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Relevant Files

Folio	Date Referred	Officer	Initials	Folio	Date Referred	Officer	Initials

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C66 ANGLESEA ISLAND
total area 32 1915
CO - 4 ha
samphires 13 8125
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Aug 1991

AN INVESTIGATION INTO

THE LOWER INLET
BUNBURY

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INTRODUCTION

In July 1984 the Leschenault Inlet Management Authority received a request from Mr Philip Smith, MLA Member for Bunbury to investigate the conditions under which the white mangroves in the Anglesea Island and adjacent areas might flourish. Concern was expressed that extensive flooding might have a detrimental effect on them.

The Lower Inlet with Anglesea Island and its surrounds are of inestimable value and form one of the most valuable assets to the City of Bunbury.

Currently there are a lot of factors and mooted proposals which could put pressure on the Lower Inlet and endanger its ecology.

The Leschenault Inlet Management Authority therefore decided to combine the study and assessment required for the mangrove query with a further but larger study incorporating flood control measures, effects on water quality of various drainage discharges, the implication of dredging a rowing course, new developments on railway land west of the inlet as well as other various landscaping and foreshore management proposals.

In 1984 an Ad Hoc Committee was formed comprising representatives from the Bunbury City Council, Bunbury Port Authority, Public Works Department, Department of Fisheries and Wild Life, Waterways Commission and Leschenault Inlet Management Authority to undertake the study. The findings of that committee are the subject of this report.

1.0 PHYSICAL CHARACTERISTICS OF THE LOWER INLET

DIMENSIONS

The Lower Inlet is approximately two kilometres long and is about two hundred metres in mean width. It is connected to Koombana Bay via a short but narrow entrance channel. Anglesea Island is located at its eastern end.

Water depths are generally in excess of 1.5 metres however mud flats are exposed during low tide along the northern and eastern boundaries. The maximum water depth in the inlet as determined by January 1984 soundings was 3.2 metres.

TIDE REGIME

Sounding Datum for the inlet is 0.640 metres below Australian Height Datum. This is the same datum as used for Leschenault Inlet and for the ocean at Bunbury.

Thus the tide regime experienced within both inlets is similar to that of the ocean indicating good water exchange with the ocean. Tide traces confirm the similarity of ocean and inlet tides.

Existing structures built within the entrance channel do not impede water exchange although they do form navigational barriers and alter localized water flow.

STORMWATER DRAINAGE

A number of stormwater drainage lines discharge into the lower inlet. In many instances headwalls are in need of repair. Stormwater discharge affects the quality of the water within the inlet.

Of special concern is the drainage outlet near James Street and Copplestone Drive which discharges, on a regular basis for five months of the year, backwash water from the Bunbury Water Boards water treatment plant at Haig Crescent. The backwash water contains ferric hydroxide which although chemically safe, is low in solubility and high in reflectivity which causes brown/red discolouration of the inlet water in this locality even at low concentrations.

Plans are in hand to close the Haig Crescent plant down however this is conditional upon available funding. Clearly, once the western end of the Lower Inlet is developed and landscaped and the public has the opportunity of using the promenades so planned backwash water discharge from this particular drainage line must stop.

Other drainage proposals for the area adjacent to the western end of the Lower Inlet need to be examined now for their effect on landscaping proposals. It is probable that some of the drainage proposals should not proceed in their current form.

STORM SURGE BARRIER

The storm surge barrier constructed across the Lower Inlet entrance channel is controlled by the Public Works Department. Its purpose is to prevent ocean tides or storm surges in excess of 1.5 metre height (LWD) from entering the Lower Inlet.

On average the gates are closed about six times per year and seldom are they shut for periods longer than two or three days. When they are shut the Lower Inlet behaves as a compensating basin with incoming stormwater slowly raising its water level. Each 0.1metre rise in level is approximately equal to 40,000 cubic metres of stormwater discharge.

It is unlikely that the operation of the storm surge barrier would affect the white mangroves on Anglesea Island which almost certainly would be able to accommodate the change in water regime from average flood conditions.

INLET CHANNEL STRUCTURES

The storm surge barrier and the railway bridge have been constructed in and across the Lower Inlet entrance channel. They form a navigational barrier to the Inlet but do not affect tidal exchange to any great extent. Proposals have now been received to realign Koombana Drive and to extend it across the entrance channel. Bridge construction for this extension is required and bridge dimensions are now being considered.

The Bunbury Port Authority has indicated that port customers will require the rail service until the year 2000 at least. The introduction of a passenger rail service linking Australind and Capel with the Bunbury Central Business District is ~~not an~~ unlikely ~~event~~ beyond the year 2000.

Westrail are in the process of realigning the track to the Outer Harbour and have advised that it is possible to raise the track at the entrance channel by up to two metres in height.

It is envisaged that with a third structure built across the entrance channel navigation through the channel will be prohibited. Since the Lower Inlet is planned to be an aquatic backdrop to the City of Bunbury with sailboarding, rowing, canoing, small boating and fishing as the main recreational pursuits it might be argued that navigational access through the entrance channel is not required.

On-land development proposals however which include a motel/boatel, feature tavern and restuarant and extensions to the lauching area for the Bunbury Power Boat Club make safe access through the entrance channel mandatory.

In view of this it is considered that the new Koombana Drive road bridge should be constructed immediately adjacent to the existing railway bridge such that:

(a) pile spacings are similar

(b) approach embankments are common

(c) the height of the road bridge is at a maximim consistent with approach grades and elevated railway track.

In addition it is considered that a storm surge barrier consisting of two sets of double gates (giving twice the area of clear channel as is now the case) should be constructed on the new road bridge and the existing storm surge barrier structure should be removed. This will require the entrance channel to be narrowed to about twenty metres in width in one location only and will allow entry to the recreation area north of Koombana Drive via an underpass below both bridges. As Koombana Drive will be a major highway safe access to the recreational area to the north is essential.

ROWING COURSE

For many years the Bunbury Rowing Club Inc. has represented the City of Bunbury in the sport of rowing with distinction. The club has done this despite having a course that is narrow, short and not straight.

The ideal and national rowing course is 2000 metres in length with an additional slow down section of 250 metres. Ideal depth is 2.0 metres and eight crews should be able to be accommodated. Clearly it is not possible to provide an ideal rowing course on the Lower Inlet.

Given the constraints, both physically and environmentally of providing a rowing course of maximum dimensions on the Lower Inlet, the Amateur Rowing Association of WA has advised that an acceptable course would be

(a) 60 metres wide to accommodate four crews

(b) of minimum depth 1.25 metres

(c) as straight as possible

An examination of the soundings shown on PWD Drawing 54077-8-1 has shown that an acceptable course could be provided by limiting dredging to the eastern end only and realigning the course at the change in direction off Albert Road. Spoil would be disposed of on low lying Bunbury Port Authority land near the junction of Oliver Street and Old Coast Road.

The estimated cost of carrying out the dredging, constructing starting pens for four crews and realigning marker bouys is $80,000. This estimate would need to be checked by the Harbours

and Rivers Branch of the Public Works Department prior to works proceeding. The dredging would be carried out without any interference to Anglesea Island. It is considered that dredging would improve the shallow flats at the eastern end of the inlet.

