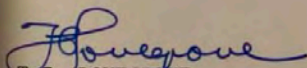


CONFIDENTIALCABINET DECISIONNO. 1026

Submission No.: 881
Title: MARINA COMPLEX - SUITABLE SITE.

Cabinet:-

- a) approved the selection of Vestey's Beach as a suitable site for a Marina complex subject to discussions and site approval by the Corporation of the City of Darwin; and
- b) agreed, subject to (a), to proceed to Stage 2 of the project for the development of a Marina complex in Darwin.


T.C. LOVEGROVE,
~~(XXXXXXXXXX)~~,
Secretary to Cabinet.

Actg.

9 January, 1980.

THE NORTHERN TERRITORY OF AUSTRALIA

Copy No: 1

CONFIDENTIAL

FOR CABINET

SUBMISSION No: 881

Title:	Marina Complex - Suitable site
Minister	Roger Steele M.L.A., Minister for Transport and Works
Purpose:	To obtain Cabinet's endorsement of a suitable site for a Marina Complex in Darwin.
Relation to existing policy:	Consistent with the Government's aim of upgrading boating facilities in Darwin.
Timing/legislative priority:	No legislation required
Announcement of decision, tabling, etc:	Press Statement is attached
Acting required before announcement:	Nil
Staffing implications, numbers and costs, etc:	Nil
Total cost:	Not applicable

CONFIDENTIAL

Department/Authority Law

COMMENT ON CABINET SUBMISSION No.

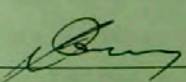
TITLE: Marina Complex - Suitable site

COMMENTS:

What I understand to be the proposed site is "reserved for the purposes of the Corporation of the City of Darwin in relation to recreation and amusement". Has the City Council been consulted at this stage?

Subject to the above, there are no legal barriers to the proposal.

There appear to be no constitutional barriers to the proposal.


SIGNED: LEGISLATIVE DRAFTSMAN
DESIGNATION: for SOLICITOR GENERAL

DATE: 7 January 1980

CONFIDENTIAL

THE ISSUE

To bring to Cabinet's notice the report on a suitable site for a Marina Complex in Darwin.

BACKGROUND

The development of a Marina Complex in Darwin was included as a Planning Initiative following representation from various interested bodies. The Department of Transport and Works commissioned D.J. Dwyer and Associates to report on suitable sites as Stage 1 of the project.

Cabinet Decision 990 asked for a submission on this subject to cover the following points:-

- (a) the desirability of making the report public;
- (b) method of inviting interested parties for the construction and operation of the Marina; and
- (c) the confirmation of the environmental assessment by the Territory Parks and Wildlife Commission.

This submission addresses these questions as well as the general question of a suitable site.

CONSIDERATION OF THE ISSUES

The report is a technical one and is therefore not conducive to public consumption. It has examined various sites and notes the technical issues involved. It is therefore considered that the report should not be made public, although if any interested person makes representation, access to a copy should be provided. There have been only 14 copies of the report printed and 9 of these have now been distributed to Cabinet.

The report recommends Vesteys Beach as the most suitable site. The attached comments from Territory Parks and Wildlife Commission confirms that there are no environmental factors inhibiting selection of the site.

Therefore Stage 1 can be considered completed and consideration should now be given to proceed with Stage 2 of the project which has been designed to cover the following areas:-

- . establishment of engineering criteria;
 - . preparation of conceptual plans; and
 - . preparation of estimates, costs and methods of operation.
- This will provide information on the scope of the proposal in relation to cost and a measure to compare future submissions from prospective developers.

In addition during Stage 2, the biological impact study will be further developed to take into account all environmental factors affecting the selected site. This extension will satisfy the Territory Parks and Wildlife Commissions' comments which are attached as Attachment A.

Stage 2 will also include interviews with all residents nearby the selected site to gauge their reaction to a Marina development.

When Stage 2 is completed, the Government, through Transport and Works or Lands and Housing, will be in a position to advertise for expressions of interest for the development of a complex in accordance with the Consultant's recommendations. It is considered that development proposals be examined by either Transport and Works or Lands and Housing and a recommendation made to Cabinet for final decision.

OPTIONS

The options available to Cabinet are to accept or reject the Report's recommendation. Rejection will lead to another study and further delays in the establishment of a Marina. When a site is accepted Stage 2 of the project can proceed.

PUBLIC IMPACT

There will be considerable interest shown by the public on both the decision to go ahead with the Marina and the selection of Vestey's as a suitable site. There will be inevitable criticism irrespective of what site is chosen, but it is considered that the majority of the population will endorse both the complex and site.

FINANCIAL CONSIDERATION

There are no financial implications with the exception of the Consultant's fee for which provision has been made in Transport and Works 1979.80 appropriation.

EMPLOYMENT CONSIDERATIONS

The construction phase of the project will provide employment for Darwin residents. There will be several additional employment opportunities when the Marina becomes operational.

PUBLICITY

If Cabinet accepts the recommendations an announcement can be made indicating both the selection of the site and the decision to proceed to Stage 2 of the project. A draft press statement is attached.

CO-ORDINATION

Territory Parks and Wildlife Commission's comments are attached.

RECOMMENDATIONS

It is recommended that Cabinet:-

- (a) approve the selection of Vestey's Beach as a suitable site for a Marina complex;
- (b) agree to proceed to Stage 2 of the project for the development of a Marina Complex in Darwin.

Roger Steele

ROGER STEELE

3/1/80.

Territory Parks and Wildlife Commission

(Established under the Territory Parks and Wildlife Conservation Ordinance 1976)



NORTHERN DIVISION OFFICE

P.O. Box 38496, Winnellie, Darwin
Northern Territory, Australia, 5789

Telephone: 22 0211
Telex Parks AA85336

In reply please quote
our reference

79/353

Your reference

31 December 1979

The Secretary,
Department of Transport and Works,
P.O. Box 2520,
DARWIN, N.T. 5794

Attention : Ms S. Butterworth

PROPOSED MARINA COMPLEX

The report "Marina Study Darwin, N.T." prepared by D.J. Dwyer & Associates has been examined by the Environment Unit and the following comments are relevant.

It is our understanding that this report is only preliminary to a much more detailed study of the technical and environmental feasibility of the marina proposal, and it is in this context that we have considered the information provided in the document.

We would be concerned if a final decision to proceed with the marina at Vestey's Beach depended only on the information in this preliminary report.

The report serves to canvass in a general way the principal factors involved in the establishment of a marina complex in the Darwin area, but there is not sufficient information within it to substantiate fully the conclusions put forward. What it does highlight, indirectly, is the need to examine and compare in more detail, the sites at North Mindi Beach, Vestey's Beach and Francis Bay. This has not been done adequately in the report.

There are several references in the report to the coastal management and hydrological studies carried out to examine the environmental, planning and engineering constraints to development in the coastal areas of Darwin, but there is very little evidence that this information was actually utilised in assessing the suitability of the various sites.

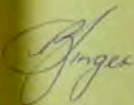
With regard to the Vestey's Beach site, for example, there is no information of any substance on sediment movement and how this could effect and be affected by marina development in the area. There is also no information as to what effect the marina will have on the stability of the beach and frontal dune system. Insufficient attention is given to the potential effects of cyclonic and other climatic conditions on the viability of a marina at Vestey's Beach. The possibility of an accumulation of stagnant water in the mooring basin and the associated health effects via mosquitoes and biting midges are not acknowledged in the report.

Although we realise that it is intended to obtain more detailed information of this nature during the proposed next stage of the marina study, more attention should have been given to these and similar aspects in the present report to enable a more balanced and realistic comparison of the various sites.

The major reason for rejecting the Francis Bay site would appear to be the existing and proposed alternative use of the area for commercial activity. However, the potential of the Vestey's Beach site to be utilised for purposes other than a marina development is not given more than passing consideration, despite the reference on page 21 to the recommendation from a recent study done by the Department of Construction, that the area be subject to further study to determine the feasibility of various development options in the area, including a possible marina.

Another aspect which should be given further consideration, is community preference. In the report only those community groups and individuals with a vested interest in the marina development have been consulted. Before a final decision is taken on the Vestey's Beach site, the wider public reaction, favourable or otherwise, to such a proposal should be canvassed, e.g. residents in Fannie Bay likely to overlook the marina and be affected by the increased vehicular and human traffic the marina would attract into the area should have some opportunity to comment on the proposal.

The need for a marina and the economic feasibility of the type of development proposed requires much more investigation and documentation than provided in this preliminary report. It is also not clear whether the marina will be a private development or partly government-backed and this could influence the scale of development, its viability and degree of public utilisation of the facility.



B. SINGER
for DIRECTOR



Marina Study Darwin, NT

D. J. Dwyer & Associates Pty. Ltd.
Consulting Engineers, Town Planners & Landscape Architects

Marina Study Darwin, NT

A Report to

Department of Transport & Works
Northern Territory of Australia

D. J. Dwyer & Associates Pty. Ltd.
Consulting Engineers, Town Planners & Landscape Architects
20 Young Street, Neutral Bay. N.S.W. 2089
Phone: (02) 908 1566

August 1979

CONTENTS

	<u>Page</u>
SUMMARY	i
<u>1. INTRODUCTION</u>	1
<u>2. MARINA DESIGN CRITERIA</u>	3
2.1 General	3
2.2 Definitions of Marinas	3
2.3 Classification of Marinas	4
2.4 Space Requirements	6
2.5 Summary	6
<u>3. SELECTION OF SUITABLE SITES</u>	7
<u>4. PLEASURE BOATING SURVEY</u>	9
4.1 General	9
4.2 Existing Facilities	10
4.3 Existing Demand	11
4.4 Future Demand	12
<u>5. SITE SELECTION CRITERIA</u>	13
<u>6. ASSESSMENT OF SELECTED SITES</u>	15
6.1 Rapid Creek	15
6.2 Ludmilla Creek	17
6.3 Vestey's Beach	21
6.4 North Mindil Beach	25
6.5 Mindil Beach Casino	28
6.6 Doctors Gully	30
6.7 Frances Bay	32
6.8 Sadgroves Creek	34
6.9 Summary	35
<u>7. CONCLUSIONS</u>	36
<u>8. RECOMMENDATIONS</u>	37

APPENDICES

APPENDIX A. BIOLOGICAL STUDY	38
APPENDIX B. CURRENT MARINA PROPOSALS	
APPENDIX C. BIBLIOGRAPHY	44
APPENDIX D. STUDY TEAM	46

LIST OF DRAWINGS

	<u>Follows</u> <u>Page</u>
1. POSSIBLE DARWIN MARINA SITES	7
2. RAPID CREEK	15
3. LUDMILLA CREEK	18
4. VESTEYS BEACH	21
5. NORTH MINDIL BEACH	25
6. MINDIL BEACH CASINO	28
7. DOCTORS GULLY	30
8. FRANCES BAY	32
9. SADGROVES CREEK	34
10. LUDMILLA CREEK MARINA PROPOSAL APPENDIX B	
11. VESTEYS BEACH MARINA PROPOSAL APPENDIX B	
12. MINDIL BEACH MARINA PROPOSAL APPENDIX B	

LIST OF FIGURES

	<u>Page</u>
1. LEISURE BOATING REQUIREMENTS	4
2. MARINA CLASSIFICATION	4
3. MARINA TYPES	5
4. USABILITY CURVE	22
5. PROPOSED BASIN AND WEIR ARRANGEMENT	22

SUMMARY

This study has been commissioned by the Department of Transport and Works, N.T. and identifies the need, design criteria and the most desirable location for a future marina in Darwin.

Specific objectives of the study are:-

1. to examine the design criteria for marinas.
2. to identify the suitable marina sites in the Darwin area.
3. to determine present and future needs for pleasure boating facilities in Darwin with particular regard to marinas.
4. to recommend the most desirable location for a marina in Darwin having regard to the following factors:-
 - . Ownership of Leases
 - . Existing Land Use Patterns
 - . Foreshore Preservation
 - . Climatic Conditions
 - . Biological Impact
 - . Engineering Feasibility
 - . Community Preference

The study examines current literature on marina development and identifies relevant factors influencing marina design criteria. In general terms, the marinas are defined as developments providing safe berths for boats and offering associated amenities and facilities. Classifications of marinas varied widely and included those based on location, function, ownership, and physical characteristics. The physical characteristics were considered the most suitable for the siting of a Darwin marina (See Section 2).

To assist in the discussions with interested groups and the assessment of sites the following criteria were determined and adopted as a basis for design:-

- . The marina would require a weir or lock mechanism to retain water at a constant level to accommodate the large tidal range in Darwin.
- . The marina would be a land-locked type with little or no breakwater construction.
- . An area of five hectares would be required for the total marina facilities.

Following an examination of previous studies and proposals for a coastal marina in Darwin, eight possible sites between Lee Point and Sadgroves Creek were identified as having the potential for a marina. The selected sites were as follows:-

1. Rapid Creek
2. Ludmilla Creek
3. Vestey's Beach
4. North Mindil Beach
5. Mindil Beach Casino
6. Doctors Gully
7. Frances Bay
8. Sadgroves Creek

Each of the eight selected sites was examined on the basis of the site selection criteria identified in Section 5, and an assessment made of the suitability of the selected sites for a marina development was made in Section 6.

The consultations with Authorities and interested groups broadly identified the boat ownership in Darwin and the likely demand for marina facilities. Existing facilities for boating are not satisfactory due to the large tidal range and wet season conditions experienced in Darwin. The tourist industry's growth indicated a growing demand in the future and that a marina would generate increased pleasure boating activity.

It was concluded that there was a need for a marina in Darwin to provide for existing and future pleasure boating activities. Further detailed investigation of this need is required to plan the size and type of facilities in the initial development.

The basic requirements for a marina in Darwin are that it provides a place where boats may be kept afloat at low tides, maintenance and repairs can be carried out, supplies can be obtained and provision is made for car parking. In addition to the basic requirements, club type facilities and a restaurant should be provided to promote usage by all sections of the community and thereby improve economic viability.

The large tidal range in Darwin is the major constraint to marina development. A land-locked basin with a weir to retain a minimum depth of water at low tide is recommended.

Two sites, Vestey's Beach and North Mindil Beach, were identified as having the most suitable characteristics for a marina with the least environmental impact. The Vestey's Beach site, however, was considered to be more favourable in view of the existing boat club facilities.

The existing boating clubs of Darwin are currently situated at Vestey's Beach, and this factor is considered to be the major issue in the selection between these two sites. It is therefore considered that the most desirable location, having regard for the factors detailed in the brief is the southern end of Vestey's Beach.

It was recommended that the following task be carried out:

1. A topographical survey on the selected site and a preliminary geotechnic report be prepared.
2. A detailed study be carried out of the pleasure boating activity in Darwin to obtain the following information:-
 - . Existing Boating Ownership
 - . Growth Rates
 - . Boat Characteristics
 - . Boat Usage
 - . Type of Chandlery
 - . Maintenance Facilities
 - . Club Usage
3. Concept plans be prepared for the total marina development and Stage 1 development.
4. A cost analysis be undertaken based on the concept plans and total budget development costs prepared.
5. An operation and management budget be prepared for assessment of economic viability.

1. INTRODUCTION

The City of Darwin with its warm climate and close proximity to large waterway areas is ideally situated for the residents to enjoy water sports and boating activity. Over recent years applications from private developers have been made to the Government Authorities for the construction of a boating marina in Darwin. However, no approval has been given by the Northern Territory Government to these proposals.

Since Cyclone Tracy, coastal management and hydrological studies have been carried out to examine the environmental, planning and engineering constraints to development in the coastal areas of Darwin. These studies established basic criteria for selection of possible marina sites.

