Proposed Sorrento Boat Harbour

Public Works Department

Report and Recommendations
by the
Environmental Protection Authority

Department of Conservation and Environment
Perth, Western Australia
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PROPOSED SORRENTO BOAT HARBOUR

PUBLIC WORKS DEPARTMENT

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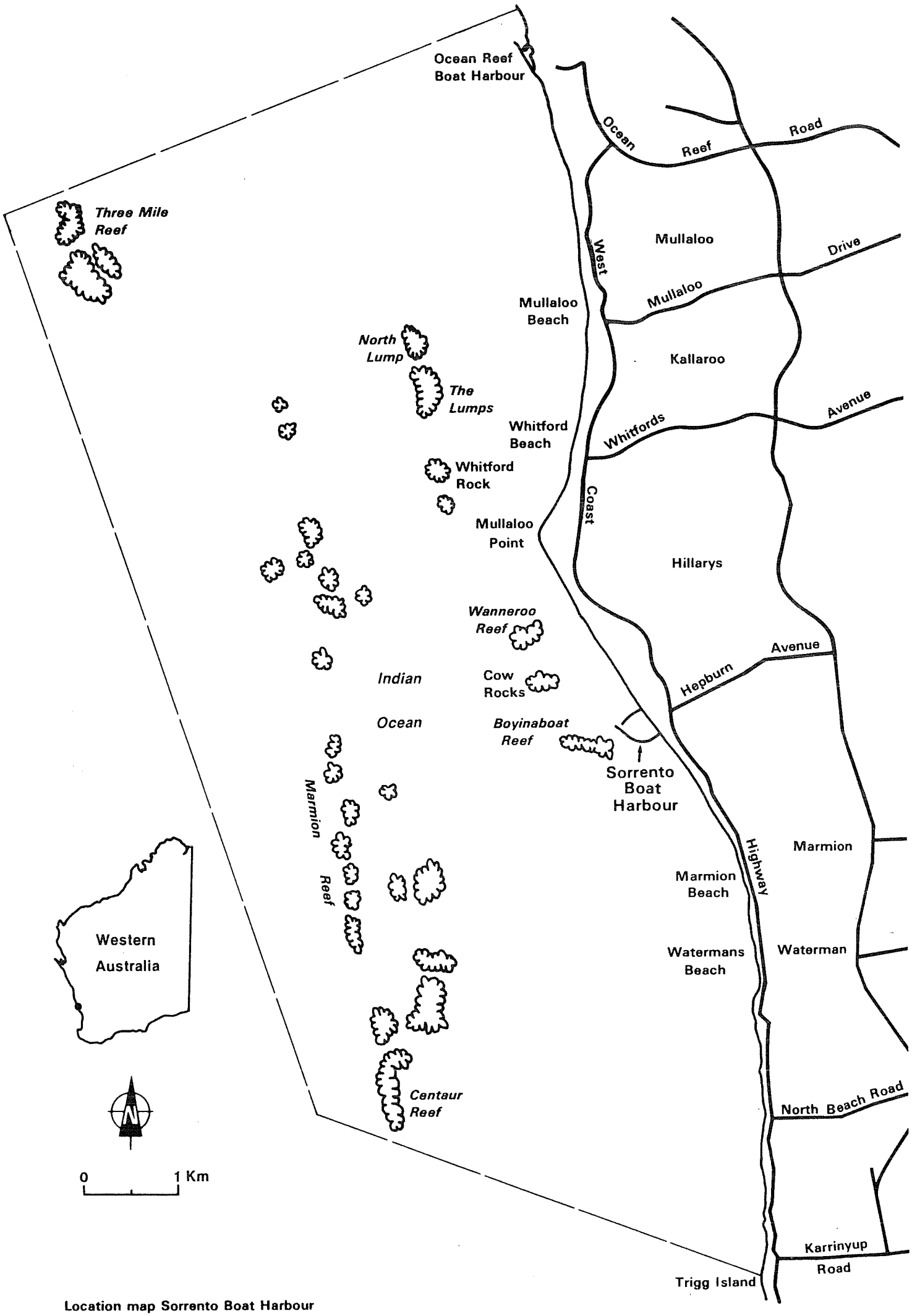
CONTENTS



Location map Sorrento Boat Harbour

1. SUMMARY

To cater for spectator craft associated with the defence of the America's Cup in early 1987 as well as providing longer term facilities for local and regional recreational boat owners, the Public Works Department has proposed the construction of a 1000 berth small boat harbour at Sorrento.

An Environmental Review and Management Programme (ERMP) was prepared by the Public Works Department at the request of the EPA. The document was released for public comment for eight weeks and submissions received have been included in the Authority's assessment of the environmental aspects of the proposal.

Concurrently with the public review period, the Department of Conservation and Environment commenced the implementation of the EPA's System 6 recommendation M 10. This recommendation, which was accepted in principle by Cabinet as part of the System 6 study, is concerned with a study and preparation of a management plan for a proposed Marine Reserve from Ocean Reef to Trigg. The site for the proposed boat harbour is within this area.

The preliminary results of this work were also available to the EPA during its assessment of the project. (A summary is at Appendix A). Largely as a consequence of these results, which will be published in full in due course, but also examining the ERMP and public comments, the EPA has no conclusive evidence at present to demonstrate that the construction and operation of the Sorrento Boat Harbour will lead to impacts on the physical and biological environment which are unacceptable, which cannot be managed - albiet at a cost, or which will be incompatible with the objectives of the proposed Marine Reserve. The EPA has made a number of recommendations on environmental management in this report which it considers should be implemented if the project proceeds.

However it is apparent from the large number of public submissions received that it is the social and economic issues involved about which the community feels most strongly.

Some of these concerns have arisen from people's perceptions of the project's impact. Others relate to objections by local residents who would bear much of the impact for providing a regional resource. Still others are associated with arguments for natural environmental values which are considered by the authors to be inherently better than man-modified environments and also criticisms over the lack of an adequate cost - benefit analysis.

The EPA has no role in being an arbiter of such social and economic values. This responsibility properly lies with the Government. However the EPA has a role in bringing the issues to the attention of Government so that they may be given proper consideration before the decision is taken on whether or not the Sorrento Boat Harbour project should proceed.

Accordingly the EPA has identified a number of social and economic issues which it has recommended that the Government should take into account when making its decision.

RECOMMENDATION 1

The EPA has concluded that in terms of the physical and biological environments the project could proceed subject to the recommendations in this report and the provisions for environmental management in the ERMP and recommends accordingly. However the EPA also recommends to Government that before a decision is taken on whether to proceed or not with the project, the social and economic issues identified in this report be given full consideration, including the Authority's concern that environmental management costs incurred by the project may not be able to be met in full by income derived from it.

The Authority wishes to give notice that in addition to the recommendations in this report, it will be submitting to Government for its consideration a management plan for the System 6 M10 area giving further detailed recommendations. This will be done in due course (after a period of public review of a draft plan) whether or not this project proceeds, although the recommendations will of course reflect the decision.

2. BACKGROUND

The State Government has supported in principle the proposed development of a recreational boat harbour on the coast north of Fremantle to cater for an anticipated short-term demand for mooring spectator craft visiting for the America's Cup defence in early 1987 but also to satisfy projected longer-term demand from the general community for such a facility.

The Sorrento Boat Harbour proposal was referred to the EPA by the Public Works Department in the form of a Notice of Intent in August 1984. The EPA decided that, in view of possible incompatability with its System 6 recommendation M10, potential environmental impacts and a significant level of public interest, an Environmental Review and Managment Programme should be prepared for the project. The EPA issued guidelines for the ERMP.

The ERMP was received by the EPA in January 1985 and subsequently released for an eight-week public review period ending on 29 March 1985.

3. THE PROPOSAL

The proposal envisages the construction of a recreational boat harbour to house 1000 craft in wet moorings adjacent to the boundary between Sorrento and Hillarys in the Shire of Wanneroo.

The Sorrento site was chosen by the Public Works Department after an evaluation of alternatives between North Fremantle and Burns Beach including Ocean Reef where a boat launching facility currently exists.

The justification for the need for the project has been expressed in terms of catering for an estimated 300 - 500 spectator craft expected during the defence of the America's Cup in early 1987, as well as satisfying local and regional demand for the next decade.

The key features of construction of the boat harbour would be:

- two breakwaters extending about 600 metres offshore with an opening to the north. The southern and northern breakwaters would be about 1100 and 550 metres in length respectively. The enclosed waterbody would be dredged to a minimum depth of 3 metres and fill from both dredging and onshore used to construct hard stand areas for land-backed facilities;

- four areas for lease would be created with the lessees providing the infrastructure;

- potential for a future ferry terminal;

- two boat-launching ramps with parking for 180 boat trailers;

- one parking bay per pen plus additional parking for 1100 cars;

- an onshore landscaped precinct with recreational facilities compatible with proposed plans for the balance of the southern Whitford node and Recreation Reserve 20561;

- a deviation of West Coast Highway some 200 metres inland at which point the highway will be made discontinuous;

. upgrading of Hepburn Avenue to dual carriage way to provide the main access from the east.

In order for the boat harbour to be ready in time for the America's Cup defence, the Public Works Department considers that the breakwaters and dredging would need to be ready by the spring of 1986 and would take about 12 - 15 months to construct.

The total cost of all stages of the project has been estimated at $13 million derived from the following:

State Government	Breakwaters, reclamation, services, navigation aids, hardstanding, lease areas	$ 7 570 000
Lessees/Developers	Pens, jetties, buildings	$ 4 000 000
Shire of Wanneroo (Commonwealth funds *)	Shore-based facilities such as roads, car parks, launching ramps.	$ 1 430 000

Responsibility for managing the boat harbour would rest with the Department of Marine and Harbours while the Shire of Wanneroo would assume responsibility for on-shore management.

In broad terms the benefits of constructing the facility have been proposed in the ERMP as:

. housing the boats of visiting spectators during the America's Cup defence;

. cater for 10 years of demand for wet moorings in the area;

. provide some boat launching ramps;

. reduce Swan River boating congestion;

. increased boating safety by providing a safe anchorage on the coast;

. improved parking for beach users;

. facility for breakwater fishing and walking.

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*Note however, paragraph 7.7 of this report.

The broad disbenefits have been described in the ERMP as:

- loss of about 800 metres of beach and dune including some of the recently purchased southern Whitfords node;
- increased noise during both construction and operational phases;
- potential conflict with the proposed System 6 recommendation M10 for a marine park;
- traffic;
- visual impact;
- use of public funds to cater for a minority user-group.

4. JUSTIFICATION FOR AND ALTERNATIVES TO THE PROJECT

In terms of placing the project into perspective with respect to its justification and alternatives to it, the EPA considers that the ERMP should have provided more details. In particular the Authority sees the following shortcomings:

- no discussion of alternatives to constructing a 1000 berth boat harbour to cater for America's Cup defence spectator craft, for example provision of temporary swing moorings.

  Such a discussion would have been especially useful since, if realistic temporary or permanent alternatives exist, more time could have been spent on assessing the potential impacts of a Boat Harbour at Sorrento without having to have the facility completed for the America's Cup defence;

- inadequate information regarding justification for the size of the proposed boat harbour, especially the lack of estimates of capital versus ongoing management costs. The ERMP states that the 1000 boat size was selected as the minimum capacity which could be self- supporting in terms of returns meeting costs as well as meeting the projected 10 year demand. No details were given of expected returns and no explanation made of estimated costs: either capital or management.

  This is considered important for the purposes of predicting the degree of impact with the scale of the project i.e. a smaller scale project could have more acceptable impacts on the environment.

- cost has been put forward as one of the main reasons for choosing the Sorrento site against further development at Ocean Reef. However no supporting figures were given. This, together with the previous deficiency concerning inadequate information on the justification for the size of the boat harbour does not strengthen the case for the Sorrento site.

- initial criteria used to examine alternative sites for the boat harbour did not include actual or proposed precommitment of the site to other uses. Inclusion of such a criterion would have identified the Marine Reserve proposal as falling into this category, and should have given it appropriate weighting early in the planning process. The preferred site may then have emerged as potentially less acceptable environmentally earlier on. The criteria used in the ERMP to examine alternative sites appear subjective, and no differential weighting appears to have been accorded potential environmental impacts.

- there appears to be an inconsistency between projected demand for boating facilities and the provision for a boat harbour. The EPA notes that while it may well be arguable that a 1000 berth boat harbour can be justified in the next decade on demand figures, the design of the project appears to deliberately avoid catering for an element of greater demand i.e., boat launching facilities. The Notice of Intent for this project states specifically that the level of trailer boat usage will be limited. However two studies cited in the ERMP, viz. PA Management Consultant's (1981) 'Study into recreational boating facilities' and R J Bowden's (1984) 'The W.A. Boating Population to 1990' support the need for boat launching facilities as a priority.

  The EPA is concerned that this approach must ultimately end in demands for additional boat launching facilities being met by additional structures on the coast with associated environmental impacts, particularly as such facilities must also be in demand during the America's Cup defence;

- The project has not been considered in the context of available mooring space still vacant and the total capacity of all marinas, boat harbours and mooring areas currently proposed or approved.

