Public Works Department N.S.W.
Hornsby Shire Council

BROOKLYN
WATERWAY PLANNING STUDY

NOVEMBER 1988

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FOREWORD

The Hawkesbury River is an increasingly important recreational amenity for the Sydney Metropolitan area and Brooklyn is one of the few gateways to the Hawkesbury.

Despite Brooklyn’s close proximity to Sydney and the availability of road and rail transport, a number of problems have restricted the development potential of the Brooklyn area for tourism and water-based recreation. These problems include siltation of navigation channels, poor public access to foreshores and congestion and conflict amongst the waterway and foreshore users.

The waterways and foreshore of the Brooklyn area are located within the Hornsby Shire Council, and planning strategies for the region between Asquith and Brooklyn are currently under review by the Council. The Public Works Department was requested by Council to assist in preparing a planning framework for the Brooklyn waterway.

This report documents the findings of the "Brooklyn Waterway Planning Study". It identifies present activities, future waterway and land requirements, factors affecting development and presents an overall plan which the Council could adopt as an appropriate strategy for the future development of Brooklyn.

The report has been prepared as part of the NSW Waterways Program and jointly funded by the Public Works Department and Hornsby Shire Council on a 3:1 basis. The assistance of the various individuals and government authorities is gratefully acknowledged.

The report in no way commits the NSW Government, the Public Works Department or Hornsby Shire Council to the implementation of any or all of the works set out in the report.
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INTRODUCTION

1.1 BACKGROUND

Brooklyn is located on the Hawkesbury River approximately 50 kilometres by road north of the Sydney Central Business District and 25 kilometres by road north of Hornsby (refer Figure 1). The Hawkesbury River is an increasingly important recreational amenity for the Sydney Metropolitan area and Brooklyn is one of the few gateways to the Hawkesbury.

Brooklyn is served by the Pacific Highway, the F3 Newcastle Freeway and by the Main Northern Railway Line with the Hawkesbury River Railway Station at the focal point of the Brooklyn Township. Despite the close proximity to the Sydney Metropolitan area and the extent of the transport infrastructure, a number of problems have restricted the potential of the Brooklyn area for tourism and water based recreation. These problems include siltation of navigation channels, poor public access to foreshores and congestion and conflict amongst the various waterway and foreshore users.

Hornsby Shire Council is currently reviewing its planning strategies for the region situated between Asquith and Brooklyn. The findings of Council’s review will be set out in an Asquith to Brooklyn Precinct Planning Study which will serve as a planning framework for the future development of the region.

The New South Wales Waterways Program, initiated in 1985, aims to facilitate and encourage the provision of better facilities for recreational boating in the State for both residents and tourists. As part of the Program, the Public Works Department (PWD) in association with Hornsby Shire Council commissioned Patterson Britton & Partners, Consulting Engineers, to undertake a study of the Brooklyn area to determine an appropriate strategy for existing and future waterway and foreshore development. This development strategy will be incorporated into the Asquith to Brooklyn Precinct Planning Study prepared by Hornsby Shire Council.

1.2 STUDY AREA

The study area encompasses the waterways and foreshores extending from Milson Island downstream to Dangar Island (refer Figure 2). Main emphasis has, however, been placed on the waterways and foreshores at Brooklyn. In particular the study has considered the southern foreshores of the Hawkesbury River east of the State Rail Authority (SRA) causeway and the southern foreshores of Sandbrook Inlet which is otherwise known as the Gut or the Gutter.

For the purpose of the study the waterway west of the SRA causeway and south of Long Island has been termed Sandbrook Inlet. The waterway east of the causeway and west of a line between the eastern tip of Long Island and Flat Rock Point (refer Figure 2) has been termed the Brooklyn Boat Harbour. The term Brooklyn Waterway has been used to describe collectively the Brooklyn Boat Harbour and Sandbrook Inlet.
1.3 AIMS AND OBJECTIVES OF THE STUDY

The principal aims of the study are as follows:

- describe the existing environment and identify the present activities within the study area,
- assess the waterway and land area requirements of the existing and likely future users,
- establish a planning framework which identifies the priorities, constraints and opportunities affecting future waterway and foreshore development,
- identify and examine options for accommodating the waterway and land area requirements of existing and future users,
- select a preferred option having regard to the planning framework, potential impacts and costs,
- provide a document on planning and management of the Brooklyn waterway which can input Hornsby Shire Council's planning strategy for the area,
- identify development and redevelopment opportunities which fall within the scope of the Public Works Department's NSW Waterways Program and NSW Fishing Ports and Government Facilities Program.
2. SUMMARY

2.1 PRESENT WATERWAY ACTIVITIES AND FUTURE REQUIREMENTS

2.1.1 General

A summary of the present waterway activities in the Brooklyn Waterway together with the future waterway requirements for each of these activities is presented at Table 4.5 and in the following sections. The future requirements have been considered for a planning horizon of 10 years.

2.1.2 Fishing Industry

Currently 14 fishing vessels are moored at a jetty in the Brooklyn Boat Harbour. The Co-operative has a small fish unloading and fuelling berth adjacent the Co-operative premises, which also sells fish to the public.

Based on a review of the Co-operative's fish and prawn production in the last ten years it is considered that the catch landed in the Hawkesbury will remain at its present level over the next ten years. While there is a demand for improved fish unloading and fuelling berth facilities, an increase in demand for fishing vessel mooring facilities is not anticipated.

2.1.3 Oyster Industry

Despite seasonal fluctuations the production of oysters in NSW has grown steadily from 1930, though production appears to show a levelling trend since the early 1970's.

Oyster production of the Sandbrook Inlet leases has reduced markedly in recent years. The Department of Agriculture is not issuing new leases but is promoting relinquishing of the low productivity leases in favour of introducing more efficient cultivation practices in the higher productivity leases. Hence it is likely that the area of oyster leases within the Inlet may decrease in the future. The spat catching area in the Brooklyn Boat Harbour will be of increasing importance to the oyster industry in the future and the waterway area required for these purposes should therefore be maintained.

Oyster depots are currently being developed in the Mooney Mooney Creek area. Due to this and the decreased productivity of the Sandbrook Inlet leases, the land area requirements for oyster depots in Sandbrook Inlet are not anticipated to increase in the planning horizon.

2.1.4 Commercial Waterway Activities

Ferry Services

There are three ferry companies operating from Brooklyn. Two ferry operators offer a scheduled service and handle in excess of 1,000 passengers per week. The other ferries offer an unscheduled water taxi service.

The use of ferries and water taxis in Brooklyn has increased in recent years as the foreshores of the Hawkesbury River have developed. The public wharf in the Brooklyn Boat Harbour is considered inadequate to meet the immediate and future demands of the ferry services.
All the ferry and water taxi services wish to expand either through replacement with larger vessels or purchase of additional vessels. The ferry and water taxi services will require land area in the Brooklyn Boat Harbour for mustering and shelter of passengers and priority use of a berth for embarkation and disembarkation of passengers. A berth length of 15 metres should be adequate for these purposes.

**Cruises**

There are two companies operating from the Brooklyn area that offer scheduled cruise services. One operator is based in the Brooklyn Boat Harbour whilst the other operates from Kangaroo Point at the mouth of Sandbrook Inlet.

The number of tourists taking day river cruises from the Brooklyn Boat Harbour is estimated by the operator at over 3,000 per week and has increased in recent years particularly tour groups arriving by bus. To meet the future requirements of tourist cruise services operating from Brooklyn Boat Harbour it is considered necessary to allocate waterway and associated land area for up to four 20 metre cruise vessels (*effective berth length of 96 metres*) in the planning horizon. The berths for the four vessels would be for use as a set-down and pick-up point. Visiting cruise vessels could use the public wharf in the Boat Harbour for embarkation and disembarkation of passengers.

The cruise service at Kangaroo Point is in its infancy and it is not possible to determine the future growth of the service. The operator considers, however, that a sister ship could be constructed in the next five years, depending on the viability of the current operation. The existing cruise vessel is 68 metres long, and if another vessel of this size were introduced on the waterway it would require comparable facilities. Potential sites to accommodate a vessel of this size do not exist either within Sandbrook Inlet or the Brooklyn Boat Harbour, though possible sites are available at Mooney Mooney or Mooney Mooney Point. Reference 33 has recommended such a facility for Mooney Mooney Point.

**Charter Boats**

There are five charter boat companies operating in the Brooklyn area and all of these companies are located in Sandbrook Inlet. The charter boats generally operate from or are run by established marinas. Based on the anticipated number of tourists visiting the Hawkesbury it is considered that the number of charter vessels operating from the Brooklyn Waterway will increase but it has been assumed that all these vessels would be berthed at marina facilities.

**Boat Hire**

There are currently six boat hire companies operating in the Brooklyn area. The boat hire companies are located in boatsheds and marinas both in Sandbrook Inlet and the Brooklyn Boat Harbour. The increased number of private boats on the waterway has reduced the demand for local boat hire. It is considered that, for the planning horizon, the demand for small boat hire will remain constant in the study area and may even reduce in this period.

**Boat Repair and Maintenance**

Boat repair and maintenance facilities are carried out by 10 companies in the Brooklyn Waterway. It is considered that additional slipway facilities would be required in the Brooklyn Waterway over the planning horizon and these would be provided at commercial marinas. There is a potential demand for slipping facilities to service deep draft and large vessels nearby to the Brooklyn Waterway.
2.1.5 Recreational Boating

Marina Berths

There are a total of six marinas in the Brooklyn Waterway and all of the marinas are located in Sandbrook Inlet. Together the marinas provide a total of 225 wet berths. The total anticipated net additional marina wet berth demand in the Brooklyn Waterway for the full planning horizon is 290 berths (including 10 visitor berths). This demand should be satisfied by the proposed 380 berth marina within the Kangaroo Point tourist development and other proposed expansions of existing marinas.

Commercial and Private Moorings

There are currently 182 commercial moorings and 147 private moorings in the Brooklyn Waterway. There is considered to be a nett additional demand for 260 moorings in the Brooklyn Waterway.

Boat Launching Ramps

Boat launching ramps are located in Parsley Bay, at the Dolphin Boatshed in Sandbrook Inlet, at Kangaroo Point and at Mooney Mooney Point. It is considered that there is a demand for an additional 5 lane boat ramp with a minimum of 150 car and trailer parking spaces. The large flat reclaimed area at Mooney Mooney Point provides the only suitable site for such a development within the study area.

Public Wharves

There are six public wharves in the Brooklyn area. A small wharf is located in the east end of Sandbrook Inlet whilst a larger wharf is located at Kangaroo Point at the western end. The wharf in the Brooklyn Boat Harbour is popular with both commercial and recreational boating.

Recently, three floating berthing structures have been constructed with two in Parsley Bay and one in Brooklyn Boat Harbour, adjacent to the tidal baths.

A public wharf with a total berth length of 35 metres is required within the Boat Harbour in the planning horizon as a pick-up and set-down point for ferry, water taxi and cruise craft. The recently constructed floating berths are more suitable for recreational craft. A 15 metre berth length would be allocated for the priority use by ferries and water taxis, a 20 metre berth length would be for general public use by visiting cruise vessels and recreational boaters. Other public wharves/jetties would be required within Sandbrook Inlet to improve public access to the waterway.

2.1.6 Non Boating Recreation

The major non boating recreational activities undertaken in the Brooklyn area comprise passive and active recreation associated with the foreshore. Such activities include swimming (mainly in the tidal baths at McKell Park), fishing, picnicking, sunbathing, walking and sporting activities.

The per capita provision of non regional open space in Brooklyn is approximately 10 times the average open space provision in Hornsby Shire. However, the public access to the foreshore is severely limited along the Brooklyn Waterway. Therefore, the approach adopted in this report has been to consider opportunities to provide for a range of recreational uses which take advantage of local site attributes and promote access to
waterside areas. Major open space areas that offer opportunities for future development include McKell Park, west of the SRA causeway, the Brooklyn Park and Quarry area, the Mangrove and Dairy Flats area, and Mooney Mooney Point. The tidal baths in McKell Park should be maintained in its present location.

2.1.7 Government Facilities

The State Rail Authority, Department of Agriculture, Fisheries Division and Water Police currently maintain offices in the Brooklyn area. The Maritime Services Board maintains a Regional Office at Hornsby and keeps a berth at Brooklyn. It is considered that it would be preferable to establish a central port administration building in the Brooklyn Boat Harbour. The building would house the Fisheries Division with a smaller office for the Water Police. The Maritime Services Board would have an office at Hornsby and only require a berth at Brooklyn. It is considered necessary to provide waterway area for a total of six vessels with a maximum length of 8 metres (58 metre berth length), though as a first stage facilities would be required for four vessels only (40 metre berth length).

2.1.8 Road Access and Parking

Road Access

Development of the Brooklyn Boat Harbour is contingent upon improved road access and vehicle manoeuvring areas. Development either north along the State Rail Authority causeway or east towards the tidal baths will require improved roadways to facilitate access by cars, buses and trucks. It is considered necessary to upgrade Brooklyn Road through widening at narrow sections and realignment where possible.

Parking

There are no formalised public parking areas along the southern foreshores of Sandbrook Inlet although parking is available along Brooklyn Road. It is recommended that formalised parking for 120 cars be provided for users of craft at moorings and for the proposed passive recreation areas. This excludes consideration of demand at commercial operations.

The parking areas around the Boat Harbour are not formally marked but provide a total of approximately 140 car parking spaces. Based on future use of the Brooklyn Boat Harbour it is estimated that there is a total demand for about 242 car parking spaces in the planning horizon. Overflow parking would be provided on the proposed Causeway West Park to cater for the excess demand.

2.2 DEVELOPMENT CONSTRAINTS

The major factors affecting development of the Brooklyn Waterway are as follows:

Planning Issues - development must take place where possible within regional and local environmental planning schemes and strategies. The proposed developments are generally consistent with the Hornsby Shire Draft Planning Study and the Hawkesbury/Nepean River Regional Environmental Plan.

Physical Constraints - available waterway area as constrained by existing water depths, wave climate, physical features and land areas.
In general it would be necessary to undertake dredging in Sandbrook Inlet and the Brooklyn Boat Harbour to provide sufficient waterway areas for future development. Additional land area would also be required to meet land base requirements.

There is insufficient sheltered waterway within the Inlet to cater for the predicted additional demand for 260 moorings. The maximum recommended mooring areas in Sandbrook Inlet would provide an additional 114 moorings. The Boat Harbour waterway is too limited to cope with additional moorings. In the future, Parsley Bay may be required to accommodate the excess demand for moorings. Some of this excess demand may be satisfied by the proposed dry storage facility within the Kangaroo Point development.

**Environmental Factors** - constraints on development include maintaining adequate water quality, mangrove areas, oyster leases and Aboriginal sites and relics.

It is considered that existing water quality would not constrain future development subject to the instigation of a water quality monitoring programme. This programme would include regular water sampling and testing similar to that described in Section 3.11.4.

It is necessary to maintain the mangrove habitats at the mouth of Seymours Creek, though other areas of mangrove within Sandbrook Inlet may be reduced. Oyster leases in Sandbrook Inlet are considered by the Fisheries Division to be of less significance than other areas and it may be possible to reduce the areas of waterway taken by these leases. Aboriginal sites within McKell Park include engravings and rock shelters with art. These should be retained and an archaeological survey should be undertaken prior to any development to establish suitable management strategies and to investigate the existence of other sites.

**Engineering Issues** - major engineering works or services that may be required to promote or facilitate future development.

The prime issues include dredging to accommodate future siltation, works to improve tidal flushing of Sandbrook Inlet, and the adequacy of existing services.

It is not considered cost effective to place culverts through the SRA causeway to reduce siltation in Sandbrook Inlet and Brooklyn Boat Harbour. It would be preferable to overdredge the waterway to make allowance for any future siltation. In addition a preliminary assessment indicates that the construction of a culvert in the causeway would not result in a marked improvement to the tidal flushing time of Sandbrook Inlet and hence would not be expected to improve water quality in the Inlet.

Other than the proposed tourist development at Kangaroo Point, the preferred actions identified in this report would not be constrained by the capacity of the existing water supply system and the lack of a mains sewerage system.

**Social Issues** - maintaining and promoting a social environment in keeping with community requirements. Specifically the need to preserve open space and improve public access to the waterway, and encourage the development of improved services in the Brooklyn Township.
2.3 DEVELOPMENT OPTIONS

As indicated above, there are significant factors which place constraints on the future development of Brooklyn and surrounding areas.

Both land and waterway facilities have developed in an unco-ordinated fashion and access to the waterway is poor. Future proposals for land and waterway development require assessment in terms of an overall planning framework, as opposed to the present piecemeal development.

Against this background, Hornsby Shire Council requested the preparation of a waterway planning study which would assist Council in the preparation of a Local Environmental Plan for the area.

Accordingly, one of the main aims of this study is to establish a planning framework for future waterway and foreshore development. Options have been examined for accommodating the waterway and land area requirements of existing and future users and a range of preferred actions identified.

In the future development of Parsley Bay and Long Island, the preferred actions which have been identified are described in Section 6.7 and 6.8. Since these actions are only considered very preliminary no further planning has been undertaken.

For the main areas of the study, Brooklyn Boatharbour, Sandbrook Inlet and Mooney Mooney Point, the preferred actions to be considered in future development are described in Section 6.3 to Section 6.6. The preferred actions have been divided into a number of phases to facilitate staged construction. These developments specifically address the waterway related facilities and exclude the existing commercial operations along Sandbrook Inlet and the proposed tourist development at Kangaroo Point. A description of the phases with estimated costs is given below and conceptual development plans are provided at Figures 15 and 21.

Brooklyn Boatharbour

Phase 1 - $2.3 million
- Dredging, reclamation, public wharf, relocated government administration building and moorings, improved parking, foreshore boardwalk and recreational amenities
- An area would be provided for cruise vessel facilities

Phase 1a - $1.5 million
- Excludes boardwalk and government administration building and berths from Phase 1
- A demountable building would be used for temporary government offices and berths provided at visitor berth jetty

Phase 2 - $0.3 million
- Improvements to McKell Park, parking and roads
Sandbrook Inlet

Phase 1 - $nil
Rationalisation of existing moorings to fore and aft, where possible

Phase 2 - $1.2 million
Dredging sufficient quantity in Inlet navigation channel to provide landfill for Causeway West Park plus provision of car parking in the park

Phase 3 - $1.0 million
Sufficient dredging of the Inlet navigation channel to provide landfill for Brooklyn Park. Improvement of Brooklyn Park with landscaping, jetty and improved waterway access

Phase 4 - $2.5 million
Dredging of navigation channel to Causeway West Park. Improve park with landscaping, jetty and improved waterway access

Mooney Mooney Point

Phase 1 - $0.4 million
Construct a 3 lane boat ramp incorporating the existing lane, parking, landscaping and picnic facilities.

Phase 2 - $0.4 million
Duplication of Phase 1

Phase 3 - $0.5 million
Provide a cruise vessel berth

These phases of development were assigned a priority based on need and practicality of staging. It was assumed that Phase 1, Sandbrook Inlet would be implemented immediately as it involves no capital costs. The recommended stages of construction and their costs are given below:

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cost</th>
<th>Location</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>$0.4 m</td>
<td>Mooney Mooney Point</td>
<td>Phase 1</td>
</tr>
<tr>
<td>Stage 2</td>
<td>$2.7 m</td>
<td>Brooklyn Boat Harbour</td>
<td>Phase 1a</td>
</tr>
<tr>
<td>Stage 3</td>
<td>$1.8 m</td>
<td>Brooklyn Boat Harbour</td>
<td>Phases 2</td>
</tr>
<tr>
<td>Stage 4</td>
<td>$0.3 m</td>
<td>Brooklyn Boat Harbour</td>
<td>Phases 3</td>
</tr>
<tr>
<td>Stage 5</td>
<td>$0.4 m</td>
<td>Mooney Mooney Point</td>
<td>Phases 2</td>
</tr>
<tr>
<td>Stage 6</td>
<td>$2.5 m</td>
<td>Sandbrook Inlet</td>
<td>Phases 4</td>
</tr>
<tr>
<td>Stage 7</td>
<td>$0.5 m</td>
<td>Mooney Mooney Point</td>
<td>Phases 3</td>
</tr>
</tbody>
</table>

Total - $8.6 m

These stages have been formulated so that they can be developed independently and represent the minimum possible stage costs. These stages could be combined if required. Also the relative timing of any stage is not meant to be fixed and opportunities which provide the means of accelerating the development with significant cost savings should be sought.

Various avenues for funding of these works exist including state and local government as well as possible ideas for attracting private capital. These aspects are discussed in detail in Section 6.9.3.
3. DESCRIPTION OF EXISTING ENVIRONMENT AND PRESENT ACTIVITIES

3.1 BROOKLYN AND SURROUNDING COMMUNITIES

3.1.1 Historic Perspective

The first European contact with Brooklyn was by a party of explorers led by the Governor, Captain Phillip on 7 March 1788 (Reference 1). The settlement at Sydney was a mere one month old, but the necessity of finding useful farming land led Phillip to explore the Hawkesbury River. The party reached the island now known as Dangar Island, which they called Mullet Island from the great quantity of their catch.

The first European settlers near the current site of Brooklyn were probably squatters, fisherman, timber-cutters or possibly runaway convicts. The first official resident in the Brooklyn area was George Peat who received a land grant of fifty acres in 1836. Throughout the nineteenth century traders plied regularly from the River to Sydney, carrying produce from local farms and supplying settlers.

By 1880 railway networks had spread throughout most of the State, and a link between Newcastle and Sydney was being considered. In 1887 a rail link from Sydney reached the Hawkesbury River to the east of Peat's Ferry (near existing road bridge). For a decade the connection to the northern lie was via large paddle-wheeled steamer from Brooklyn to Brisbane Water and latter upper Mullet Creek.

In 1899 construction was completed on the first rail bridge over the Hawkesbury River. The Union Bridge Company of the USA won the tender to build this bridge and it was this company, which also built the New York Brooklyn Bridge, that gave the local township its name.

Brooklyn, after completion of the railway bridge, became the most significant settlement on the lower Hawkesbury. At the turn of the century "Town and Country Journal" gave the following description (Reference 1) ....

"Brooklyn is striking and picturesque. It is very much scattered ... the population comprised in the area of the police patrol reaches 500. The most notable edifices are the hotels ... two within a stone's throw of the railway station. The police station and lockup is, excepting the railway station, the next pretentious building. Then there are a fairly large public hall, seating 200 people, a post and telegraph office, several small stores and a butchers shop. The public school, churches, houses and cottages furnished for visitors completed a list of noteworthy buildings. The remainder are the humble, neat, homely habitations of the fisher folk."

Plates 1 and 2 show the Brooklyn township and foreshore area following the construction of the railway causeway at the turn of the century. In Plate 1, a significant shoal is evident in both the boatharbour and Sandbrook Inlet. This shoal was probably present prior to the construction of the causeway.

3.1.2 Existing Community Needs

The Draft Asquith to Brooklyn Precinct Planning Study proposed by Hornsby Shire Council (Reference 2) provides useful data about the Brooklyn community and other suburbs within the Asquith to Brooklyn precinct.
BROOKLYN BOATHARBOUR AND RAILWAY CAUSEWAY (CIRCA 1900)
BROOKLYN BOATHARBOUR
(FORESHORES)
(CIRCA 1900)
The Brooklyn area community is well established and generally adequately provided for in terms of community services. Surveys undertaken by Council (Reference 2) indicate that the existing residents appreciate the tranquility and beauty of the area and do not wish these qualities to be altered.

The residents have indicated that they would like improvements to roads, transportation and sewerage services. These facilities are largely dependent, however, on attracting greater population or visitation to the area to justify the expenditure of public funds. An increase in population would also increase the potential for service businesses (e.g., auto repair, supermarket etc) to be established in the area to serve existing and new residents of the community alike.

Notwithstanding this, any further development of the Brooklyn area is severely constrained by topography and the need to sustain those natural qualities which make the area attractive to residents and visitors.

3.1.3 Population Characteristics

The population of the Brooklyn area in 1986 was estimated to be 1,276 persons. Assuming land currently zoned for residential purposes was developed the population of the Brooklyn area is anticipated to increase by a further 945 (refer Appendix A). This figure is based on the assumptions that current residential zonings will not be altered or extended. Development of some land relies on the Water Board being able to provide adequate water supply services.

Census information indicates that the Brooklyn area population is aging, retirees are tending to settle in the area and that the community has generally remained static over an extended period.

A unique feature of the Brooklyn area workforce population is its reliance on walking and public transport for its mode of travel to work. Dangar Island residents contribute significantly to the 15 percent of the workforce who use ferries as a mode of travel to work in the Brooklyn area. Approximately 40 percent of the Brooklyn area workforce (approx 400) is currently employed in water based industries (e.g., oyster, boating related industries). This reinforces the importance of the waterway to the local community for employment.

3.2 WATERWAY AND LAND FEATURES

Existing development in Brooklyn is contained within a 3 kilometre long, foreshore zone on the lower Hawkesbury River estuary and occupies a land area of approximately 45 hectares.