In order to determine the needs for boating facilities in Darwin, the Department of Lands and Housing recently requested our Company to prepare a draft brief for a study of the pleasure boating needs of Darwin. The draft brief identified eight possible marina sites between Lee Point and Sadgroves Creek.

The Department of Transport and Works in June this year commissioned our Company to carry out a study for a future marina in Darwin. The letter offering the commission dated 23rd May, 1979 required the study to be carried out in two stages; the first stage to identify needs and options and the most suitable location; the second stage to develop conceptual plans and design criteria utilising the selected site.

This study considers the first stage requirements of the brief and the basic objective is to determine the most desirable location for the marina.

More particularly the objectives are:-

- (1) to examine the design criteria for marinas.
- (2) to identify suitable marina sites in the Darwin area.

- (3) to determine present and future demands for pleasure boating facilities in Darwin with particular regard to marinas.
- (4) to recommend the most desirable location for a marina in Darwin having regard to the following factors:-

- . Ownership of Leases
- . Existing Land Use Patterns
- . Foreshore Preservation
- . Climatic Conditions
- . Biological Impact
- . Engineering Feasibility
- . Community Preference

These basic factors are referred to in Section 5 of this report as site selection criteria and an examination of each site under these headings has been described in Section 6. A biological assessment of each site was carried out by Dr. K. O'Gower of Ecological Consultant Services Pty. Ltd. and this report has been included in Appendix A.

2. MARINA DESIGN CRITERIA

2.1 General

In order to identify the broad issues associated with marina development the design criteria for marinas has been researched from current literature on the topic (see Appendix C Bibliography).

These issues are described under three headings:-

- (1) Definition of Marinas
- (2) Classification of Marinas
- (3) Space Requirements

2.2 Definitions of Marinas

A number of definitions of marinas were found and three examples are given below:-

"A marina is a place where boats may be kept afloat whatever the state of the tide, where they may be reached without the use of a dinghy, where they may be maintained, fitted out, repaired, bunkered and provisioned, where their owners and crew may obtain all their essential supplies, where cars may be parked close to the waterfront and, above all, where order and efficiency prevail. The marina is a complex dedicated to boats and boating. It may form part of a village or a city waterfront, it may be the nucleus of a new community or the modest extension of a boatyard. Essentially the marina is intended to make boating more attractive, more convenient, and more enjoyable." (Webber 1972)

"The term marina is now understood to refer to the development supporting and including a boat harbour or moorings, and providing necessary amenities and facilities. It can be located by fresh or salt water; on a river, canal, estuary or on the coast; cover one acre or eighty acres, and be planned for river boats, luxury motor cruisers or deep-sea sailing craft. It is, however, basically a recreational venture and not a commercial port, but should provide a secure and protected haven." (Head 1974)

"The word 'marina' is defined as meaning 'a modern waterfront facility for recreational boats' and was coined in 1928 by the National Association of Engine and Boat Manufacturers Incorporated of America. The Association further described the term as being a facility offering services which have come to be part of modern boating: a place where boatmen may berth, launch, repair, fuel and provision their craft conveniently and be able to have a hot shower, dine ashore and be within easy reach of shops, communications and transport. Notwithstanding this description, the word is commonly and wrongly used as meaning any collection of moorings no matter how casually located, how small their number, how poor their quality or how under-provided they may be with even the most rudimentary services." (Adie 1975)

The scope of these definitions is particularly wide and the specific requirements for the Darwin marina are described later in this report.

2.3 Classification of Marinas

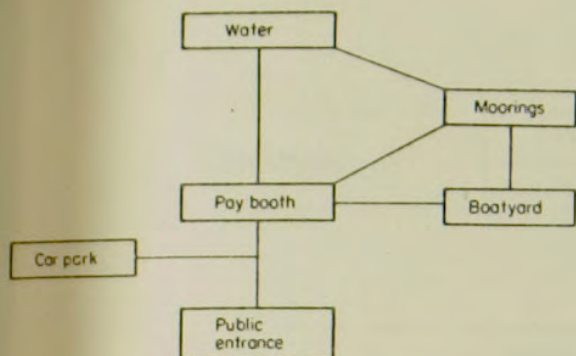
As with definition, a number of ideas on the classification of marinas can be found in the literature.

Mills (1976) identifies three types of leisure boating and provides the basic requirements of each type. These types are shown in Figure 1.

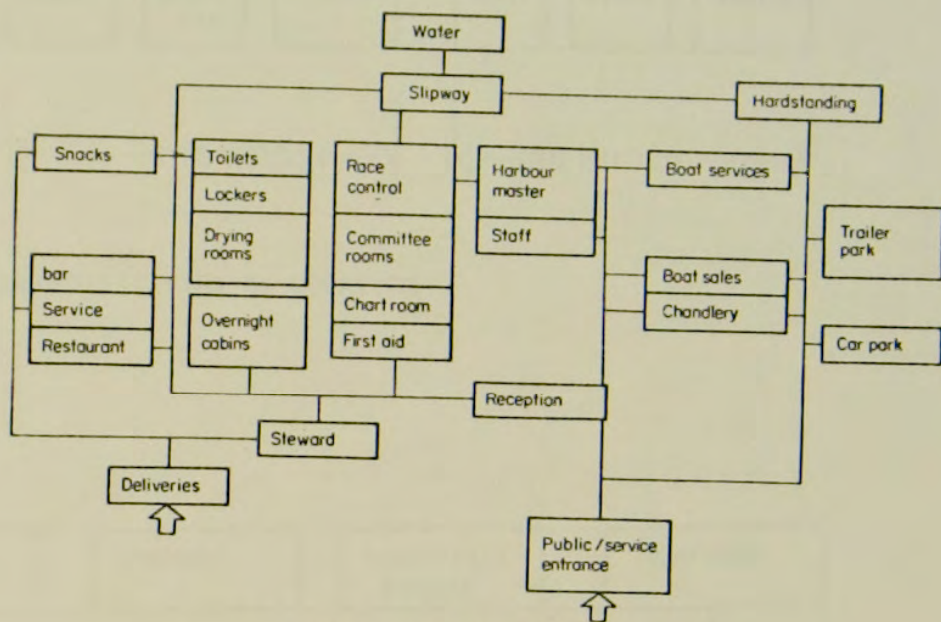
Adie (1975) suggests marinas can be divided into several different categories and two of these based on location and ownership are shown in Figure 2.

To these may be added distinctions of size, sailing area, general quantity of facilities, function, fees and other charges related to the service provided and the kind of boat and owner.

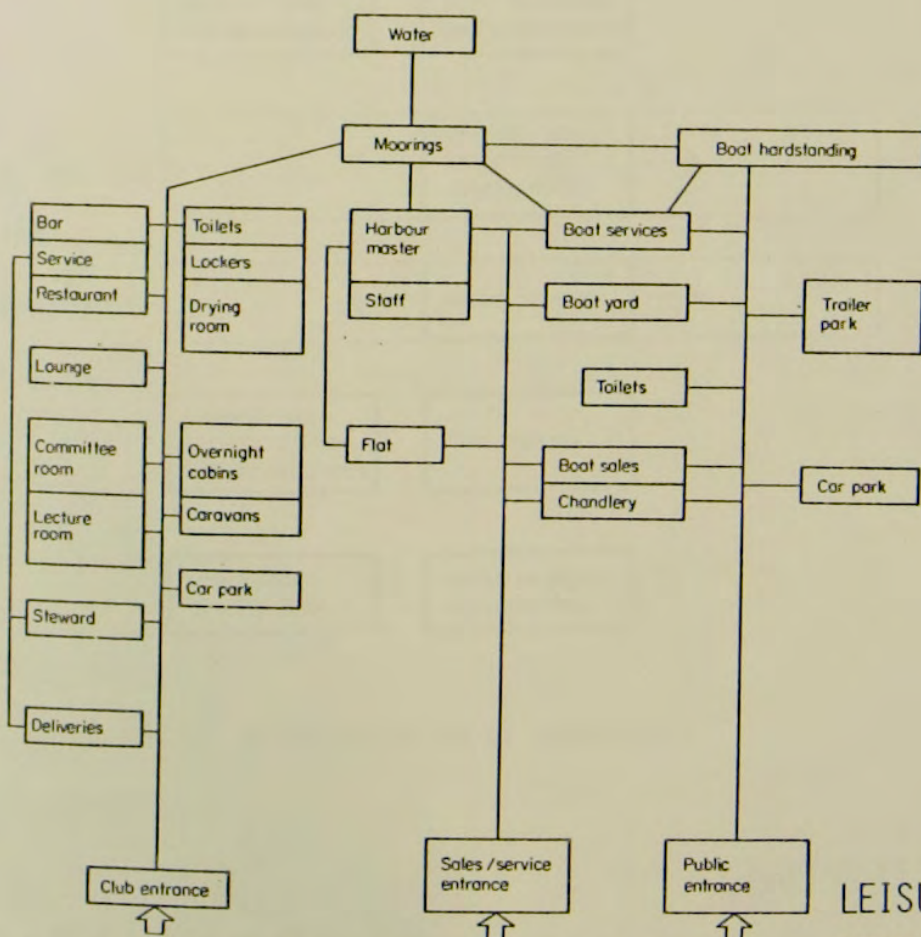
The function, shape and size of marinas varies considerably and is highly flexible, dependent primarily upon the factors mentioned above, each tailored to the constraints and opportunities of the site and serving the needs of local boat owners.



Casual and by-the-hour boating



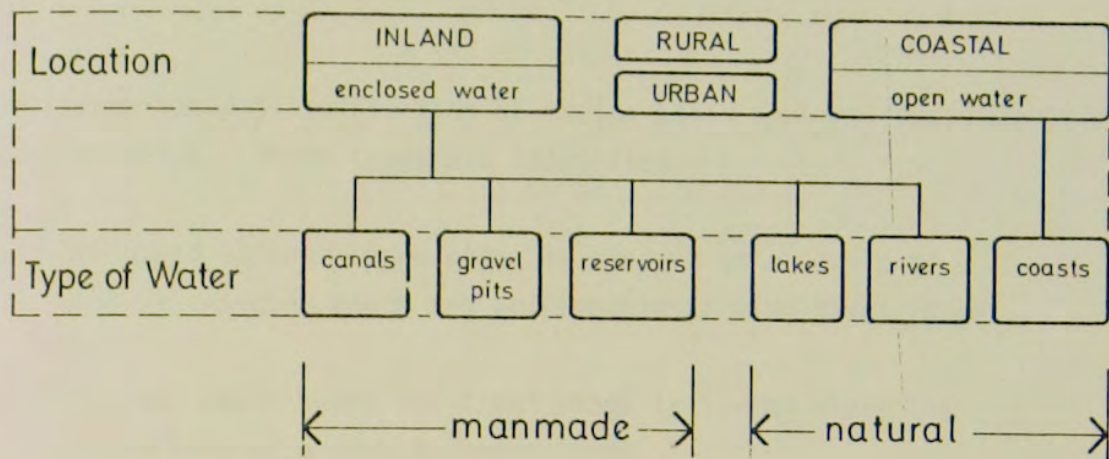
Day and weekend boating (offshore cruising, all racing)



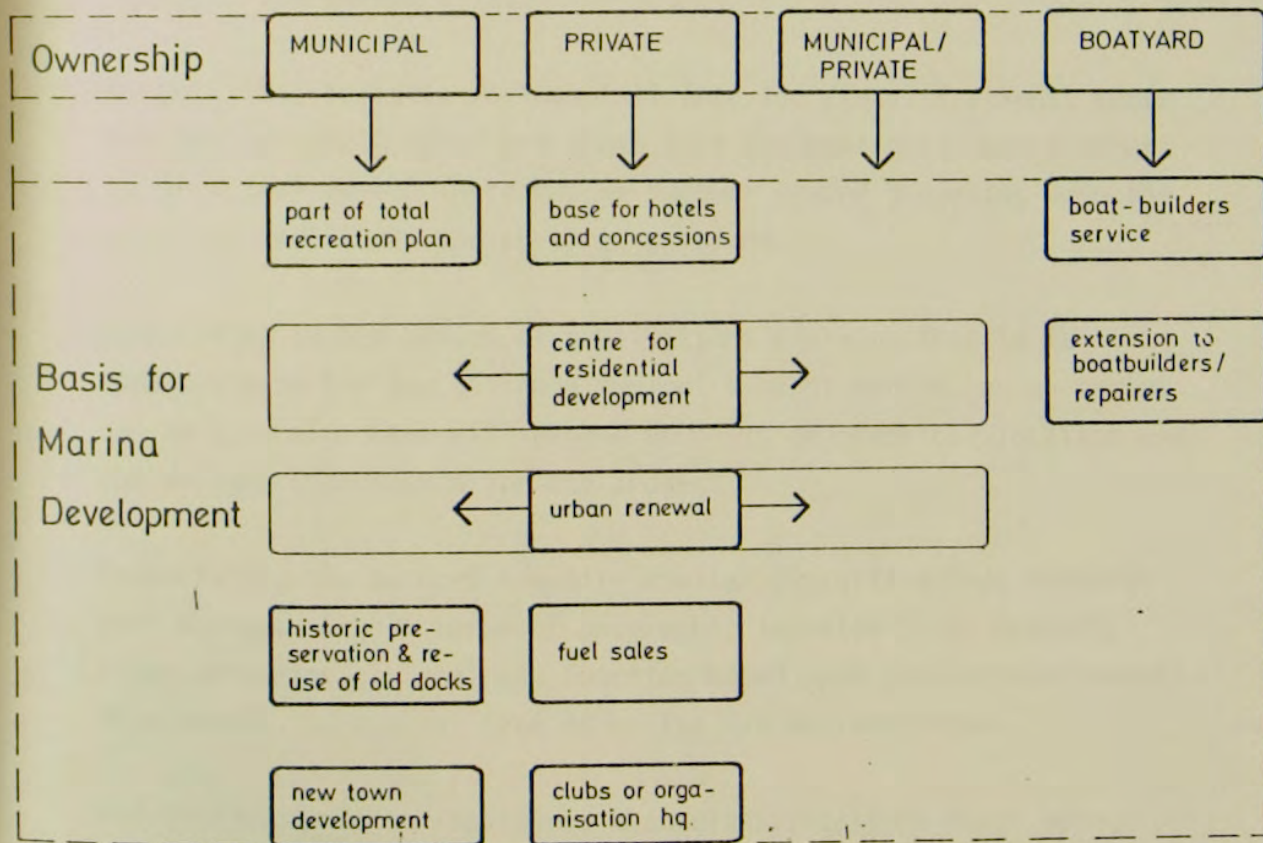
Source: MILLS (1976) Full scale holiday cruising (upriver, inland waterways)

LEISURE BOATING
REQUIREMENTS

FIG. 1



CLASSIFICATION BY LOCATION



CLASSIFICATION BY OWNERSHIP

DIAGRAM 2

MARINA CLASSIFICATION

Source: ADIE (1975) p.39

FIG. 2

Adie recognises a classification of marina based upon physical characteristics. Three types are identified:-

- (a) The locked harbour where water is trapped at a constant level or designed range and accommodates a wide tidal range.
- (b) The tidal basin where the tidal range is low or where the construction of a lock is impractical.
- (c) The haul-out marina where boats are stored on hard standing. This facility requires equipment to enable boats to be placed in and removed from water.

The classification type (a) is the physical characteristic applicable to the Darwin marina sites.

Chaney (1961) believes marinas fall into two classifications, those that are privately owned and those that are publically owned or of the municipal type. These may be further graded depending upon the extent of facilities and services provided.

Head (1974) in his series of publications explains that it is impossible to try and define a typical type of marina, as no marina can be typical. Each will depend upon its geographical location and the design requirements for the project.