The EPA notes that a number of submissions received on the ERMP supported the principle of a boat harbour catering for the northern suburbs but not at Sorrento. Many also supported directly the Ocean Reef site despite the additional cost penalty. As well as Ocean Reef, other alternative sites were also proposed.

5. ENVIRONMENTAL IMPACTS AND MANAGEMENT

5.1 Physical and Biological Environment

5.1.1 The System 6 M10 Recommendation

On 19 March 1984 State Cabinet approved of the progressive implementation, as far as possible, of 209 specific locality recommendations made by the EPA on its System 6 Study. One of these, M10, was concerned with an offshore area from Trigg to Ocean Reef and recommended that the EPA commission a study of the area with a view to establishing a Marine Reserve for scientific research, education, conservation and recreation followed by the preparation of a management plan for the area.

Until the Sorrento Boat Harbour was proposed, implementation of the M10 recommendation was not accorded a top priority for a number of reasons including the lack of appropriate legislation under which to declare the Marine Reserve (the recently proclaimed Conservation and Land Management Act now provides a mechanism). In February the Government granted extra funds for the implementation of the M10 recommendation to enable the EPA to have available more information on the area during the assessment of the Sorrento Boat Harbour proposal.

A summary of the results of the study to date is at Appendix A.

The proposed Sorrento Boat Harbour site is approximately in the middle of the M10 area. In examining the potential environmental impacts of the Boat Harbour on the physical and biological environment, the Authority was concerned firstly with any philosophical incompatibility, and secondly any bio-physical incompatibility between a boat harbour and the proposed Marine Reserve.

Philosophically the EPA has concluded that, bearing in mind its comments in section 4 of this report, and provided:

- bio-physical impacts are acceptable or manageable;

- the purpose for which the boat harbour is proposed is compatible with the objectives of the Marine Reserve;

- user groups contribute proportionately to management costs ie., the true management cost of the boat harbour includes an appropriate apportionment of managing the M10 area because of increased public access;

the Authority can accept the principle of siting the boat harbour at Sorrento.

On the basis of available evidence, the EPA believes the first two criteria are filled and recommends below on the third. The Authority considers that the objectives for the proposed Marine Reserve as contained in the System 6 M10 recommendation require recreation as well as conservation values to be met. Therefore the Marine Reserve falls into the concept of a marine park, rather than a marine nature reserve.

RECOMMENDATION 2. The EPA recommends that if the project proceeds, a clear commitment is made concurrently by Government that the Marine Reserve will be declared as soon as possible and management resources to the level necessary for full and effective management of the M10 area will be allocated. The EPA points out that the true management costs of the project include a major apportionment of managing the M10 area because of the increased public access afforded by the facility. In keeping with the user pays philosophy, such revenue could reasonably be expected to be derived from operating the boat harbour. Proper management of the area will be required simultaneously with construction and operation of the facility.

5.1.2 Marine biota

During the construction phase, the main impact will be increased suspended solids in the water from creation of the seawalls, disturbance of the ocean's sediments and dredging. This will cause some loss of seagrass and other marine flora, and possibly loss of some marine fauna. Within the harbour it is expected that the marine biota will be modified significantly. Outside the harbour the main impact will be on seagrass meadows and the faunal and floral assemblages associated with Boyinaboat Reef and Cow Rocks.

Based on evidence from the M10 study which includes an examination of the effects of the Ocean Reef boat launching facility and the Two Rocks Marina, the EPA believes that these impacts are acceptable for the following reasons:

- the area of habitat affected is estimated to be between 2 and 5 percent of the total area of similar habitat in the proposed Marine Reserve. In addition it is predicted in the ERMP that loss of seagrass should not contribute unduly to unmanageable destabilization of the sea floor nor markedly increase sediment movement. The EPA has no evidence to the contrary. The Authority considers that these reasons in themselves are insufficient to recommend against the project;

- the Authority was especially interested in potential impacts on the in-shore reefs Boyinaboat Reef and Cow Rocks. While their biological value is high it appears that they are by no means in pristine condition.

  The M10 study results suggest no loss of the range of species present or significant reduction of their numbers outside the Boat Harbour from construction.

  During the operational phase however there is potential for significant impacts to occur on marine biota resulting from increased accessibility to the area from the boat harbour. Given proper resources, the pressure by the public can and should be managed if the project proceeds.

  The EPA is cognisant that some of the evidence upon which these conclusions are based was not contained in the ERMP and therefore not available for public perusal during the public review period. However the Authority gives notice that the M10 study results and management programme will be released for public comment prior to final recommendations for management of the Marine Reserve being forwarded to Government;

- the additional impact of reflected wave energy from breakwaters is unlikely to add to disturbances caused naturally in a high energy coastline.

The EPA will be making specific recommendations on management of the proposed Marine Reserve in due course.

The potential effects of water from within the harbour affecting marine biota are discussed in 5.1.4.

5.1.3 Coastal Processes

The EPA accepts in general terms the ERMP's discussion of the potential effect of the boat harbour on both gross and net littoral drift. The breakwaters will probably contribute to the stability of the Sorrento coastline as predicted, and the Authority accepts that if the coastline in this area was not to continue to erode in the future some form of coastal engineering could be necessary.

However a deficiency in the ERMP's discussion of coastal processes is in not addressing the implications of sand being lost from the active beach system into deeper water. If this occurs, it will either exacerbate local and long term erosion of beaches to the north or have to be replaced from elsewhere at a cost. Consequently it appears that management costs may have been considerably under-estimated for the long term.

The EPA considers that the boat harbour should not be allowed to contribute to erosion of beaches to the north which are likely to become more popular if the project proceeds. This implies that if sand is lost to the system, it would be necessary (and expensive) to replace it from elsewhere.

5.1.4 Water Quality

(a) Groundwater

The EPA considers that the ERMP covers this matter adequately.

(b) Water within the Boat Harbour.

The EPA notes that no criteria for breakwater configuration were given in the ERMP and no alternative designs discussed. Therefore the Authority is unaware whether water circulation and exchange were included in criteria used as the literature cited in the ERMP suggests they should.

The ERMP does not specify (although the Notice of Intent did) but suggests that water quality within the harbour would be maintained to fulfil the EPA's water quality criteria in Schedule 16 of Department of Conservation and Environment Bulletin 103*. Schedule 16 relates to criteria for Navigation and Shipping.

In view of the fact that, if the Boat Harbour is built, it will be sited in an area used for direct contact recreation as well as in a proposed Marine Reserve, the EPA considers that it is reasonable to expect the water quality criteria which should apply need to satisfy Schedule 10 (reproduced at Appendix B to this report).

In the particular case of this proposal the EPA believes that Schedules 1 and 7 class (3) (reproduced at Appendices C and D) should apply to waters within the harbour for the first five years following construction after which time the water quality monitoring and management programme contained in Recommendations 3 and 4 (below) should be reviewed by the Authority.

To achieve acceptable water quality will require appropriate resources for "active" management, not merely regulatory powers by the Department of Marine and Harbours. This includes fulfilling commitments made in section 8.9 of the ERMP relating to oil, fuel, flotsam, anti-fouling paint, effluent, foodstuffs etc. As well, the EPA points out that if commercial fishing boats and any associated facilities use the harbour, their activities will also need controlling to maintain acceptable water quality standards.

RECOMMENDATION 3. In addition to commitments made in the ERMP, the EPA recommends that the water quality criteria which should be met within the boat harbour are those in Schedules 1 and 7 (c) of the EPA's water quality criteria and which are reproduced in Appendices C and D to this report. These criteria should be used to assist in setting the objectives of the water quality monitoring and management programme in Recommendation 4 (below).

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*Western Australian (1981) 'Water Quality Criteria for Marine and Estuarine Waters of Western Australia'. Department of Conservation and Environment, Western Australia. Bulletin 103.

(c) Water quality outside the boat harbour

The circulation of water within the boat harbour and its exchange with the ocean are key issues.

The EPA has assessed a number of marina and boat harbour projects and has noted that without exception, inadequate information on circulation and flushing rate projections have been presented because of lack of available data.

The EPA considers therefore that because of the size and site of the Sorrento project, a comprehensive monitoring and management programme including water quality should be developed to provide data for both managing the project but also serve as a basis on which to design and assess similar proposals in the future.

RECOMMENDATION 4. The EPA recommends, should the project proceed, that a comprehensive monitoring and management programme be developed by the proponent in consultation with the Department of Conservation and Environment to the satisfaction of the EPA, and that appropriate resources be allocated for the proponent to implement it through the body proposed in Recommendation 7 (below). The programme should aim to achieve the following:

(i) measure physical, biological and chemical parameters appropriate to Recommendation 3 within and outside the harbour;

(ii) develop a predictive model for water circulation and exchange, and test the model with field data;

(iii) include as an objective maintenance of Schedule 7, class (1) water quality criteria at Boyinaboat Reef;

(iv) include monitoring and management of coastal processes including plans for managing foreshore access and full records of sand movements both natural and management initiated with costs for the latter.

(v) be consistent with approved management principles for the proposed Marine Reserve;

(vi) ensure that management strategies are developed for implementation in the event of criteria not being met, particularly in the case of accidental spillages;

(vii) ensure that contingency planning in (vi) includes funding and resources;

(viii) report back to the EPA after five years from the conclusion of construction with results of monitoring and recommendations for future requirements, or sooner if any problems arise.

(d) Seagrass Wrack

Seagrass wrack has the potential to be a nuisance if it is accumulated by the breakwaters in areas suitable for swimming or if trapped within the harbour.

The EPA notes that the ERMP commits the Department of Marine and Harbours to remove the seagrass wrack under these circumstances and considers that this commitment should be upheld.

5.2 SOCIAL ENVIRONMENT

Impacts on the social environment are perceived by many of the people making submissions to the Authority as being of most concern. The EPA receives these expressions of concern as part of the environmental impact assessment process because there is no other mechanism available which allows members of the public to comment on such aspects of proposals outlined in some detail as in an ERMP.

The Authority does not see itself in this case as having a role in arbitrating between the costs and benefits of the project at a social equity level. It believes that the Government quite properly has this responsibility.

Nevertheless, the EPA considers that many of the social and economic issues have environmental components or implications and therefore believes it should bring these to the Government's attention before any decision is taken on whether or not to proceed with this project.

RECOMMENDATION 5. The EPA recommends that the Government gives full consideration to the following issues associated with potential impacts on the social environment and take them into account when deciding whether or not to proceed with the Sorrento Boat Harbour project. The Authority advises the Government that many of the issues raised by members of the public, and those about which they feel most strongly, fall within this category.

5.2.1 Loss of Beach

The construction of the boat harbour would remove nearly 800 metres of beach from public use. It is likely that swimming within the harbour would be discouraged from a safety viewpoint at least. Sandy beaches within the metropolitan region are a finite resource and in general terms, should not be used for developments where realistic alternatives exist.

Some data on beach usage at Sorrento are available (Appendix A). It is acknowledged that beach usage can be expected to increase because of increased urban development in the northern corridor and completion of Hepburn Avenue allowing easier access to Sorrento from inland.

Many of the features which make Sorrento suitable for a boat harbour also make it suitable for a family recreation beach, for example protection from ocean swell by offshore reefs, fairly shallow and a predominantly sandy bottom. There is no public swimming pool in the local authority area and Sorrento is used for swimming lessons for children. It has been cited as one of two safe swimming beaches in the Metropolitan area.

Construction of sea walls would increase the trapping of flotsam and jetsam, rubbish and seagrass. This is a management issue.

The location of such a major boat harbour would add road and boat traffic and noise to an otherwise fairly tranquil setting.

Issues related to loss of the beach were the main concerns felt by the public (See Section 6.)

Some public submissions perceived a direct conflict between Government statements made at the time of purchasing the southern Whitfords Node and the Boat Harbour proposal. Recommendations in other reports in the public arena were also perceived to be in conflict with this project, for example the Public Works Department's ERMP on the Ocean Reef Boat Launching Facility, the Scott and Furphy (1979) report on the coastal nodes development plan and Dr P J Woods (1984) Coastal Management Report to the Shire of Wanneroo.

Compared to these disbenefits are potential benefits including increasing the width of beaches especially on the northern side where protection from the summer seabreezes will be offered. It is possible that the northern beach could become extremely popular for small children as a consequence.

Use of the Sorrento beach appears to correspond with the limits of available car parking. Increased car parking resulting from the development will allow increased use of the remaining beach.

Construction of the facility will provide the stimulus for the development of a range of associated facilities which will be available to beach users. This includes some development of the southern Whitfords Node for recreation.

5.2.2 Impact on lifestyle

The proposed Boat Harbour will change irretrievably the nature of the Sorrento area and will consequently have an impact on local residents' lifestyles.

This a common occurrence when local communities are faced with bearing the main impacts of a regional resource.

Some people made submissions to the effect that they fear high-rise developments and light industrial support facilities will follow the boat harbour thus exacerbating the change. The EPA points out that it has no statutory responsibilities in this area. However normal statutory planning requirements are required to be fulfilled in the event of any high rise development proposals. This would allow further public input if any such project was proposed in the future.

Others pointed out that they settled at Sorrento because of the access to the beach and the quiet setting. There is no realistic compensation for persons thus affected.