The main waterway feature of the Brooklyn area is the Hawkesbury River. The river has its origins to the west of Sydney, and flows north and then south-east toward the coast (refer Figure 1). The river drains a catchment of approximately 20,000 square kilometres, an area which includes the subcatchments of the Nepean, Grose, Colo and McDonald Rivers (Reference 3). The length of the Hawkesbury River considered in this study is approximately 10 kilometres long extending from Milson Island downstream to beyond Dangar Island (refer Figure 2). The major waterway areas within the study area are as follows:

- Sandbrook Inlet, otherwise known as "the Gut", a tidal backwater between Brooklyn and Long Island. This backwater was formed after the construction of the railway causeway linking Brooklyn to the eastern end of Long Island in the mid 1880's. Sandbrook Inlet is approximately 2.5 kilometres in length and ranges in width from 300 to 400 metres.
Brooklyn Boat Harbour, the waterway immediately east of the railway causeway comprising the navigable channel between Brooklyn Wharf and the main river channels east of Flat Rock Point, and adjacent oyster lease areas

Parsley Bay to the south-west of Flat Rock Point

Generally the topography of the shoreline and adjacent areas to the south of the river between Milson Island and Dangar Island is rugged and steep. Between Prickly Point (opposite Milson Island) and Kangaroo Point (at the entrance to Sandbrook Inlet) the shoreline rises steeply up to the Muogamarra Ridge located some 200 metres above the waterway. Immediately south of Brooklyn and west of Parsley Bay, the land rises steeply to similar elevations. The topography of Long Island is characterised by two, steeply sided hills, towards either end of the island. The elevations of both hills and the intervening saddle crest are approximately 100 metres and 40 metres above Indian Spring Low Water (ISLW) respectively.

The vegetation within the vicinity of the study area, where not cleared for urban development, has been classified by the Sydney Royal Botanical Gardens as low woodland and open scrub which comprise Eucalyptus, Banksia and Hakea species (Reference 2). These types of vegetation are associated with the infertile and poorly drained soils derived from Hawkesbury Sandstone (refer Section 3.9).

The soil in the Brooklyn area is generally infertile, unsuitable for top-soiling, has a hard setting surface and is associated with a high soil erosion hazard. In the western foreshore areas of Sandbrook Inlet close to the mouth of Seymours Creek (Figure 7), there is a sizeable deposit of silty to peaty quartz sand (Reference 2).

3.3 WATERWAY DEPTHS, AREAS AND NAVIGATION

The Hawkesbury River is approximately one kilometre wide in the vicinity of Milson Island, narrowing downstream to 0.5 kilometres at Hawkesbury River Bridge (Peats Ferry Bridge) between Kangaroo Point and Mooney Mooney Point. Downstream of Mooney Mooney Point the river generally widens to 2 kilometres in the vicinity of Parsley Bay.

Water depths in the Hawkesbury River, Sandbrook Inlet, and the Brooklyn Boat Harbour vary from those at the shallow, sediment-accreted intertidal flats (approximately one metre above Indian Spring Low Water (ISLW)), to the deep, scour-maintained areas located at the outside of bends in the main river channel (approximately 20 metres below ISLW), refer Figure 3. The navigation channel in the main river varies in depth from 5 to 10 metres below ISLW.

Within Sandbrook Inlet, water depths are generally shallower than 2 metres below ISLW, typically reducing from the inlet entrance off Kangaroo Point, to the SRA causeway. The Inlet is generally shallower along the Brooklyn foreshore than along the Long Island foreshore. There are no detailed hydrographic surveys available to ascertain water depths in the Inlet prior to the railway causeway construction. However, Plate 1 shows a significant sand shoal which extended from the Boatharbour into the Inlet.

A 40 to 50 metre wide navigation channel at a depth of approximately 2.0 metres below ISLW is located in the Brooklyn Boat Harbour. The channel, which is dredged when required (see Table 3.3), provides navigable access to the waterfront facilities located along the causeway. The channel was last dredged in early 1980. Water depths in Parsley Bay are typically less than one metre below ISLW.
The approximate waterway areas in the study area are as follows:

- Sandbrook Inlet: 117 hectares
- Brooklyn Boat Harbour: 22 hectares (enclosed by a line from the eastern tip of Long Island to Flat Rock Point)
- Parsley Bay: 5 hectares (enclosed by a line across the mouth of the Bay).

### 3.4 TIDAL PLANES AND TIDAL HYDRAULICS

As part of the Hawkesbury River tidal monitoring programme, the PWD has collected tidal data in the main river channel between Long Island and Spectacle Island (Reference 3, Reference 4). Tidal gradients for the study area as established by the PWD are presented in Figure 4.

The data collected by the PWD indicates that the largest tidal currents in the main river channel typically occur during an ebb cycle close to Long Island. For a typical mean spring tidal range of 1.3 metres, a maximum depth-averaged ebb tidal velocity of 1.0 metres per second would be expected in the deep channel close to Long Island. For the same tidal condition, depth-averaged maximum flood velocities of approximately 0.6 metres per second would be expected across the full river section.

Previous studies of the Brooklyn Waterway undertaken by the PWD (draft editions only: Reference 5, Reference 6) have concluded the following:

- the tidal range within Sandbrook Inlet is approximately 90 percent of that measured in the Brooklyn Boat Harbour;
- the maximum water elevation differential across the SRA causeway is approximately 0.1 metres at mid tide,
- maximum flushing velocities at the entrance to Sandbrook Inlet are estimated to be 0.25 metres per second.

No tidal velocity information is available for inside Sandbrook Inlet, the Brooklyn Boat Harbour or Parsley Bay, however tidal velocities at these locations would not generally be expected to exceed 0.2 metres per second. The tidal flushing characteristics of Sandbrook Inlet are examined further in Section 3.11.5.

### 3.5 FLOODING

The March 1978 flooding of the Hawkesbury River is well documented and has provided a basis for estimation of inundation levels along the Hawkesbury River (Reference 7). The estimated recurrence interval for this flood event varies and has been estimated at between 20 and 100 years depending on the gauging location. At Windsor Bridge located some 125 kilometres upstream from the mouth, the flood is reported to have peaked at 14.45 metres AHD, a level which according to flooding records extending back to the mid 1800's corresponds to a recurrence interval of between 35 and 40 years.

Flood peak levels for the March 1978 flood were measured as far downstream as Spencer, 20 kilometres upstream from Brooklyn. The peak water level at Spencer measured approximately one metre above the predicted tide level. The river and lower estuary widen significantly downstream of Spencer, with Brooklyn located only 15 kilometres from the ocean. Consequently the flooding component contributing to the total water level at Spencer would clearly decrease downstream toward Brooklyn and flooding due to an extreme rainfall event alone is not considered to be
The Public Works Department, in the absence of more definitive studies, suggested an appropriate inundation level of 20 metres above AHD for design of facilities in the Brooklyn waterway. This level was interpolated from known flooding levels upstream of Spencer and from estimated elevated ocean water level at the entrance to Broken Bay (pers. comm. PWD 7.8 87).

### 3.6 WINDS

No wind data is available specifically for the study area. However, long term wind records from Sydney Airport are considered representative of the general wind regime for Brooklyn and the lower Hawkesbury estuary (Reference 5, Reference 6, Reference 8).

The most common wind direction during the summer months is north-east. Sea breezes from this direction are generally of low velocity (less than 30 kilometres/hour), although they can exist for sustained periods (2 to 3 days). During the winter, westerlies are usually stronger than the summer north-easterlies, and are capable of blowing for similar sustained periods of time. Less seasonal, but regular and equally important, are the gusty south-easterlies observed mainly between February and August. The strongest winds predicted for the study area are southerly. These frequently reach gale force (50 kilometres/hour) and are typically of short duration.

The steep and elevated shoreline areas generally found within the study area (refer Section 3.2) would introduce topographic wind shielding to protected down-wind areas and also increase the occurrence of winds with directions parallel to the river alignment (ie funnelling). Brooklyn would therefore be well protected from the stronger southerly to south-easterly winds, particularly those areas west of the SRA causeway. Parsley Bay, however, is directly exposed to the south-east. As Brooklyn is located close to the ocean, diurnal cooling and warming differentials between the ocean and the land result in land breezes down the river valley in the early mornings (particularly in winter), and sea breezes up the valley later in the day (particularly in summer).

### 3.7 WAVE ACTION

The wave climate within the study area comprises local wind generated waves and boat wake.

#### 3.7.1 Wind Waves

The wind wave climate is dependent on the wind velocity and duration, the uninterrupted upwind length of water surface called the fetch, and the water depth. The predicted one year and fifty year return period wind wave climates for Sandbrook Inlet, the Brooklyn Boat Harbour, and for Parsley Bay, are presented in Table 3.1.

Wind wave directions within Sandbrook Inlet are likely to be shore-parallel, particularly in those areas east of Seymours Creek. The location of Seymours Creek is shown on Figure 7. As indicated in Table 3.1, wind wave heights within Sandbrook Inlet are predicted to decrease from both the causeway and Seymours Creek ends toward the centre of the waterway. East of the causeway the most severe wind wave direction is north-east, and to a lesser extent, east. The intertidal flats south of Dangar Island limit the extent of the easterly fetch. Parsley Bay is more exposed to wind waves than other areas of the waterway. An approximately 5 kilometre long fetch to the south-east results in wave heights of 0.8 metres and 1.4 metres for one and fifty year return period events respectively.

#### 3.7.2 Boat Wake

Typical boat wake height of 0.1 to 0.3 metres with a maximum of 0.5 metres would be expected to be regularly attained in the main Hawkesbury River channel passing through the study area (say daily), with a possible extreme event boat wake of 0.8 to 1.0 metres. Although the existence of any uninterrupted boat wake activity would be expected to be low,
large single boat wake events are important in the design of small waterway structures (i.e., mannas).

Boat wake generation at a waterway site depends on boat hull shape, boat displacement, boat speed, water depth and distance from the sailing line. As a 4 knot boat speed limit is in force in the Brooklyn waterway, boat wake may be anticipated to be low. A predicted extreme event wake of 0.5 metres is considered reasonable for design purposes.

It is noted that although wind waves and boat wake are a measure of separate wave climate contributions, typically they do not occur simultaneously. For example, even in a one year return period storm, it is unlikely that boats would be operating. This should be recognised when considering the combined wind and boat wake design wave climate for the Brooklyn Waterway.

### TABLE 3.1 BROOKLYN WATERWAY - WIND WAVE CLIMATE

<table>
<thead>
<tr>
<th>Waterway Location</th>
<th>Site</th>
<th>Incident 45° Sec</th>
<th>1 year</th>
<th>Return Period 50 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandbrook Inlet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western areas near mouth of Seymours Creek</td>
<td>E</td>
<td>0.4</td>
<td>19</td>
<td>0.7</td>
</tr>
<tr>
<td>Central areas in vicinity of recreation reserve</td>
<td>E or W</td>
<td>0.3</td>
<td>1.6</td>
<td>0.5</td>
</tr>
<tr>
<td>Eastern areas close to causeway</td>
<td>W</td>
<td>0.0</td>
<td>2.1</td>
<td>-0.8</td>
</tr>
<tr>
<td>Brooklyn Boat Harbour</td>
<td>Public jetty</td>
<td>E</td>
<td>0.4</td>
<td>18</td>
</tr>
<tr>
<td>Oyster lease/spat catching area</td>
<td>NE</td>
<td>0.5</td>
<td>22</td>
<td>0.7</td>
</tr>
<tr>
<td>Parsley Bay</td>
<td>Parsley Bay</td>
<td>SE</td>
<td>0.8</td>
<td>30</td>
</tr>
</tbody>
</table>
3.8 SEDIMENT TRANSPORT AND SEDIMENTATION

Sediment transport within the Brooklyn Waterway is caused by the action of tidal currents, fresh water flood flows and waves. The extent to which sediment transport occurs depends on sediment grain size distribution and sediment cohesion, as well as the transporting water velocity.

Estuarine sediments typically comprise a mixture of riverine and marine derived sediments, the extent of the riverine component increasing with distance into the estuary. Sediment samples taken by the PWD at several locations along the lower Hawkesbury River indicate sediments ranging from medium sands to silts (Reference 5, Reference 9). Bed sediment samples collected from the central and western areas of Sandbrook Inlet by the PWD indicate a medium sand with a 50 percent passing diameter ($D_{50}$) of approximately 0.35 mm. The bed sediment type in the Brooklyn Waterway would therefore be expected to be a mixture of silt and sand.

During periods of flood, high loads of sedimentary material are transported down the Hawkesbury River into the broader waterway areas of the lower estuary. Reduced flow velocities in the lower estuary together with increasingly steep saline gradients contribute to a confined area for sediment flocculation and hence deposition. The history of sedimentation within the Brooklyn area has been investigated through an examination of available hydrographic surveys as listed in Table 3.2.

The earliest available hydrographic survey conducted in 1872 covers the area east of the causeway including Parsley Bay but not Sandbrook Inlet. This survey is part of a larger Hawkesbury River and Broken Bay survey drawn to the scale of 1:25,000. Although this is a particularly small scale with which to reference the Brooklyn waterway areas, when viewed in conjunction with ground photography dating back to the same period (Reference 9), an expansive intertidal shoal is clearly indicated in the vicinity of the causeway. This shoal is separated from Flat Rock Point by a 100 to 200 metre wide navigation area, the bed of which is shown to be between 3 and 10 metres below ISLW. Part of this navigation area forms the channel that exists today. A history of dredging in navigation areas east of the causeway is presented in Table 3.3.

It is apparent from existing hydrographic surveys and the compiled dredging history of the navigation areas in the Brooklyn Boat Harbour that siltation of the channel has hampered access to the western corner of the Harbour. Since 1968, some 25,000 cubic metres of bed material has been dredged from this area. A comparison of the 1980 post dredge survey and hydrographic survey undertaken in September 1986 indicates siltation rates of between approximately 30 to 130 millimetres per year in the navigation channel with an average of 80 millimetres per year.

The 1931 hydrographic survey presents spot depth information for the main channel within Sandbrook Inlet, and other inshore areas surrounding Long Island. Depths are shown to typically reduce from 4.3 metres below ISLW at the inlet entrance off Kangaroo Point to 1.3 metres below ISLW close to the causeway. The 1975 hydrographic survey of Sandbrook Inlet and the waterway area east of the causeway is the most recent to reference the immediate Brooklyn area. Comparing this survey to the 1931 survey for Sandbrook Inlet suggests that some accretion of sediments has taken place. Accepting that the 1975 depth of the main channel $(ie 1.0 \text{ to } 1.5 \text{ metres below ISLW})$ could have been partly maintained by propwash, the accretion rate within the channel during the interim period is shown to vary from zero in the eastern area of the inlet to a maximum of 10 to 20 millimetres per year close to the entrance. The 1931 hydrographic survey does not cover the waterway outside of the main channel, hence it is not possible to measure siltation rates at other locations in the Inlet. It is anticipated, however, that the siltation rates for other areas of the Inlet will typically be at the upper limit for siltation in the main channel, that is typically 20 millimetres per year. Siltation rates in the vicinity of Seymours Creek and Salt Pan Creek may be expected to be higher than for other areas of the Inlet and will fluctuate with varying discharge and sediment load from the creeks. The sediment load is likely to have been increased in Seymours Creek during the construction of the Sydney-Newcastle expressway.
<table>
<thead>
<tr>
<th>Date</th>
<th>Coverage</th>
<th>Authority and File Reference</th>
<th>Scale</th>
<th>Datum</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1872</td>
<td>Broken Bay and Hawkesbury</td>
<td>Royal Navy (PWD)</td>
<td>Approx 1:25000</td>
<td>Low Water of Ordinary Spring Tide</td>
<td></td>
</tr>
<tr>
<td>1931</td>
<td>Between Long Island, Dangar Island and Brooklyn</td>
<td></td>
<td>-ISLW</td>
<td></td>
<td>Spot depths along thalweg in Sandbrook Inlet</td>
</tr>
<tr>
<td>Nov 1974</td>
<td>Police and Fisheries Boatshed</td>
<td>PWD MD 3008/56</td>
<td>1.500</td>
<td>ISLW</td>
<td>Predredge Survey</td>
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<tr>
<td>1975</td>
<td>Sandbrook Inlet and Brooklyn Boat Harbour</td>
<td>PWD B-10456</td>
<td>1.2000</td>
<td>ISLW</td>
<td>Orthophoto Base</td>
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<tr>
<td>Oct 1977</td>
<td>Corrective Services Wharf - Long Island</td>
<td>PWD B-7099/9</td>
<td>1.200</td>
<td>ISLW</td>
<td>Limited hydrographic coverage</td>
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<tr>
<td>Apr 1978</td>
<td>Main Channel East of Causeway</td>
<td>PWD MD 3008/56</td>
<td>ISLW</td>
<td></td>
<td>Predredge Survey</td>
</tr>
<tr>
<td>Nov 1978</td>
<td>Parsley Bay</td>
<td>PWD</td>
<td>H 1:500 V 1:200</td>
<td>ISLW</td>
<td></td>
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<td>Dec 1978</td>
<td>Dredge Spoil Disposal Area - Dangar Island</td>
<td>PWD MD 3008/56</td>
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<td>ISLW</td>
<td></td>
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<td>Jan 1980</td>
<td>Main Channel East of Causeway</td>
<td>PWD MD 114/2</td>
<td>1:500</td>
<td>ISLW</td>
<td>Postdredge</td>
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<tr>
<td>Sept 1986</td>
<td>Main Channel East of Causeway</td>
<td>PWD Plan Cat 7962</td>
<td>1:500</td>
<td>ISLW</td>
<td>Assessment of any resultation after dredging</td>
</tr>
</tbody>
</table>
TABLE 3.3  BROOKLYN BOAT HARBOUR NAVIGATION CHANNEL - DREDGING HISTORY

<table>
<thead>
<tr>
<th>Date</th>
<th>Dredge Location</th>
<th>Dredge Depth (Metres below ISLW)</th>
<th>Quantity (Cubic Metres)</th>
<th>Spoil Location</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968</td>
<td>Main navigation channel between causeway and tidal baths</td>
<td>not available</td>
<td>13,400</td>
<td>Mud flats south of Dangar Is</td>
<td>Undertaken by Davidsons Reclamation for PWD</td>
</tr>
<tr>
<td>1975</td>
<td>Berthing and turning basin adjacent to Fisheries and Police Jetty</td>
<td>2.5</td>
<td>500</td>
<td>Between coal loader and rail line at Long Island end of SRA causeway</td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td>Main navigation channel between causeway and tidal baths*</td>
<td>2.5</td>
<td>11,000</td>
<td>Mud flats south of Dangar Is</td>
<td>Maintenance dredging</td>
</tr>
<tr>
<td>Jan 1979 to Jan 1980</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Note  This dredging was undertaken by a cutter-suction dredge pumping through a 1500 metre disposal line. Concern was expressed by Dangar Is residents regarding the means of spoil deposition in southern beach areas

The 1872 hydrographic survey indicates spot depths within Parsley Bay to be approximately 0.6 metres below ISLW. This order of depth is approximately the same as that measured in the lee of the breakwater in the November 1978 hydrographic survey. It may be deduced, therefore, that siltation of the Bay is probably not significant.

3.9 GEOLOGY AND GEOTECHNICAL CONDITIONS

The lower estuary of the Hawkesbury River may be described as a drowned river valley.

The geology of the area is characterised by a layer of Hawkesbury Sandstone up to 275 metres thick which overlies a 15 to 30 metres thick bed of discontinuous sandstone, siltstone, claystone, conglomerate and shale. Borehole data within the general area indicates sandstone to be up to 90 metres thick (Reference 5).

As stated in Section 3.8 river bed sediments in the area range in size from medium sands to fine silts. Silty materials transported from the upper river reaches form a surface layer of variable depth throughout the Brooklyn Waterway. The finer sediments generally overlay medium sands of variable depth.
Large deposits of sand are located at Seymours Creek and Salt Pan Creek (Figure 7) in Sandbrook Inlet (Reference 5, Reference 6). The sand deposits in the vicinity of Salt Pan Creek overlay dense blue clays.

A seismic reflector survey undertaken by the Department of Mineral Resources in 1978 at the west end of Sandbrook Inlet south of Kangaroo Point (Reference 10) showed bedrock at between 1 and 19 metres below the seabed. A channel incised into bedrock to a depth of approximately 15 metres was found in the middle of the waterway at this location. The character of the observed seismic reflection inferred the sediment to be fine to medium grained, possibly a sandy mud.

3.10 AQUATIC FLORA AND FAUNA

Distributions of wetland plant communities in the estuaries of New South Wales were mapped by the Department of Agriculture Fisheries Division between 1981 and 1984 (Reference 11). Vegetation types identified on these maps comprise saltmarshes, mangroves and seagrass, of which only mangroves are indicated within the Brooklyn Waterway.

Five species of mangrove have been identified within the estuaries of New South Wales. Of these, Grey and River mangrove are identified within the Hawkesbury system. Grey Mangrove, a large tree characterised by a dull grey leaf undersurface and tall peg roots, is the most common species in the Brooklyn Waterway (Reference 12).

Fragments of dead leaves, bark and fruit (known as litter) shed by mangroves form a basic input into what is called the detrital food chain within Sandbrook Inlet. Recent studies in New South Wales have shown that one hectare of Grey Mangrove forest contributes about six tonnes of leaf litter each year to the detrital food chain. Where soluble nutrients are leached out of the detrital litter by rain and tides, microscopic fungi and bacteria take its place. The colonised litter is called detritus which is eaten by small animals such as prawns and crabs. The prawns and crabs are in turn eaten by larger fish and water birds.

Fish and marine life are plentiful in the Hawkesbury River with the principal species being the mullet, bream, luderick, garfish, tailor and flathead. Oysters (Sydney Rock Oyster) are commercially grown, while cockles and mussels occur naturally. A number of water birds including the White Faced Heron, Silver Gull and Rubicon inhabit the waterway contributing to the ecology and colour of the region.

3.11 WATER QUALITY AND TIDAL FLUSHING

3.11.1 General

Tidal flushing refers to the exchange of water within a contained embayment, backwater or canal system resulting in "fresh" or "new" water being introduced from the host water body under tidal action. Given a pollutant load, the extent of tidal flushing together with mixing induced by the action of wind, waves and riverine flow all contribute to define water quality for a particular waterway.

3.11.2 Pollutant Load

The quantification of the pollutant load in the Brooklyn Waterway area was outside the study brief. It would however be expected to include the following:

- leaching from septic systems,
- oil, detergent, paint, etc spilled from shoreside industries and activities,
- bilge and boat toilet discharge,
anti fouling paint action,
stormwater run-off

3.11.3 Water Quality Criteria

Water quality criteria have been examined from three sources as set out below; details are
generated in Appendix B

State Pollution Control Commission
Scales and Alach (Reference 14)
Commonwealth Department of the Environment and Conservation

3.11.4 Water Quality Investigations

A water quality field investigation was undertaken (as part of this study's brief) in the
Brooklyn Waterway on the morning of 8 September 1987 by JH & ES Laxton -
Environmental Consultants Pty Ltd. Besides water sample analyses for heavy metal
contaminants undertaken by Fox Laboratories Pty Ltd, all other laboratory work was
conducted by Laxton (refer Appendix B). Water samples were taken at six locations
throughout the Brooklyn Waterway including the Brooklyn Boat Harbour and Sandbrook
Inlet. The results of the field investigation have been interpreted with respect to
recommended water quality criteria for canal estate developments (refer Table B1) and for
supporting estuarine aquatic life (refer Table B2). Where applicable, these results have also
been compared with existing water quality data for the Brooklyn Waterway and details are
included at Appendix B.

Wet weather conditions prior to the water quality field investigation adversely impacted on
water clarity and suspended solids. Nevertheless, water clarity in the Sandbrook Inlet was in
fact better than that in the main Hawkesbury River channel and the suspended solids values
were substantially lower than the recommended criteria for supporting aquatic life. The
remaining water quality parameters assessed, namely temperature, salinity, pH, dissolved
oxygen, nutrients, chlorophyll-a and certain toxic metals were all shown to be satisfactory
when compared to the above water quality criteria. Further discussion of water quality
aspects is contained in Section 5.2.4.

3.11.5 Tidal Flushing and Mixing in Sandbrook Inlet

The assessment and prediction of water quality is complex. As indicated earlier in Section
3.11.1, water quality is not only governed by pollutant load, but by tidal flushing and mixing
as well. Tidal flushing is usually measured by flushing time, ie the time taken to fully
exchange "old" water from a waterbody with "new" water from the host or parent waterbody.

The lower limit of flushing time for the Sandbrook Inlet was estimated to be 15 days
(details at Appendix B). It was assumed the Inlet would have a relatively high flushing
efficiency because of the influence of wind induced and main river currents.

There are a number of references in the available literature to flushing times considered by
authors as being acceptable for maintenance of satisfactory water quality in canals - these
vary from less than 4 days up to 30 days (Reference 18).

3.11.6 Conclusion

Based on direct water quality comparisons with the recommended criteria, and given the
(albeit lower-limit) estimate of flushing time for Sandbrook Inlet, it would appear that
existing water quality within the study area is satisfactory.
However, should any increase in pollutant load or reduction in tidal flushing and mixing be anticipated with a planning proposal, more detailed assessment may be required to:

- quantify overall pollutant load,
- permit an improved estimate of flushing time using mathematical and/or physical models,
- assess possible adverse impacts of reduced water quality on the Brooklyn Waterway environment

### 3.12 COMMERCIAL FISHING INDUSTRY

#### 3.12.1 The Fleet and its Operation

Commercial Fishing on the Hawkesbury River comprises prawn trawling and netting for demersal species such as bream, flathead and jewfish.

There are currently a total of 30 licensed commercial fishing vessels and 60 licensed commercial fishermen operating in the Hawkesbury River (Reference 19). A total of 69 vessels have an endorsement for prawn trawling in the Hawkesbury River though some of these vessels are based outside of the Hawkesbury River. A review of current licences for fishing vessels and fishermen has indicated that 17 fishing vessels and 5 fishermen are registered with a Brooklyn address.

Thirty of the licensed fishermen and fishing vessels in the Hawkesbury River are active members of the Hawkesbury River Fishermen's Co-operative which covers the stretch of river between Spencer and Patonga. Approximately 15 of these vessels are equipped for prawn trawling whilst the remainder are equipped for fish netting.