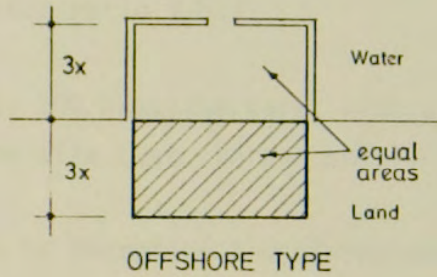
Essentially, the authors identify similar classifications although most marinas vary in terms of geographic location (e.g. coastal, river estuaries, inland) and function based upon design requirements. As a result, no typical type of marina can be identified.

For this study it is considered that classifications based upon physical characteristics are much more suitable for siting and design purposes. Four types suggested by Adie are illustrated in Figure 3 and for the Darwin coastline the land-locked type is considered the most suitable.

Land-to-water relationship

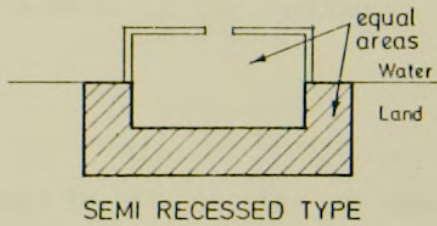
The land-to-water area in each case remains equivalent and constant but the shapes and relationships vary as the land wraps around the water. The off-shore marina has the shortest land/water interface but some land is 3 times further from the water than with the land-locked type

Advantage
 Minimum bulkhead wall
 Minimum land take
 Minimum dredging



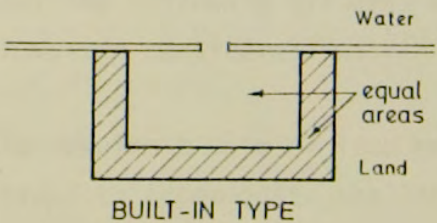
Disadvantage
 Expensive in deep water
 Vulnerable to weather, currents
 Navigation hazards
 Minimum enclosure
 Silting by littoral drift

Advantage
 Good for cut-and-fill economics



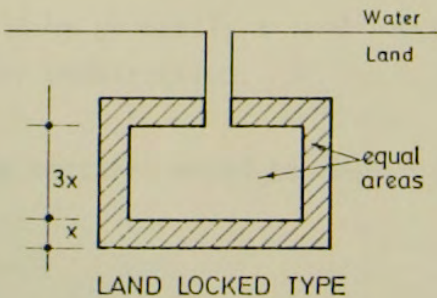
Disadvantage
 Navigation hazard

Advantage
 Uninterrupted shore-line
 Large land/water interface
 Considerable enclosure



Disadvantage
 Large land take
 Length of bulkhead wall
 Amount of dredging

Advantage
 Maximum enclosure
 Minimum interruption of shore-line



Disadvantage
 Maximum bulkhead wall
 Distance from open water

2.4 Space Requirements

In order to determine the area requirements for the basic elements of the marina, a review of the generalised land/water space requirements was carried out.

The following assumptions were made for the calculations:-

1. Overall land/water ratio 1.5:1
2. Storage capacity 100 boats/hectare, with a requirement for 200 boats of varying size (wet storage only).

The total site area is therefore 5 hectares comprising 2 hectares of water area and a land area of 3 hectares. Included in this 5 hectares is approximately 1 hectare for car parking.

2.5 Summary

The aspects considered in this section are general characteristics of marinas. In order to test the reaction of the various interested groups to the proposal the following criteria were adopted at this stage as a basis for design considerations:-

- (1) The marina would require a weir or lock mechanism to retain water at a constant level to accommodate the large tidal range in Darwin.
- (2) The marina would be generally a land-locked type with little or no breakwater construction.
- (3) An area of five hectares would be required for total marina facilities.

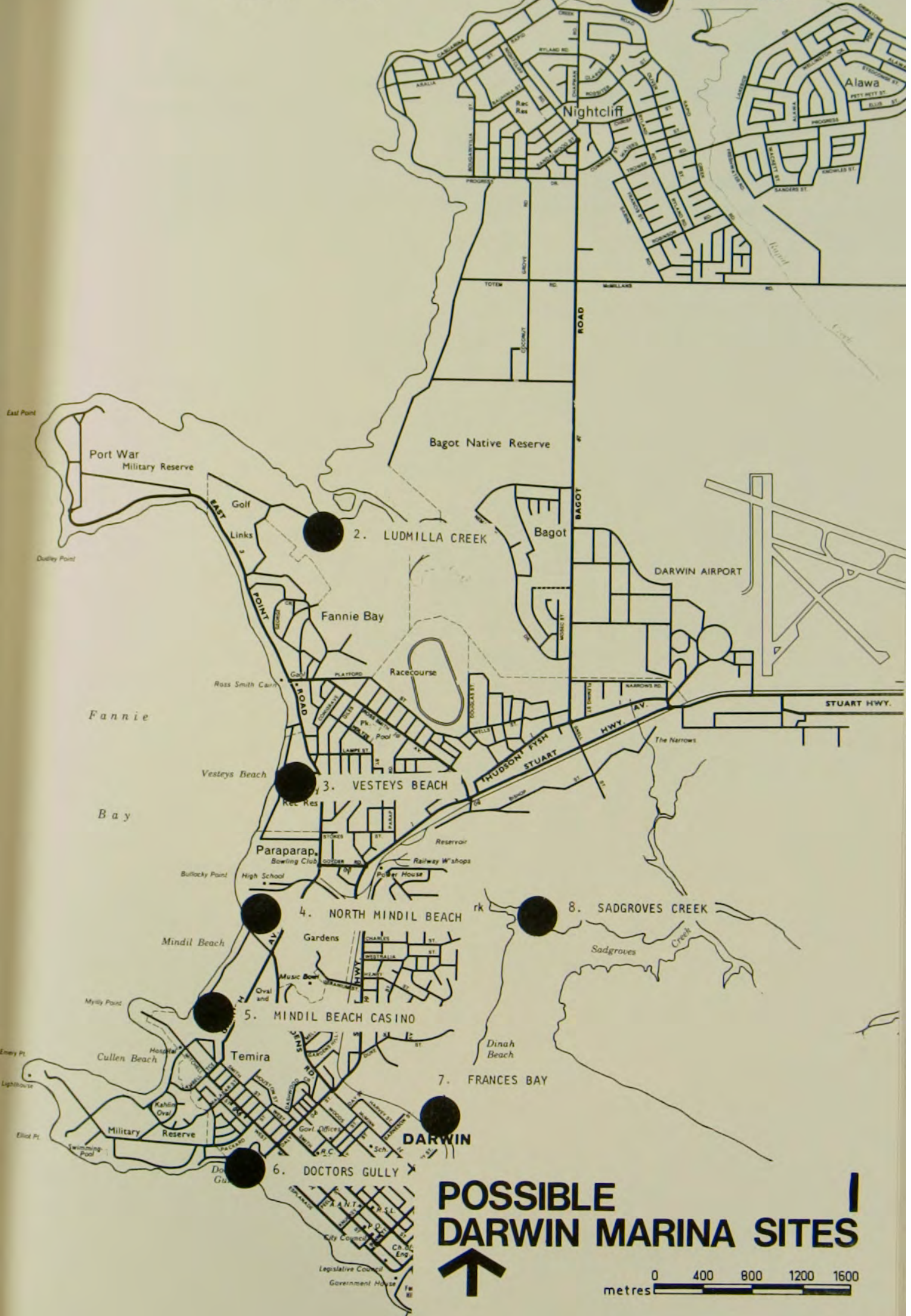
3. SELECTION OF SUITABLE SITES

In recent years there have been a number of proposals put forward to Government for the construction of a coastal marina in Darwin. Many sites have been suggested between Lee Point and Sadgroves Creek and with this background information and reference to recent reports on coastal activities, an inspection was made of the coastline.

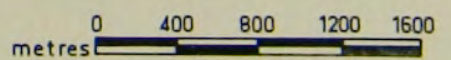
The sites that have been suggested over the years all had various reasons for their selection and no new sites were considered worthy of further investigations.

The selected sites shown on Drawing 1 were as follows:-

1. Rapid Creek - This site is a popular recreational area at the mouth of Rapid Creek and was considered for possible inclusion in the overall planning of the Rapid Creek Recreational Area.
2. Ludmilla Creek - Beachside Developments Pty Ltd has recently applied to the Government for the construction of a marina near the existing boat repair business "Spot On Marine".
3. Vestseys Beach - Mr. Peter Dermoudy, Architect, on behalf of Mr. L. Frankenfeld has put forward proposals for the construction of a marina "Can Tiki" north of Conacher Street and adjoining the Sailing Club.
4. North Mindil Beach - Mr. Peter Dermoudy has submitted a proposal for a marina at the extreme northern end of the beach between Liveris Drive and Darwin High School.
5. Mindil Beach Casino - A potential site exists adjoining the proposed casino at the southern end of the beach.
6. Doctors Gully - This site has been considered for boating activity for some time and is situated in a deep water inlet on the southern coastline.
7. Frances Bay - A traditional site for Darwin boating near the commercial fishing and Port Authority Leases.



POSSIBLE DARWIN MARINA SITES



8. Sadgroves Creek - A deepwater creek off Frances Bay, used for the mooring of boats.

All eight sites were identified as having potential for the construction of a marina and the criteria for selection of the sites are described in Section 5.

4. PLEASURE BOATING SURVEY

4.1 General

Preliminary investigations into existing and future demand for pleasure boating facilities indicated that no accurate information was available. It was decided that a reasonable assessment of these needs could be obtained from consultation with interested groups and Government Authorities. This information would then be used for the selection of a suitable marina site. However, it was considered that before the design of any facilities is carried out, further study of the existing and future demands will be required.

Representatives of the following groups were interviewed and their views recorded. Opinions regarding each of the possible marina sites was also obtained.

Government Authorities: N.T. Department of Transport & Works
 N.T. Port Authority
 N.T. Department of Lands & Housing
 N.T. Department of Industrial Development
 N.T. Tourist Bureau

Interested Groups: Darwin Sailing Club
 Darwin Trailer Boat Club
 N.T. Water-Ski Club
 Charter Boat Owners

Private Developers and
 Consultants : Gordon Onn - Spot On Marine
 Peter Dermouly - Architect
 Roger Veness - Consulting Engineer

4.2 Existing Facilities

The main pleasure boating facilities in Darwin are located at Vestey's Beach in Fannie Bay. Three boating clubs operate from leased land adjoining the beach namely the:-

Darwin Sailing Club
Trailer Boat Club and
N.T. Water-Ski Club

The clubs have the normal facilities such as club rooms, bar and showers but there is little covered storage for boats and no wet marina type storage.

Three boat ramps are located opposite the Vestey's Beach clubs and the Port Authority recently constructed a fourth called the "Doyle Ramp", a full length concrete structure at the southern end of the beach off Conacher Street, near the Water-Ski Club.

All three Vestey's Beach ramps require upgrading and are not usable in the wet season. In addition to the Vestey's Beach ramps there is one at Frances Bay and another at Nightcliff. The Frances Bay ramp is not suitable for recreational use. However, it is considered the only ramp usable in the wet season. The Nightcliff ramp is difficult to use at certain tides and requires improvements.

Large sailing and motor craft are moored in Fannie Bay during the dry season and are removed by crane to dry storage on club grounds for the wet season. The cost of crane hire per boat is in the order of \$200. Large craft also use the Darwin Port facilities from time to time but these areas are normally reserved for commercial activities.

Sadgroves Creek is also used for the mooring of boats and is considered a deep anchorage with good protection from storms.

A boat repair facility is located at Ludmilla Creek where a few boats are moored and repairs carried out.

4.3 Existing Demand

It is estimated that there are approximately 200 large boats in Darwin and approximately 100 of these would use the wet storage facility or a marina. There are approximately 100 of the large boats moored in Fannie Bay and many of these boats would probably use the marina.

There were 850 registered power boats in Darwin in 1977/78 which increased to 1,000 in 1978/79. However, these figures include small dingies with motors and it is considered that very few of the registered boats would use the wet storage of a marina. These figures also included sailing craft with auxiliary motors.

The Trailer Boat Club members either take their boats home or leave them at the club. Of the 450 club members, it is anticipated that only about 12 boats would use the wet storage. Therefore whilst the club members would use the general facilities of the marina such as restaurants and chandlery, very few would rent a berth.

The N.T. Water-Ski Club has approximately 400 members with a total of 35 boats, with 75 members who are active skiers. It was generally considered that very few members would use the berthing facilities of the marina. A further constraint to usage would be the rental fees charged and the facilities provided. This aspect is discussed later in the report.

Difficulties are experienced by boat owners in getting on and off small craft from the existing boat ramps and in general these facilities are not suitable for the larger boats. The charter boat industry is growing in Darwin and will continue to grow whilst tourist facilities are improving. However, operation of a charter service from the existing boat ramps is not satisfactory.

4.4 Future Demand

There has been a general increase in Darwin boat usage in recent years and this growth has occurred in other parts of Australia. The tendency is to the larger type of boat that is more suitable for marina storage.

There are a number of sailing craft that visit Darwin each year and a figure of 25 boats was estimated to be the current number of itinerant craft. It is considered that if marina facilities were available, visiting craft would increase.

The boating activity in Darwin is mainly private, however, growth in charter boating is occurring and would increase if marina facilities were available.

The attractions for charter tours are both the scenic views from the waterways and the excellent fishing at places such as Perron Islands. About half a dozen boats are currently operating charter services and it is considered that these numbers would also increase if access to the boats from a marina was available.

Current population and boating statistics and growth rates need to be examined in a further study to forecast more accurately the number of boats that would use a Darwin marina.

5. SITE SELECTION CRITERIA

In order to recommend the most desirable location for the marina each site was assessed based on a number of site selection criteria.

In general, the characteristics to be considered are the basic town planning, engineering and environmental development constraints detailed in Section 1 and described below:-

Ownership of Leases

Identification of ownership within each possible site together with any future proposals by Government Authorities.

Existing Land Use Patterns

The regional context of the site together with the area of available land. Detailed examination of topographical, vehicular access and engineering services also need to be considered.

Foreshore Preservation

In recent years investigations have been carried out on foreshores in the Darwin area and a coastal management policy is being developed. Consideration is required about the work already carried out and proposed by the various Government Authorities.

Climatic Conditions

The climatic conditions for both the wet and dry seasons in Darwin are factors affecting site location. The prevailing winds during the sailing season require investigation for each site together with any protection afforded during the wet season.

Biological Impact

A biological study of each site is required to determine the impact of marina construction on aquatic and terrestrial life in the area. A preliminary study has been carried out in Appendix A.

Engineering Feasibility

This is the major factor governing the economic issues associated with particular sites, and broad cost factors require assessment. In addition to the hydrological and coastal engineering, issues such as tidal range, currents and cyclonic surge, coastal erosion, littoral drift and construction issues need investigation.

Community Preference

This includes views of interested groups and organisations associated with boating activity, and impact on the activities of nearby residents, including property values.

6. ASSESSMENT OF SELECTED SITES

6.1 Rapid Creek

Description of Site

The proposed site forms part of Portion 6247 at the mouth of Rapid Creek and is Crown Land zoned open space recreation (see Drawing 2). It is a gently sloping grassed area at the rear of the coastal dune of the Casuarina Beach and a popular informal recreation field used for activities such as kite flying, model plane flying and archery. Small boats can be launched into Rapid Creek from the attractive sandy banks.

Residential development is a considerable distance from the proposal and the marina would be visually pleasing for the residents of houses fronting Rapid Creek Road.

Vehicular access would be from the north and ample area is available for all marina facilities including parking.