5.2.3 Costs and benefits

Many of the points contained in public submissions against the project were concerned that the benefits did not outweigh the corresponding costs. Included were issues such as:

- the project caters for a wealthy, minority user-group;
- it discriminates against present users of the area;
- long-term community needs are more important than short-term boating needs, particularly if the America's Cup is lost;
- the ERMP investigation and project planning is inadequate to objectively and reliably predict impacts;
- the project would not cater adequately for trailer boats for which more facilities are urgently required and which comprise 92% of registered boats in W.A.;
- it removes recreational opportunities and loss of amenity value which do not outweigh the recreational opportunities created;
- it will increase local rates and taxes;
- the money could be better used elsewhere (many examples cited).

With the exception of the fourth point, these are largely matters outside the Authority's statutory responsibilities. This report addresses inadequacies which the EPA considers relevant to the environmental aspects of the project.

5.2.4 Aesthetics

The aesthetics of siting a major coastal structure in a section of sandy beach is largely a matter of individual perception. The Sorrento Boat Harbour proposal will undoubtedly have a major visual impact on the coastline. A deficiency of the ERMP was the lack of oblique photographs with a sketch of the proposal superimposed to give a sense of its scale.

It is worth noting that almost the same percentage of issues made against the project as issues made for it were concerned with aesthetics.

Those opposed argued against a visual intrusion in the sweep of sandy coast from Trigg to Mullaloo which is very visible from West Coast Highway claiming it would lead to loss of calm and great natural beauty of the area.

Those in favour pointed out that the project would upgrade the area and add elements of interest and excitement.

Should the project proceed, the EPA believes that the proponent has a responsibility to ensure that the overall facilities including height, profile and colour are of a standard consistent with public expectations and general community taste. This should be done by consultation between the proponent and the local authority.

5.2.5 Noise, Traffic and Parking

(a) Construction

The main potential noise problem during construction is considered to be truck movements. These should be kept to main access roads and not residential streets.

RECOMMENDATION 6. The EPA recommends, that should the project proceed, trucks are required to use designated access roads to the site during construction. The designated access roads should be specified by the Shire of Wanneroo in consultation with the proponent.

(b) Operation

Road traffic to the project is, in the opinion of the EPA, covered satisfactorily in the ERMP to the extent that proposal road systems should be adequate for road traffic although there is little doubt that the boat harbour will generate an increase in urban traffic levels.

However the EPA is concerned that should Hepburn Avenue not be constructed to dual carriageway as pointed out in the Shire of Wanneroo's submission, then there may be less incentive for traffic to use it as a main access route to the boat harbours and less incentive for north-south commuters to deviate to Marmion Avenue via Hepburn Avenue at the point of the proposed discontinuity of West Coast Highway. In this event, local traffic patterns may not be excluded from increases associated with the boat harbour.

Boat traffic, especially at night, has the potential to create a noise nuisance for the nearby urban areas. The slapping of halyards on metal masts has also been cited in public submissions as a potential noise problem.

With northern access near Mullalloo Beach and southern access around Centaur Reef, potential boat traffic noise is likely to be considerably greater than if a safe, westward access was available to the Boat Harbour.

In the event that either of these becomes a long term nuisance, appropriate management steps could be taken to control them, for example requiring the tying down of halyards, controlling the muffling of boat exhausts, imposing operational curfews at certain times, controlling boat speeds etc. However the EPA is unsure of whether such controls are enforceable, particularly if fishing boats were involved. The responsibility for ensuring that proper steps are taken and for their success would reside with the Department of Marine and Harbours.

(c) Parking

The EPA notes that parking requirements for potential ferry operations have not been included in the discussion on parking in the ERMP. The Authority also points out the inconsistency between providing 180 boat trailer parking bays for 2 boat launching ramps. At 6 minutes per launch and the same time for recovery it would take 9 hours to launch and 9 hours to remove the boats for which the 180 bays are designed. This appears unrealistic. The Authority also points out its comments on boat launching facilities in Section 4 of this report.

5.2.6 Safety

(a) Boats

Concerns have been raised in public submissions about the possible safety aspects of boats navigating in waters containing inner and outer reefs.

While recognising that the ERMP does not propose any reef blasting the Authority considers that any blasting of reefs within the proposed Marine Reserve is unacceptable.

(b) Other recreational users

Concerns too have been raised over possible safety problems caused by boats interfering with swimmers, divers and surfers.

The EPA considers both these issues management problems which fall within the jurisdiction of the Department of Marine and Harbours and should be so addressed by that Department if the project proceeds.

Nevertheless the Authority points out that many public submissions including from the Boating Industry Association of Australia W.A. (Inc.) and the Whitford's Sea Sports club, comments made by the Whitford's Sea Rescue Group and matters raised in private submissions from persons citing direct experience of boating in the waters near the proposal, express considerable concern over potential safety problems with boating.

(c) Dredging of Lal Bank

Of direct environmental concern to the EPA is the possibility of requests on safety grounds for some dredging of Lal Bank between Little Island and Mullaloo Point, should the Boat Harbour be built. The Boat Harbour is to be maintained at 3 meters depth yet most of Lal Bank is less than 3m.

This is not addressed in the ERMP, and therefore the potential environmental impacts have not been estimated.

The EPA's conclusions in this report are based on the premise that dredging of Lal Bank will not occur, and the Authority gives notice that such dredging would not be acceptable within the context of the ERMP for this project.

If there are any anticipated requirements for future dredging for any reason, then the matter needs urgent investigation and resolution to the EPA's satisfaction prior to the project proceeding.

5.3 Environmental Management

5.3.1 Management Costs

As mentioned in Section 4. of this report, the ERMP did not include sufficient information for a comparison between capital and management costs for the proposal and alternatives for it. Nor were estimates given of the probability of problems arising or the likely range of management costs associated with predicted impacts such as sand bypass, sand re-nourishment and maintenance of water quality.

A justification for the size of the boat harbour has been given as 1000 berths being necessary to support projected management costs. On the basis of existing evidence as discussed elsewhere in this report, the EPA is concerned that because:

- the extent of potential sediment problems may have been underestimated;
- it considers that more stringent water quality criteria should apply;
- a major proportion of management costs of the M10 area should be derived from the facility because of increased public access afforded by it and thereby producing major potential impacts;

the economic costs and benefits of the project may change.

The Government should consider these aspects when making its decision on whether the project should proceed.

5.3.2 Management Structure

In the event of the project proceeding the EPA believes that there is a need for a formal coordinating mechanism between the Department of Marine and Harbours, the Shire of Wanneroo, the vestee of the Marine Reserve and the four commercial lessees of the harbour, to ensure that:

- the authorities responsible for each management segment are clearly identified, and proper and effectual liaison occurs between management of the boat harbour and management of the Marine Reserve;
- management is effective and carried out through proper, legally enforced mechanisms;
- sources of capital and ongoing management funds and resources are identified;
- timetables for management are met;
- monitoring programmes are implemented and procedures given for incorporating monitoring results into management by amendment, if appropriate, of the management programme;
- other approved management conditions are implemented.

RECOMENDATION 7. The EPA recommends that if the project proceeds, a formal management body be established comprising representatives of the Department of Marine and Harbours, the Shire of Wanneroo, the vestee of the proposed Marine Reserve and representatives of the proposed four commercial lessees of the harbour. The points raised in section 5.3.2 of this report should be included in the terms of reference for the management body.

6. PUBLIC SUBMISSIONS

The Sorrento Boat Harbour ERMP was released for an eight-week public review period which ended on 29 March 1985. During this time 4211 submissions were received. This number was seven times higher than the previous highest total for an ERMP which in itself is an indication of the level of interest felt by the community in the project.

The Department of Conservation and Environment normally acknowledges the receipt of all public submissions on behalf of the EPA. However in this case the task has proven overwhelming and therefore the EPA wishes to record here its appreciation of all persons and organisations who made submissions.

The submissions were divided into the following categories

	CATEGORY	NUMBER
A	Personal letters from individuals and organisations opposing the project	396
B	Duplicated letters of opposition to the project	3641
C	Comprehensive submissions either either opposed to or expressing concerns about the project	49
D	Submissions neither for nor against but offering comments should the project proceed	3
E	Submissions supporting the project	114
F	Comments from Government agencies	8
	TOTAL	4211

6.1 Summary of Issues Common to Categories A B, C and D

6.1.1 Impacts on the biological and physical environment.

(a) EPA's System 6 M10 Recommendation for a Marine Reserve.

- perceived philosophical incompatibility with the M10 Recommendation, especially since the project was proposed prior to implementation of the Recommendation;
- explicit support for implementation of the M10 Recommendation;
- loss of EPA credibility if the recommendation is not implemented and the boat harbour built after the costly and lengthy System 6 study;
- proposal incompatible with National Park management guidelines on siting facilities outside Parks boundaries.

(b) Destroy marine (particularly reef) biota.

- near-shore reefs (particularly Boyinaboat Reef and Cow Rocks) will suffer from increased boat traffic, construction of sea walls, pollution, exploitation because of increased accessibility, sedimentation;
- loss of recreation, conservation and education opportunities;
- possibility raised of blasting reefs for navigational purposes.

(c) Seagrass

- seagrass destroyed with loss of habitat and with potential increased mobilisation of sediment;
- trapping of seagrass wrack within and outside the harbour leading to decay, eutrophication and offensive smells. Some submissions pointed out that the existing Sorrento groynes trap seagrass wrack.

(d) Water Quality

- no predictions for circulation and flushing rates within the proposed harbour;

- concern that seagrass wrack, rubbish, effluent, fuels, oils, anti-fouling paints, suspended solids, and nutrients will adversely affect water quality;

- impact of water from within harbour on ocean biota, particularly nearby reefs;

- possibility of attracting fishing boats and associated industrial facilities which will then affect water quality.

(e) Coastal Processes

- degree of uncertainty about sediment movement;

- management costs of by-passing sand;

- loss of coastal vegetation;

- potential increase in coastal erosion;

- inappropriate use of coastal dunes.

6.1.2 Impacts on the social environment

(a) Loss of beach

- harbour is proposed for a beach which can expect increased use because of the rapidly growing urban areas in the northern suburbs;

- project is against 'accepted convention' that beaches are for people, not development;

- Sorrento is a safe family recreation beach, one of only two mentioned as such in a Department of Youth, Sport and Recreation publication on Perth beaches;

- Sorrento beach is used for swimming lessons because there is no public swimming pool in the Shire of Wanneroo;

- Sorrento beach is of higher recreational value than others because of reef protection;

- completion of Hepburn Avenue will mean greater future usage;

- object to foredunes being levelled for development;

- believe that sandy beaches are a greater tourist asset than a boat harbour.

(b) Pollution of beach

- disruptive noise from boats travelling north and south to gain access to the open sea;
- fuel and oil spillages;
- rubbish;
- seagrass wrack (see 6.1.1 (c))

(c) Use of the Southern Whitford Node

- conflict between the proposal and the Government statement of 1 May 1984 about future use of the southern node when purchased;
- perceived conflict with other reports on the area including Scott and Furphy (1974), P J Woods (1984), Ocean Reef Boat Launching Facility ERMP (1978). (Full references are in the ERMP).

(d) Social equity (including costs and benefits at the social level)

- facility would cater for a wealthy, minority user-group;
- discriminates against present users;
- local community bears the impacts of a regional resource;
- long-term community needs are more important than short-term visitor needs, particularly if the Cup is lost;
- oppose creation of potential long-term environmental problems to satisfy a short-term contingency, particularly if the Cup is lost. Inadequate investigation and planning to objectively and reliably predict impacts;
- will not adequately cater for trailer boats which comprise 92% of registered boats in W.A.;
- will increase local authority rates and taxes;
- no cost-benefit analysis done.

(e) Impact on lifestyle

- disruption of existing residents' lifestyles - many of whom moved to the area to escape such developments;
- conflict between the boat harbour and urban areas;
- potential for high-rise coastal and light industrial development to follow as well as setting a precedent for other (unspecified) beach developments;
- potential to attract 'undesirable' elements of society such as alcoholics and drug addicts.

(f) Noise

- increased noise levels from construction, trucks bringing material, machinery, halyards slapping on metal masts of boats, boat engines particularly at night;

(g) Aesthetics

- a major visual impact on the coastline, very obvious from West Coast Highway;
- interfere with existing views of residents;
- carparking areas will be an eyesore;
- loss of calm and great natural beauty from the coastal landscape.

(h) Traffic

- increase in traffic from construction and operation.

(i) Safety

- concern for safety of swimmers, surfers and divers from boats using harbour;
- concern for safety of boaters navigating near inner and outer reefs.

(j) Commercial fishing

- potential interference with (unspecified) commercial fishing.

(k) Ferries

- inadequate information in the ERMP on potential impacts of a ferry terminal (e.g. parking, traffic, behaviour).

6.1.3 Environmental Management

(a) Costs

- taxpayer will have to pay for ongoing management costs should harbour not attract full use, if sand bypass has been underestimated and if seagrass wrack needs removal;

- no details given of capital versus management costs versus alternative sites.

