grid (generally rectangular). Thus a model cannot be expected to provide details of trajectories at resolutions less than 2-3 cells in size. (To some extent these problems can be avoided by the nesting of model grids of different sizes).

Depending on the location, water currents can vary their predictability

In most semi-enclosed and shallow coastal embayments and estuaries the currents will be dominated by tidal forces, which are inherently predictable. In areas of open coast these tidal currents may be modified by large-scale ocean circulations, which can influence the oil trajectory, particularly in light wind conditions. It is always worthwhile seeking advice from oceanographers or local mariners about prevailing current conditions in such areas.

Model output focuses on the bulk of the oil

Simulations are designed to indicate the trajectory of the bulk of the oil mass, which is where the primary clean-up effort should be targeted. Oil sheens of a few microns thick will appear over much larger areas than the model indicates. The model is thus most useful in concentrating clean-up effort on the areas most heavily oiled.

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7. Comments on the current data used in the modelling

The M_2 tidal currents, incorporated into these simulations, were the result of a project originally commissioned by the Australian Maritime Safety Authority (formerly under the Department of Transport and Communications). The entire Bass Strait region was hydrodynamically modelled by VIMS on a grid of 80 cells across and 52 cells down, with individual cells measuring 10,000 metres by 10,000 metres. Tidal currents were computed for a typical M_2 tide and output at hourly intervals over a tidal cycle. The resulting current information was then transferred to the Macintosh for inclusion into the OSSM database.

As part of the modelling process, the output from the VIMS model was verified against tide gauge records available in the scientific literature. This verification process involved a comparison against the phase and amplitude of the M2 constituent of the tidal cycle. (A comparison against actual current speeds and directions would be preferable, but insufficient current meter records were available to justify this approach). Model output was analysed for phase and amplitude contours, and these were plotted in map form, along with actual tide gauge records (Appendix 4). The results obtained fit well with the tide records, particularly across the Bass Strait Basin.

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8. Presentation of Results

Results of the modelling are provided in two formats. Within Appendix 1 of this report the individual scenarios are listed, the extent of impact described and, on the opposing page, the end result summary of the model output is given. The end of the spill trajectory is generally defined as the point when less than 10% of the released oil is still floating.

In Appendix 2 all model output is given at six hourly intervals. The percentages of the oil (floating, evaporated, or beached) given below the maps are proportions of the oil shown on the map.

The wind analysis, upon which VIMS based the selection of meteorological conditions, is contained in Appendix 3. The results are presented in two formats; a table of percentage occurrences in the May - July wind records and a contour chart of the same data.

Appendix 4 contains plots of phase and amplitude across Bass Strait taken from the VIMS hydrodynamic models used in OSSM. Tide gauge data available in the current scientific literature have also been plotted as a comparison.

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9. Likelihood of oil impacting with coastline

Of the twenty-two scenarios modelled by OSSM, only four resulted in oil impacting with coastline. The time in the tidal cycle that the discharge occurs does not markedly affect the final result or its timing.

In the case of a spill occurring at the Pipipa site, the result is that oil will beach on the northern Tasmanian coast near Stanley after approximately 4.5 days. This accounts for two of the four cases. The wind conditions used in these scenarios occur with a probability of approximately 0.02 (2%).

In the case of a spill occurring at the Cormorant site, the result is that oil will beach on the southern Victorian coast near Wilson's Promontory after approximately 3.5 days. This accounts for the other two cases. The wind conditions used in these scenarios occur with a probability of approximately 0.03 (3%).

Both these events are relatively unlikely. In most of the scenarios, the oil was either carried away from coastal areas or remained close to the original spill site. Given that the conditions used in the modelling process were specifically selected in an attempt to acheive impaction, the likelihood of other conditions occurring that would result in beaching is minimal.

It also should be noted that no attempt has been made to model the possible effects of dispersants on the oil spill. The application of suitable dispersants would greatly lessen the likelihood of oil impacting with the coastlines of Tasmania and Victoria.

These probabilities must be multiplied by the probability of a blowout.

$3 \times 10^{-5} \times 3 \times 10^{-2} = 9 \times 10^{-7}$

$\approx 1 \times 10^{-6}$ (1 chance in 1 million)

10. References

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Appendix 1

Summary results of trajectory simulations

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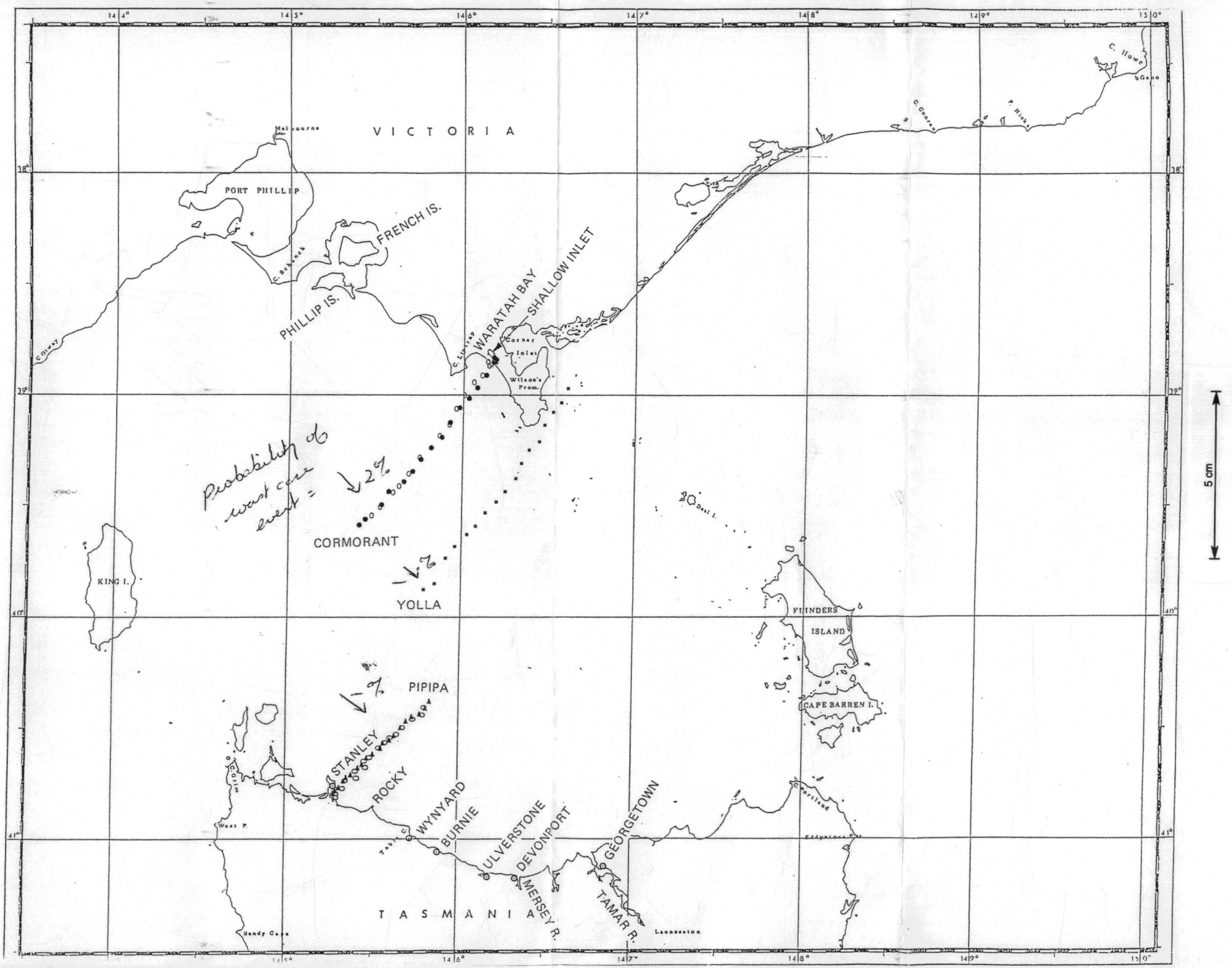

144°
145°
146°
147°
148°
149°
150°
38°
39°
40°
41°
VICTORIA
Melbourne
PORT PHILLIP
FRENCH IS.
PHILLIP IS.
C. Schanck
C. Otway
C. Liptrap
WARATAH BAY
SHALLOW INLET
Corner Inlet
Wilson's Prom.
C. Howe
Gabo
C. Conran
P. Hicks
Probability of worst case event =
2%
CORMORANT
YOLLA
KING I.
Deal I.
FLINDERS ISLAND
CAPE BARREN I.
PIPIPA
STANLEY
ROCKY
WYNYARD
BURNIE
ULVERSTONE
DEVONPORT
GEORGETOWN
MERSEY R.
TAMAR R.
TASMANIA
Launceston
Sandy Cape
West P.
C. Portland
5 cm

event 1.4

Approximately 53% (2.7 kB) of the oil afloat off the eastern side of Wilson's Promontory. The oil originated from the Yolla site.

event 3.2

Approximately 48% (2.4 kB) beached near Stanley on the northern Tasmanian coast after 120 hours. The oil originated from the Pipipa site and first impacted with the coast after 108 hours.

event 4.2

Approximately 49% (2.5 kB) beached near Stanley on the northern Tasmanian coast after 114 hours. The oil originated from the Pipipa site and first impacted with the coast after 108 hours.

event 5.3

Approximately 50% (2.5 kB) beached at Waratah Bay to the west of Wilson's Promontory after 96 hours. The oil originated from the Cormorant site and first impacted with the coast after 84 hours.

event 6.3

Approximately 51% (2.6 kB) beached at Waratah Bay to the west of Wilson's Promontory after 96 hours. The oil originated from the Cormorant site and first impacted with the coast after 84 hours.

Yolla scenarios

Event 1.1

Spill:

A discharge of oil from the Yolla site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Yolla site in the Bass Strait Basin.

39°52'S, 145°47'E

Time of spill:

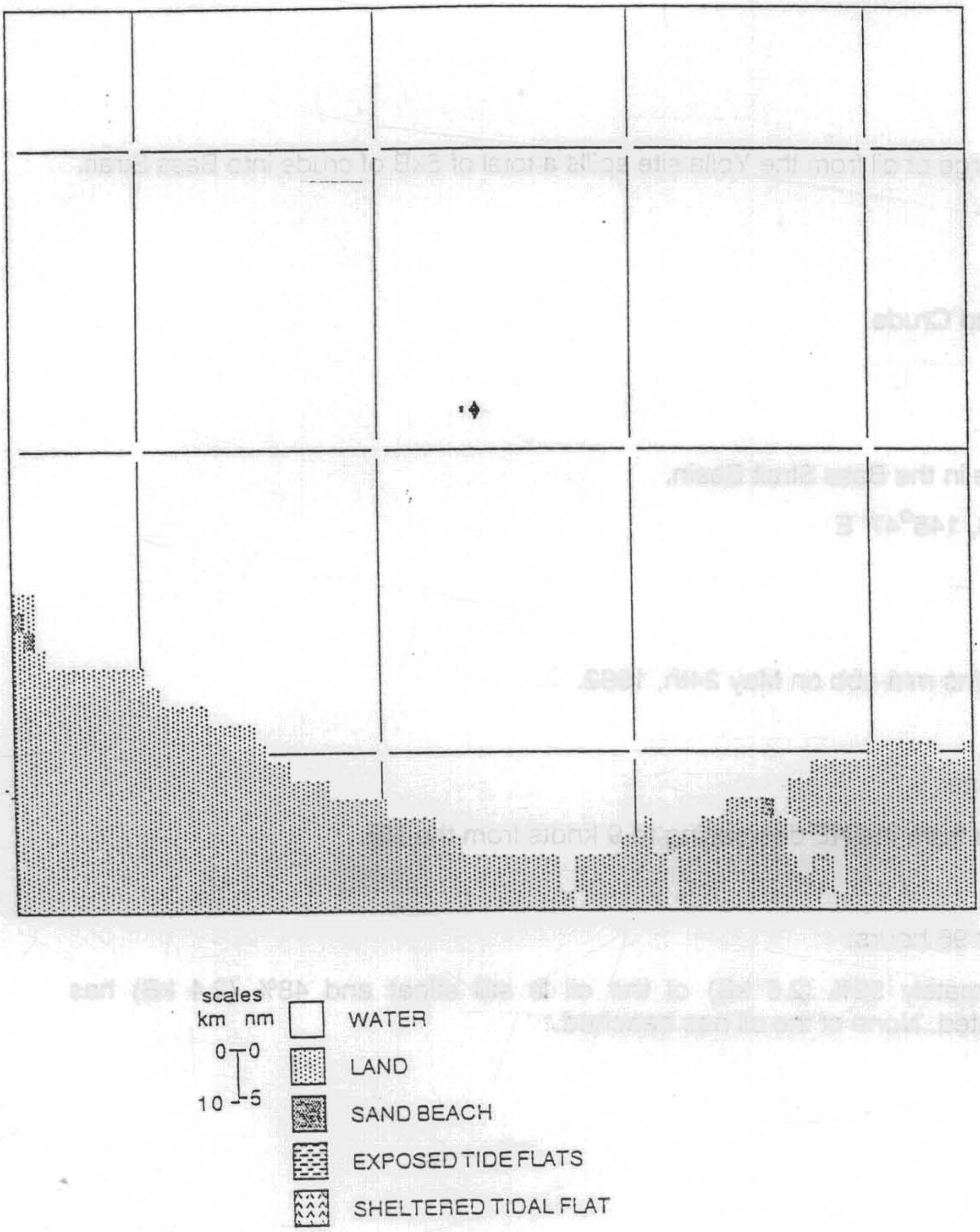
spill begins mid-ebb on May 24th, 1992.

Wind conditions:

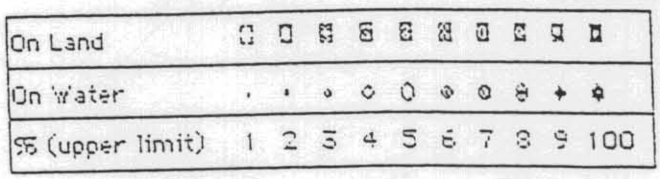
15 knots from the NW coming around to 15 knots from the N.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.



Symbols indicating the percentage of discharged oil at particular location



event 1.1 after 96 hours

5 cm

Event 1.2

Spill:

A discharge of oil from the Yolla site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Yolla site in the Bass Strait Basin.

39°52' S, 145°47' E

Time of spill:

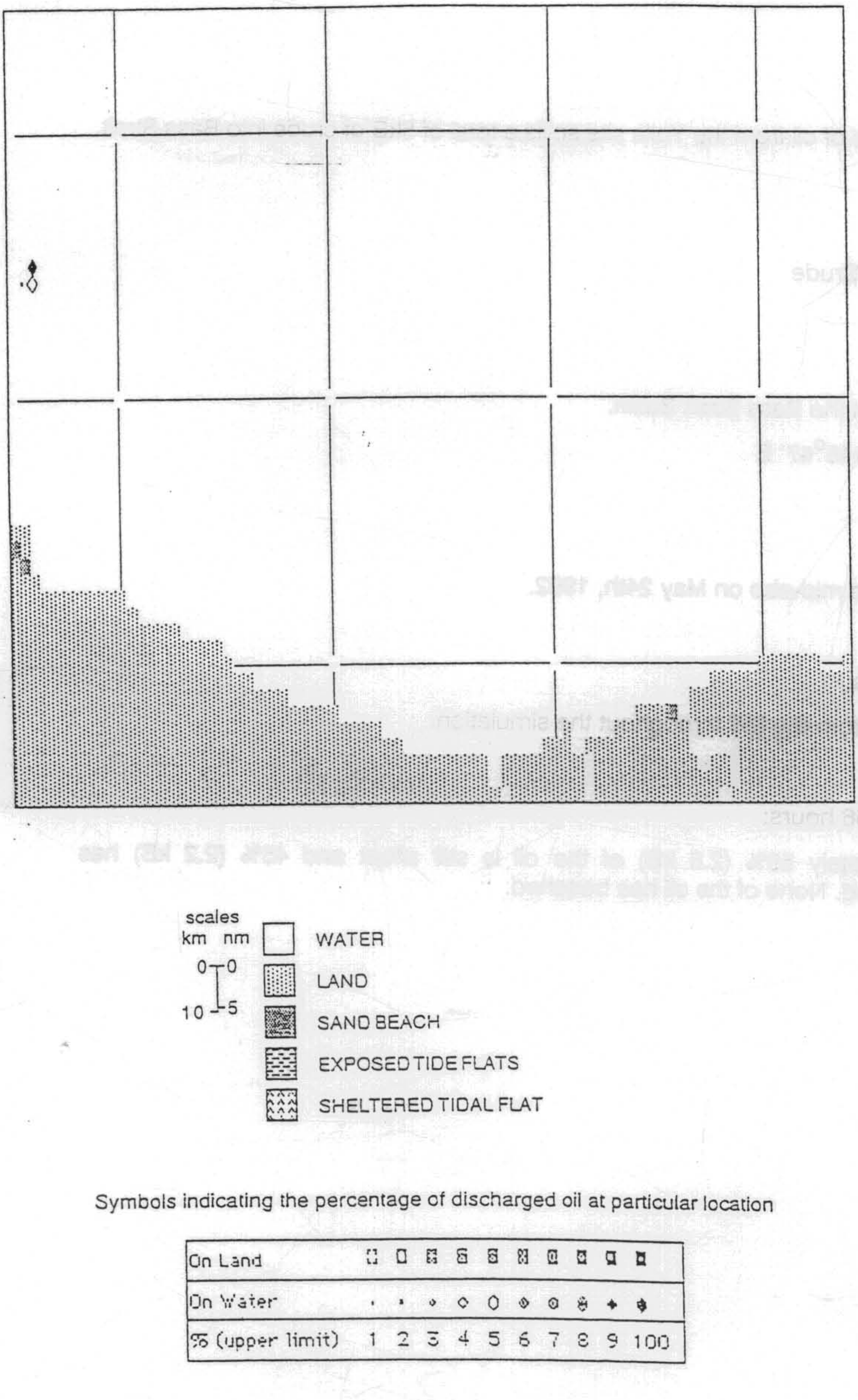
spill begins mid-ebb on May 24th, 1992.

Wind conditions:

13 knots from the NE decreasing to 9 knots from the NE.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.



event 1.2 after 96 hours

5 cm

Event 1.3

Spill:

A discharge of oil from the Yolla site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Yolla site in the Bass Strait Basin.

39°52' S, 145°47' E

Time of spill:

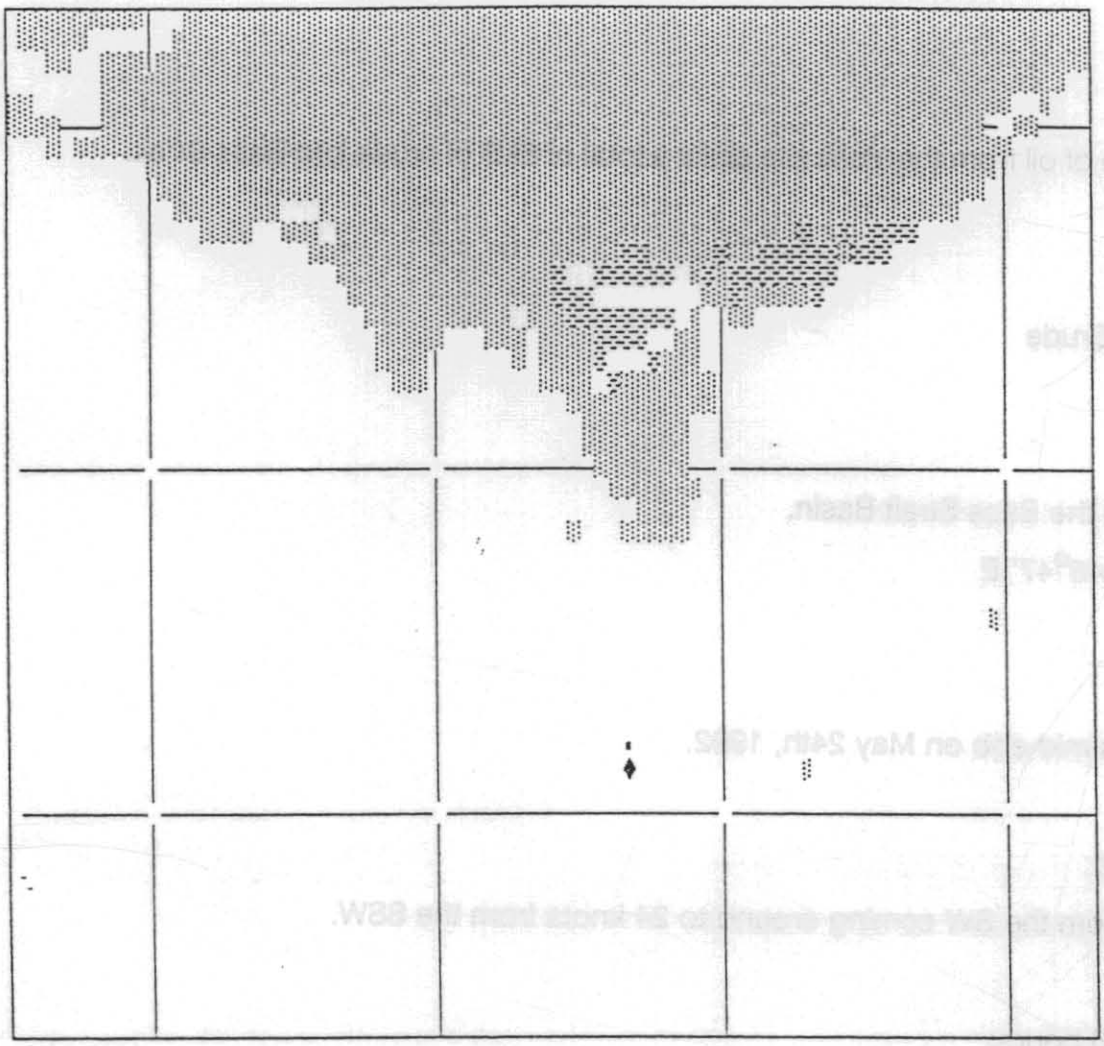
spill begins mid-ebb on May 24th, 1992.

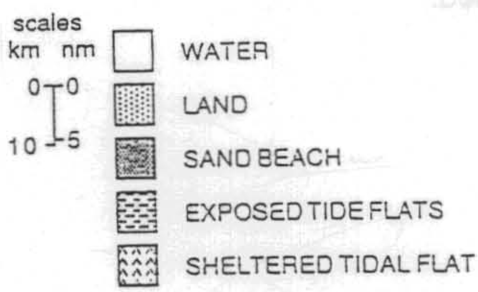
Wind conditions:

13 knots from the SW throughout the simulation.

Situation after 96 hours:

Approximately 55% (2.8 kB) of the oil is still afloat and 45% (2.2 kB) has evaporated. None of the oil has beached.





Symbols indicating the percentage of discharged oil at particular location

On Land	□	□	□	□	□	□	□	□	□	□
On Water	·	•	◦	○	○	◈	◎	◈	✦	◆
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 1.3 after 96 hours

5 cm

Event 1.4

Spill:

A discharge of oil from the Yolla site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Yolla site in the Bass Strait Basin.

39°52' S, 145°47' E

Time of spill:

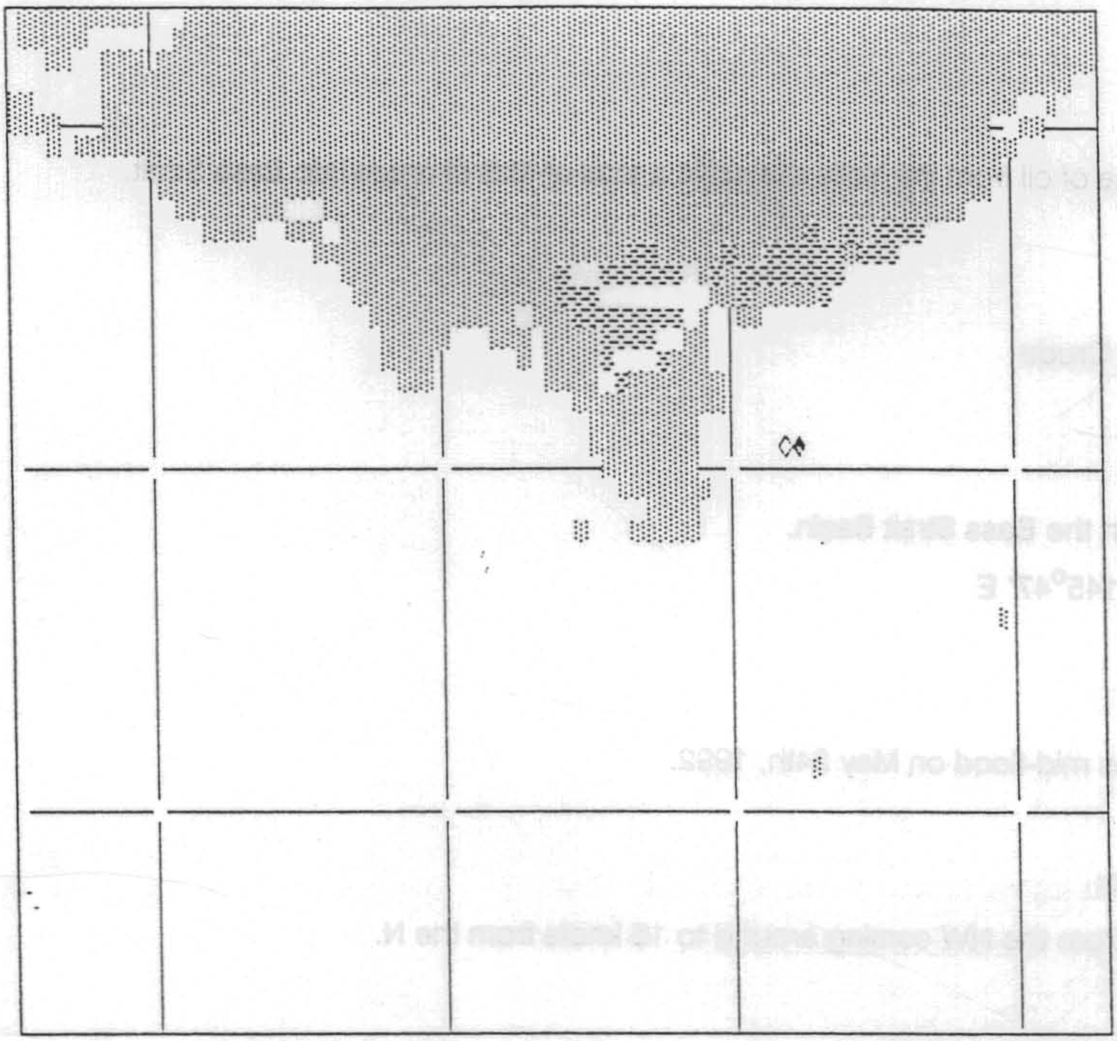
spill begins mid-ebb on May 24th, 1992.

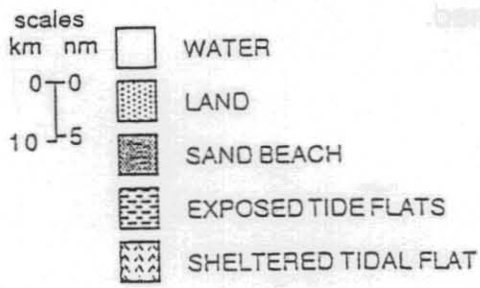
Wind conditions:

24 knots from the SW coming around to 24 knots from the SSW.

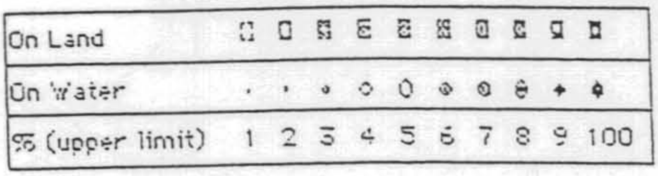
Situation after 96 hours:

Approximately 53% (2.7 kB) of the oil is still afloat and 47% (2.3 kB) has evaporated. None of the oil has beached.

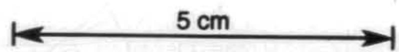




Symbols indicating the percentage of discharged oil at particular location



event 1.4 after 96 hours



Event 2.1

Spill:

A discharge of oil from the Yolla site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Yolla site in the Bass Strait Basin.

39°52' S, 145°47' E

Time of spill:

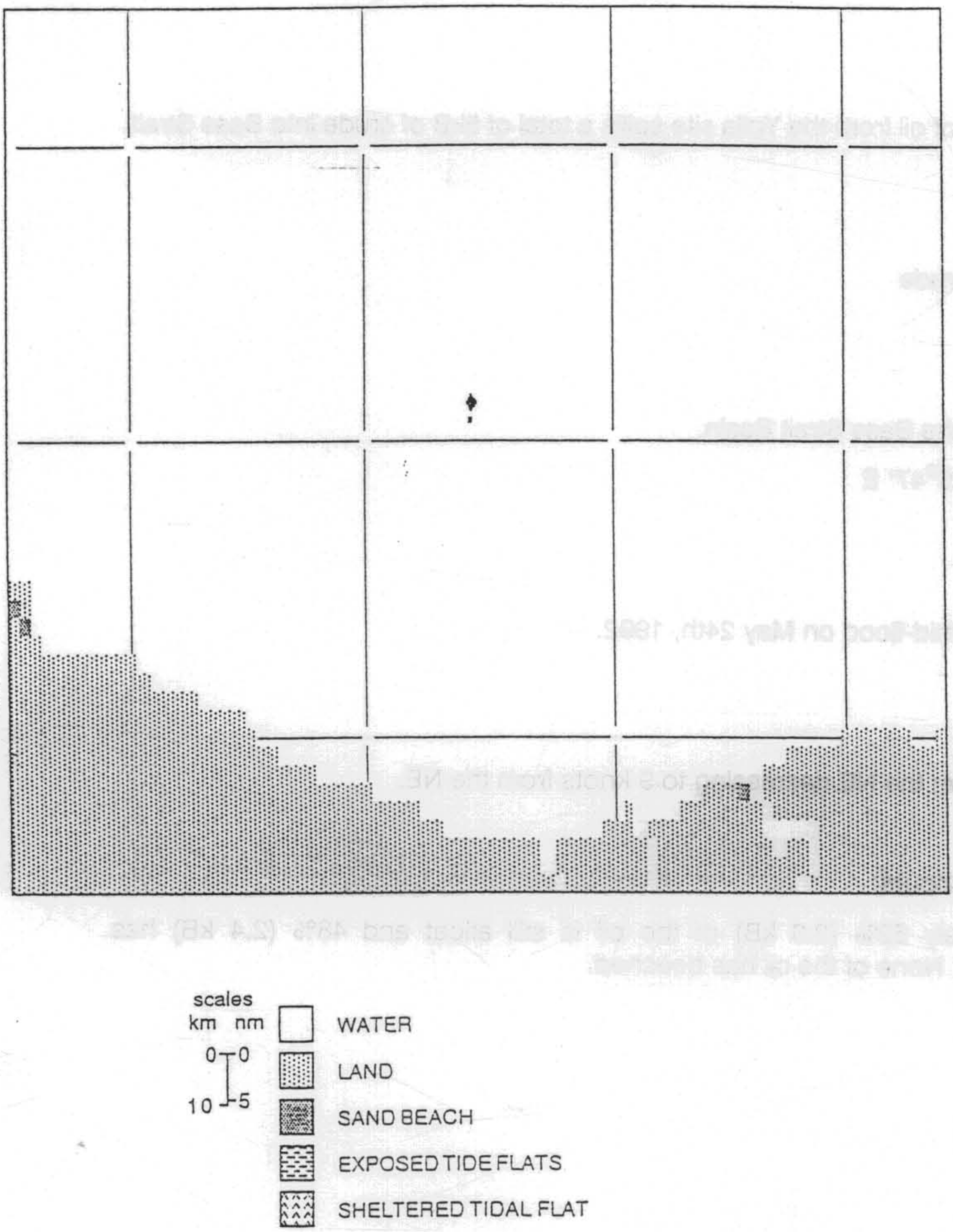
spill begins mid-flood on May 24th, 1992.

Wind conditions:

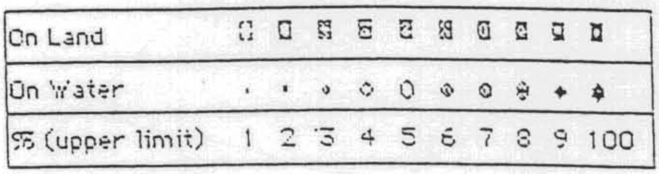
15 knots from the NW coming around to 15 knots from the N.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.



Symbols indicating the percentage of discharged oil at particular location



event 2.1 after 96 hours

5 cm

Event 2.2

Spill:

A discharge of oil from the Yolla site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Yolla site in the Bass Strait Basin.