Site Analysis

Because of the close proximity of the frontal dune to Casuarina Beach the site is highly sensitive to the movement of sand in the area. The Territory Parks and Wildlife Commission have carried out protective measures in recent years to prevent sand movement on the dunes. Structural measures could be taken with a development project to ensure the stability of the area, however, interference with sand in the area is not desirable.

The site is particularly exposed and would be subject to the wet season winds but would be suitable for general boating activity in the dry season.

Biology

The biological study in the Rapid Creek area indicated a high degree of aquatic habitat potential and a medium potential for terrestrial habitat (see Appendix A).

BEAGLE GULF

Casuarina Reserve

Beach

Darwin Community College

SITE

Creek

Rapid

Mangroves

CASUARINA

DRIVE

Rapid

RAPID

Housing

CREEK ROAD

Ck

Mangroves

LAKESIDE

Housing

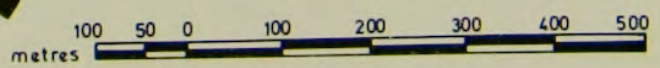
Title and Ownership:
Part POR 6247, Crown Land.

Zoning:
Open space recreation.

Area:
Approximately 5 hectares.

RAPID CREEK

2





1. VIEW OF RAPID CREEK SITE



2. VIEW OF RAPID CREEK AND NIGHTCLIFF

The combined biological impact when compared with the other possible marina sites is shown in the following table from the study. The lowest assessment has the least detrimental biological impact.

Locality	Summed Assessment	
Vesteys Beach	2	low
Mindil Beach	2.5	
Frances Bay	2.5	
Mindil Beach Casino	4	
Rapid Creek	5	
Sadgroves Creek	5	
Doctors Gully	6	
Ludmilla Creek	6	high

POTENTIAL BIOLOGICAL IMPACT (see Appendix A)

Engineering Feasibility

The major issue to be considered with this site was the sand movement at the entrance to Rapid Creek and possible erosion problems.

The storm tide levels at this point are also the highest in the Darwin Coastal area. The following table shows the storm tide levels for various sites in Darwin from a Department of Housing and Construction report on storm surge at Darwin, 1975.

SITE	STORM TIDE LEVEL (TOWN DATUM) IN METRES	
	1% Probability of Exceedence (Metres) $\frac{1}{100}$ Primary	Recommended Level Secondary 0.1% Probability of 1 Exceedence (metres) $\frac{1}{1000}$
Open Coast (Casuarina)	9	10
Rapid Creek, Ludmilla	9.5	10.5
Cullen Beach		
Frances Bay	8	9

STORM TIDE LEVELS AT VARIOUS SITES, DARWIN

The details of the marina design for this site would be similar to those described later in this section for the Vestey's Beach site.

The likely excavation costs for the marina mooring basin would be relatively low in comparison with the other selected sites assuming sand excavation only is required.

The access road to the site would require upgrading and sealing to provide for the increased traffic and usage of the area.

All other costs would be comparable with the most economical of the other possible sites.

Consultations

The views of the groups interviewed for this site were basically that the area was ecologically sensitive and not suitable. However, it is convenient to the northern suburbs and support for a club or facilities in this area could be forthcoming if a suitable proposal was put forward. The existing boating clubs have a considerable investment at Vestey's Beach and whilst half the membership is in the northern suburbs the beach sites of Fannie Bay would be preferred.

Conclusions

In general the site is well situated for the marina type of recreational activity. The problems of erosion and sand movement at the mouth of Rapid Creek are not well-known and further study would be required to determine engineering constraints.

The ecological issues of frontal dune movement and the measures taken by the Government to preserve this area indicate that this site is not suitable without "hard" engineering solutions to these problems.

6.2 Ludmilla Creek

Description of Site

This site, shown on Drawing 3, has been proposed by Beachside Developments Pty. Ltd. in a development application to the Government and adjoins the existing commercial boat repair development on Portion 3522. A copy of the proposed layout, Drawing 10, is included in Appendix B of this report.

Portion 1791, the proposed mooring site is Crown Land zoned open space conservation and Portion 3522, owned by Beachside Developments is zoned open space organised recreation.

The site adjoins Ludmilla Creek on the edge of a mangrove swamp and the proposed marina basin is located on an old salt extraction area. Access to Beagle Gulf is along the Ludmilla Creek which has a boating channel possessing a high percentage usability.

There are no residential areas in the vicinity, the site is flat and access is by a gravel road from East Point Road.

Site Analysis

The area around the site is subject to sand movement and deep holes are known to exist. A study of soil conditions and sand movement would be required before accurate judgements could be made regarding the water access requirements.

No mention of this area has been made in recent reports on foreshores in Darwin and in general the area appears to be stable without environmental problems when considered from a coastal management viewpoint. This view could change with the construction of a marina which may effect the movement of sand in the area.

The wet season winds affect this area. It was described by a boating person interviewed as a choppy bay, Ludmilla Creek being more exposed to the north-west winds than the Fannie Bay beaches.

There is no particular problem with the dry season winds in this area.

BEAGLE GULF

Sand bars

Mangroves

Ludmilla Creek

Ludmilla

SITE

Access

BEACHSIDE DEV. P/L PROPOSAL

Housing

CRES

ROAD

GEORGE

Title and Ownership:

POR 1791, Crown Land

POR 3522, Beachside Dev. P/L

Zoning:

POR 1791, Open space conservation.

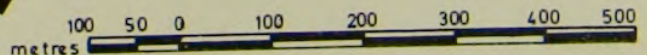
POR 3522 Open space organised recreation.

Area:

Approximately 9 hectares.

LUDMILLA CREEK

3





3. VIEW OF LUDMILLA CREEK



4. EXISTING FACILITY AT LUDMILLA CREEK

Biology

The biological study indicated that this area had the highest biological potential and therefore a high environmental impact on aquatic and terrestrial life.

Engineering Feasibility

The sand movement and erosion potential of the site require special study as indicated for Rapid Creek. Storm surge as in Rapid Creek is high.

Excavation of the basin by dragline would be economical and material would be disposed of on site. The proposed development is staged and provides direct access to Ludmilla Creek for small boats with tides from 3.6 metres and above. The sides of the excavation for the marina basin will require support, however, constructional details of the proposal have not yet been determined. No weir mechanism is to be used in the system and therefore usability is less than the Fannie Bay proposals described in the next sub-sections.

The consultant for the developers advised that the estimated cost of Stages 1 & 2 would be approximately \$1 Million and the anticipated income from 100 sites would only cover the maintenance and interest on capital. A further amount would be required for road access improvements. Government assistance is therefore required for the viability of this proposal.

Consultations

The site has no visual impact on the residential areas and as previously indicated, the boating clubs prefer the Vestey's Beach area. However, this area could receive support from persons requiring less facilities and the ability to carry out boating repairs. Details of the facilities required for a marina in Darwin are necessary before a judgement on this issue can be made.

Conclusions

The site is not visually attractive and the proposed marina has fewer facilities than the Vestey's and Mindil Beaches proposals. The site is subject to further study on sand movements and engineering requirements

before the submitted proposal could be considered. Biological impact is high and, in general, those interviewed did not favour the site. The estimated costs are reasonable but it is not commercially viable without Government assistance.

6.3 Vesteys Beach

Description of Site

The most suitable location for a marina at Vesteys Beach is shown on Drawing 4 and a proposal named "Can Tiki" on this site has been prepared by Mr. P. Dermoudy, Architect, on behalf of Mr. L. Frankenfeld (see Appendix B, Drawing 11).

The proposed site Portion 3497 is Crown Land and zoned open space organised recreation.

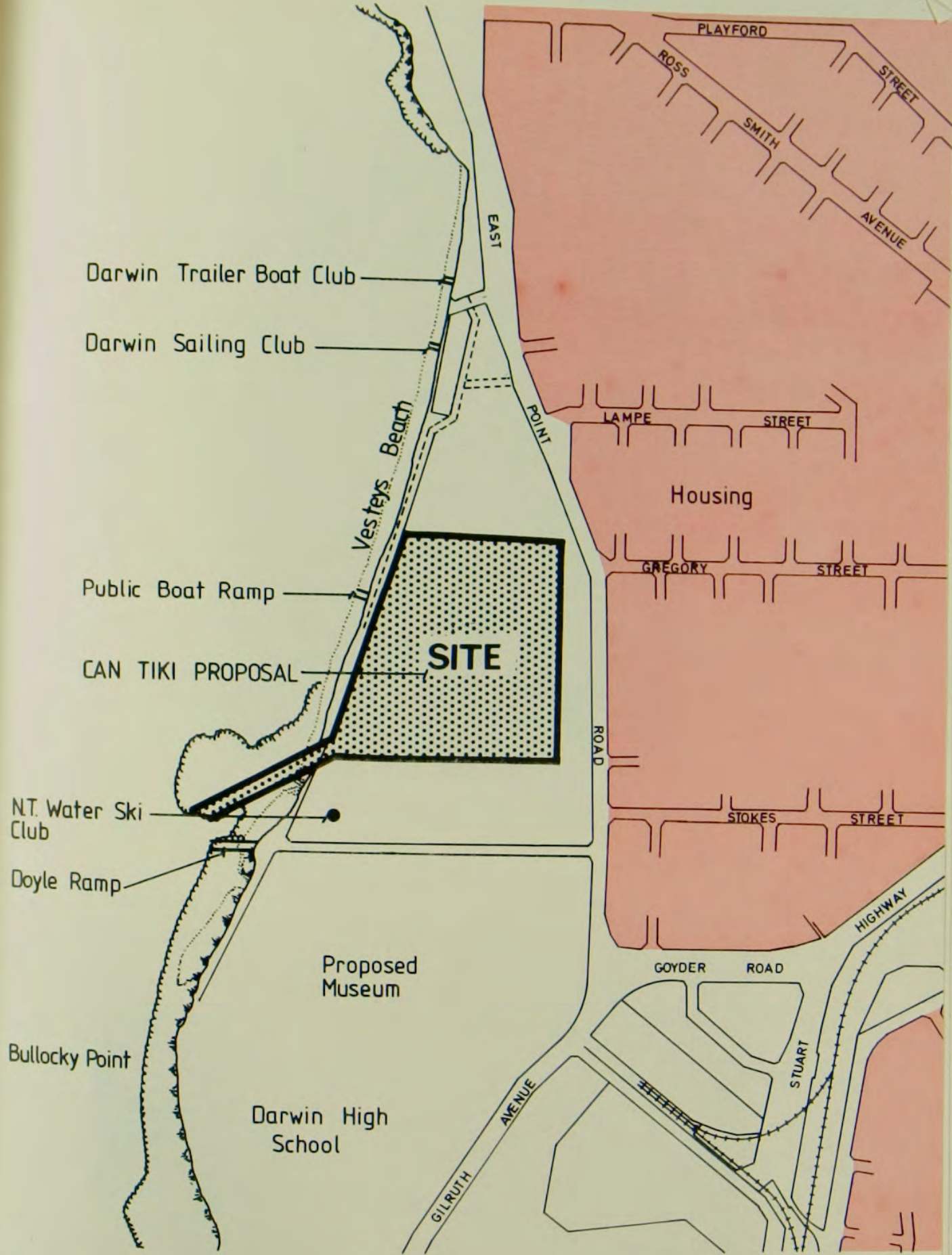
The area at Vesteys Beach is wedge-shaped and is a natural drainage basin for the surrounding residential area with an outlet at the southern end of the site. The site adjoins the boating clubs of Darwin on the coast and the area for the marina is a filled swamp subject to periodic inundation with only small areas of significant vegetation remaining near the outlet of the existing creek.

The proposed museum for Darwin is located south of Conacher Street and will be a compatible land use to the marina. Tourist activity will be encouraged to the Fannie Bay beach area with the attractions of proposals such as a marina, museum, casino and the existing Botanical Gardens.

Site Analysis

The swamp area of the site is a suitable location for the mooring basin of the marina and the entrance to Fannie Bay would be a rock channel at the southern end of the Beach. Recent studies on the foreshores of Darwin prepared by Commonwealth Department of Construction for N.T. Department of Lands and Housing have clearly recommended that the Vesteys Beach hinterland be subject to further study to determine the feasibility of development options in the area including an ornamental lake parkland and possible marina. The present state is unattractive and the natural depression is a breeding ground for mosquitoes.

Members of the boating clubs and the public have access to four launching ramps on this beach and it is the main boating activity area in Darwin. Because of these activities it would appear to be the ideal location for a marina.



Title and Ownership:
 POR 3497, Crown Land
 Zoning:
 Open space organised
 recreation.
 Area:
 Approximately 9 hectares.

VESTEYS BEACH **4**

↑

100 50 0 100 200 300 400 500
metres



5. VIEW OF VESTEYS BEACH



6. VESTEYS BEACH AND DUDLEY POINT SHOWING
BOAT MOORINGS

Consideration of the frontal dune area is an important factor on all coastal areas and the man-made structures, and many intrusions into this dune area have occurred on Vestey's Beach. In general, it is considered that this site is suitable for a land locked type marina subject to environmental controls that have been detailed in the coastal management studies referred to in this report.

Rapid Creek and Ludmilla Creek are more exposed to the wet season winds than all sites in Fannie Bay and therefore the Fannie Bay sites are preferable. The dry season winds are comparatively safe for Fannie Bay boating and in general this area is well located from the climatic viewpoint.

Biology

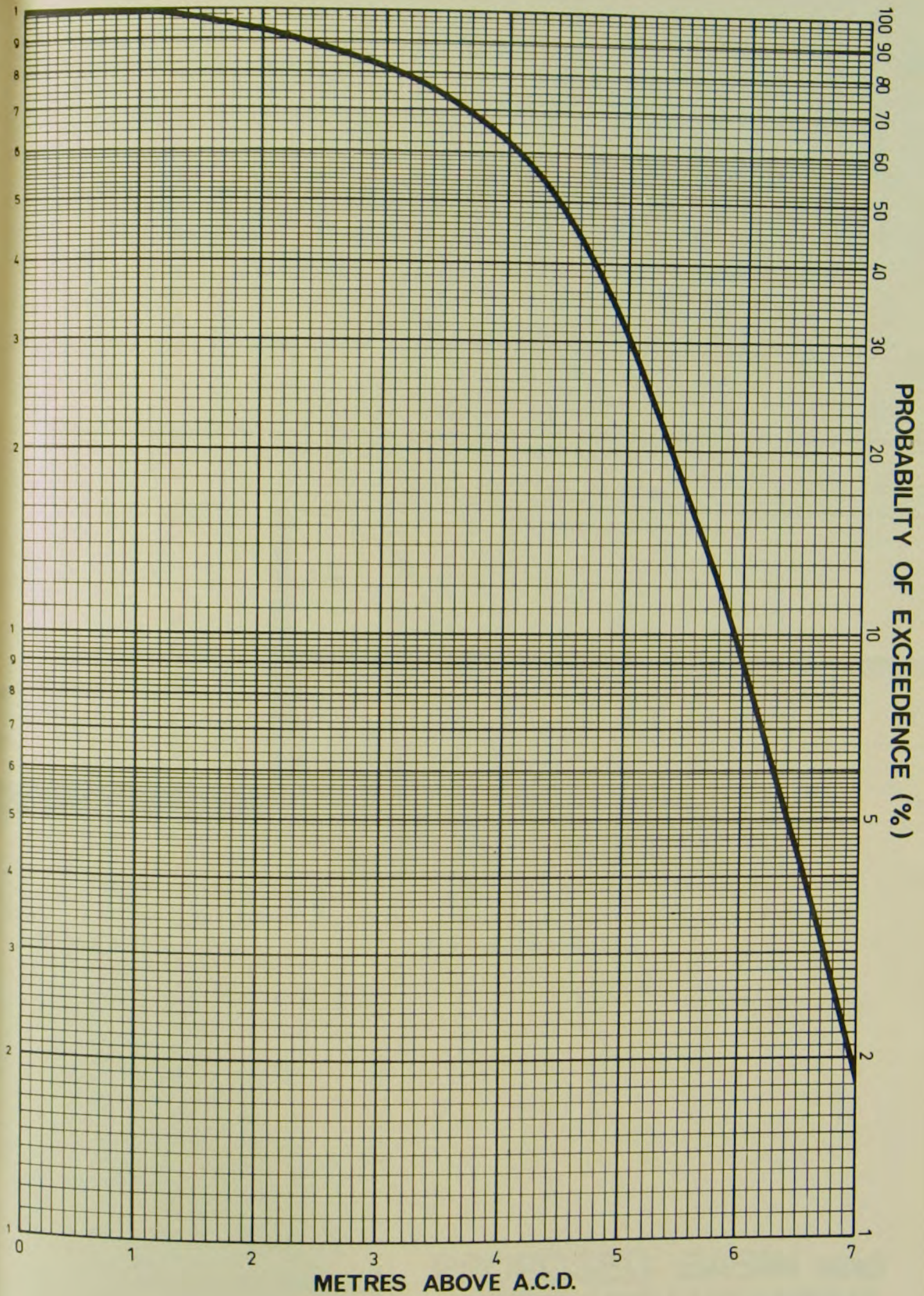
The biological study indicated that this site of all those studied had the least biological impact and was therefore most suitable from this viewpoint for development of a marina.