#### 3.12.2 Mooring Facilities

The Hawkesbury River Fishermen's Co-operative have constructed a mooring jetty to the north of the Brooklyn Boat Harbour along the SRA causeway (refer Figure 5). The jetty is of timber construction and provides mooring for 14 fishing vessels ranging in size from 5 to 10 metres length overall (LOA). The jetty structure is covered by a permissive occupancy from the Department of Lands. Other members of the Co-operative generally moor their vessels at swing moorings or small jetties adjacent their residences along the River.

#### 3.12.3 Unloading and Marketing of Catch

Fish and prawns taken in the Hawkesbury River by members of the Co-operative are generally landed in the Brooklyn Boat Harbour. The Co-operative has a small jetty adjacent to its receive station (refer Figure 5) and unload the catch in boxes which are transported by a trolley on rails to the station where the catch is weighed, marked, iced and placed in cold storage.

Over 95 percent of the catch is transported to the Sydney Fish Market for sale, the remainder being sold locally from a small retail outlet in the Co-operative building. A local carrier transports the fish each weekday morning to the fish market. Due to its proximity to Sydney the catch from Brooklyn has a high demand owing to its freshness. The average annual total fish and prawn production for the Hawkesbury River represents approximately 60 percent of the total catch for estuaries in the Sydney region, that is from Pittwater to Port Hacking, and four percent of the total catch from all the estuaries in NSW (Reference 11). The Hawkesbury River Fishermen's Co-operative handle approximately 70 percent of the total catch landed in the Hawkesbury River.
The annual fish and prawn production of the Co-operative is shown on Figure 6. Prawn production, as estimated from data published by the FMA, Department of Agriculture, Fisheries Division (Reference 11) and the NSW Marine Fisheries and Fishing Ports Study (Reference 20) is typically approximately 15 percent of the total Co-operative fish and prawn production.

3.12.4 Fuel Berth

The Co-operative operates a small fuel berth at the head of its jetty at the receival station. The same berth is used for fish unloading. The Co-operative dispenses petrol and diesel to its members, fuel is not supplied to the general public.

3.12.5 Fishermen's Co-operative Building

The Co-operative has a small receival station and retail outlet on freehold land located in the Brooklyn Boat Harbour (refer Figure 5). The receival station comprises a small office, weighing area, ice making plant and cold storage. A small fenced area is located to the east of the building and is used for storage of fish boxes and other sundry equipment. The retail outlet is in the same building as the receival station and sells wet and cooked fish to the general public.

3.12.6 Gear Storage and Net Repair

Other than the small storage yard adjacent to the Co-operative building there are no formal gear storage or net repair areas in the Brooklyn Boat Harbour area. In general the fishermen store and repair nets and fishing gear at their private residences or on board their vessels.

3.12.7 Ship Repair and Maintenance

The Hawkesbury River Fishermen's Co-operative does not maintain any ship repair facilities. There are a number of facilities available within the Brooklyn Waterway with Brown's Slipway used by the majority of the commercial fishing fleet (refer Section 3.14.6).

3.12.8 Summary of Commercial Fishing Land and Waterway Area Use

The existing land and waterway area use by commercial fishing activities in the Brooklyn Waterway is summarised in Table 3.4.
TABLE 3.4 BROOKLYN WATERWAY - SUMMARY OF COMMERCIAL FISHING ACTIVITIES LAND AND WATERWAY AREA USE

<table>
<thead>
<tr>
<th>Activity</th>
<th>Land Area Use (hectares)</th>
<th>Waterway Area Use (hectares)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish Unloading and Fuelling of Fishing Vessels</td>
<td>0.005</td>
<td>0.005</td>
<td>Waterway area includes one vessel at berth</td>
</tr>
<tr>
<td>Fishing Vessel Mooring Facilities</td>
<td></td>
<td>0.07</td>
<td>Includes 14 vessels at jetty</td>
</tr>
<tr>
<td>Fishermen’s Co-operative Building including Storage, Office, Gear Storage and Retail Outlet</td>
<td>0.013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.018</td>
<td>0.075</td>
<td></td>
</tr>
</tbody>
</table>

3.13 OYSTER INDUSTRY

3.13.1 Oyster Cultivation

Systematic rock oyster cultivation has been practiced in the Hawkesbury River since the late 1800s. Since that time various cultivation techniques have been tried and with improved efficiency oyster production has progressively increased. Oyster farming is a primary industry in Brooklyn and Mooney Mooney and may be considered to be the main source of employment in the area.

There are a total of 319 oyster leases in the Hawkesbury River representing approximately 8 percent of the total number of leases in NSW. The leases extend from Mangrove Creek, 18 kilometres upstream of Brooklyn Boat Harbour to Green Point, 2 kilometres south of the Harbour. No new leases have, however, been granted in the Hawkesbury for several years and oyster farmers are now being encouraged to cultivate the more productive areas only and to surrender leases in poor growing areas.

There are 43 oyster leases in Sandbrook Inlet and 4 leases immediately north of the Brooklyn Boat Harbour. The latter leases are used for spat (young oyster) catching and cultivation and is the prime area in the Hawkesbury suitable for such activities. The lease areas in the Brooklyn Waterway are shown in Figure 7. The leases in Sandbrook Inlet occupy an area of approximately 32 hectares or 27 percent of the waterway in the Inlet. The total lease area including the spat catching leases in the Brooklyn Boat Harbour is approximately 5 hectares.
3.13.2 Oyster Farming Depots

The handling and processing of the oysters and cultivating trays and equipment is undertaken at yards or depots. The depots have waterfront access and generally occupy a large land area.

There are a total of 14 depots of varying size occupying several parcels of land adjacent to Sandbrook Inlet (refer Figure 7). These depots service the requirements of both the adjacent leases in Sandbrook Inlet as well as some of the leases on the opposite side of the river at Mooney Mooney. The oyster depots occupy a total land area of approximately one hectare representing approximately 7.5 percent of the available land area between the Brooklyn Road and west of the SRA causeway. The depots are generally concentrated between Baden Powell Avenue and Government Road and are mostly on freehold land. Lease owners throughout the study area generally use these depots.

At many locations the farmers have constructed timber jetties to facilitate water access. The jetties are used for the unloading of oysters and oyster racks and for mooring of shallow draft punts used to transport materials and oysters to and from the leases. The waterway area occupied by these jetties is estimated to be 0.2 hectares.

3.13.3 Production and Marketing of Oysters

For the year 1984-85 (the last year for which comprehensive statistics are available) the annual oyster production in the Hawkesbury River had reached a total of 10,700 bags representing approximately 9 percent of the total NSW production and the fourth largest producing area in NSW. This figure comprised approximately 95 percent plate oysters and 5 percent bottle oysters (which are smaller than the plate oyster).

Despite seasonal fluctuations the production of oysters in NSW has grown steadily from the 1930's (refer Figure 8) until the early 1970's when production reached a plateau. Recently the production has fluctuated principally due to outbreaks of food poisoning in 1978 attributed to the Sydney rock oyster. This is thought to have occurred due to water temperature variations and river flooding which can have a devastating effect upon oyster cultivation. Now, all oysters must undergo purification processing prior to sale.

All rock oysters cultivated in the Hawkesbury are sold to markets in Sydney. The oysters are transported to Sydney by a local carrier who calls at each of the oyster depots. Each farmer is responsible for the counting and transport of the catch, the Australian Oyster Farmers Pty Ltd (the oyster farmers association) does not organise these activities.

3.13.4 Summary of Oyster Industry Land and Waterway Area Use

The existing land and waterway area use by the Oyster Industry in Sandbrook Inlet and the Brooklyn Boat Harbour is summarised in Table 3.5. Whilst oyster leases and oyster depots are located in many areas along the Hawkesbury River only those areas which impact upon Brooklyn and environs have been considered.
TABLE 3.5  BROOKLYN WATERWAY - SUMMARY OF OYSTER INDUSTRY
LAND AND WATERWAY AREA USE

<table>
<thead>
<tr>
<th>Land Area Use (hectares)</th>
<th>Waterway Area Use (hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oyster Leases</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Oyster Depots</td>
<td>1.0</td>
</tr>
</tbody>
</table>

3.14 OTHER COMMERCIAL WATERWAY ACTIVITIES

3.14.1 General

Other commercial waterway activities in the Brooklyn area include ferry tourist services, charter boats, boat hire and cruises, and repair and maintenance facilities. These activities service the oyster farmers and fishermen, tourists and recreational boaters, and the residents of Brooklyn, Dangar Island, Little Wobby Beach and the smaller communities along the Hawkesbury River.

For the purpose of this study charter boats are considered to be vessels over 7.0 metres in length that would typically be chartered for several days or weeks. Hire boats are considered to be vessels less than 7.0 metres in length that would be hired on an hourly or daily basis. A summary of the land and waterway area use by commercial activities is presented in Table 3.10, Section 3.14.7.

3.14.2 Ferry Services

There are three ferry services operating from Brooklyn. The services operate from the Brooklyn Boat Harbour and offer a range of services for both commuters, tourists and local residents. A summary of the services is presented in Table 3.6.

3.14.3 Cruises

There are two companies operating from the Brooklyn area that offer scheduled cruise services, notably Hawkesbury River Tourist Services and Captain Cook Cruises.

Hawkesbury River Tourist Services

The Hawkesbury River Tourist Services operate 3 vessels, ie 15, 18 and 20 metre craft with capacity for 90, 120 and 220 passengers respectively. Services offered include the twice daily Hawkesbury River Mail Run and cruise to Pittwater as well as an unscheduled service twice weekly to the Department of Sport and Recreation Fitness Camps at Little Wobby Beach and Patonga. The average number of passengers handled per week is approximately 3,000.

Two of the cruise vessels are berthed at a small jetty at the western end of the Brooklyn Boat Harbour, the third vessel is moored at a piled mooring adjacent to the SRA causetway. The waterway area occupied by these craft at their berths is 0.025 hectares.
TABLE 3.6  BROOKLYN WATERWAY - SUMMARY OF FERRY SERVICES

<table>
<thead>
<tr>
<th>Company</th>
<th>Vessels Operated, Brooklyn Destination</th>
<th>Ferry Services Provided</th>
<th>Average Number of Passengers Handled per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terry's Ferry</td>
<td>10 metre - 40 passenger ferry</td>
<td>Scheduled service, 11 trips per day for 7 days per week between Brooklyn Boat Harbour, Dangar Island and Little Wobby Beach</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>12 metre - 60 passenger ferry</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- public wharf, Boat Harbour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life Boat River</td>
<td>Two - 4.3 metre vessels</td>
<td>Unscheduled Taxi Service operating 7 days per week</td>
<td>Not known</td>
</tr>
<tr>
<td>Shuttle</td>
<td>One - 4.9 metre vessel</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Fishermen's Co-op</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Taxi</td>
<td>Two - 7.3 metre vessels</td>
<td>Unscheduled Taxi Service operating 7 days per week</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>One - 5.5 metre vessel</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- public wharf/ Don's Boats</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Captain Cook Cruises

Captain Cook Cruises have recently introduced a large cruise vessel to the Hawkesbury River. The Lady Hawkesbury is a 130 passenger cruise vessel, 68 metres long, and offers a 4 day mid week cruise and a 2 day weekend cruise along the Hawkesbury River.

Passengers embark at a private berth constructed specifically for the vessel at Kangaroo Point at the mouth of Sandbrook Inlet (refer Figure 9). The land and waterway area occupied by this facility is estimated to be 0.04 and 0.225 hectares respectively. The vessel cruises between Wisemans Ferry 46 kilometres upstream of Kangaroo Point and Pittwater 20 kilometres downstream of Kangaroo Point.

Whilst the operation has only been recently introduced, approximately 200 passengers per week currently take the cruises offered.

3.14.4 Charter Boats

There are five charter boat companies operating in the Brooklyn area, all these companies are located in Sandbrook Inlet. With one exception the charter boat operations are part of a marina development offering other boating services (refer Section 3.15.2). A summary of the charter boat services is presented in Table 3.7 and their locations are shown in Figure 9.
3.14.5 Boat Hire

There are six boat hire companies operating in the Brooklyn area. Four companies are located in Sandbrook Inlet and two are located in the Brooklyn Boat Harbour. The hire boat companies are generally run by marina or boatshed operators which also offer other boat services such as fuelling or repairs. There is a total of 87 boats available for hire. A summary of the boat hire operations is provided in Table 3.8.

3.14.6 Boat Repair and Maintenance

Boat repair and maintenance activities are carried out by 10 companies in the Brooklyn Waterway. These companies have a total of 11 slipways, comprising 9 slipways in Sandbrook Inlet and 2 slipways in the Brooklyn Boat Harbour. Eight of the slipways are operated by marinas or boatsheds whilst one company provides a boat repair service with three slipways, and one company undertakes engine repairs and does not operate a slipway.

A summary of the boat repair and maintenance facilities within the Brooklyn Waterway is presented in Table 3.9.

3.14.7 Summary of Commercial Activities Land and Waterway Area Use

A summary of the existing land and waterway area use by commercial activities undertaken in the Brooklyn Waterway is presented in Table 3.10. It is noted that several companies provide more than one of the services or activities described in the preceding sections. In these cases the land and waterway areas used by that company for the particular service or activity have been estimated. For marinas and boat sheds that provide wet berths or moorings the estimated waterway/land area use is given in Section 3.15.

TABLE 3.7 BROOKLYN WATERWAY - SUMMARY OF CHARTER BOAT OPERATIONS

<table>
<thead>
<tr>
<th>Charter Boat Company</th>
<th>Location</th>
<th>Charter Boats</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dolphin Boatshed</td>
<td>Sandbrook Inlet</td>
<td>3 9 metre cruising yachts</td>
<td></td>
</tr>
<tr>
<td>(marina/slipway)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fenwick's Hawkesbury</td>
<td>Sandbrook Inlet</td>
<td>12 10.7 metre houseboats</td>
<td></td>
</tr>
<tr>
<td>River Houseboats (marina)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holidays Afloat (marina)</td>
<td>Sandbrook Inlet</td>
<td>15 10 metre houseboats</td>
<td></td>
</tr>
<tr>
<td>Aquahouse Holidays</td>
<td>Sandbrook Inlet</td>
<td>9 from 9 to 12 metres houseboats</td>
<td></td>
</tr>
<tr>
<td>(Baymac Marina)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hawkesbury River Tourist Services</td>
<td>Brooklyn Boat Harbour</td>
<td>(as per Table 3.6)</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 3.8  
**BROOKLYN WATERWAY - SUMMARY OF BOAT HIRE OPERATIONS**

<table>
<thead>
<tr>
<th>Boat Hire Company</th>
<th>Location</th>
<th>Boat Hire No</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bait n' Boats *</td>
<td>Sandbrook Inlet</td>
<td>13</td>
<td>4.3 metre</td>
</tr>
<tr>
<td>Baymac Marina</td>
<td>Sandbrook Inlet</td>
<td>16</td>
<td>4.3 to 6.1 metre</td>
</tr>
<tr>
<td>Don's Boats</td>
<td>Brooklyn Boat Harbour</td>
<td>15</td>
<td>4.3 to 4.9 metre</td>
</tr>
<tr>
<td>Hawkesbury River Boat Hire</td>
<td>Brooklyn Boat Harbour</td>
<td>18</td>
<td>4.4 metre</td>
</tr>
<tr>
<td>Hibbs Boat Shed</td>
<td>Sandbrook Inlet</td>
<td>4</td>
<td>4.3 metre</td>
</tr>
<tr>
<td>Wharf Street Marina</td>
<td>Sandbrook Inlet</td>
<td>1</td>
<td>6.4 metre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>4.9 metre</td>
</tr>
</tbody>
</table>

* Now incorporated within Baymac Marina
### Table 3.9: Brooklyn Waterway - Summary of Boat Repair and Maintenance Facilities

<table>
<thead>
<tr>
<th>Boat Repair and Maintenance Facility</th>
<th>Location</th>
<th>Slipways No</th>
<th>Slipways Capacity (See Note)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baymac Marina</td>
<td>Sandbrook Inlet</td>
<td>1</td>
<td>20 tonnes</td>
<td>Two mobile slips <em>(up to 8.5 m vessels)</em>, comprehensive service</td>
</tr>
<tr>
<td>Brooklyn Marina</td>
<td>Sandbrook Inlet</td>
<td>1</td>
<td>10 metre LOA</td>
<td>Principally used by marina patrons</td>
</tr>
<tr>
<td>Brown's Slipway</td>
<td>Sandbrook Inlet</td>
<td>3</td>
<td>Max Capacity 70 tonnes</td>
<td>Comprehensive service to mainly fishing vessels, 2-3 cradles per slip</td>
</tr>
<tr>
<td>Dolphin Boatshed</td>
<td>Sandbrook Inlet</td>
<td>1</td>
<td>12 metre LOA</td>
<td>2 cradles per slip</td>
</tr>
<tr>
<td>Don's Boats</td>
<td>Brooklyn Boat Harbour</td>
<td>1</td>
<td>14 tonnes</td>
<td>Accommodates up to 1.8 m draft vessels</td>
</tr>
<tr>
<td>Hawkesbury River Boat Hire</td>
<td>Brooklyn Boat Harbour</td>
<td>1</td>
<td>10 tonnes</td>
<td>-</td>
</tr>
<tr>
<td>Hibbs Boatshed</td>
<td>Sandbrook Inlet</td>
<td>1</td>
<td>Not known</td>
<td>Facility not used commercially</td>
</tr>
<tr>
<td>Holidays Afloat</td>
<td>Sandbrook Inlet</td>
<td>1</td>
<td>10 tonnes</td>
<td>Mainly for houseboat maintenance</td>
</tr>
<tr>
<td>Pro Marine Services</td>
<td>Sandbrook Inlet</td>
<td>Not applicable</td>
<td></td>
<td>Engine repair only</td>
</tr>
<tr>
<td>Wharf Street Marina</td>
<td>Sandbrook Inlet</td>
<td>1</td>
<td>15 metre LOA</td>
<td>Principally used by marina patrons</td>
</tr>
</tbody>
</table>

**Note:** LOA denotes overall length of vessel that can be accommodated when tonnage capacity of slipway is not known.
### TABLE 3.10  BROOKLYN WATERWAY - SUMMARY OF COMMERCIAL ACTIVITIES LAND AND WATERWAY AREA USE

<table>
<thead>
<tr>
<th>Commercial Waterway Activity</th>
<th>Land Area Use (hectares)</th>
<th>Waterway Area Use (hectares)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferry and Water Taxi Services</td>
<td>-</td>
<td>-</td>
<td>Ferry services generally use the public wharf</td>
</tr>
<tr>
<td>Cruises</td>
<td>0.04 S</td>
<td>0.225 S</td>
<td>Includes Hawkesbury River Tourist Services (B) and Captain Cook Cruises (S)</td>
</tr>
<tr>
<td>Charter Boats</td>
<td>0.075 S</td>
<td>0.210 S</td>
<td>Includes Holidays Afloat Hawkesbury River Tourist Services included in Cruises section. All other charter boat operations are located in marinas, refer Table 3.13</td>
</tr>
<tr>
<td>Boat Hire</td>
<td>0.08 S</td>
<td>0.08 S</td>
<td>Includes Bait n' Boats, Don's Boats, Hawkesbury River Boat Hire and Hibbs Boat Shed. All other boat hire operations are located in marinas, refer Table 3.13</td>
</tr>
<tr>
<td>Boat Repair and Maintenance</td>
<td>0.15 B</td>
<td>0.42 S</td>
<td>Includes all facilities as given in Section 3.14.6 excepting Hibbs Boatshed and Holidays Afloat Pty Ltd</td>
</tr>
</tbody>
</table>

| Total                        | 0.345 S                  | 0.935 S                     |

Note:  
S - denotes waterway and land area use in Sandbrook Inlet  
B - denotes waterway and land area use in Brooklyn Boat Harbour
3.15 RECREATIONAL BOATING

3.15.1 General

Recreational boating facilities in the Brooklyn Waterway comprise marina berths, moorings, boat launching ramps and public wharves.

It is important to distinguish between the types of berths and moorings referred to in the report, and the manner in which they are administered. This is set out below.

**marina wet berth** - this is an individual berth, on the water, within a marina. The total waterway area occupied by all of the berths is the subject of a permissive occupancy or wet lease issued to the marina operator by the Crown Lands Office. The marina operator then offers individual berths within the total waterway area for rental to boat owners.

**commercial mooring** - this is a mooring, both swing moorings and fore and aft moorings, for which a commercial occupation licence has been issued by the Maritime Services Board for a vessel to "occupy the waterway and obstruct navigation".

It is common for a number of commercial moorings to be associated with a marina or boatshed. In these cases the mooring occupation licences are issued to the marina or boatshed operator who in turn rents the mooring to boat owners. The boatshed usually offers dinghy storage for these moorings.

**private mooring** - this is a mooring, either a swing mooring, piled mooring or fore and aft mooring, for which a private occupation licence has been issued by the Maritime Services Board for a nominated vessel to "occupy the waterway and obstruct navigation". This type of mooring occupation licence would typically apply to a privately owned craft on a mooring which is not associated with a marina or club facilities.

**private berth (on a private jetty)** - this is a berth adjacent to a private jetty and subject to a permissive occupancy issued to the land owner by the Crown Lands Office.

Within the Brooklyn Waterway, there are no dry storage facilities nor dinghy storage facilities other than that provided at the marinas and boatsheds.

3.15.2 Marinas

There are a total of six marinas in the Brooklyn Waterway, all of the marinas are located in Sandbrook Inlet. A summary of the existing marina facilities and the services they provide is set out in Table 3.11. The location of the marinas within the study area is shown on Figure 9.

Together the marinas provide a total of 225 wet berths and 109 commercial moorings. (Note: there are also an additional 73 commercial moorings provided at boatsheds and other boating facilities in the study area, refer Section 3.14.3.) A summary of the marinas land and waterway area use is presented in Table 3.13.
<table>
<thead>
<tr>
<th>Marina Site</th>
<th>Baymac Marina</th>
<th>Brooklyn Marina</th>
<th>Dolphin Boatshed</th>
<th>Fenwicks Marina</th>
<th>Holidays Afloat</th>
<th>Wharf St Marina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet Berths</td>
<td>76</td>
<td>30</td>
<td>28</td>
<td>48</td>
<td>15</td>
<td>28</td>
</tr>
<tr>
<td>Moorings</td>
<td>22</td>
<td>32</td>
<td>30</td>
<td>-</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>62</td>
<td>58</td>
<td>48</td>
<td>28</td>
<td>40</td>
</tr>
<tr>
<td>% Occupation</td>
<td>100%</td>
<td>97%</td>
<td>100%</td>
<td>98%</td>
<td>93%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Dinghy Storage: 40
Waiting List: YES NO NO NO NO YES
Car Parking: 70 50 84 50 17 14
Public Toilets: YES YES YES YES YES YES
Pay Phones: NO NO NO NO NO NO
Boat Brokerage: YES NO YES NO NO YES
Mechanical Service: YES NO YES NO YES NO
Shipwright Service: YES NO YES NO YES NO
Electrical Service: YES NO YES NO YES NO
Slipway: YES YES YES NO YES YES
Provisions: YES NO NO YES NO NO
Diesel: YES NO YES NO YES NO
Petrol: YES NO YES YES NO NO
Ice: YES YES YES YES YES YES
Bait N Tackle: YES YES YES YES YES YES
Hire Boats: YES NO NO NO NO YES

APPLICATION FOR EXPANSION
No appl Wishes to add 60 wet berths in next 5 years
No appl No immediate plans for expansion
No appl Wishes to extend marina to max total of 120 berths in longer term
No appl Wishes to expand to provide 60 berth marina and hardstand area
No appl Wishes to expand to provide additional 30 wet berths

1 mooring vacant
1 wet berth vacant
3.15.3 Moorings

As stated in Section 3.15.1 the moorings may be classified as either commercial or private occupation licences. The numbers and locations of these moorings are as follows.

Commercial Occupation Licences (*Commercial Moorings*)

As of August 1987 (*latest available figures*) there were a total of 182 commercial moorings in the Brooklyn Waterway, 155 of the moorings are located in Sandbrook Inlet, 24 in the Brooklyn Boat Harbour and 3 in Parsley Bay. The distribution of the moorings throughout the study area is shown in Figure 10 and is summarised in Table 3.12. The location of the commercial moorings generally correspond to commercial activities such as marinas, boat charter operations, boat maintenance operations, and mooring areas occupied by commercial fishing vessels.

**TABLE 3.12 BROOKLYN WATERWAY - DISTRIBUTION OF MOORINGS**

<table>
<thead>
<tr>
<th>Commercial Operator/ Organisation</th>
<th>No. of Commercial Moorings</th>
<th>No. of Private Moorings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sandbrook Inlet</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baymac Marina</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Brooklyn Marina</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Brown’s Slipway</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Dolphin Boatshed</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Hibbs Boatshed</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Holidays Afloat</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Wharf Street Marina</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>155</td>
<td>76</td>
</tr>
<tr>
<td><strong>Brooklyn Boat Harbour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’s Boats</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Hawkesbury River Boat Hire</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Terry’s Ferry Service</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Bobbin Head Cruising Club</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Hawkesbury River Tourist Services</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>24</td>
<td>32</td>
</tr>
<tr>
<td><strong>Parsley Bay</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hawkesbury River Boat Hire</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>182</td>
<td>147</td>
</tr>
</tbody>
</table>
Private Occupation Licences (Private Moorings)

There are a total of 147 registered private occupation licences within the Brooklyn Waterway. These moorings comprise both piled and swing moorings. The distribution of these moorings within the waterway is shown in Figure 10 and summarised in Table 3.12.