39°52' S, 145°47' E

Time of spill:

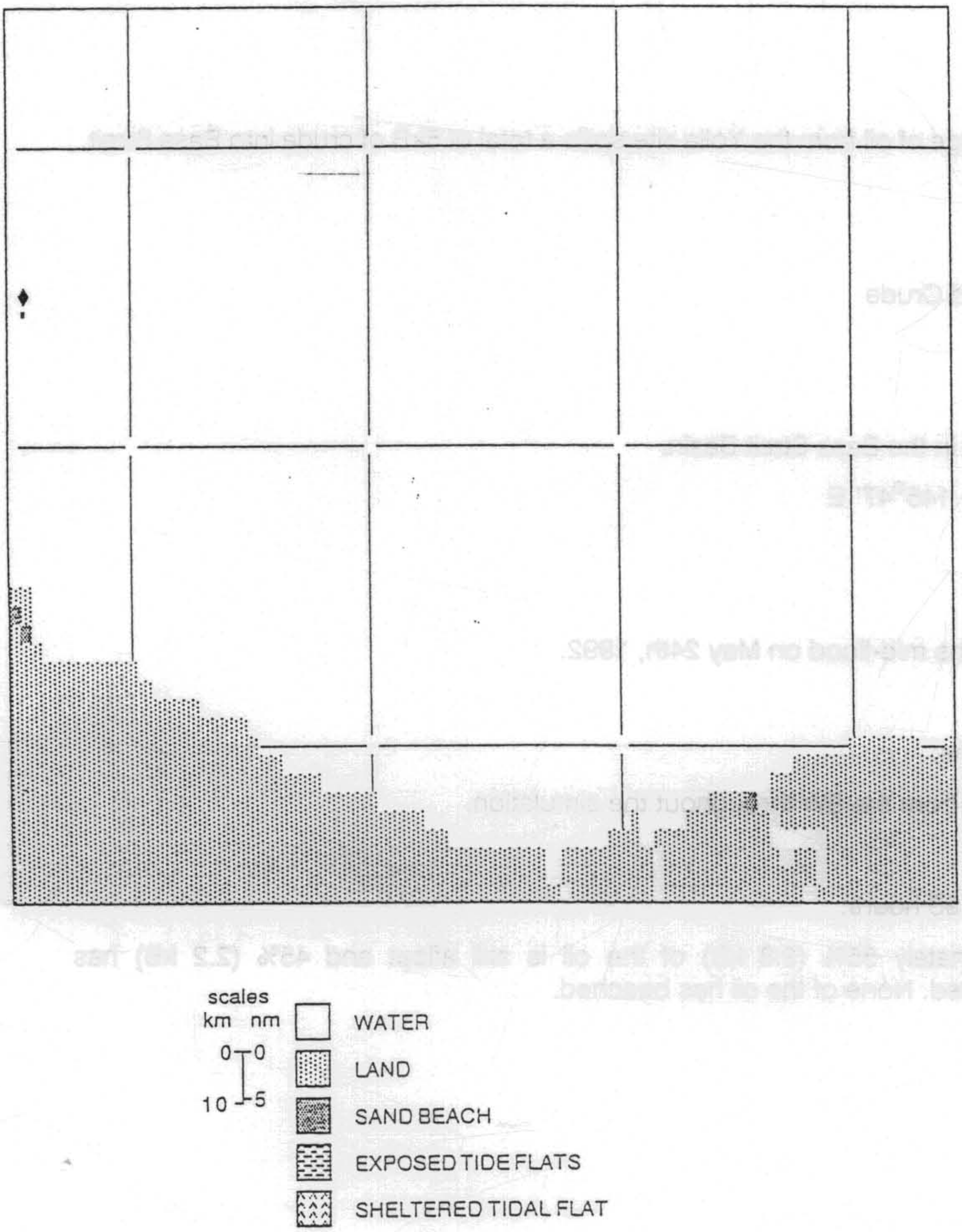
spill begins mid-flood on May 24th, 1992.

Wind conditions:

13 knots from the NE decreasing to 9 knots from the NE.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.



Symbols indicating the percentage of discharged oil at particular location

On Land										
On Water										
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 2.2 after 96 hours

5 cm

Event 2.3

Spill:

A discharge of oil from the Yolla site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Yolla site in the Bass Strait Basin.

39°52' S, 145°47' E

Time of spill:

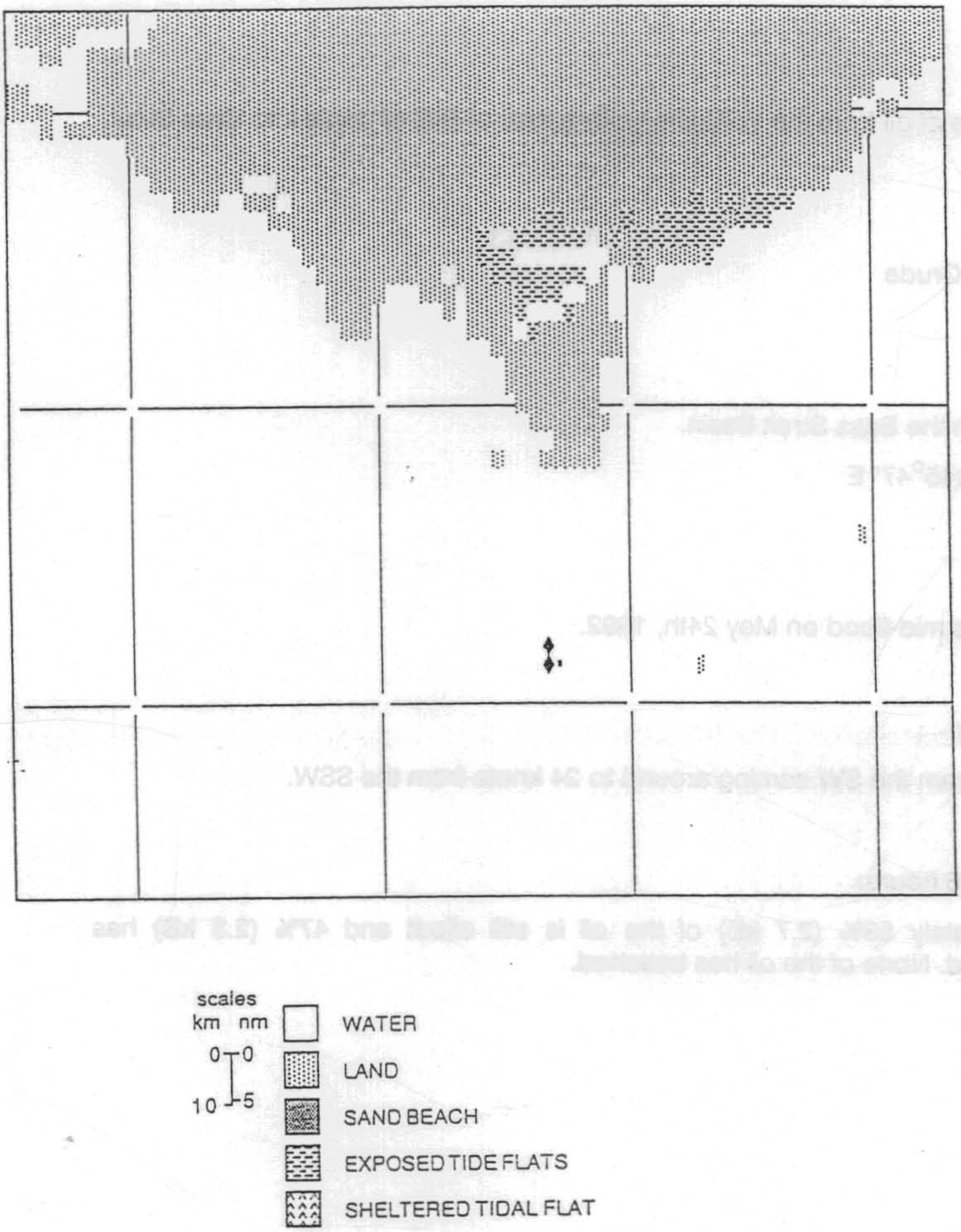
spill begins mid-flood on May 24th, 1992.

Wind conditions:

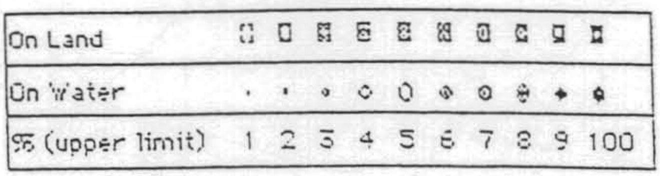
13 knots from the SW throughout the simulation.

Situation after 96 hours:

Approximately 55% (2.8 kB) of the oil is still afloat and 45% (2.2 kB) has evaporated. None of the oil has beached.



Symbols indicating the percentage of discharged oil at particular location



event 2.3 after 96 hours

5 cm

Event 2.4

Spill:

A discharge of oil from the Yolla site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Yolla site in the Bass Strait Basin.

39°52' S, 145°47' E

Time of spill:

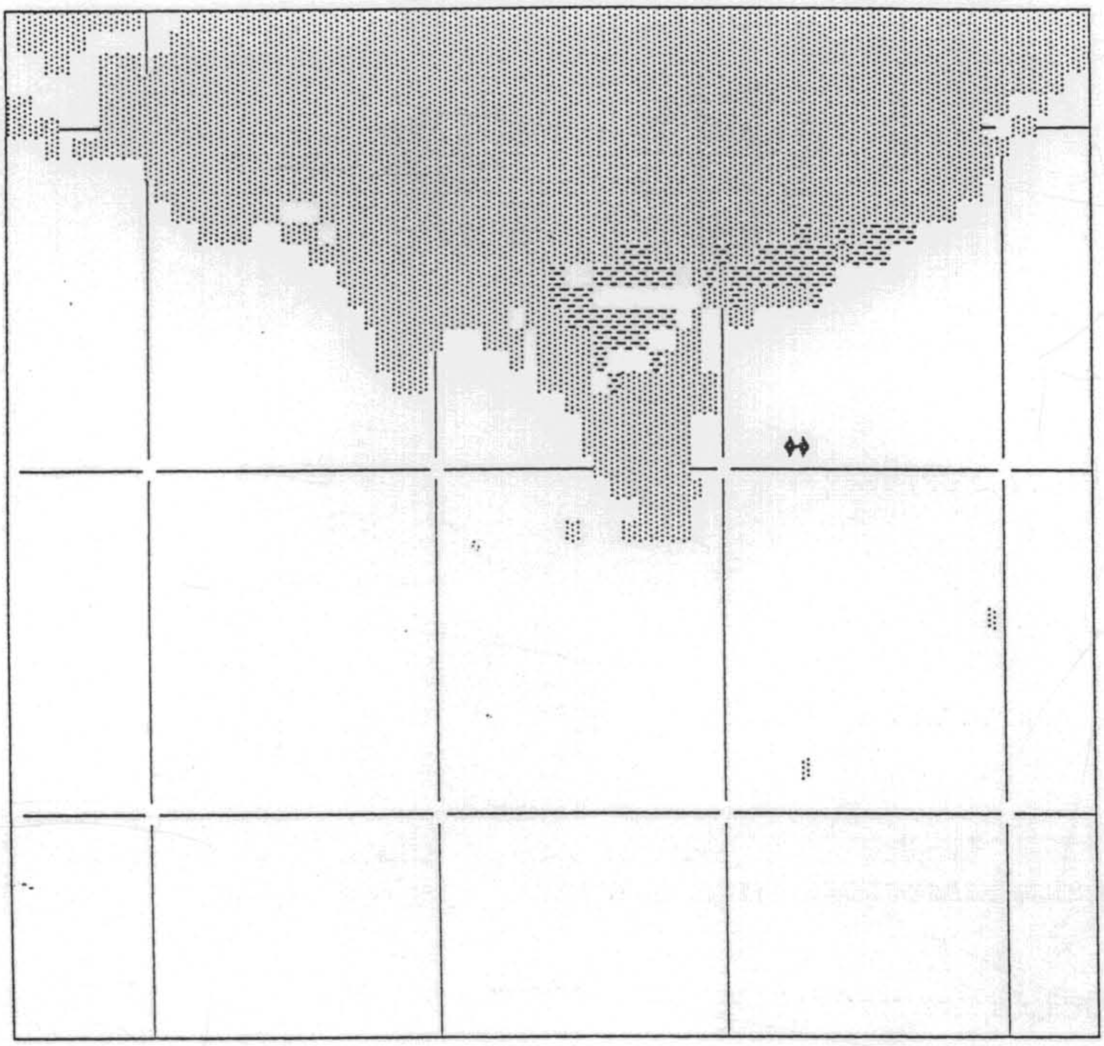
spill begins mid-flood on May 24th, 1992.

Wind conditions:

24 knots from the SW coming around to 24 knots from the SSW.

Situation after 96 hours:

Approximately 53% (2.7 kB) of the oil is still afloat and 47% (2.3 kB) has evaporated. None of the oil has beached.



scales
km nm
0 0
10 5

WATER
LAND
SAND BEACH
EXPOSED TIDE FLATS
SHELTERED TIDAL FLAT

Symbols indicating the percentage of discharged oil at particular location

On Land										
On Water										
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 2.4 after 96 hours

5 cm

Pipipa scenarios

Event 3.1

Spill:

A discharge of oil from the Pipipa site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Pipipa site in the Bass Strait Basin.

40°22' S, 145°50' E

Time of spill:

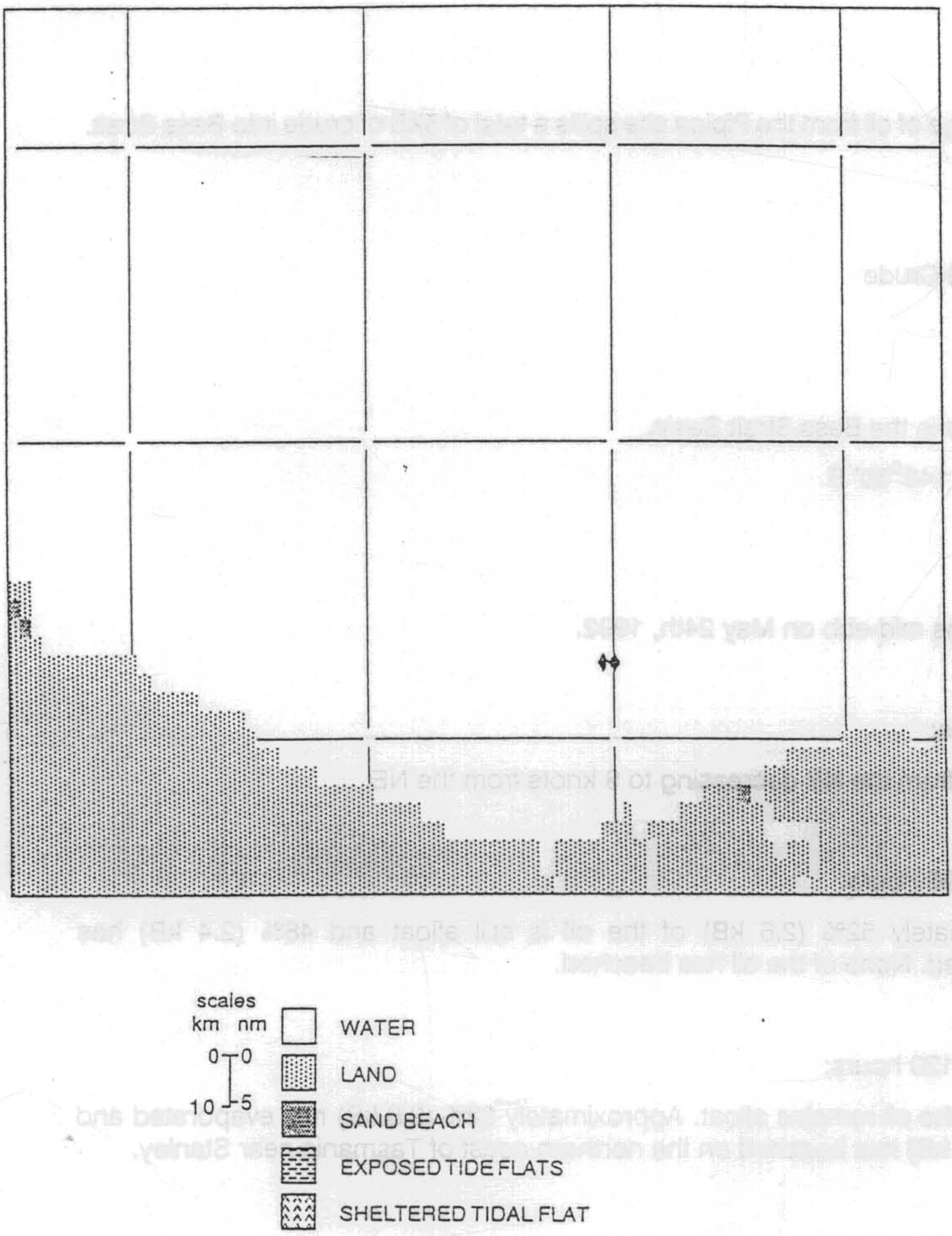
spill begins mid-ebb on May 24th, 1992.

Wind conditions:

15 knots from the NW throughout the simulation.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.



Symbols indicating the percentage of discharged oil at particular location

On Land	□	□	□	□	□	□	□	□	□	□
On Water	·	·	◦	○	○	◎	◎	◎	◆	◆
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 3.1 after 96 hours

5 cm

Event 3.2

Spill:

A discharge of oil from the Pipipa site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Pipipa site in the Bass Strait Basin.

40°22' S, 145°50' E

Time of spill:

spill begins mid-ebb on May 24th, 1992.

Wind conditions:

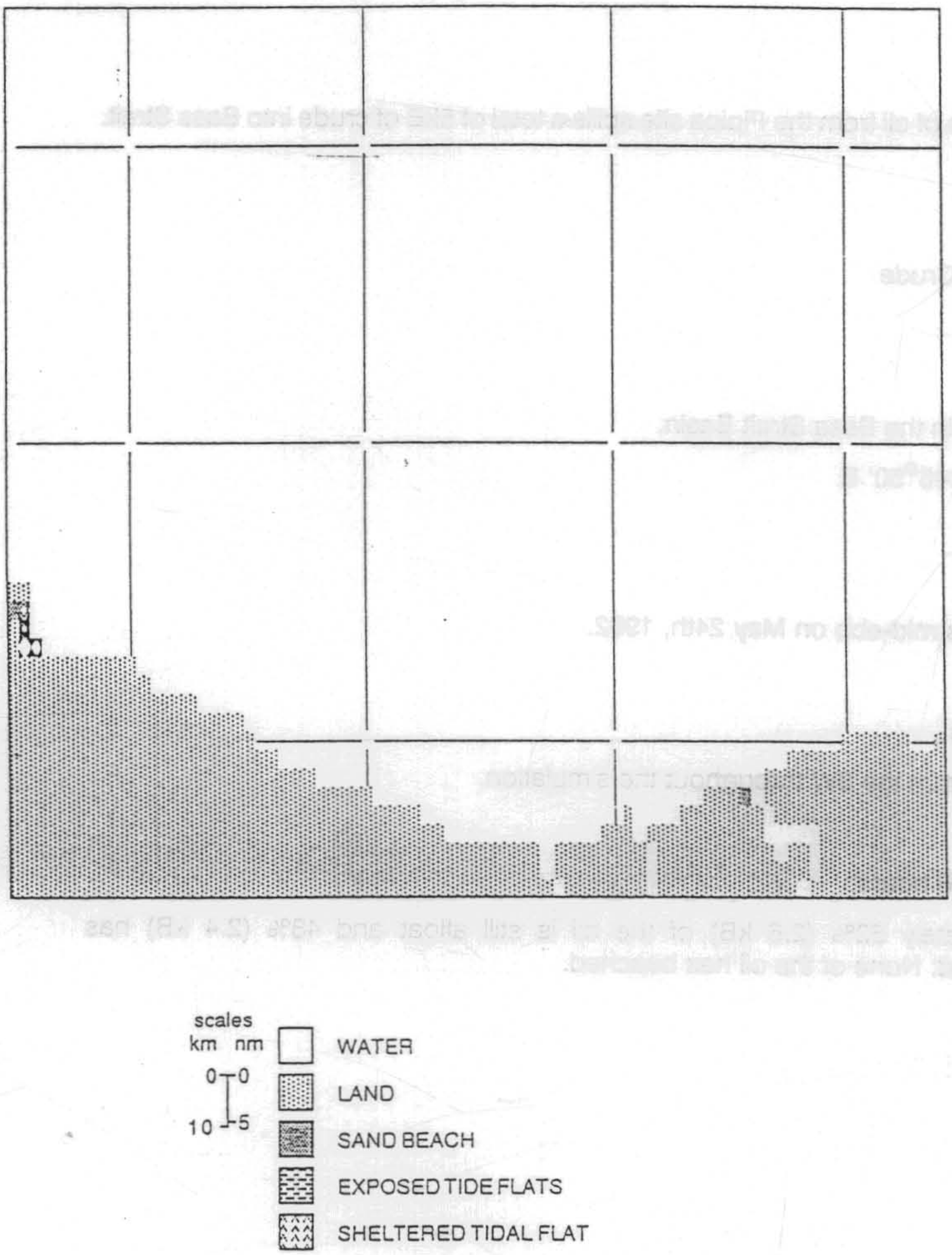
13 knots from the NE decreasing to 9 knots from the NE.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.

Situation after 120 hours:

None of the oil remains afloat. Approximately 52% (2.6 kB) has evaporated and 48% (2.4 kB) has beached on the northern coast of Tasmania near Stanley.



Symbols indicating the percentage of discharged oil at particular location

On Land										
On Water										
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 3.2 after 120 hours

5 cm

Event 3.3

Spill:

A discharge of oil from the Pipipa site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Pipipa site in the Bass Strait Basin.

40°22' S, 145°50' E

Time of spill:

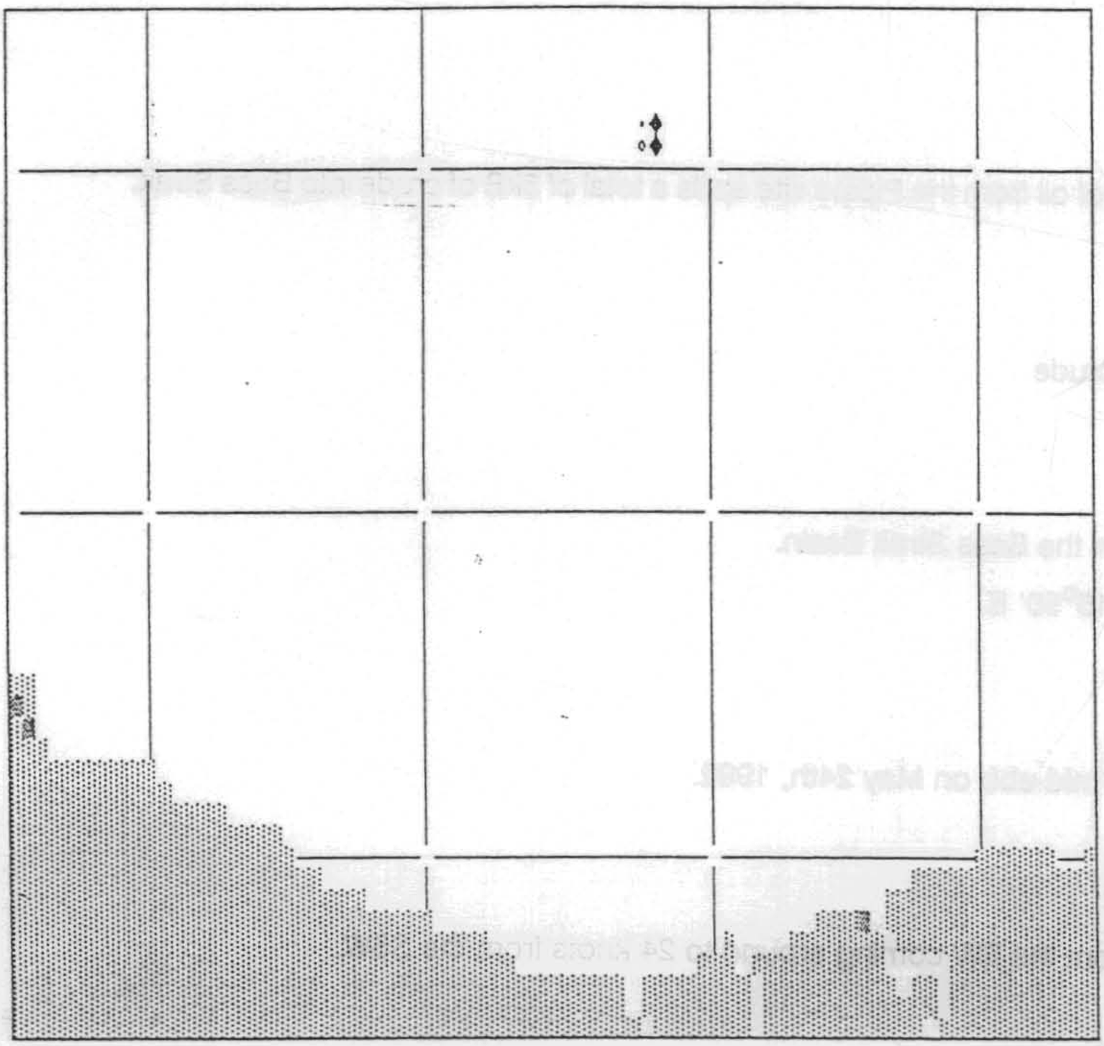
spill begins mid-ebb on May 24th, 1992.

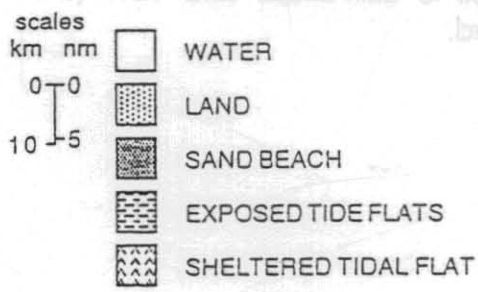
Wind conditions:

13 knots from the SW throughout the simulation.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.





Symbols indicating the percentage of discharged oil at particular location

On Land										
On Water										
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 3.3 after 96 hours

5 cm

Event 3.4

Spill:

A discharge of oil from the Pipipa site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Pipipa site in the Bass Strait Basin.

40°22' S, 145°50' E

Time of spill:

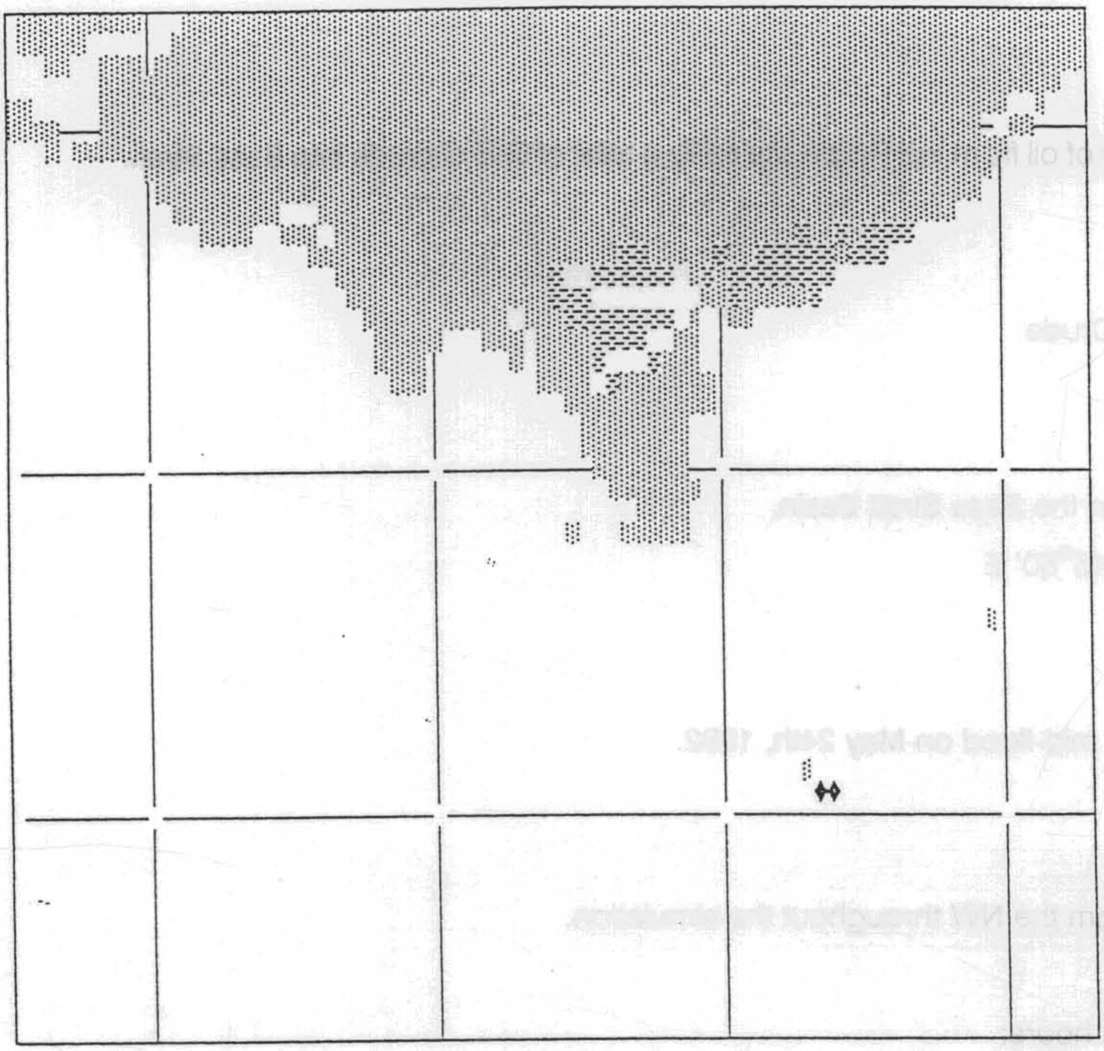
spill begins mid-ebb on May 24th, 1992.

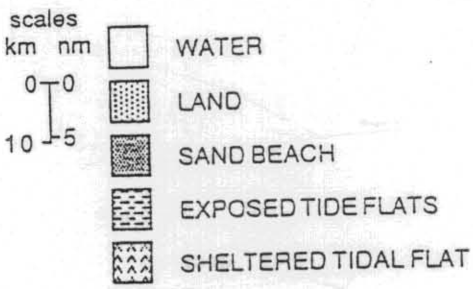
Wind conditions:

24 knots from the SW coming around to 24 knots from the SSW.

Situation after 96 hours:

Approximately 88% (4.4 kB) of the oil is still afloat and 12% (0.6 kB) has evaporated. None of the oil has beached.





Symbols indicating the percentage of discharged oil at particular location

On Land										
On Water										
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 3.4 after 96 hours

5 cm

Event 4.1

Spill:

A discharge of oil from the Pipipa site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Pipipa site in the Bass Strait Basin.

40°22' S, 145°50' E

Time of spill:

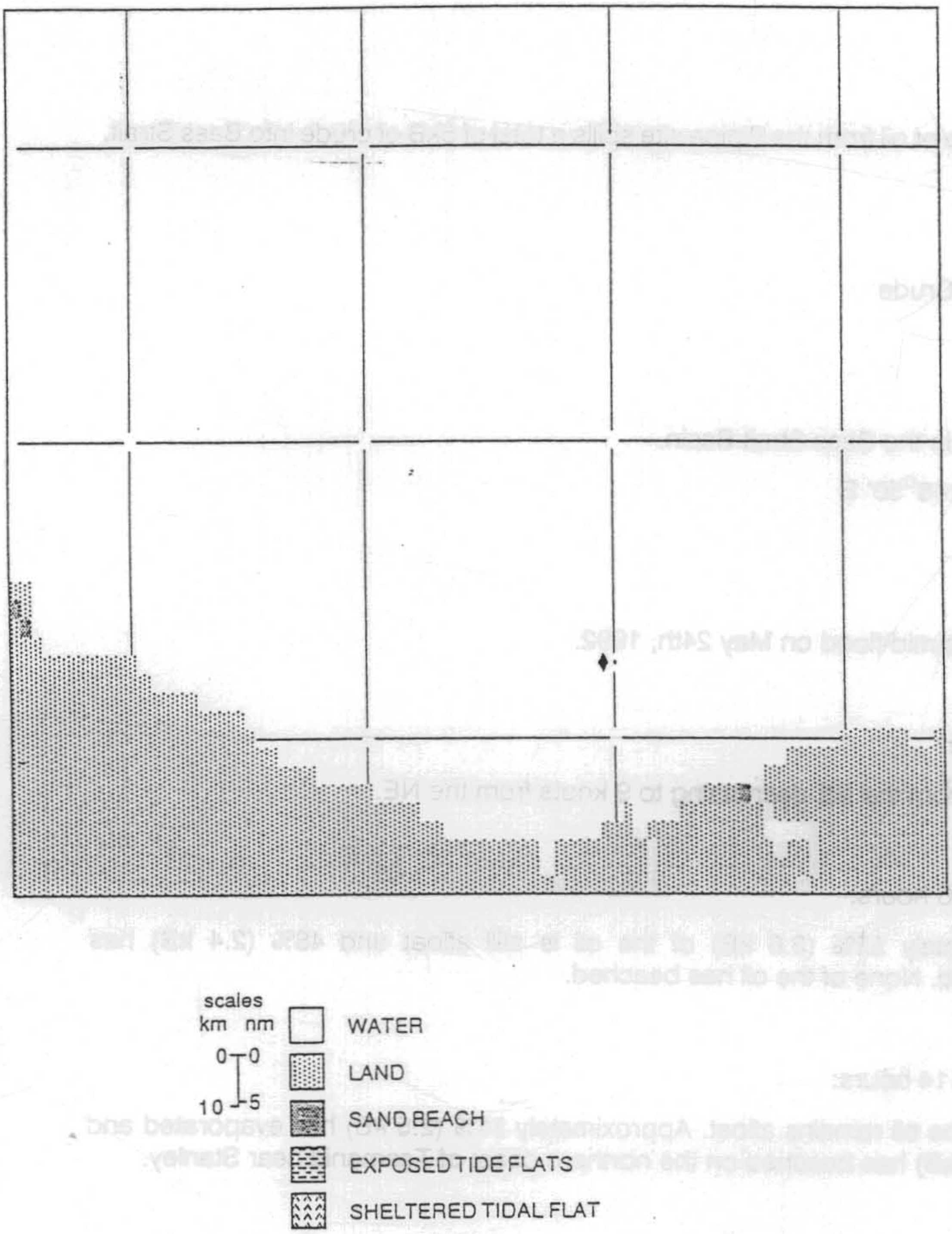
spill begins mid-flood on May 24th, 1992.

Wind conditions:

15 knots from the NW throughout the simulation.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.



Symbols indicating the percentage of discharged oil at particular location

On Land										
On Water										
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 4.1 after 96 hours

5 cm

Event 4.2

Spill:

A discharge of oil from the Pipipa site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Pipipa site in the Bass Strait Basin.

40°22' S, 145°50' E

Time of spill:

spill begins mid-flood on May 24th, 1992.