Engineering Feasibility

The proposal by Mr. P. Dermoudy for this site has been examined and it is considered that the mooring basin and the outlet to the sea are located in the most suitable position. Details of treatment to batters and walls that would be required are not shown in the proposal. The proposal indicated in the sketch plan Drawing 11 is for a large mooring basin which would be far in excess of the current needs for Darwin. However, the basic geometry of the proposal is considered satisfactory.

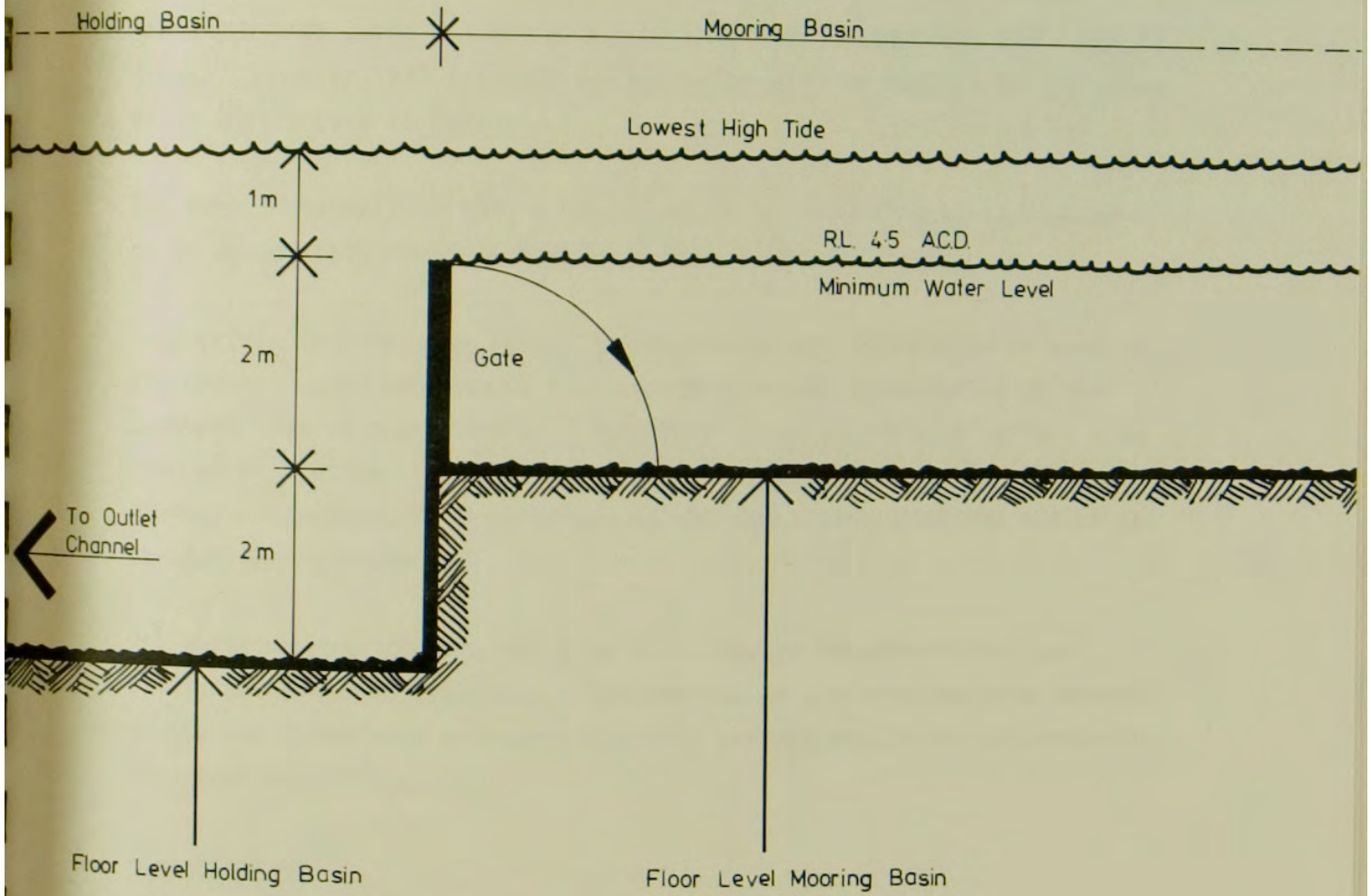
The layout consists of an outlet channel at low tide level with a usability of approximately 90%. (See curve in Figure 4 showing metres above Admiralty Chart Datum (ACD) vs Probability of Exceedence). The channel is connected to a holding basin at the low level capable of storing temporarily all boats that enter at the lower tide levels.

A higher level basin, the mooring basin, has a floor level approximately two metres above the holding basin. A two metre high weir with a hinged gate connects the two basins. The levels of the respective basins are shown in Figure 5 and the usability of the mooring basin is approximately 50%.



USABILITY CURVE

FIG. 4



PROPOSED BASIN and WEIR ARRANGEMENT

FIG. 5

The operating technique is to use the holding basin to enter the marina from the sea when the tides are low, and when the tide has reached R.L. 4.5 the weir gate is dropped and the boat is transferred to the mooring basin and berthed. This method of operation is considered to be the most suitable to overcome the large Darwin tidal range and the engineering feasibility for each site has been based on this type of marina.

The storm tide surge in Fannie Bay is less than Rapid Creek and Ludmilla Creek. However, all possible marina sites will be subject to the storm surge that occurs in Darwin.

The outlet channel for this proposal would be on the rocky section of beach immediately north of the Doyle boat launching ramp.

Sand drifts in this area appear to be minimal and deposition of sand in the channel could be reduced to acceptable levels by mounding on the northern side of the channel. The beach slope is steeper in this area than other sections of Fannie Bay and well-suited for the marina outlet. Minimal disturbance will be caused to the beach area with the outlet at the extreme southern end.

The existing road through the site will require reconstruction and provision of new access roads. Excavation of the site would be minimal in the low lying area and costs for this project should be comparable to the other possible sites.

Consultations

The interested groups clearly were in favour of this area. The location next to the boating activity is a major factor for the popularity of the site. The views of residents that overlook the marina should be sought before further design details are determined.

Conclusions

The proposed marina site is a filled swamp and adjoins the major boating activity for the Darwin area. In general the boat owners likely to use the marina facilities are members of the existing clubs or those who have a boat moored in Fannie Bay. The location is suitable and access is provided from East Point Road.

Of all possible sites the biological impact is lowest at Vestey's Beach. The outlet channel and existing levels of the site for the holding basin are suitable only for a land-locked marina. The anticipated cost of the facilities is comparable with all other sites investigated, however, the economic viability would be subject to further examination.

6.4 North Mindil Beach

Description of Site

The site under consideration is part owned by the N.T. Government (Por 3716) and part Crown Land (Portion 3481) with the land use zoning comprising special purposes and open space (see Drawing 5). It is located between the existing sealed access road, Liveris Drive and the Darwin High School with direct access available from Gilruth Avenue.

A proposal by Mr. P. Dermoudy, Architect, for a marina at the northern end of Mindil Beach is currently being considered by the Government and Drawing 12 in Appendix 2 shows a perspective view of the proposed development.

In recent times part of the site has been filled with rubbish and has been built up to a level higher than the natural surface levels. The open drain from the Darwin Botanical Gardens flows through the site and enters the sea at the northern end of Mindil Beach near Bullocky Point. A rocky shelf extends some 600 metres from high tide level to low tide. There is no significant vegetation on the filled area of the site however, some natural growth extends on the northern side of the watercourse adjoining the Darwin High School site.

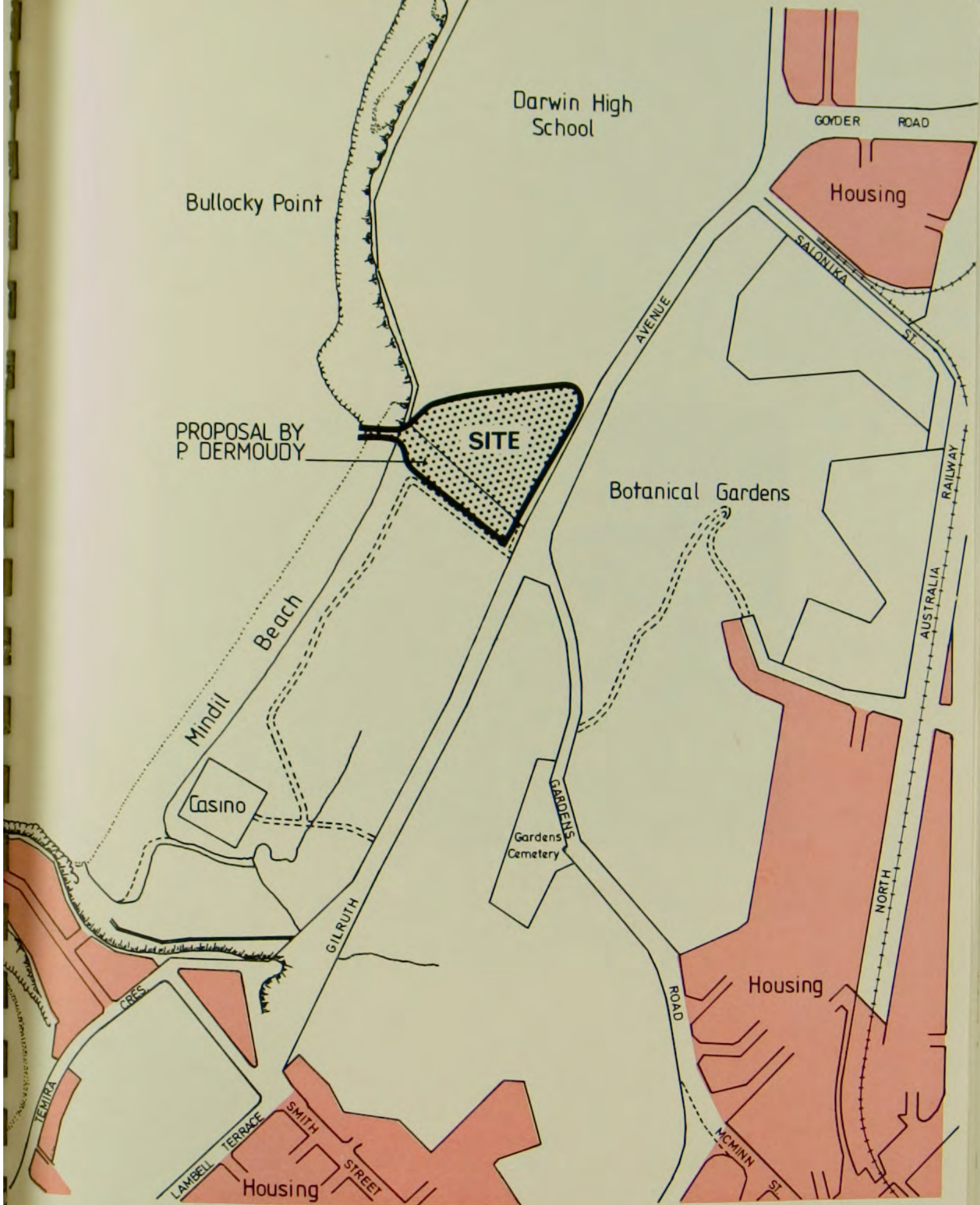
There are no residential properties in the vicinity of the site and the adjoining land use is the Botanical Gardens, Beach Reserve and the Darwin High School.

Site Analysis

The location of the proposal is the most suitable in the Mindil Beach area. The outlet channel will be excavated in rock and will be protected by Bullocky Point to the north.

The open space between Mindil Beach and Gilruth Avenue is used for informal recreation and is the area for visiting circuses, and activities and will not interfere with the existing activities of the Mindil Beach Reserve.

The recent foreshore studies have recommended that the hinterland behind Mindil Beach should be retained as an extension of the parkland precinct

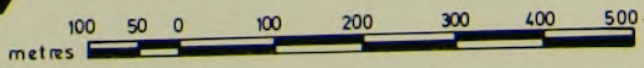


Title and Ownership:
 Part POR 3481, Crown Land
 Part PO R 3716, NT Government

Zoning:
 Part POR 3481 Open space
 Part PO R 3716, Special purposes

Area:
 Approximately 5 hectares

NORTH MINDIL BEACH 5





7. VIEW OF MINDIL BEACH - CASINO SITE IS LOCATED TO UPPER RIGHT OF BEACH. THE NORTH MINDIL BEACH SITE IS LOCATED IMMEDIATELY ADJOINING HEADLAND TO LOWER LEFT OF PHOTO

of the Botanical Gardens providing both shade, landscaped picnic facilities and informal open space. However, it is considered that with environmental controls this land-locked type marina proposal could be achieved by observing coastal management techniques.

Access to the site is good and there is adequate area available to provide a marina for over 200 boats.

Biology

The biological report indicated a medium classification for marine biological potential and low rating for terrestrial biological potential. This site is of low biological impact when compared with the alternative sites and only the Vestey's Beach site had a lower rating (See table in Sub-section 6.1)

The level of water in the proposed mooring basin will restrict the storm-water flow in the existing open drain with discharges on to Mindil Beach. This drain passes through the Botanical Gardens and the water table in the Gardens will rise. Further investigations would be required into the likely impact of the water level and salt content on existing planting.

Engineering Feasibility

This proposal is similar to the Vestey's Beach proposal by Mr. P. Dermouly. In general, the levels and the basis for design for the outlet, holding basin and mooring basin geometry will also be similar.

The littoral sand drift along the coast is generally north to south. Bullocky Point therefore will act as a groyne for the outlet channel to this proposal. Some dredging of sand could be required at this and all sites in the Fannie Bay area. The tidal range is more noticeable at Mindil Beach and it is flatter than Vestey's Beach. The open channel would be excavated for some 500 metres from the frontal dune and pedestrian access along the beach at high tide would require consideration.

The excavation of the marina basin will be in earth and rock. The treatment of the basin edges has not been detailed in the sketch proposals and with a depth to low water of approximately 6 metres this work could be a major cost factor. Mr. P. Dermouly indicated that the excavation

could be carried out and the filling sold within the Darwin area. The project would be staged and as rentals were obtained from moored boats the facilities would be improved.