(b) Mechanisms

- engineering techniques for management were not described in any detail in the ERMP;

- no confidence expressed in the State being able to manage the facility;

- lack of evidence that breakwaters/boat harbour design was optimal to minimise the likelihood of water quality problems.

6.1.4 Alternatives

(a) Support concept but not site

- some submissions supported the concept of a boat harbour in the northern suburbs but not at Sorrento;

- some submissions nominated Ocean Reef as an alternative despite the cost increase;

- a range of other sites were suggested as alternatives e.g. Mindarie, North Fremantle and City Beach;

(b) Alternatives to the project

- no discussion in the ERMP of alternatives to the project.

6.2 Category A : Personal letters from Individuals and Organisations opposing the project

Nearly four hundred personal letters were received opposing the project. One feature of submissions received was that multiple issues were raised in most cases. For example submissions in this category averaged 5 issues each.

The following figure demonstrates the percentage breakdown of issues and compares them to the aggregate of all submissions in categories A, B, and C.

Raised in submissions in this category but not included in 6.1 (above) was an additional point suggesting that private enterprise, not Government should build such projects. Included in this category are simple hand-written objections which gave no reasons for opposition.

6.3 Category B : Duplicated leters of opposition to the project

The 3641 submissions in this category were represented by 28 different forms of duplicated letters. Only those giving a name and address were accepted. Each submission raised two issues on average. Most of the key points contained in 6.1 (above) were included in this category.

The following figure gives a breakdown of issues and compares them to aggregates of all submissions in Categories A, B, and C.

6.4 Category C : Comprehensive Submissions either opposed directly or expressing Concerns about the Project

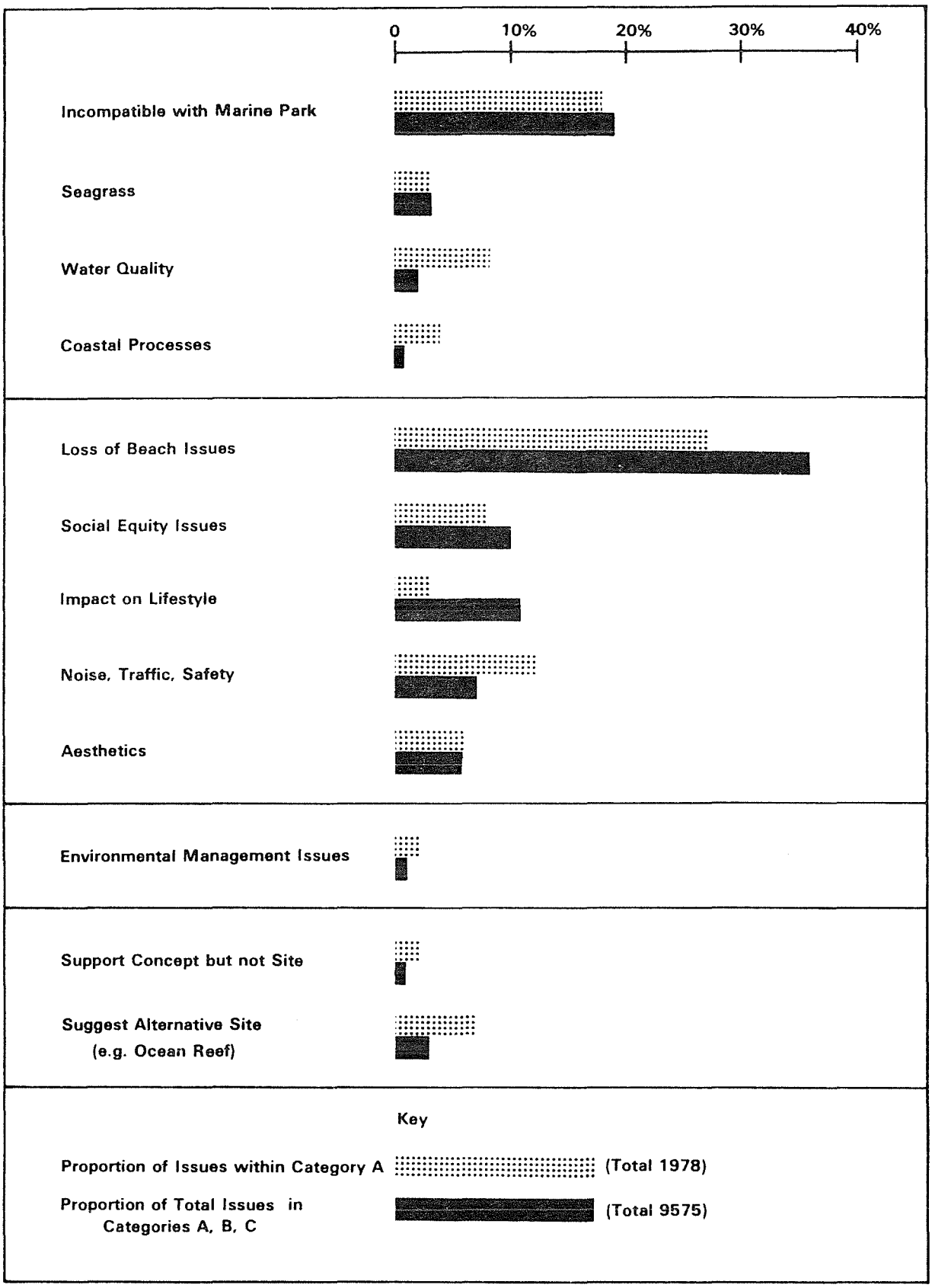
The 49 submissions which comprise this category provided detailed arguments on issues raised. The submissions generally covered wide areas of interest with an average of 10 issues per submission. In general they were sophisticated, well reasoned arguments.

Inevitably many of these matters overlap issues raised in other categories and therefore are covered in 6.1 (above). However the following additional points were included:

- potential for industrial support facilities to establish - these should be confined to a light industrial area elsewhere;
- concern that the Sorrento boat harbour would turn into a commercial failure and environmental disaster leading to no future Governments being willing to build similar facilities again;
- no details of quarrying in ERMP;
- inconsistencies between boat launching ramps and trailer parking spaces;
- dredging of Lal Bank required for navigational purposes. This was not mentioned in the ERMP.

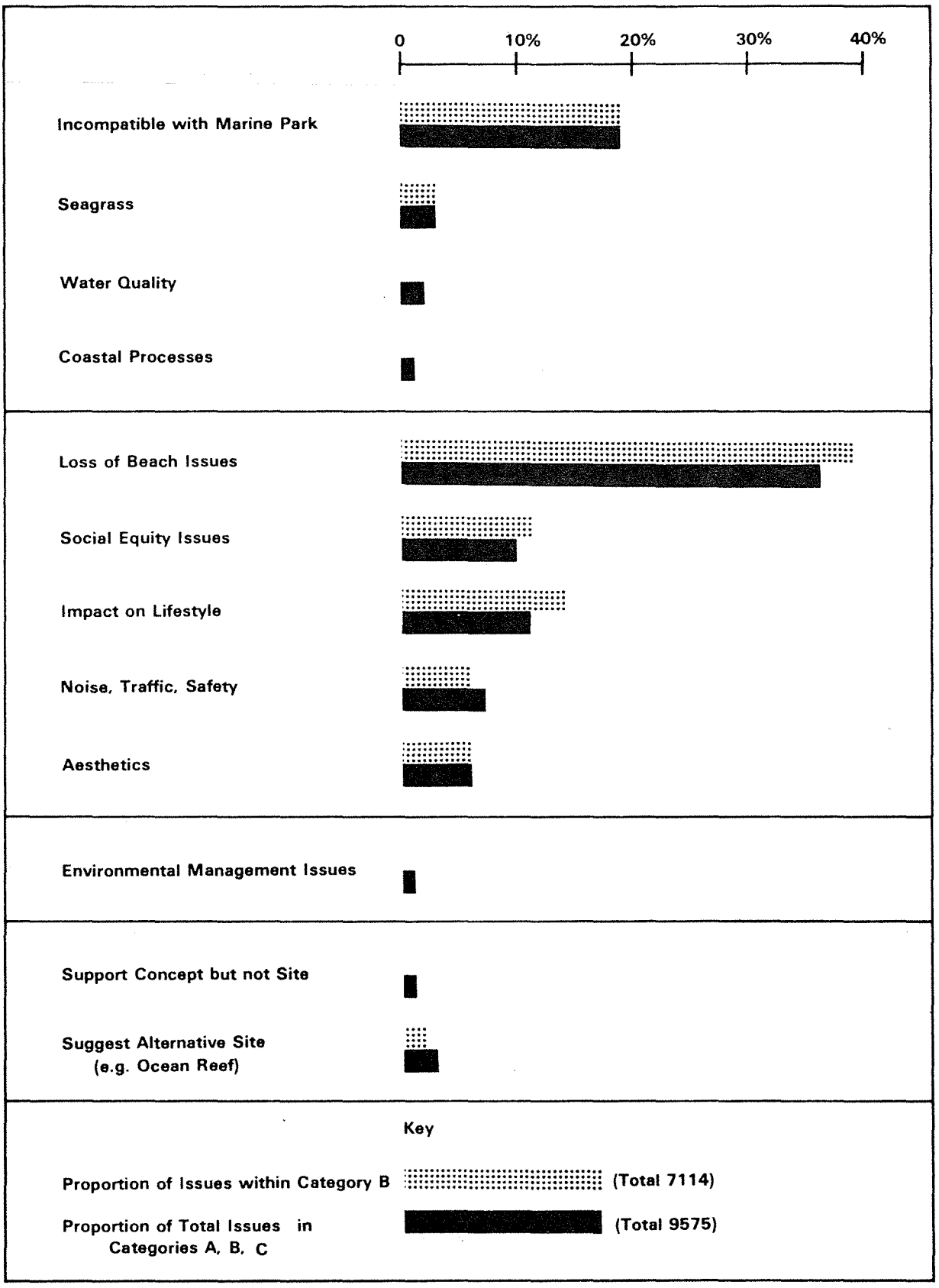
A comparative table of issues follows:

% Breakdown of Submissions for Category A



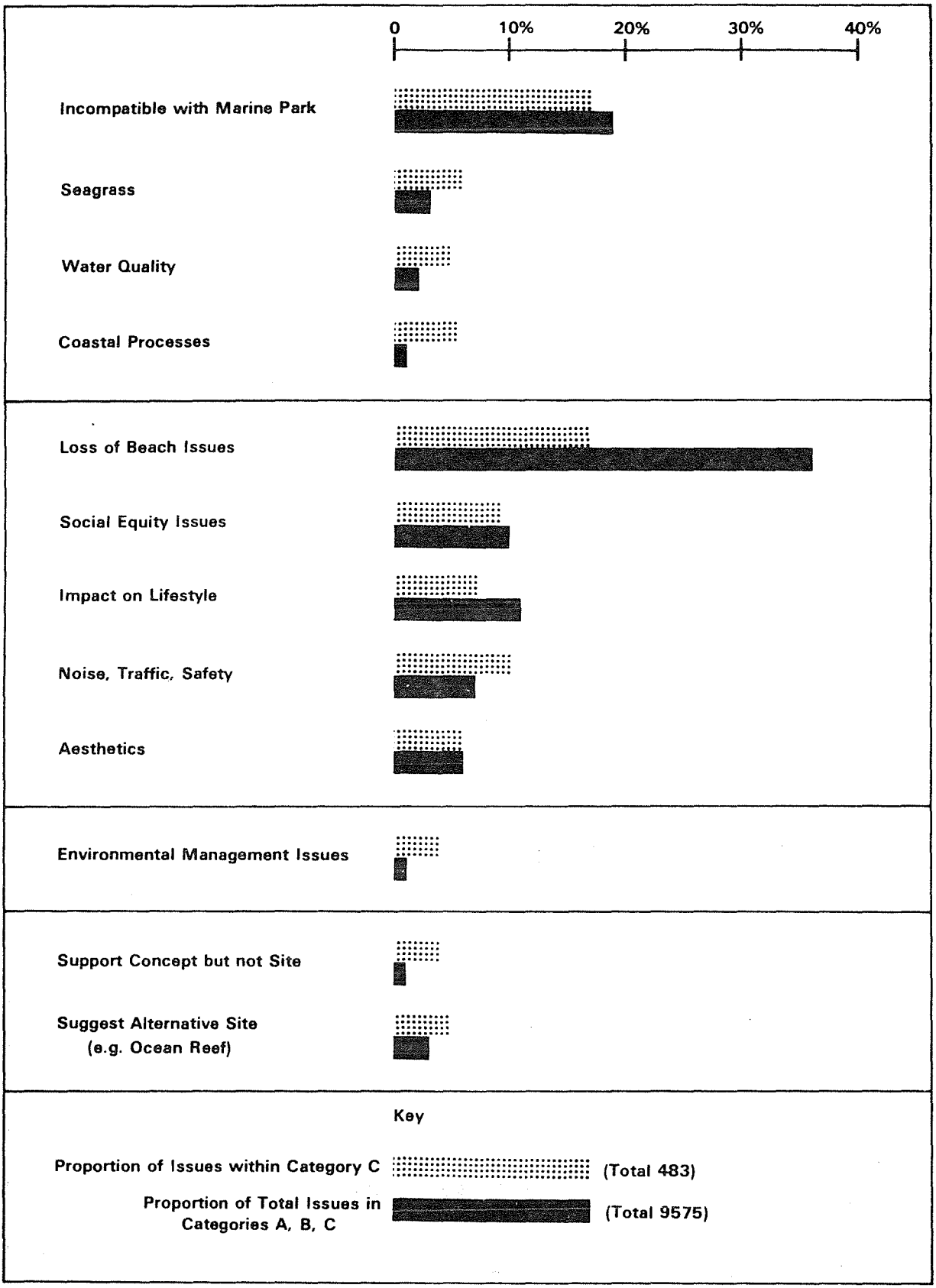
Personal Letters Opposing the Project : Total 396