Wind conditions:

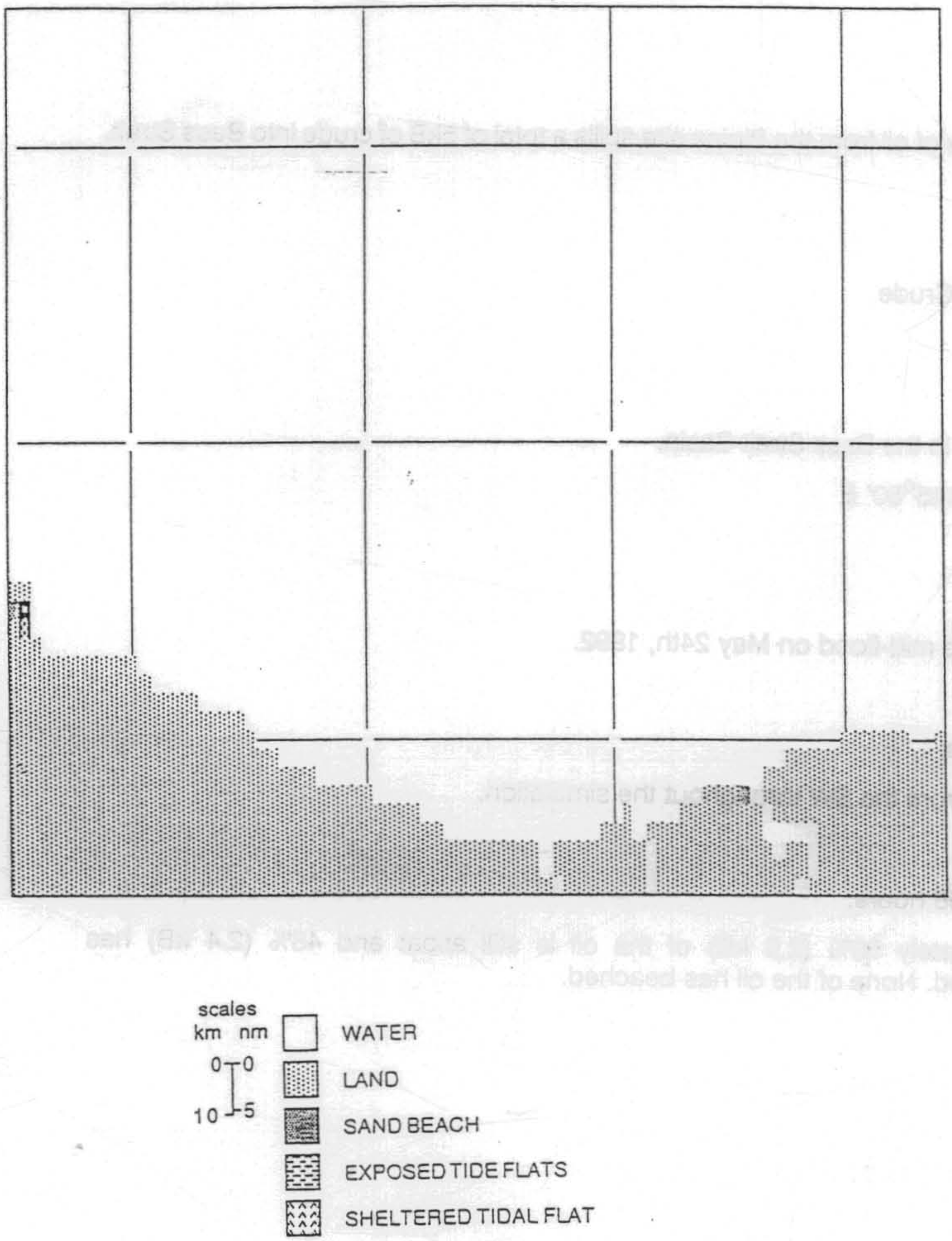
13 knots from the NE decreasing to 9 knots from the NE.

Situation after 96 hours:

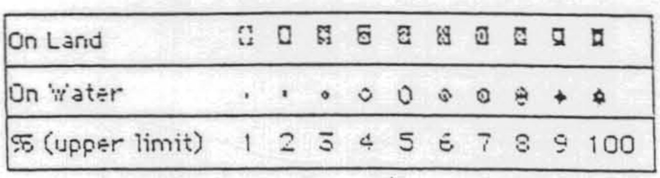
Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.

Situation after 114 hours:

None of the oil remains afloat. Approximately 51% (2.5 kB) has evaporated and 49% (2.5 kB) has beached on the northern coast of Tasmania near Stanley.



Symbols indicating the percentage of discharged oil at particular location



event 4.2 after 114 hours

5 cm

Event 4.3

Spill:

A discharge of oil from the Pipipa site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Pipipa site in the Bass Strait Basin.

40°22' S, 145°50' E

Time of spill:

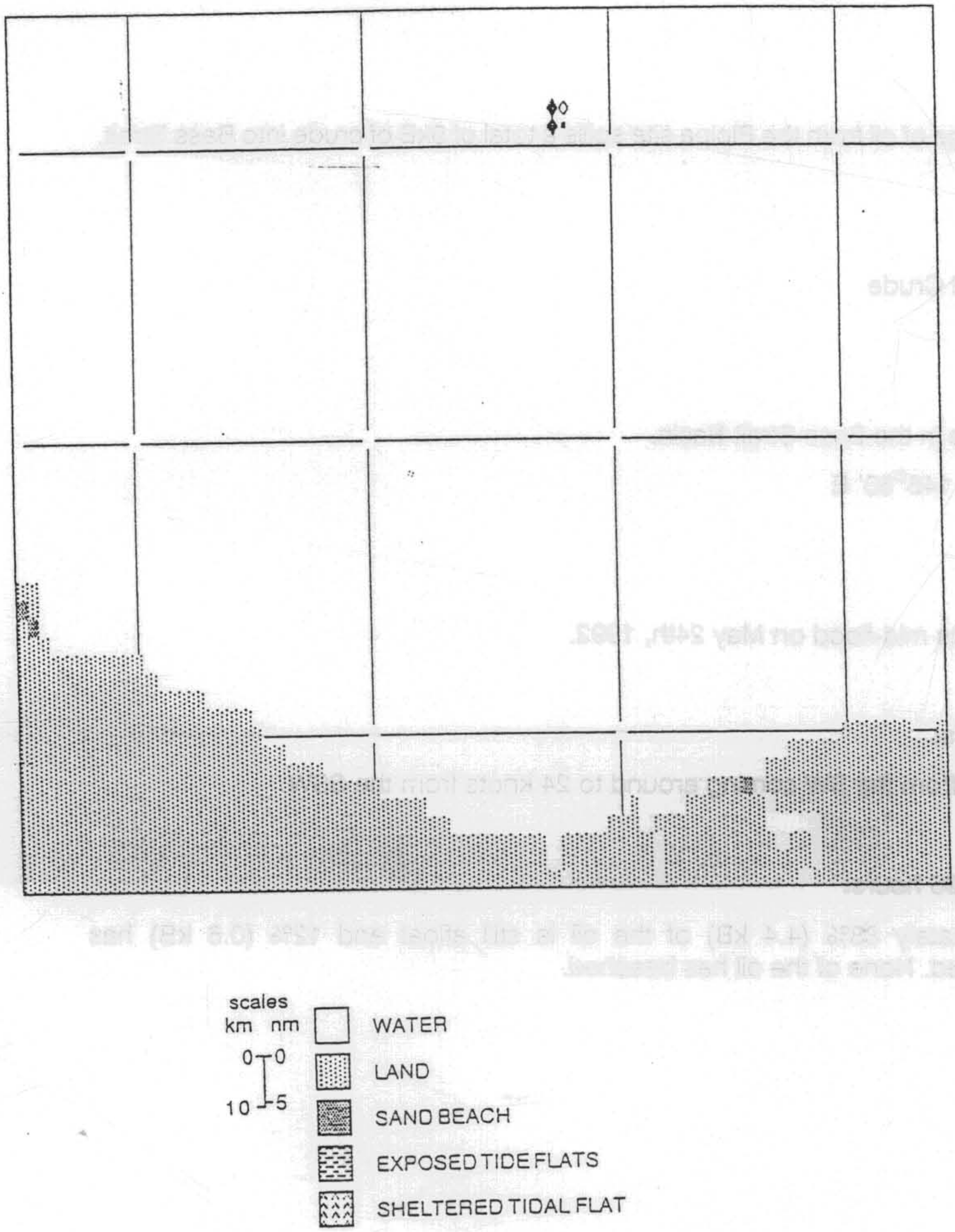
spill begins mid-flood on May 24th, 1992.

Wind conditions:

13 knots from the SW throughout the simulation.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.



Symbols indicating the percentage of discharged oil at particular location

On Land										
On Water										
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 4.3 after 96 hours

5 cm

Event 4.4

Spill:

A discharge of oil from the Pipipa site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Pipipa site in the Bass Strait Basin.

40°22' S, 145°50' E

Time of spill:

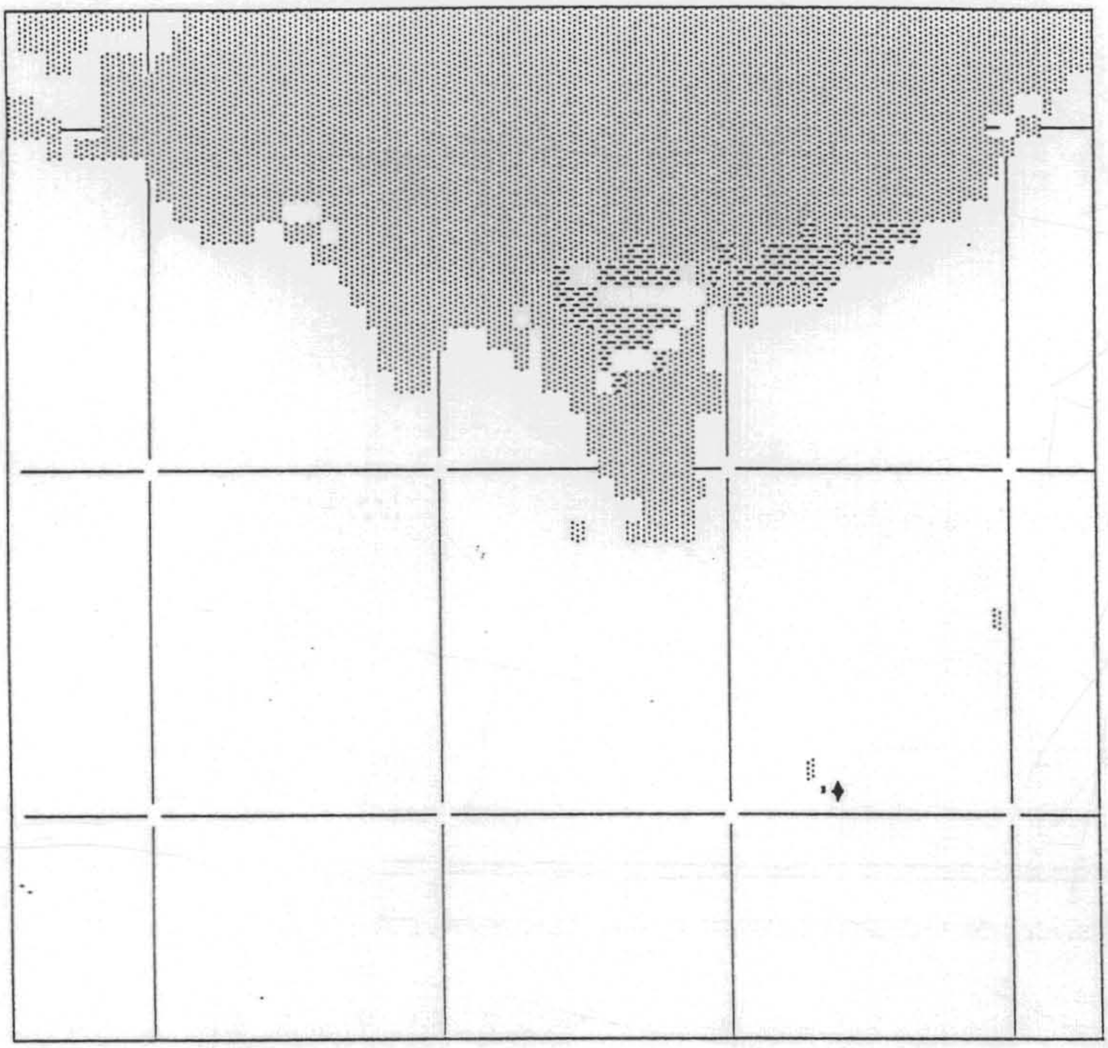
spill begins mid-flood on May 24th, 1992.

Wind conditions:

24 knots from the SW coming around to 24 knots from the SSW.

Situation after 96 hours:

Approximately 88% (4.4 kB) of the oil is still afloat and 12% (0.6 kB) has evaporated. None of the oil has beached.



scales
km nm
0 0
10 5

	WATER
	LAND
	SAND BEACH
	EXPOSED TIDE FLATS
	SHELTERED TIDAL FLAT

Symbols indicating the percentage of discharged oil at particular location

On Land										
On Water										
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 4.4 after 96 hours

5 cm

Cormorant scenarios

Event 5.1

Spill:

A discharge of oil from the Cormorant site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Cormorant site in the Bass Strait Basin.

39°37' S, 145°24' E

Time of spill:

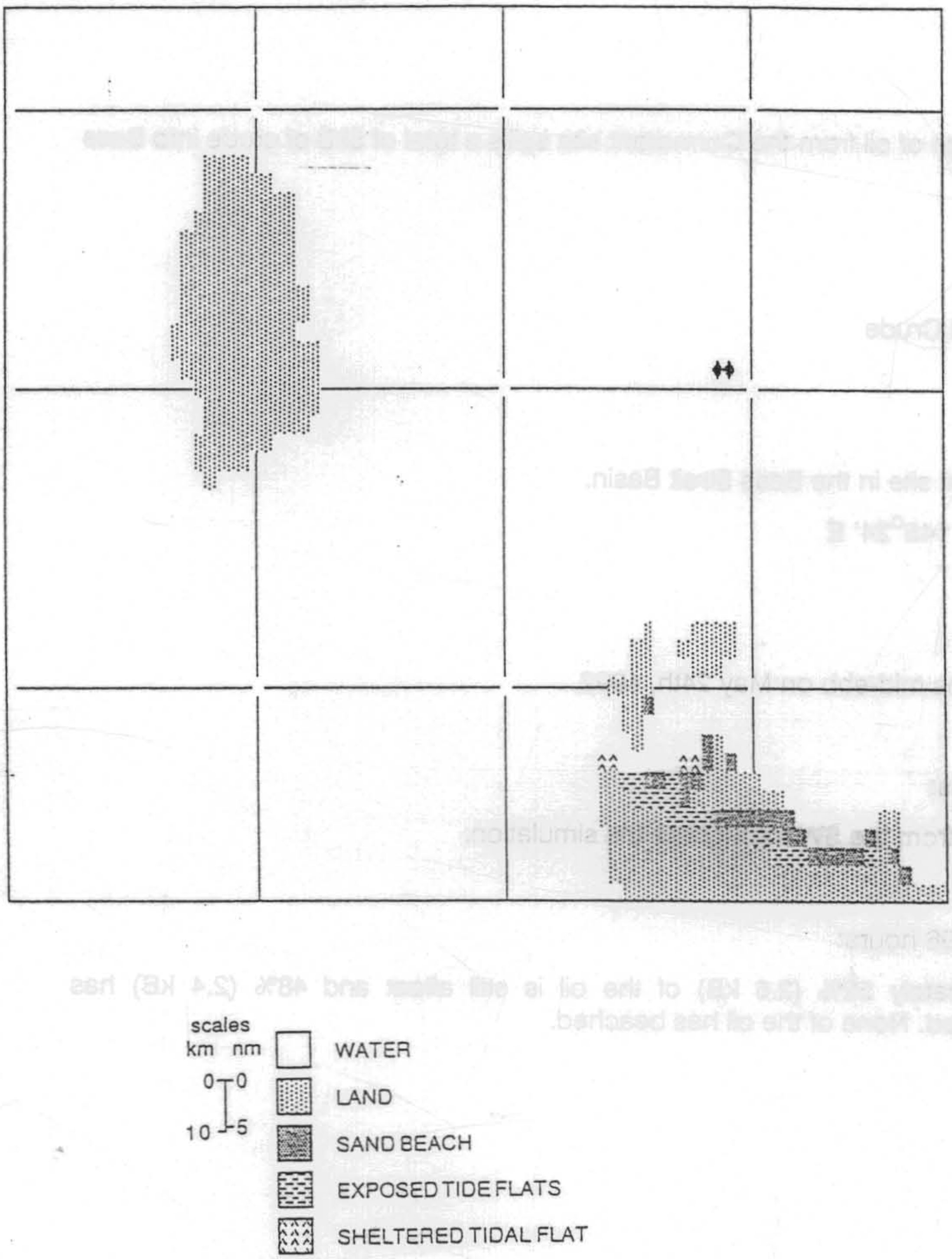
spill begins mid-ebb on May 24th, 1992.

Wind conditions:

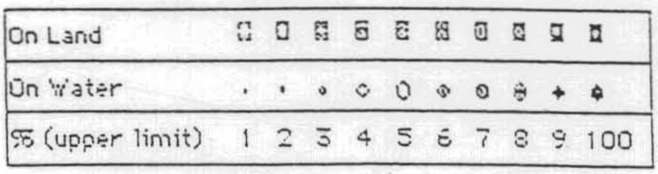
13 knots from the NE decreasing to 9 knots from the NE.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.



Symbols indicating the percentage of discharged oil at particular location



event 5.1 after 96 hours

5 cm

Event 5.2

Spill:

A discharge of oil from the Cormorant site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Cormorant site in the Bass Strait Basin.

39°37' S, 145°24' E

Time of spill:

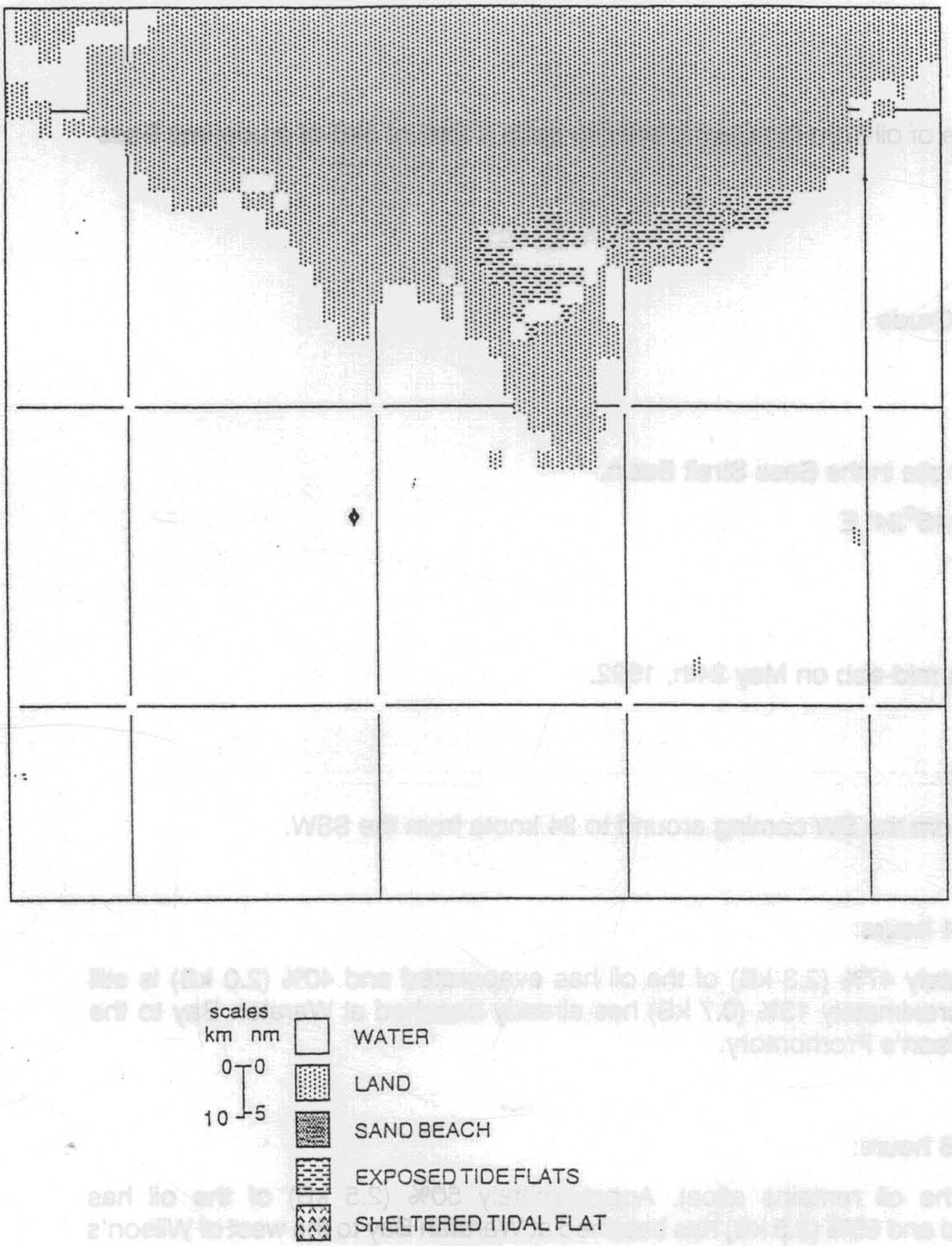
spill begins mid-ebb on May 24th, 1992.

Wind conditions:

13 knots from the SW throughout the simulation.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.



Symbols indicating the percentage of discharged oil at particular location

On Land	□	□	□	□	□	□	□	□	□	□
On Water	·	▪	◇	○	O	◇	◎	◈	✦	◆
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 5.2 after 96 hours

5 cm

Event 5.3

Spill:

A discharge of oil from the Cormorant site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Cormorant site in the Bass Strait Basin.

39°37' S, 145°24' E

Time of spill:

spill begins mid-ebb on May 24th, 1992.

Wind conditions:

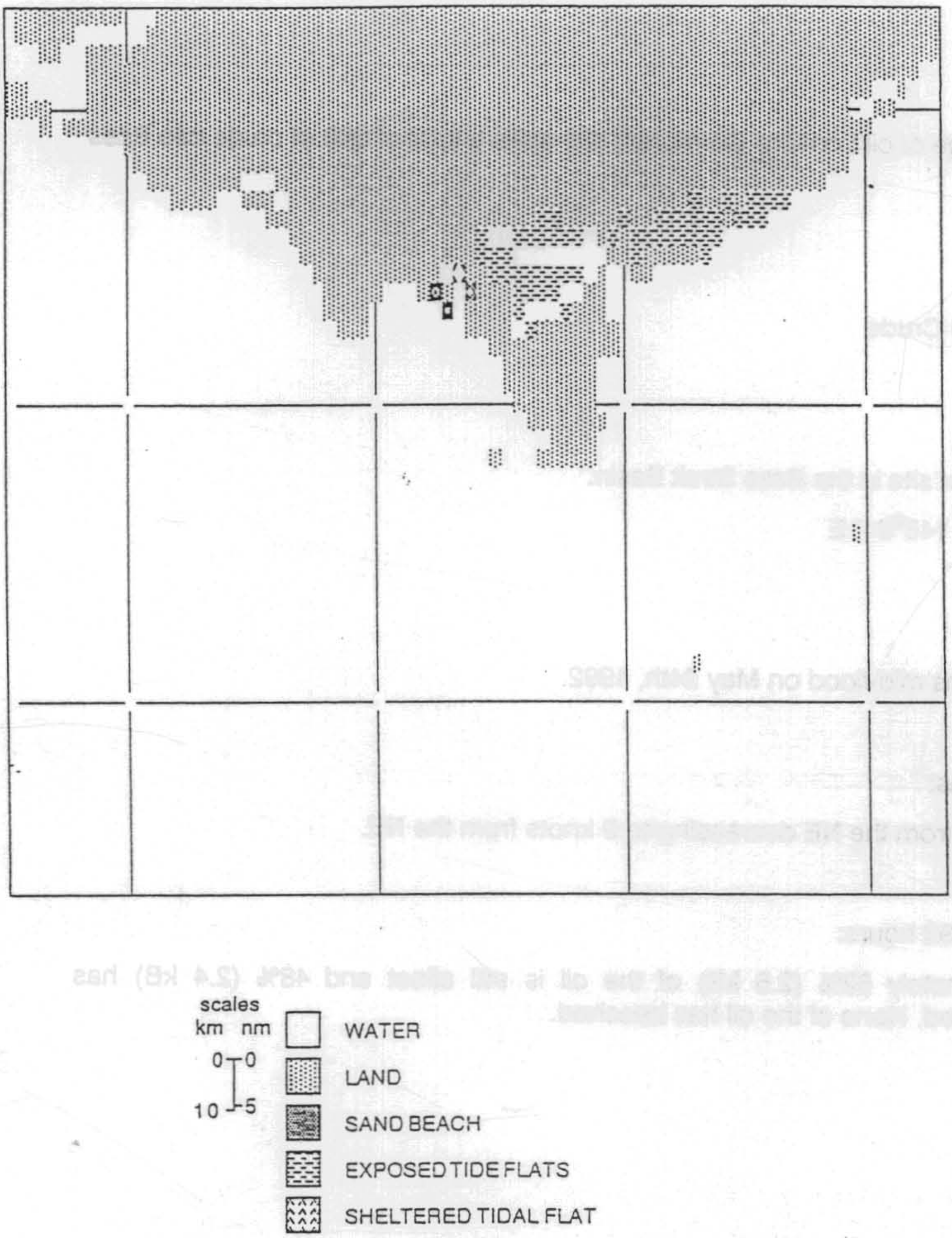
24 knots from the SW coming around to 24 knots from the SSW.

Situation after 84 hours:

Approximately 47% (2.3 kB) of the oil has evaporated and 40% (2.0 kB) is still afloat. Approximately 13% (0.7 kB) has already beached at Waratah Bay to the west of Wilson's Promontory.

Situation after 96 hours:

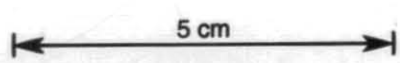
None of the oil remains afloat. Approximately 50% (2.5 kB) of the oil has evaporated and 50% (2.5 kB) has beached at Waratah Bay to the west of Wilson's Promontory.



Symbols indicating the percentage of discharged oil at particular location

On Land										
On Water										
% (upper limit)	1	2	3	4	5	6	7	8	9	100

event 5.3 after 96 hours



Event 6.1

Spill:

A discharge of oil from the Cormorant site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Cormorant site in the Bass Strait Basin.

39°37' S, 145°24' E

Time of spill:

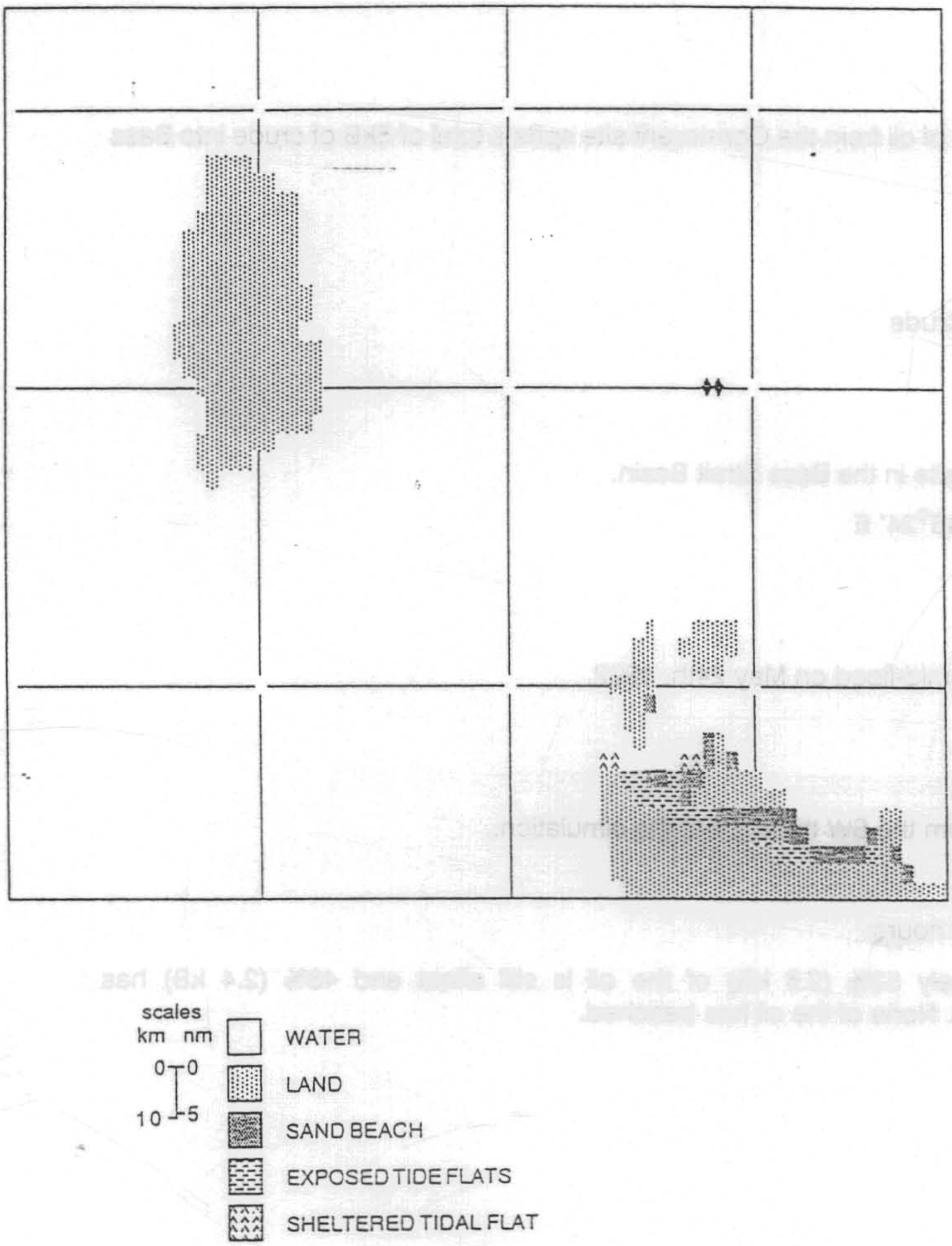
spill begins mid-flood on May 24th, 1992.

Wind conditions:

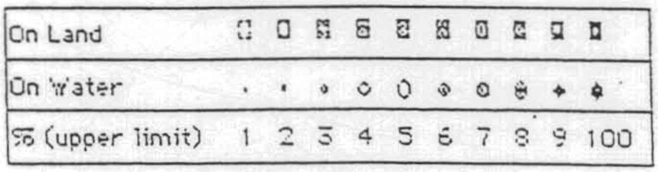
13 knots from the NE decreasing to 9 knots from the NE.

Situation after 96 hours:

Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.



Symbols indicating the percentage of discharged oil at particular location



event 6.1 after 96 hours

Event 6.2

Spill:

A discharge of oil from the Cormorant site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Cormorant site in the Bass Strait Basin.

39°37' S, 145°24' E

Time of spill:

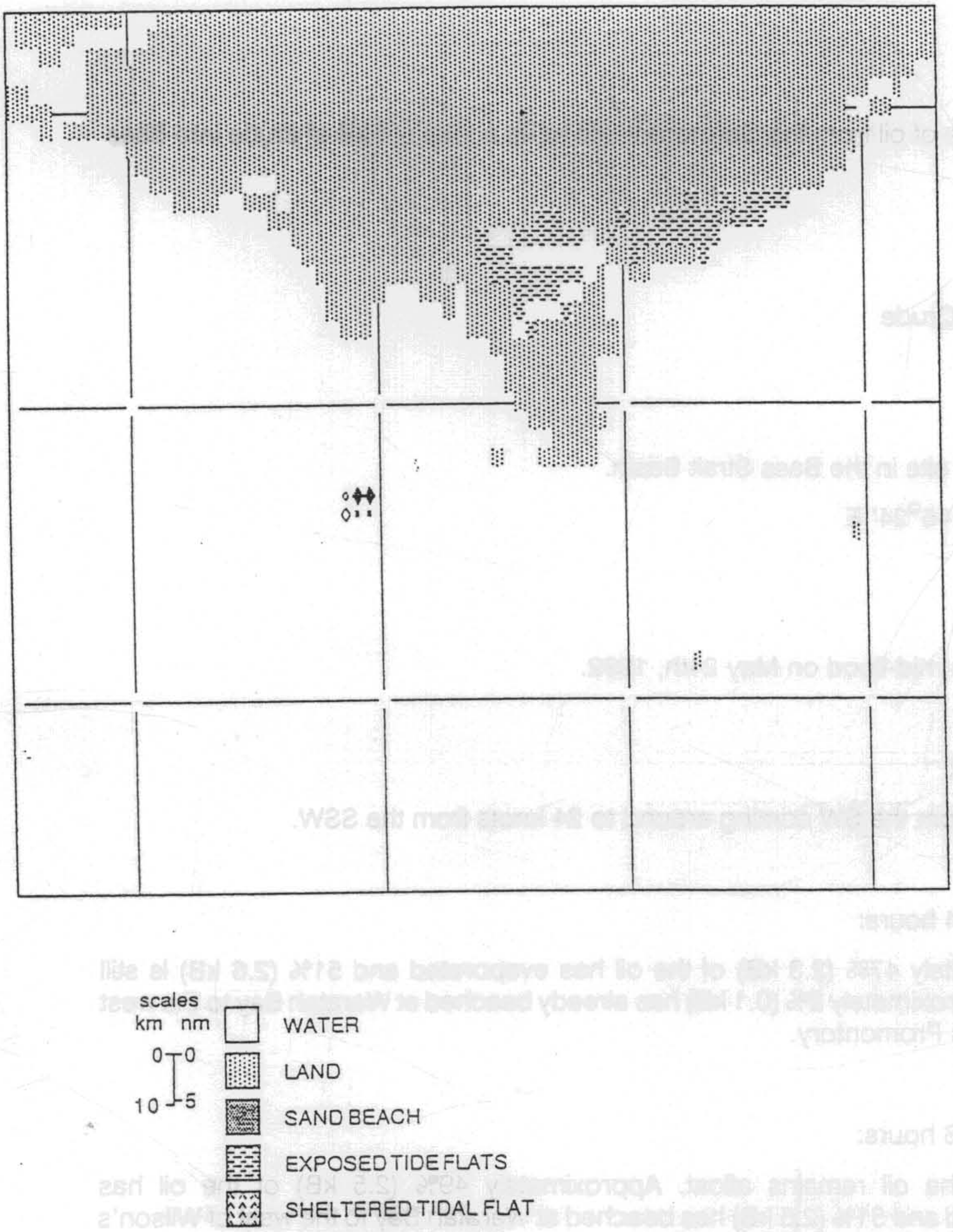
spill begins mid-flood on May 24th, 1992.