It has been estimated by Mr. P. Dermoudy that the total cost of the works would be in the order of \$2 million.

Estimated rental charges were obtained and the prices varied with the size of craft. The floating storage charges for a 13 metre boat would be in the order of \$1,000 p.a., covered land storage for a 5 metre boat would be approximately \$450 p.a.

The method of financing the operation has not been determined and further study would be required on the economic viability of this proposal.

Consultations

The site has no visual impact on residential areas and the groups consulted considered that this area was a good site for the Darwin marina. It was considered that this area is more attractive as open space land than the Vestey's Beach site and a preference for Vestey's Beach on these grounds was indicated.

Conclusions

The northern end of Mindil Beach is a visually suitable location for the proposed marina and is compatible with existing land use. The outlet to Fannie Bay is well-located immediately south of Bullocky Point. Further investigations are required for the basin design and rock excavation. The biological impact is low. The economic issues require further examination before this proposal could be approved and in general all groups interviewed considered the site suitable.

6.5 Mindil Beach Casino

Description of Site

This area is located at the southern extremity of Mindil Beach and is between the proposed casino site and Temira Crescent (see Drawing 6). The site, portion 3451, is owned by the Crown and is zoned open space. The site is relatively small compared with the land available in other sites. However, it is unique in its location next to the proposed casino which will attract tourists from other parts of Australia and overseas.

Site Analysis

The site is relatively level and being at the southern edge of Fannie Bay is subject to the littoral drift of sand in this direction.

Foreshore preservation controls would apply to this site and the final treatment would be subject to the casino waterfront proposals.

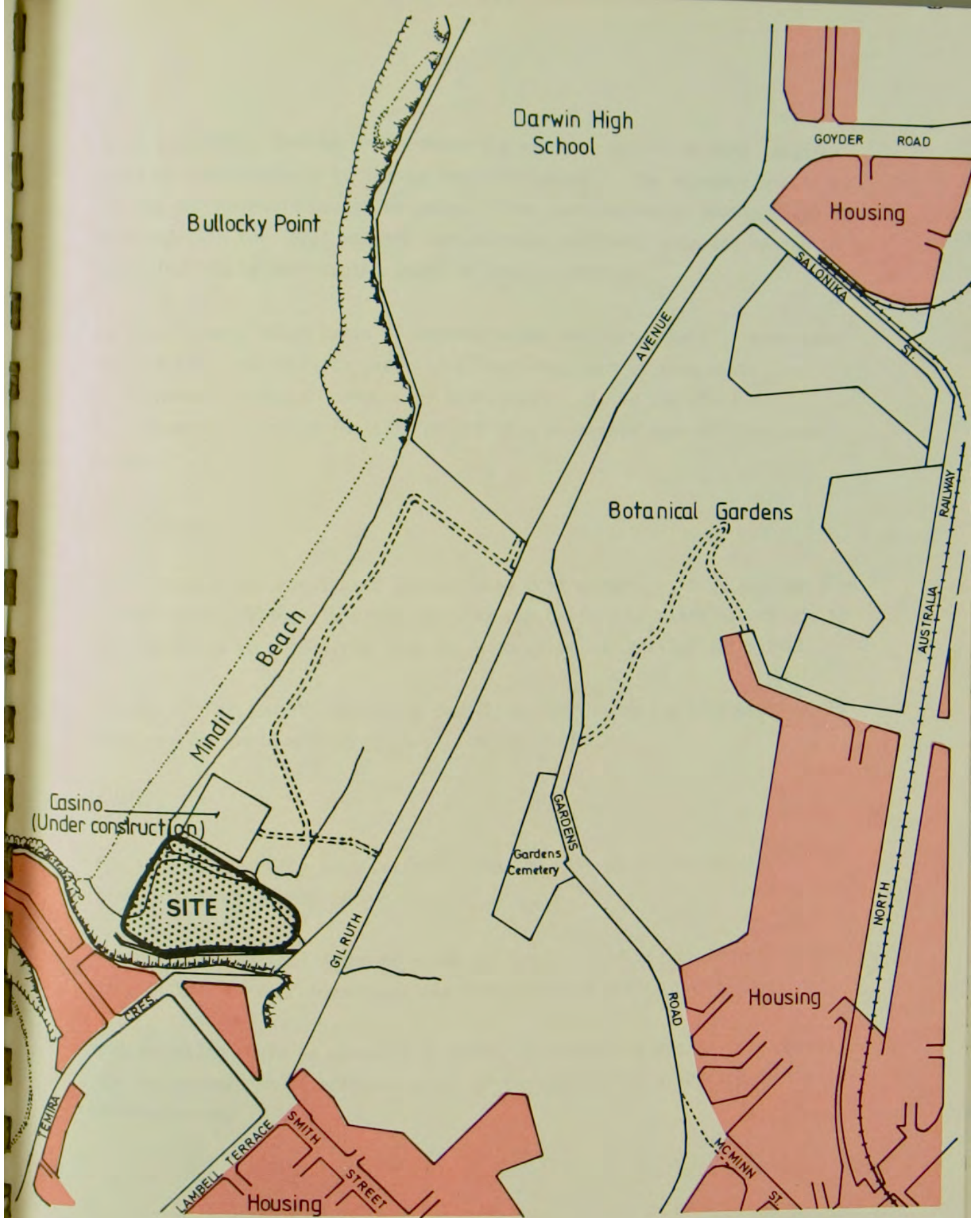
Access to the site is good and in general the levels would be similar to the proposals by P. Dermoudy for the Vestey's and North Mindil Beach proposals. The climatic conditions are similar to other sites in Fannie Bay.

Biology

The terrestrial and aquatic biological potential has a medium rating and when compared with other sites it is midway on the rating scale of detrimental biological impact.

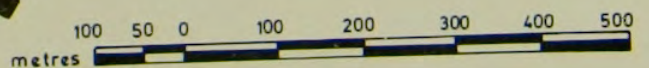
Engineering Feasibility

The major issues associated with this site would be restricted site area and the sand movement that may block the outlet channel to Fannie Bay. All other issues are similar to the North Mindil Beach proposals. A study of sand movements in this area would be required together with the layout proposals adjoining the casino.



Title and Ownership:
 Part POR 3481, Crown Land
 Zoning:
 Open space
 Area:
 Approximately 5 hectares

MINDIL BEACH CASINO 6



It is considered that an environmentally pleasing marina in this location would be complimentary to the casino development. The economic viability for the marina could depend on usage. The combination of boating, and accommodation for local persons and overseas visitors, with the casino adjoining, would improve the usage of both facilities.

Marinas in many other parts of Australia and overseas generally have some other associated activity generating land use, such as town house development, hotels or commercial activities. It is therefore considered that the casino site offers this advantage over all the other sites.

Consultations

This site was not considered desirable by most groups. It is too far from the existing sailing clubs and, as with the balance of Mindil Beach, it is considered to be a people's area for picnicking and similar activities.

The Act of Parliament specifying conditions on the casino developers would also require amendment for this site to be used.

Conclusions

The site is generally less suitable than the Vestey's and North Mindil proposals and the area is small.

Further study on sand movement would be required and the biological impact is such that further investigations and safeguard action may be required.

Consideration could be given to a marina adjoining the casino development and be included in an economic study of the commercial viability of the Darwin marina.

6.6 Doctors Gully

Description of Site

Doctors Gully has been considered as a possible marina site because of the sheltered location and deep water close to the shore. The sides of the gully are relatively steep and the area adjoining the waterfront is relatively small compared with other possible sites (see Drawing 7).

The ownership is Crown Land together with a lease Portion 3430 to C. Atkinson and it is zoned open space organised recreation. The surrounding land use is residential and access is by a steep narrow road. The site at the present time is visually poor and a marina would improve the appearance and be beneficial to the existing environment.

Site Analysis

The site is not well located for vehicular access and improvements to the access together with land acquisition for additional area may be required. The environmental coastal problems of Fannie Bay are not applicable to this site and the construction of a marina would improve the foreshore area. Special design considerations would be necessary to achieve a compatible mix of existing detached dwellings and the marina activity.

Protection from the wet season winds is better than Fannie Bay sites, however, the dry season winds from the south can cause problems to the berthing of boats.

Biology

Fishing is prohibited in Doctors Gully and there is a plentiful supply of fish from observation at high tide when the fish are fed by the lessee in the Gully, Mr. C. Atkinson. The high degree of fish life is reflected in the findings of the biological study which reported the highest terrestrial and aquatic biological potential at Doctors Gully.

Engineering Feasibility

This site is suitable for marina construction and would be subject to reclamation, rock excavation and breakwater construction.



Title and Ownership:
 POR 3430, C. Atkinson
 Crown Land

Zoning:
 POR 3430 Open space, Crown
 Land, Organised recreation

Area:
 Approximately 4 hectares

DOCTORS GULLY 7

↑

metres 100 50 0 100 200 300 400 500



8. DOCTORS GULLY



9. VIEW OF DOCTORS GULLY FROM AIR

The access road to the site would require reconstruction and realignment to provide for increased traffic. A sewerage outfall is located in the Gully and would require further investigation.

The Navy is building a new patrol boat base with breakwater construction nearby and this could afford some protection to a marina in Doctors Gully.

The construction costs for this site are not considered to be higher than other sites but there are unknown quantities of rock excavation that could increase these costs.

Consultations

The general feeling about this site was that it was too small in area and access was through residential areas. It was suggested as a good ferry terminal site for future traffic between the Harbour and Cox Peninsula. Also, the Navy are unlikely to support a proposal for pleasure craft nearby the proposed patrol boat base.

In general a good location for access to deep water.

Conclusions

Doctors Gully has a different topography to all other sites and is relatively small in area with acquisition of land being required.

It is an interesting site for a marina and would enhance the residential areas surrounding the Gully. Protection from the wet season winds is an advantage of this site compared with Fannie Bay sites.

The fish life in the Gully is a tourist attraction and the construction of a marina would have the highest biological impact of all sites considered.

Reclamation and rock excavation are required which could increase construction costs in comparison with other sites.

6.7 Frances Bay

Description of Site

This site is located on Crown Land near the commercial fishing area on the western side of Frances Bay near the Port of Darwin (see Drawing 8).

It is not a visually pleasing location and is well away from the pleasure boating activities of Vestey's Beach. The Port Authority controls the leasing of land in this area and the surrounding land use is industrial and commercial.

Site Analysis

The site is suitable for a dredging operation that is currently being undertaken by John Holland (Constructions) Pty. Ltd. in the building of the commercial shipping harbour. The dry season wind conditions are not as suitable in this location as the Fannie Bay sites, however, good protection is available in the wet season on this side of Frances Bay.

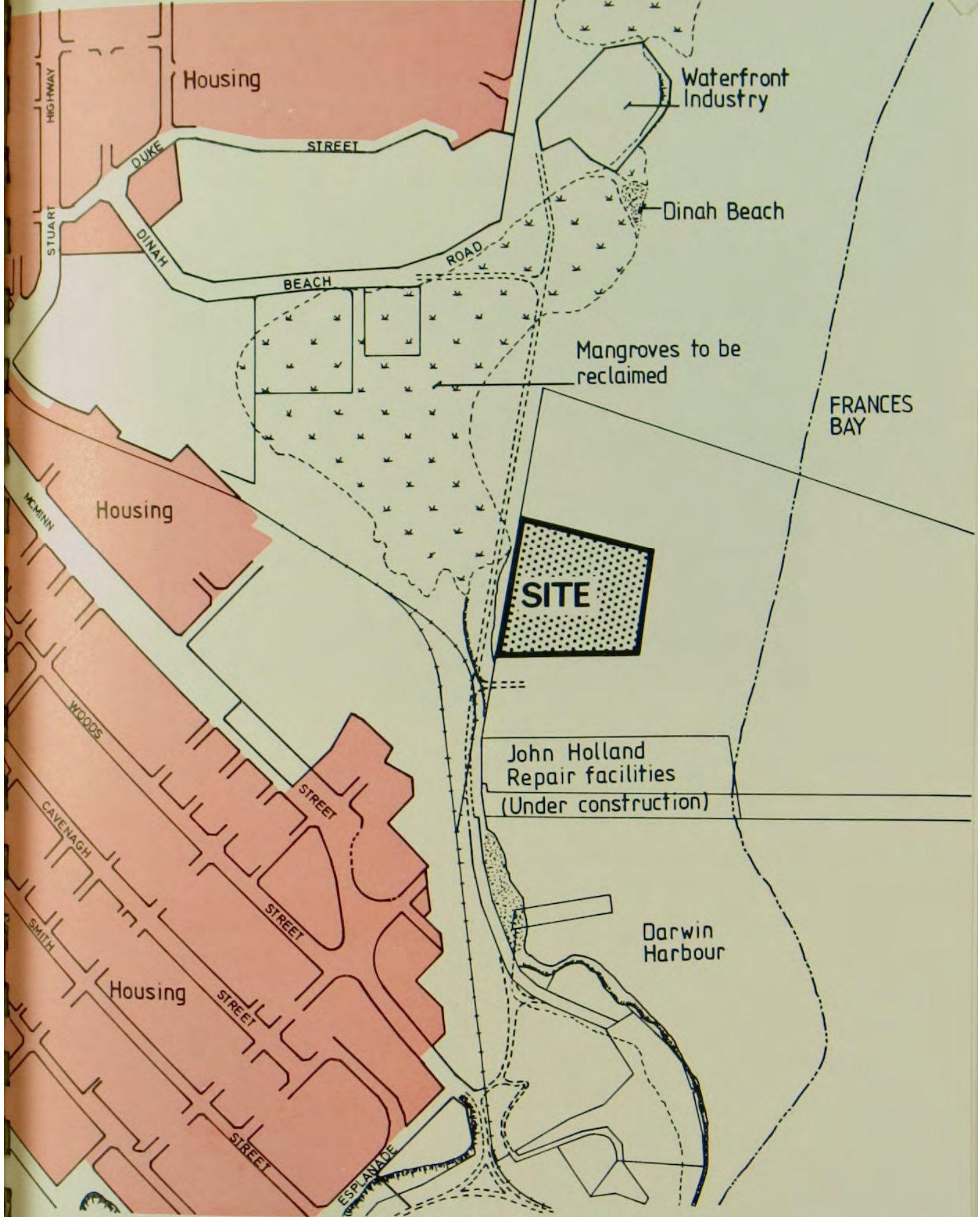
The site has been considered in recent studies as a desirable location for a marina. The environmental controls for the foreshore are minimal and beach erosion and frontal dune management problems do not exist.

Biology

The biological study for this area indicated the site had a low terrestrial potential and a medium aquatic potential. The site is listed after Vestey's Beach and North Mindil Beach as having low biological impact.

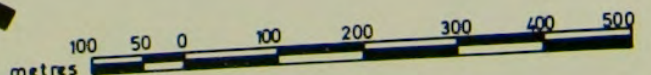
Engineering Feasibility

The site is well suited for marina construction and the engineering constraints are minimal compared to the other possible sites. Storm tide levels are lower in Frances Bay than at Fannie Bay and other sites. Construction costs for this site would be comparable with all other sites and economic viability would be the major issue.



Title and Ownership:
Crown Land
Zoning:
Not applicable
Area:
Approximately 5 hectares

FRANCES BAY





10. FRANCES BAY SITE

Consultations

Most groups agreed that the site was suitable from an engineering viewpoint. However, it was too far from the existing pleasure boating activity.

The Port Authority considers the area will be leased to the commercial fishing industry and that no pleasure boating facilities should be located in Frances Bay.

In addition the Department of Industrial Development is encouraging the expanding prawning industry to operate in this area.