SILTATION

Public Works Department soundings of the Lower Inlet taken in May 1979 and January 1984 have been examined. The soundings show that there has been no siltation of any significance within the inlet during that period.

2.0 WATER QUALITY

In 1976 the inner harbour complex was officially opened. This development resulted in the division of the Leschenault Inlet into two portions separated by the harbour. The effect of this development on the water quality is unknown as monitoring of the Leschenault Estuary began in the same year as the opening of the harbour (LIMA, 1984).

Figure 1 illustrates the sampling sites used to monitor estuary water quality. This statement of water quality will consider in detail only sites 11, 13 and 16.

REVIEW

Figures 2, 3 and 4 represent seven water quality parameters for each sample station during the period 1976 to 1984. All stations show very similar ranges of all parameters as well as simultaneous peaks and troughs.

Chloride levels at all stations approximate that of seawater and there is little stratification between surface and bottom waters. When stratification does occur it is the result of high drainage discharge diluting the surface waters only. Water colum mixing in this section of the estuary is satisfactory. The similarity of chloride levels with the ocean indicates good marine exchange.

There is little temperature variation between sites and little stratification between surface and bottom waters. This supports the conclusion that the waterbody is well mixed.

Water colour is an indication of the presence of natural organic matter, plankton, weeds, metallic ions and industrial wastes in the water (Government Chemical Laboratories, 1983). Peaks in colour levels generally occur with a salinity decrease indicating that fresh water entering the system is carrying a proportion of the suspended material while re-suspension of bottom sediments contributes at other times.

Dissolved organic acids derived from decomposing plant material washed into the estuary remain for much of the time. Stratification between surface and bottom waters occurs at all sites with regard to ammonia-nitrogen levels. Bottom levels are generally higher than surface levels as a result of decomposition of organic matter in the sediments and bottom waters.

Levels of nitrate nitrogen are generally constant at 0.02mg/L for the three stations. Peaks above this level correspond to increased fresh water flow and which brings with it high levels of nitrates. Bottom waters are consistently lower than surface waters because of the low penetration of fresh water into bottom layers.

Inorganic phosphorus data is limited to the period 1981 to 1984 and levels are a consistent 0.01mg/L for all sites. However, a higher peak in levels did occur at all sites during June 1982.

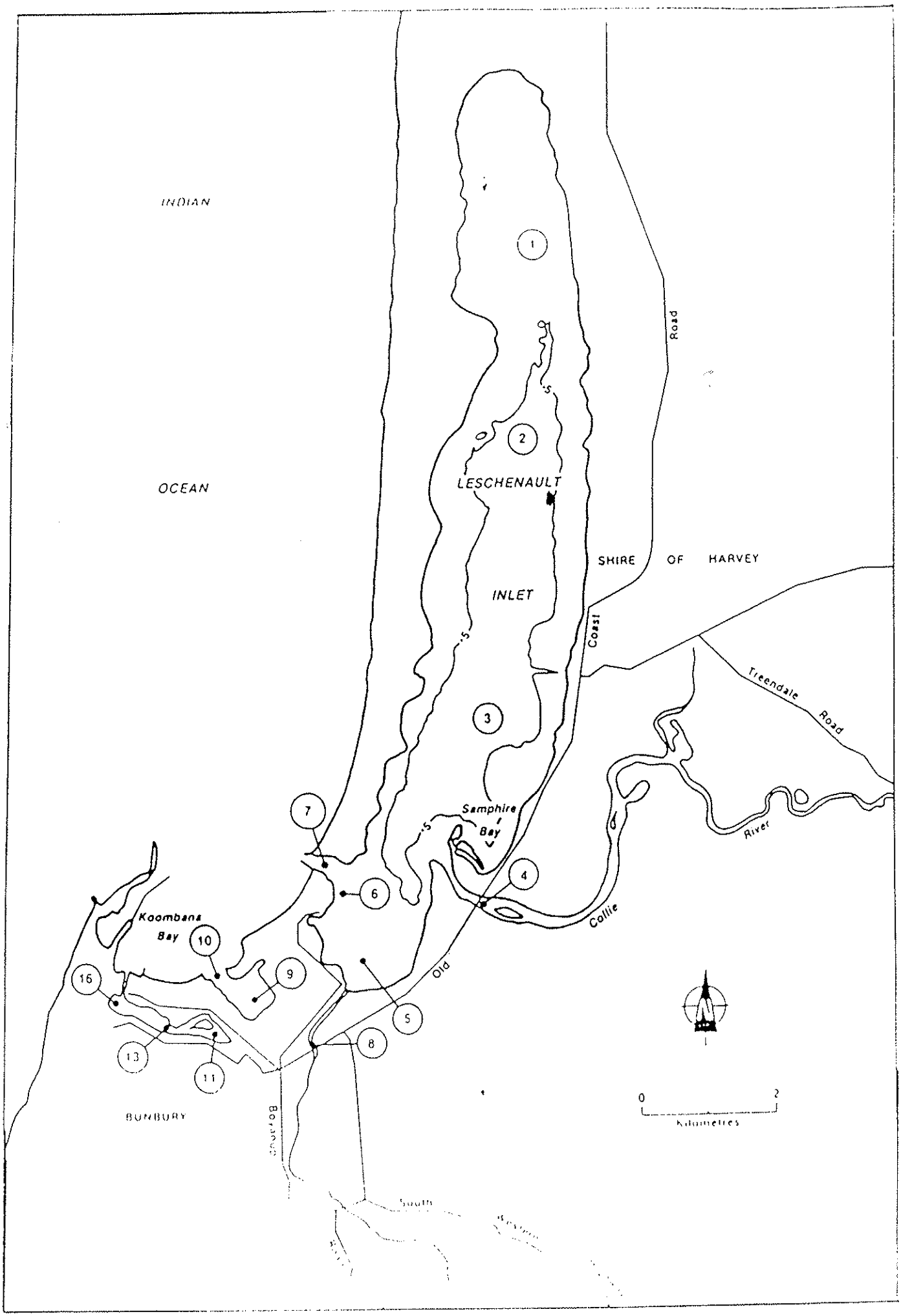


FIGURE 1 - LESCHENAULT ESTUARY AND SAMPLING SITES

Table 1 compares the ranges of total phosphorus, inorganic nitrogen and total chloride of the study sites with those of Vittoria Bay and north of the pipeline areas of the Leschenault Inlet. the range of total phosphorus is similar between the three stations and the two areas of the main estuary.

Levels of inorganic nitrogen for the study sites are similar to the range found north of the pipeline. The Vittoria Bay area has a considerably higher range of this nutrient because of the input from river water.

Total chloride levels do not range as low as the study sites as they do in the main estuary. However, maximum levels are very similar. The higher minimum at the three stations is possibly the result of less fresh water input.

	1976-1984			1980-1983	
	Station 11	Station 13	Station 16	Northern Estuary	Vittoria Bay
Total P mg/L	0.046-0.075 (0.05-0.09)	0.038-0.05 (0.048-0.068)	0.034.0.05 (0.05-0.063)	0.018-0.061	0.03-0.098
Inorganic N mg/L	<0.04-0.19 (< 0.042-0.14)	<0.04-0.18 (<0.036-0.11)	<0.04-0.19 (<0.047-0.11)	0.045-0.169	0.05-0.76
Total Chloride mg/L	15300-20100 (17300-20000)	14800-20000 (17700-20100)	15700-20200 (17600-20200)	12000-22100 (12000-22100)	5900-20000 (12800-20100)

Table 1: Comparison of the Three Study Stations with Two Sections of the Leschenault Estuary. (Numbers in parenthesis indicate bottom Concentrations.