Four of the moorings in the Parsley Bay area are in the lee of the breakwater and are within a permissive occupancy in the name of Hornsby Shire Council, and the Maritime Services Board do not allocate moorings within this area.

3.15.4 Boat Launching Ramps

There are a total of four boat ramp facilities within the study area providing a total of 6 lanes. The total capacity of these ramps has been estimated at about 210 launchings and retrievals per day. The principal facilities at each of these boat launching ramps are as follows:

Parsley Bay Boat Launching Ramp

The Parsley Bay boat launching ramp facility was constructed in 1981 by Hornsby Shire Council with funds provided by the Public Works Department. The facility is located east of Brooklyn in Parsley Bay (refer Figure 10) and comprises a two lane boat ramp and 112 car and trailer parking spaces with public toilets, picnic areas, fish cleaning table, and a boat washdown area. The facility is well maintained and is very popular with recreational boaters. There is little potential for expansion of this facility.

Mooney Mooney Boat Launching Ramp

A single lane boat launching ramp is located west of Mooney Mooney Point on the northern bank of the Hawkesbury River within the area of Gosford City Council. There is an adjacent area of unpaved flat land capable of accommodating approximately 100 car and trailer parking spaces. No other facilities are provided. The use of the ramp is restricted by the number of launchings and retrievals which would be practical on one lane. The capacity has been assumed to be that recommended by the Public Works Department for a single lane ramp, i.e., 40 launchings and retrievals per day.

The ramp is not as popular as the Parsley Bay boat launching ramp, but is closer to the recently constructed expressway off ramp at Mooney Mooney and increased usage may be anticipated. There is significant potential for expansion of this facility on the surrounding flat land.

Dolphin Boatshed

Dolphin Boatshed operates a 2 lane boat launching ramp at its facility located at the west end of Sandbrook Inlet. The boatshed also has 84 car parking spaces which could accommodate a maximum of approximately 40 cars and trailers.

The boat launching ramp is used every day and is popular at weekends. However, there is a $5 charge to use the ramp and generally boat owners prefer to travel further along the Brooklyn Road to use the Parsley Bay boat ramp. There is little potential for expansion of this facility.
Kangaroo Point

A single lane boat ramp is located adjacent to the cruise vessel berth at Kangaroo Point. Parking is limited for ramp users and most users park their cars and trailers along the nearby access road, which is also used by tourist buses, private cars and pedestrians for access to the cruise vessel berth. Due to the limited parking, the capacity of this ramp is considered to be about 18 launchings and retrievals per day. A charge of $5 is made for the use of this ramp. Given the lack of facilities, the conflicting use impacts with the cruise vessel berth, and the lack of adequate land area, it would not be appropriate to expand the use of this boat ramp.

3.15.5 Public Wharves

There are six public wharves within the Brooklyn Waterway. The wharf located in Brooklyn Boat Harbour comprises timber piles and timber deck with landing steps. It is approximately 120 metres long with water depths of approximately 20 metres below Indian Spring Low Water (ISLW) at the berth face. The wharf is in a good state of repair and is very popular with both commercial and recreational boating. The wharf is often congested during the summer months with cruisers and yachts wishing to land to purchase provisions etc. There is often a conflict of use between recreational boating and the ferry and water taxi services using the wharf. The wharf is also being increasingly used by charter cruise vessels from Pittwater wishing to embark or disembark passengers.

A landing platform consisting of floating pontoons with an access ramp has recently been constructed off the eastern timber deck wall of the public baths in McKell Park. The eastern berthing face of the concrete pontoons is 15 m long and they are held in position by concrete piles. This landing was installed to cater for visiting recreational craft as a setdown and pickup point. It will reduce the congestion at the public wharf however the taxis, ferries and cruise vessels would still prefer to use the wharf with its more central location to facilities. Another similar landing platform has been provided within Parsley Bay to also cater for recreational craft. A third landing pontoon has been provided as a setdown and pickup point for craft launched at the Parsley Bay boat ramp.

A public wharf is located at the eastern end of Sandbrook Inlet immediately north of the Hawkesbury River Railway Station. The wharf comprises timber piles and timber deck with landing steps. The wharf is approximately 5 metres long with water depths of approximately 5 metres below ISLW at the berth face. The wharf is not very popular, principally due to the limited water depths at the berth face. The wharf is used principally by boaters with moorings in the eastern end of Sandbrook Inlet and by commuters with residences along the Hawkesbury River.

The timber wharf at Kangaroo Point is located just north of the boat ramp and Captain Cook Cruises berth. The wharf is approximately 5 m long, has landing steps and steel piles. It is generally in good condition with water depths at the berthing face of about 1.5 m ISLW. However due to limited land base available for parking and the potential conflict of usage with other facilities, it would not be appropriate to expand this wharf.

A small wharf is also located in Parsley Bay south of Flat Rock Point (refer Figure 10). The wharf is used occasionally by the Department of Main Roads to service river ferries, though public vehicular access is not possible.

3.15.6 Aquatic Licences

An Aquatic Licence is a licence which has been issued by the Maritime Services Board for a nominated activity to occupy an area of the waterway and obstruct navigation for a
particular period of time. The licence is issued annually and is classified into either recreational or commercial hire.

There are currently five recreational and one commercial aquatic licences issued annually for the Brooklyn Waterway. The recreational licences are held by recreational boating clubs or associations for either specific annual or seasonal events. The commercial licence is held by a float plane operator but the waterway specified, which is west of Dangar Island, has never been used by the operator.

The clubs or associations holding licences, the events covered and the waterway used for recreational activities is as follows:

Hawkesbury River Sailing Club

The Hawkesbury River Sailing Club hold an aquatic licence for club racing in a triangular area of the waterway between Porto Bay, Little Wobby Beach and Gunyah Point (refer Figures 2 and 10). The licence is valid for every Sunday between 11:00 am and 4:00 pm. Club sail boats are generally launched and rigged at the Parsley Bay boat launching ramp.

Hornsby - Ku-ring-gai Police Citizens Youth Club

The Police Citizens Youth Club hold sailing races every Saturday in its season which runs from the beginning of October through to Easter. The club holds an aquatic licence for the same area of waterway as the Hawkesbury River Sailing Club. The licence is valid every Saturday between 11:00 am and 4:00 pm. Approximately 50 percent of the club’s fleet are kept at the clubhouse, the remainder are trailered and launched at the Parsley Bay boat launching ramp.

NSW Water Ski Association

The NSW Water Ski Association have aquatic licences for two annual ski events, as follows:

International Bridge to Bridge Water Ski Classic - this water ski race has taken place every year for the past 26 years. The race takes place in November (actual date depending on tides) and runs upstream between Dangar Island and Windsor Bridge. The NSW Water Ski Association have exclusive use of the mainstream between Dangar Island and Windsor from 8:00 am to 2:30 pm on the race day. There are typically 400 participants (4 people to a crew) and over 20,000 spectators lining the banks of the Hawkesbury. The majority of the participants launch their boats at the launching ramps at Parsley Bay and Mooney Mooney.

Lion Island Classic - this water ski race is also run two weeks after the Bridge to Bridge race. The skiers start at Laughtondale (5 km downstream of Wisemans Ferry) and race downstream to Juno Point and then return to Laughtondale. As for the Bridge to Bridge race the NSW Water Ski Association have exclusive use of the waterway on the race day between 8:00 am and 2:30 pm. There are approximately 200 entrants, all vessels are launched at Wisemans Ferry or Laughtondale.

Upper Hawkesbury Powerboat Club

The Upper Hawkesbury Powerboat Club is based in Windsor. Every year on the first weekend in May the club organise a Bridge to Bridge race which runs from Dangar Island to Windsor Bridge. The club has an aquatic licence for exclusive use of the mainstream between Dangar Island and Windsor on the race day between 9:00 am and 2:00 pm. There are approximately 300 entrants each year. The majority of boats are launched at Parsley Bay or Mooney Mooney.
3.15.7 Summary of Recreational Boating Land and Waterway Area Use

A summary of the existing land and waterway area use by recreational boating activities in the Brooklyn Waterway is presented in Table 3.13

<table>
<thead>
<tr>
<th>Boating Facility</th>
<th>Sandbrook Inlet</th>
<th>Brooklyn Boat Harbour</th>
<th>Parsley Bay and Environs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Land Area Use hectares</td>
<td>Waterway Area Use hectares</td>
<td>Land Area Use hectares</td>
</tr>
<tr>
<td>Marinas</td>
<td>1.360</td>
<td>1.270</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(Excluding Holidays Afloat, Hibb's Boatshed, refer Table 3.10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial and Private Swing Moorings</td>
<td>-</td>
<td>13.800</td>
<td>-</td>
</tr>
<tr>
<td>Boat Launching Ramps</td>
<td>0.3</td>
<td>0.1</td>
<td>-</td>
</tr>
<tr>
<td>Public Wharves</td>
<td>-</td>
<td>0.005</td>
<td>-</td>
</tr>
</tbody>
</table>

3.16 GOVERNMENT FACILITIES

3.16.1 General

Three government agencies maintain facilities or offices in the Brooklyn area. These agencies comprise the State Rail Authority, Department of Agriculture (Fisheries Division), and the Water Police. The Maritime Services Board maintain a boat at Brooklyn. Whilst the State Rail Authority do not have administration control over the waterway, the land area controlled by the SRA has a direct impact upon waterway and associated land use. The existing facilities provided by each of the government agencies are described in the following sections.

3.16.2 State Rail Authority

The State Rail Authority's main northern line runs south of and parallel to the Brooklyn Road along Sandbrook Inlet (refer Figure 2). The line passes under the road west of the Brooklyn Township and runs across a causeway between the Brooklyn Boat Harbour and
the east end of Long Island. The causeway forms the east end of Sandbrook Inlet and the western limit of the Brooklyn Boat Harbour. The causeway is approximately 40 metres wide and has four tracks, two of which continue north through the Long Island tunnel. The line continues north through a tunnel on Long Island, across the Hawkesbury River Rail Bridge, and follows the western shoreline of Mullet Creek northward.

The Hawkesbury River Station at Brooklyn comprises sidings, platforms and station offices and a maintenance area. Commuter parking is provided for approximately 30 vehicles, though this area is currently occupied by SRA plant and equipment.

Adopting the Brooklyn Road as a southern boundary and the intersection of the Brooklyn road and railway at the road overpass as the western boundary the total land area occupied by the SRA is approximately 13.5 hectares. This includes the foreshore area north of the rail line at the east end of Sandbrook Inlet, the causeway, and the eastern end of Long Island.

3.16.3 Department of Agriculture, Fisheries Division

The Department of Agriculture, Fisheries Division maintain a small office in the Brooklyn township. A house is also provided for the District Inspector stationed in Brooklyn and is located on the Brooklyn Road. The Fisheries Division operate a 50 metre runabout and a 60 metre oyster punt which are moored at the Water Police jetty in the Brooklyn Boat Harbour (refer Figure 5) normally near the head of the jetty along the eastern side.

3.16.4 Water Police

Water Police duties are carried out by members of the police force stationed at Brooklyn and as such the Brooklyn Police Station is used as offices for the water police. The Water Police do, however, maintain a small boathouse adjacent to the Fishermen's Co-operative building. The total waterfront land area allocated to the Water Police is approximately 0.025 hectares. The building has recently been replaced with a steel clad demountable building. Other facilities include a small slipway forming part of the boathouse, a small causeway and timber jetty (refer Figure 5).

The Water Police operate a 7.9 metre power vessel used for patrol and police work. The vessel is generally moored along the western side of the timber jetty situated adjacent to the Fishermen's Co-operative jetty.

3.16.5 Maritime Services Board

The MSB operate a 6.5 metre power vessel and rent a wet berth in Don's Boats. A regional office at Hornsby has responsibility for the Brooklyn waterway.

3.16.6 Summary of Government Facilities Land and Waterway Area Use

The land and waterway area use by Government Facilities in the Brooklyn Waterway is presented in Table 3.14. Whilst the MSB wet berth is located in Don's Boats the area has been given to identify the current area use.
### TABLE 3.14  BROOKLYN WATERWAY - SUMMARY OF EXISTING GOVERNMENT FACILITIES LAND AND WATERWAY AREA USE

<table>
<thead>
<tr>
<th>Government Facility</th>
<th>Land Area Use (hectares)</th>
<th>Waterway Area Use (hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Rail Authority</td>
<td>2.25 S 11.25 B</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Department of Agriculture, Fisheries Division</td>
<td>Included in water police land area Excludes office space in Brooklyn Township</td>
<td>0.004 B (Berth Area - 11 metre berth length)</td>
</tr>
<tr>
<td>Water Police</td>
<td>0.025 B Excludes office space in Brooklyn Township</td>
<td>0.003 B (Jetty and Berth Area - 9 metre berth length)</td>
</tr>
<tr>
<td>Maritime Services Board</td>
<td>0.003 B (Wet Berth in Don's Boats - 8 metre berth length)</td>
<td>0.003 B</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0.027 Excluding State Rail Authority land area</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**Note:** S - denotes waterway and land area use in Sandbrook Inlet  
B - denotes waterway and land area use in Brooklyn Boat Harbour

#### 3.17 PRIVATE JETTY FACILITIES

Private jetties are located along the southern shore of Sandbrook Inlet, along the shoreline of Dangar Island, and along Little Wobby Beach. The jetties are located in a waterway area subject to a permissive occupancy issued to the land owner by the Lands Department. The general policy adopted by the Lands Department for Dangar Island is to issue a permissive occupancy that would allow jetty construction to a maximum length of 25 metres with a further allowance of 5 metres to accommodate vessels moored at the head of the jetty. For Sandbrook Inlet the Lands Department would generally issue a permissive occupancy that would allow construction of a jetty to provide a minimum water depth of 1.2 metres below ISLW at the jetty head, providing such a structure did not obstruct navigation. It is noted, however, that in certain areas of the Inlet it would not be possible to achieve the minimum water depth. The distribution of these private berths within the waterway and the approximate waterway area taken by the permissive occupancy is presented in Table 3.15.
TABLE 3.15  BROOKLYN WATERWAY - DISTRIBUTION OF PRIVATE JETTIES

<table>
<thead>
<tr>
<th>Location</th>
<th>No of Private Jetties (permissive occupancies)</th>
<th>Approximate Waterway Area taken by Permissive Occupancy (hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandbrook Inlet</td>
<td>18</td>
<td>0.72</td>
</tr>
<tr>
<td>Dangar Island</td>
<td>63</td>
<td>1.32</td>
</tr>
</tbody>
</table>

3.18 NON-BOATING RECREATIONAL ACTIVITY

3.18.1 General

The major non-boating recreational activities undertaken within the Brooklyn area comprise passive and active recreation associated with the foreshore. Such activities include swimming (*mainly in the tidal baths at McKell Park*) fishing, picnicking, sunbathing, walking and sporting activities.

The open space provided within the study area and the activities undertaken in these areas are described in the following sections.

3.18.2 Existing Open Space Provisions

Open space may be classified as regional, that is, areas generally greater than 40 hectares administered by the State government or non regional open space administered by Council.

Non Regional Open Space

Of a total of 41 hectares of open space within the Brooklyn area, approximately 7 hectares have been designated for active recreational use and approximately 34 hectares for passive recreational pursuits. Although the open space provision is high in comparison with other areas of the metropolitan region, much of the designated open space is either subject to inundation or undeveloped. Accessible and usable open space is currently confined to McKell Park, Brooklyn Park and Rest Park (refer Figures 5 and 15).

The majority of passive open space is located adjacent to the water, however access to the waterside is limited. McKell Park, a passive park, to the east of Brooklyn village, receives the greatest amount of passive waterside recreational use by local residents and visitors alike. The principal areas of non regional open space in the vicinity of the Brooklyn Waterway are set out in Table 3.16 and are shown in Figures 5, 7, 11 and 15.

Regional Open Space

Regional open space includes the Long Island Nature Reserve north of Sandbrook Inlet and the Ku-ring-gai Chase National Park south of the Brooklyn Waterway. These areas receive little use as access is either difficult or not promoted. Access to the nature reserve is considered by the National Parks and Wildlife Service only upon written application.
3.18.3 Main Activities and Locations

Recreational Activities

No survey data is available on participation rates and types of recreational activities undertaken within the Brooklyn area. However, observations made during the course of this study enable some generalisations about non-boating recreational activities to be made. The facilities provided and activities undertaken at each of the major recreation areas are as follows.

M'CKell Park

The foreshores of M'CKell Park are the main focus of activities such as swimming (mainly in the tidal baths) fishing, picnicking, sunbathing, walking etc. This is primarily due to M'CKell Park's locational advantages relative to transport, services and amenities provided along the foreshore and because the level of facility provision is greater than in other areas. Facilities in M'CKell Park include public toilets, picnic shelters, dry fuel barbecues, play equipment, and tidal baths. As there are limited enclosed swimming areas in the region, it was understood that the tidal baths in M'CKell Park would be maintained in its existing location. M'CKell Park is one of the few reserves in which pedestrian access is readily available to and along the waters edge for the majority of its perimeter.

East End of Long Island

The eastern end of Long Island is a popular fishing spot. Although this area is not zoned for open space purposes it offers direct access to the waters edge for passive recreational activities.

Sandbrook Inlet

The majority of the foreshore reserve fronting Sandbrook Inlet generally between Cole Street and Baden Powell Avenue is subject to inundation, heavily vegetated and has no access from Brooklyn Road. Brooklyn Park is located in the south-east corner of this reserve and has been developed for active recreation.

Facilities in Brooklyn Park comprise a basketball court, soccer pitch, cricket nets, toilets, two tennis courts and girl guide hall. Informal parking is available on the verge adjacent to Brooklyn Road.

The reserve between Brooklyn Road and the northern railway adjacent to Cole Street is currently fenced and used as a waste disposal depot. It is not developed and the only recreational activity undertaken on the site is trail bike riding.
TABLE 3.16  BROOKLYN WATERWAY - NON REGIONAL OPEN SPACE PROVISIONS IN VICINITY OF FORESHORE

<table>
<thead>
<tr>
<th>Location</th>
<th>Approximate Open Space Provision (hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandbrook Inlet</td>
<td></td>
</tr>
<tr>
<td>Rest Park</td>
<td>0.65</td>
</tr>
<tr>
<td>Cemetery Area</td>
<td>0.75</td>
</tr>
<tr>
<td>Daury Flat Area</td>
<td>2.50</td>
</tr>
<tr>
<td>Quarry Park</td>
<td>3.20</td>
</tr>
<tr>
<td>Brooklyn Park</td>
<td></td>
</tr>
<tr>
<td>Passive Recreation Area</td>
<td>5.05</td>
</tr>
<tr>
<td>Active Recreation Area</td>
<td>1.45</td>
</tr>
<tr>
<td>North of SRA station</td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td><strong>13.85</strong></td>
</tr>
<tr>
<td>Brooklyn Boat Harbour</td>
<td></td>
</tr>
<tr>
<td>Mเกก Park</td>
<td>5.00</td>
</tr>
<tr>
<td>Dangar Island</td>
<td>0.65</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19.50</strong></td>
</tr>
</tbody>
</table>

Rest Park located between the Pacific Highway and the Brooklyn Cemetery is the most developed recreational area within Brooklyn. Facilities comprise toilets, play equipment, picnic shelter, barbecues and picnic tables. A feature of the park is the aviaries which are privately owned and maintained and exhibit a variety of Australian parrots, peacocks and emus. Rest Park is accessed from the Pacific Highway and is used by the local community for gatherings, weddings etc.

Other Open Space Areas

The foreshore adjacent to the boat ramp at Mooney Mooney Point is used for boating related activities. However, the use of the foreshores is low due to the lack of facilities.

The reserves on Dangar Island are predominantly used by local residents and have little use by visitors, apart from during the Bridge to Bridge boat races.

Other Associated Activities

The foreshores of Brooklyn (particularly Mเกก Point) are used throughout the year depending on weather conditions. The greatest use occurs during the Bridge to Bridge ski and Bridge to Bridge Power Boat races (refer Section 3.15.6). Upward of 3,000 spectators use the river foreshores and those of Dangar Island as vantage points.
3.18.4 Summary

Assuming existing reserves are developed, current open space provision is adequate to service the passive and active recreation needs of existing residents of Brooklyn. The open space areas are distributed over the whole waterway foreshore which promotes a distribution of users. However, the level of facility provided within most of the open space areas is not sufficient to serve the needs of weekend visitors particularly during the summer months. This situation is likely to be exacerbated with any growth in visitor numbers. It would be difficult to justify expenditure on facilities to cater for peak use during Bridge to Bridge boat races. However, some provision should be made to upgrade facilities in the existing areas of open space along the foreshore.

3.19 ROAD ACCESS AND PARKING

3.19.1 Road Access

Main road access to the Brooklyn Waterway is via the F3 Newcastle Freeway or the Pacific Highway (refer Figure 2 and Figure 7). The Freeway currently runs from Berowra north to Lake Macquarie. A southern extension of the Freeway to Pearces Corner is currently under construction and is anticipated to be completed in 1988/89. The Freeway will also eventually bypass Newcastle. The completion of an off ramp at Mooney Mooney Point in August 1987 has greatly improved direct road access to Brooklyn and it is now possible, for travel northwards, to exit or enter the freeway from the Pacific Highway at this location.

The latest available Department of Main Roads (DMR) statistics for average daily traffic flows for the F3 Freeway, Pacific Highway and the Brooklyn Road are provided in Table 3.17. Following completion of the Mooney Mooney Point Freeway off ramp the distribution of these traffic flows may be anticipated to change with possible increased traffic flows along the Brooklyn Road.

<table>
<thead>
<tr>
<th>TABLE 3.17</th>
<th>AVERAGE DAILY TRAFFIC FLOWS IN THE BROOKLYN AREA - 1985</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average Daily Traffic Flow</td>
</tr>
<tr>
<td>F3 Highway</td>
<td>28,845</td>
</tr>
<tr>
<td>Pacific Highway</td>
<td>2,527</td>
</tr>
<tr>
<td>Brooklyn Road</td>
<td>1,566</td>
</tr>
</tbody>
</table>

The Brooklyn Road is a two lane narrow rural road with soft shoulders and poor site distances. Access by vehicles with trailers is made difficult, particularly when kerbside parking encroaches onto the carriageway. Road access along the south of the Brooklyn Boat Harbour to McCall Park is via a 4.5 metre wide road. Access along the SRA causeway is through a 5 metre wide unpaved road at the end of Dangar Road which widens to 8 metres at midway along the causeway.
3.19.2 Parking

Existing parking areas on the foreshores of the Brooklyn Waterway may be considered to be in two areas, notably Sandbrook Inlet and the Brooklyn Boat Harbour

Sandbrook Inlet

Street parking is provided at various locations along the Brooklyn Road and in private parking areas at marinas and commercial businesses. There are no formalised public parking areas along the southern foreshores of Sandbrook Inlet.

The total number of parking spaces for businesses located along the Brooklyn Road is estimated to be as follows

<table>
<thead>
<tr>
<th>Description</th>
<th>Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marinas (refer Table 3.11)</td>
<td>285</td>
</tr>
<tr>
<td>Boatsheds and Slipways</td>
<td>35</td>
</tr>
<tr>
<td>Other Businesses</td>
<td>100</td>
</tr>
<tr>
<td><em>(Includes car parking spaces at Kangaroo Point)</em></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>420</strong></td>
</tr>
</tbody>
</table>

(Note: Total excludes street parking and informal parking in open spaces.)

Brooklyn Boat Harbour

Public car parking is provided in McKell Park both north and south of the southern access road and in an area east of the centre of the harbour in the vicinity of the tidal baths (refer Figure 5). These areas are not formally marked. An estimate has been made, however, of the number of parking spaces at each of these locations as follows

<table>
<thead>
<tr>
<th>Location</th>
<th>Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>McKell Park North of South Access Road</td>
<td>35</td>
</tr>
<tr>
<td>McKell Park South of South Access Road</td>
<td>23</td>
</tr>
<tr>
<td>Don's Boats and Hawkesbury River</td>
<td>12</td>
</tr>
<tr>
<td>Boat Hire</td>
<td></td>
</tr>
<tr>
<td>McKell Park in Vicinity of Tidal Baths</td>
<td>70</td>
</tr>
<tr>
<td><em>(Assumes parking in all of foreshore area except fenced area)</em></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>140</strong></td>
</tr>
</tbody>
</table>

(Note: These totals do not include the commuter parking at the Hawkesbury River Station or street parking in the Brooklyn Township.)

3.20 VISUAL ENVIRONMENT

The lower Hawkesbury is one of the most visually spectacular waterways within New South Wales. The natural visual qualities are further enhanced by the activities of people on the waterways both at work and at leisure.

Views of the scenery are best appreciated from the waterway, however high quality vistas are available from the bridges and certain vantage points, such as McKell Park, eastern end of Long Island, Kangaroo Point and Mooney Mooney Point (refer Figure 12).
From the river the unfolding views to vegetated landforms, rock outcrops and pockets of
development are spectacular and are recognised as the major attraction of the Hawkesbury River
The conservation of this scenery is critical in consideration of any development. The southern
foreshore of Sandbrook Inlet between Kangaroo Point and the causeway is screened to views from
the waterway by Long Island. Similarly as stated above, views to Sandbrook Inlet from Brooklyn
Road are unavailable due to the screening effect of the vegetation. Whilst the southern foreshore
of Sandbrook Inlet is developed this development is not visible which maintains the "natural" quality
of the waterway as viewed from the main waterway.

Apart from the bridge crossings there are few places along the major roads where vistas to the
waterways are available. This is primarily due to topography and vegetation screening long distance
views.