Wind conditions:

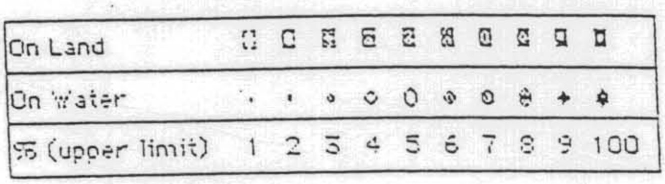
13 knots from the SW throughout the simulation.

Situation after 96 hours:

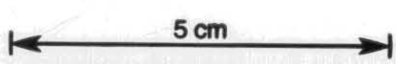
Approximately 52% (2.6 kB) of the oil is still afloat and 48% (2.4 kB) has evaporated. None of the oil has beached.



Symbols indicating the percentage of discharged oil at particular location



event 6.2 after 96 hours



Event 6.3

Spill:

A discharge of oil from the Cormorant site spills a total of 5kB of crude into Bass Strait.

Oil type:

Gippsland Crude

Location:

Cormorant site in the Bass Strait Basin.

39°37' S, 145°24' E

Time of spill:

spill begins mid-flood on May 24th, 1992.

Wind conditions:

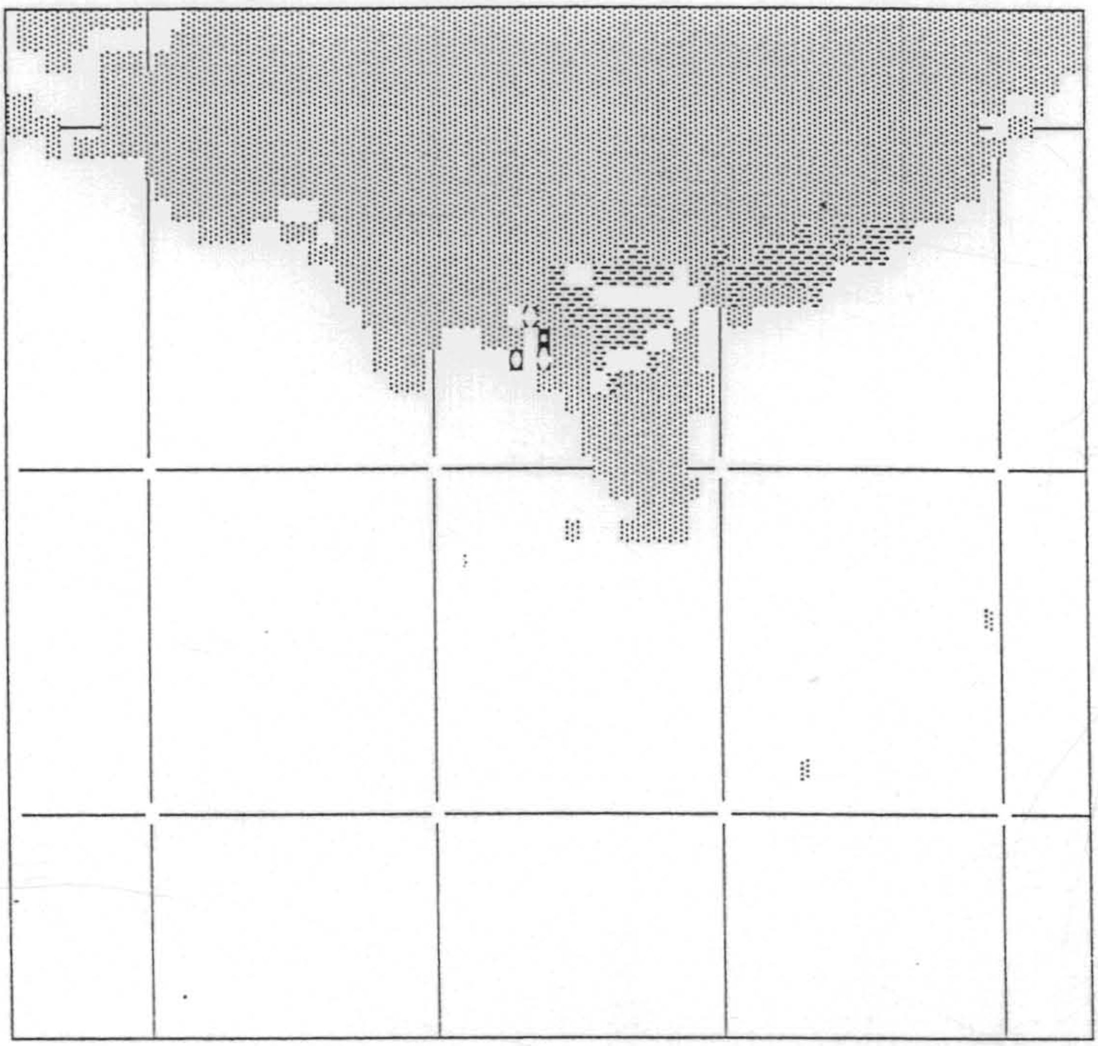
24 knots from the SW coming around to 24 knots from the SSW.

Situation after 84 hours:

Approximately 47% (2.3 kB) of the oil has evaporated and 51% (2.6 kB) is still afloat. Approximately 2% (0.1 kB) has already beached at Waratah Bay to the west of Wilson's Promontory.

Situation after 96 hours:

None of the oil remains afloat. Approximately 49% (2.5 kB) of the oil has evaporated and 51% (2.5 kB) has beached at Waratah Bay to the west of Wilson's Promontory.



scales
km nm
0 0
10 5

WATER
LAND
SAND BEACH
EXPOSED TIDE FLATS
SHELTERED TIDAL FLAT

Symbols indicating the percentage of discharged oil at particular location

On Land										
On Water										
% (upper limit)	1	2	3	4	5	6	7	8	9	100

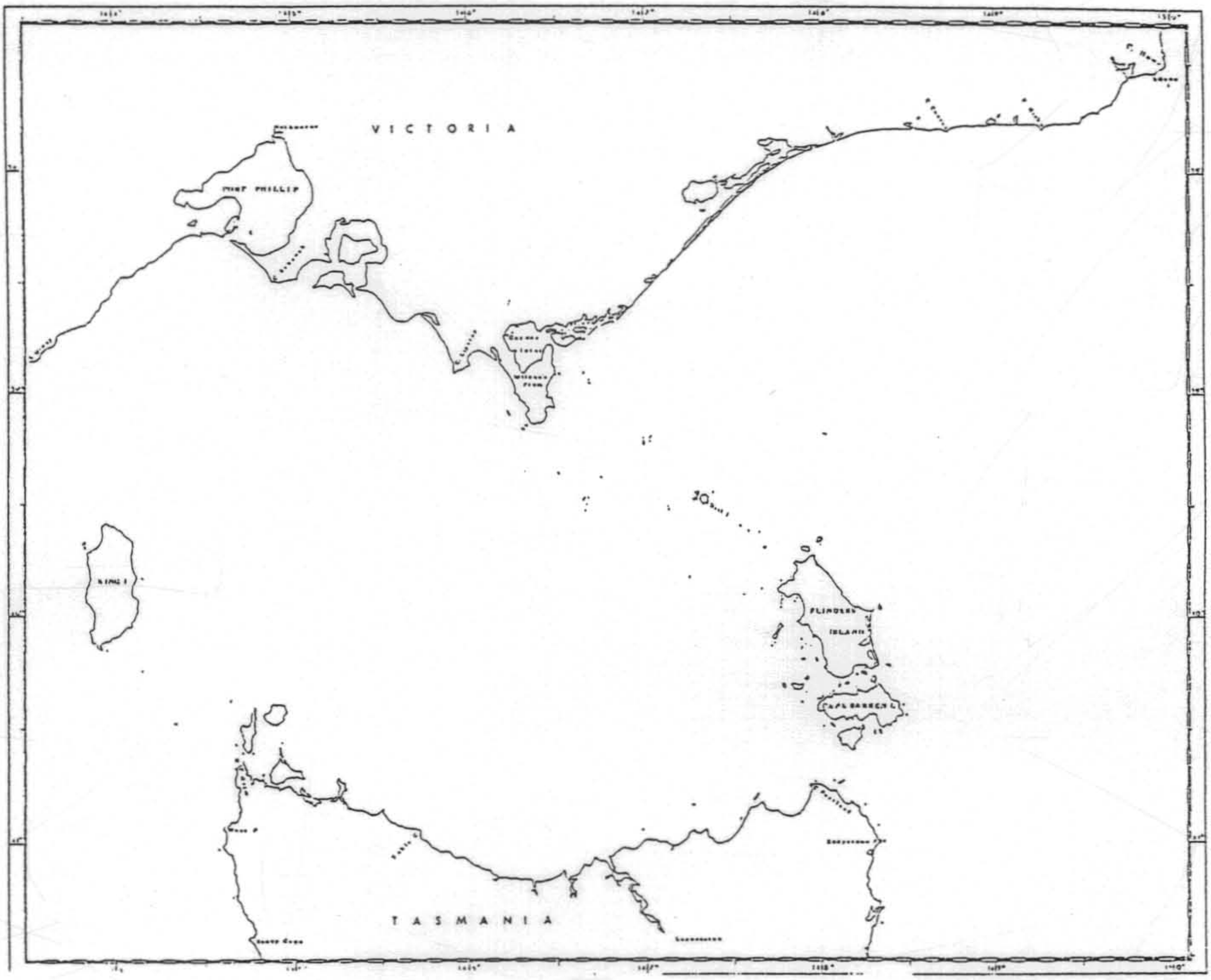
event 6.3 after 96 hours

5 cm

502121

FIGURES

502122

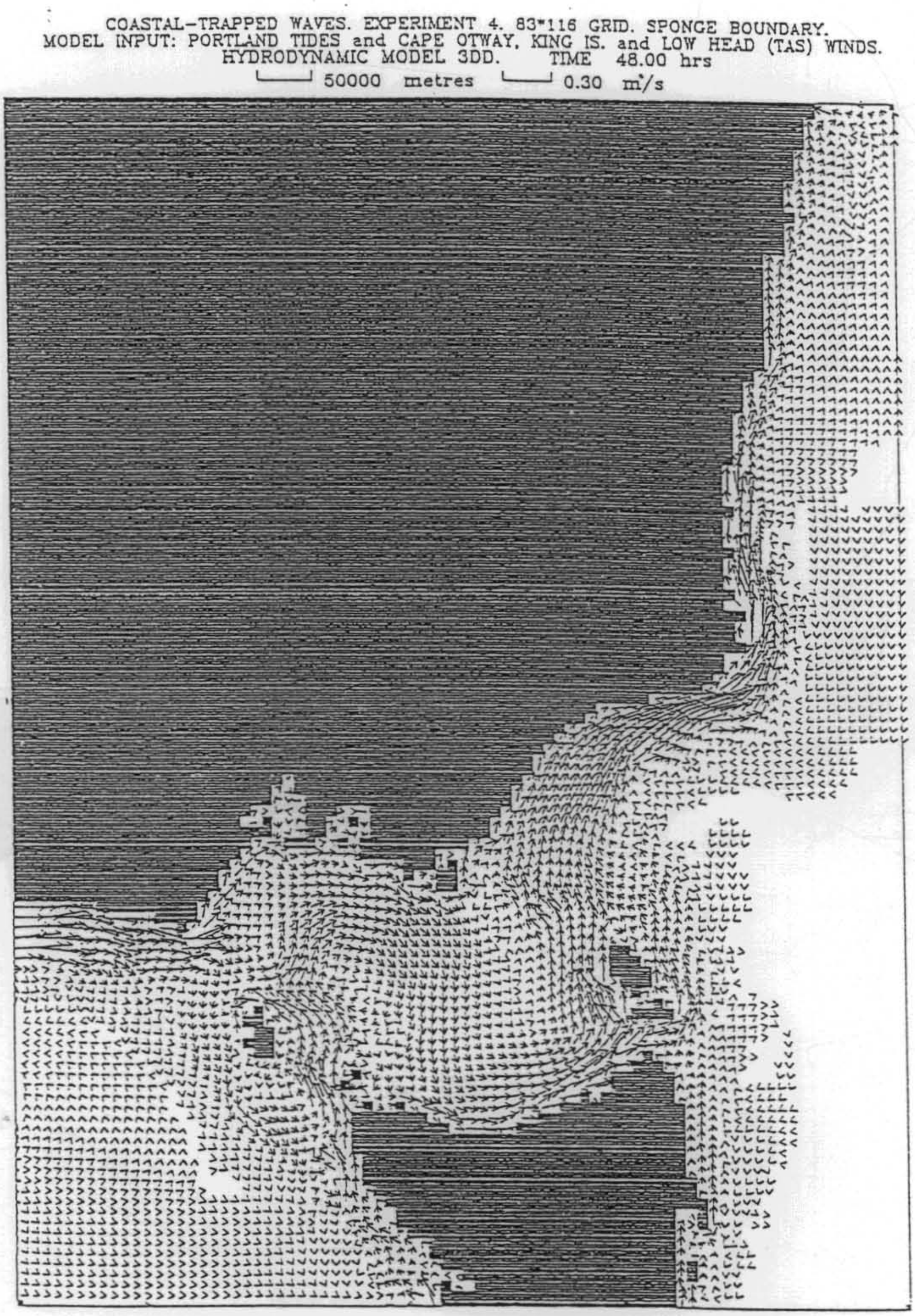


5 cm

Appendix Figure 1.1

The Bass Strait Basin study region

502123

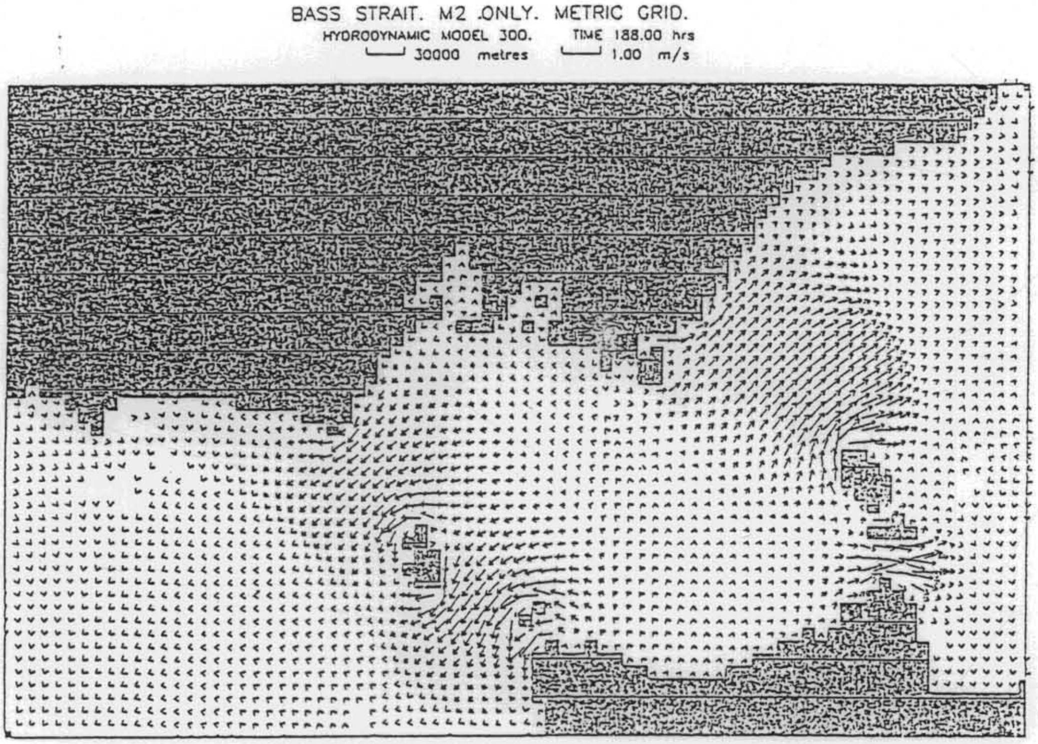


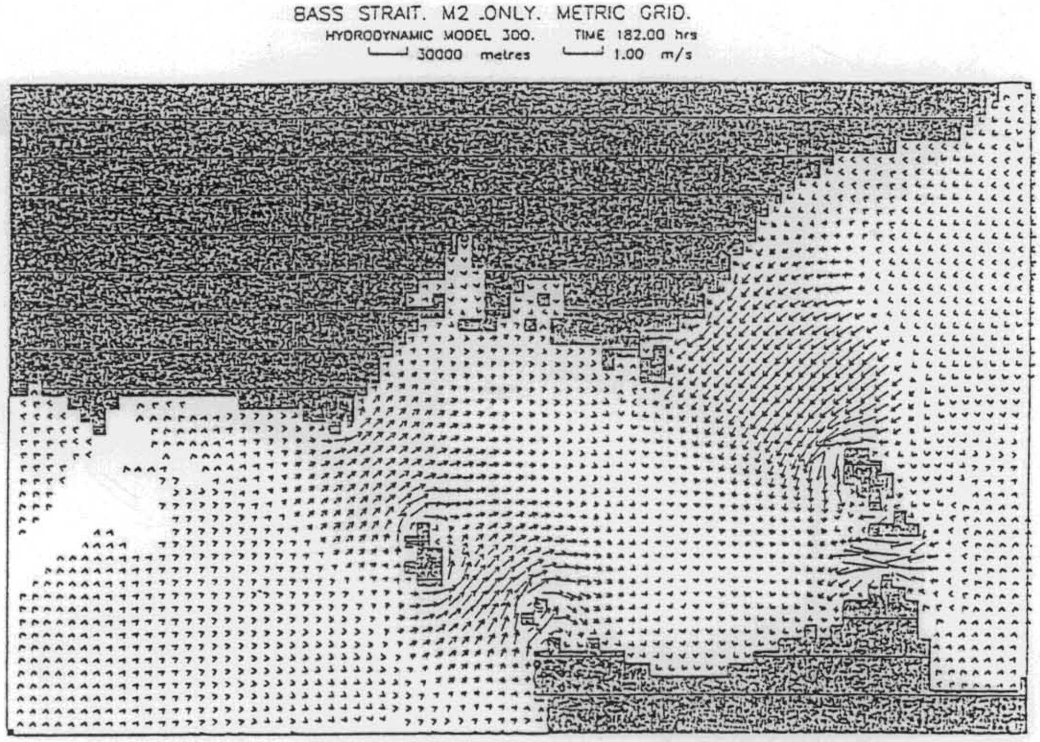
Appendix Figure 1.2

Vector plots of currents in Bass Strait induced by coastal-trapped waves. (Black et al., in prep.)

5 cm

502124

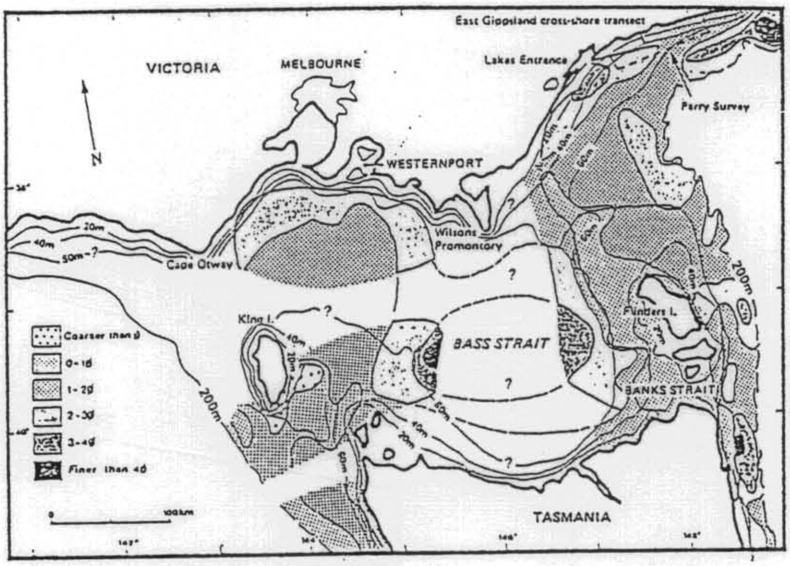


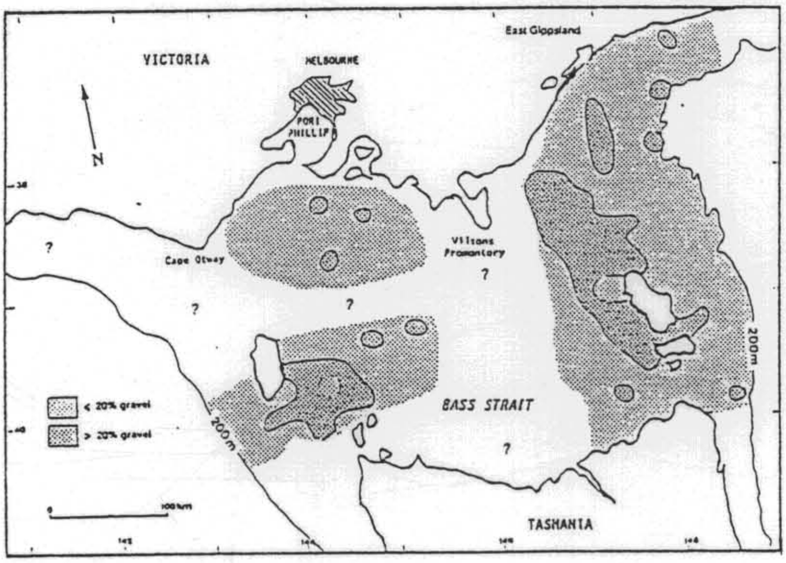


Appendix Figure 1.3

Vector plots of the M2 tidal currents in Bass Strait.
(Greilach et al., 1991)

5 cm



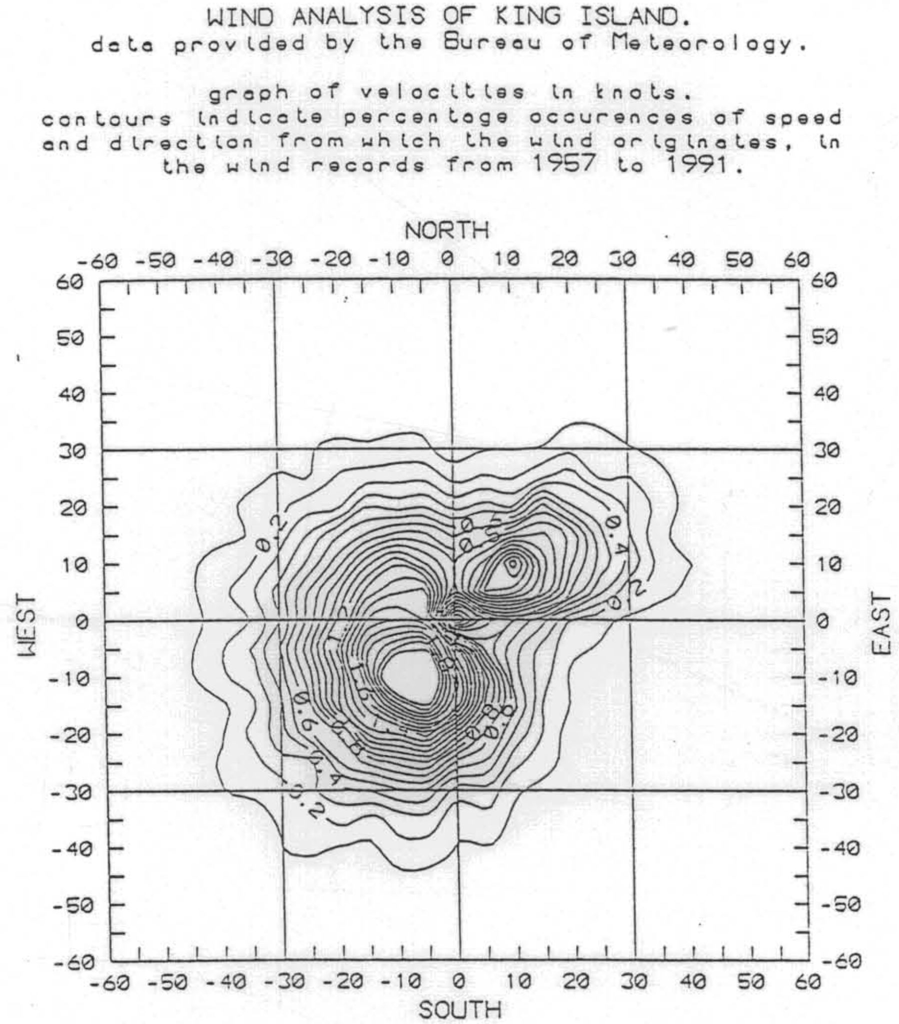


Appendix Figure 1.4

Distribution of sediments within the Bass Strait region.
(Black, 1991)

5 cm

502126

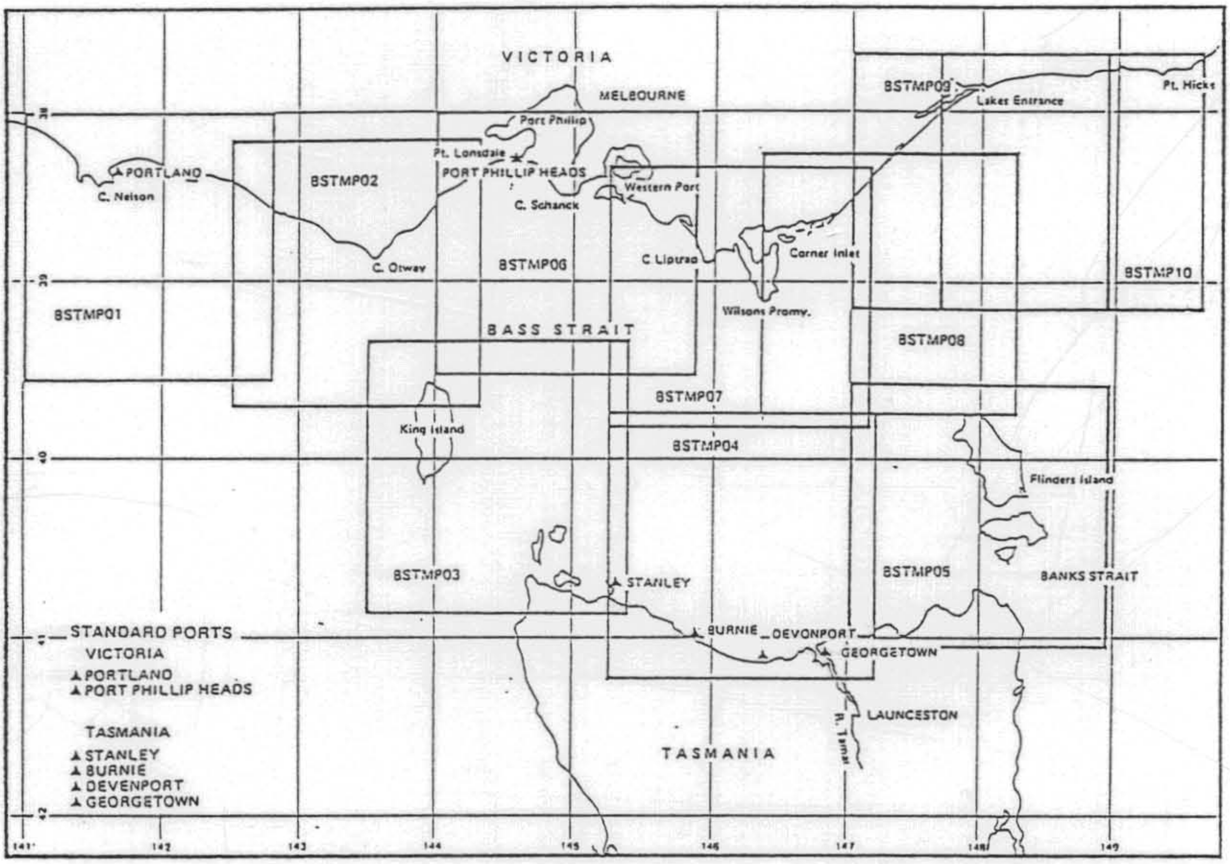


5 cm

Appendix Figure 1.5

Wind rose for King Island for the May-December period.
Data provided by the Bureau of Meteorology for the years 1956-1991,
and analysed by VIMS.

502127

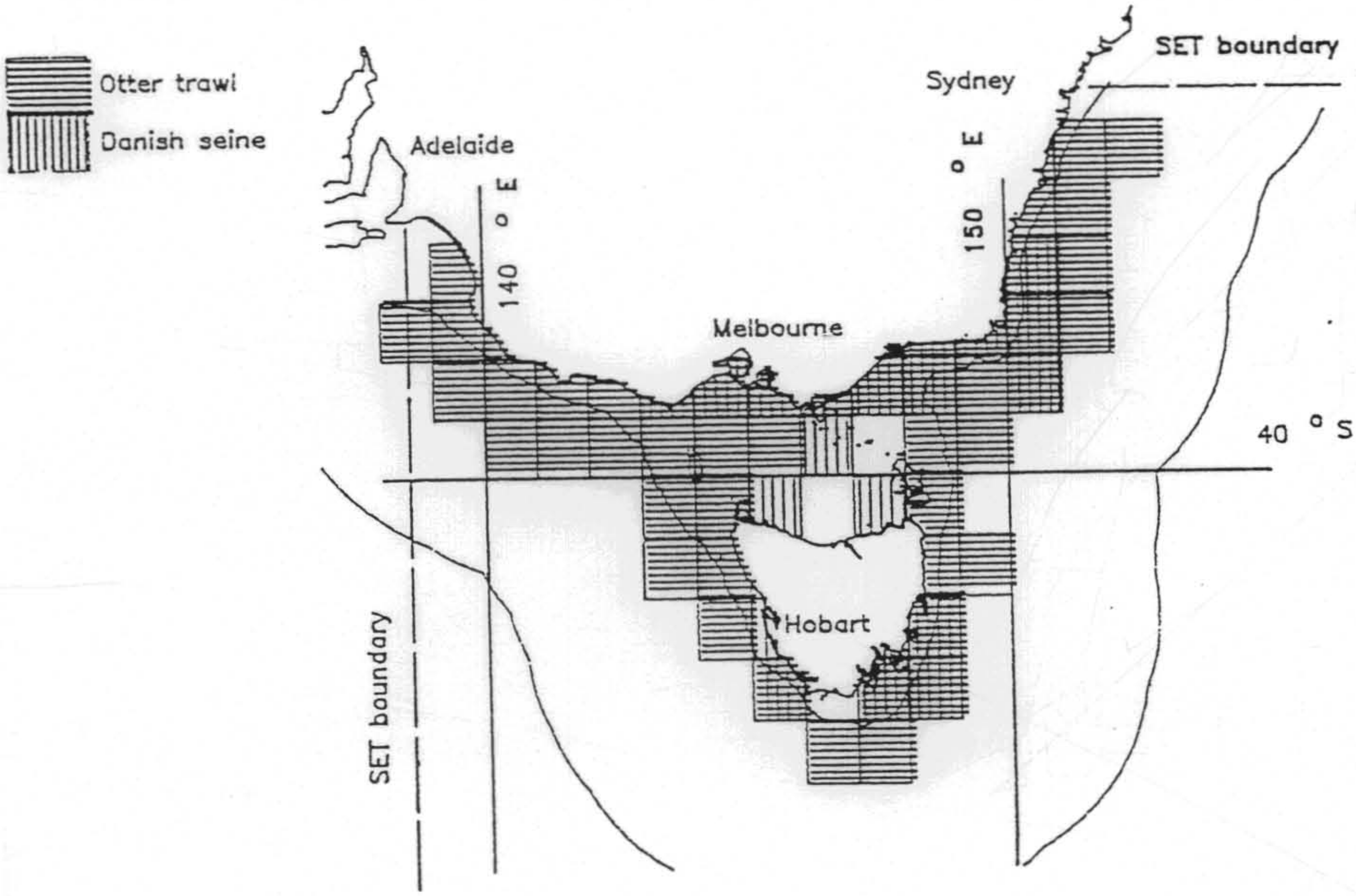


Appendix Figure 1.6

The regions within Bass Strait covered by OSSM.