There is stratification between surface and bottom levels of total phosphorus, with bottom waters generally having the higher concentration. This is attributed to the release of phosphorus from sediments.

Table 2 indicates the estuarine classification as ultra-oligotrophic while phosphorus levels give a eutro-polytrophic classification using the Vollenweider classification system (see Wood, 1975). The main estuary has the same phosphorus classification but has an oligo-mestrophic classification with regard to inorganic nitrogen levels.

There is little difference between the water quality of the study sites and the main estuary. Classification of an estuarine system when chlorophyll "a" data are unavailable is usually determined by total phosphorus levels as this nutrient is usually regarded as the major limiting factor for algal growth. Therefore, the study area is classified as eutro-polytrophic. However, algal levels have failed to reach nuisance proportions possibly as a result of salt water flushing.

Water States	Total P mg/L	Inorganic N	Station 11		Station 13		Station 16	
			P Level	N Level	P Level	N Level	P Level	N Level
Ultra-oligotrophic	<0.005	<0.20		<0.044-0.19		<0.044-0.18		<0.04-0.19
Oligo-mesotrophic	0.005-0.01	0.20-0.40						
Meso-eutrophic	0.01-0.03	0.30-0.65						
Eutro-polytrophic	0.03-0.10	0.05-1.5	0.046-0.075		0.038-0.05		0.034 0.05	
Polytrophic	0.10	1.5						

Table 2: Classification of the Study Sites with regard to Phosphorus and Inorganic Nitrogen (Classification ranges from Wood, 1975).

SUMMARY

The quality of the water in study area is considered to be satisfactory, although total phosphorous levels are slightly high. However, this does not seem to be of major concern as it is of similar range to the main estuary. The study area waterbody would appear to be typically phosphorus enriched similar to many estuaries in the south west of Western Australia.

This may result in accumulations of algae from time to time, however, there is to the Authority's knowledge no history of this causing nuisance.