The most visually degraded areas are the storage pens/work sites adjacent to slipways at some of
the marinas and the SRA land which has a derelict appearance common to most rail corridors in
New South Wales. Of particular concern is the commuter parking area adjacent to Hawkesbury
Station and the causeway which is littered with abandoned construction materials and infested with
noxious weeds.

3.21 LAND TENURE

3.21.1 General

The majority of land within the study area is Crown Land (refer Figure 13). Crown Land
has been referred to in Figure 13 as either State or Local Government. The latter
designation refers to Crown Land in the care and control of Council.

Land in private ownership is concentrated in the following areas:

- each side of Brooklyn Road extending from Seymours Creek in the west to
  Government Road in the east, excepting the open space area between Saltpan Creek
  and Baden Powell Avenue;

- the Brooklyn Village Centre precinct;

- escarpment land to the south of Brooklyn Village Centre and bordering the Ku-ring-
gai Chase National Park, often referred to as the Brooklyn Estate;

- strategically located lots at Brooklyn Boat Harbour, (ie. Don's Boats, Robbey's Cafe,
  Fishermen's Co-operative), and

- escarpment slopes of Dangar Island, Little Wobby Beach, Cogra Bay

3.21.2 Key Proposals

A number of changes to land tenure are under consideration by various authorities and may
have an effect on development proposals for the waterway and adjacent areas (refer Figure
15).
Kangaroo Point

This area of Crown and Council land and adjacent waterway has been leased to a developer for the construction of a major resort and marina complex.

Long Island East

The State Rail Authority is considering sale of this land to the existing lessee.

Brooklyn Boat Harbour

The two lots adjacent to the waters edge (notably Don’s Boats and Hawkesbury River Boat Hire) have been recently purchased by the same owner who has indicated his intention to redevelop the sites to cater for boating and related activities within a proposed marina called the Hawkesbury River Marina.

Mooney Mooney Point

The PWD is negotiating with Gosford City Council, Hornsby Shire Council and Lands Department to locate a boat ramp and associated facilities.

3.21.3 Summary

As a considerable portion of the land within the study area is owned by government authorities, the government is in a key position to influence and facilitate development of Brooklyn. Recent initiatives at Kangaroo Point and the funding of this study are indicative of government concern for the future development of the land and the waterway. Through consultations with private sector land owners in key areas, a plan for the co-ordinated development of the area could be readily achieved.

3.22 ZONING AND LAND USE

The study area is zoned for a range of uses including residential, open space, industrial and special uses under the Hornsby Planning Scheme gazetted in 1977 and the Gosford City Planning Scheme gazetted in 1968 and as varied by subsequent Interim Development Orders.

The centreline of the main channel of the Hawkesbury River approximates the local government boundary between Gosford City Council in the north and Hornsby Shire Council in the south.

The principal zoning precincts are shown in Figure 11 and a summary of permitted development and development with the consent of Council is presented in Appendix C.

Current zoning within the study area places limitations on the further development of water based recreation facilities and the provision of commercial facilities to service the existing and any increase in local population.

Water recreation related development would be facilitated if selected foreshore areas within the current Residential 2(a2), Special Business 3(b) and Open Space 6(a) zones were rezoned to enable development for the purposes of a boating facility with the consent of Council. This approach is similar to that adopted for the Parramatta River Region and proposed amendments to the Manly Local Environmental Plan. Under the Parramatta River REP a boating facility is defined as

"boating facility means a building or place used for the purposes of recreational boating activities and includes a marina, boat launching ramp, boat repair and servicing facility, wharf, jetty or any means of dry storage of boats."
This definition would be appropriate for allowing a greater range of water related recreational uses on areas of foreshore open space. Also, it could further be widened to include food service, boatel and motel accommodation and associated amenities in areas currently zoned Residential 2(a2) and Special Business 3(b). This would have the dual benefit of reinforcing the villages current commercial role and allowing investors to develop business in response to greater visitation or local population growth.

3.23 ITEMS AND PLACES OF HISTORIC INTEREST

Reference 2 has recommended that the following items in the Brooklyn area be included within the Heritage Schedule of the Hornsby Planning Scheme Ordinance:

- Bar Island Cemetery
- Brooklyn Cemetery
- "Blinkbonnie", 206 Brooklyn Road, Brooklyn
- Governor Phillip Monument, Brooklyn
- Hawkesbury railway tunnels, station and the rail bridge

In addition to the above sites, the old railway dams above the Great Northern Railway on Lots 1 and 2, DP 54563 are considered landscape conservation areas by the National Trust of Australia (NSW Division). This area is being acquired by the National Parks and Wildlife Service and will be included in an extension to the Ku-ring-gai National Park.

There are Aboriginal sites in the vicinity of McKell Park. The sites consist of engravings and rock shelters with art. The shelters may also contain archaeological deposits. There is potential for further sites along the southern shores of Sandbrook Inlet, especially in those areas largely unmodified.

The conservation of items of heritage value and historic interest within the Brooklyn area is of importance to the local community and visitors alike.

3.24 SERVICES

3.24.1 General

The Brooklyn township and residences along Sandbrook Inlet are serviced by water, electricity and telephone. Dangar Island and Little Wobby Beach have electricity and telephone services, though no direct water supply. No residences in the Brooklyn area are connected to a mains sewerage system.

The means of supply of the principal services in the Brooklyn area and the estimated capacity of these services are described in the following sections.

3.24.2 Electricity Supply

A zone substation at Berowra supplies electricity via an overhead feeder line to the Brooklyn area including existing development along Sandbrook Inlet, the Brooklyn township and Dangar Island. Residences at Little Wobby Beach are supplied through an overhead line from a zone substation at Patonga.

Sydney County Council consider that the existing electricity supply system would generally meet the future demand from likely waterways type developments in Brooklyn.
### 3.24.3 Water Supply

The major elements of the water supply system serving Brooklyn are shown on Figure 14. Supply to Brooklyn is pumped by Hornsby Pump Station via Berowra, Cowan and Cowan North Reservoirs. Flow gravitates from Cowan North Reservoir to Brooklyn along a 250 millimetre diameter main which reduces to a 150 millimetre diameter main as the line turns off the Pacific Highway into Brooklyn and along Brooklyn Road.

The Sydney Water Board (SWB) advises that the capacity of the water supply system to Brooklyn is sufficient to cater for the existing land uses and zonings. No reserve capacity exists however for additional developments or changes in zoning. Any development requiring water supply beyond the capacity allowed for in the current zoning will require extensive amplification of the system. This amplification could involve works such as construction of an additional main from Wahroonga Reservoir, amplification of Hornsby Pumping Station and provision of a new reservoir at Brooklyn. The extent of amplification would depend on the proposed development and as a general rule the Board would require the developer to bear the costs of all works.

It is noted that the proposed marina development at Kangaroo Point (refer Sections 3.21 and 6.3.4) would increase water demand beyond the suggested system capacity.

### 3.24.4 Sewerage

As stated in Section 3.24.1 the existing township of Brooklyn is not sewered, and sewage is treated with septic tanks with trench drainage or pumpout, with some residences utilising a night soil service. The SWB has no plans to sewer Brooklyn and adjacent areas. Major developments in the area would require provision of sewerage collection, treatment and effluent disposal facilities. The cost of these works would be borne by the developers concerned and the works would need to be designed in accordance with the requirements of the State Pollution Control Commission and SWB.

Provision of sewerage facilities for the Brooklyn area has been investigated on several occasions for proposed developments in the area. Potential treatment works sites have been identified with a view to the likely effluent discharge requirements. The effluent discharge locations proposed by these studies have all been to the Hawkesbury River east of Brooklyn township, off Flat Rock Point or Lookout Point, or, more recently, into the main channel of the river at about 10 metres water depth. Alternative treatment works sites at Lookout Point, west of the Hawkesbury Railway station and in Dead Horse Bay have been considered in previous investigations.
3.25 ADMINISTRATION AND MANAGEMENT

The government agencies responsible for the administration and management of the Brooklyn Waterway are listed below and their roles are detailed in Appendix D. This has been presented to identify which government agencies would be instrumental in future development of the Brooklyn Waterway. Only those aspects of the government agencies related directly and indirectly to the waterway and foreshore have been considered in the study.

Hornsby Shire Council
Public Works Department
Department of Lands
Maritime Services Board
Gosford Shire Council
Department of Planning
Department of Main Roads
State Rail Authority
National Parks and Wildlife Service
Water Police
Department of Agriculture, Fisheries Division
State Pollution Control Commission
Department of Sport and Recreation
Tourism Commission
4. WATERWAY AND LAND AREA REQUIREMENTS

4.1 GENERAL

The future waterway and land area requirements have been considered for a planning horizon of 10 years. The growth of each of the major activities in the waterway within the planning horizon has been determined through an analysis of past trends, a review of past studies, and discussions with various waterway users and government authorities. There are several physical and social constraints to development and redevelopment opportunities. Whilst these factors and their effects are identified within the Planning Framework in Section 5, the influences of these factors have not at this stage been directly considered in determining the waterway and land area requirements. In this way the full potential of each of the waterway activities and uses may be examined.

4.2 COMMERCIAL FISHING INDUSTRY

4.2.1 Future Growth of the Industry

A review of the Hawkesbury River Fishermen's Co-operative fish and prawn production for the last ten years (refer Figure 6) shows a general growth in the tonnage of fish and prawns landed up to 1981. After 1981 the catch tonnage levelled somewhat with minor annual fluctuations.

In 1986 the Department of Agriculture, Fisheries Division, introduced restrictions to prawn trawling in the Hawkesbury River and other NSW estuaries due to concerns that prawn stocks were becoming depleted as a result of overfishing. No further special prawn trawling endorsements are being issued by the Department and the restriction is expected to continue in the future. Thus despite seasonal fluctuations, which are dependent upon climatic conditions, the prawn catch is anticipated to remain at existing levels over the planning horizon.

The Hawkesbury River fishery is a finite resource. As development increases along the foreshores of the Hawkesbury and recreational boating increases it is unlikely that fish stocks will increase in the future. Fish in the Hawkesbury are caught using either mesh netting or gill netting techniques. These methods are considered to be well suited to the fishery and it is not considered that fishing techniques may be improved in the foreseeable future. Therefore, it is considered that the fish catch will remain at present levels over the next 10 years.

4.2.2 Waterway Area Requirements

The demand for waterfront facilities is not anticipated to increase above current levels in response to predicted stable fish and prawn catches. The principal waterway area requirements for the Hawkesbury River Fishermen's Co-operative in the Brooklyn Boat Harbour are for mooring of fishing vessels and for a fish unloading berth.

Mooring Facilities

The Co-operative currently has a small jetty accommodating 14 fishing vessels which generally moor two abreast. It is preferable that vessels be moored with direct access to the jetty. Given the scarcity of waterway area within Brooklyn Boatharbour, the vessels could be moored perpendicular to a jetty giving direct access to each craft but occupying a minimum of extra waterway compared to the present situation. Assuming the vessels have an average length of 7.5 metres, the Fishing Ports Guidelines recommend (Reference 22) a berth length of 72 metres. This assumes a jetty width of approximately 2.0 metres corresponding to a total waterway area of approximately 0.08 hectares.
Unloading Facilities

The existing fish unloading berth is inadequate to meet the requirements of the Co-operative. The Co-operative require two dedicated fish unloading berths in the vicinity of the receive station. Assuming that two vessels would be moored at the unloading berth at one time and further assuming one vessel of 100 metres in length and one of 50 metres in length then the total berth length required would be approximately 20 metres with a waterway area of approximately 0.01 hectares.

4.2.3 Land Area Requirements

Co-operative Premises

Reference 21 suggests that the land area requirements for Fishermen’s Co-operative premises for a minor port is 0.06 hectares or 20 metres by 30 metres.

The Hawkesbury Fishermen’s Co-operative is relatively small and hence will not have the same land area requirements as specified in Reference 22. In particular fish sorting and cleaning is undertaken on the fishing vessels and amenities such as office and boardroom, storeroom and workshop facilities and the loading bay would not generally require as much area as larger Co-operatives. It is considered therefore that an area of 0.04 hectares would be sufficient to meet the Co-operative’s requirements.

Net Repair and Gear Storage Areas

Reference 21 suggests the following areas.

Net drying and repair - 50 m x 20 m = 0.10 hectares
Gear storage compound - 20 m x 20 m = 0.04 hectares

It is recognised that land area is at a premium in the Brooklyn Boat Harbour, the present location of the fishing activities. Furthermore the majority of fishermen currently repair their nets and store fishing gear at their residences. Thus whilst it may not be possible to include provision for these facilities within the Boatharbour, the area requirements have been considered in the development of the planning options where practical.

4.2.4 Summary

The waterway and land area requirements for the commercial fishing industry in the Brooklyn Waterway for the next 10 years may be summarised as follows:

<table>
<thead>
<tr>
<th>Waterway Area</th>
<th>Land Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mooring Facilities</td>
<td>Co-operative Premises</td>
</tr>
<tr>
<td>0.080 hectares</td>
<td>0.04 hectares</td>
</tr>
<tr>
<td>(Berth length - 72 metres)</td>
<td>(Berth length 20 metres)</td>
</tr>
<tr>
<td>Fish Unloading</td>
<td>Net Drying and Repair</td>
</tr>
<tr>
<td>0.010 hectares</td>
<td>0.10 hectares</td>
</tr>
<tr>
<td>(Berth length - 20 metres)</td>
<td>(Berth length - 72 metres)</td>
</tr>
<tr>
<td>Gear Storage Compound</td>
<td>Gear Storage Compound</td>
</tr>
<tr>
<td></td>
<td>0.04 hectares</td>
</tr>
</tbody>
</table>
4.3 OYSTER INDUSTRY

4.3.1 Future Growth of the Industry

Production of oysters in the Hawkesbury River has generally followed national trends. The introduction of oyster purification beds in the late 1970's has improved the quality of the oysters and further reductions in consumption due to possible food poisoning are not anticipated. The demand for oysters is high and will continue to rise. It is considered therefore that the production of oysters will rise and despite seasonal fluctuations increased production will continue throughout the planning horizon of 10 years.

Spat catching areas are of increasing significance in the Hawkesbury River due to the possible invasion of the Pacific Oyster on the NSW coastline. The Pacific oyster is a prolific coloniser however its quality is inferior and its keeping life is extremely limited compared to the Sydney rock oyster. Therefore the established spat catching areas for the Sydney rock oyster are important in maintaining production against any likely significant spread of the Pacific oyster.

4.3.2 Waterway Area Requirements

No new oyster leases are being issued to oyster farmers in NSW and the Department of Agriculture is now encouraging oyster farmers to cultivate more productive areas and to surrender leases in poor growing areas so that these can be returned to their natural state or used for other waterway activities. This combined with improved cultivation techniques should result in no increased waterway area requirements in the Brooklyn Waterway for oyster leases in the future.

In Brooklyn Boat Harbour, which is an important spat catching area for the Sydney rock oyster, the existing total area of oyster leases should be maintained. Some modification of existing lease boundaries would however be possible to accommodate other waterway activities.

Approximately 27 percent of the waterway area in Sandbrook Inlet is currently occupied by oyster leases. In the last 10 to 20 years there has been a large increase in the number of vessels at moorings or in marina berths in Sandbrook Inlet. There has been a dramatic decrease in oyster production from leases in the Inlet, possibly as a result of the increasing number of vessels and possible reduced water quality of the waterway. In future, it is unlikely that oyster production will increase in the Inlet. In fact, in light of the Department of Agriculture policy, the less productive leases in the Inlet may be removed in preference to more productive areas elsewhere.

4.3.3 Land Area Requirements

There are 14 Oyster Farming Depots located in Sandbrook Inlet (refer Section 3.13.2). The majority of the depots are on freehold land and have been established in the area for many years. The depots were located adjacent to the then productive leases in the Inlet and close to the Brooklyn Road and the Hawkesbury River Railway Station, facilitating transport of the oysters to markets in Sydney.

Additional oyster depots are currently being developed in Mooney Mooney Creek north of the Mooney Mooney Workers Club. These depots will have direct road access to the Pacific Highway. With the development of depots in other foreshore areas of the Hawkesbury River and the decline of oyster production in Sandbrook Inlet, it is considered that no new oyster farming depots will develop along the foreshores of the Inlet. Thus the land area requirements for oyster depots in the study area are not anticipated to increase in the future.
4.4 COMMERCIAL WATERWAY ACTIVITIES

4.4.1 Ferry and Water Taxi Services

For the purposes of examining future requirements, the operators included as ferry and water taxi services include Terry's Ferry and the water taxis. The Hawkesbury River Tourist Services was considered to be essentially a cruise vessel operation.

Ferry and water taxi services are expected to expand in the future with increase in population. However, there is likely to be a larger increase in usage of these services by tourists and this demand is addressed in the following sections.

The vessels operated by Terry's Ferry and Water Taxi are moored outside the Boat Harbour whilst the Life Boat River Shuttle operate small craft from the Fishermen's Co-operative. The basic ferry service for residents and visitors is likely to increase slowly in the future, and hence mooring berths within the Boat Harbour are not warranted for these vessels.

The prime need for these operators is a pick-up and set-down point within the Boat Harbour. At present, the ferries and water taxis compete with various craft type for use of the public jetty and other private jetties. A set-down and pick-up berth is required on a public jetty for which these craft have priority use. This berth should be 15 metres long to accommodate a 12 metre vessel. There is also a need to incorporate land area adjacent to this berth for the purposes of mustering and sheltering of passengers.

Summary

The future land and waterway area requirements for Ferry and Taxi Services within the Brooklyn Boat Harbour are as follows:

<table>
<thead>
<tr>
<th>Land Area</th>
<th>Water Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.005 hectares</td>
<td>0.010 hectares</td>
</tr>
</tbody>
</table>

4.4.2 Cruises

Hawkesbury River Tourist Services

The number of tourists taking river cruises has increased in recent years, particularly tour groups arriving by bus. The operator considers the number of vessels operated by the company to be sufficient to meet the immediate demand. To accommodate possible future growth the operator is considering purchasing a fourth vessel, though no definite plans have been made at this time.

Given Brooklyn Boat Harbour's proximity to rail and road transport, the availability of services in the commercial area and the limited number of access points to the Hawkesbury River, it is considered appropriate to provide cruise vessel facilities within the Boat Harbour.

To meet existing requirements it is necessary to accommodate three cruise vessels. For future requirements, a minimum area capable of accommodating 4 cruise vessels up to 20 metres length should be provided. The area could be developed by operators for mooring as well as pick-up and set-down points. This would alleviate congestion at the public wharf on both the land and waterway areas. It is considered that additional cruise vessels should be accommodated elsewhere because of the restricted foreshore area in the Boat Harbour.
Hence a waterway area of approximately 0.125 hectares is required (berth length of approximately 96.0 metres with space allowance between vessels). For onshore facilities it would be necessary to consider provision of the following land areas:

- **Ticket Office and General Office**
  - 10 metres x 5 metres = 0.005 hectares

- **Mustering Area**
  - 10 metres x 10 metres = 0.01 hectares

  **Total** 0.015 hectares

Cruise vessels visiting the Boat Harbour could use the public wharf for a pick-up and set-down berth.

**Captain Cook Cruises**

Due to the relatively short period of the present operation, it is not possible to determine the future growth of this service. The operator considers, however, that a sister ship could be constructed in the next five years.

If another vessel were introduced it could require comparable facilities to the existing vessel. Potential sites for such facilities do not exist either within Sandbrook Inlet or the Brooklyn Boat Harbour. Sites with adequate road access and sufficient land base are located on the northern shores of the Hawkesbury River in the vicinity of Mooney Mooney Point. Reference 33 recommends that a regional service area for large cruise vessels by developed at Mooney Mooney. This area would include a wharf, service area, parking, refreshments and souvenir outlets.

It is not possible at this stage to confidently predict the likely future number of large cruise vessels operating in the area. However, at this stage, an area should be set aside at Mooney Mooney Point for a large cruise vessel berth with further review in five years to reassess demand for such a facility (refer Section 6.6).

**Other Cruises**

There has been a proposal to dredge an access channel to the Mooney Mooney Workers Club Wharf in Mooney Mooney Creek (refer Figure 2) to provide access for a large cruise vessel which would offer a similar service as Captain Cook Cruises. This proposal was not proceeded with however it still has potential and if such a service were introduced it would reduce the long term demand for additional large cruise vessel facilities.

**Summary**

The future land and waterway area requirements for cruise services which would be located solely in the Boat Harbour are as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land Area</strong></td>
<td>0.015 hectares</td>
</tr>
<tr>
<td><strong>Water Area</strong></td>
<td>0.125 hectares</td>
</tr>
</tbody>
</table>

*(Berth length of 96.0 metres)*
4.4.3 Charter Boats

The use of charter vessels (defined in Section 3.14.1) is seasonal, with the peak season being between October and April during which time the vessels are generally fully booked. In the off season from May to September charter boats use generally varies with occupancy levels between 30 and 50 percent.

The charter fleet comprises houseboats and cruising yachts. Whilst the cruising yachts are generally fully booked during the peak summer season the demand is limited, principally due to the lack of an open body of water upstream of the Hawkesbury River Railway Bridge. The demand for charter houseboats is considered by the majority of vessel operators to be generally increasing at a gradual rate, though subject to fluctuation depending upon socio-economic conditions. One operator wishes to increase the fleet by 10 vessels though the majority of operators foresee a lesser expansion.

In keeping with statewide trends the number of tourists visiting the Hawkesbury may be anticipated to increase. Growth in both domestic and international tourist visitors to NSW have averaged over 10 percent per annum since 1983 (Reference 24). Approximately 50 percent of these tourists visit the state for holidays. It may be assumed therefore that the maximum growth rate for tourist services would be 10 percent per annum for the planning horizon. Assuming further that, due to the seasonal nature of the charter business that only 50 percent of the operators would expand at this growth rate, then an average growth rate of 5 percent would result. With 36 charter houseboats and a 5 percent growth rate per annum for 10 years the number of houseboats operating from the Brooklyn area may be anticipated to increase by 22.

It has been assumed that all these vessels would be berthed at marina facilities. Consequently this anticipated increase in the number of charter houseboats has been included in the marina berth demand as given in Section 4.5.1.

4.4.4 Boat Hire

The demand for small boat hire is seasonal with peak demand during the Christmas vacation period, though all the small boat hire operations are rarely fully booked. There is an increasing trend to small trailerable boat ownership in the Sydney Metropolitan area (Reference 24). The construction of the Parsley Bay boat ramp in 1981 was a marked improvement in boat launching facilities in Brooklyn which has increased the number of trailerable private boats using the waterway. The increased number of trailered boats launching at Brooklyn has reduced the demand for local boat hire and demand has remained at the same level or even reduced during the past few years. There are no plans by any of the boat hire companies to expand their fleets and many operators do not foresee a marked growth in boat hire operations in the future.

It is considered that for the planning horizon the demand for small boat hire will remain constant in the study area and may even reduce during the period. Consequently there will be no demand for extra facilities for these operations.

4.4.6 Boat Repair and Maintenance

Current slipway demand varies with several marinas reporting full utilisation whilst the remainder would typically be occupied for between 30 and 40 percent of the time. None of the slipways in the Brooklyn Waterway can accommodate deep draft vessels. The slipway at Don’s Boats in the Brooklyn Boat Harbour can slip vessels to a maximum draft of approximately 1.8 metres. The remainder of the slipways can only accommodate vessels to a maximum draft of less than 1.5 metres. The larger vessels in the waterway particularly those operated by the
less than 1.5 metres. The larger vessels in the waterway particularly those operated by the Hawkesbury River Tourist Services are too large for local slipways and have to use facilities in Pittwater for maintenance and repair.

Future slipway expansion, especially facilities in Sandbrook Inlet will be dependent upon future growth in marinas and recreational boating in the waterway. At present there are 456 vessels at marina berths and commercial and private moorings in Sandbrook Inlet. These vessels are serviced by a total of nine slips. With reference to Sections 4.5.1 and 4.5.2 it may be seen that the total boat population in the Brooklyn Waterway is anticipated to increase by an additional 540 vessels if demand is fully realised. Only 395 moorings and berths out of this 540 could be provided in the Inlet. It is estimated that the slipways in the Brooklyn Waterway currently operate, on average, at approximately 40 percent occupancy. Consequently as there are currently 456 vessels in the Inlet and assuming say 50 percent of these vessels utilise slipways in the Inlet then the reserve capacity of the existing slipways would accommodate approximately 340 additional vessels. This capacity is less than the anticipated increase in boat population of 445 additional vessels in the Inlet. However, the actual occupancy rate required by slips to ensure viability will vary markedly from the assumed rate of 50 percent. Nonetheless, there are several plans to construct new slipways or boat maintenance facilities at existing marinas or boatsheds in the Brooklyn Waterway.

There is a possible demand for a slipway capable of accommodating deeper draft and larger vessels. Such a facility would provide a service to sailing craft and the larger ferries operating in the area and may further attract larger vessels from Pittwater. It would be necessary to locate such a facility in an area with sufficient water depth and to cater for larger yachts, to locate it downstream of the Hawkesbury River railway bridge. A possible site might be on the eastern end of Long Island although the feasibility of this site is dependent on the SRA’s intended use of the site.

4.5 RECREATIONAL BOATING

4.5.1 Marina Berths

There is currently a total of 6 marinas in the Brooklyn Waterway providing a total of 225 marina wet berths.

The demand for marina facilities is dependent upon a large number of factors, many of which are not directly quantifiable. Furthermore the demand actually realised is subject to many external influences. Consequently the marina berth demand generated in the following sections is indicative of future trends only and it will be necessary to periodically reassess this demand throughout the planning horizon.