5 cm

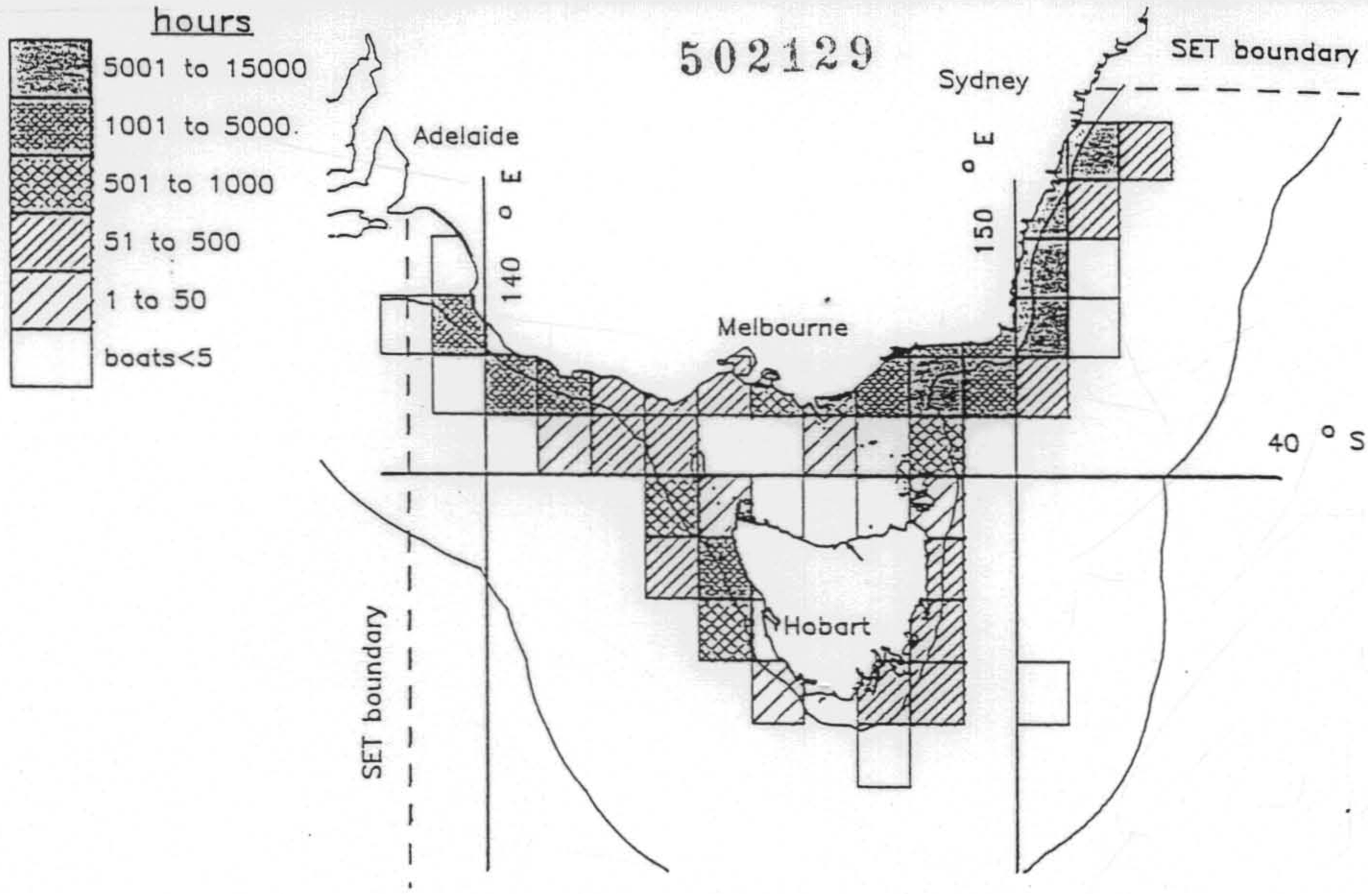
502128



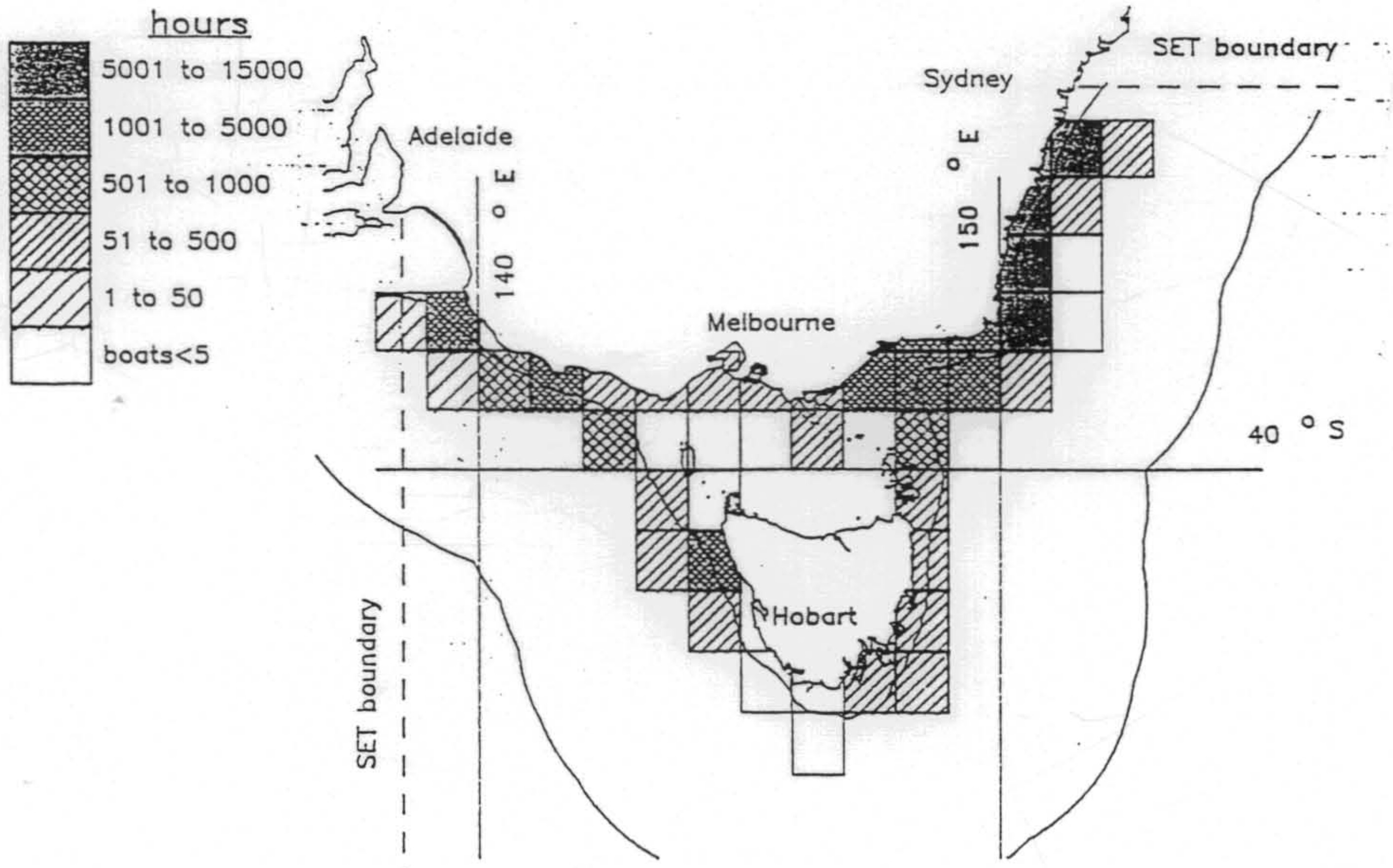
Appendix Figure 2.1

Distribution of fishing methods by area.

5 cm



Appendix Figure 2.2
Total effort (hours) by area for 1986.

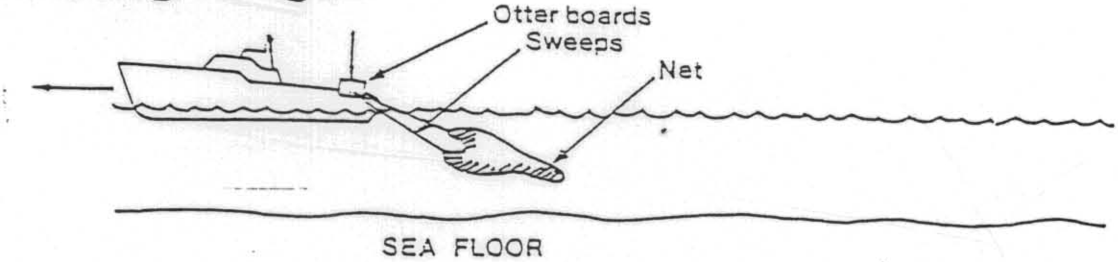


Appendix Figure 2.3
Total effort (hours) by area for 1987.

5 cm

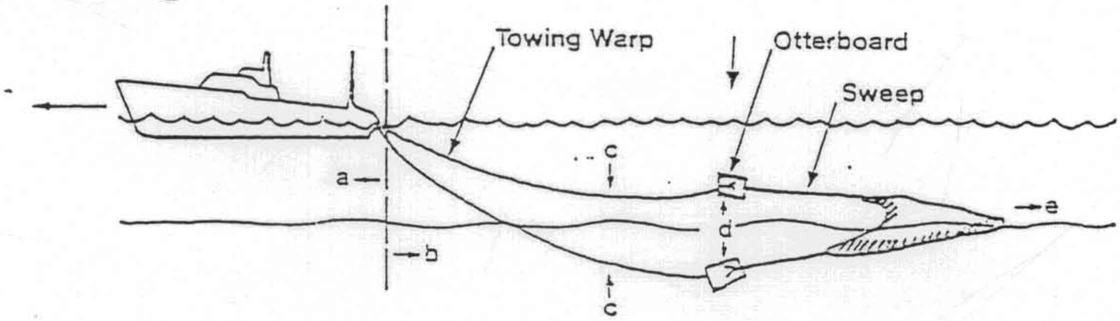
502130

1 Shooting the gear



When the sweeps have been paid out, the otter boards are released and the warps are paid out by the winch.

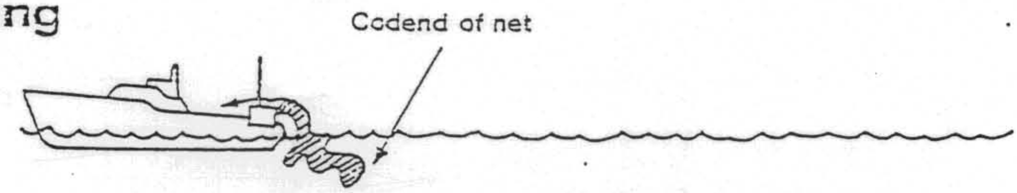
2 Trawling



During towing, the otter boards keep the net open and close to the sea floor. The major forces at work are:

(a) forward movement of boat, and
(b) backward pull of net, controlled by:
(c) inward pressure of warps,
(d) outward spread of otter boards, and
(e) water resistance through net meshes.

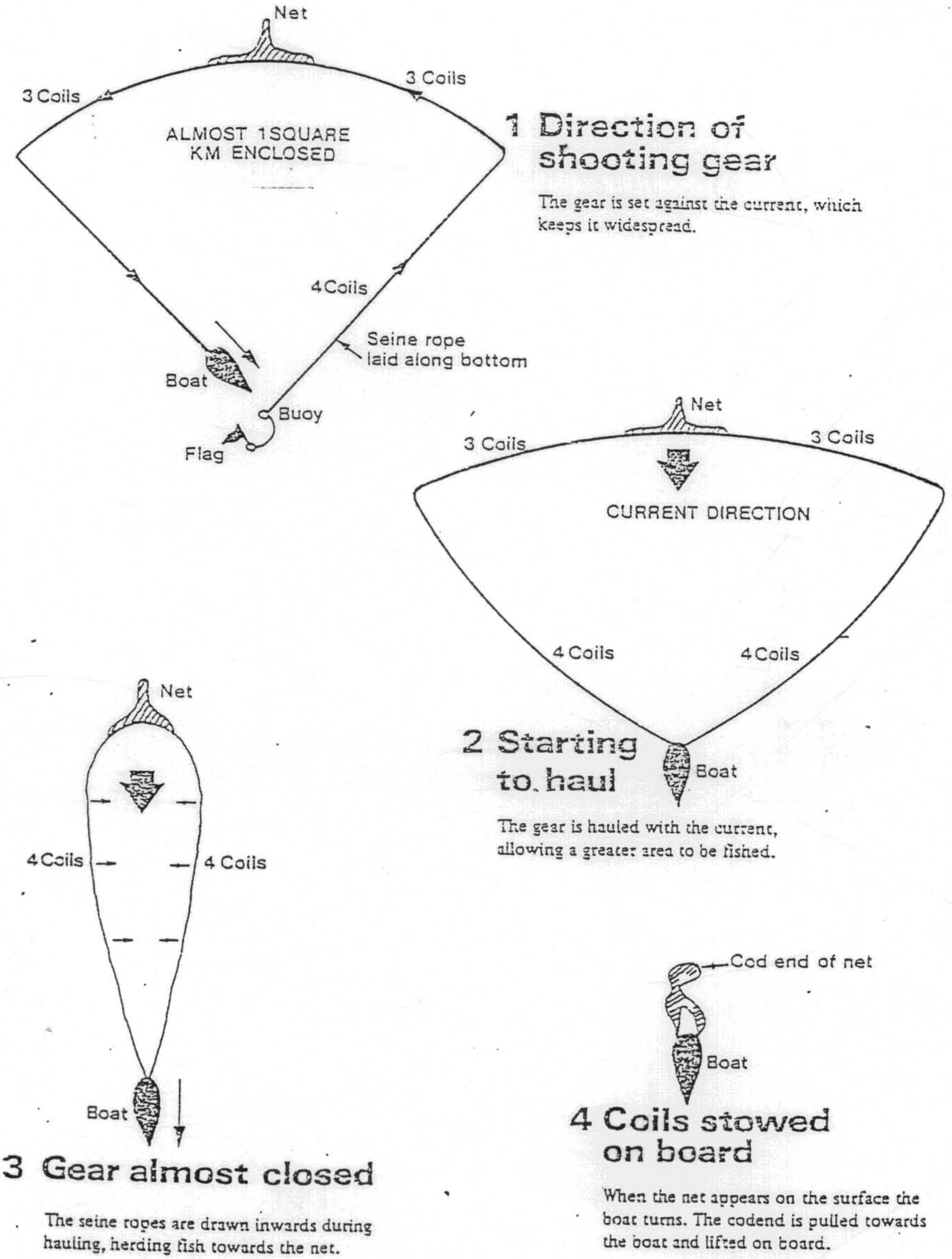
3 Hauling



The warps are winched aboard, the otter boards and sweeps are secured and the codend is lifted aboard, with or without the rest of the net.

Source: Garner (1977) and others

Appendix Figure 2.4: Otter Trawling



Source: Aust. Fish. Dev. Conf. (1967)

Appendix Figure 2.5: Danish Seining

Fig 9 Gummy Shark Total Catch 1973–75

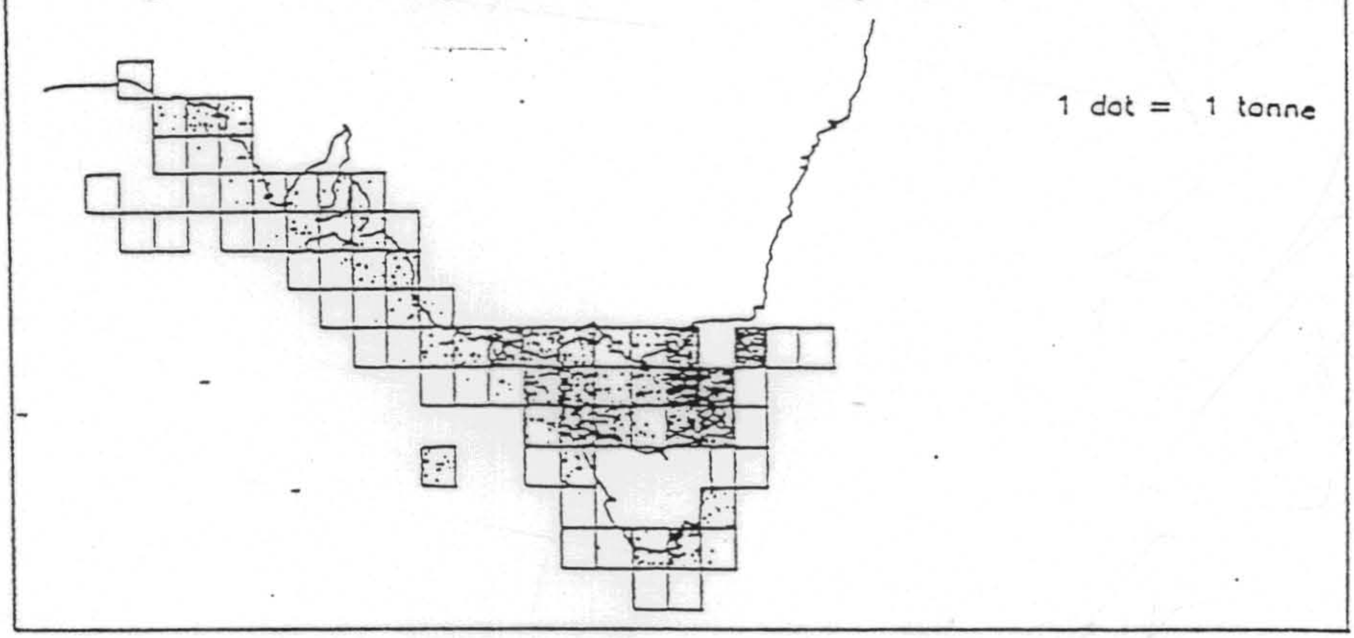
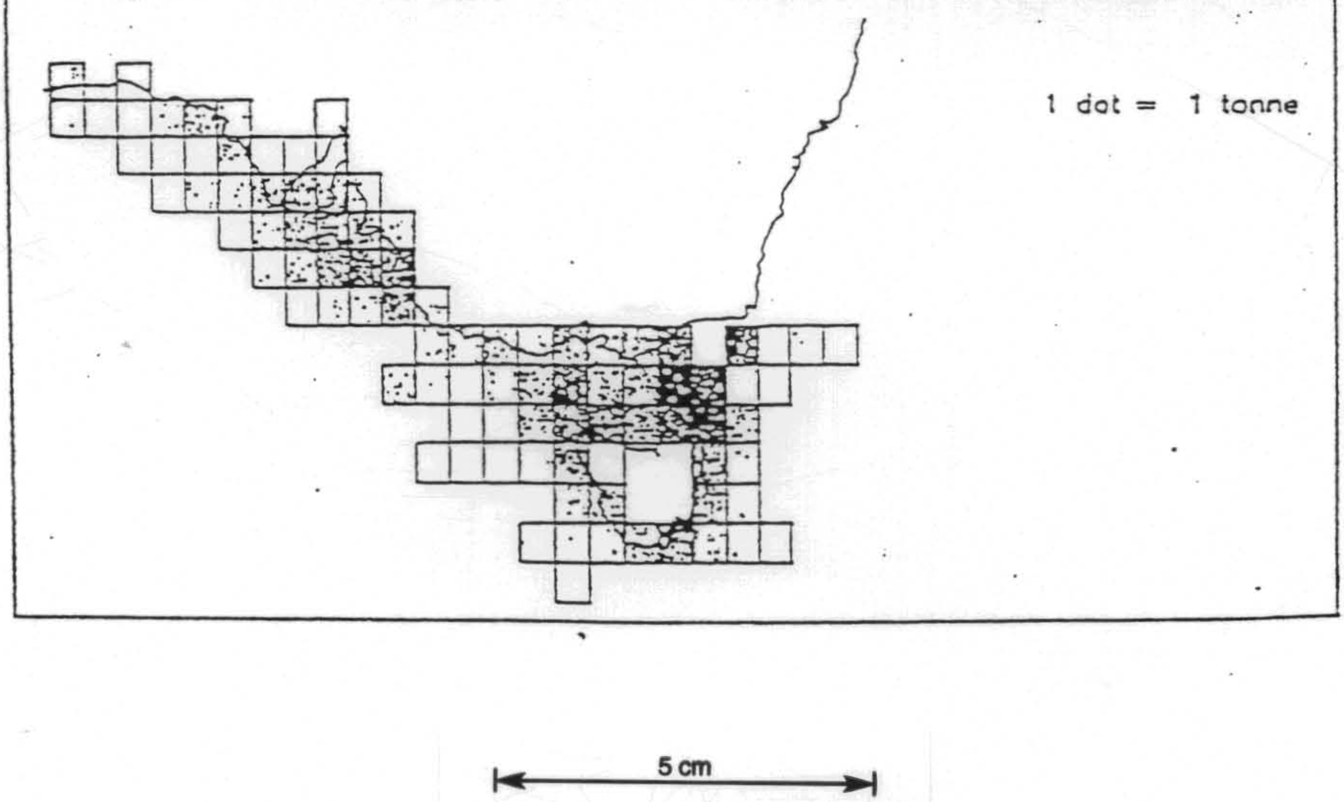
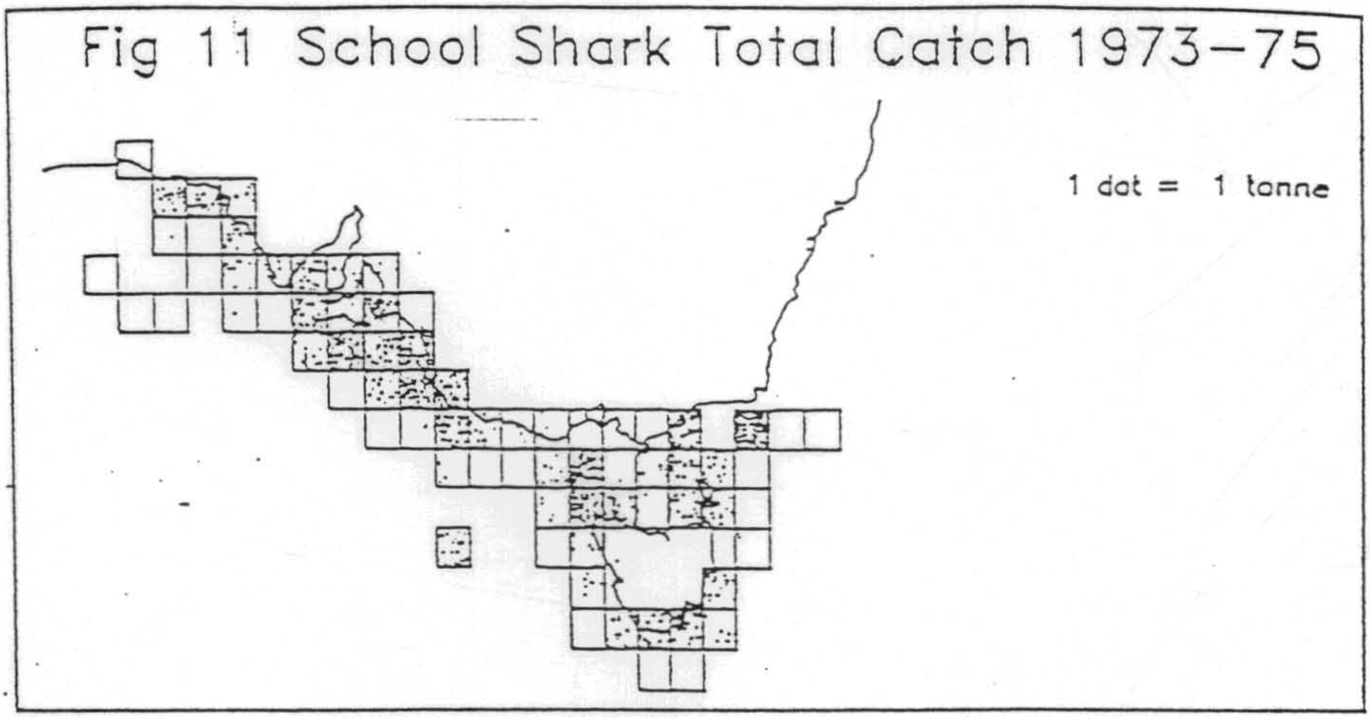
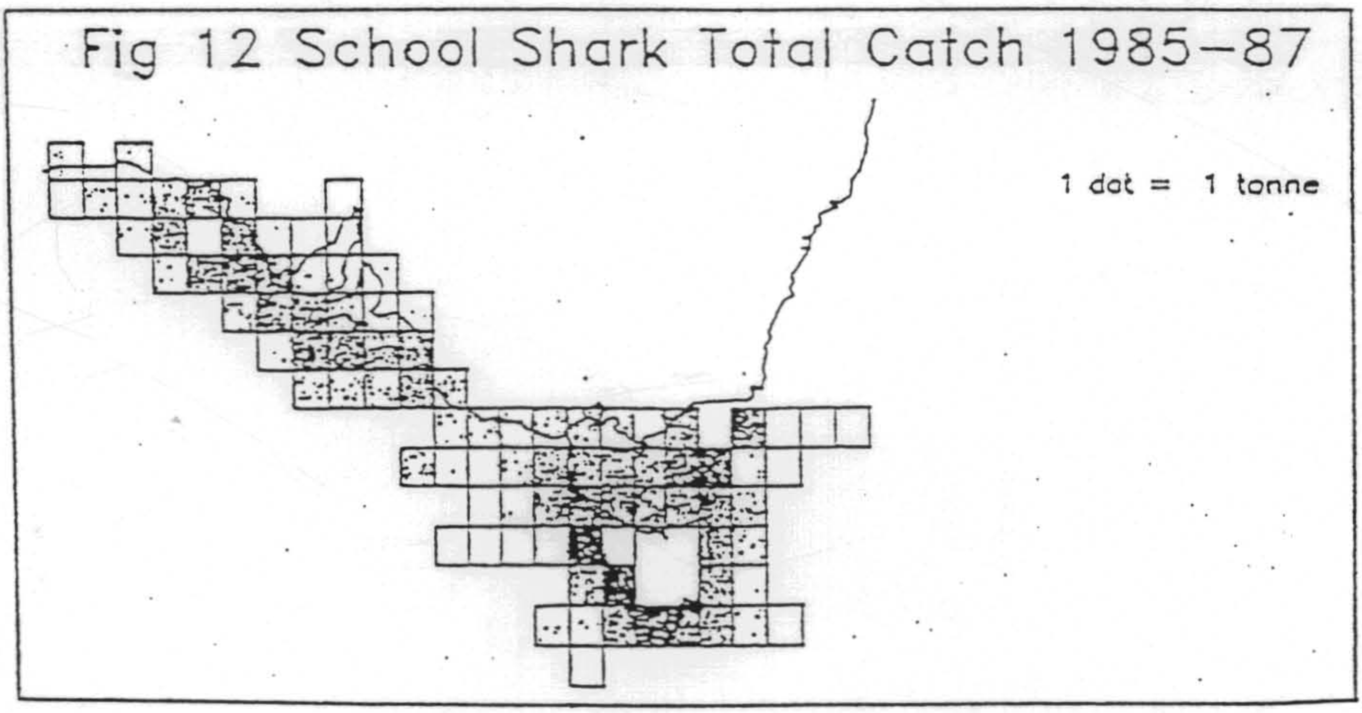


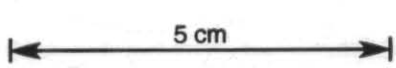
Fig 10 Gummy Shark Total Catch 1985–87



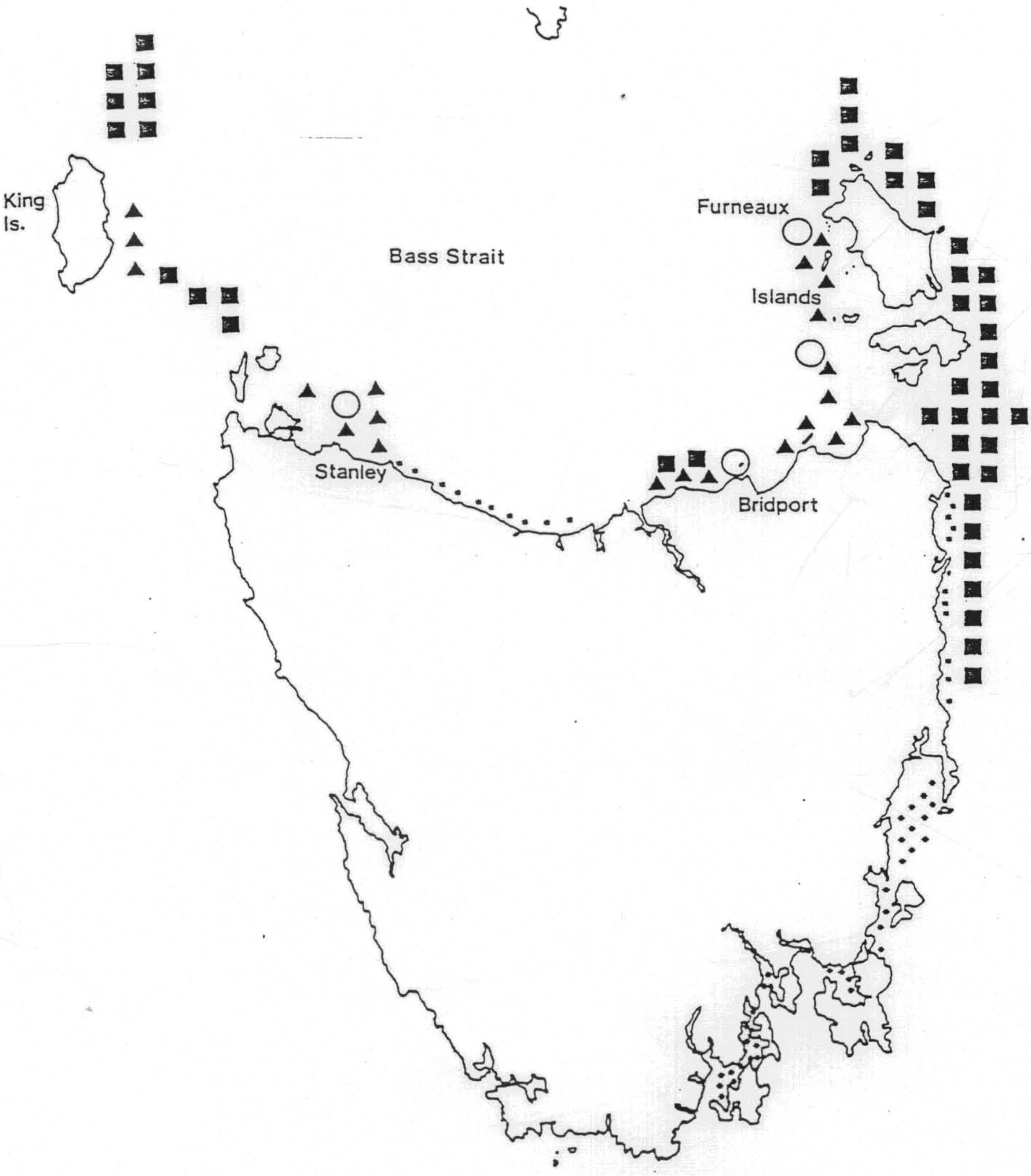
Appendix Figure 2.6: Distribution of Gummy Shark Catch





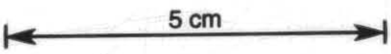


Appendix Figure 2.7: Distribution of School Shark Catch

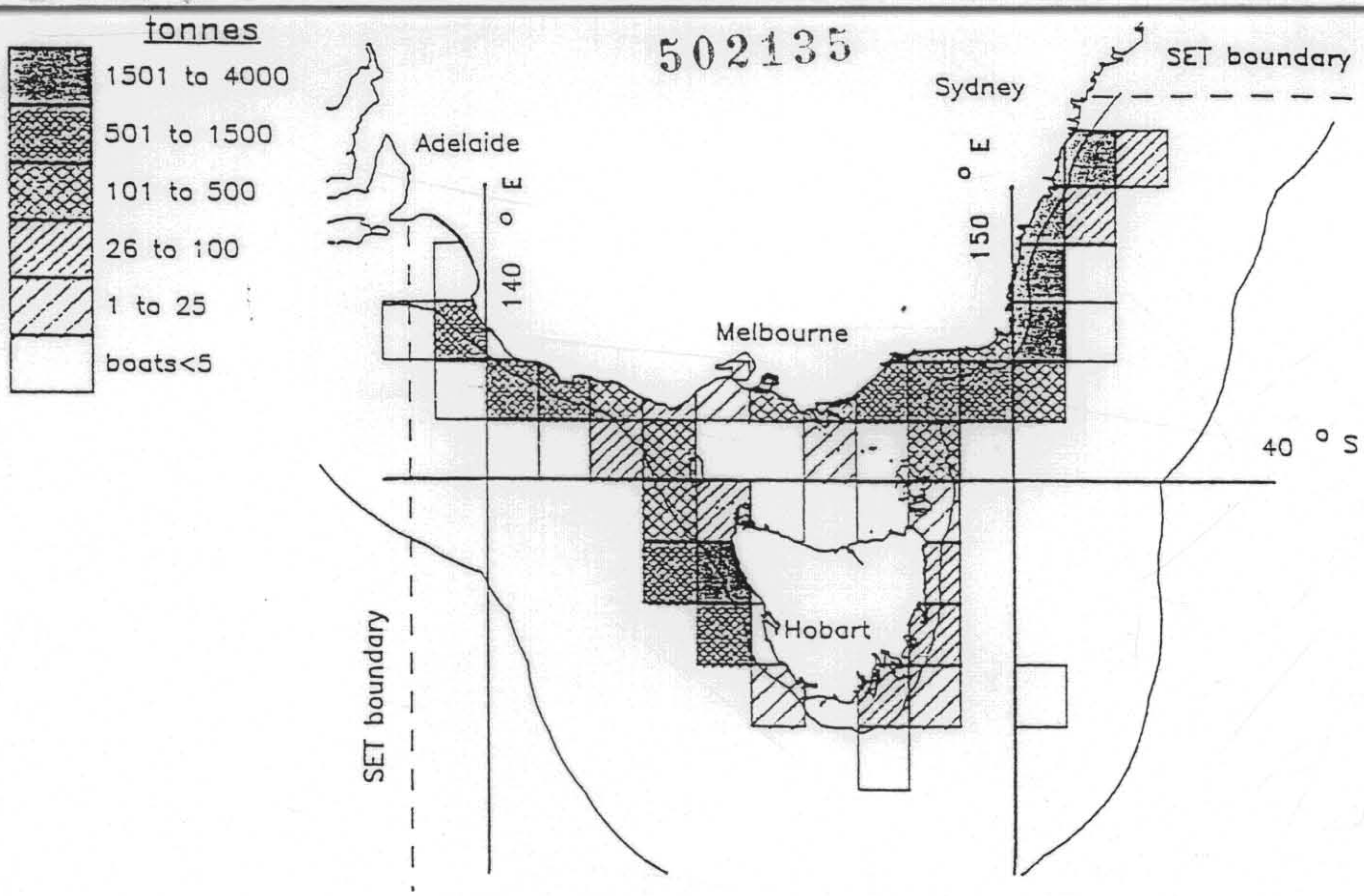


Expansion of the Tasmanian scallop fishery from a predominantly inshore coastal fishery to a large Bass Strait fishery. Prior to 1972 (•) ; by 1975 (▲) ; complete exploitation by 1983 (■). Open circles show high density areas located in the 1973 survey.