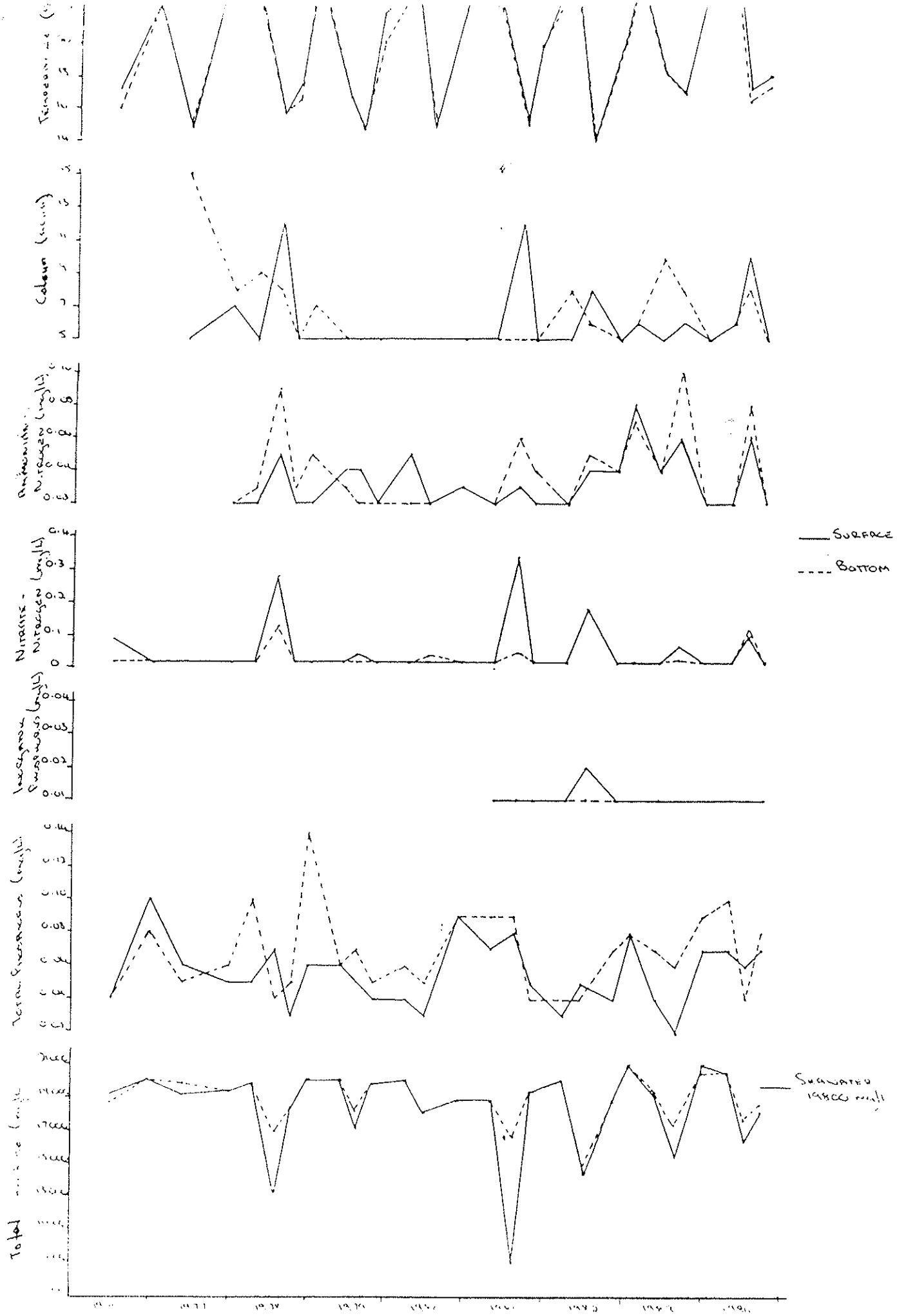


Figure 2: Station 11 - Parade Hotel

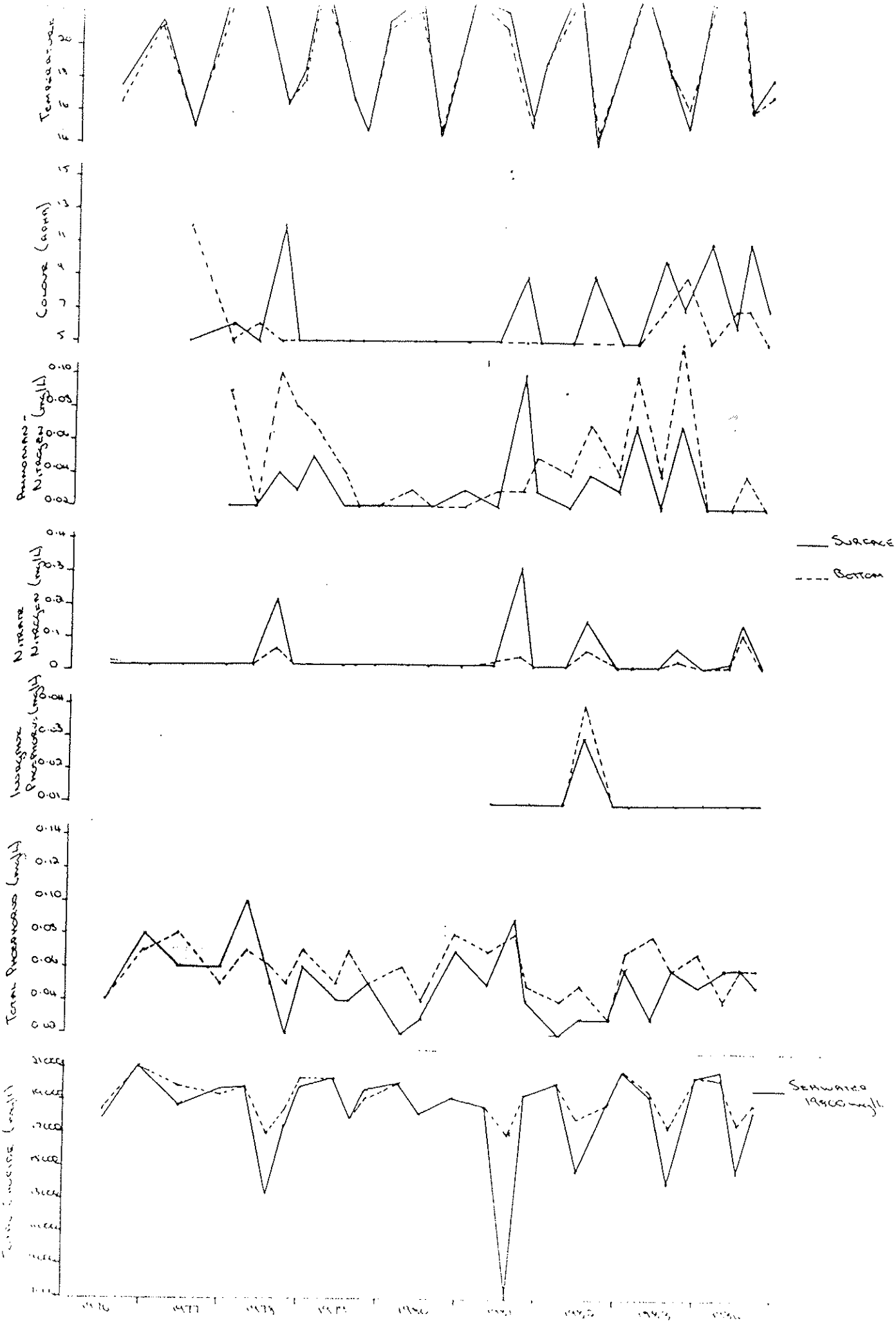


Figure 3: Station 13 - Adjacent to Meredith Creek

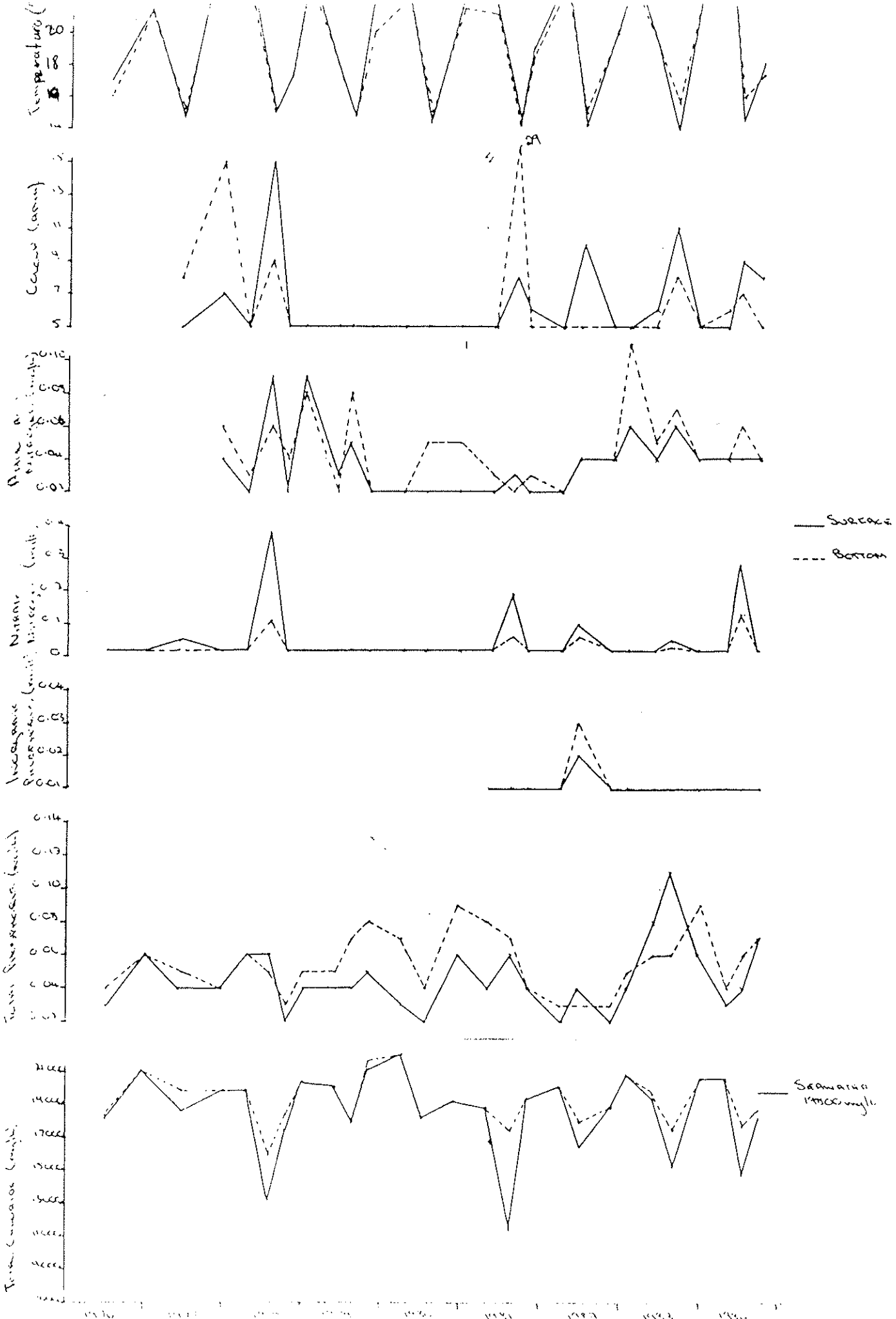


Figure 4: Station 10 - West of Dredged Inlet, Midstream

3.0 FLORA AND FAUNA

CONSERVATION RESERVES

Conservation Reserves for Western Australia as recommended by the Environmental Protection Authority - 1983 are included in DCE Report 13, The Darling System - System 6, Part II. DCE Report 13 has been approved by Cabinet.

Angelsea Island is referred to on page 117 of that Report and its description and recommendations have been reproduced in full in Figure 1 of this section.