Conclusions

The physical characteristics of the site are suitable for the development of a marina. The environmental and engineering constraints are minimal in comparison with other sites. The view of both interested groups and Government Departments were of the opinion that the area was not suitable for commercial activity and pleasure boating facilities should not be located in this area.

6.8 Sadgroves Creek

Description of Site

Sadgroves Creek is a mangrove swamp area with a deep water channel off Frances Bay (see Drawing 9). It is not visually pleasing and, similar to Frances Bay, is well away from the pleasure boating activities. The area surrounding the site is primarily residential with a large area of Crown Land separating the site from any building development. The site is on Crown Land and is subject to tidal inundation.

Site Analysis

The site is suitable for a reclamation dredging operation similar to Frances Bay and would provide a deep sheltered channel for the boats. The area is popular at the present time for mooring of large boats and is considered climatically to be the best of all possible sites.

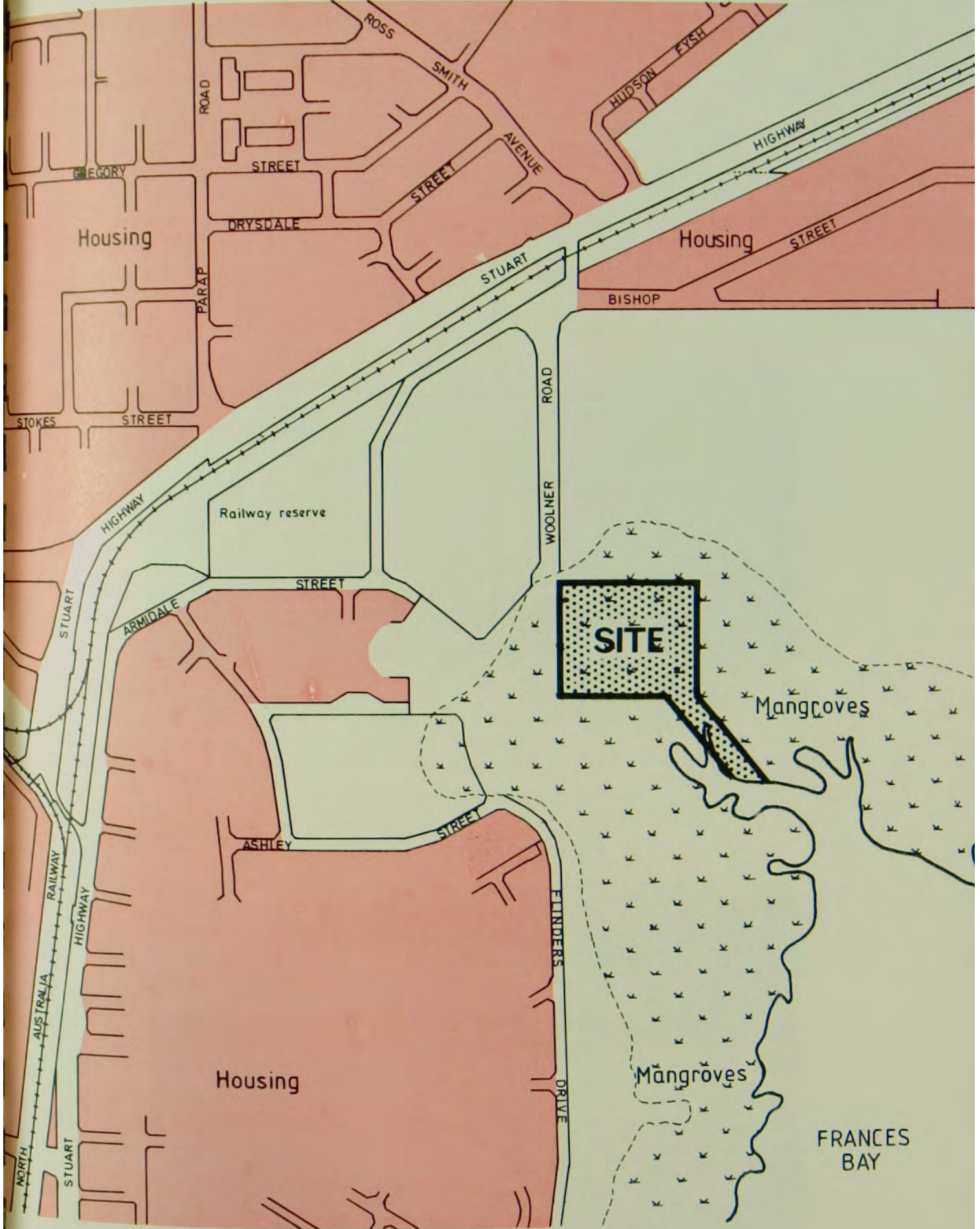
Biology

The biological study ranked Sadgroves Creek as the third highest impact assessment with a high biological potential. Safeguard action would therefore be required to reduce the biological impact of marina construction on this site.

Engineering Feasibility

Access to the site would be required from Woolner Street or Flinders Drive. However, no constructed access road is available at present. Apart from the road construction and dredging, costs would be comparable to other sites.

Because of the location and surrounding area, it is considered that economic viability rather than construction costs would be the major problem with this site.

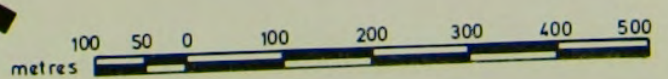


Title and Ownership:
Crown Land

Zoning:
Not applicable

Area:
Approximately 5 hectares.

SADGROVES CREEK 9





11. VIEW OF SADGROVES CREEK SITE TO WOOLNER ROAD
FROM FLINDERS DRIVE



12. VIEW OF SADGROVES CREEK SITE TO FAR LEFT
OF PHOTO

The existing boating activity in the deep channel indicates that mooring could be made available in the Sadgroves Creek area to encourage safe usage of this popular mooring site.

Consultations

Reaction to this site was varied and the presence of mosquitoes and sandflies in the mangroves was considered to be a major constraint to development.

The distance from the Fannie Bay beaches and the Boat Clubs was also considered to be a major drawback and in general it was not favoured.

Conclusions

The site is flat and generally visually unattractive and dredging would be necessary to achieve the levels required. Safeguard action would be required for the environmental issues and a new road constructed to link the site with existing residential areas.

The lack of support from interested groups and the mosquito problem are considered to be the major objections to this site.

Consideration could be given to the installation of moorings in Sadgroves Creek to cater for the existing use of this area.

6.9 Summary

The eight possible sites have been examined as described in the site selection criteria and conclusions to each assessment have been made.

The significant site characteristics were then selected and each site re-examined on this basis. The criteria with marginal advantages and disadvantages such as climate were eliminated.

The most desirable sites having the least environmental impacts, suitable land tenure and favoured by the community, are the Vestey's Beach and North Mindil Beach sites. The existing boating clubs of Darwin are currently situated at Vestey's Beach and this factor is considered to be the major issue in the final selection between these two sites. It is therefore considered that the most desirable location having regard for the factors detailed in the brief is the southern end of Vestey's Beach.

7. CONCLUSIONS

The study has shown that there is a need for a marina in Darwin to provide for existing and future pleasure boating activities. Further detailed investigation of this need is required to plan the size and type of facilities required.

The basic requirements for a marina in Darwin are that it provides a place where boats may be kept afloat at low tides, maintenance and repairs can be carried out, supplies can be obtained and provision is made for car parking. In addition to the basic requirements, club-type facilities and a restaurant should be provided to promote usage by all sections of the community and thereby improve economic viability.

The large tidal range in Darwin is the major constraint to marina development. A land-locked basin with a weir to retain a minimum depth of water at low tide is recommended.

Two sites of the possible eight selected for investigations have advantages over the other sites if the marina is to be constructed in the immediate future. They are the Vestey's Beach and the North Mindil Beach sites.

The existing boating clubs of Darwin are currently situated at Vestey's Beach, and this factor is considered to be the major issue in the selection between these two sites. It is therefore considered that the most desirable location, having regard for the factors detailed in the brief is the southern end of Vestey's Beach.

8. RECOMMENDATIONS

1. A topographical survey be carried out on the selected site and a preliminary geotechnic report be prepared.
2. A detailed study be carried out of pleasure boating activities in Darwin to obtain the following information:-
 - . Existing Boating Ownership
 - . Growth Rates
 - . Boat Characteristics
 - . Boat Usage
 - . Type of Chandlery
 - . Maintenance Facilities
 - . Club Usage
3. Concept plans be prepared for the total marina development and Stage 1 development.
4. A cost analysis be undertaken based on the concept plans and total budget development costs prepared.
5. An operation and management budget be prepared for assessment of economic viability.

APPENDIX A

BIOLOGICAL STUDY

Prepared by

Dr. A. K. O'Gower, M Sc, Ph D
of
Ecological Consultant Services Pty. Ltd.
P.O. Box 4, Bowraville. N.S.W. 2449.
June 1979

ASSESSMENT OF THE PROBABLE BIOLOGICAL IMPACTS OF A PROPOSED
MARINA AT ONE OF EIGHT POSSIBLE LOCALITIES IN THE DARWIN AREA

The proposal by the Department of Transport and Works to construct a marina at one of eight possible sites in the Darwin area will involve a series of engineering problems the solution of which will affect the environment at the selected locality. Therefore the selection of the "best" site must encompass an assessment of the relative biological impacts of the construction of the marina at each of the eight possible localities. These biological impacts will involve both the shallow marine habitat and the terrestrial environs at each locality.

The assessment of the impact of any proposed alteration of the environment on the ecosystem should involve extensive and detailed, ecological studies of that environment. But, if restrictions of time and budget limit the scope of such studies, then the assessment can be based on the detailed examination of a key habitat or an extrapolation from similar studies. In this instance limitations of both time and budget meant that this assessment of probable biological impacts was based on a detailed study of the shallow marine benthos at each locality and extrapolations from studies on the terrestrial habitat in the Darwin area.

The shallow marine benthos at each of the eight localities shown in Drawing 1 was sampled with a modified anchor grab. Each sample was sieved through a two millimetre sieve and all benthic organisms collected were identified and counted. These data were computed to give means and standard deviations for both numbers of species and numbers of individuals, and analyses of variance (ANOVAR) were carried out for both species and individuals.

Table A1 shows the substrate at each locality, the mean number of individuals (\bar{x} ind.) with standard deviation (S.D.), the mean number of species (\bar{x} sp.) with its standard deviation (S.D.) and the number of species of benthic organisms (n. sp.).

Analyses of variance of these data gave the following ANOVAR tabulations:

ANOVAR Individuals

Source	s.s.	d.f.	m.s.	F
Within	3046.6	72	56.4	
Between and	1563.1	7	312.6	5.54

ANOVAR Species

Source	s.s.	d.f.	m.s.	F
Within	52.4	72	0.97	
Between	47.0	7	9.4	9.69

As the 1% level of probability for the variance ratio test has an "F" value of 2.91 for these degrees of freedom, these ANOVAR analyses showed significant variations between both numbers of individuals and number of species at the eight localities ("F" ind. = 5.54 and "F" sp. = 9.69).

Examination of the data in Table A1 shows the benthos at Vestey's Beach to be clearly inferior in density of individuals (\bar{x} ind. = 1.40), density of species (\bar{x} sp. = 0.50) and number of species (3) to each of the other seven localities, whereas the benthos of Doctors Gully, Frances Bay and Sadgrove Creek are clearly superior to those of the other localities. Based on the above ANOVAR analyses these differences are statistically significant.

Using the data of Table A1 to assess the biological potential of the habitat at each of the eight possible marina sites, we derive the values shown in Table A2, except that the values for Rapid Creek and Ludmilla Creek have been upgraded because they are associated with mangroves. From Table A2 it can then be deduced that the eight possible marina sites are roughly grouped into three categories of low, medium or high marine biological potential, viz,

Habitat Potential	Locality
Low	Vesteys Beach
Medium	Palmerston Gardens Mindil Beach Frances Bay
High	Rapid Creek Ludmilla Creek Doctors Gully Sadgroves Creek

From an examination of small mammal trappings at five localities in the Darwin area (Lions Park, Rapid Creek (fresh), Marra Swamp, Rapid Creek - Darwin College area and Botanical Gardens; see Rapid Creek Study), it was apparent that a combination of dense unburnt undergrowth with proximity of water formed an ideal habitat for small mammals, whereas open cleared, mown grassy or burnt areas away from water supported few small mammals. Extrapolating from these findings it is possible to deduce the biological potentials of the terrestrial habitats at each of the eight, proposed marina sites shown in Drawing 1. These extrapolations are presented in Table A2 and the eight sites can then be roughly grouped into three categories of low, medium or high terrestrial biological potential as follows:

Habitat Potential	Locality
Low	Vesteys Beach Mindil Beach Frances Bay
Medium	Rapid Creek Sadgroves Creek Palmerstone Gardens
High	Ludmilla Creek Doctors Gully

noting the upgrading of the habitat potential of Rapid Creek because this site is on the Casuarine Reserve.

Now summing both the marine and terrestrial assessments shown in Table A2, the eight possible marina sites can be placed in increasing order of overall biological potential as follows:

Locality	Summed Assessment
Vesteys Beach	2
Mindil Beach	2.5
Frances Bay	2.5
Palmerston Gardens	4
Rapid Creek	5
Sadgroves Creek	5
Doctors Gully	6
Ludmilla Creek	6

It can therefore be deduced that the construction of a marina at one of the above eight possible sites would have detrimental biological impacts commensurate with the position of that site in the summed assessment tabulation. That is, detrimental biological impacts would be least at the Vesteys Beach area progressing until they were greatest at the Doctors Gully and Ludmilla Creek sites.

Conclusion

Based on objective marine benthic sampling with statistical analysis and on extrapolation from parallel studies on terrestrial, small mammal fauna, detrimental environmental impacts caused by the construction of a marina would be least at Vesteys Beach, Mindil Beach and Frances Bay and greatest at Doctors Gully and Ludmilla Creek, but of all the eight possible sites Vesteys Beach is clearly biologically preferable.

TABLE A1

Littoral benthos off the eight possible marina sites in the Darwin area

LOCALITY	SUBSTRATE	STATISTIC				
		\bar{x} ind.	S.D.	\bar{x} sp.	S.D.	n. sp.
Rapid Creek	sand	9.80	4.785	0.90	0.875	6
Ludmilla Creek	mud/gravel	3.40	3.776	0.50	1.032	5
Vesteys Beach	sand	1.40	2.503	0.50	0.707	3
Palmerston Gardens	sand	3.90	3.884	2.50	1.455	11
Mindil Beach	sand	3.70	3.945	2.10	0.994	12
Doctors Gully	sand/mud/gravel	16.80	8.854	2.70	1.337	9
Frances Bay	sand/gravel	2.30	1.567	2.70	2.162	15
Sadgroves Creek	sand/mud	2.80	1.135	5.90	3.900	11

TABLE A2

Assessment of habitat potential (terrestrial and marine) of the eight possible marina sites in the Darwin area

LOCALITY	TERRESTRIAL		MARINE	
	Habitat	Potential*	Habitat	Potential*
Rapid Creek	grass	2	sand	3
Ludmilla Creek	mangrove/ <u>Acacia</u>	3	mud/gravel	3
Vesteys Beach	grass	1	sand	1
Palmerston Gardens	grass/ <u>Acacia</u>	2-3	sand	1-2
Mindil Beach	grass	1	sand	1-2
Doctors Gully	<u>Acacia</u>	3	sand/mud/gravel	3
Frances Bay	industrial	1	sand/gravel	1-2
Sadgroves Creek	mangrove	2	sand/mud	3

(footnote* Assessed in the range of low, medium or high with values of 1-3)

APPENDIX C: BIBLIOGRAPHY

APPENDIX D: STUDY TEAM

APPENDIX CBIBLIOGRAPHY

ADIE, D.W.