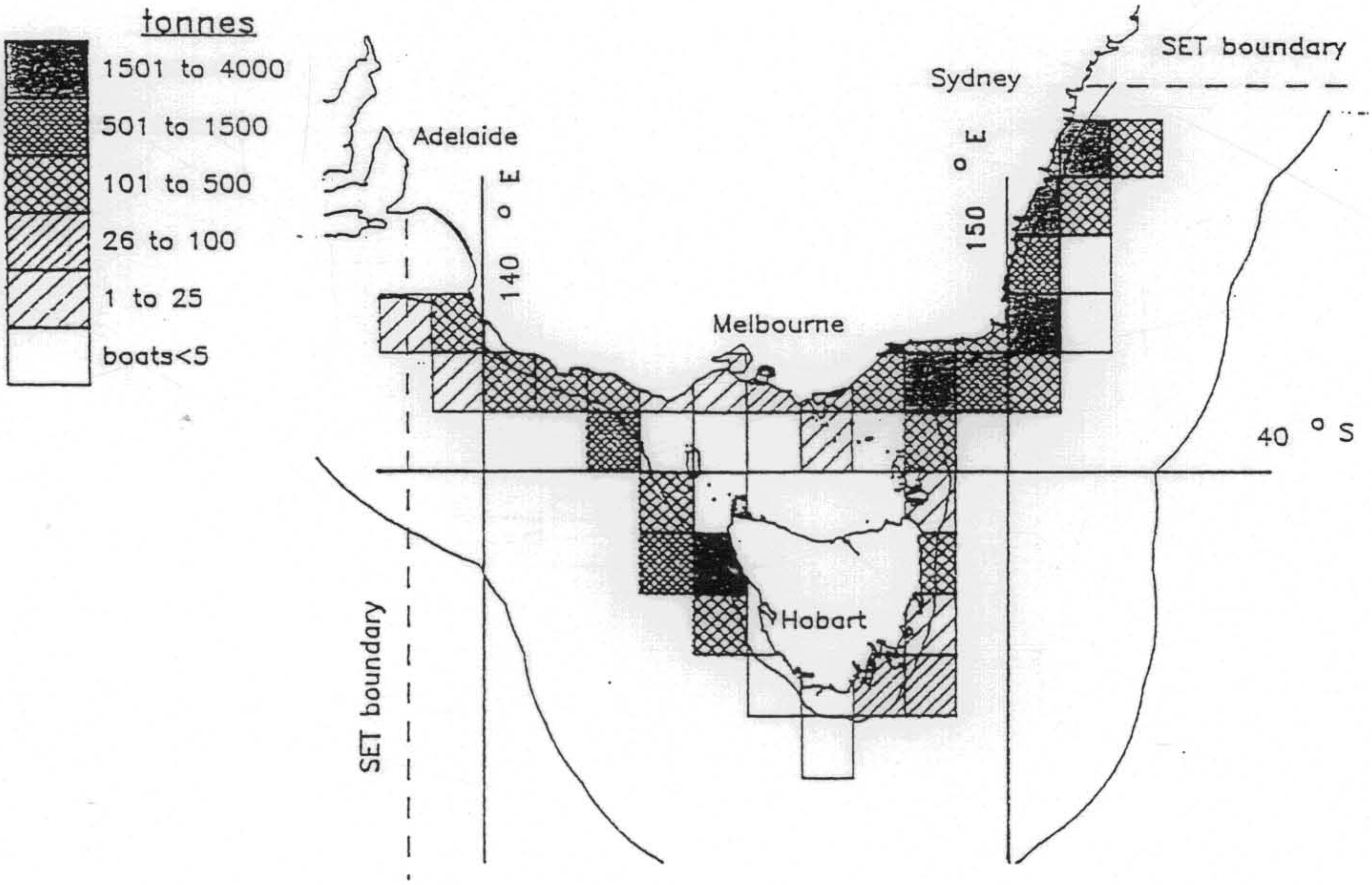
Appendix Figure 2.8



502135



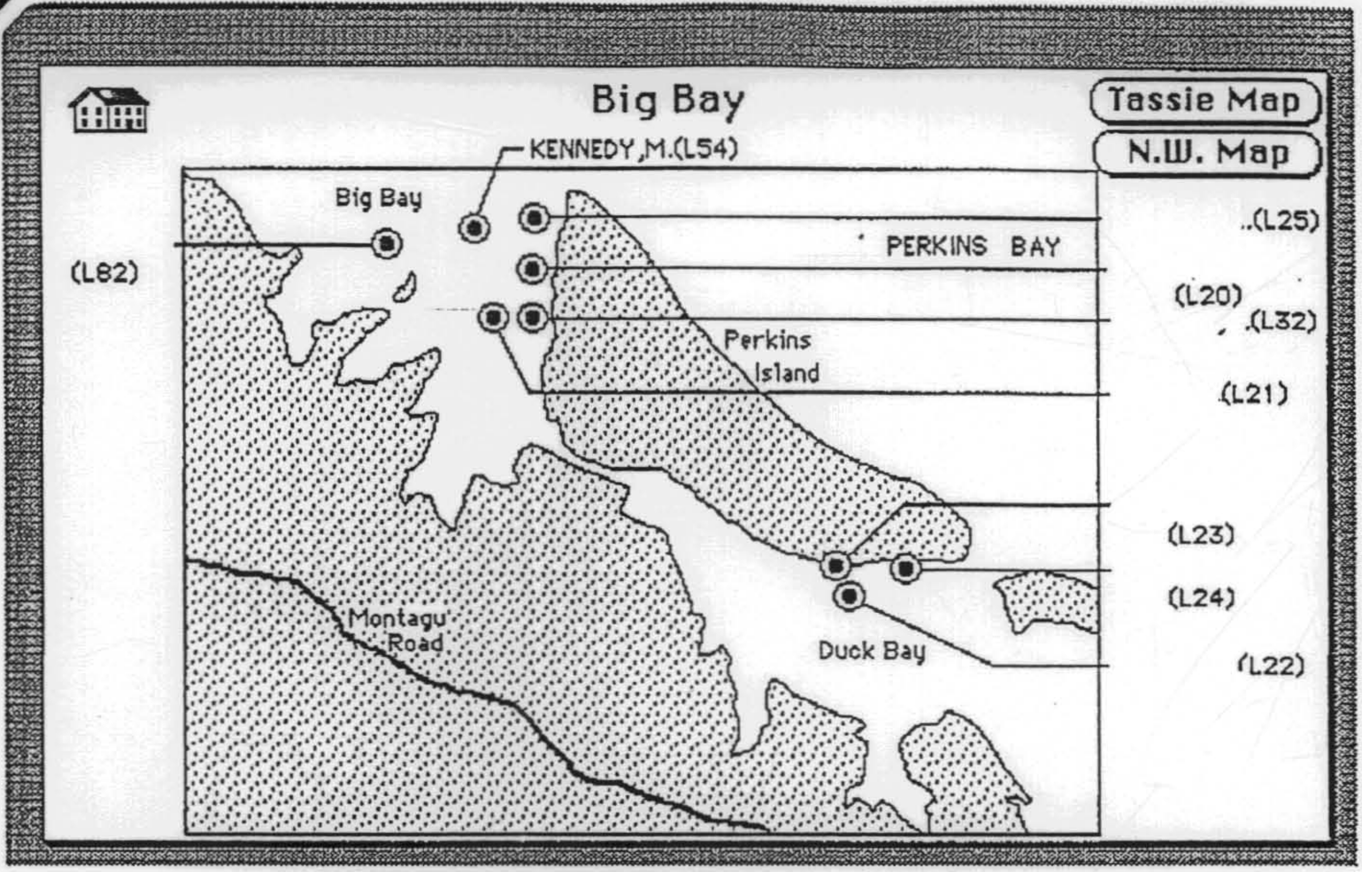
Appendix Figure 2.9
Total catch of all species by area for 1986.



Appendix Figure 2.10
Total catch of all species by area for 1987.

5 cm

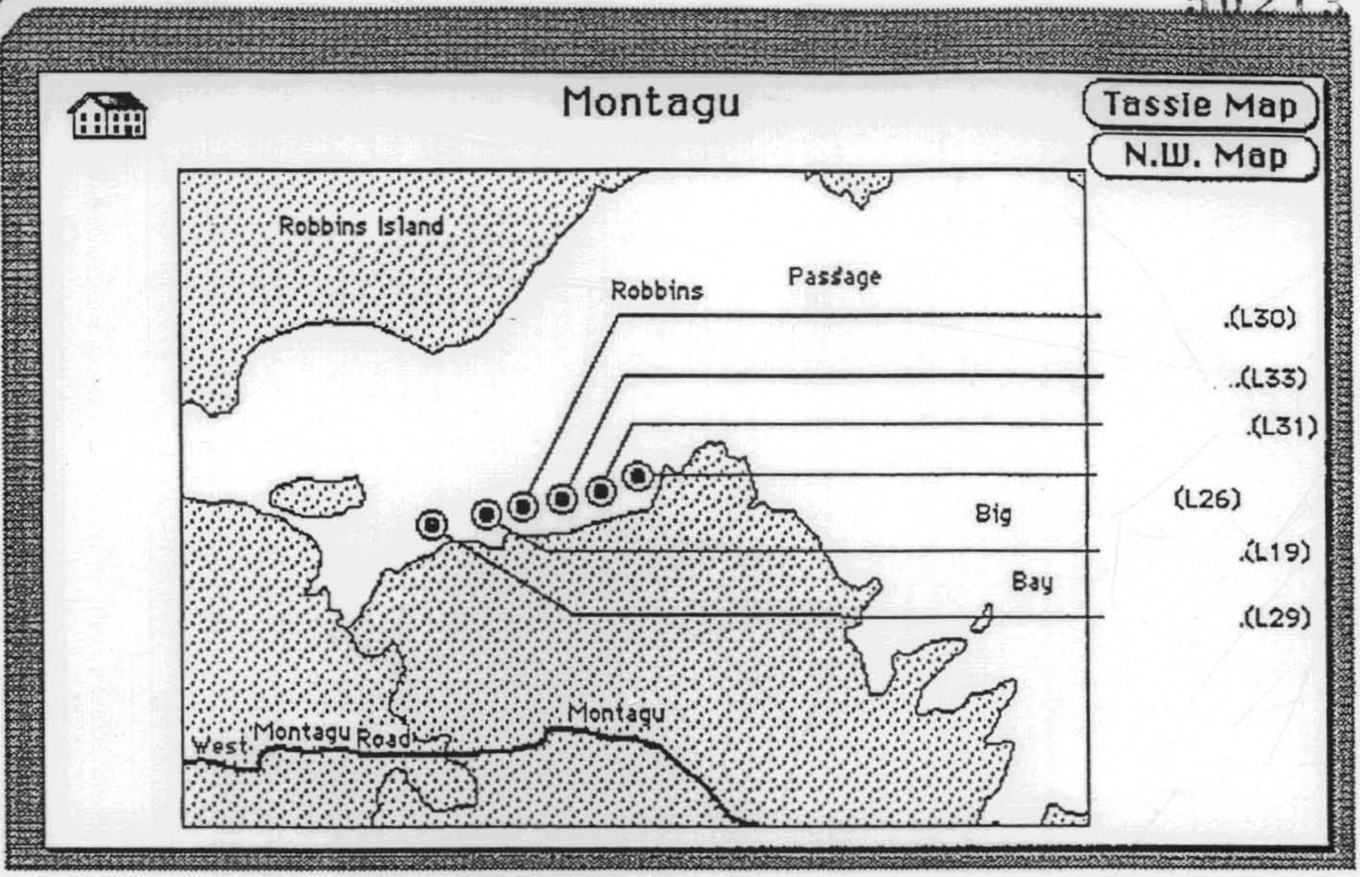
502136



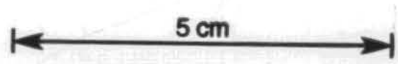
25 - Pacific oysters
20 - Pacific oysters
32 - Pacific oysters, Flat oysters
21 - Pacific oysters, Flat oysters
23 - Pacific oysters, Flat oysters
24 - Pacific oysters
22 - Pacific oysters, Flat oysters
82 - Pacific oysters

5 cm

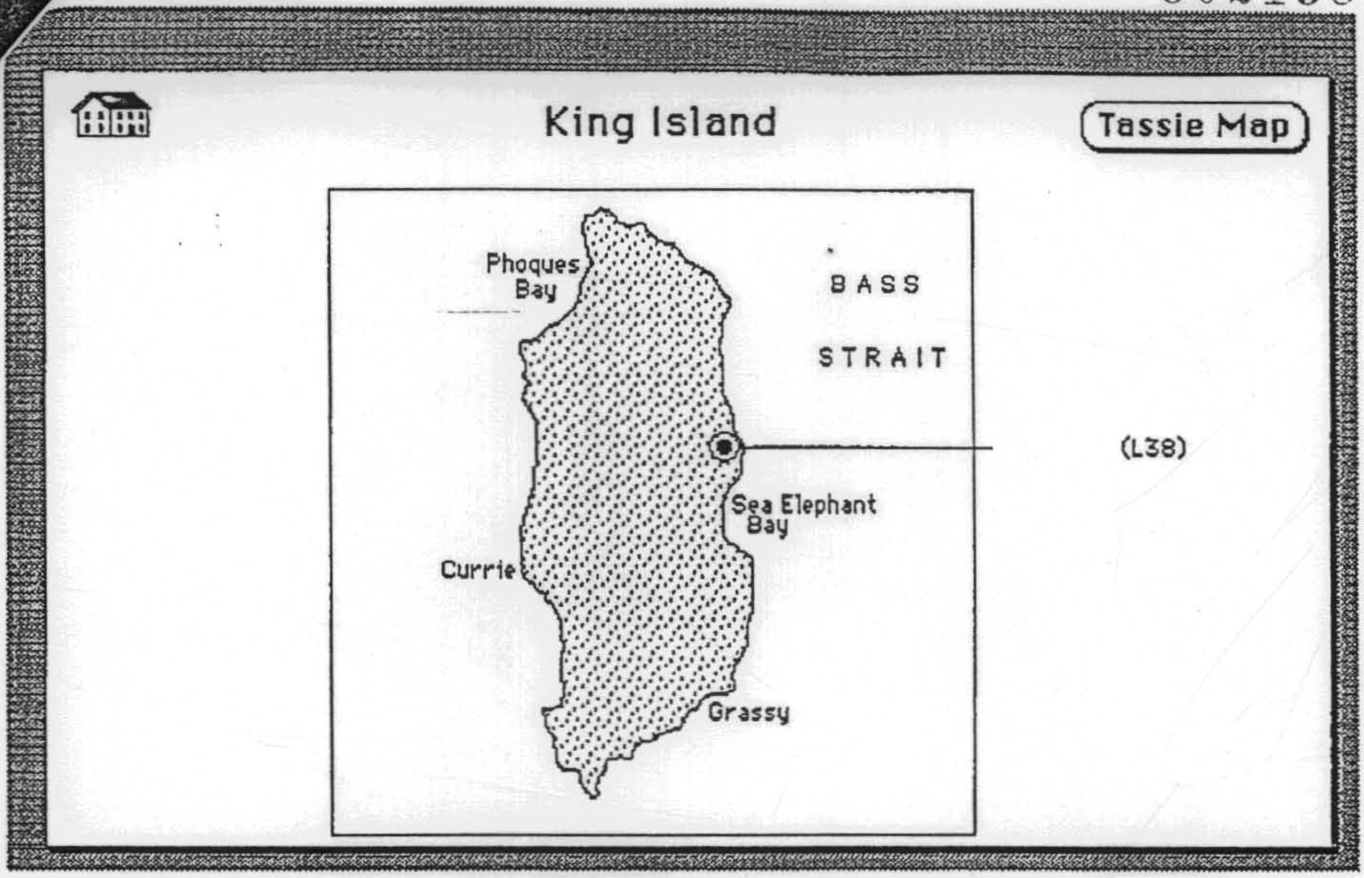
APPENDIX FIGURE 4.1A: BIG BAY AND DUCK BAY OYSTER LEASE SITES



30 - Pacific oysters, Flat oysters
33 - Pacific oysters
31 - Pacific oysters, Flat oysters
26 - Pacific oysters
19 - Pacific oysters
29 - Pacific oysters, Flat Oysters

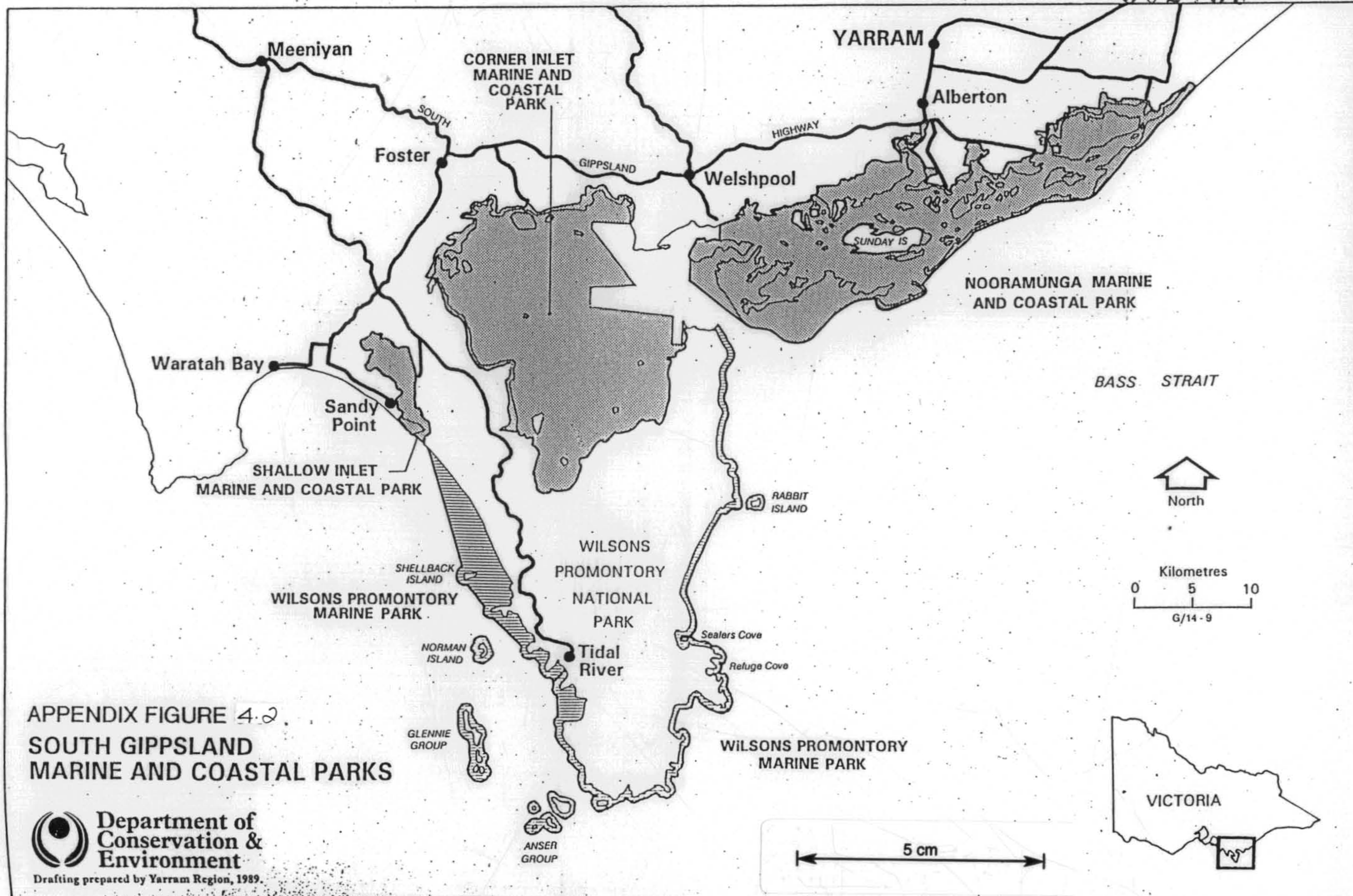


APPENDIX FIGURE 4.1B: ROBBINS PASSAGE OYSTER LEASE SITES



38 - Pacific oysters
Flat Oysters

APPENDIX FIGURE 4.1c: KING ISLAND OYSTER LEASE SITES



APPENDIX FIGURE 4.2.

SOUTH GIPPSLAND MARINE AND COASTAL PARKS

Department of Conservation & Environment

Drafting prepared by Yarram Region, 1989.

502140

GUIDE TO SYMBOLS

COASTLINE TYPE

Sand beach ....

Prominent sand dunes..........

Gravel / Pebble / Boulder beach..........

Intertidal sand / Mud flats..........

Cliff with face greater than 5m..........

Rock foreshore..........

1:100 000 maps only :

Clifflet with face less than 5m ....

Moorings..........

BIOLOGICAL RESOURCES

Seabird rookery ....

TYPES:

Little Penguin	LP
White-capped Albatross	WCA
Fairy Prion	FP
Short-tailed Shearwater	STS
White Faced Storm Petrel	WFSP
Common Diving Petrel	CDP
Sooty Shearwater	SS
Australasian Gannet	AG
Australian Pelican	AP
Crested Tern	CT
Little Tern	LT
Fairy Tern	FT
White-fronted Tern	WFT
Black-faced Cormorant	BFC
Kelp Gull	KG
Pacific Gull	PG
Silver Gull	SG

Kelp forest ....

Seagrass meadow ....

Seal colony..........

Wetland or Saltmarsh ....

Rare plant or animal species ....

FISHERIES

Marine farm X

- Oyster.......... O
- Mussel .... M
- Scallop.......... S
- Abalone .... A
- Seaweed for abalone ....
- Fin fish..........

Major recreational fishing area ....

Popular area for harvesting wild shellfish..........

Major area important to commercial fishing

Scale fish ....

Scallop..........

CULTURAL HERITAGE RESOURCES

Historic site.......... H

Aboriginal site .... A

TRANSPORT & INFRASTRUCTURE

Lighthouse ....

Wharf; Jetty; Breakwater..........

Wreck; exposed / submerged..........

Boat ramp ....

Pipeline..........

Oil storage tanks..........

Seawater intake pipe..........

Airport; Landing ground..........

TRANSPORT & INFRASTRUCTURE

Ferry route..........

Railway line..........

Roads sealed/unsealed ....

Vehicular track..........

Foot track..........

TIDES, CURRENTS & SEABED CONTOURS

Shallow water - generally less than 10m..........

Shoal water around rocks and reefs dangerous to navigation ....

Prominent tidal currents (ebb & flood)

RECREATION

Yacht club .... YC

Camping site..........

Caravan park ....

Scenic lookout ....

Picnic place..........

Popular swimming area..........

Popular diving locations..........

Popular surfing area ....

Popular anchorage..........

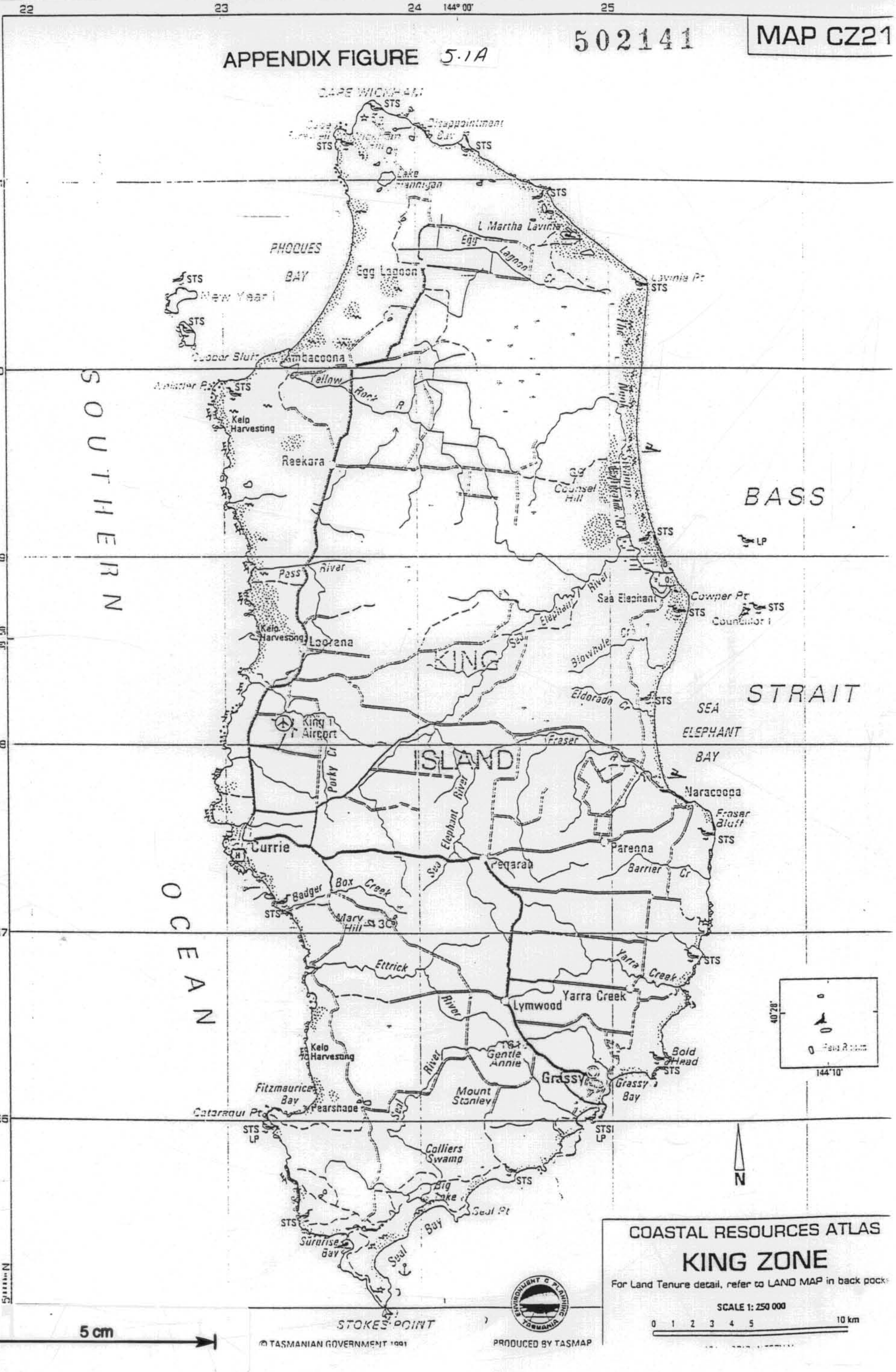
Shack concentration..........

APPENDIX FIGURES 5.1.

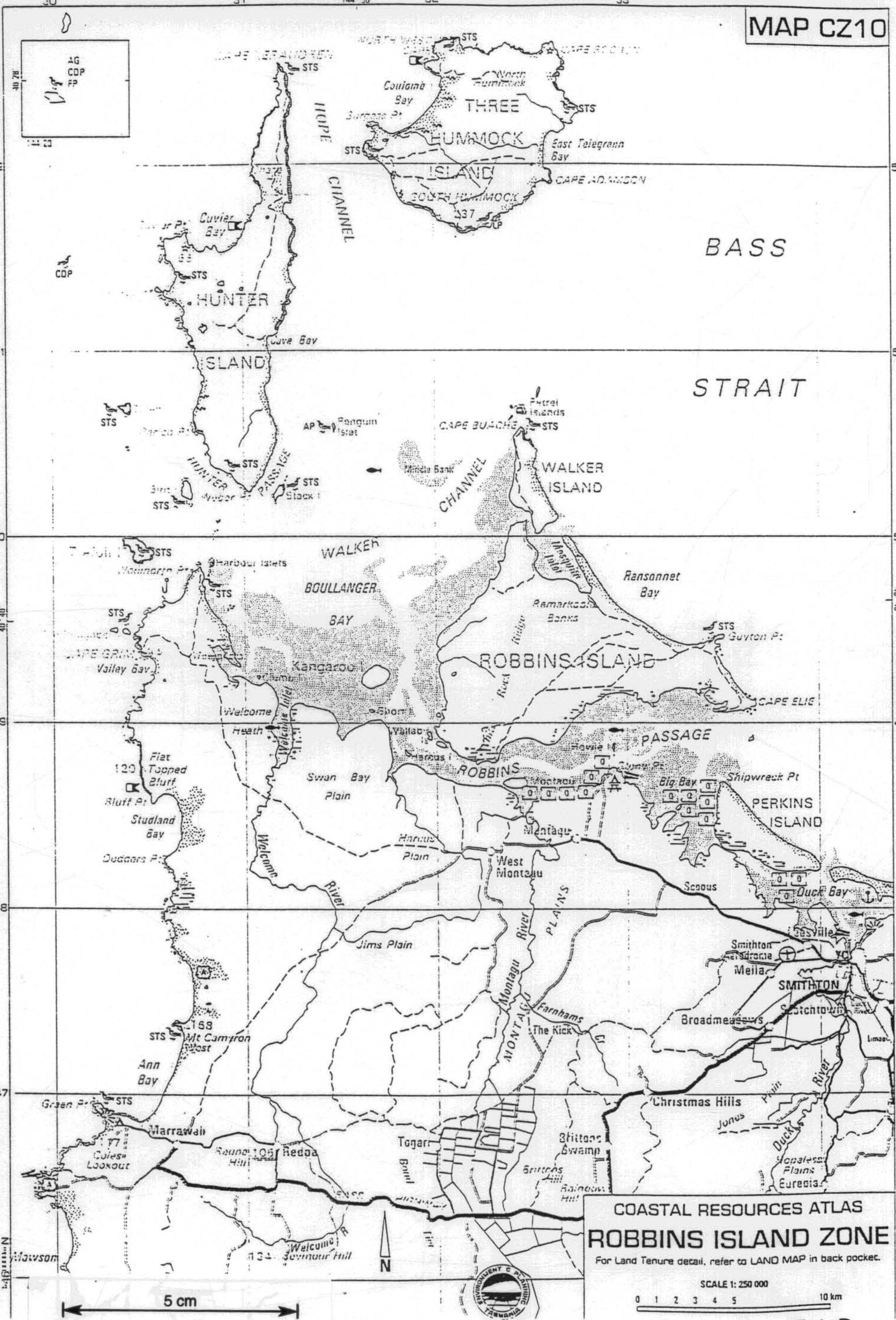
502141

APPENDIX FIGURE 5.1A

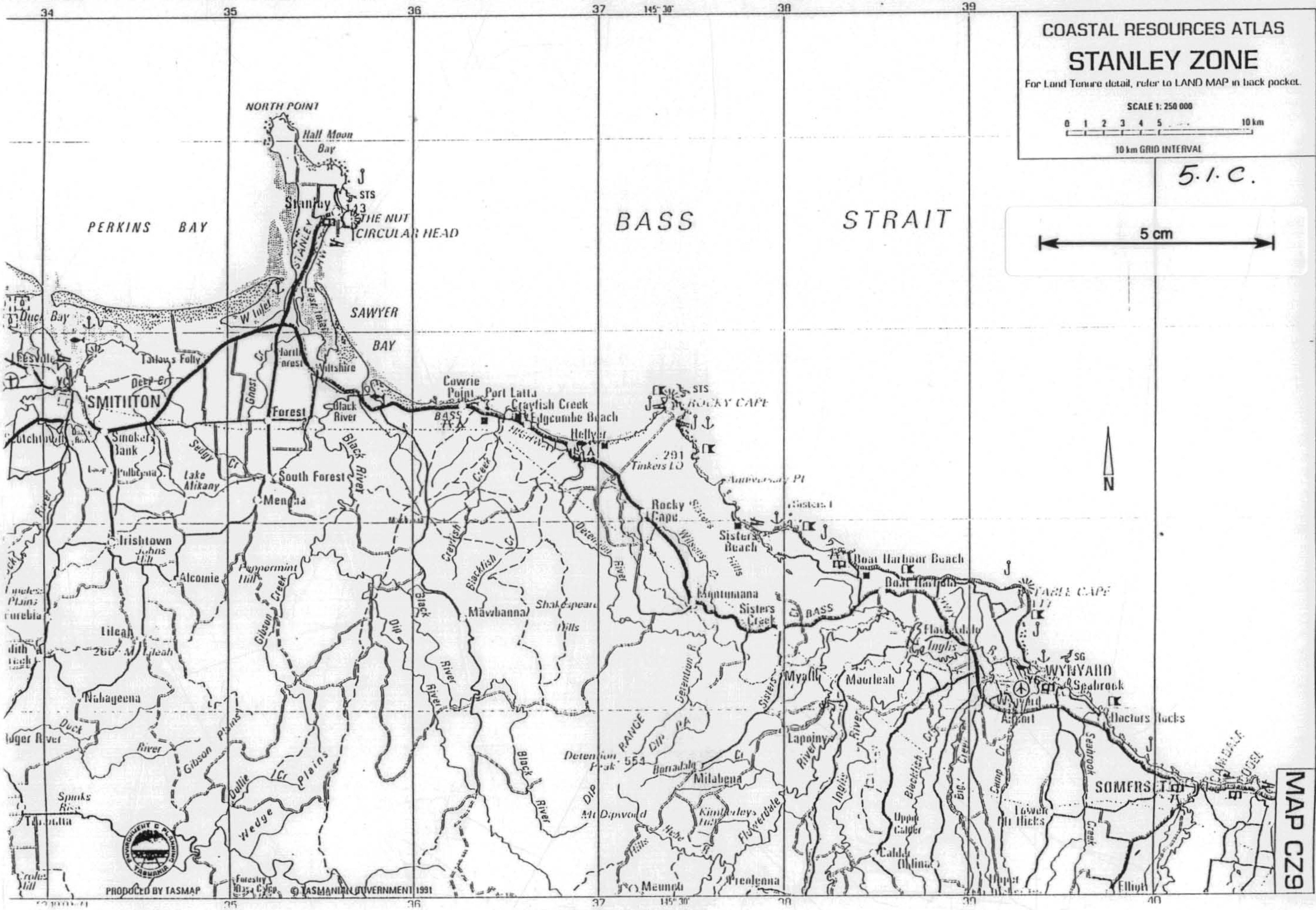
MAP CZ21



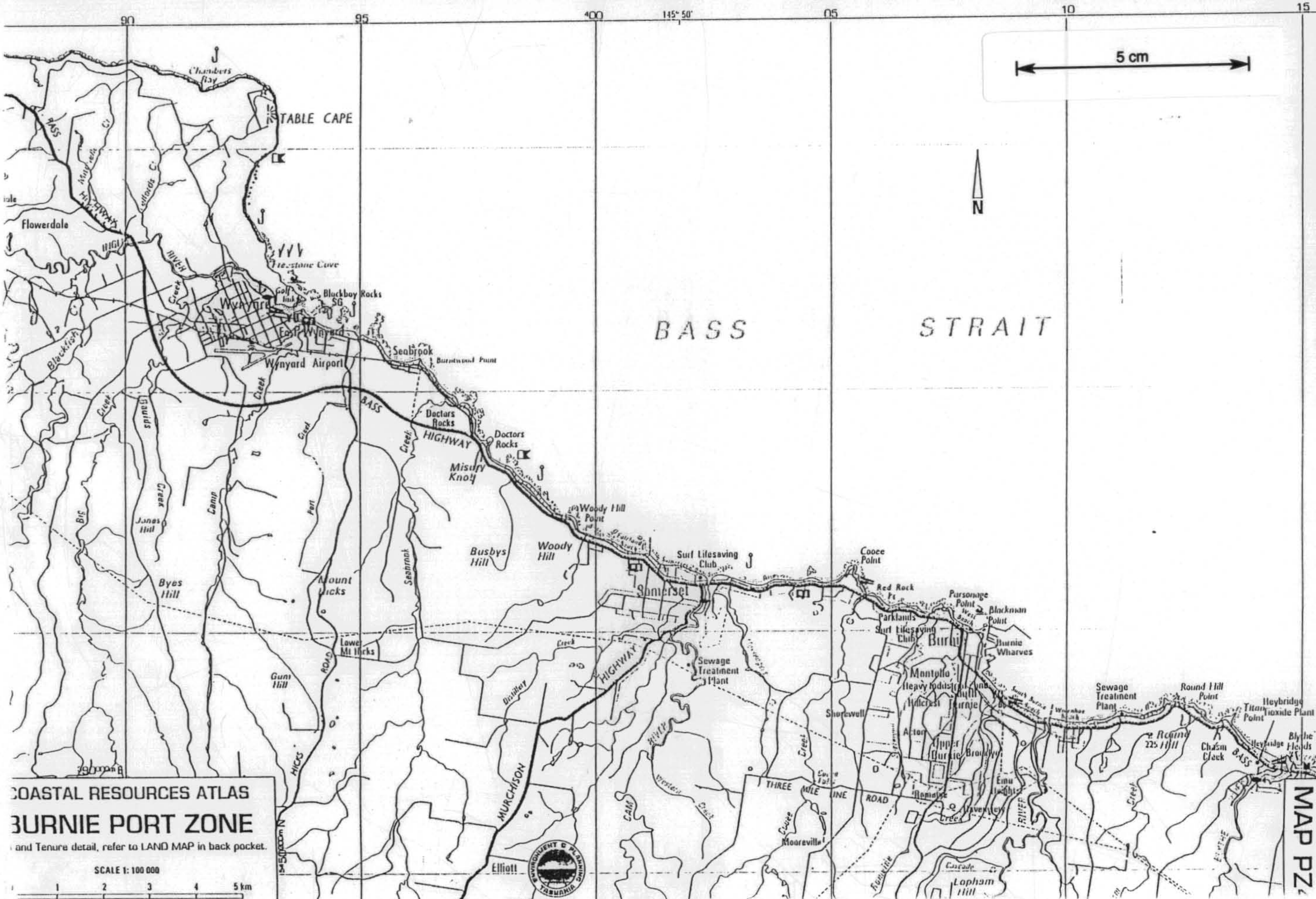
502142


MAP CZ10
COASTAL RESOURCES ATLAS
ROBBINS ISLAND ZONE
For Land Tenure detail, refer to LAND MAP in back pocket.
SCALE 1: 250 000
0 1 2 3 4 5 10 km
5 cm
BASS
STRAIT
THREE
HUMMOCK
ISLAND
North Hummock
South Hummock
Coulomb Bay
East Telegraph Bay
CAPE ADAMSON
HOPE CHANNEL
HUNTER
ISLAND
Cuvier Bay
Cave Bay
HUNTER PASSAGE
Penguin Islet
Petrel Islands
CAPE BUACHE
WALKER
ISLAND
Middle Bank
WALKER CHANNEL
Harbour Islets
BOULLANGER
BAY
Ransonnet Bay
Guyton Pt
ROBBINS ISLAND
CAPE ELIE
Kangaroo I
Valley Bay
Welcome Heath
Welcome Inlet
ROBBINS PASSAGE
Big Bay
Shipwreck Pt
PERKINS
ISLAND
Swan Bay Plain
Flat Topped Bluff
Bluff Pt
Studland Bay
Montagu
West Montagu
Harcus Plain
Welcome River
Scopus
Duck Bay
Jims Plain
Montagu River
PLAINS
MONTAGU
Smithton Aerodrome
Mella
SMITHTON
Broadmeadows
Farnhams
The Kick
Mt Cameron West
Ann Bay
Green Pt
Christmas Hills
Marrawah
Redpa
Togari
Brittons Swamp
Duck River
Eurebia
Welcome R
Seymour Hill
Mawson
STS
CDP
AP
N
30
31
32
33
144° 50'
40° 40'
47
48
49
50
51
52