THE WHITE MANGROVE

The mangrove plant community, called a mangal usually grows between high spring tide and mean sea level. Mangals are generally found in sheltered coastal environs where they are protected from strong currents and waves. Wave action and strong tides erode established mangals and hinder the establishment of seedlings. Manglas require tidal inundation to maintain the salinity balance of the ground water, the food chain pathways between the mangal and the estuary, the alteration of aquatic and terrestrial habitats for fauna within the mangal and oxygenation of the surface sediments and mangrove root zone (including the pneumatophores, aerial respiratory roots).

Mangroves depend on a regular tidal cycle and grow within the range of that cycle. The flood tide brings with it nutrients, aquatic fauna (e.g., fish, crustaceans), silts and maintains the salinity regime and water balance of the mangal. The ebb tide flushes detritus into the estuary, a source of food for species such as mullet, and allows the mangal surface sediment zone to "dry out" to some degree. This "drying out" phase enables oxygen diffusion to the surface sediments benefiting the infauna living there, direct diffusion of gases into pneumatophores and dropped seedlings to take root.

Interruptions to the tidal regime will alter the balance of these processes in some way, depending on the severity of the change.

Prolonged inundation can lead to a "water logging" effect. This causes the deoxygenation of surface sediments killing fauna that lives there, and if the pneumatophores are covered with water for too long, gas exchange is prevented.

Extended ebb tides resulting from say closing tide gates at a low tide could increase ground water salinities above the tolerance limits of the mangrove.

The manipulation of a tidal cycle may increase the rate at which the ebb tide is discharged. The resultant increase in discharge velocities may cause the erosion of silts from around the roots of the mangroves reducing stability.

C68 ANGLESEA ISLAND

The recommended area is situated immediately to the north of Bunbury and comprises Reserve A12636, for Recreation; part of Reserve C28033, for Caravan Park, Camping, Beach Resort, Recreation and Aquatic Sports, part of Reserve C28034, for Recreation, all vested in the City of Bunbury; and vacant Crown land (Figure 47).

Cable Sands Pty. Ltd. has an agreement with Bunbury City Council to deposit tailings on part of Reserve C28034. Anglesea Island and its surrounding waters may be affected by PWD works, necessary to control flooding of nearby low-lying residential land. There are SEC lines in the area, and it may be affected by future SEC lines and underground gas pipelines, and by port and industrial developments.

Apart from a very small stand in the north of the Leschenault Estuary, this is the only area south of Shark Bay where the white mangrove occurs. It is an unusual plant, believed to be a relic of an earlier tropical period. There are associated salt marsh plants such as samphire, and an occasional swamp sheoak.

Anglesea Island has pools of permanent water and low-lying samphire flats which provide good feeding and roosting areas for many water-birds, including greenshank, white-faced heron, white egret and common sandpiper. Some of these species migrate annually from the northern hemisphere, and in all, over fifty species have been recorded here. One of this area's greatest values is that it has a complete range of the estuary's major water-bird species, right next to Bunbury. Therefore it rates highly from the points of view of conservation, scientific interest and recreation.

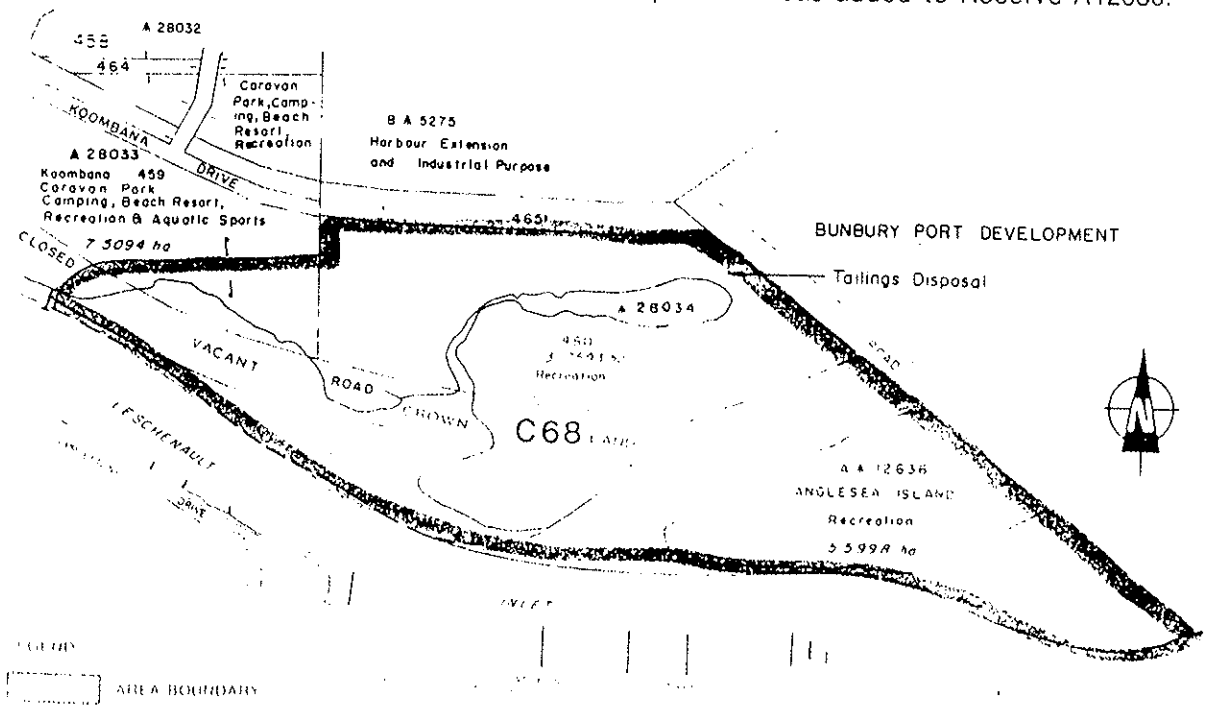
The mudflats adjacent to Koombana Park and Anglesea Island provide large numbers of worms, molluscs and crustacea, which are essential for most of the wading birds. The tidal flats are also nursery areas for commercial and angling species of fish.

Recommendations:

C68.1 That the purpose of Reserve A12636 be amended to Conservation of Flora and Fauna and that the Reserve be vested in the W.A. Wildlife Authority.

C68.2 That the vacant Crown land and the area of water, as shown in Figure 47, be added to Reserve A12636.

C68.3 That the southern portion of Reserve C28033 and all but the north-eastern portion of Reserve C28034 be excised and their respective areas added to Reserve A12636.



CITY OF BUNBURY

Figure 1

Any one or a combination of these disturbances can cause the degradation of the mangal. Degradation is likely to be gradual over a long period of time, initially expressed as a reduction in vigour of the mangroves. Such changes usually go unnoticed until the later stages of deterioration.

The likelihood of deterioration and the rate at which this may occur depends on the changes to the upper and lower limit of tidal inundation, time for each cycle and the frequency of the interrupted cycles.

The mangal on Anglesea Island may of course be able to accommodate some perturbation of the existing normal tidal cycle.

BIRD LIFE

Due to the terrain of Anglesea Island and adjacent areas the samphire flats and pools of water provide roosting and feeding areas for many water birds. It is known that some species migrate annually to the area from the northern hemisphere. Over fifty species have been recorded in the area.

MONITORING

A comprehensive survey and report on the birdlife was carried out by the Department of Fisheries and Wildlife about seven years ago. That report indicated the importance of the area as a refuge and feeding ground for migratory birds.