The demand for marina berths in the Brooklyn Waterway for the planning horizon of 10 years has been assumed to comprise of the following components:

- Population Growth - the demand created by general population growth trends in the recreational boating catchment of Brooklyn
- Local Mooring Waiting Lists - demand from boat owners on mooring waiting lists in the area wishing to relocate to a marina berth
Overflow from Sydney and Pittwater - demand generated by boat owners on waiting lists for moorings in Sydney and Pittwater electing to use marinas in the Brooklyn Waterway

Charter Boat and Boat Hire Demand - the demand created by growth in the charter boat and boat hire industries

Latent Demand - demand generated by the provision of new marina facilities.

Visitor Berths - demand for berths for use overnight or for short periods of time. This component of demand has been identified separately as it may be possible to provide facilities solely for this use.

Population Growth

Horwath & Horwath (Reference 25) have undertaken a Recreational Boating Demand Study for New South Wales. The study divided New South Wales into seven coastal and seven inland regions. Brooklyn is included in the Sydney Region. Based on an analysis of population growth, and existing and projected per capita marina berth demand, the total demand for marina berths in the Sydney region has been estimated at 3,675 berths in 1997 for the full planning horizon.

Horwath & Horwath have established that the current total marina wet berth supply in the Sydney region is 2,795. There are currently 225 wet berths in the Brooklyn Waterway or 8 percent of the total supply for the region. If demand from population growth is anticipated to increase to 3,675 berths from the Sydney region by 1997, then assuming the same proportional demand for Brooklyn of 8 percent, there will be a total marina wet berth demand from population growth of 294 berths, or a net additional demand of 294 less 225 that is 69 berths, say approximately 70 berths.

Local Mooring Waiting Lists

As noted in Section 4.5.2 the current waiting lists for private moorings is 213 or approximately 70 percent of the total mooring supply. Through the introduction of fore and aft moorings and additional swing moorings the current waiting lists may be anticipated to be reduced though it may not be possible to completely eliminate the waiting lists (refer Section 4.5.2). It is assumed that 10 percent of those on the waiting list would take a marina berth thus generating a demand for 20 berths over the next 10 years. There is already a waiting list for 10 berths at one marina.

Overflow from Sydney and Pittwater

There are approximately 1,800 applicants on the priority waiting lists (1987) for moorings in Sydney Harbour and Pittwater. In addition, waiting lists are in force at most of the existing marina facilities in Sydney and Pittwater. These waiting lists reflect a need for additional marina and mooring facilities. Furthermore, as the waiting lists continue to grow, the charges for wet berths and moorings within the Sydney Metropolitan area may be expected to increase.
The recent construction of the F3 Freeway off ramp at Mooney Mooney has improved the accessibility of Brooklyn to residents of the Sydney Metropolitan area. The Brooklyn Waterway will now become an even more attractive alternative to Sydney boat owners as both a less expensive and convenient area for recreational boating.

As Brooklyn has 8 percent of the wet berths in the Sydney region, it would be reasonable to expect that over time about 8 percent of applicants on the waiting lists could be attracted to the Brooklyn Waterway. This would represent a demand of about 145 berths.

**Charter Boat and Boat Hire Demand**

As stated in Sections 4.4.3 and 4.4.4, there is estimated to be an additional demand of 22 berths for charter boats (houseboats) in the Brooklyn Waterway for the full planning horizon. There is not anticipated to be an increase in the total number of hire boats.

**Latent Demand**

Latent demand is the demand which exists, but is not satisfied until facilities are developed or improved. This demand would be derived from local residents, holiday-makers and the Sydney area. It is considered that a reasonable estimate of this demand would be about 10 percent of the current number of berths, i.e., 25 by 1997.

**Visitor Berths**

The Regional Officer at Hornsby receives several enquiries per week regarding berths and moorings for rent for short term stays. It is difficult to quantify the demand for such facilities, though as with the latent demand for marina berths, if such facilities were provided then boat owners would be encouraged to cruise the Hawkesbury River using such visitors berths as a base. Brooklyn is also a major centre on the Hawkesbury for recreational boating offering a wide range of boat services and would thus be an ideal location for such facilities. Based on the above, it is estimated that there would be a minimum demand for approximately 10 berths, though actual demand would vary seasonally.

**Summary**

The total anticipated marina wet berth demand in the Brooklyn Waterway for the full planning horizon is summarised in Table 4.1 below. In 1997, there would be 505 wet berths (280 + 225) in the Brooklyn waterway. This represents an increase from 8% to 14% of the total Sydney region berths (see Population Growth).
TABLE 4.1 BROOKLYN WATERWAY - SUMMARY OF MARINA WET BERTH DEMAND

<table>
<thead>
<tr>
<th>Source</th>
<th>Marina Wet Berth Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Growth</td>
<td>70</td>
</tr>
<tr>
<td>Local Mooring Waiting Lists</td>
<td>20</td>
</tr>
<tr>
<td>Overflow from Sydney and Pittwater</td>
<td>145</td>
</tr>
<tr>
<td>Charter Boat and Boat Hire</td>
<td>22</td>
</tr>
<tr>
<td>Latent Demand</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong> (Excluding Visitor Berths)</td>
<td>282 (say 280)</td>
</tr>
<tr>
<td>Visitor Berths</td>
<td>10</td>
</tr>
</tbody>
</table>

Note: This is a net additional demand for marina berths

4.5.2 Commercial and Private Moorings

The demand for both commercial and private moorings in the planning horizon has been assumed to comprise the following:

- Current Waiting Lists: demand from current waiting lists for private moorings.
- Population Growth: the demand created by general trends in population growth in the Sydney region.
- Overflow from Sydney and Pittwater: demand generated by boat owners on waiting lists for moorings in Sydney and Pittwater.

The resulting mooring demand has then been corrected for those boat owners who are on a mooring waiting list and elect to take a marina wet berth (refer Section 4.5.1)

Current Private Mooring Waiting List

There are currently a total of 213 on waiting lists for moorings in the Brooklyn Waterway. The distribution of the waiting lists by area is as follows:
Population Growth

The waiting lists provide an estimate of the current demand for moorings. An estimate of the future demand for moorings may be made by considering the existing number of moorings per capita and applying this rate to projected population growth.

Horwath & Horwath (Reference 25) have estimated that there are currently approximately 12,200 moorings in the Sydney region. The existing moorings in Brooklyn (329) represent approximately 2.7% of the total for the Sydney region.

Assuming that the per capita mooring ratio remains constant for the full planning horizon and assuming an annual population growth of 0.6% per annum for the Sydney region (Reference 25) then the total mooring demand for the Sydney region in 10 years may be anticipated to be approximately 13,000. Assuming that 2.7% of this demand would occur in the Brooklyn Waterway then the future demand would be approximately 351 moorings. This represents a demand for an additional 20 moorings.

Overflow from Sydney and Pittwater

As stated in Section 4.5.1 there are approximately 1,800 applicants on the priority waiting lists for moorings in Sydney Harbour and Pittwater. With the recent construction of the F3 Freeway off ramp at Mooney Mooney boat owners on mooring waiting lists in Sydney Harbour may be anticipated to transfer to the waiting lists for the Brooklyn Waterway. It could be reasonably expected that at least 2.7% of the present ratio of moorings in Brooklyn, would be attracted from the Sydney waiting list. This would result in a demand for an additional 45 moorings over the next ten years.

Summary

The total demand for moorings in the Brooklyn Waterway for the full planning horizon is summarised in Table 4.2 below. It was assumed that all additional demand for recreational craft moorings (260) would be provided in Sandbrook Inlet due to the limited sheltered waterway in Parsley Bay and Brooklyn Boat Harbour. As there is nearly an equal number of private and commercial moorings, it was assumed this ratio would be maintained. This would result in 206 private moorings in Sandbrook Inlet when the future demand (130) is combined with the existing 76 private moorings.

In 1997, there would be 590 private and commercial moorings in the Brooklyn waterway. This represents an increase from 2.7% to 4.5% of the total Sydney region moorings (see Population Growth).
TABLE 4.2  BROOKLYN WATERWAY - SUMMARY OF COMMERCIAL AND PRIVATE MOORINGS DEMAND

<table>
<thead>
<tr>
<th>Source</th>
<th>Mooring Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Private Mooring Waiting Lists</td>
<td>213</td>
</tr>
<tr>
<td>Population Growth</td>
<td>20</td>
</tr>
<tr>
<td>Overflow from Sydney Harbour/Pittwater</td>
<td>45</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>278</strong></td>
</tr>
<tr>
<td>Less those boat owners on the local mooring waiting list that elect to take a marina wet berth</td>
<td>20</td>
</tr>
</tbody>
</table>
| **Total**                                                             | **258**        say 260

Note: *This is a nett additional demand for moorings*

4.5.3 Boat Launching Ramps

Surveys conducted in 1978 (Reference 26) showed that a significant number of ramp users at Parsley Bay originated from Sydney's southern suburbs. Following improvement of the Parsley Bay ramp facilities in 1981, construction of the F3 Freeway, and most recently the off ramp at Mooney Mooney Point, the use of the boat launching ramps in the Brooklyn Waterway, particularly by those users from Sydney's eastern and southern suburbs, has increased greatly.

The demand for boat launching facilities has been based on an estimate of the number of trailerable boats that would use ramps in the Hawkesbury/Pittwater waterway and the projected growth in the number of trailerable boats for the planning horizon.

Through an analysis of boat trailer registration Horwath & Horwath (Reference 25) have established that the trailerable boat ownership ratio for the Sydney region is approximately 19.7 boats per 1,000 head of population. It was further established that this ratio has remained constant for the last 7-10 years. Consequently assuming that the ratio remains constant for the planning horizon and based on predicted population growth (Reference 25) then the total estimated trailerable boat population for the Sydney region would be approximately 59,500 by 1997.

The Hawkesbury/Pittwater waterway is one of five major waterways in the Sydney Metropolitan area used by trailerable boats. Assuming therefore on a peak usage summer day that 10 percent of all the trailer boats (Reference 26) are on the five waterways, then it may be assumed that 2 percent of the vessels would be on the Hawkesbury/Pittwater waterway. Hence by 1997 the peak trailerable boat usage of the Hawkesbury/Pittwater waterway would be 2 percent of 59,500, that is 1,190 boats.

There are a total of nine boat launching ramps south of the Hawkesbury River that would service the Hawkesbury/Pittwater waterway. Three of these ramps or one third of the total are in the Brooklyn Waterway. Assuming that the vessels would be evenly distributed throughout...
the ramp facilities then as an indication it may be assumed that one third of the boats would use ramps in the Brooklyn area, that is approximately 400 boats. In fact the distribution of vessels using ramps in the region will depend upon factors such as road access, car trailer parking and the number of ramp lanes etc. It is known that (Reference 26) the ramp at Parsley Bay is considered to be one of the most popular in the region. Consequently launchings and retrievals per day as determined above may be considered to be a conservative assessment of likely future ramp usage in the Brooklyn Waterway.

With reference to Section 3.15.4 it may be seen that the existing boat launching facilities provide a total of six lanes with an estimated maximum capacity of 210 launchings and retrievals per day. Thus there is demand for additional boat launching ramp facilities to accommodate a maximum of approximately 190 launchings and retrievals per day. Based on a capacity of 40 launchings and retrievals per lane per day, such a facility would require five boat launching lanes.

4.5.4 Summary of Recreational Boating Requirements

A summary of the recreational boating requirements is presented in Table 4.3 below. In preparation of the area requirements the following base data has been used:

| Marina Wet Berths          | 60 boats/hectare of waterway (includes allowance for fairways and boat manoeuvring areas) |
| Marina Land Area to Waterway Area Ratio | 0.4 to 0.6 |
| Swing Moorings             | 10 boats/hectare of waterway |
| Two Point Swing Moorings   | 20 boats/hectare of waterway |
| Fore and Aft Moorings      | 30 boats/hectare of waterway |
| Boat Launching Ramps       | 0.09 hectare/launching lane (including waterway manoeuvring area) |

Land Area | 0.012 hectare/car and trailer space (including manoeuvring area and landscaping)
TABLE 4.3  BROOKLYN WATERWAY - RECREATIONAL BOATING
SUMMARY OF ADDITIONAL FUTURE LAND AND WATERTWAY AREA REQUIREMENTS

<table>
<thead>
<tr>
<th></th>
<th>Additional Facilities Required</th>
<th>Additional Waterway Area Requirements (hectares)</th>
<th>Additional Land Area Requirements (hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charter Boats</td>
<td>-</td>
<td>Included in marina requirements</td>
<td>Included in marina requirements</td>
</tr>
<tr>
<td>Boat Hire</td>
<td>-</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Boat Repair and Maintenance</td>
<td>-</td>
<td>Demand accommodated in existing facilities</td>
<td>Demand accommodated in existing facilities</td>
</tr>
</tbody>
</table>

**Recreational Boating**

- **Marinas**: 280 wet berths, 4.67 hectares, 2.8 hectares
- **Commercial and Private Moorings**: 260 moorings, 260 maximum, 87 minimum, See Section 4.9 for parking requirements
- **Boat Launching Ramps**: 5 lanes with minimum of 150 car/trailer spaces, 0.45 hectares, 1.8 hectares

**Note**  The waterway areas for commercial and private moorings have been determined assuming both swing moorings and fore and aft moorings to give the possible range in waterway area requirements.

**4.6 GOVERNMENT FACILITIES**

**4.6.1 General**

For future management of the waterway it is considered necessary to provide facilities for the Fisheries Division, the Water Police and the Maritime Services Board.

The future land and waterway area requirements for Government facilities in the Brooklyn Waterway have generally been based on the suggested area allocations as given in the Fishing Ports Planning and Design Guidelines (Reference 22) for each of the relevant government authorities. It is recognised, however, that the scale of operation of several of the government...
authorities would not be as large as in major fishing ports and the possibility of combined facilities was considered. Recently, the possibility of the Government authorities being accommodated within the proposed Hawkesbury River Marina (incorporating Don's Boats and Hawkesbury River Boat Hire) has arisen. This may be a suitable medium term solution to the need for Government facilities within the waterway.

4.6.2 Land Area Requirements

The Fisheries Division would benefit from consolidated offices in a location in proximity to the Brooklyn Boat Harbour and their vessel berths. The Water Police whilst requiring storage and vessel servicing facilities would maintain offices within the local police station to centralise policing duties. The Maritime Services Board only maintain a boat at Brooklyn. It is considered that it would be preferable to establish a central port authorities building in the Brooklyn Boat Harbour. The building would principally house the Fisheries Division with smaller offices for the Maritime Services Board and the Water Police. For the Water Police, the office would be associated only with the vessel servicing activities as are currently undertaken at the existing police boatshed. A storage compound would be located adjacent to this building for common use.

Based on Reference 22 and with reduced areas for the Water Police and Maritime Services Board, the following land areas have been determined:

<table>
<thead>
<tr>
<th>Office Area</th>
<th>10 metres by 10 metres</th>
<th>0.01 hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compound Area</td>
<td>10 metres by 10 metres</td>
<td>0.01 hectares</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>0.02 hectares</strong></td>
</tr>
</tbody>
</table>

4.6.3 Waterway Area Requirements

Based on discussions with the government authorities, it is considered that the number of vessels operated at present would generally remain constant in the near future. Through increased development along the Hawkesbury River and the need to provide increased policing of the waterway, and the need for improved management and policing of the Hawkesbury River Fishery, there would, however, be a possible increase in the number of Fisheries Division and Water Police vessels for the full planning horizon. As a first stage, however, facilities would initially be required for four vessels (the existing number - 40 metre effective berth length) until the future requirements could be fully established.

Government Authorities - Waterway Area Requirements (long term)

Vessel Berths - Berth Length 58 metres - 0.04 hectares

4.7 PUBLIC WHARVES AND PRIVATE JETTIES

4.7.1 Public Wharves

Commercial Activities

It is considered necessary to provide a pick-up and set-down berth allocated for priority use by ferry and water taxi services. As noted in Section 4.4.1, a berth length of 15 metres would be required.

An area has been allocated (Section 4.4.2) for combined mooring and set-down and pick-up points for existing cruise vessels operating from the Boat Harbour. Area for an additional cruise vessel has been allowed for future growth. However, a number of cruise vessels from...
Pittwater are making increasing use of the public wharf in the Brooklyn Boat Harbour. The wharf provides a popular embarkation point for passengers arriving at Brooklyn by train. If the public wharf facilities were improved then it is considered that use of the wharf by cruise vessels would increase. Whilst it is difficult to quantify this demand it is considered necessary, within the planning horizon, to provide wharfage as a set-down and pick-up point for visiting cruise vessels. This requirement would be additional to the wharf allocation for ferry and water taxi services. Cruise vessels operating in the Hawkesbury River are typically a maximum of 20 metres in length and it would be necessary to provide wharfage facilities to accommodate a separate pick-up and set-down point for vessels of this size.

**Recreational Activities**

The public wharf in the Brooklyn Boat Harbour is utilised by recreational boaters for the drop off and pick up of passengers, and very occasionally for temporary mooring by vessels wishing to visit the Brooklyn village. There has, in the past, often been a conflict of use between recreational boating and the ferry and water taxi services using the wharf. The provision of landing pontoons within the Boatharbour and Parsley Bay will reduce this conflict. However, the present location of the public wharf is closest to facilities and hence would continue to be used by recreational and commercial craft alike. Therefore it would be necessary to provide a berth at the wharf for the priority use by ferries and water taxis and a separate berth for recreational craft. Given the nature of the use of a berth by cruise vessels and recreational craft, it would be feasible for these two groups to share a 20 metre pick-up and set-down berth. The proposed boardwalk along the western foreshore of the Boatharbour would provide further informal set-down and pick-up points for smaller craft.

The public wharf in Sandbrook Inlet (*east end*) is used principally by boaters with moorings in Sandbrook Inlet and by commuters with residences along the Hawkesbury River. Whilst this wharf is not as popular as the one in the Brooklyn Boat Harbour, it is considered necessary to maintain a facility at this location to service the existing users and to form an integral part of the proposed recreational development in this area as described in Sections 4.8.2 and 6.3.6. There is the opportunity to improve access to the waterway with provision of jetties/wharves at passive recreation areas along the Inlet (Section 6.3).

**Summary**

To meet the future requirements for commercial and recreational activities it is considered necessary to provide the following waterway areas and pick-up and set-down berth lengths at a public wharf:

**Brooklyn Boat Harbour**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Berth Length</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferries and Water Taxis</td>
<td>15 metres</td>
<td>0.005 hectares</td>
</tr>
<tr>
<td>(refer Section 4.4.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visiting Cruise Vessels and</td>
<td>20 metres</td>
<td>0.010 hectares</td>
</tr>
<tr>
<td>Recreational Boating</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sandbrook Inlet**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Berth Length</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreational Boating</td>
<td>three 5 metre berths</td>
<td>0.008 hectares</td>
</tr>
</tbody>
</table>
4.7.2 Private Jetties

The future development of private jetties on Dangar Island and Little Wobby Beach would possibly increase usage of public wharves, especially within the boatharbour. However, it is not considered necessary to provide separate wharfage for these craft.

There are approximately 30 waterfront lots either with private residences or vacant land along the southern shore of Sandbrook Inlet. Seventeen of these lots have been granted non-commercial permissive occupancies. It is possible therefore that 13 private jetties may be further developed in the area. To provide sufficient waterway area for boat mooring, navigation, and open waterway it is recommended that in general jetty structures extend no further than 40 metres from the high water mark. It is noted that at some locations this may necessitate some dredging to permit mooring of vessels. Based on this maximum jetty length and the average width of waterfront lots along the Inlet, then the total waterway area requirements for full development of jetties at all privately owned non-commercial waterfront lots in Sandbrook Inlet has been estimated to be 1.8 hectares.

The Lands Department is promoting the rationalisation of private jetties with community sharing of structures and demolition of derelict structures. This may reduce the number of private jetties in the future; however, as a conservative approach it was assumed there was a jetty for each foreshore property.

There are no private jetties within the Brooklyn Boat Harbour, as only commercial permissive occupancies have been granted for the commercial activities in the Harbour. Based on current land zoning and tenure (refer Sections 3.21 and 3.22), it is considered that no private (non-commercial) over water facilities could be developed in the Brooklyn Boat Harbour.

4.8 NON-BOATING RECREATION USES

4.8.1 General

The per capita provision of non-regional open space in Brooklyn is approximately 10 times the average open space provision in Hornsby Shire (References 2 and 21). Consequently due to the large areas of open space and the lack of data on current and anticipated levels of use, it is inappropriate to determine land requirements for non-boating recreational uses based on estimates of existing and potential demand. A better approach is to consider opportunities to provide for a range of recreational uses which take advantage of local site attributes.

4.8.2 Non-Boating Recreation Requirements

A key aspect in assessing the opportunities for non-boating recreation is the identification of areas that have natural qualities which may be capitalised upon in the provision of facilities for recreation and leisure pursuits. In Brooklyn, these areas are primarily located adjacent to the water.

The determination of the types of activities which could be encouraged and catered for in these areas is based on such factors as location, surrounding land uses, access and site attributes. Of particular importance is the need to provide both visual and physical access to waterside areas for the public. This is so for the following reasons:

whilst the Brooklyn area is surrounded by water, there are few opportunities for the public to gain access to the water's edge for activities other than boating use,
the use of the waterside for other than boating activities is generally confined to McKell Park and its environs which encourages congestion in this area to the detriment of all recreational user groups,

the safe and scenic waterside areas of Sandbrook Inlet are virtually inaccessible at present to those without boats.

The following major open space areas have been identified for opportunities to improve the range of recreational activities for non boating users in the Brooklyn area.

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brooklyn Boat Harbour</td>
<td>- McKell Park/Causeway East</td>
</tr>
<tr>
<td>Sandbrook Inlet</td>
<td>- Causeway West</td>
</tr>
<tr>
<td></td>
<td>- Brooklyn Park and Quarry Area</td>
</tr>
<tr>
<td></td>
<td>- Mangrove and Dairy Flats Area</td>
</tr>
<tr>
<td>Mooney Mooney</td>
<td>- Mooney Mooney Point</td>
</tr>
<tr>
<td>Other Areas</td>
<td>- The Railway Dams area south of the SRA right of way</td>
</tr>
<tr>
<td></td>
<td>- Long Island - eastern point</td>
</tr>
<tr>
<td></td>
<td>- Rest Park</td>
</tr>
<tr>
<td></td>
<td>- Smaller Reserves throughout Brooklyn</td>
</tr>
</tbody>
</table>

The opportunities to improve these areas are presented in Section 6. The location of the main areas considered is shown in Figures 7 and 15.

4.9 ROAD ACCESS AND PARKING REQUIREMENTS

4.9.1 General

The road access and parking requirements have been identified for the Brooklyn Boat Harbour and more generally for Sandbrook Inlet. The parking requirements for Sandbrook Inlet have been identified only for the possible passive recreation areas and for users of private moorings. It has not been within the scope of this study to determine specific parking requirements at each of the waterway related facilities along Brooklyn Road.

4.9.2 Road Access

Brooklyn Road

Following the (August 1987) completion of Mooney Mooney Point Freeway off ramp, traffic along the Brooklyn Road may be anticipated to increase. There is also an increasing number of buses using the Brooklyn Road transporting tourists to the river cruises offered at the Brooklyn Boat Harbour. It is considered necessary to upgrade the Brooklyn Road in the near future to meet the predicted increased traffic flows. Upgrading should include widening of the road at narrow sections and realignment where possible at tight bends particularly at the western end of the Brooklyn Road. The possible methods of funding such improvements are discussed in Section 6.9.3.

Brooklyn Boat Harbour

Development of the Brooklyn Boat Harbour is contingent upon improved road access and manoeuvring areas. Development either north along the SRA causeway or east towards the tidal baths will require improved roadways to facilitate possible access by cars, buses and trucks. For development along the causeway the existing roadway would require sealing...
and widening to a minimum roadway width of 7.0 metres. If significant development occurred along the McKell Park then it would be necessary to improve the road access through the Park adjacent to the Fishermen’s Co-operative and to the south of Don’s Boats and Hawkesbury River Boat Hire. The existing roadway width at these locations is approximately 4.0 to 5.0 metres. It would be necessary to increase the roadway widths to 7.0 metres to accommodate bus and truck traffic. To preserve the existing row of Cabbage Tree Palms it would be necessary to construct an additional roadway south of the palms.

Hornsby Shire Council has developed plans for a bus turning circle at the northern end of Dangar Road and proposes to construct the turning circle in the near future. If the turning circle is constructed at this location then buses would not use the roadways along the causeway or to McKell Park, though this would not significantly reduce road access requirements for other vehicular traffic. The alternative possible locations of bus turning circles in the Brooklyn Boat Harbour are considered in Section 6.5.8.

4.9.3 Parking Requirements

The future parking requirements for the Brooklyn Boat Harbour and for recreation areas for the Sandbrook Inlet are presented in Table 4.4. The parking requirements are based on Public Works Department standard car parking space to user ratios for fishing ports and tourist development and are based on the existing use and future requirements as described in Sections 3 and 4 respectively.

The demand for parking spaces associated with moorings has been assessed on a basis of 0.2 spaces per mooring and only private moorings have been included. It is assumed operators have provided sufficient parking for commercial moorings. It is also assumed that there is sufficient waterway area within Sandbrook Inlet to cater for all the future demand. This is unlikely to be the case and the actual parking demand will have to be reassessed once the conflicting demands for waterway area have been resolved in Section 6.

The Public Works Department’s (Reference 29) requirement of 30 car and trailer parking spaces per boat launching ramp lane has been used to establish future parking requirements at boat ramps. It has been assumed that a 6 lane boat ramp would be required at Mooney Mooney Point to cater for future demand to 1997. This would necessitate the upgrading of the existing one lane ramp at Mooney Mooney Point to a 6 lane ramp.