% Breakdown of Submissions for Category B



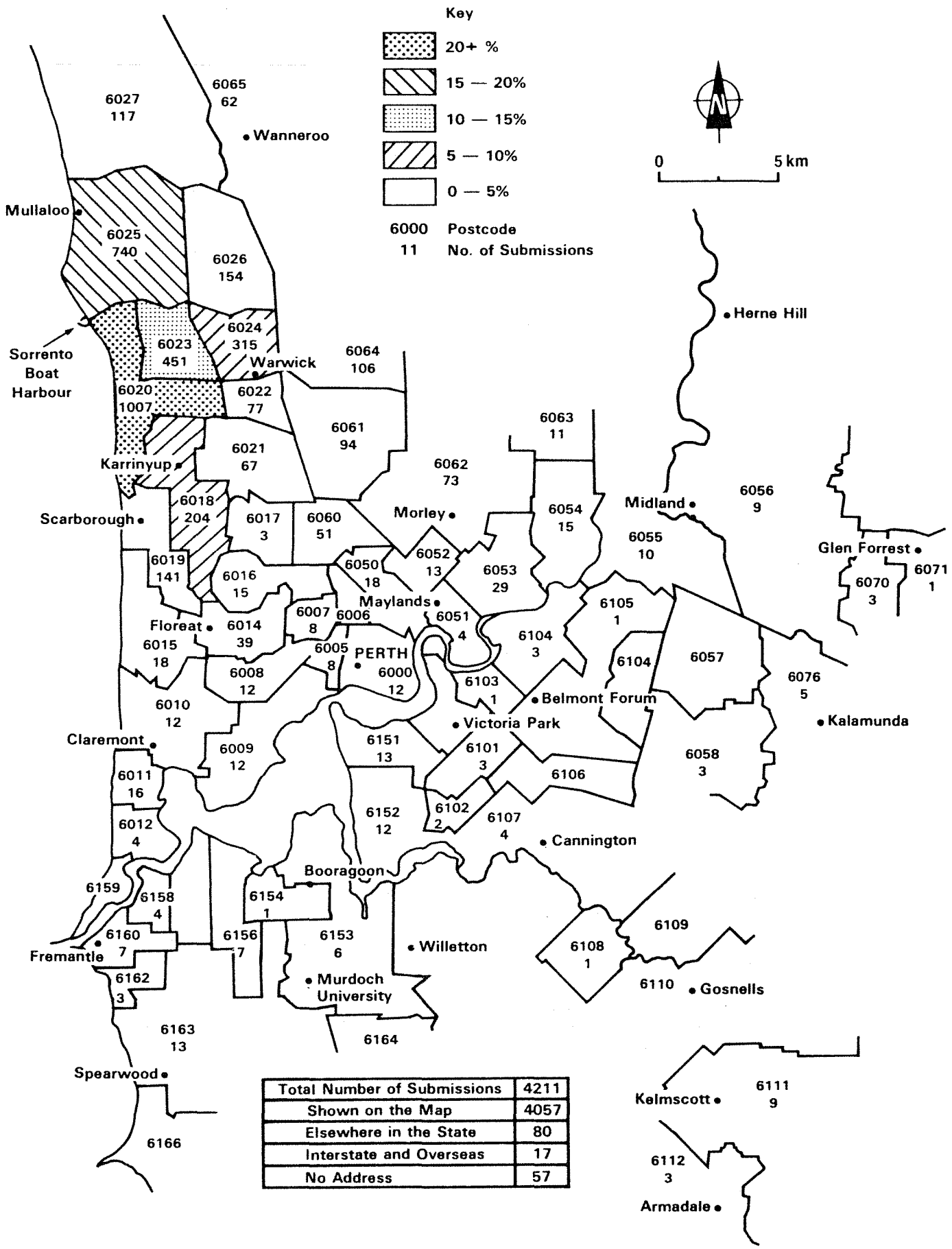
Duplicated Letters of Opposition to the Project : Total 3641

% Breakdown of Submissions for Category C



Comprehensive Submissions Opposed to or Concerned About the Project : Total 49

DISTRIBUTION OF SUBMISSIONS BY POSTCODE OF ORIGIN



Total Number of Submissions	4211
Shown on the Map	4057
Elsewhere in the State	80
Interstate and Overseas	17
No Address	57

6.5 Category D : Submissions neither for nor against but offer comments should the project proceed.

Three submissions fell into this category and made the following comments:

- breakwater design of the harbour should maximise water circulation and exchange;

- strongly recommends the immediate banning of net fishing by professionals and amateurs in the System 6 M10 area;

- Sacred Heart College which is situated very near the proposal expressed concern over decreased safety for pedestrian and cycle traffic to area from the College, and potential increases in security problems, vandalism and threats to students' personal safety. The EPA draws the Shire of Wanneroo's attention to the College's requests for:

  - adequate safety provisions for cyclists,

  - provision for safe crossing of West Coat Highway by pedstrians and cylists,

  - the college's western boundary fence be upgraded to a suitable design,

  and suggests that the Shire takes appropriate action.

6.6 Category E : Submissions supporting the project

A total of 114 submissions were received which supported the project proceeding. In general they were quite comprehensive and nearly five points per submission were averaged.

This category includes letters of unqualified support as well as those expressing conditional support for the project.

In summary the points raised are as follows (percentage figures in parantheses relate to the proportion of the particular issue compared to the total raised in this category):

- need for facility is justified (16%)

- specific benefits
  - reduce river congestion (6%)
  - allow rapid ocean access (5%)
  - provide a safe ocean haven (7%)
  - serve as a ferry terminal (5%)
  - recreational opportunities (6%)
  - associated facilities beneficial (6%)
  - upgrade area and add interest and excitement (7%)
  - boost local business and attract more industry (4%)
  - increase employment (2%)
  - cheaper than Ocean Reef (2%)

- beach
  - only a small proportion of beach taken up (5%)
  - the site has only light beach usage (3%)
  - seawalls will stabilize beach (5%)
  - area of groynes used most (1%)
  - provide more usable beach (1%)

- breakwaters
  - allow recreational fishing (5%)
  - increase marine biota habitat (2%)
  - have acceptable impact on biota (2%)

- Cautious but favour provided good management is enforced (4%)

- Specific boat owner (2%)

- Specific non-boat owner (2%)

- Ocean Reef too exposed (1%)

- Complained about methods used to collect anti-boat harbour signatures (1%)

Postcodes	Districts	Number	%
6025	Hillarys, Kallaroo, Mullaloo Padbury, Craigie, Beldon	38	33
6023	Duncraig	32	28
6020	Sorrento, Marmion, Trigg, North Beach, Waterman Carine	31	27
6026	Kingsley, Woodvale	3	3
6018, 6019, 6000	Churchlands, Doubleview Innaloo, Karrinyup, Woodlands, Scarborough, Wembley Downs, Perth	6	5
6024, 6062, 6151, 6008, 6154	Greenwood, Warwick Dianella, Morley South Perth, West Perth Booragoon etc.	4	4
	TOTAL	114	100

DISTRIBUTION BY POST CODE OF SUBMISSIONS SUPPORTING PROPOSAL

It is clear that most points raised in submissions supporting the proposal emphasised positive benefits which would accrue from the project proceeding.

6.7 Category F : Comments from Government Agencies

These are summarised in Section 7 of this report.

6.8 Distribution of submissions by postcode of origin

The following map gives a spatial breakdown of all submissions plotted by the postcode of origin.

As might be expected the greatest number of submissions received were from post code districts nearest the proposed site.

Submissions in favour of the proposal represent less than 3% of the total received; hence for comparative purposes the following table identifies their spatial distribution.

7. SUBMISSIONS FROM GOVERNMENT AGENCIES

Eight submissions were received from Government agencies including technical comments from the CSIRO Marine Laboratories. The Metropolitan Region Planning Authority requested that its submission be kept confidential. A summary of the others follows with the exception of comments by the Shire of Wanneroo which, with the permission of the Shire, have been reproduced in full.

RECOMMENDATION 8. Except where the EPA has made a specific recommendations in this report, the Authority recommends that the proponent takes the comments made by Government agencies into account if the project proceeds, and takes action upon them where appropriate.

7.1 CSIRO Marine Laboratories

The CSIRO provided technical comments on the ERMP and did not make a formal submission.

Points made were:

- flushing of harbour waters should be able to be modelled;
- no evidence that the new habitat created (harbour, breakwaters) will be more productive or diverse than present system as the ERMP suggests;
- no evidence that the (local) sewage outfalls supply significant nutrients to the coastal waters;

- benthic fauna and fish may not be less abundant in seagrass beds than on reef assemblages.

7.2 Department of Agriculture

The Department of Agriculture expressed two main concerns:

- the harbour may affect coastal land forms, but potential problems may be managed if monitoring (coastline, dunes) and periodic sand replenishment is undertaken. Foreshore and foredunes must be protected from human pressure: a foreshore management plan is needed;

- loss of seagrass from harbour construction and operation may result in massive sand movement onshore. This was not addressed in the ERMP, and quantification of the movement which may occur, and management of it, should be addressed.

7.3 Fisheries Department

7.3.1 Environmental Impacts

- loss of seagrass within harbour confines will be a major impact with localised effects of turbidity plume and wave scouring on seagrass surrounding the harbour;

- if ERMP predictions are correct further seagrass loss should be minimal. Department cannot comment on accuracy of predictions made;

- Boyinaboat Reef will be affected, but extent and duration of changes are not predictable;

- important abalone stocks in the inshore reef zone are unlikely to be impacted by construction activities, sediment movement or reduction in water quality;

- reduced water quality should be confined to harbour vicinity;

- none of the (commercial) fin fish, rock lobster or abalone stocks are dependent upon the locality for breeding, and seagrass loss will not influence stocks;

- harbour should not interfere significantly with the quantity of drift macrophytes available for juvenile fish habitat;

- breakwaters will provide habitat for some reef-dwelling organisms and angling species;

- in summary, no long-term significant harmful effects on fisheries from the construction or presence of the harbour are anticipated. However increased exploitation may cause some species to become rare. Depending on their extent, such pressures may necessitate regulation by management procedures, including the creation of reserve areas.

7.3.2 Monitoring

Additional to water quality parameters suggested in the ERMP, the following are proposed for within the harbour and up to 500 m from the harbour entrance:

- toxic components of anti-fouling paints (eg. tri-butyl tin, copper);

- hydrocarbons;

- turbidity;

- studies of flushing of harbour;

  coarse monitoring of benthos and fish (also on Boyinaboat Reef and on an offshore control reef).

7.4 Fremantle Port Authority

- the FPA are in favour of the proposed Sorrento boat harbour, because it will reduce danger to and congestion by small craft in the Fremantle Harbour area;

- the Sorrento site is well-serviced and located far enough away from Fremantle not to add to congestion;

7.5 W.A. Museum

The Museum's comments in summary were:

- loss of seagrass could lead to extensive, uncontrolled erosion leading to detrimental consequences to both the biological and physical environment;

- the PWD's present estimates of sediment movement are based on a stable seafloor and current erosion rates. However higher rates of sediment movement than anticipated could result;

- about half the inshore reefs within the M10 reserve may be degraded; these are the ones of highest conservation importance;

- the harbour may interfere with juvenile fish nursery areas (in the detritus-laden surf zone), and may interfere with or trap migrating adult and juvenile fish. Southward-migrating shoals may perish in the poor water quality of the harbour;

- eutrophication of harbour could be far greater than anticipated;

- the proposed Marine Reserve area will require a high degree of regulation and management;

- a more northerly site in the vicinity of Ocean Beach would be preferable.

7.6 Department for Youth, Sport and Recreation

The Department for Youth, Sport and Recreation made the following points:

- a marina is justified for the northern suburbs, and will increase potential for aquatic activities in the area;

- recreational impact on the M10 area is unknown, but management guidelines can be developed to protect area from adverse impact;

- this proposal should be considered in concert with other proposals for marinas, so that a state of serious over supply may be avoided;

- the DYSR supports the marina proposal in principle, provided that adequate safeguards are implemented to protect recreational, conservation, scientific and educational values of M10 Marine Reserve;

- further details should be provided by Department of Marine and Harbours on the nature and extent of harbour facilities and services proposed;

- the proposal should be reviewed in a regional context.