As a follow up to that study the Department has undertaken to carry out a further survey which will determine what changes have occurred if any, during the past seven years. The results of that survey will not be available until early 1986, due to the need to study a full season of migratory bird habits. Casual observation would indicate that the area would have lost none of its importance as a bird refuge and breeding ground particularly as there has been considerable reduction in wet land areas in the South West Region over the years.

A survey of the white mangroves was conducted by the Department of Fisheries and Wildlife about five years ago. The Department has agreed to review the findings of that study and a sample survey will be conducted and compared with measurements previously taken. That will determine what changes, if any, have taken place during the five year period. The results of the survey should be available by July 1985. Casual observation would indicate that the mangal community as a whole is thriving although some localized areass of poor growth are certainly noticeable. Since this is the southern most stand of white mangroves in Western Australia, its retention as a conservation measure would remain a high priority.

4.0 LANDSCAPING AND DEVELOPMENT

GENERAL

Examination of the site reveals that three separate zones exist. They have been shown in Figure 1 and are described as:

(a) An area at the eastern end of the Inlet which is clearly an important location for the preservation and conservation of wildlife.
Noted as CONSERVATION.

(b) The mild area immediately east of the outlet, currently being used for boat access to the water, a golf course and a Caravan Park.
Noted as ACTIVE RECREATION AND CIVIC.

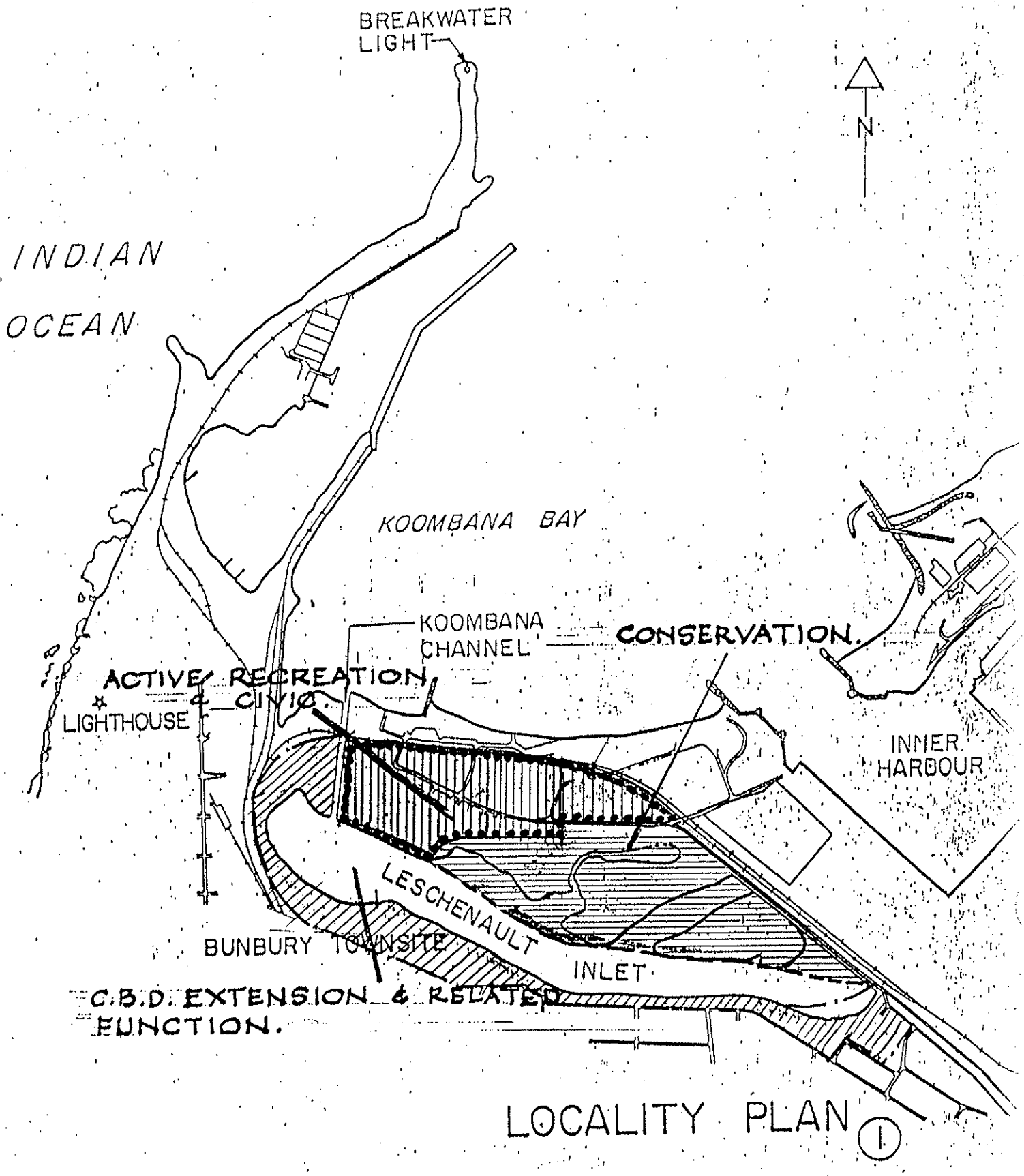
(c) That land at the western end of the Inlet now occupied by the Railway and forming land to be developed as an extension of the Central Business District and to accommodate the proposed Koombana throughway.
Noted as CBD AND CIVIC.

TOPOGRAPHY

Mainly flat with a small hillock adjacent to Koombana Drive. This is McLeod Point.

Anglesea Island is, for the most part, scrub and grassland which appears to be seldom flooded. Adjacent land, however, shows signs of fairly frequent flooding at periods of high tide and this has produced a mosquito hatching area.

Wind pruning is a serious problem. No relief from this can be expected as the wind shadow area is restricted to the Inlet water body and does not extend to the northern shore.



KOOMBANA PARK . LAND UTILISATION.

LESCHENAULT INLET MANAGEMENT AUTHORITY.

FIGURE 1

VEGETATION

The area is sparsely populated by native species and for the most part consists of substantial plantings of exotic trees i.e. Poplars, Coral Trees, Pines, Brazilian Peppers, Hibiscus, Palms and other species common to early twentieth century development.

Some established areas of Mangroves are apparent on the southern shore of Anglesea Island and the promontory adjoining. These narrow strips appear to be quite healthy and are beginning to increase.

It is also noted that Mangrove seedlings, yet few in number, have succeeded in beginning to colonise the narrow inlets on the northern side of Anglesea Island.

For the most part vegetation is sparse and relatively unimportant, consisting as it does of small areas of wattle, Typha, introduced plants and grasses. Grass species are mainly Kuikuyu, Couch and some annual grasses.

It is noted that the first of these is beginning to appear on the mineral sands reclamation area and is quite healthy. Couch grass too, is appearing.

Important Native species adjoining the Mangrove areas are Paperbarks and Casuarinas however wind-pruning appears to be a substantial problem and restricts their growth.

LANDSCAPE PROPOSALS

CONCEPTUAL DEVELOPMENT

Conceptual landscape development proposals have been shown in Figure 2. The proposals are described in detail in this section.