5.1.B



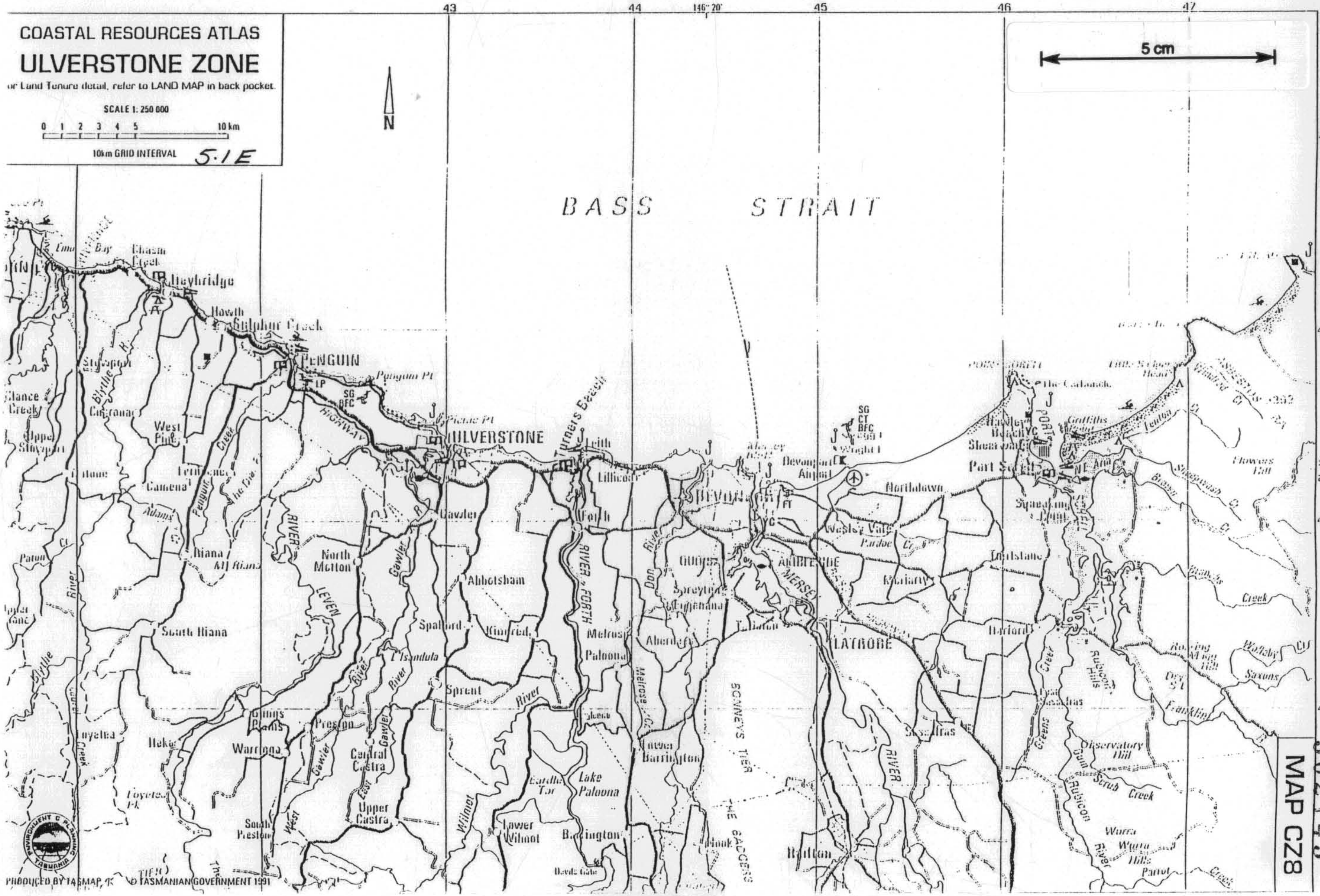
COASTAL RESOURCES ATLAS
STANLEY ZONE
For Land Tenure detail, refer to LAND MAP in back pocket.
SCALE 1: 250 000
10 km
10 km GRID INTERVAL
5.1.C.
5 cm
MAP CZ9
BASS
STRAIT
PERKINS BAY
NORTH POINT
Hall Moon Bay
Stanley
STS
THE NUT
CIRCULAR HEAD
SAWYER BAY
Duck Bay
W Inlet
East Inlet
Tatlows Folly
SMITHTON
Forest
South Forest
Black River
Smokers Bank
Lake Mikany
Mengha
Irishtown
Johns Hill
Alcomie
Peppermint Hill
Lileah
Nabageena
Duck River
Gibson Plains
Wedge Plains
Cowrie Point
Port Latta
Crayfish Creek
Edgcumbe Beach
Hellyer
ROCKY CAPE
Tinkers LO
Rocky Cape
Sisters Beach
Wilsons Hills
Boat Harbour Beach
Boat Harbour
TABLE CAPE
Montumana
Sisters Creek
BASS
Flowerdale
Inglis
WYNYARD
Seabrook
Myalla
Moorleah
Doctors Rocks
SOMERSET
Mawbanna
Shakespeare Hills
Detention Peak 554
Detention River
Blackfish Cr
Dip River
Dip Range
Mt Dipwood
Lapoinya
Milabena
Kimberleys Hill
Upper Calder
Calder
Meunna
Preolenna
Elliott
Tewkesbury
N
PRODUCED BY TASMAP
© TASMANIAN GOVERNMENT 1991
34
35
36
37
38
39
40
46
47
48
145° 30'
40° 50'



COASTAL RESOURCES ATLAS
BURNIE PORT ZONE
and Tenure detail, refer to LAND MAP in back pocket.
SCALE 1: 100 000
1 2 3 4 5 km
MAP PZ
5 cm
N
BASS STRAIT
TABLE CAPE
Chambers Bay
Flowerdale
Wynyard
East Wynyard
Wynyard Airport
Blackboy Rocks
Seabrook
Doctors Rocks
Misery Knob
Woody Hill Point
Woody Hill
Busbys Hill
Surf Lifesaving Club
Somerset
Cooee Point
Red Rock Pt
Parsonage Point
Blackman Point
Parklands
Burnie
Burnie Wharves
Montello
Heavy Industrial Zone
Hillcrest
South Burnie
Shorewell
Acton
Upper Burnie
Brooklyn
Emu Heights
Havenview
Romaine
Sewage Treatment Plant
Round Hill Point
Round Hill
Chasm Creek
Titan Point
Heybridge
Heybridge Tioxide Plant
Blythe Heads
Jones Hill
Byes Hill
Mount Hicks
Lower Mt Hicks
Gum Hill
Elliott
Mooreville
Lopham Hill
BASS HIGHWAY
MURCHISON HIGHWAY
HICKS ROAD
THREE MILE LINE ROAD
CAM RIVER
EMU RIVER
Big Creek
Camp Creek
Seabrook Creek
Distillery Creek
90
95
400
145° 50'
05
10
15
65
60
55
41° 00'

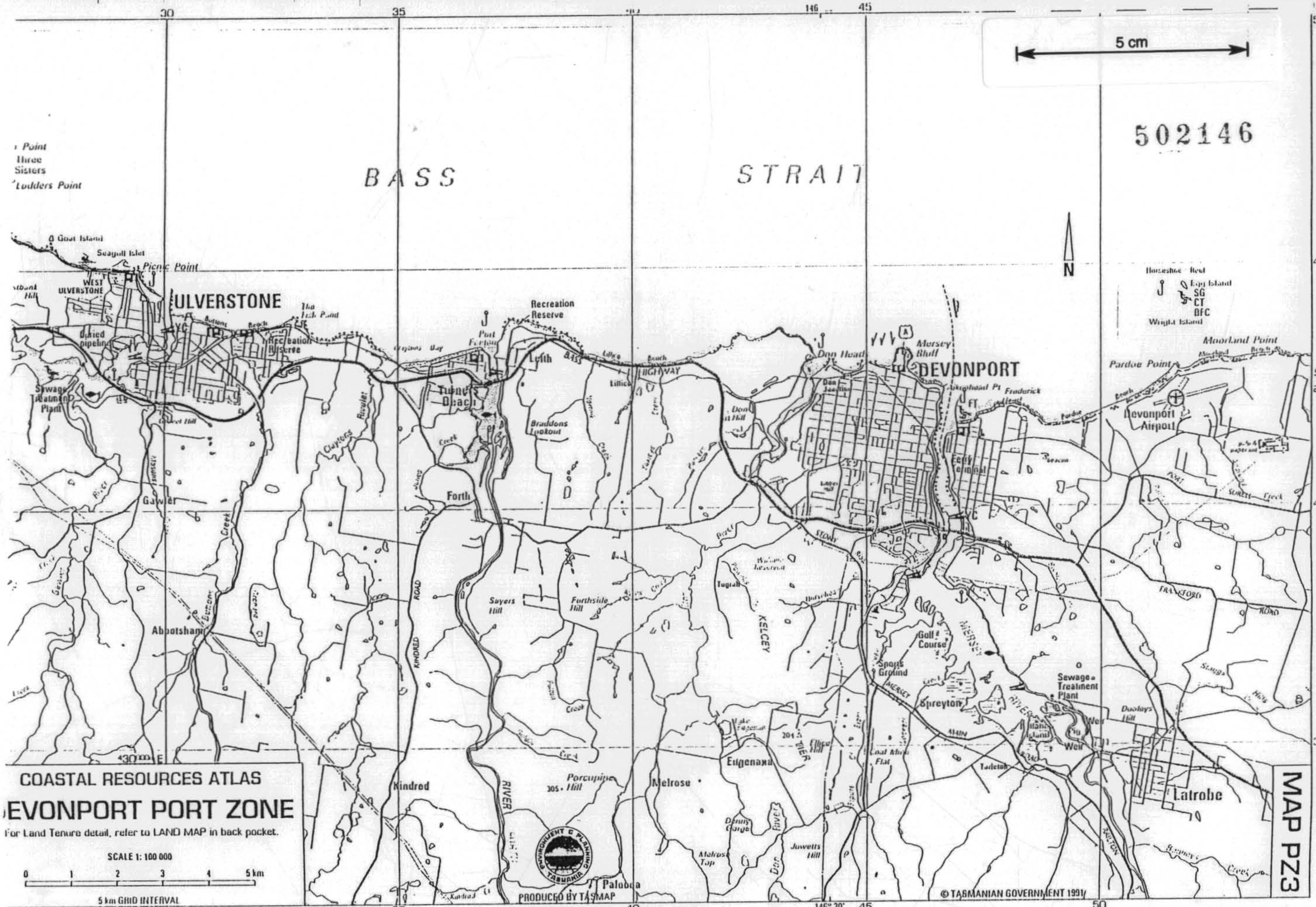
5.1 D

502144



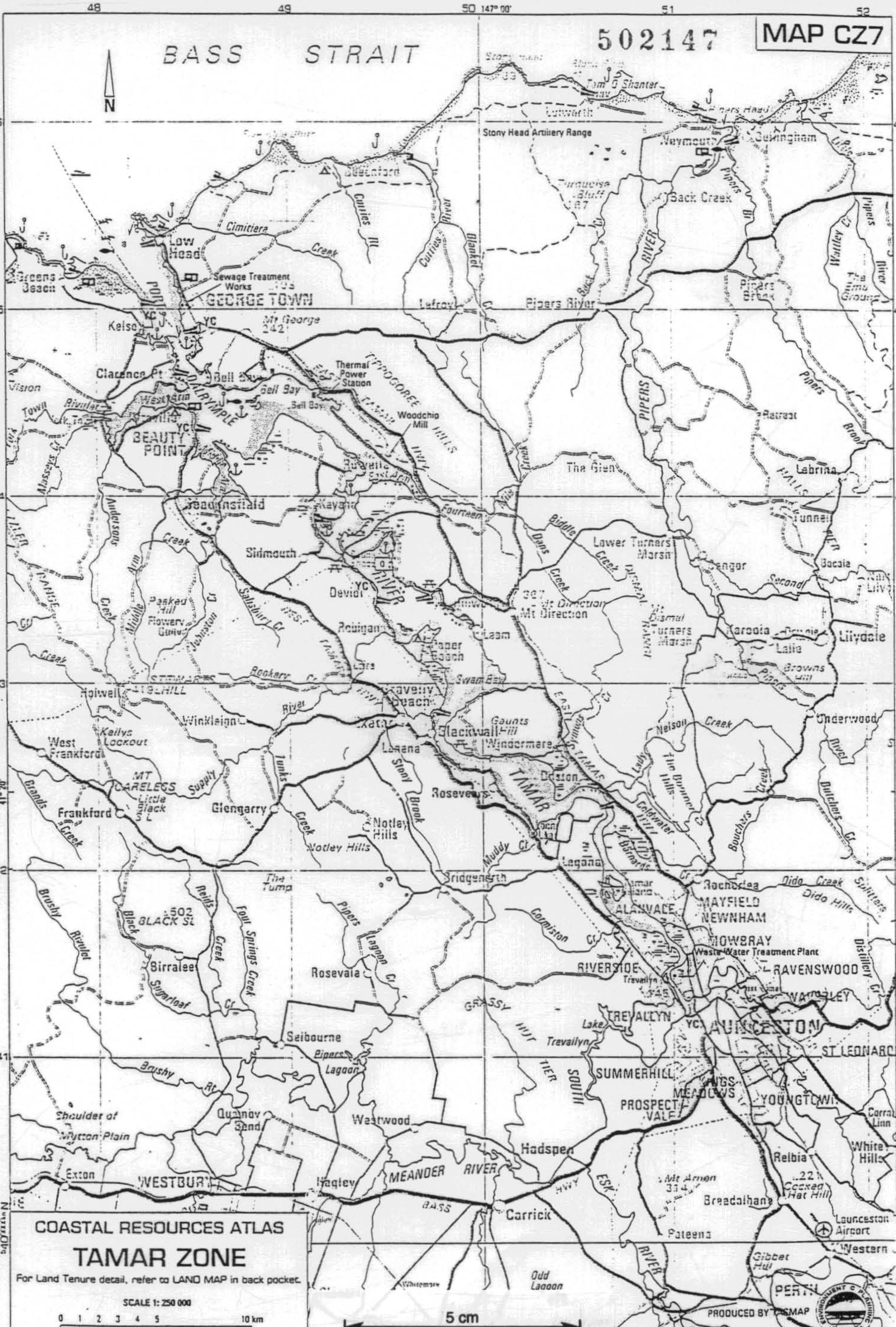
MAP CZ8

502145

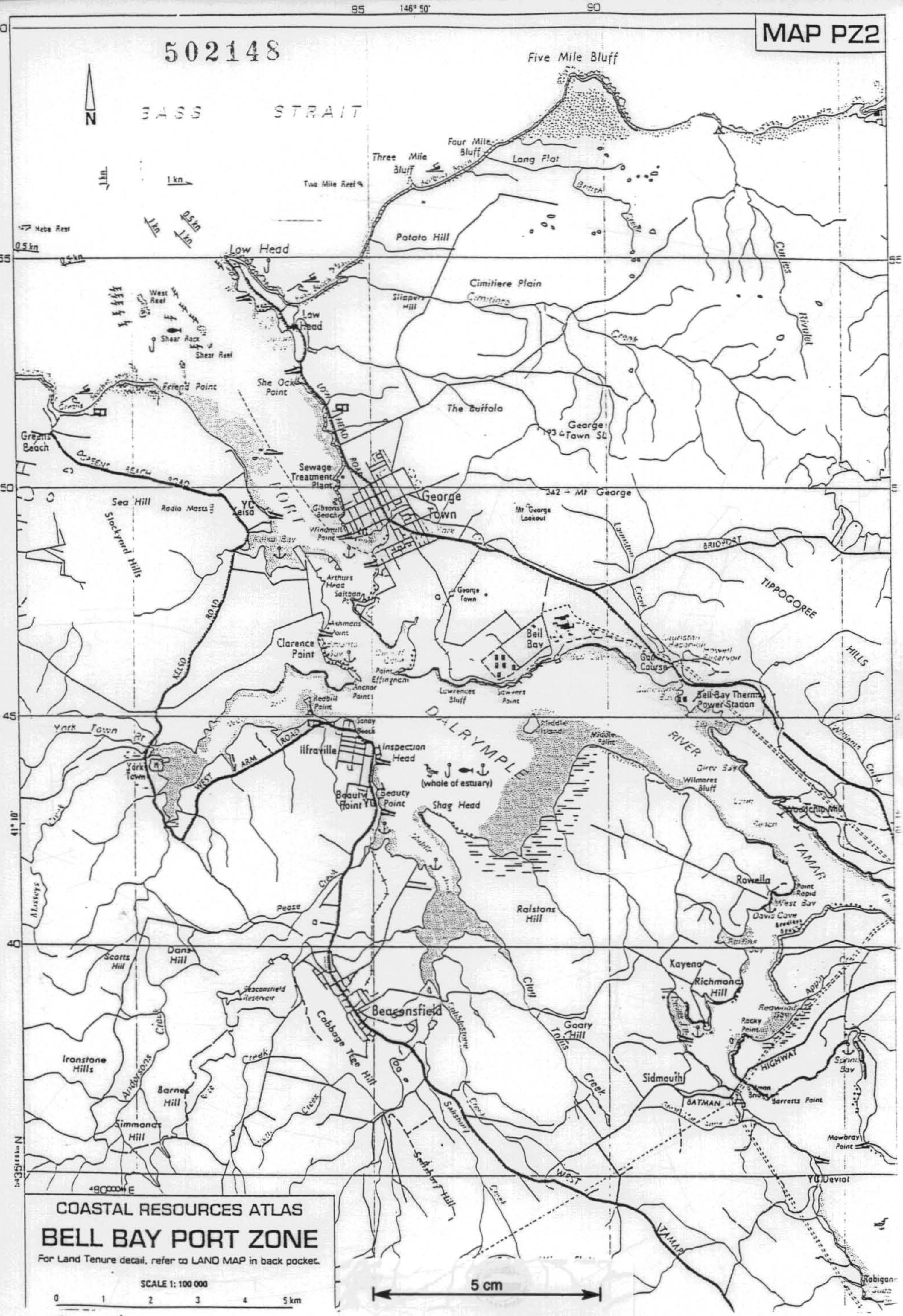


5 cm
502146
BASS
STRAIT
N
Three Sisters
Lodders Point
Goat Island
Seagull Islet
Picnic Point
WEST ULVERSTONE
ULVERSTONE
Buried pipeline
Recreation Reserve
Sewage Treatment Plant
Gawler
Abbotsham
Port Fortie
Leith
Turners Beach
Forth
Braddons Lookout
Sayers Hill
Forthside Hill
KINDRED ROAD
Kindred
Porcupine Hill
RIVER
Melrose
Eugenana
Melrose Top
Jowetts Hill
Paloona
KELCEY
Tugrah
Don Heads
Don Hill
Mersey Bluff
DEVONPORT
Pardoe Point
Moorland Point
Devonport Airport
Horseshoe Reef
Egg Island
Wright Island
Frederick Point
Ferry Terminal
Golf Course
Sports Ground
Spreyton
MERSEY
Sewage Treatment Plant
Dooleys Hill
Tarleton
Latrobe
Coal Mine Flat
Weir
COASTAL RESOURCES ATLAS
DEVONPORT PORT ZONE
For Land Tenure detail, refer to LAND MAP in back pocket.
SCALE 1: 100 000
0 1 2 3 4 5 km
5 km GRID INTERVAL
PRODUCED BY TASMAP
© TASMANIAN GOVERNMENT 1991
MAP PZ3

5.1 F

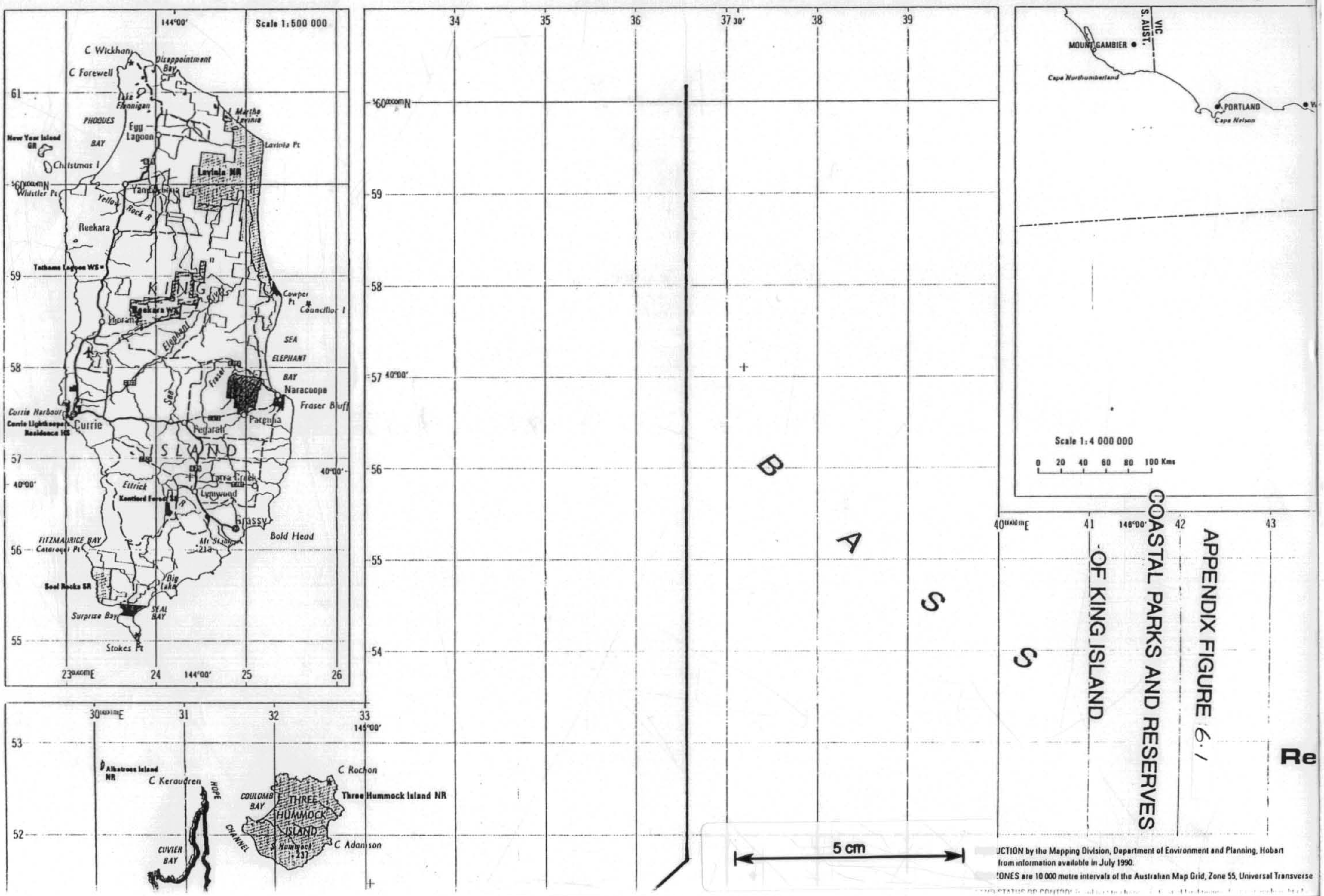

502147
MAP CZ7
BASS STRAIT
N
Stony Head Artillery Range
Tom O Shanter
Weymouth
Bellingham
Back Creek
Low Head
Sewage Treatment Works
GEORGE TOWN
Greens Beach
Kelso
Mt George 242
Lefroy
Pipers River
Pipers Brook
Clarence Pt
Bell Bay
Thermal Power Station
Woodchip Mill
DALRYMPLE
BEAUTY POINT
Retreat
The Glen
Lebrina
Beaconsfield
Kayena
Sidmouth
Deviot
Robigana
Lower Turners Marsh
Mt Direction
Turners Marsh
Karoola
Lalla
Lilydale
Paper Beach
Swan Bay
Holwell
Winkleigh
Gravelly Beach
Exeter
Blackwall
Gaunts Hill
Windermere
Lanena
Underwood
West Frankford
Kellys Lookout
MT CARELESS
Frankford
Glengarry
Rosevears
Notley Hills
TAMAR
Legana
Bridgenorth
Rocherlea
MAYFIELD
NEWNHAM
MOWBRAY
Waste Water Treatment Plant
RAVENSWOOD
RIVERSIDE
Trevallyn
Birralee
Rosevale
TREVALLYN
LAUNCESTON
ST LEONARDS
Selbourne
Pipers Lagoon
SUMMERHILL
KINGS MEADOWS
PROSPECT VALE
YOUNGTOWN
Quamby Bend
Westwood
Shoulder of Mytton Plain
Exton
WESTBURY
Hagley
MEANDER RIVER
Hadspen
Carrick
Relbia
White Hills
Mt Arnon
Breadalbane
Launceston Airport
Pateena
PERTH
COASTAL RESOURCES ATLAS
TAMAR ZONE
For Land Tenure detail, refer to LAND MAP in back pocket.
SCALE 1: 250 000
0 1 2 3 4 5 10 km
5 cm
PRODUCED BY TASMAP
© TASMANIAN GOVERNMENT 1991

5.1G.


MAP PZ2
502148
BASS STRAIT
N
Five Mile Bluff
Four Mile Bluff
Three Mile Bluff
Long Flat
Two Mile Reef
Hebe Reef
Low Head
Potato Hill
Cimitiere Plain
Cimitiere Creek
Curries Rivulet
Sleepers Hill
West Reef
Shear Rock
Shear Reef
Friend Point
She Ock Point
The Buffalo
George Town SL
Greens Beach
Sea Hill
Radio Masts
Stockyard Hills
Sewage Treatment Plant
Gibsons Beach
Windmill Point
George Town
242 Mt George
Mt George Lookout
BRIDPORT
TIPPOGOREE HILLS
Arthurs Head
Saltpan Pt
Ashmans Point
Clarence Point
Bell Bay
Golf Course
Point Effingham
Anchor Point
Lawrences Bluff
Sawyers Point
Bell Bay Thermal Power Station
Redbill Point
Sandy Beach
Ilfraville
Inspection Head
KELSO ROAD
York Town Rt
York Town
WEST ARM ROAD
DALRYMPLE
(whole of estuary)
Middle Island
Beauty Point
Shag Head
RIVER
Wilmores Bluff
Woodchip Mill
TAMAR
Rowella
Point Rapid
West Bay
Davis Cove
Ralstons Hill
Pease
Scotts Hill
Dans Hill
Beaconsfield Reservoir
Beaconsfield
Cabbage Tree Hill
Kayena
Richmond Hill
Goaty Hill
Ironstone Hills
Barnes Hill
Simmonds Hill
Sidmouth
BATMAN
HIGHWAY
Garretts Point
Mowbray Point
Deviot
WEST TAMAR
Robigana
COASTAL RESOURCES ATLAS
BELL BAY PORT ZONE
For Land Tenure detail, refer to LAND MAP in back pocket.
SCALE 1: 100 000
0 1 2 3 4 5 km
5 cm

5-1 H.

502149



APPENDIX FIGURE 6.1
COASTAL PARKS AND RESERVES OF KING ISLAND

...UCTION by the Mapping Division, Department of Environment and Planning, Hobart from information available in July 1990.
...ZONES are 10 000 metre intervals of the Australian Map Grid, Zone 55, Universal Transverse

6.1A.

RECREATIONAL RESERVES INDEX

In addition to the named reserves listed below, almost the entire coastline of Tasmania is reserved within the limits of high and low tides.

GRID REFERENCE - To locate the grid square containing a reserve.
The first two digits of the reference indicate the vertical line to the left of the grid square.
The second two digits indicate the horizontal line at the bottom of the grid square.
The percentage of the total land mass taken up by each land tenure division is shown in brackets.

PRIVATE PROPERTY (40.1%)

COMMONWEALTH (0.5%)
Includes Military Training Areas, Quarantine Stations and land required for communication purposes.

HYDRO ELECTRIC COMMISSION (1.2%) Reservoirs and lakes are popular for acquatic activities. Some land areas are not available for recreation during the construction of dams and associated works.

LAND ADMINISTERED BY THE FORESTRY COMMISSION (24.1%)

STATE FOREST

Areas for forest production and protection and for recreation. Many areas are open to the public, with some restrictions on hunting, fires and camping that should be checked with the local District Forester.

TIMBER RESERVE

Areas for production forestry, managed by the Forestry Commission with similar restrictions as those in State Forest.

FOREST RESERVES (FR) •

Scenic, recreation and species protection areas featuring a range of facilities. Check with local District Forester for facilities, camping and fire restrictions.

Name	Grid Ref
Arm River	4338
Balfour Track	3244
Boyd	4425
Brookerana	5731
Dalgarth	4743
Dip Falls	3645
Drys Bluff	4838
Esperance River	4920
Evercreech	5841
Fortescue	5722
Griffin	5640
Hardings Falls	5936
Hollybank	5142

FOREST RESERVES (FR Cont.