7.7 Shire of Wanneroo

The Shire of Wanneroo's comments are reproduced in full:

" COMMENTS ON ... 'ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME FOR SORRENTO BOAT HARBOUR'

I wish to advise you that at its meeting of 27th March 1985, Council considered the abovementioned report and resolved that the following comments be forwarded to the Environmental Protection Authority for consideration:

1. The ERMP states that the project has the support of the Shire. (ref. page 2-1, section 2.1, paragraph 3). No mention is made of the conditions which the Council applied to its support, as resolved at its meeting of 10th May 1984. It is most important that the EPA be made aware of these conditions, which were:

   i) The completion of a proper environmental impact study by the Government;

   ii) Council being granted control of all internal development within the marina precinct, to secure public use of the facility and a possible equity for the ratepayers of Wanneroo;

   iii) Government financial assistance being forthcoming towards any related infrastructure costs external to the actual marina precinct, these might include parking, environmental works and roads (particularly the extension of the Mitchell Freeway and dual carriageway development of Hepburn Avenue);

   iv) Full development of the southern Whitfords Node in the manner generally envisaged in the Scott and Furphy study, with Government support for C.E.P. funding and possible use of Gibson Avenue, Padbury land sale proceeds;

   v) Public access to all beach and other public areas external to the marina precinct being guaranteed;

   vi) Government assisting in every way possible to facilitate a marina development at Ocean Reef as originally proposed by the Council.

2. The ERMP places the responsibility for the development of the onshore areas (excluding the proposed leasehold areas) with the Shire. At its meeting of 27th February, 1985, Council resolved that the Minister Responsible for the America's Cup Defence, the Hon. D. Dans, be advised that the Shire was unable to allocate any funds for such development. At that meeting, Council also endorsed several projects which had been submitted to the America's Cup Defence Committee, seeking Federal Government Funds. These projects included the development of the harbour precinct, the development

of the southern node and the dualling of Hepburn Avenue. Advice has recently been received from the America's Cup Defence Office, to the effect that only the project relating to the development of the park area immediately north of the marina within the southern node is to be the subject of further consideration for possible Federal Government funding.

In view of the above, the EPA should be advised that there is now some uncertainty as to whether the Shire will be in a position to be able to develop the harbour precinct as indicated in the ERMP.

3. The ERMP states that Hepburn Avenue will be dualled between the coast and Wanneroo Road by mid-1986 and will therefore help in alleviating any traffic problems associated with the harbour. As mentioned in 2) above, this project has not been recommended for funding. The EPA should therefore be advised that it is doubtful that the Shire will be in a position to be able to dual Hepburn Avenue, as described in the ERMP.

4. The ERMP states that the Department of Marine and Harbours will be responsible for maintaining the stability of the coastline on both sides of the harbour and for removing any accumulation of seaweed, should this problem occur. (Ref page 8-1, final paragraph; page 8-2, section 8.3). The EPA should be advised that the Shire places great importance upon this commitment given by the Department of Marine and Harbours and would wish to see it incorporated in any approval which may be given for the project to proceed."

Subsequent to receiving this submission the Shire of Wanneroo has advised the EPA that the State Government has indicated to the Shire that it is committed to make the necessary funds available for support facilities for the boat harbour ($1.43 million) if Commonwealth funds are not forthcoming.

8. CONCLUSIONS

The EPA's assessment of this project has proven somewhat difficult because information obtained from the System 6 M10 Study undertaken by the Department of Conservation and Environment and upon which the Authority has partly based its conclusions, only emerged late in the assessment process. As well an extraordinary number of public submissions, many raising complex social and economic issues, have had to be analysed.

The EPA is very aware of the apparent incompatability between siting a large boat harbour within a proposed Marine Reserve, particularly when it was the EPA's own recommendation to Government to create the Reserve.

Philosophically the EPA considers that the objectives for the proposed Marine Reserve, as recommended in the System 6 report, require conservation and recreation values to be met. Therefore the Marine Reserve falls into the category of a marine park, rather than a marine nature reserve. Consequently if the Boat Harbour can enhance public recreation and has acceptable or manageable environmental impacts, then the Authority cannot recommend against it proceeding.

The study of the area undertaken by the Department of Conservation and Environment indicates that the proposed Marine Reserve is already exhibiting evidence of deterioration from human pressure, and therefore requires management as soon as possible. The study also suggests that the impact of constructing the Boat Harbour will not produce unacceptable or unmanageable impacts. Based on this evidence and information in the ERMP, the EPA concurs with the above.

Under normal circumstances, the greatest potential for environmental impacts on biological and physical elements will come from enhanced access to the area from the Boat Harbour. The EPA contends that these impacts are manageable, given proper resources and funding. Experience indicated in the management of marine reserves in Eastern States suggests that a combination of regulatory enforcement and public education can be very effective. Nevertheless if the project proceeds, effective environmental management of both the facility and the Marine Reserve are essential for its acceptability on physical and biological environmental grounds.

The EPA believes that the user pays philosophy should apply to management of the Boat Harbour, and because the facility would generate the majority of future impacts, it should contribute proportionately to the overall management costs of the Marine Reserve.

The Authority has already noted in Sections 4 and 5.2.5 (c) how the facility would restrict trailer boat usage. It could be argued that such boats would be the vehicle for most human impact on the proposed Marine Reserve, rather than the deep draught vessels for which the Boat Harbour is designed. As well, by only providing limited boat launching facilities

to act as a disincentive for this class of boat, the Boat Harbour should not be expected to contribute significantly to management costs of the M10 area. The EPA believes that even if only limited boat launching facilities are provided, that would be sufficient to increase impact on the area. As well the Boat Harbour would not only provide a focus for boats launched elsewhere as a safe haven and for facilities such as fuel, but also as a focus for land-based recreation such as diving and swimming. Thus despite the design of the facility for deep-draught, wet moored boats, the Boat Harbour will be responsible for increased human use pressures on the proposed Marine Reserve and thus be responsible for increased management costs. However, because of this and other factors identified in this report, the Authority is concerned that commercial returns from the facility will not meet the full environmental management costs. There are no data on anticipated income or projected management costs in the ERMP on which to base a more definite conclusion.

Many issues relating to the social environment and the economics of the project were raised in public submission. The EPA has not avoided addressing these issues because of their complexity and contentiousness. It believes that resolution of them is not currently within its statutory responsibilities but rests with the Government. However the EPA believes it has a responsibility to draw the Government's attention to them for consideration prior to Government deciding whether or not the project should proceed.

In conclusion, the EPA considers that impacts on the physical and biological elements of the environment are either acceptable or manageable at a cost, but draws attention to the complex and contentious social and economic issues involved if the project proceeds.

RECOMMENDATION 1

The EPA has concluded that in terms of the physical and biological environments the project could proceed subject to the recommendations in this report and the provisions for environmental management in the ERMP and recommends accordingly. However the EPA also recommends to Government that before a decision is taken on whether to proceed or not with the project, the social and economic issues identified in this report be given full consideration, including the Authority's concern that environmental management costs incurred by the project may not be able to be met in full by income derived from it.

The Authority wishes to give notice that in addition to the recommendations in this report, it will be submitting to Government for its consideration a management plan for the System 6 M10 area giving further detailed recommendations. This will be done in due course (after a period of public review of a draft plan) whether or not this project proceeds, although the recommendations will of course reflect the decision.

RECOMMENDATION 2

The EPA recommends that if the project proceeds, a clear commitment is made concurrently by Government that the Marine Reserve will be declared as soon as possible and management resources to the level necessary for full and effective management of the M10 area will be allocated. The EPA points out that the true management costs of the project include a major apportionment of managing the M10 area because of the increased public access afforded by the facility. In keeping with the user pays philosophy, such revenue could reasonably be expected to be derived from operating the boat harbour. Proper management of the area will be required simultaneously with construction and operation of the facility.

RECOMMENDATION 3

In addition to commitments made in the ERMP, the EPA recommends that the water quality criteria which should be met within the boat harbour are those in Schedules 1 and 7 (c) of the EPA's water quality criteria and which are reproduced in Appendices C and D to this report. These criteria should be used to assist in setting the objectives of the water quality monitoring and management programme in Recommendation 4 (below).

RECOMMENDATION 4

The EPA recommends, should the project proceed, that a comprehensive monitoring and management programme be developed by the proponent in consultation with the Department of Conservation and Environment to the satisfaction of the EPA, and that appropriate resources be allocated for the proponent to implement it through the body proposed in Recommendation 7 (below). The programme should aim to achieve the following:

(i) measure physical, biological and chemical parameters appropriate to Recommendation 3 within and outside the harbour;

(ii) develop a predictive model for water circulation and exchange, and test the model with field data;

(iii) include as an objective maintenance of Schedule 7, class (1) water quality criteria at Boyinaboat Reef;

(iv) include monitoring and management of coastal processes including plans for managing foreshore access and full records of sand movements both natural and management initiated with costs for the latter;

(v) be consistent with approved management principles for the proposed Marine Reserve;

(vi) ensure that management strategies are developed for implementation in the event of criteria not being met, particularly in the case of accidental spillages;

(vii) ensure that contingency planning in (vi) includes funding and resources;

(viii) report back to the EPA after five years from the conclusion of construction with results of monitoring and recommendations for future requirements, or sooner if any problems arise.

RECOMMENDATION 5

The EPA recommends that the Government gives full consideration to the following issues (see paragraphs 5.2.1 to 5.2.6) associated with potential impacts on the social environment and take them into account when deciding whether or not to proceed with the Sorrento Boat Harbour project. The Authority advises the Government that many of the issues raised by members of the public, and those about which they feel most strongly, fall within this category.

RECOMMENDATION 6

The EPA recommends that, should the project proceed, trucks are required to use designated access roads to the site during construction. The designated access roads should be specified by the Shire of Wanneroo in consultation with the proponent.

RECOMMENDATION 7

The EPA recommends that if the project proceeds, a formal management body be established comprising representatives of the Department of Marine and Harbours, the Shire of Wanneroo, the vestee of the proposed Marine Reserve and representatives of the proposed four commercial lessees of the harbour. The points raised in section 5.3.2 of this report should be included in the terms of reference for the management body.

RECOMMENDATION 8

Except where the EPA has made a specific recommendation in this report, the Authority recommends that the proponent takes the comments made by Government agencies into account if the project proceeds, and takes action upon them where appropriate.

APPENDIX A

INTERIM FINDINGS AND CONCLUSIONS OF THE STUDY TEAM WORKING ON THE PROPOSED M10 MARINE RESERVE, WITH REFERENCE TO THE PROPOSED SORRENTO BOAT HARBOUR PROPOSAL

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1. INTRODUCTION

On February 1, 1985, the Department received a directive to proceed with an urgent, high priority study of the proposed M10 marine reserve as described in the System 6 Report (see attachments #1 and #2).

The terms of reference are:

(i) to characterise and describe the marine environments and marine communities of the area (as shown in attachment #2) and produce a report on the findings of the study,

(ii) to identify and evaluate present and future impacts on the proposed M10 marine reserve, and

(iii) after consideration of (i) and (ii) above, and in consultation with representatives of the user groups with interests in the proposed M10 marine reserve area, to frame a management plan for the proposed reserve, with respect to scientific research , education, conservation and recreation.

Field work has been completed and data analyses should be finished within the next week. This memorandum regarding interim findings and conclusions is based on preliminary analyses and the consensus views to date of the M10 study team.

2. RESULTS

Benthic communities have been sampled intensively along 63 x 150 metre transects, from the intertidal coast to 24 m depth (about 5.5 km from shore). Extrapolations to the habitat and community structure have been made largely using recent colour aerial photography (1:25,000), with additional information from CSIRO (Marmion) and the University of Western Australia.

The proposed M10 area, of 6100 hectares, may be divided into the following geomorphological habitat units.

	GEOMORPHOLOGICAL HABITAT UNIT	AREA (ha)	PERCENTAGE (of total M10 area)
i	Terrestrial areas between high-tide level and West Coast Highway	529	8.7
ii	Intertidal coastal sand beaches	64.2	1.1
iii	Intertidal coastal rock platforms (31)	23.1	0.4
iv	Offshore high reefs (15)	961.8	15.8
v	Offshore sand (mobile, essentially bare)	2065.8	33.8
vi	Offshore seagrass, low reefs, or "broken bottom"	2455.9	40.2
vii	Little Island, and offshore reef areas mostly above low tide level	4.0	0.1
	TOTAL	6103.8	100

Some boundaries between these geomorphological habitat units are well defined; for example, the boundaries between sand and high reef. However, the communities within each unit are very heterogeneous (e.g. the organisms found on the tops of reefs are markedly different to the diverse assemblage of organisms found in caves and crevices). Unit vi (above) is extremely heterogeneous. The "offshore seagrass, low reefs, or broken bottom" actually includes most of the range of organisms and habitat-types found in the M10 area, but these habitats form a complex mosaic that could not be separated. Patches range in size from about 0.01 ha of seemingly homogenous community (for example, Posidonia meadow), to less than 0.01 m^2 (for example a few clumped individuals on small areas of exposed rock, on otherwise sand sea-floor). This complex mosaic (of habitat unit vi above) covers about 2500 ha (about 40 per cent of total M10 area).