CONSERVATION AREA

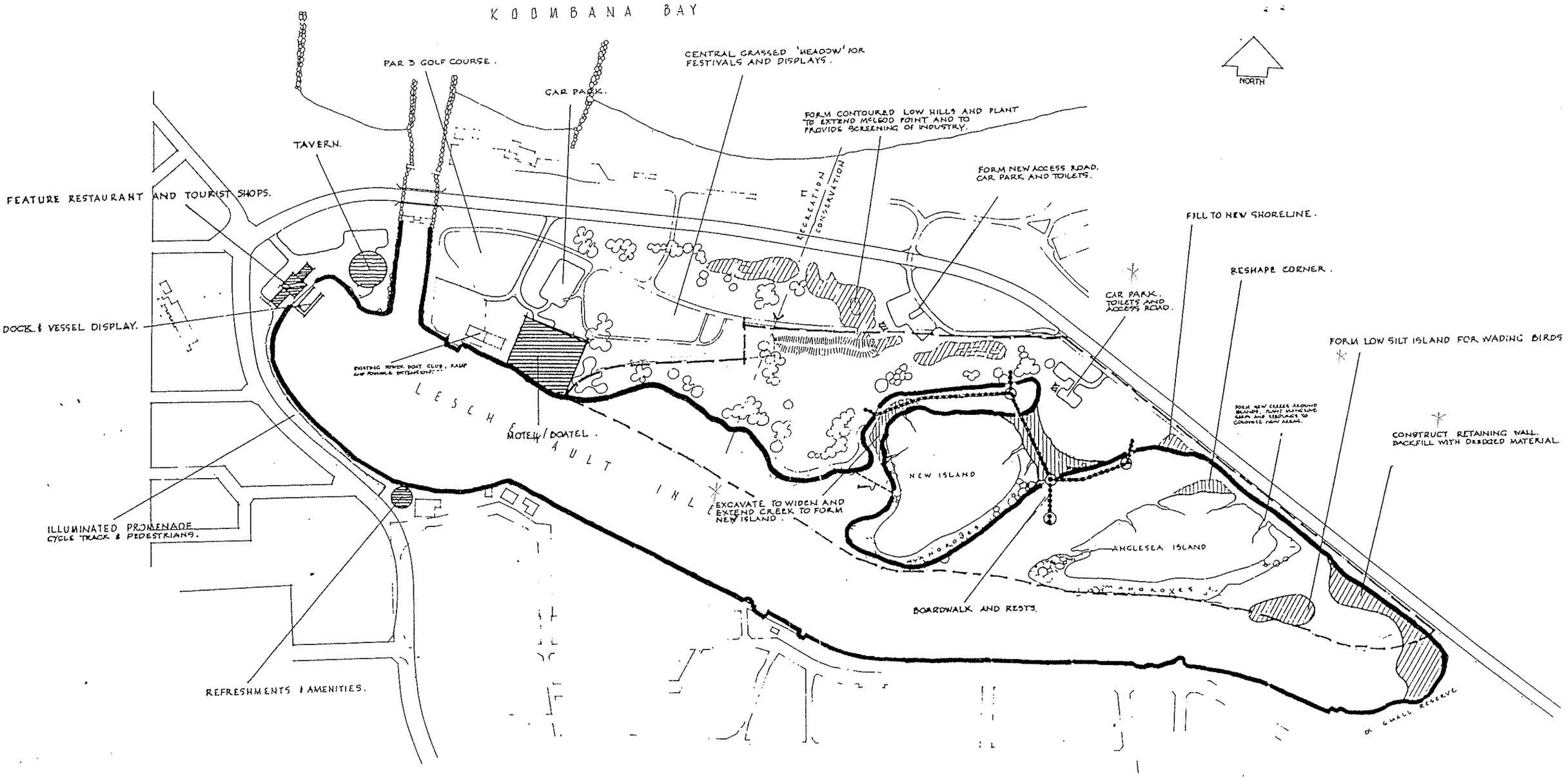
Existing uses:

This area is the only valuable site where the environment is natural and as yet, not subject to damage. However it is small and when development occurs, substantial deterioration will ensue if appropriate design measures are not undertaken.

The area is a refuge for wildfowl and many species of birds frequent the foreshore and Mangroves.

The Mangroves are attempting to colonise and the first evidence of this can be seen.

The problem is to use the area properly and to isolate the environment for its own protection.



LESCHENAULT INLET MANAGEMENT AUTHORITY.
WATERWAYS COMMISSION.

SKETCH OF ---------- LANDSCAPE SCHEME FOR KOOMBANA PARK.

DATE 17 MARCH 1983 DRAWN: AC/DH BUILDING MANAGEMENT AUTHORITY. DWG. 07/309/1-2.

BUILDING MANAGEMENT AUTHORITY OF WESTERN AUSTRALIA

FIGURE 2

Proposals

Isolation of this sensitive environment can be created by the formation of a second island as shown and by restricting the access of boats to the internal waterway so created by the construction of booms or floating barriers.

Public enjoyment of the area can be achieved by construction of a water Boardwalk with rest stations at appropriate points along its length. A small Car park and Comfort Block could be constructed as shown, to service the area.

Re-shaping the foreshores of both islands to a minimal extent and the formation of small creeks can encourage the growth of new Mangroves by replanting with seeds and seedlings from the parent area. No work to the low flooded areas is contemplated.

Internal circulation of the entire area should be controlled and pathways formed to link with the Boardwalk and Car Park.

The North-Western extremity would, perhaps, accommodate a small picnic area.

ACTIVE RECREATION AND CIVIC

Existing Uses

The area so designated is currently used as a Caravan Park, small golf course, public boat ramp and as the headquarters of the Power boat Club. Anglers, both juvenile and adult frequent the shoreline adjacent to the outlet and boat ramp areas.

Proposals

As has been recommended by others, re-siting of the Caravan Park will leave the area vacant. It could then be re-designed to provide an adequate site for the construction of a Motel/Boatel, a properly designed and maybe floodlit Par3 Golf Course, Festival meadow and appropriate Car Parks, toilet block and such other Civic small buildings as may be desired.

Construction of the proposed Koombana Drive and bridge will immediately make access easy and promote the area's desirability to City dwellers, previously excluded from easy access. It is suggested that this will give rise to suggestions for development of the site for more active use by a larger section of the population.

Bunbury 2000 could well give rise to A KOOMBANA FESTIVAL and similar annual local celebrations and the formation of a site to accommodate these appears to be practical.

The enlargement of the Mcleod point hillock to form a long and low range would, when formed and planted, provide a useful screen to the industrial works situated between the Koombana Park and the Inner Harbour. Correctly designed these would not obscure

the sight of vessels using the harbour facilities.

Substantial planting between the CONSERVATION area and the ACTIVE RECREATION area would serve to separate the functions and tend to protect the more sensitive of the two.

A review of the stability of the bank and foreshore condition will be necessary when the site of the Caravan Park is vacated to determine the extent of work needed to protect it against the possible erosion caused by the proposed use, i.e. greater power boat activity and general foreshore usage.

CBD AND CIVIC

Existing uses

Resumption of the Railway land is possibly the most dramatic of all the pojected developments in the Koombana Park area.

The immediate alterations to the character of the area, assuming that the proposed new access road is constructed, are as follows:

(a) Easy and free access to the northern sector of the Koombana Park area.