Name	Grid Ref
Hopetoun	4920
Jean Brook	4141
Julius River	3344
Lake Chisholm	3344
Lilley	4738
Lost Falls	5734
Lower Marsh Creek	6039
Mathinna Falls	5741
Meander	4638
Meetus Falls	5735
Mersey White Water	4338
Milkshake Hills	3444
Mt Maurice	5442
Mt Puzzler	5937
Mt Victoria	5742
Mt Wedge	4425
Myrtle Grove	5443
Oldina	3845
Quamby Bluff	4738
Sandspit River	5627
Scamander	6041
South Weld	4723
Spinning Gum	5329
Stringybark	4125
Tahune	4722
Teepookana	3632
Tombstone Creek	5541
Tooms White Gum	5732
Upper Natone	4043
Warrawee	4542
Wes Beckett	3443

Dogs are allowed in many areas managed by the Dept. of Environment & Planning and the Forestry Commission if the owner controls them.

LAND ADMINISTERED UNDER THE CROWN LANDS ACT

NON-ALLOCATED CROWN LAND
(8.7%) Much of which is leased for mining or agricultural purposes.

LAND RECREATION AREAS (3.9%)

PROTECTED AREAS (PA) ▲

Large areas managed to allow controlled use of resources, as well as protecting the natural environment and encouraging community recreation.

Name	Grid Ref
Arthur Pieman	3341
Central Plateau (CPPA)	4835
Mount Roland (proposed)	4340
Seven Mile Beach	5425
Waterhouse	5547
Wellington Range (proposed)	5125

COASTAL RESERVES (CR) ▲

Coastal, River and Lakeside Reserves are managed to protect the natural environment as well as providing for public access to rivers, coasts and lakes.

Name	Grid Ref
Adventure Bay	5220
Ansons Bay	6045
Bay of Fires	6043
Boltons Beach	5830
Carlton Beach	5525
Clifton Beach	5424
Coles Bay	6033
Coswell Beach	5833
Cressy Beach	5833
Denison Rivulet	6037
Double Sandy Point	5248
Eaglehawk Bay	5723
Egg Beach	5658
Flinders Bay	5724
Fossil Bluff	3948
Four Mile Creek	6039
Granite Point	5346
Kelvedon Beach	5832
Lagoons Beach	6038
Lillico Beach	4444
Little Beach	6039
Low Head	4845

COASTAL RESERVES (CR) Cont.

Name	Grid Ref
Mayfield Bay	5832
Millingtons Beach	5728
Musselroe Bay	5947
Parnella	6042
Peggs Beach	3547
Point Meredith	6034
Ralphs Bay	5324
Raspins Beach	5728
Ringarooma (proposed)	5647
Roaring Beach	5522
Scamander	6041
Seymour	6037
Spiky Beach	5832
Surveyors Bay	5020
Swansea	5833
Table Cape	3946
Tatlows Beach	3548
West Inlet	3548

CROWN RESERVES (CRes) ▲

Special reserves which, where compatible, are managed to protect natural and recreation values.

Name	Grid Ref
Brinktop	5326
Mt Nelson Signal Station	5224
Pelham Tier	5028
Truganini	5224
W A G Walker Rhododendron Park	5143
Whalers Lookout	6038

LAKESIDE RESERVES (LR) ▲

Name	Grid Ref
Interlaken	5133
Little Pine Lagoon	3548

RIVER RESERVES (RR) ▲

Name	Grid Ref
Ansons	6045
Brid	5348
Tomahawk	5648
West Arm	4844

STATE RECREATION AREAS (SRA) ▲

Areas managed to provide for community recreation, with some controlled commercial use of resources, whilst protecting the natural environment.

Name	Grid Ref
Briant Hill	3447
Coningham	5222
Four Springs	4841
Gordons Hill	5225
Hope Island	5020
Humbug Point	6143
Kate Reed	5140
Knopwood Hill	5224
Lake Barrington	4341
Meehan Range-Redgate Section	5325
Meehan Range-Mt Direction Section	5228
Mount Rumney	5325
Recherche Bay	4917
Rosny Hill	5325
Snug Falls	5122
South Arm	5424
St Helens Point	6142
Trevallyn	5041

Unnamed areas mainly comprise reserves for quarries, agricultural research, water and schools.

LAND ADMINISTERED UNDER THE NATIONAL PARKS AND WILDLIFE ACT (25.2%)

NATIONAL PARKS ■

Extensive areas for the conservation of natural ecosystems, enjoyment and study of the natural environment, with provision for community recreation.

Name	Grid Ref
Asbestos Range	4644
Ben Lomond	5539
Cradle Mt Lake St Clair	4136
Douglas-Apsley	5936
Franklin-Gordon Wild Rivers	4130
Freycinet	6032
Hartz Mountains	4821
Maria Island	5928
Mount Field	4627
Mount William	6046
Rocky Cape	3747
Southwest	4323
Strzelecki	5954
Walls of Jerusalem	4436

STATE RESERVES (SR) ■

Generally small areas where balance between conservation and recreation is maintained.

Name	Grid Ref
Alum Cliffs	4540
Baldocks Cave	4439
Bradys Lookout	4942
Cape Bernier	5729
Cape Pillar	5821
Cape Raoul	5621
Croesus Cave	4339
Derwent Cliffs	5026
Devils Gullet	4539
Eugenana	4443
Fairy Glade	4738
Ferndene	4144
Fluted Cape	5319
Forth Falls	4339
Gunns Plains Caves	4142
Hastings Caves	4819
Hellyer Gorge	3843
Henty Glacial Moraine	3735
Holwell Gorge	4843
Ida Bay	4919
Junee Cave	4626
Kentford Forest	2458
King Solomons Cave	4439
Kubla Khan	4439
Labillardiere	5118
Liffey Falls	4838
Lookout Rock	6036
Marakoopa Cave	4439
Marriotts Falls	4727
Mount Arthur	5622
Mount Barrow	5341
Mount Barrow Falls	5342
Mount Montgomery	4244
Murchison Highway	3838
Notley Gorge	4942
Nut, The	3548
Palmers Lookout	5422
Pieman River	3339
Point Puer-Crescent Bay	5722
Roger River	3345
St Columba Falls	5742
St Marys Pass	6040
St Patricks Head	6039

STATE RESERVES (SR) Cont.

Name	Grid Ref
Steppes	4933
Stewarts Bay	5722
Tasmans Arch	5723
Tessellated Pavement	5723
Thermal Springs	4541
Trowutta Caves	3445
Waterfall Creek	5219
Zeehan-Renison Bell	3737

HISTORIC SITES (HS) ■

Areas of significance in terms of European exploration or settlement with provision for recreation.

Name	Grid Ref
Batchelors Grave	5224
Callington Mill	5331
Coal Mines	5524
Currie Lightkeepers Residence	2357
Davey St 161	5225
D'Entrecasteaux Monument	5221
D'Entrecasteaux Watering Place	4917
Entally House	5040
George III Monument	5018
Highfield	3548
Kangaroo Bluff	5325
Lyons Cottage	3548
Macquarie Harbour	3730
Mt Direction	5228
Old Trinity Church-Criminal Courts	5225
Oyster Cove	5022
Port Arthur	5622
Richmond Gaol	5326
Risdon Cove	5225
Ritchies Mill	5141
Ross Female Convict Station	5434
Shot Tower	5224
Strahan Customs House	3633
Sydney Cove	5951
Tasman Monument	5625
Toll House	5020
Waubedebars Grave	6038
Womens Prison	5224
Wybalenna	5757
York Town	4744

NATURE RESERVES (NR) ■

Essentially for conservation of a particular flora or fauna habitat which is unique and important, but in some cases provision is made for recreation.

Name	Grid Ref
Albatross Island	3052
Bass Pyramid	5250
Betsey Island	5323
Big Green Island	5855
Black Pyramid Rock	Inset
Chappell Islands	5754
Coal River Gorge	5329
Curtis Island	Inset
Diamond Island	6038
Dismal Swamp	3146
Doughboys, The	3049
East Kangaroo Island	5755
East Risdon	5225
Foster Islands	5849

NATURE RESERVES (NR) Cont.

Name	Grid Ref
George Rocks	6146
Green Island	5221
Green Point	5226
Hippolyte Rocks	5823
Hospital Creek	5626
Ile des Phoques	5930
Isabella Island	5855
Judgement Rocks	Inset
Lavinia	2560
Lime Bay	5524
Low Islets	5655
Macquarie Island	Inset
Moriarty Rocks	6050
Native Point	4942
North East Islet	Inset
Penguin Islet	3150
Reid Rocks	Inset
Rodondo Island	Inset
Tenth Island	4546
Three Hummock Island	3252
Three Sisters-Goat Island	4244
West Moncoeur Island	Inset
Wright Rock	Inset

CONSERVATION AREAS (CA) / WILDLIFE SANCTUARIES (WS) ■

Areas under joint management with another land owner, that protect wildlife and their habitat, and may provide for recreation.

Name	Grid Ref
Adamsfield	4426
Badger Corner	5650
Ben Lomond	5640
Burnie Fernglade	4145
Cape Contrariety	5423
Cape Direction	5323
Cape Portland	5848
Carr Villa	5143
Chauncy Vale	5228
Deal Island	Inset
Deloraine	4740
Derwent (River)	5026
Four Mile Creek	6044
Fulton Park	4343
Glenorchy Water Reserve	5125
Goose Island	5653
Goulds Lagoon	5126
Grimes Lagoon	5433
Henry Somerset	4543
Kingston Beach Golf Course	5224
Lake Dulverton	5331
Launceston Golf Course	5141
Marble Hill	4818
Paterson Island	5140
Pabiarcha	6057
Pipers River	5144
Punchbowl	5141
Reskara	2458
Sandspit River	5727
Scottsdale Northeast Park	5444
Southport Lagoon	4918
Southwest (SWCA)	3828
The Lea	5224
Tooms Lake	5734
Wayatinah Lagoon	4530
Woodstock Lagoon	5039

CONSERVATION AREAS (CA) / WILDLIFE SANCTUARIES (WS) ■

Areas under the Dept's management that protect wildlife and their habitat, and provide for recreation.

Name	Grid Ref
Briggs Islet	6054
Cat Island	6157
Central Plateau (CPCA)	4837
Chalky Island	5756
Egg Islands	5022
George Town	4845
Gull Island	6252
Lackrana	6055
Lake Sorell	5134
Logan Lagoon	6155
Maxwell River Protected Arch. Site *	4128
Medeas Cove	6042
Mile Island	5755
Night Island	5851
Oyster Rocks	5953
Port Cygnet	5021
Reef Island	5755
South Esk River	5039
Tamar River	4943
Tathams Lagoons	2359
Wargata Mina Protected Arch. Site *	4621
Wright and Egg Islands	4544
Wybalenna Island	5756

GAME RESERVES (GR) ■

Essentially the same as Nature Reserves except that provision is made for particular forms of hunting and the maintenance of game populations.

Name	Grid Ref
Actaeon Island	4918
Bird Island	3050
Bruny Island Neck	5321
Farm Cove	3731
Lake Tiberias	5330
Little Dog Island	6054
Moulting Lagoon	5934
New Year Island	2760
Petrel Island	3250
Stack Island	3150
Steep Island	3050

MUTTONBIRD RESERVES (MR) ■

Crown land for which special provision is made for commercial and private muttonbirding.

Name	Grid Ref
Babel Island	6157
Great Dog Island	6054
Hunter Island	3151
Little Green Island	6054
Outer & Inner Sister Islands	5860

ABORIGINAL SITES (AS) ■

Areas containing relics of Aboriginal peoples or known to be of significance to them.

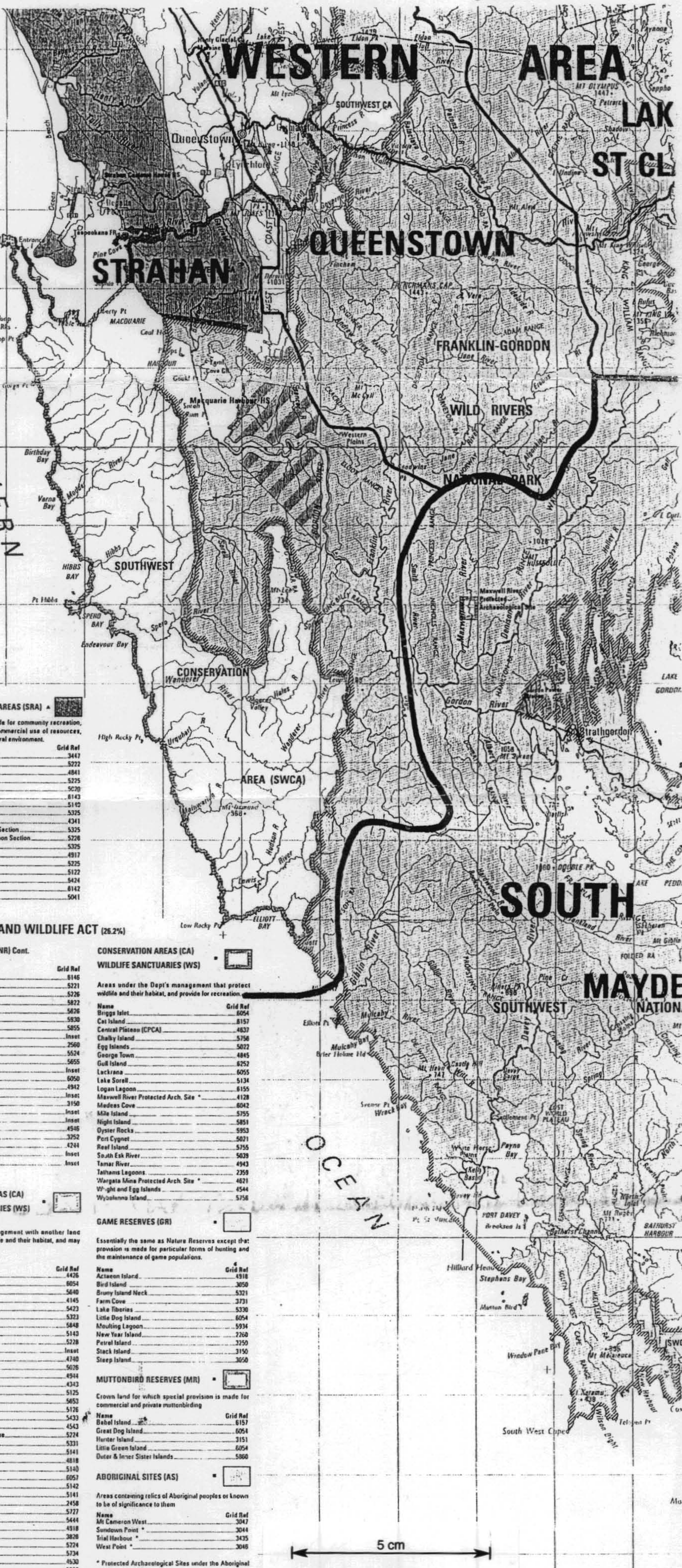
Name	Grid Ref
Mt Cameron West	3047
Sundown Point *	3044
Trial Harbour *	3435
West Point *	3046

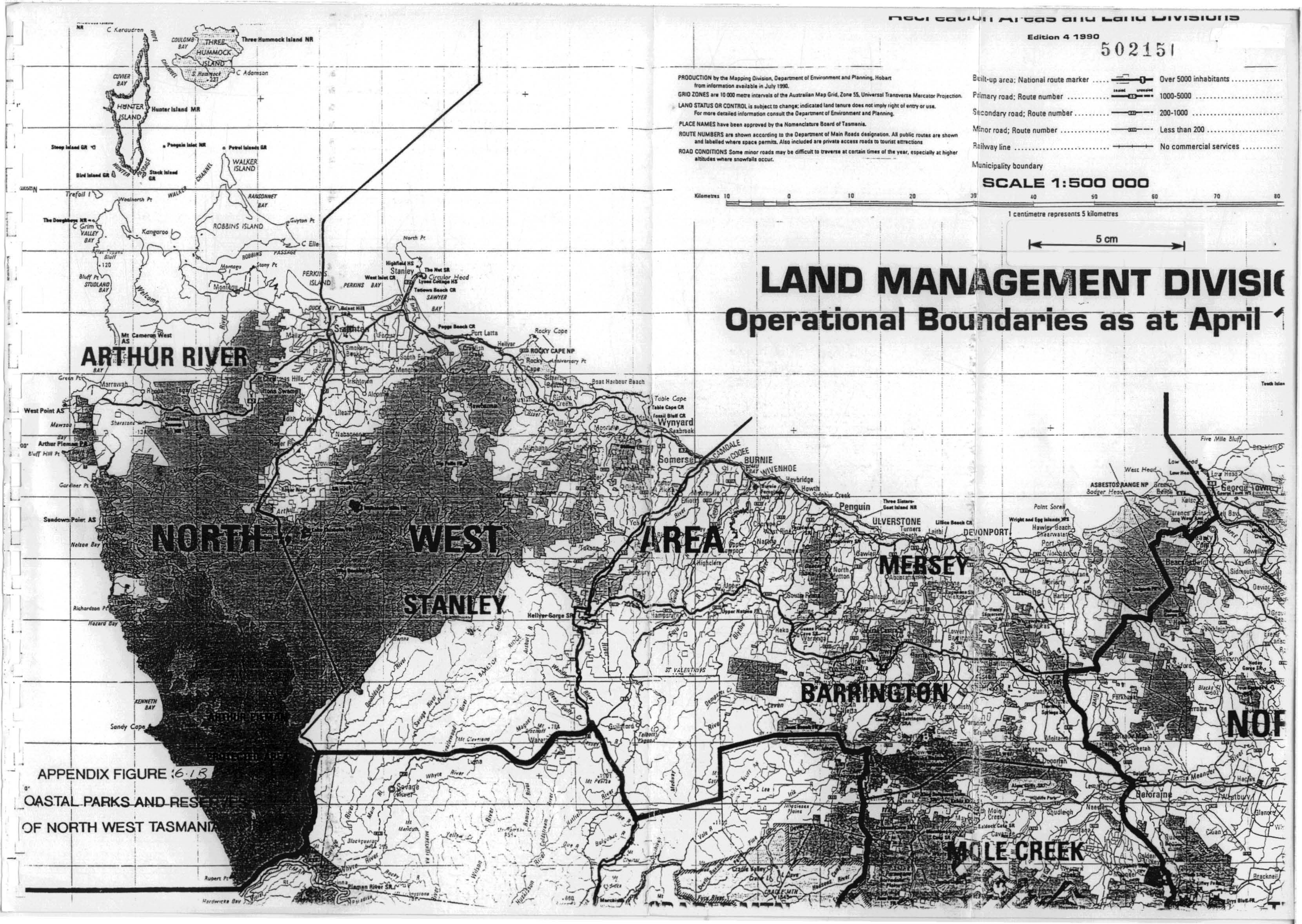
* Protected Archaeological Sites under the Aboriginal Relics Act 1975.

WORLD HERITAGE AREA

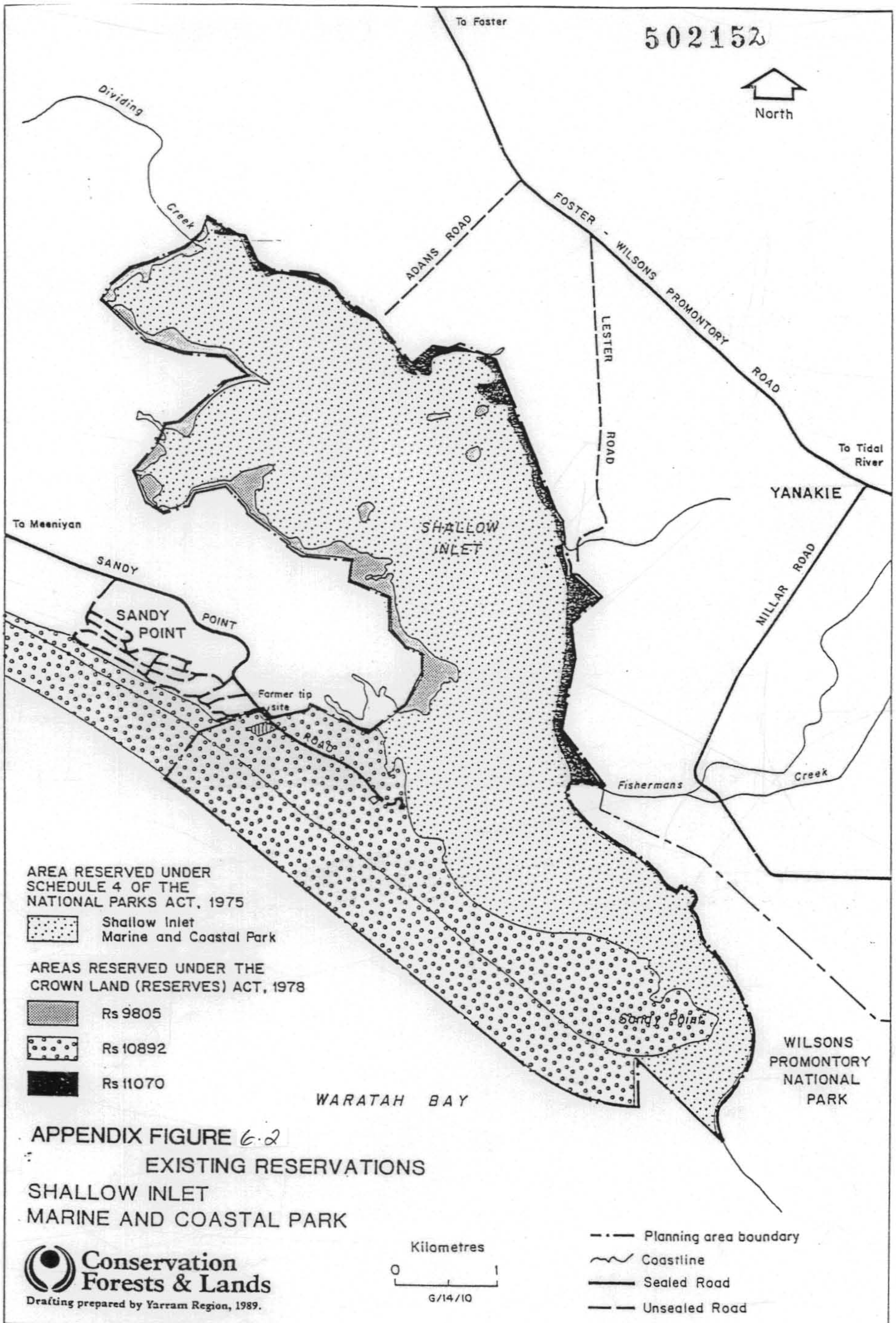
Registered on the World Heritage List for its outstanding natural and cultural values.

Domestic pets are not allowed in these areas.





APPENDIX FIGURE 6.13
COASTAL PARKS AND RESERVES
OF NORTH WEST TASMANIA

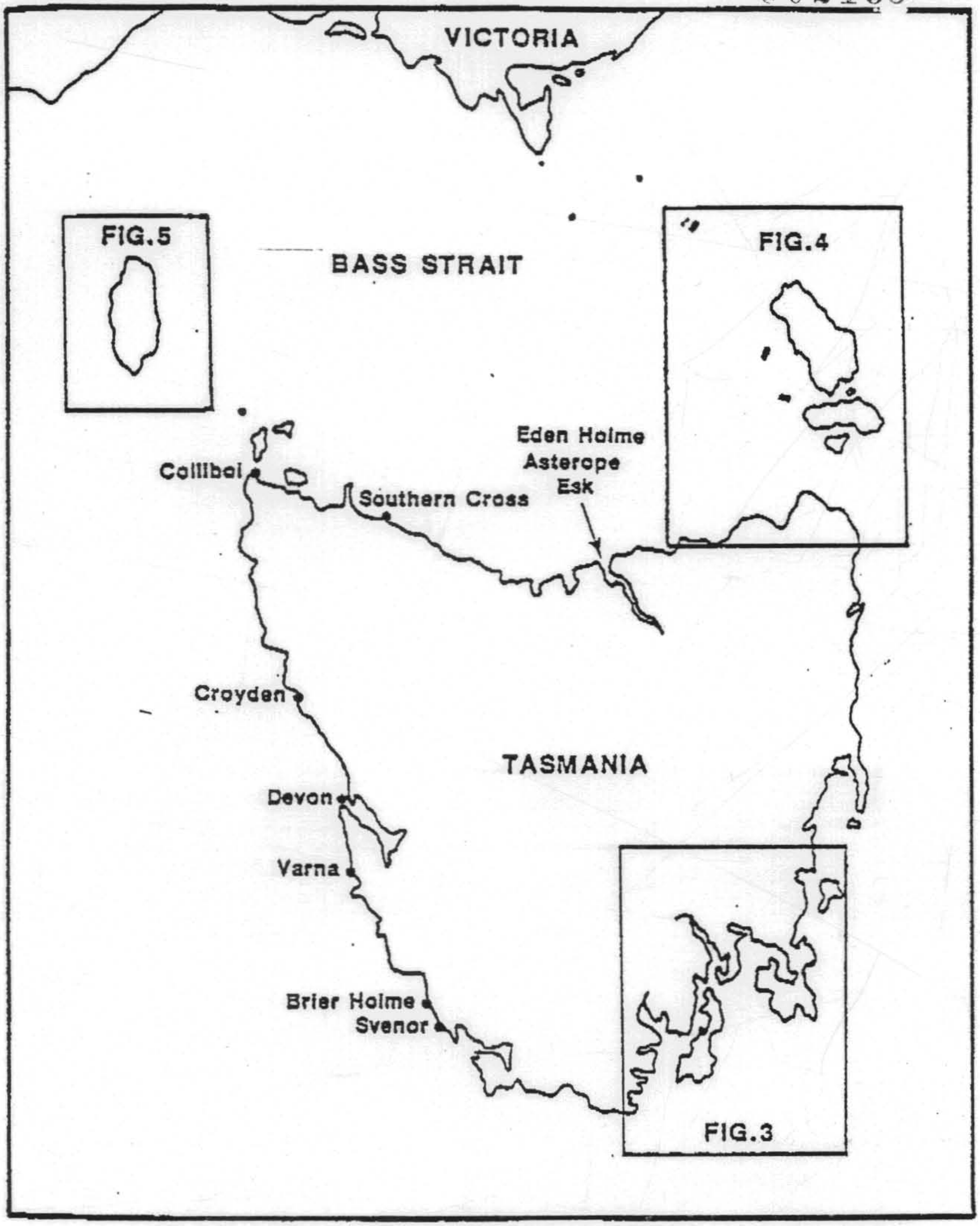


APPENDIX FIGURE 6.2

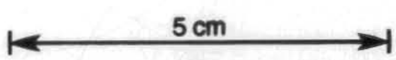
EXISTING RESERVATIONS

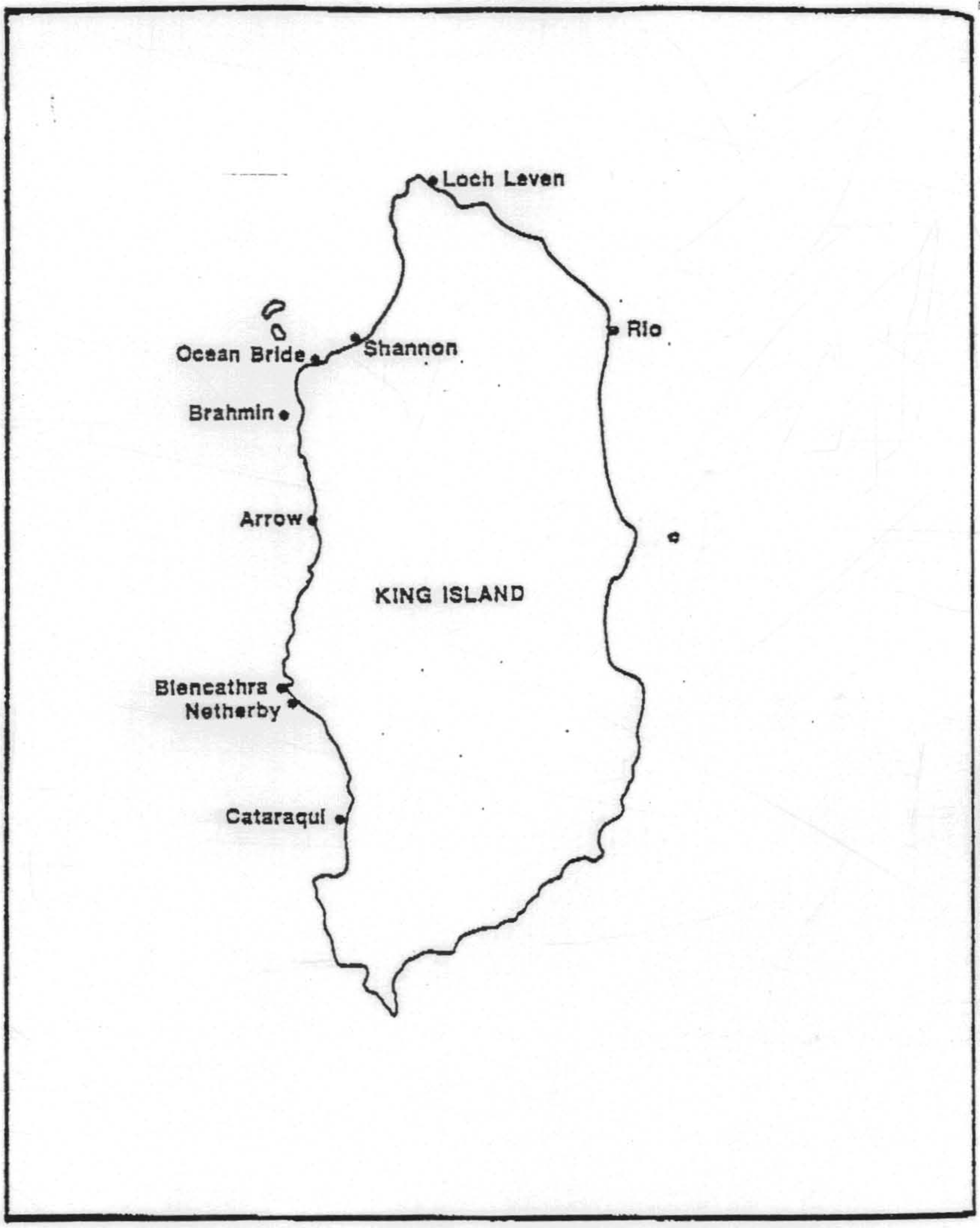
SHALLOW INLET MARINE AND COASTAL PARK

5 cm



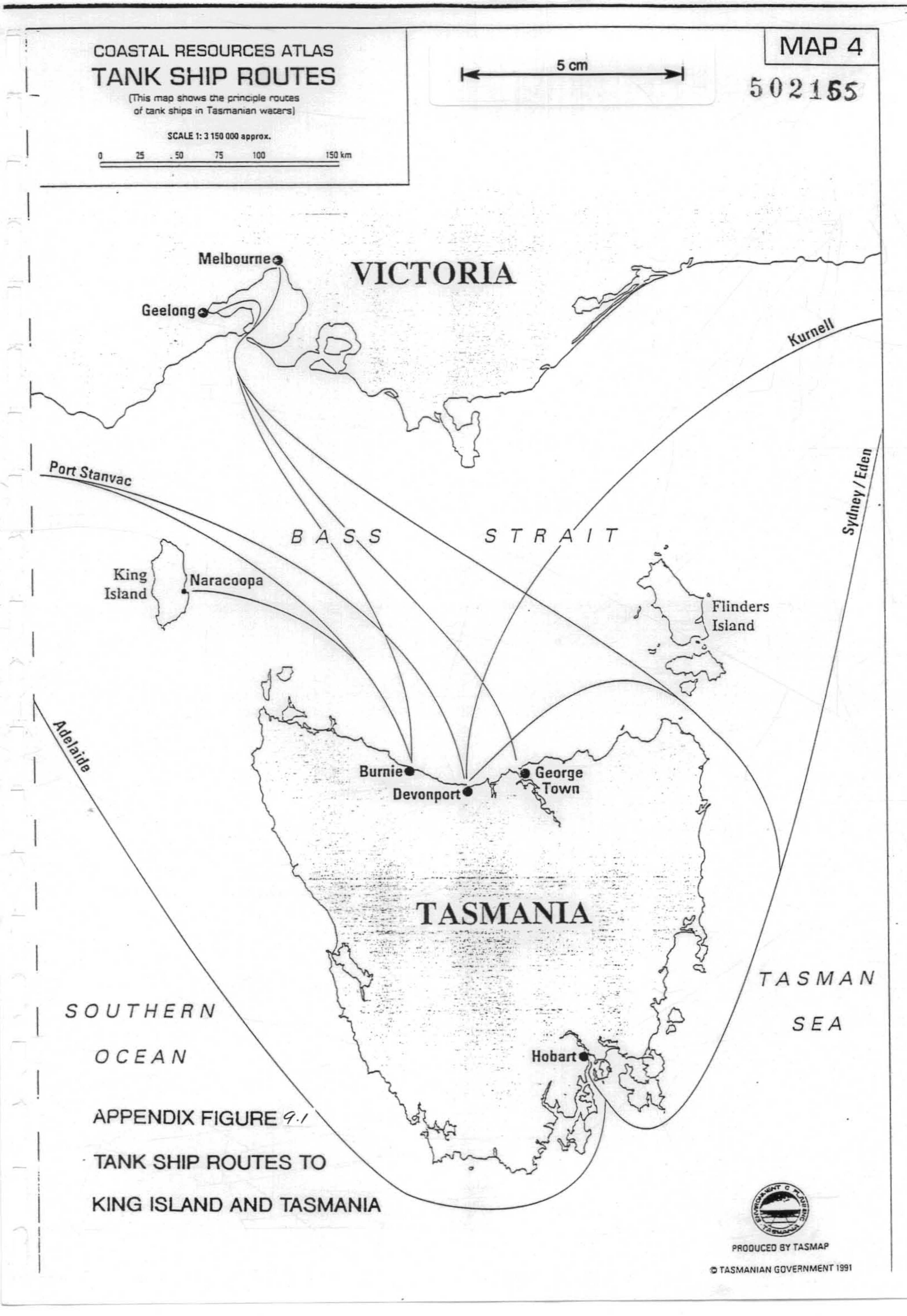
APPENDIX FIGURE 8.1A Wreck Site Locations - Tasmania





APPENDIX FIGURE 8·1B Wreck Site Locations - King Island

5 cm



APPENDIX FIGURE 9.1

TANK SHIP ROUTES TO

KING ISLAND AND TASMANIA