Marinas, a Working Guide to their Development and Design

The Architectural Press Ltd, London, 1975.

CHANEY, C.A.

Marinas, Recommendations for Design, Construction and Maintenance

National Association of Engine and Boat Manufacturers, Inc., New York 1961

Corporation of City of Darwin, Report on Foreshore Problems of Darwin

11 November, 1975.

Darwin Reconstruction Commission, Report on Potential Marina Status in Darwin Area.

Department of Construction For N.T. Dept of Lands & Housing

Environmental Planning and Coastal Management Study

Vesteys/Mindil Beaches, Rapid Creek, Casuarina Beaches November 1978.

DUNHAM J.W. AND FINN, A.A.

Small Craft Harbours: Design, Construction and Operation

U.S. Army Coastal Engineering Research Centre, 1974.

HEAD, D.

Marinas, Viewpoint Publications, London, 1976

JOHNSON, R.J.

Small Boat Harbour Development on the Pacific Coast

Journal of the Waterways and Harbours Division.

Vol. 87, February, 1961.

Land Conservation Unit, Darwin Coastal Erosion Survey, January, 1978

LEE, C.E.

Small Craft Harbour Problems

Journal of the Waterways and Harbours Division:

Proceedings of the American Society of Civil Engineers.

Vol. 90, No. WW3, August, 1964.

MILLS, E.D.

Planning: Buildings for Administrative Entertainment and Recreation
Newnes-Butterworths, London, 1976.

Northern Territory Port Authority, Report on Launching Ramps, April, 1977

WARD, G.D. et. al.

Some Factors in Planning for Marinas
Journal of the Waterways and Harbours Division. Vol. 93, May, 1967.

WEBBER, N.B.

Marinas and Small Craft Harbours Southampton University Press, 1972.

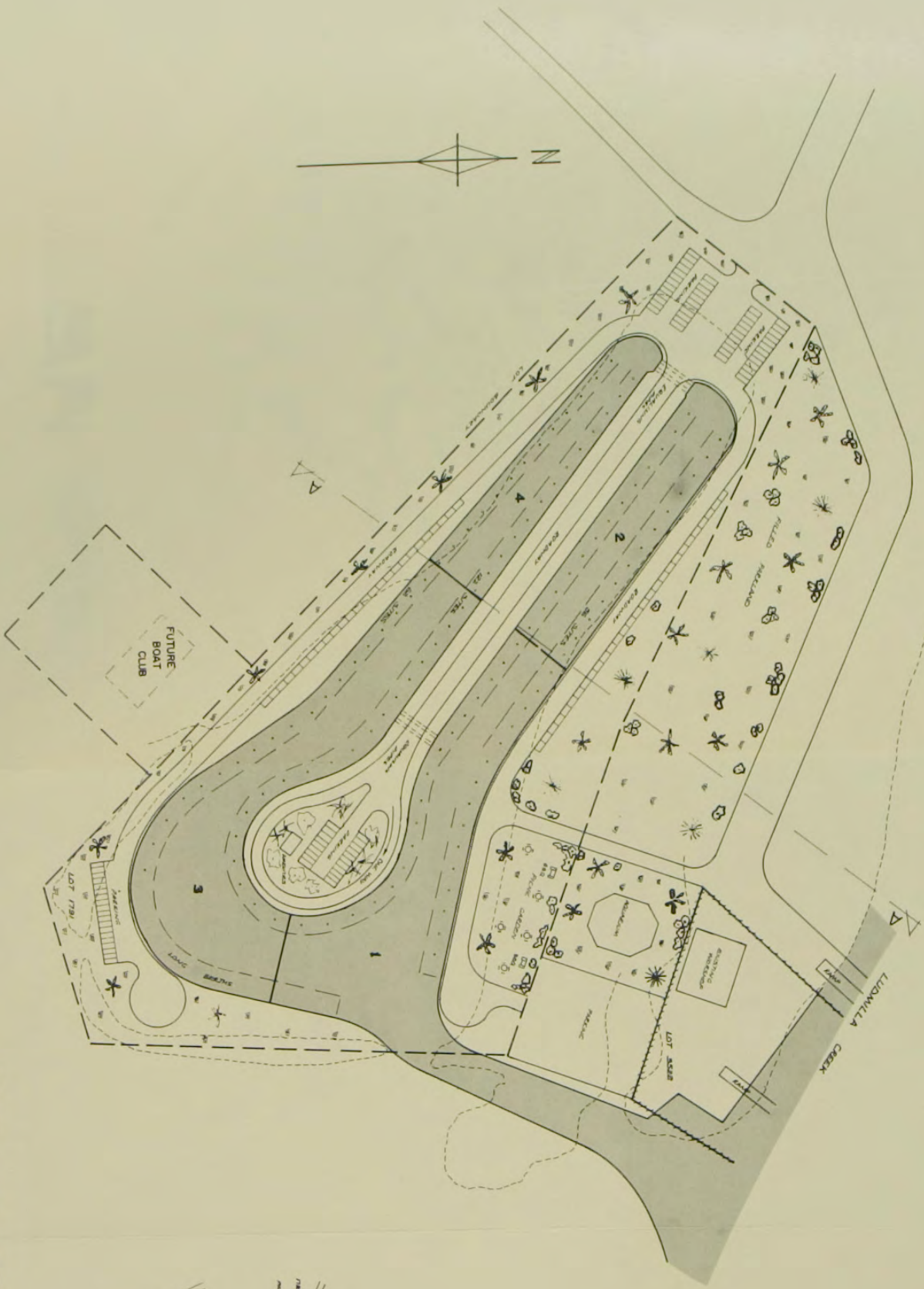
APPENDIX DSTUDY TEAM

Study Manager	W. Keirnan, ASTC, Dip HE, MIE (Aust), LGE, Cert TCP
Town Planner	J. Falk, BTP hons (NSW), M Eng Sc (NSW), MRAPI, Cert TCP
Research Planner	M. Watt, B Sc hons (NSW)
Darwin Liaison	R. Lloyd BCE, MIE (Aust) (Darwin Manager, Gutteridge, Haskins & Davey) J. Kenworthy, B Eng (Civil), Grad. I E Aust (Senior Engineer, Gutteridge, Haskins & Davey)

APPENDIX B

CURRENT MARINA PROPOSALS

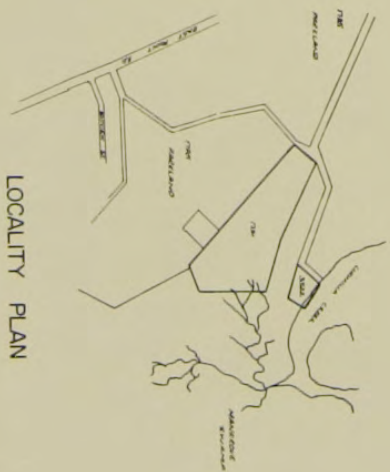
- . LUDMILLA CREEK
- . VESTEYS BEACH
- . MINDIL BEACH



**LUDMILLA CREEK 10
MARINA PROPOSAL**

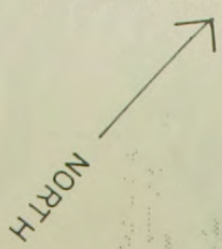
ROGER G. VENESS
CHARTERED ENGINEER
22 WALNUT ST
DARWIN NT
PHONE 81 3863

PROPOSED DEVELOPMENT
LOTS 3522 & 1791 LUDMILLA CREEK
FANNIE BAY
FOR BEACHSIDE DEVELOPMENTS PTY. LTD.
AS A MARINA



LOCALITY PLAN

SCALE
1:1000
P 479
SHEET 1
OF



PETER DERMOUDY ARCHITECT

VESTEYS BEACH

SLIPS
MOORING BASIN

WEIR

RESTAURANT AND CONTROL LOOKOUT

HOLDING BASIN

CHANDLERY

DRY STORAGE

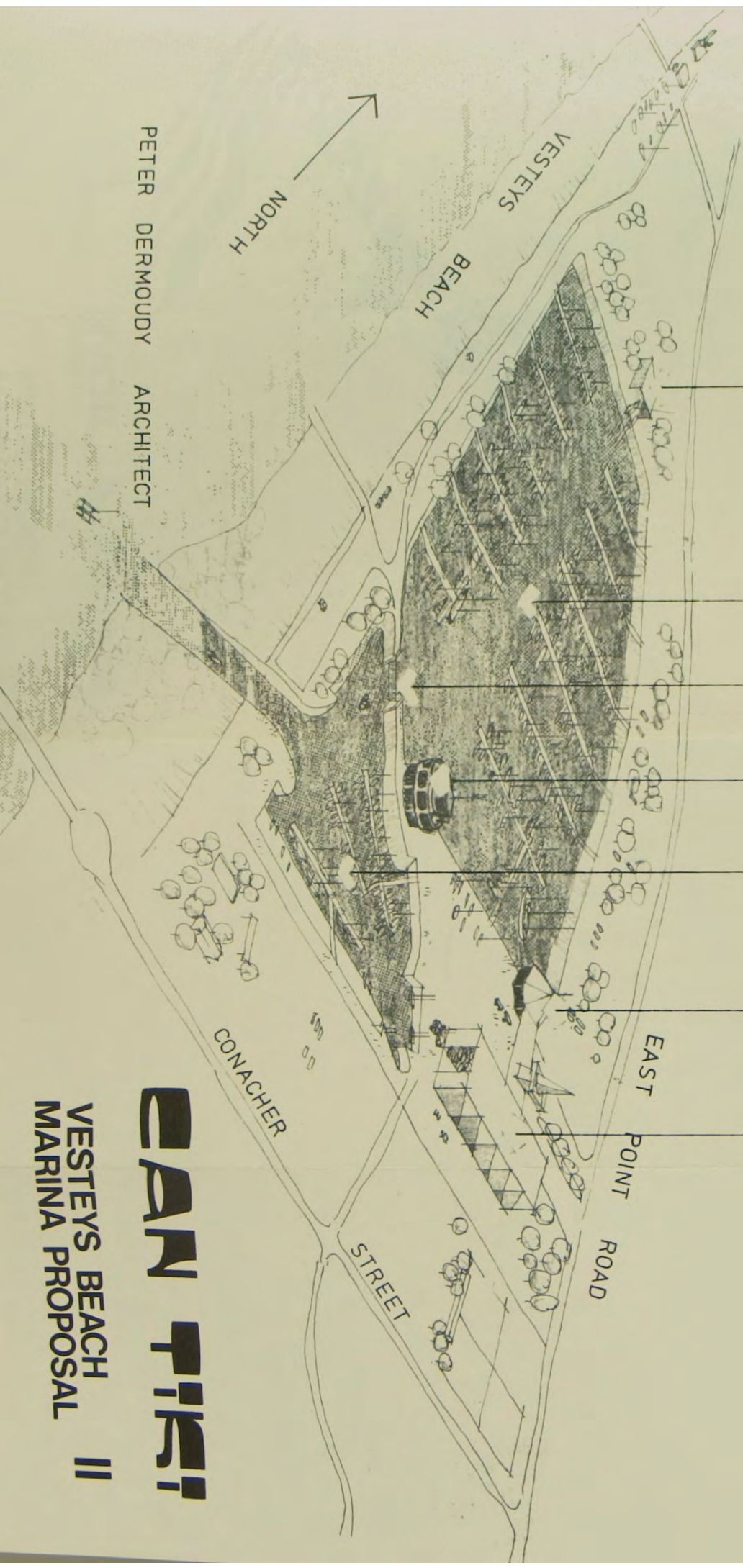
EAST POINT ROAD

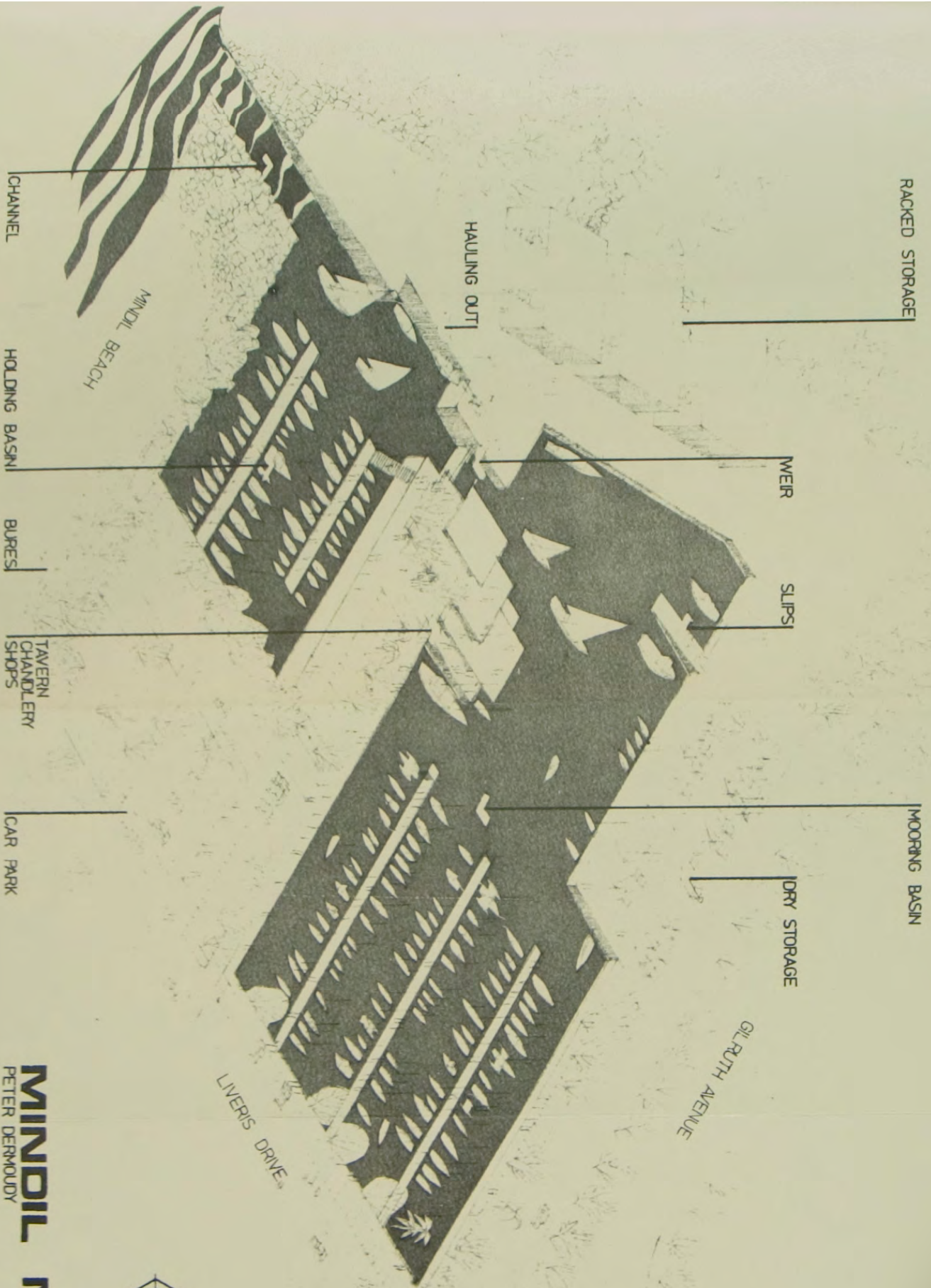
CONACHER

STREET



VESTEYS BEACH MARINA PROPOSAL II





MINDIL MARINA
 PETER DERMOUDY ARCHITECT
 MINDIL BEACH MARINA PROPOSAL 12