(b) The creation of a new and signigicant focal point to the City's centre. Where once, the Railway station formed the backdrop to the retail and Civic heart of Bunbury, this opening of the vista both inwarldly and along the northern/eastern approaches, now transfers the attention to the resumed area. It will become a most important 'front door' and be a very significant element in the City's reputation if correctly developed.

(c) It will transfer the direction of recreation from the ocean side thereby relieving pressure.

(d) It offers the opportunity to develop an attractive element in the City's amenities within easy walking distance of Hotels, Motels and the City proper.

Proposals

The formula to develop this area appears to be based upon Concept planning rather than a Landscape scheme. Significant and individual ideas can be incorporated into a general scheme as they are offered and examined.

Accepting the intention of providing pedestrian and cycle use of the foreshore with integral raised linkways across the proposed road, raises the question of what additional features could usefully service the area. The importance of this area has been offered in para.b. above.

For the main part the area is very restricted in width and has been shown as a prestigious promenade with accommodation for cycling. Terminal developments are shown as:

South: An area designated for refreshment kiosks, toilet block (if necessary), small tourist amenities and related utilities.

North: The opportunity to develop this as a very significant amenity to the City's Tourist and general advantage is implicit in the size and location of the sites.

Being as it will be, in close proximity to the City, a feature has been shown which is related to the early discovery and settlement of the area and to the Tourist and Citizen's benefit.

Briefly it is proposed to construct a dock in front of the shoreline and to exhibit in it either a replica of an early vessel, i.e. The Geographe, details of which are shown in Table 1, or a collection of historic boats.

Overlooking this has been shown a Restaurant as part of a Tourist shopping complex serving the day visitors and catering for boat owners and anglers.

The site adjoining the outlet and overlooking the water and the proposed Promenade, has been selected for the construction of a Tavern or similar development.

Visitor use of the proposed dock or jetty and foreshore for controlled boat parking, meter controlled, could be examined.

It is reiterated that the land based proposals mentioned above are an indication only of what might be able to be achieved. The responsibility for the land based work quite rightly rests with the City of Bunbury however in the planning for the Lower Inlet it is necessary to have some indication of what the water orientated resource is planned to service.

PRINCIPAL DIMENSIONS OF THE CORVETTE, THE *GÉOGRAPHE*

ngth from rabbet to rabbet	124 feet
Width at the main beam	30 feet
Moulded depth	14 feet 10 inches

Draught Upon Departure from Le Havre

the bow	13 feet 3 inches
the stern	14 feet 4 inches
Difference	1 foot 1 inch

	Length	Diameter	Mast-head
Dimensions of the Masts			
Mainmast	75 feet	23 inches	10 feet
remast	70 feet	22 inches	10 feet
izzenmast	58 feet	17 inches	8 feet
Bowspirit	50 feet	22 inches	—
Main topmast	44 feet	13 inches	6 feet
re topmast	43 feet	12½ inches	6 feet
Mizzen topmast	38 feet	10 inches	5 feet
			Pole-head
ain topgallant mast	38 feet	8½ inches	13 feet
re topgallant mast	34 feet	8 inches	12 feet
Mizzen topgallant mast	28 feet	6 inches	10 feet
-boom	32 feet	9½ inches	—
Yards			Yard-arms
ain-yard	62 feet	15 inches	6 feet
Fore-yard	56 feet	14 inches	6 feet
Mizzen-yard	43 feet	10 inches	5 feet
ritsail yard	44 feet	10 inches	5 feet
ain topmast yard	44 feet	10 inches	5½ feet
Fore topmast yard	43 feet	10 inches	5½ feet
zzen topmast yard	34 feet	7 inches	5 feet
ain topgallant yard	30 feet	6 inches	3 feet
Fore topgallant yard	27 feet	5½ inches	3 feet
Mizzen topgallant yard	24 feet	4½ inches	2 feet
tit-topsail yard	27 feet	6 inches	3 feet
Boom	41 feet	9 inches	—
Gaff	30 feet	8 inches	1 foot

577

TABLE 1

KOOMBANA BAY

373 200mE
6 312 400mN

374 400mE
6 312 400mN

SAILING CLUB

KOOMBANA CHANNEL

STORM SURGE BARRIER

M4

KOOMBANA CARAVAN PARK

KOOMBANA DRIVE

ROWING COURSE

APPROACH CHANNEL LEADS

A

CABLE SANDS

SSM BYN 7

KOOMBANA DRIVE

KB10

M6

KB2

M7

KB3

M8

KB4

M9

KB5

M10

KB6

M11

KB7

KB8

M18

M17

M16

KB9

LESCHENAULT INLET

ANGLESEA ISLAND

M12

M13

M14

DRIVE

373 000mE
6 311 800mN

BLAIR ST.

CROWHURST WAY

STIRLING STREET

STANLEY STREET

STIRLING STREET

KING ROAD

HAYES STREET

373 200mE
6 311 400mN

INDIAN OCEAN

BREAKWATER LIGHT

THE CUT

KOOMBANA BAY

BUNBURY POWER STN.

KOOMBANA CHANNEL

LIGHTHOUSE

INNER HARBOUR

PRESTON RIVER DIVERSION

BUNBURY TOWNSITE

LESCHENAULT INLET

PRESTON RIVER

LOCALITY PLAN (1)

500 0 500 1000
(1) SCALE OF METRES
(1 : 20 000)

50 0 50 100
(2) SCALE OF METRES
(1 : 2 500)

GENERAL NOTES

UNLESS OTHERWISE SHOWN ALL DIMENSIONS ARE IN METRES.

1. SOUNDINGS PLOTTED ARE FROM JANUARY 1984 SURVEY P.W.D.,W.A. 50976-4-1, 4-2 & 4-3.
2. ☐M SERIES-CONTROL POINTS FOR ORIGINAL BASELINE
3. FOR CADASTRAL INFORMATION REFER TO PORT AUTHORITY PLANS P.W.D.,W.A. 53735.

SCALES AS SHOWN

MICROFILMED 0

DATUM

SOUNDING DATUM WHICH IS 4.77m BELOW BM BYN 7 AND 0.640m BELOW AHD

DESIGN	BOOK
CHECKED	BOOK
DRAWN M.J.B	CHECKED I.K.
TRACED	CHECKED

SUBMITTED DATE 1/3/85
J Kent
SENIOR ENGINEERING DRAFTSMAN

APPROVED DATE 1/3/85
WATERWAYS COMMISSION ENGINEER

PUBLIC WORKS DEPARTMENT — WESTERN AUSTRALIA

WATERWAYS COMMISSION
BUNBURY-LESCHENAULT INLET
SOUNDINGS, JANUARY 1984

P.W.D.,W.A. 54077-5-1

ZONE	DATE	REVISION	DR'N	APPT

SURVEY BOOKS				FILE No
LB 32351	SB 32353			PW 343/81A

PRINTS
a 011
D No
n 5
A

TIME SCALES

It is to be emphasised that all or any of the proposals for areas b. and c. will require considerable investigation and research into their feasibility and viability, but the time frame envisaged for the resumption and acquisition of the land will comfortably accommodate these needs.

The development of the area shown (a), the CONSERVATION area, however, can proceed as and when desired and could well form the premise for a government sponsored scheme i.e. a Commonwealth Employment Project.

Such further design details as may be required to implement such a scheme could be forthcoming in a relatively short time.