For the tourist services, the number of car spaces is based on the number of passengers anticipated to arrive by car. Cruise operators have indicated that the majority of cruise passengers arrive by bus or train. It is expected that up to 150 passengers would arrive by car on any one day. This represents about 15% of the average daily cruise/ferry craft capacity.

For the Dangar Island and Little Wobby commuter parking requirements a parking ratio of 0.5 spaces per dwelling has been assumed. It is noted that this is less than the Hornsby Shire Council Planning Ordinance (Reference 28) requirements but has been adopted to reflect the reduced car ownership of persons residing at these locations.

For open space active recreation areas the Hawkesbury/Nepean Valley Report (Reference 30) recommends a car parking space ratio of 25 spaces per hectare. But because the proportion of open space to population in Brooklyn is ten times larger than in Sydney’s residential areas, it is considered that a lower ratio of 15 parking spaces per hectare would be appropriate.
As noted in Section 4.9.1 it has not been within the scope of this study to determine specific parking requirements at each of the commercial waterway related facilities along the Brooklyn Road.

In general however it is recommended that for such facilities the following parking ratios be adopted:

- **Marinas**: 0.6 car parking spaces for each marina wet berth (Reference 29)
- **Moorings**: 0.2 car parking spaces for each mooring

The future requirement for 120 car spaces along Sandbrook Inlet (Table 4.4) could be readily provided within the development of the passive recreation areas. At Parsley Bay the number of car and trailer spaces exceeds the Public Works Department guideline for a 2 lane ramp. This, combined with the availability of street parking is considered satisfactory for providing spaces for users of boats at moorings within Parsley Bay. The future demand for 242 spaces within the Boat Harbour far exceeds the 140 spaces presently available.

### 4.10 SUMMARY OF WATERWAY AND LAND AREA REQUIREMENTS

A summary of the waterway and land areas based on the future requirements as described in the preceding sections is presented in Table 4.5. Where appropriate these requirements have been compared with existing facilities to highlight specific demands for waterway and land areas.

The major future requirements are for additional land area within the Boat Harbour and waterway area within the Inlet for moorings and berths.
<table>
<thead>
<tr>
<th>User/Facility</th>
<th>Parking Space to User Ratio</th>
<th>Number of Users/Area/Residences</th>
<th>Parking Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandbrook Inlet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moorings - Private</td>
<td>0.2/mooring</td>
<td>206</td>
<td>40</td>
</tr>
<tr>
<td>Causeway West Park</td>
<td>15/ha</td>
<td>0.8 ha</td>
<td>12</td>
</tr>
<tr>
<td>Brooklyn Park (excludes Quarry area)</td>
<td>15/ha</td>
<td>2.0 ha</td>
<td>30</td>
</tr>
<tr>
<td>Mangrove and Dairy Flat Area</td>
<td>15/ha</td>
<td>2.5 ha</td>
<td>38</td>
</tr>
<tr>
<td>Parsley Bay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moorings - Private</td>
<td>0.2/mooring</td>
<td>39</td>
<td>8</td>
</tr>
<tr>
<td>Brooklyn Boat Harbour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moorings - Private</td>
<td>0.2/mooring</td>
<td>32</td>
<td>6</td>
</tr>
<tr>
<td>Tourist Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Tourist Workers</td>
<td>0.75 pp</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>- Tourist Cruise</td>
<td>0.5 pp</td>
<td>150</td>
<td>75</td>
</tr>
<tr>
<td>Visitors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- McKell Park</td>
<td>15/ha</td>
<td>3.3 ha*</td>
<td>50</td>
</tr>
<tr>
<td>Fishing Industry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Fishing Fleet</td>
<td>1.5/vessel</td>
<td>14</td>
<td>21</td>
</tr>
<tr>
<td>- Co-operative</td>
<td>0.75 pp</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Government Facilities</td>
<td>0.75 pp</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Commuter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking (Dangar Island and Little Wobby Beach)</td>
<td>0.5 per residence</td>
<td>150</td>
<td>75</td>
</tr>
<tr>
<td>Public Boat Launching Ramps (car and trailer spaces)</td>
<td></td>
<td></td>
<td>TOTAL 242</td>
</tr>
<tr>
<td>Mooney Mooney Point</td>
<td>Minimum 30 spaces/lane</td>
<td>6 lanes</td>
<td>180</td>
</tr>
</tbody>
</table>

* Upper McKell Park not included in the area as it has provision for car parking
<table>
<thead>
<tr>
<th>WATERWAY USER/ FACILITY</th>
<th>EXISTING FACILITIES</th>
<th>TOTAL FUTURE REQUIREMENTS TO 1997</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Land Area (hectares)</td>
<td>Number/ Length</td>
<td>Waterway Area (hectares)</td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fishing Industry</td>
<td>0 018 B</td>
<td>-</td>
<td>0 075 B</td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waterway Activities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Ferry &amp; Water Taxi Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cruises</td>
<td>0 040 S</td>
<td>0 225 S</td>
<td>0 225 S</td>
</tr>
<tr>
<td>- Charter Boats</td>
<td>0 075 S</td>
<td>0 210 S</td>
<td>0 075 S</td>
</tr>
<tr>
<td>- Boat Hire</td>
<td>0 080 S</td>
<td>0 080 S</td>
<td>0 080 S</td>
</tr>
<tr>
<td>- Boat Repair &amp;</td>
<td>0 150 S</td>
<td>0 420 S</td>
<td>0 210 S</td>
</tr>
<tr>
<td>Maintenance</td>
<td>0 020 B</td>
<td>0 060 B</td>
<td>0 020 B</td>
</tr>
</tbody>
</table>
### TABLE 4.5 BROOKLYN WATERWAY - SUMMARY OF WATERWAY AND LAND AREA REQUIREMENTS continued

<table>
<thead>
<tr>
<th>WATERWAY USER/FACILITY</th>
<th>EXISTING FACILITIES</th>
<th>TOTAL FUTURE REQUIREMENTS TO 1997</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Land Area (hectares)</td>
<td>Number/Length</td>
<td>Waterway Area (hectares)</td>
</tr>
<tr>
<td>Recreational Boating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Marina Wet Berths</td>
<td>1360 S</td>
<td>225 wet berths</td>
<td>1270 S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2800 S</td>
<td></td>
</tr>
<tr>
<td>- Commercial</td>
<td></td>
<td>231 S</td>
<td>13 800 S</td>
</tr>
<tr>
<td>&amp; Private Moorings</td>
<td></td>
<td>56 B</td>
<td>0 750 B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>42 P</td>
<td>3 840 P</td>
</tr>
<tr>
<td>- Boat Launching Ramps</td>
<td></td>
<td>14 P</td>
<td>112 P</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 lanes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>98 S</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 lanes</td>
</tr>
<tr>
<td>Public Wharves &amp; Private Jetties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Public Wharves</td>
<td></td>
<td>-</td>
<td>0 005 S</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 010 B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 010 P</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Private Jetties</td>
<td></td>
<td>-</td>
<td>0 720 S</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATERWAY USER/ FACILITY</td>
<td>EXISTING FACILITIES</td>
<td>TOTAL FUTURE REQUIREMENTS TO 1997</td>
<td>REMARKS</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------</td>
<td>----------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td>Land Area (hectares)</td>
<td>Number/Length</td>
<td>Waterway Area (hectares)</td>
</tr>
<tr>
<td>Government Facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- State Rail Authority</td>
<td>2250 S</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Department of Agriculture, Fisheries Division</td>
<td>11250 B</td>
<td>-</td>
<td>11250 B</td>
</tr>
<tr>
<td>- Water Police</td>
<td>0025 B</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>- Maritime Services Board</td>
<td>003 B</td>
<td>-</td>
<td>003 B</td>
</tr>
<tr>
<td>Navigation Channels and Turning Areas (Section 6.3.5)</td>
<td>-</td>
<td>Sandbrook Inlet 11200 S</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40 m wide channel at -1.0 to -1.5 m ISLW</td>
<td>50 m wide channel at -2.3 m ISLW (includes turning circle)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45 m wide channel at -2.0 m ISLW (includes turning circle)</td>
<td>45 m wide channel at -3.0 m ISLW (includes turning circle)</td>
</tr>
</tbody>
</table>
TABLE 4.5 BROOKLYN WATERWAY - SUMMARY OF WATERWAY AND LAND AREA REQUIREMENTS continued

<table>
<thead>
<tr>
<th>WATERWAY USER/ FACILITY</th>
<th>EXISTING FACILITIES</th>
<th>TOTAL FUTURE REQUIREMENTS TO 1997</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Land Area (hectares)</td>
<td>Number/ Length</td>
<td>Waterway Area (hectares)</td>
</tr>
<tr>
<td>Non Boating Recreation Uses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Formalised passive &amp; active recreation areas</td>
<td>5 350 S</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>- Sandbrook Inlet</td>
<td>5 000 B</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>- Parsley Bay</td>
<td>8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>- Brooklyn Boat Harbour</td>
<td>0 280 B</td>
<td>140</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>16 743</td>
<td>8 202</td>
<td>17 200</td>
</tr>
<tr>
<td>TOTAL BROOKLYN BOAT HARBOUR</td>
<td>10 605</td>
<td>60 230</td>
<td>13 740</td>
</tr>
</tbody>
</table>

Note:  
S - denotes waterway and land area use or requirements in Sandbrook Inlet  
B - denotes waterway and land area use or requirements in Brooklyn Boat Harbour  
P - denotes waterway and land area use or requirements in Parsley Bay
5. PLANNING FRAMEWORK

5.1 PLANNING OBJECTIVES

The overall planning objectives of the Brooklyn Waterway Planning Study may be summarised as follows:

- Provide input into Hornsby Shire Council's Local Environmental Plan for the Asquith-Brooklyn region
- Identify and control waterway and foreshore development to meet the immediate and future requirements of waterway and foreshore users
- Minimise any conflicts in the use of public waterfront facilities.
- Encourage the provision of better facilities for tourist activities and recreational boating for both local residents and tourists
- Accommodate and support the fishing industry through the provision of port facilities

Development programs can be combined with these planning objectives to provide manageable future development. However, various factors will govern the practical extent to which these objectives can be achieved.

5.2 FACTORS AFFECTING DEVELOPMENT

5.2.1 General

There are several factors which will place constraints and priorities on development within the Brooklyn Waterway. The major factors affecting development are as follows:

- **Planning Issues**
  - development must take place where possible within regional and local environmental planning schemes and strategies.

- **Physical Constraints**
  - existing available waterway and land areas

- **Environmental Factors**
  - constraints on development such as maintenance of water quality, flora and fauna, and estuarine habitats

- **Engineering Issues**
  - major engineering works or services that may be required to promote or facilitate future development.
Social Issues - maintaining and promoting a social environment in keeping with community requirements

5.2.2 Planning Issues

The Hornsby Shire Council Draft Planning Study (Reference 1) recognises that increasing recreational use of the Hawkesbury Valley will place increased demands for development of the waterway. The Planning Study made the following recommendations:

- boating is considered to be the predominant activity in the region and waterway access should be encouraged for both commercial and public use,
- tourist developments should be consolidated with established areas rather than development in areas without supporting infrastructure,
- the range of permissible land uses within residential (a2) zoning should be broadened to include waterway recreational developments.

The Hawkesbury/Nepean Valley Report (Reference 30) reviewed recreation and regional open space in the Hawkesbury Valley. The study concluded that tourist/recreational development should be encouraged in Brooklyn and more generally made recommendations for open space recreation. The foreshores of the Brooklyn Waterway were considered suitable for intensive informal recreation which would include active parks.

5.2.3 Physical Constraints

The physical features of the Brooklyn Waterway and the available waterway and land areas will control future development in Sandbrook Inlet and the Brooklyn Boat Harbour. Physical constraints within these waterways also include the degree of protection from wind generated waves and available water depths.

Sandbrook Inlet

Water Depths

The Hawkesbury River Railway Bridge has a mast height restriction of 11.5 metres. This restricts the maximum size of sailing vessels that may use the Inlet to approximately 9 metres. The average draft of sailing vessels of this size would be 1.8 metres. Power craft up to 15 metres in length would be expected to regularly use the Inlet. The average draft of these craft is about 1.4 metres. Thus with an average allowance for siltation (10 year allowance) and wave action of 0.2 and 0.3 metres respectively the required minimum depth would be 2.3 metres below ISLW. It would therefore be necessary to undertake dredging of the Inlet if the full development requirements were to be achieved.

Wave Climate

The predicted maximum wave height (50 year return period) in the Inlet is approximately 0.7 metres in an easterly or westerly direction with a maximum boat wake of 0.5 metres, which would generally be an acceptable wave climate for waterway developments such as marinas (with the correct berth orientation), fore and aft moorings, and general recreational boating. The wave climate in the Inlet is therefore not considered to be a constraint upon development.
Waterway Areas

Assuming that marina development was to take place within Sandbrook Inlet (as proposed in the Kangaroo Point development, refer Section 6.3.4) and that all additional moorings are placed in the Inlet as fore and aft moorings, then with reference to Table 4.5 it may be seen that the total waterway area requirements for the Inlet would be 71 hectares, or 39 hectares excluding the oyster leases but including navigation channels and turning circles. This compares with a total available waterway area of 117 hectares. Thus it would be possible to accommodate the future requirements within the total waterway area. It is noted, however, that only 36 hectares of the waterway are at water depths greater than 1.0 metres below ISLW.

The requirements for a navigation channel within the Inlet to provide access to moorings have been based on waterway planning guidelines and the size and type of craft that use boating facilities in the Inlet. The PWD Marina Guidelines (Reference 29) recommend entrance channel navigable widths of 40-50 metres whilst the Fishing Ports Planning and Design Guidelines (Reference 22) suggest a fairway width between moored craft of twice the maximum vessel length. Bray (Reference 32) recommends for navigable waterways a turning circle of four times the maximum vessel length or for Sandbrook Inlet approximately 60 metres. A channel width of 50 metres is recommended for the Inlet.

Brooklyn Boat Harbour

Water Depths

Water depths in the Brooklyn Boat Harbour vary from 0.0 ISLW to 2.5 metres below ISLW. The maximum size tourist cruise vessel that is anticipated to use the Boat Harbour would have a draft of approximately 2.0 metres. This draft corresponds to a sailing vessel of between 10 and 12 metres in length (Reference 29). Siltation rates in the Brooklyn Boat Harbour vary between 30 and 130 millimetres per year. Allowing a period of 10 years between maintenance dredge operations and with an average rate of 80 millimetres per year then an overdredge within 0.8 metres would be required. The minimum required dredge depth to accommodate a 20 metre cruise vessel including an allowance for wave action of 0.2 metres would be 3.0 metres below ISLW. It would be necessary therefore to dredge the waterway to achieve the full development requirements.

Wave Climate

The Brooklyn Boat Harbour is exposed to fetches to the north and north east, and at Flat Rock Point to wind waves from the south east. The maximum wind wave height (50 year return period) in the Harbour would be 0.6 metres with a boat wake of approximately 0.5 metres. As for Sandbrook Inlet the wave climate would be acceptable for the waterway developments required in the Harbour, notably public wharves, tourist facilities and for fore and aft mooring if correctly oriented towards the principal north and north easterly wave directions.

Waterway and Land Area

The total waterway area requirement in the Brooklyn Boat Harbour is estimated to be 8.8 hectares and 3.8 hectares excluding the oyster lease areas (refer Table 4.5). The existing available waterway area bounded by the southern boundary of the oyster leases to the north...
of the Harbour and a line between the east edge of the swimming enclosure and the east end of Long Island is 3.4 hectares. It may be seen therefore that it would be necessary to encroach upon the oyster lease area north of the Harbour in order to achieve the full development potential. Through discussions with Department of Agriculture, Fisheries Division officers and oyster farmers, it has been established that it would be possible to relinquish an area of the oyster leases in this area providing an equal area was granted in compensation at the south-eastern corner of this oyster lease area (refer Figure 7).

The existing navigation channel to the Harbour has a minimum width of approximately 45 metres and is constrained by the pile moorings to the south and pile moorings and oyster lease areas to the north. The requirements for the channel would be the same as for Sandbrook Inlet. As considerable works and relocation of facilities would be required for a channel width of 50 metres, it is recommended that the existing minimum width of 45 metres be maintained.

A turning circle of 80 0 metres would be required in the vicinity of the tourist cruise vessel berths and the public wharf. Due to physical constraints in the waterway it would only be possible to provide a turning circle of 50 metres diameter in the vicinity of the public wharf. The type of large vessel using the wharf would, however, be extremely manoeuvrable as is evidenced by the present charter vessel operations in the area. Thus it is considered that a smaller turning circle in this area would not cause a restriction to the use of the public wharf.

An additional 0.5 hectares of land area in the Boat Harbour would be required to accommodate future requirements (refer Table 4.5). This does not include a further allowance for the separation of the cluttered existing development to improve the overall operational efficiency of the harbour. The available land is restricted by the presence of the SRA causeway, the steep slopes of McKell Park and the tidal baths. The baths is an important recreational asset for the area and should be retained. Another constraint is the freehold development at the Fishermen’s Co-operative, Hawkesbury River Boat Hire and Don’s Boats. Therefore, additional land area would have to be reclaimed to cater for future demand.

5.2.4 Environmental Factors

The principal environmental factors that would place constraints on developments both in Sandbrook Inlet and the Brooklyn Boat Harbour are as follows:

Water quality - maintaining adequate water quality in keeping with existing and future waterway use and water quality guidelines.

Mangrove areas - maintaining existing areas of mangroves in accordance with Department of Agriculture, Fisheries Division general requirements.

Oyster leases - maintaining important oyster leases in accordance with Department of Agriculture, Fisheries Division requirements.

Aboriginal Sites - maintaining important sites and relics in accordance with the National Parks and Wildlife Service requirements.

The principal constraints placed on existing and future development by each of these environmental factors are described in the following sections.
Water Quality

It has been concluded that the existing water quality in the waterway is satisfactory and meets standard water quality criteria for the support of aquatic life. It has not been possible, however, to assess the levels of organo-tins in the waterway. The effects of these and other toxins on oyster growth in the Hawkesbury is the subject of an investigation currently being undertaken by the Fisheries Division.

Future developments will result in increased boating activity and hence an increased pollutant load in the waterway. The impacts of shoreline development may be controlled through the monitoring and treatment of effluent discharges into the waterway.

Due to the present low levels of pollution it is considered possible to increase the number of vessels in the waterway and in Sandbrook Inlet, though it is not possible to determine an upper limit number for vessels moored at this location. It would, however, be possible to monitor the water quality impacts of such increases in vessel numbers on a regular basis through the establishment of a water quality monitoring programme. In this way it will be possible to regulate the maximum number of vessels in moorings and marina berths consistent with an acceptable water quality criteria (refer also Oyster Leases below).

Mangrove Areas

There are three distinct areas of mangroves in Sandbrook Inlet, notably adjacent the Dairy Flats area, mid way along the south shore of the Inlet in the vicinity of Salt Pan Creek, and adjacent the SRA land at the east end of the Inlet.

The Department of Agriculture, Fisheries Division recognize that the Brooklyn Waterway is the centre for recreational boating and commercial development on the Hawkesbury River and that it would not be possible to preserve mangrove habitats at all locations along the Inlet. The Fisheries Division consider that it is, however, important to maintain as much mangrove area as possible. In this respect the Fisheries Division consider that it is important to preserve the mangrove area adjacent to the Dairy Flat area, though it would be possible to reduce the size of the mangrove stands at the other locations in the Inlet.

The possible impacts of developments on the mangroves at the Dairy Flat area can be examined in detail at the Development Application stage.

Oyster Leases

There has been a dramatic decrease in oyster production from leases in Sandbrook Inlet. Whilst the preliminary water quality investigations taken as part of this study indicate that generally the water quality in the Inlet is supportive of marine life, there has nonetheless been a decrease in the productivity of these leases in recent times. As noted under the Water Quality section above this may be attributed to high levels of organo-tins from boat anti-foulings, though this is the subject of investigation currently being undertaken by the Fisheries Division.

Through discussions with Fisheries Division officers it has been established that the oyster leases in Sandbrook Inlet are of less significance than other areas of the waterway and it would be possible to reduce the areas of waterway taken by these leases.

The spat catching area in the Brooklyn Boat Harbour is important to the oyster industry and oyster leases in this area should be maintained. It would, however, be possible to relocate an area to an existing lease on the south-eastern corner in order to provide more waterway area for Brooklyn Boat Harbour.
Aboriginal Sites

There are Aboriginal sites within McKell Park consisting of engravings and rock shelters with art. The rock shelters may also contain archaeological deposits. There is also good potential for previously unlocated sites to exist along the southern shores of Sandbrook Inlet, especially where the landscape has been largely unmodified.

Prior to any development, an archaeological survey should be undertaken by a qualified archaeologist and consideration should be given to the possible impacts of development and increased usage on existing sites.

5.2.5 Engineering Issues

The principal engineering issues considered to affect the existing and future development of the Brooklyn Waterway are as follows:

- **Dredging and sedimentation**: the requirement to dredge the waterway to provide improved navigable access.

- **Tidal flushing of Sandbrook Inlet**: the requirement to improve the water quality and possibly reduce siltation in the Inlet.

- **Services provision**: the requirement for additional services compatible with future development.

The importance of these issues and the engineering works that may be required to facilitate development in the Brooklyn Waterway are discussed in the following sections.

**Dredging and Sedimentation**

Due to the high siltation rate within the Brooklyn Boat Harbour (average - 80 mm/year; refer Section 3.8) it has become necessary to undertake maintenance dredging twice in the last 20 years. It will also be necessary to undertake dredging in both Sandbrook Inlet and the Brooklyn Boat Harbour to promote future waterways development.

To reduce the siltation in the Brooklyn Boat Harbour it would be necessary to increase tidal circulation in the Harbour. Engineering works such as the installation of culverts in the SRA causeway may reduce siltation at various locations dependent upon culvert size, and configuration and the existing tidal current patterns. Whilst further engineering investigations would be required, it is not, at this time, considered feasible from both a practical and cost standpoint to implement engineering works to alleviate the siltation problem within the Brooklyn Boat Harbour. It is considered more practical and cost effective to make an overdredge allowance in any future dredging works to accommodate anticipated future siltation and to continue the practice of maintenance dredging.

Siltation rates in Sandbrook Inlet (10 - 20 mm/year, refer Section 3.8) are markedly less than in the Brooklyn Boat Harbour. Based on a review of PWD records and discussions with local residents, it has been established that no maintenance dredging of navigation channels has been undertaken in Sandbrook Inlet. To reduce the siltation rates it would be necessary...
to increase tidal flow circulation in the Inlet. This may be possible with the construction of a culvert through the SRA causeway. However, an engineering investigation, through the use of physical and/or numerical models, should be considered to enable more accurate assessment of the effectiveness of this solution (refer also to Tidal Flushing of Sandbrook Inlet below). The flows from the Inlet may have adverse effects on the important oyster spat catching leases. As for the Brooklyn Boat Harbour it is considered it would be more cost effective to over dredge, as part of any dredging in Sandbrook Inlet, to accommodate future siltation.

**Tidal Flushing of Sandbrook Inlet**

As noted above it may be possible through the construction of culverts in the SRA causeway to improve the flushing efficiency of the Inlet. The existing flushing time is about 3 times shorter than the longest time recommended for canal subdivisions (Reference 18). Therefore flushing rates are acceptable. Consequently, dependent upon the pollutant load, any such culverts would be required to markedly improve the flushing time to result in improved mixing with the host waterbody.

A preliminary qualitative assessment of the possible effects of a culvert suggest that a culvert approximately 7 metres wide constructed to a depth of approximately 15 metres below ISLW (to allow the navigation of small craft) may reduce the Inlet flushing time to one day. It is emphasised, however, that further studies would be required to verify this assessment. It is estimated that a culvert of these dimensions, required for a causeway width of approximately 80 metres, would have a capital cost of approximately $3.0 million. This proposal would also be dependent on the State Rail Authority's approval.

From this preliminary analysis, it is considered that a decrease in flushing time from 1.5 to 1.0 days would not result in a marked improvement in water quality, especially as such improvements would require a capital expenditure of some $3.0 million. To improve water quality it would be preferable to reduce the pollutant load through the control of discharges from developments into the waterway.

**Services Provision**

Any future development of the Brooklyn Waterway may be constrained by the capacity of the existing water supply system and the lack of a mains sewerage system. The principal waterways developments which may be affected by this constraint would be marina or resort type developments. The type of development requirements outlined in Section 4 would not generally be constrained by the lack of these services.

**5.2.6 Social Issues**

The Brooklyn area community is very dependent upon the waterway as both a source of employment, through the oyster industry, boating industry and tourist related services, and as a recreational resource. The community has expressed the need for improved services in Brooklyn, the wish to preserve open space, and the tranquility and beauty of the area, and also to improve access to the waterway.

In keeping with the requirements of the community the waterway development plan should promote development which best serves these needs in balance with the many other demands on the area.
6. WATERWAY DEVELOPMENT PLAN

6.1 GENERAL

Waterway Development Plans are presented in this report for Sandbrook Inlet and for the Brooklyn Boat Harbour. The Brooklyn Boat Harbour is the focus of boating activities in the waterway and currently suffers from severe congestion of waterfront facilities. Consequently consideration has been given to a detailed plan of this area. In this respect two development options have been considered for the Harbour so that the development potential of this important area may be fully examined.

For Mooney Mooney Point, Parsley Bay and Long Island East management strategies are advocated based on the future needs of the area (refer Sections 6.6, 6.7 and 6.8). No detailed development plans have been prepared for these locations.

At Mooney Mooney Point, Lands Department, Gosford City Council and PWD have an interest in the development of this site. Preparation of any plan at this stage would pre-empt current negotiations, however it is suggested that any development include a boat ramp, cruise vessel wharf and public wharf.