At the present time, and considering the available data, the study team agrees with the general statement of the System 6 Report (p.174) "The reefs are biologically rich and unsurpassed locally as an underwater spectacle." With the exception of Sydney, members of the study team are not aware of any other capital city in Australia that has such a diversity of marine habitats immediately adjacent its metropolitan coast. Unlike Sydney, however, the proposed M10 marine reserve is readily accessible from all parts of the Perth metropolitan area, and hence does constitute open space of great regional significance for the purposes of conservation, education and recreation. Additionally, with

the siting of the CSIRO and Department of Fisheries marine research laboratories, the M10 area should also be considered important for the purpose of scientific research.

3. PRESENT AND FUTURE IMPACTS

The study team is in the process of identifying these impacts and examining them in detail, in collaboration with officers from the Departments of Public Works, Fisheries, Conservation and Land Management, and Marine and Harbours. In addition, representatives of the two universities, the W.A. Museum, CSIRO, local Shire councils and user organisations are being consulted.

For brevity, present and future impacts, under present consideration, are simply listed below.

Present Impacts

User access to beaches and headlands	(for swimming, fishing, surfing, sailboarding; by foot or off-road vehicles)
Off-beach vehicle parking facilities	(coastal strip west of highway)
Boat launching facilities	(ramps or Ocean Reef marina)
Recreational fishing	(angling, spearfishing, collecting of abalone and crayfish, some netting)
Professional fishing	(abalone and crayfish)
Boat moorings	(particularly offshore Mullaloo beach)
Boat anchor damage	(particularly to reefs, by boats anchoring for angling, or SCUBA-diving)
Collection of marine life	(by reef-walkers along the coast, by recreational divers offshore)
Research activities	
Sewage disposal	(Ocean Reef outfall)
Stormwater and groundwater inflow	
Litter	

Future Impacts

As the population of Perth continues to increase, and in particular as the northern metropolitan suburbs are developed, all impacts identified above could potentially increase.

In the near future, the greatest potential impacts on the marine environment are likely to arise from increased number (or upgraded capability) of small boat launching-ramps, and the proposed marina at Sorrento if it proceeds. It should be noted, however, that circumstantial evidence suggests there is an existing considerable level of user pressure on the proposed M10 area, from existing recreational and commercial activities.

These impacts are considered under the two categories below:

(i) impacts of increased user pressure

The main impacts are increased pressure, by recreational and professional users, on limited biological resources, and increased physical damage (by vessel anchors, people landing on Little Island, and diver damage to reefs) to marine habitats.

It is considered that these impacts can be held to acceptable levels by the enforcement of appropriate management regulations.

(ii) physical impacts of future structures

The physical impact of small boat launching-ramps is local, generally minor and will be considered in detail in the draft management plan.

The physical impact of the proposed Sorrento marina has been examined in detail by members of the M10 study team and an officer from Public Works Department. The results are summarised below.

(i) extent and nature of the plume resulting from dredging activities

Sediment stratigraphy at the proposed marina site is not clear from the marina ERMP; however, PWD has informed us the intention is to construct both breakwaters before any dredging proceeds and then dredge from the beach using a dragline. Hence the dredge plume should be contained within the marina breakwaters.

(ii) sediment plume resulting from emplacement of the breakwaters

According to PWD, the nature of the construction material is such that the plume resulting from the construction should be temporary, and the sediments from the construction material should settle quickly, within a few hundred metres, and not have any significant impact on surrounding marine communities. The M10 study team has no data to suggest otherwise.

(iii) extent and impact of interruption to longshore sand movements

Some members of the M10 study team consider that the amount of beach sand likely to be lost, to offshore areas during winter storms, has been underestimated.

If this is so, both the animals on the nearby reefs, and the seagrass beds adjacent to the proposed marina, could be affected. The latter would be considered particularly serious, since the living seagrass beds have a major stabilising effect on the marine sediments.

Additionally, increased loss of sand to deep water would require increased coastal protection work, such as beach sand renourishment by trucking sand into the area from elsewhere.

This point was discussed with PWD, in context of the known hydrodynamics and sediment dynamics in the Pinnaroo Point and Sorrento beach area, and in context of other boat harbours and breakwaters in W.A. The conclusion was that the Sorrento marina ERMP statement represents the best advice on the basis of available information, but that if beach sand problems do arise, there should be sufficient notice to initiate appropriate management actions.

(iv) extent and impact of habitat destruction resulting from construction of the proposed Sorrento marina

The area within the proposed marina would undoubtedly suffer catastrophic change to the present marina communities, but the surrounding areas should be affected to a radius of possibly less than 100 metres. The affected community is mostly seagrass meadows, low reefs or broken bottom. It is estimated that two per cent of this habitat would be destroyed by the marina, and a further three per cent could be severely affected (based on area of similar habitat within boundary of proposed M10 area).

4. BEACH USE STUDY

In general, density of beach use is related to beach access: density of people on beaches is highest where there is easy access and carparking facilities. Sand beaches are more heavily used than the rocky shores, and users particularly congregate where there are extra facilities such as change-rooms and kiosks. User density is significantly higher adjacent to fully developed residential areas, compared to the undeveloped residential areas in the vicinity of Pinnaroo Point and northwards.

While development of a marina at Sorrento would probably deter some present users of that area from using it in the future, other, new users would be attracted by the easy beach access, carparking facilities, and protection afforded by the marina breakwaters.

5.1 MANAGEMENT

Two draft management plans are being formulated, though at present both are in the concept stage only.

Option 1: if the proposed Sorrento marina does not proceed, and

Option 2: if the proposed Sorrento marina does proceed.

Both options intend that

(i) the boundaries of the proposed M10 marine reserve, as shown in the System 6 report (attachment #2) should be modified. The northern boundary of the M10 area should be slightly south of the present Ocean Reef boat harbour, and should run due west from the shore, seawards for 5.5 km. The western boundary should be approximately 5.5 km from shore. (see attachment #3).

(ii) the eastern boundary should be the West Coast Highway, and terrestrial areas between high water level and the West Coast Highway should be managed as part of the M10 reserve.

(iii) the coastal beaches should be designated according to intended use and marked accordingly (e.g. beaches designated as "off-limits to power vessels", "approved for dogs with owners", "nude bathing", and so on).

(iv) offshore high protection areas should be designated. These should be set aside as areas for non-destructive activities only, with the exception of permits for approved scientific or educational activities requiring minimal sampling.

(v) offshore medium protection areas should be designated. These areas should be set aside for

any non-destructive activities, approved scientific or educational activities requiring sampling (by permit), and amateur angling.

(vi) other offshore areas within the M10 boundary should be designated low protection areas. It is envisaged that the following activities would be permitted:

- all activities permitted in the high and medium protection areas
- recreational angling
- taking of abalone for personal consumption
- taking of abalone by professional abalone divers
- taking of crayfish by professional crayfishermen
- taking of crayfish by hand for personal consumption
- spearfishing, without the use of compressed air equipment
- dropnetting for crabs.

(vii) It is envisaged the following activities would be banned from the entire M10 marine reserve:

- netting for fish
- spearfishing using compressed air equipment
- taking of crayfish using compressed air equipment
- collection of live molluscs (except abalone) or mollusc shells
- collection of corals and other marine invertebrates (except for scientific or educational purposes and by permit).

5.2 EXTENT OF OFFSHORE HIGH- AND MEDIUM-HIGH PROTECTED AREAS

As described in Section 3 (above), siting of a marina at Sorrento would be expected to result in a marked increase of user pressure on the M10 area, and particularly on the areas of high reef. As an initial working indication, the following areas (as percentages of total offshore area) are suggested for high, medium and low protection for the two options.

	OPTION #1 (no marina)	OPTION #2 (marina)
High protection	5%	15%
Medium protection	10%	15%
Low protection	85%	70%

6. SUMMARY

Present indications are that the proposed M10 marine reserve area is already under considerable user pressure, and that the pressure would increase significantly with the development of the Sorrento marina incorporating launching facilities for small boats.

The construction of the marina would destroy two to five per cent of similar marine community within the proposed M10 reserve area. It is a value judgement whether this is a serious loss or not.

It is suggested that, should the Sorrento marina proposal be accepted, the M10 management plan should take into account the increased pressure on the area, in order to ensure that the marine reserve area is adequately maintained for the purposes of scientific research, conservation education and recreation, and also taking into account commercial fishing activities (rock lobster and abalone).

This management plan should involve appropriate ongoing monitoring of the impact any marina development has, and also the impact of user pressure on the marine resources. It is suggested that the latter may require a marine reserve ranger, full-time for five years after construction of any marina for both enforcement of management policies and public education.

ATTACHMENT #1

SYSTEM 6 REPORT (1983): M10 RECOMMENDATIONS

M10 OFFSHORE REEFS — OCEAN REEF TO TRIGG

The recommended area is centred on Whitfords, about 22km north-west of Perth. Its coastal boundary is at the high water mark and it includes an offshore reef which protects a series of smaller reefs (Figure 82).

The area is affected by an MWA sewage outfall and a boat ramp at Whitfords. There is some commercial fishing of these waters for abalone, fish and crayfish.

The reefs are biologically rich and are unsurpassed locally as an underwater spectacle. Because the reefs have been heavily exploited, and as the area has education value, it is considered essential that they be reserved and protected to conserve the marine communities, including a rare species of cowrie shell which is much sought by collectors.

The area has high recreational value because the sheltered water provides safe boating, diving, swimming and fishing conditions.

Many submissions were received by the EPA on this locality and expressed the high recreational value of the area as well as the need for management to set aside areas of high educational and conservation value.

The recommended area constitutes open space of regional significance (see Figure 1, Chapter 4) because of its high conservation, education and recreation values. Any management plan for the area should have these values as primary management objectives.

Recommendations:

M10.1 That our general recommendations on planning and management of Regional Parks be applied to this area (see Recommendation 15, Chapter 5).

M10.2 That a study of the area be commissioned by the Environmental Protection Authority with the aim of establishing a Marine Reserve to be managed for the purposes of scientific research, education, conservation and recreation.

M10.3 That, subject to the implementation of M10.2, a management plan be prepared for the Reserve.

ATTACHMENT #2

SYSTEM 6 REPORT (1983): M10 BOUNDARY

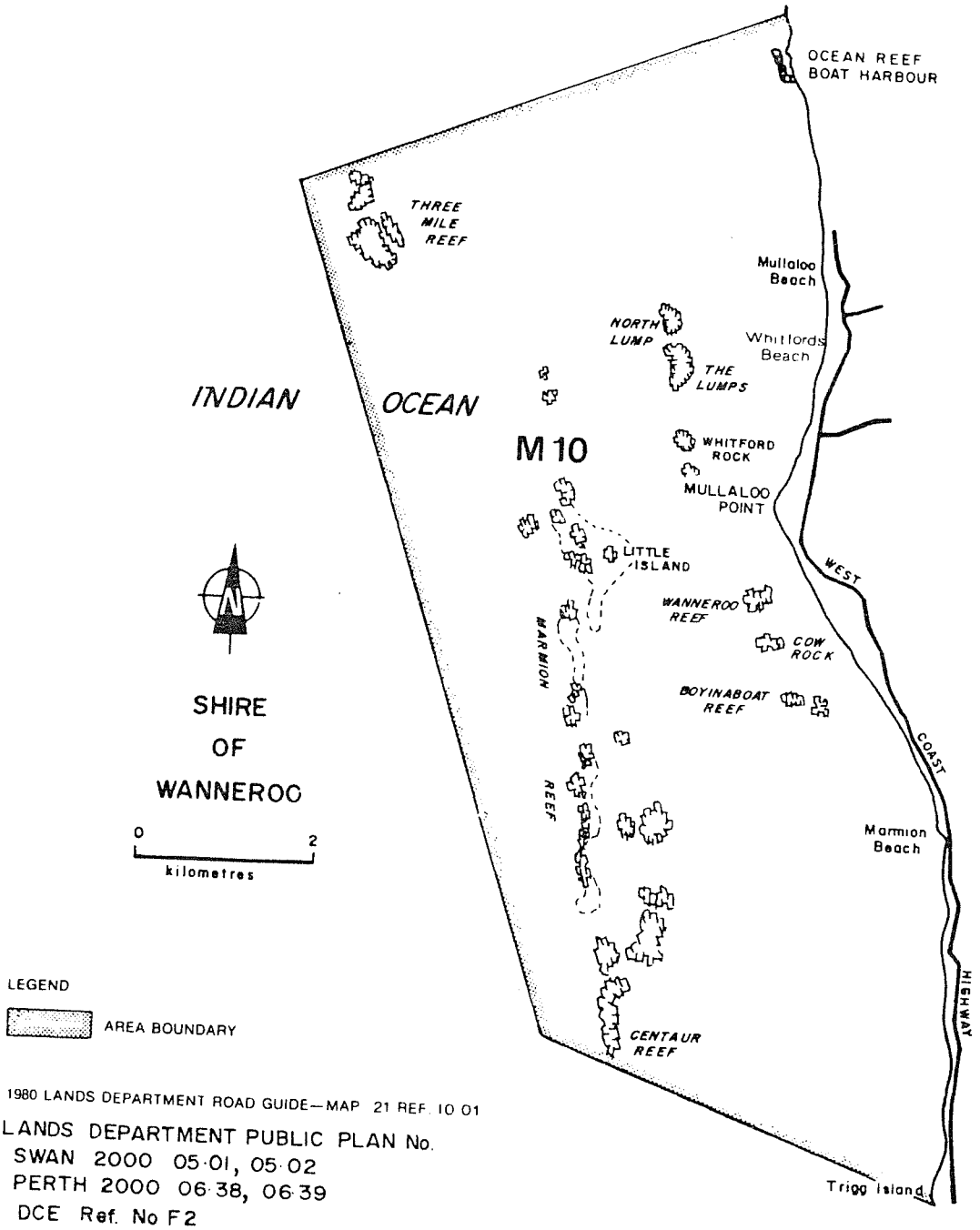
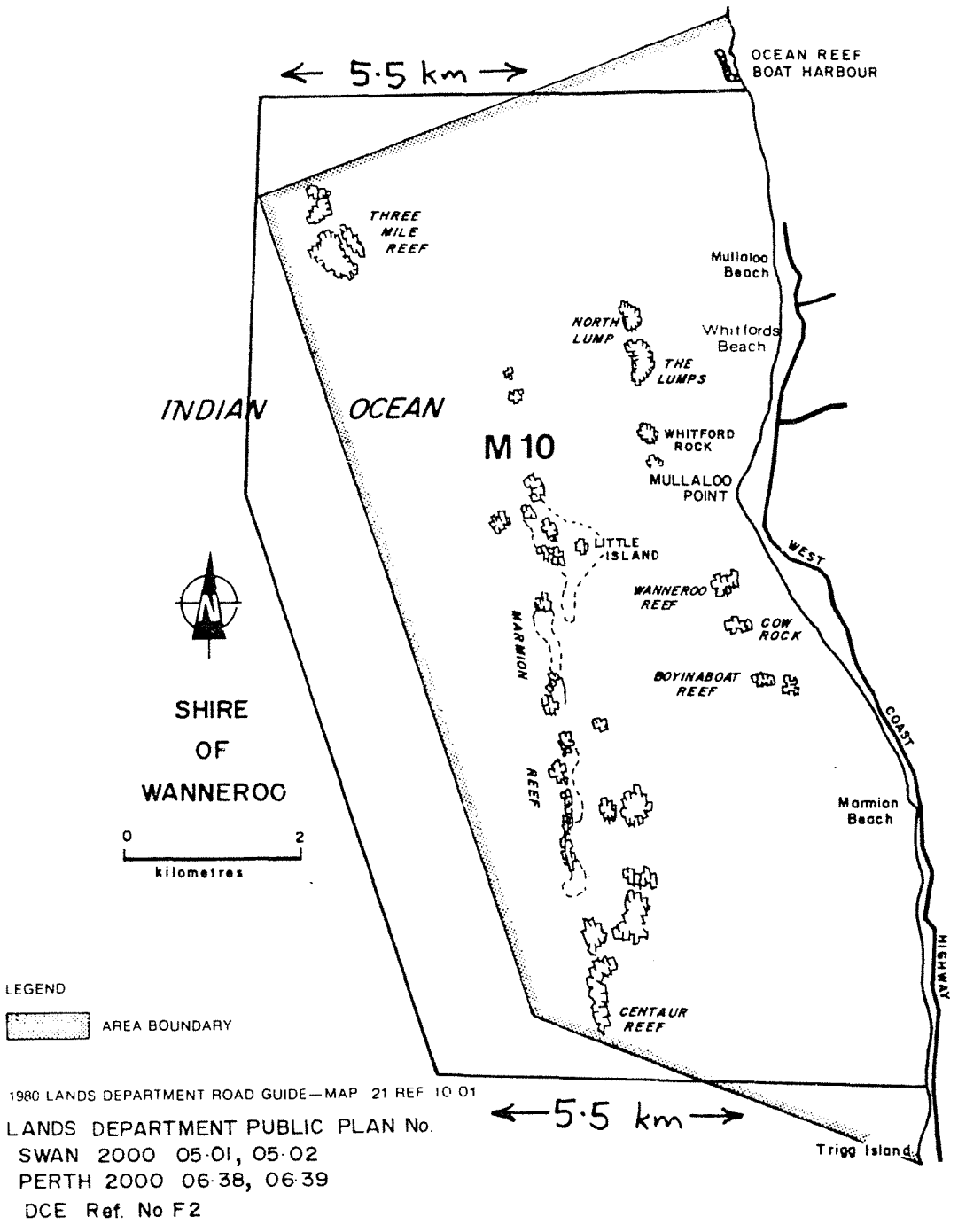


Figure 82

ATTACHMENT #3

PROPOSAL FOR REVISED MARINE BOUNDARY OF M10 RESERVE



APPENDIX B

SCHEDULE 10

MARINE AND ESTUARINE WATER QUALITY CRITERIA FOR FLUSHING WATER AND WATER REPLENISHMENT

Criteria

When flushing and replenishment waters arrive in a zone of defined beneficial use or uses, their effect should not be detrimental to the beneficial use or uses defined for that zone.

Consequently, specific water quality criteria for flushing and replenishment waters can only be determined on a case-by-case basis bearing in mind both the degree of mixing which will occur and the criteria established for the waters that they will be mixing with or replenishing.

The free movement of flushing waters should not be impeded in any way which will be detrimental to this beneficial use.

APPENDIX C

SCHEDULE 1

MARINE AND ESTUARINE WATER QUALITY CRITERIA FOR DIRECT CONTACT RECREATION

Parameter	Criterion	Source
Aesthetic Considerations	As on page 8.	USA EPA (Comp)
Physical Hazards	The water in bathing and swimming areas should be free of submerged bodies and other subsurface hazards.	NH&MRC
Light Penetration	A Secchi disc should be visible to a depth of 2m except in "learn to swim" areas where a Secchi disc should be visible on the bottom.	NH&MRC
pH	6.5-8.5, except for waters with a low buffer capacity where a range of pH between 5.0 and 9.0 may be tolerated.	NH&MRC
Chemicals and Biological Materials	The waters should not contain chemicals and biological materials in such concentrations as to be irritating to the skin or mucous membranes of the human body upon brief immersion. In addition, they should not contain chemicals and biological materials in such concentrations as to be toxic to man if small quantities are ingested.	NH&MRC
Faecal Coliforms	A health investigation level for water in open and unenclosed bathing and swimming areas may be established on the basis of a minimum of five samples taken over not more than a 30-day period under conditions representative of the water quality to which users are commonly exposed, and is reached either when the median reading of such samples exceeds 150 organisms/100mL, or when more than 20% of the total samples during this period exceed 500/100mL. For this purpose samples during the wettest quarterly interval may be omitted if users are not commonly exposed during that interval. The water in bathing and swimming areas in which the median reading ordinarily exceeds 50/100mL and/or in which more than 20% of samples ordinarily exceed 150/100mL, should be protected against any degradation in that quality from a new or increased source of pollution. Water of higher quality should be similarly protected against degradation beyond the levels mentioned in this paragraph.	WG
Faecal Material	The water in bathing and swimming areas should be protected against direct contamination with fresh faecal material of human or domesticated animal origin.	WG
Radioactive Substances	The waters should not contain radioactive substances in such concentrations as to be deleterious to man if small quantities are ingested.	DH&MS

APPENDIX D

SCHEDULE 7 (3)

MARINE AND ESTUARINE WATER QUALITY CRITERIA FOR MAINTENANCE AND PRESERVATION OF AQUATIC ECOSYSTEMS

Class 3

Parameter	Criterion	Source
Aesthetic Considerations	As on page 8.	USA EPA (Comp)
Light Attenuation	The combined effects of turbidity and colour should not reduce the depth of the compensation point for photosynthetic activity by more than 50% from the seasonal background value.	USA EPA
Settleable Matter	Unnatural inputs of settleable material should not cause the formation of deposits which are harmful to aquatic organisms.	VIC EPA (M)
Suspended Solids	Upper limit of 80 mg/L and depth of compensation point for photosynthetic activity should not be reduced by more than 20% from the natural seasonal norm.	Hart/WG
Temperature	The maximum acceptable variation in the weekly average temperature due to artificial sources is 2°C for waters north and 4°C for waters south of latitude 27°S during all seasons of the year, provided that no single value exceeds by more than 2°C the highest summer maximum recorded over the previous five years inclusive.	WG
Salinity	Unnatural influences should not change the seasonal mean salinity, measured preferably over not less than five years, by more than 0.25 of the standard deviation, nor change the salinity beyond the range recorded over that period.	WG/VIC EPA (G)
Ionic Ratio	The ratios of major ions should not be altered such that this beneficial use is affected.	WG
pH	6.5-8.5 and no change in excess of 0.5 units from normal. For waters of salinity below 5 000 mg/L (5°/oo) the pH range should be 6.0 to 9.0 and no change in excess of 1.0 units.	USA EPA/WG/Hart
Dissolved Oxygen	Not to fall below 3.5 mL/L (5.0 mg/L) for more than 6 consecutive hours, and never to fall below 3.0 mL/L (4.3 mg/L).	WG
Arsenic	6 month median not to exceed 8 μg/L No more than 20 per cent of readings to exceed 80 μg/L. No single reading to exceed 500 μg/L.	Calif (K&S)
Cadmium	6 month median not to exceed 3 μg/L. No single reading to exceed 8 μg/L.	Calif (K&S)
Chromium (total)	6 month median not to exceed 2 μg/L. No single reading to exceed 7 μg/L.	Calif (K&S)
Copper	6 month median not to exceed 5 μg/L. No single reading to exceed 40 μg/L.	Calif (K&S)
Lead	6 month median not to exceed 8 μg/L. No more than 20 per cent of readings to exceed 80 μg/L. No single reading to exceed 200 μg/L.	Calif (K&S)

Mercury	6 month median not to exceed 0.14 μg/L. No more than 20 per cent of readings to exceed 1.4 μg/L. No single reading to exceed 3 μg/L.	Calif (K&S)
Nickel	6 month median not to exceed 20 μg/L. No more than 20 per cent of readings to exceed 200 μg/L. No single reading to exceed 450 μg/L.	Calif (K&S)
Silver	6 month median not to exceed 0.45 μg/L. No more than 20 per cent of readings to exceed 4.5 μg/L. No single reading to exceed 10 μg/L.	Calif (K&S)
Zinc	6 month median not to exceed 20 μg/L. No single reading to exceed 200 μg/L.	Calif (K&S)
Aldrin	Not to exceed 0.003 μg/L	USA EPA
Azinphosmethyl	Not to exceed 0.01 μg/L	USA EPA
Camphechlor	Not to exceed 0.005 μg/L	USA EPA
Chlordane	Not to exceed 0.004 μg/L	USA EPA
2,4-D	Not to exceed 4 μg/L	NAS/NAE
DDT	Not to exceed 0.001 μg/L	USA EPA
Dieldrin	Not to exceed 0.003 μg/L	USA EPA
Endosulfan	Not to exceed 0.001 μg/L	USA EPA
Endrin	Not to exceed 0.004 μg/L	USA EPA
Heptachlor	Not to exceed 0.001 μg/L	USA EPA
Lindane	Not to exceed 0.004 μg/L	USA EPA
Maldison	Not to exceed 0.1 μg/L	USA EPA
Methoxychlor	Not to exceed 0.03 μg/L	USA EPA
Parathion	Not to exceed 0.04 μg/L	USA EPA
Other Pesticides	Not to exceed 0.01 of the 96-hour LC_{50} value for the selected test species.	WG
Ammonia (expressed as Nitrogen)	6 month median not to exceed 600 μg/L. No single reading to exceed 2000 μg/L.	Calif (K&S)
Chlorine (total residual)	6 month median not to exceed 2 μg/L. No single reading to exceed 10 μg/L.	Calif (K&S)
Cyanide	6 month median not to exceed 5 μg/L. No single reading to exceed 10 μg/L.	Calif (K&S)
Fluoride	6 month median not to exceed 2 mg/L. No single reading to exceed 10 mg/L.	WG
Hydrogen Sulphide	Not to exceed 2 μg/L.	USA EPA
Total Hydrocarbons	Not to exceed 10 μg/L.	WG
Aromatic Hydrocarbons	Not to exceed 1 μg/L.	WG
Phenolic Compounds	6 month median not to exceed 300 μg/L.	Calif (K&S)
Polychlorinated Biphenyls (PCBs)	Not to exceed 0.001 μg/L.	USA EPA
Surfactants	Not to exceed 0.01 of the 96-hour LC_{50} value for the test organisms.	WG
Other Toxic Substances	No material should be present in an amount exceeding 0.01 of the 96-hour LC_{50} value for the test organism.	WG
Radioactive Substances	Radioactive substances should not be present in concentrations that are deleterious to human, plant, animal, or aquatic life or that result in the accumulation of radioactive substances in the food	Calif.

	web to an extent that presents a hazard to human, plant, animal, or aquatic life.	
Nutrients and Other Biostimulants	The loads of nutrients and other biostimulants to receiving waters should not cause excessive or nuisance growths of algae or other aquatic plants, or deleterious reductions in dissolved oxygen concentrations in those waters.	VIC EPA (M)