The SRA are in the process of negotiating the sale of its land on the eastern end of Long Island to the existing lessee of this area. Hence a development plan is not relevant for this area. However, development of this land would require access along the causeway and would impact on the area allowances for access in the preferred development plan for Brooklyn Boat Harbour. No allowance for impacts relating to the development of the SRA land has been included in this plan.

6.2 PLANNING PRINCIPLES

The Planning Principles for the Brooklyn Waterway and the Brooklyn Boat Harbour are as set out in the following sections. The planning principles identify a possible range of development opportunities to meet the future waterway requirements within the planning framework discussed in Section 5 and provide a guide for specific management strategies and development plans for the main waterway/foreshore areas.

6.2.1 Sandbrook Inlet

The planning principles for the Brooklyn Waterway including Sandbrook Inlet are set out in Figure 15. The main theme of the waterway planning for Sandbrook Inlet is to concentrate development of maritime facilities at certain areas of the waterway and foreshore and to provide open space and open waterway areas as buffers to areas of existing and future developments. These open space areas include the mangrove habitat at Seymours Creek, Brooklyn Park and the Causeway West.

Mooring areas have been concentrated opposite the major development areas with open areas of waterway adjacent to foreshore open space provisions.

A navigation channel would separate the mooring zones and would provide navigable access to the east end of the Inlet.
6.2.2 Brooklyn Boat Harbour

The planning principles for the Brooklyn Boat Harbour are set out in Figure 16. The Boat Harbour is very congested with inadequate land and waterway area for many of the users. Waterfront facilities are concentrated at the head of the Harbour in the vicinity of the Fishermen’s Co-operative and the public wharf.

The principles of the development opportunities presented for the Brooklyn Boat Harbour are to spread future development away from the head of the Harbour either along the SRA causeway or towards the tidal baths in McKell Park. In promotion and development at these locations, it is recognised that road access to these areas would require upgrading and is a key issue in these developments. Similarly, future development would require additional car parking spaces either through the rationalisation of existing areas or provision of new car parks.

The planning principles also suggest a consolidation of the various waterway activities in the Harbour. In this respect, it is possible to provide areas of land and associated waterway for ferry and charter boat services, government facilities, fisheries, and commuter and transient craft facilities.

6.3 SANDBROOK INLET DEVELOPMENT PLAN

6.3.1 General

The development plan for the Inlet is presented in general terms on Figure 15 and has been based on the management strategies advocated in the following sections.

6.3.2 Oyster Industry

The preferred actions include:

- oyster leases be consolidated into smaller waterway areas away from mooring areas and areas of recreational boating activities;

- subject to further investigation, consideration be given to prohibiting the use of certain anti-fouling compounds for vessels mooring in the Inlet;

- the discharge of pollutants from vessels in the Inlet be controlled through the provision of pumpout facilities for sewage and bilge water (refer Section 6.3.4 - Marinas)

6.3.3 Commercial Waterway Activities

The preferred actions include:

- commercial boating activities be concentrated around existing areas and commercial development be in accordance with the planning principles;

- zoning be extended to permit further development of commercial boating facilities around existing areas.

- the development of large cruise vessel facilities not be encouraged within Sandbrook Inlet;
6.3.4 Recreational Boating

Marinas

A demand has been identified for 280 additional marina wet berths in the Brooklyn Waterway in the planning horizon to 1997 (refer Section 4.5.2). The demand may be accommodated by a single marina development and through development of existing marinas. Possible sites for major marina developments in the Brooklyn Waterway are as follows (refer Figure 15):

- Sandbrook Inlet - south of Kangaroo Point
- East end of Long Island
- Parsley Bay

It is proposed to develop a major resort complex south of Kangaroo Point in Sandbrook Inlet incorporating a 380 berth marina and 150 dry storage berths as part of the development. This will thus satisfy the major demand for marina berths in the planning horizon. It is noted that development consent has been given for a 22 berth marina in another location within Sandbrook Inlet. Thus these developments within Sandbrook Inlet would satisfy the demand to 1997.

The potential site at the east end of Long Island would require reclamation to create sufficient land base and possible major protection works to form a sheltered waterway. Further, a marina would restrict the navigable waterway between Dangar Island and Long Island. These aspects would detract from the feasibility of a marina in this location.

The waterway area south of Parsley Bay has potential for marina development, though infrastructure works such as a breakwater, dredging, land reclamation, and the construction of an access road would be required to implement such a development. Also there would be increased traffic through the Brooklyn township as well as past the boat ramp.

At present, this site should be considered as only a long term possibility for a marina proposal and is mentioned to allow this use to be considered in future planning for the area.

The preferred actions include:

- the development of a marina be encouraged at Kangaroo Point and incorporation of sewage and bilge water pumpout facilities,
- future expansion of marinas in Sandbrook Inlet should be undertaken in accordance with the Public Works Department Marina Guidelines, particularly in respect to the provision of onshore facilities,
- the initiation of a water quality monitoring program to regularly assess water quality in Sandbrook Inlet.

Moorings

Based on the planning principles presented in Section 6.2 mooring areas have been defined for Sandbrook Inlet and are shown in Figure 17. The total mooring area provided in the development plan is 11.5 hectares compared with an existing area of 13.8 hectares. Based on the mooring densities for fore and aft moorings it would be possible to supply a total of 345 moorings or a net additional 114 moorings in Sandbrook Inlet. This would not satisfy the demand for 260 additional moorings but is considered to represent the maximum area of moorings consistent with the planning principles. The balance of about 146 moorings
would have to be accommodated where possible in the Parsley Bay mooring area. Some of this demand may be absorbed by the proposed dry storage berth facility at Kangaroo Point.

The preferred actions include:

- swing mooring areas in Sandbrook Inlet be rationalised as shown in Figure 17,
- the total number of moorings in Sandbrook Inlet be increased from 231 to 345 subject to maintenance of acceptable water quality.

Public Wharves and Jetties

To promote access to the waterway, wharves or jetties could be incorporated at the proposed passive recreation areas. These facilities would be suitable for small craft and for recreation pursuits such as fishing.

The preferred actions include:

- a public wharf be located in the east end of Sandbrook Inlet and incorporated in development of a passive recreation area at this location;
- a small public jetty within each foreshore passive recreation area.

Private Jetties

The preferred actions include:

- rationalisation of private jetties and promotion of community sharing structures, along with provision of communal access and removal of derelict jetties;
- the extent of jetty structures in Sandbrook Inlet be restricted to 40 metres from the high water mark. Such a policy would be contingent upon dredging at some locations where there are inadequate water depths for navigation.

6.3.5 Navigation and Dredging Requirements

The preferred actions include:

- dredging of a navigation channel 50 metres wide and 2.3 metres (below ISLW) deep for the full length of Sandbrook Inlet to provide access to boating facilities. A basin be dredged at the eastern edge of the Inlet to provide a turning basin (minimum diameter of 60 m) and recreational craft access to the foreshore of the passive recreation area;
- material from dredge operations to be used as landfill for passive recreation areas or deposited in approved deep water disposal sites in the Hawkesbury River mainstream.

The proposed dredging plan for Sandbrook Inlet is shown in Figure 17.

6.3.6 Non Boating Recreation

The opportunities for open space areas in Sandbrook Inlet are as follows.
Causeway West

This area is currently owned by the State Rail Authority and is well protected from prevailing winds by the railway embankment. The protection afforded by the surrounding landform would provide boating facilities for day trippers who may not be willing to hire boats and use the Hawkesbury River proper. It would also help reduce conflicts with inexperienced boating users on other areas of the waterways.

Pedestrian access to the area would be available from the Hawkesbury River Station by the existing pedestrian bridge and vehicular access from Government Road could be developed. There is potential for further reclamation to the north and development of an accommodation boatel complex. The feasibility of such a proposal would depend on the success of the Kangaroo Point and Long Island East proposed developments. This alternative has not been allowed for in any development plans for this area.

The preferred actions include:

- Development of a waterside park and associated waterway area suitable for informal boating at this location,
- Provision of a wharf/jetty, toilets, picnic and barbecue facilities, small boat launching areas, foreshore walk and parking. Concessions could be let by Council for the operation of canoe, small boat hire and kiosk. Car parking areas would supplement existing parking in the Brooklyn Boat Harbour. A development plan for the Causeway West area is presented in Figure 21.

Brooklyn Park and Quarry Area

These sites are centrally located within Brooklyn and have the potential to be developed to cater for both boating and land based recreation and associated activities. The development of these areas would alleviate much of the traffic congestion around the Brooklyn township and McCullum Park environs.

These sites are the largest areas of generally flat land within Brooklyn and as they are zoned open space 6(a) have the potential to be developed in the short term to increase recreational opportunities as well as improving visual and physical access to the waters edge. The former quarry area has been designated by Hornsby Shire Council as unhealthy building land unsuitable for residential use or use as a caravan park.

The preferred actions include:

- Selective clearing of vegetation and reclamation be undertaken to open views to the waters edge and raise the area north of Brooklyn Road above the high water level,
- Carparking, pedestrian/cycle paths, picnic areas and associated amenities be provided,
- Small public wharves, jetties etc for fishing, casual public mooring of small craft be developed,
- A playing field and/or car park be constructed in the area of the former quarry;
- A well defined pedestrian link between Brooklyn Park and the former quarry across Brooklyn Road be included.
Council would be in a better position to prepare a development plan which achieved the appropriate mix of the above facilities once decisions have been made on the higher priority passive recreation areas of McKell Park and Causeway West Park.

**Mangrove and Dairy Flats areas adjacent to Seymours Creek**

The Mangrove area has the potential to be developed as a tourist attraction with restricted access provided to the mangroves via boardwalks. These boardwalks could be developed as interpretive trails with signs illustrated with information about mangrove ecosystems located at various points.

The Seymours Creek area on the south side of Brooklyn Road, often termed the Dairy Flats, has been used for the deposition of sand reclaimed from Sandbrook Inlet. The site is suited to recreational uses such as picnic areas, golf course, car park, etc. The Dairy Flats was acquired by the State Government for open space purposes and is subject to legal restrictions precluding residential use. However, development of Brooklyn is being hindered by a low permanent population to support a major upgrading of facilities. Therefore, residential development of the Dairy Flats should not be dismissed without a rigorous review of its possible uses.

**The preferred actions include:**

- the mangrove area be developed as a tourist attraction with restricted access provided via boardwalks;
- development of recreational areas on the Dairy Flats be considered.

**Other Parks and Open Space Areas**

**The preferred actions include:**

- maintenance of a public access to the former railway dams area south of Sandbrook Inlet;
- continuation of present management practices for the existing smaller parks and reserves in Sandbrook Inlet.

**6.3.7 Road Access and Parking**

**Road Access**

**The preferred actions include:**

- the upgrading of Brooklyn Road including widening at narrow sections and realignment where possible at tight bends particularly at the western end of the road.

**Parking**

**The preferred actions include:**

- provision of 40 parking spaces along the Inlet to cater for use of craft at private swing moorings;
- incorporation of a total of 80 parking spaces in the development of the passive recreation areas (see Table 4.4).
adoption by the commercial developments of the parking to craft ratios of 0.6 for marinas and 0.2 for moorings,

provision be made west of the causeway for overflow car parking areas to service the Boat Harbour users (see Section 6.5.8)

6.3.8 Services

The preferred actions include:

examination of the capacity of the existing water supply by the Sydney Water Board in respect to the future marina development at Kangaroo Point,

maintenance of existing water quality by discharge of effluent into the Hawkesbury River mainstream subject to the approval of the appropriate government authorities

6.4 BROOKLYN BOAT HARBOUR DEVELOPMENT OPTIONS

6.4.1 General

Two alternative development options have been considered and the principles of the two development options are presented in the following sections. The theme of the options is to develop either along the SRA causeway or along the foreshores of McKell Park. In both options, however, it is considered necessary to accommodate public wharf facilities near to the existing location.

6.4.2 Development Option 1

The Brooklyn Boat Harbour Development Option 1 is presented in Figure 19. In this option future development is concentrated along the SRA causeway. Material dredged from the Harbour would be used to reclaim a land base along the causeway. Dredge material has been used in the past to reclaim areas in McKell Park west of Don’s Boats. Development on the causeway would include port administration including offices, storage and berthing facilities, a mooring jetty for fishing vessels, and associated parking area requirements. An area has been allocated for commercial development of cruise craft facilities. With this option opportunities also exist to develop retail and tourist related services on the causeway. The development along the causeway would be a mix of commercial activities, the fishing industry and port and waterways administration. The commercial activities have in general been located to the south towards the focus of the Harbour whilst other non-commercial facilities have been located together to the north.

To service the development it would be necessary to improve road access along the causeway. The existing roadway would have to be widened to accommodate two way traffic and a pedestrian walkway.

Public wharfage would be developed on the southern end of the causeway. The wharf has been located so as to provide sufficient vessel manoeuvring area in the adjacent waterway.

The Fishermen’s Co-operative is located on freehold land and it is not considered feasible at this time to relocate this development adjacent to the fishing vessel mooring area although this should be a long term planning objective. Fish unloading and fuelling berths have thus been located adjacent to the Co-operative building.
The identified demand for recreational boating visitor berths (Table 4.1) has been accommodated in a facility adjacent to McKell Park in the vicinity of existing boating facilities. Other development in this area includes parking areas. It is noted that there would not be sufficient land area to meet the parking requirements for the Boat Harbour. Whilst it would be possible to create additional land base along the causeway, it is considered this would not make optimum use of land within the Harbour. Consequently, to meet future car parking requirements, space has been allocated in the proposed passive recreation area to the west of the SRA causeway.

6.4.3 Development Option 2

The Brooklyn Boat Harbour Development Option 2 is presented in Figure 20. In this option, future development is concentrated on land reclaimed along McKell Park and the SRA causeway. Commercial development has been located in the McKell Park area and includes the tourist cruise services and berthing facilities, visitor berths and parking areas. Development along the SRA causeway would be related to the fishing industry and port administration and includes a mooring jetty for the Fishermen’s Co-operative, port administration office, storage and berthing facilities, and associated parking requirements.

Public wharfage and the Fishermen’s Co-operative fish unloading and fuelling berth would be developed in the same locations as for Option 1.

To service the development, it would be necessary to improve the road access through McKell Park and along the causeway. For this Development Option, the roadway through McKell Park would be widened by the addition of a second lane to the south of the existing palm trees.

As for Option 1, to meet future parking requirements, it would be necessary to develop parking areas on the proposed passive recreation area to the west of the SRA causeway.

6.4.4 Preferred Development Option

Development along the SRA causeway as represented by Option 1 has the potential for future expansion north along the causeway, though future development in this area would require relocation of oyster lease areas. The tourist services area, located along the causeway, is in close proximity to the Hawkesbury River Railway Station and the proposed parking area (via the pedestrian rail overpass) west of the causeway.

Development of tourist services in McKell Park (Option 2) would promote increased vehicular and pedestrian traffic along the roadway through McKell Park, particularly bus traffic. Future expansion of waterfront facilities along the foreshore of McKell Park would be limited by the tidal baths and lack of land base towards Flat Rock Point. Development at this location would not, however, require relocation of existing oyster leases. Tourist facilities for Option 2 would be relatively remote from the Hawkesbury River Railway Station and the proposed parking area west of the causeway. It would not be as practical to accommodate pedestrian traffic through McKell Park as along the causeway.

In conclusion, it is considered preferable to promote development along the SRA causeway. Development Option 1 has thus formed the basis for the Brooklyn Boat Harbour Development Plan presented in Section 6.5. Further refinements have been made to Option 1 to optimise the development plan. These refinements have included relocation of the port administration facility to McKell Park following a suggestion from the Tourism Commission. This allows a greater degree of flexibility for commercial development of cruise vessel facilities as well as fishing craft facilities on the causeway. The government facilities would not generate significant traffic movements and hence would not conflict with...
other users of McKell Park. Another possibility which has arisen recently is the incorporation of berths and offices for the government authorities within the proposed development of the Hawkesbury River Marina on the site of Don's Boats and Hawkesbury River Boat Hire. Given the number of possibilities, it is preferable that the provision of Government facilities be staged in the following manner:

provide temporary facilities at the visitor berth
give consideration to relocation in medium term to a commercial marina or in long term, to the causeway or McKell Park.

Other changes include rationalisation of the parking layout in McKell Park, and consideration of alternative locations for bus turning circles.

6.5 BROOKLYN BOAT HARBOUR DEVELOPMENT PLAN

6.5.1 General

The preferred Brooklyn Boat Harbour Development Plan is presented in Figure 21. The development plan has been based on the management strategies advocated in the following sections.

6.5.2 Oyster Industry

The preferred actions include:

- relocation of the south-western corner (0.4 ha) of the spat catching leases to facilitate dredging of the waterway and development along the SRA causeway,

- provision of an equal waterway area in an existing lease to the east as compensation for the acquired lease areas.

6.5.3 Fishing Industry

The preferred actions include:

- location of mooring facilities for the fishing fleet to the north of the development along the causeway. Waterway areas would be required to accommodate a single mooring jetty, 36 metres in length, with vessels moored perpendicular to the jetty,

- location of a fish unloading and fuelling berth adjacent to the existing Fishermen’s Co-operative. Waterway area would be required for a berth length of 20 metres,

- provision of land area for gear storage adjacent the mooring jetty. Consideration would have to be given to relocating the Fishermen’s Co-operative adjacent to the mooring jetty.

6.5.4 Commercial Waterway Activities

The preferred actions include:

- allocation of sufficient area for tourist cruise services along the SRA causeway to accommodate two finger piers with an effective berth length of 96 metres,
restriction of the seaward extent of jetty and float construction at the existing boating services facilities to a common boundary compatible with future waterways development,

upgrading of the public wharf to provide a pick-up and set-down berth length of 15 metres for priority use by ferries and water taxis and a mustering area of 0.005 hectares

6.5.5 Recreational Boating

The development along the SRA causeway and adjacent McKell Park would result in the loss of 20 pile moorings. Seventeen additional moorings may be provided at piled moorings adjacent McKell Park, thus a net three moorings would need to be provided. It would not be possible to provide additional moorings in the Brooklyn Boat Harbour. The mooring demand should thus be accommodated where possible in the Parsley Bay mooring area.

The preferred actions include:

- allocation of waterway area for additional 17 pile moorings adjacent McKell Park,
- provision of ten visitor berths adjacent to existing boat services operations. The berths to be administered either by Council or by a commercial operator;
- provision of a pick-up and set-down berth length of 20 metres additional to the ferry berth for use by recreational boaters and by cruise vessels

6.5.6 Navigation and Dredging Requirements

The preferred actions include:

- maintenance of a navigation channel with a minimum width of 45 metres and a 50 metre diameter turning circle,
- provision of a minimum dredge depth for the navigable waters within the Harbour of 3.0 metres below ISLW

6.5.7 Non Boating Recreation

The preferred actions include:

- maintenance of the tidal baths in McKell Park;
- vehicular access arrangements and car parking be formalised,
- reclamation be undertaken to provide more land base to service tourists and users of the Boat Harbour;
- the foreshore around Flat Rock Point be improved to provide a better pedestrian link and access to the waters edge for fishing,
- a promenade be developed along the eastern side of the causeway to extend the length of accessible foreshore and provide access to the popular fishing areas at the eastern end of Long Island
6.5.8 Road Access and Parking

Road Access

Hornsby Shire Council has development plans for a bus turning circle to be located at the northern end of Dangar Road adjacent to the Fishermen's Co-operative. It would also be possible to locate turning circles either north of the proposed development along the causeway or opposite the Hawkesbury River Railway Station in the vicinity of the disused retail establishment. Any of these alternatives would allow development of the McKell Park area for passive recreation and additional car parking spaces.

A turning circle located opposite the Railway Station would increase the distance tourists would be required to walk to the tourist cruise vessels. A turning circle located north of the proposed development on the causeway would increase bus and large vehicle traffic along the length of roadway.

Access to McKell Park, would be required to the proposed location of the government facilities and to the parking areas. The majority of additional parking areas would however be provided west of the causeway (refer below). Consequently traffic into McKell Park is not anticipated to increase markedly. It is not considered necessary, therefore, to upgrade the access roadway in this area at this time.

The preferred actions include:

- sealing of the access road to the causeway and widening to a minimum width of 7 metres,
- preparation by Hornsby Shire Council of a plan of management for the vehicular access to the area and consider alternative locations for turning circles along the causeway, in McKell Park (at the end of Dangar Road), or adjacent the Hawkesbury River Railway Station.

Parking

The preferred actions include:

- provision of a minimum of 117 car parking spaces within the vicinity of the Brooklyn Boat Harbour,
- inclusion of a minimum of 125 car parking spaces within the proposed passive recreation area west of the causeway to cater for the remainder of the future demand at the Boat Harbour,
- inclusion of another 12 car parking spaces within the Causeway West Park to cater for passive recreational use of this area (Table 4.4) bringing the total minimum requirement to 137 spaces.

6.5.9 Services

The preferred actions include:

- investigation of the capacity of the existing water supply by the Water Board in respect to the future development along the SRA causeway,
maintenance of existing water quality by disposal of effluent into the Hawkesbury River mainstream downstream of Flat Rock Point subject to the approval of the appropriate government authorities

6.5.10 Government Facilities

The preferred actions include:

a jetty for mooring of the MSB, Fisheries Division and Water Police craft be located, in the short term, adjacent to the proposed reclaimed land in McKell Park *(four berths would be provided on the end of the visitor berth jetty)*;

offices and a storage compound for the above authorities be located adjacent the mooring jetty on an area of about 0.02 hectares.

in the medium term, consider relocation of government facilities within a commercial marina,

in the longer term, assess the relative merits of the government facilities remaining within a commercial marina or being located on either the causeway or in McKell Park

6.6 MOONEY MOONEY DEVELOPMENT PLAN

The preferred actions include:

development of a 6 lane boat ramp at Mooney Mooney Point with a minimum of 180 car and trailer parking spaces. This would include the existing single lane ramp;

allocation of land and waterway area at Mooney Mooney Point for a large cruise vessel berth,

provision of a wharf/jetty in the proposed development at the Point to improve public access to this important waterway.

6.7 PARSLEY BAY DEVELOPMENT PLAN

The preferred actions include:

optimum use of the waterway to accommodate excess demand for recreational craft moorings *(146 by 1997)*,

in the longer term, examine the feasibility of a marina development in the Parsley Bay area.

6.8 LONG ISLAND DEVELOPMENT PLAN

The preferred actions include:

maintenance of the current restricted access arrangements to Long Island Nature Reserve to assist the conservation of this area,
provision of the following for any development of the eastern end of the island
- support improved access to the waterway,
- improve road access along the causeway,
- consider allocating an appropriate area for the possible development of a deep draft slipway (refer Section 4.4.6)

6.9 MECHANISMS FOR DEVELOPMENT IMPLEMENTATION

6.9.1 Infrastructure Cost Estimates

Cost estimates have been prepared for the following major infrastructure works in Brooklyn Boat Harbour, Sandbrook Inlet and at Mooney Mooney Point. The costs have been given in 1988 dollars. The proposed works at each location have been divided into phases to permit staging of construction and details are included in Appendix E. It was assumed the proposed Kangaroo Point tourist development would be developed with private capital and the marina berths provided would satisfy demand up to 1997.

A description of the works included in each phase is given below and conceptual details are shown for the Brooklyn Boat Harbour and Causeway West Park on Figure 21.

**Brooklyn Boat Harbour**

Phase 1 - $2.3 million
- Provision of new public wharf and parking on the reclaimed land east of the SRA causeway. The government facilities and berth would be relocated to reclaimed land adjacent M^2^Kell Park. An area is allocated for commercial development of the cruise vessel facilities.

Phase 1a - $1.5 million
- Excludes the boardwalk and government administration building and berths from Phase 1. A demountable building would serve as temporary accommodation until funds were available to build a permanent structure. Berths would be provided at the end of the visitor berth jetty.

Phase 2 - $0.3 million
- Improvements to M^2^Kell Park, parking and roads.

**Sandbrook Inlet**

Phase 1 - nil
- Rationalisation of moorings to fore an aft where possible.

Phase 2 - $1.2 million
- Sufficient dredging of navigation channel to provide landfill for Causeway West Park and provision of parking within the park.

Phase 3 - $1.0 million
- Sufficient dredging of navigation channel to provide landfill for Brooklyn Park. Improvement of Brooklyn Park with landscaping, timber jetties and better waterway access.

Phase 4 - $2.5 million
- Dredging of navigation channel to Causeway West Park. Improve Causeway West Park with landscaping, jetty, and improved waterway access.
Mooney Mooney Point

Phase 1 - $0.4 million  - Provision of a 3 lane boat ramp, incorporating the existing ramp, parking, landscaping and picnic facilities
Phase 2 - $0.4 million  - Duplication of Phase 1
Phase 3 - $0.5 million  - Construction of a cruise vessel berth jetty

6.9.2 Staged Development

There is the possibility of implementing a staged development which would improve the feasibility of funding such works from the various limited sources of capital. To establish an appropriate timing of the various phases detailed above, each phase was allocated a priority based on the need or demand for the facilities and the practicality of combining the phases.

The priorities established were.

<table>
<thead>
<tr>
<th>Priority</th>
<th>Site</th>
<th>Phase</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority 1:</td>
<td>Sandbrook Inlet</td>
<td>Phase 1</td>
<td>Immediate 1</td>
</tr>
<tr>
<td></td>
<td>Mooney Mooney Point</td>
<td>Phase 1</td>
<td>2</td>
</tr>
<tr>
<td>Priority 2:</td>
<td>Brooklyn Boat Harbour</td>
<td>Phase 1a</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Sandbrook Inlet</td>
<td>Phase 2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Brooklyn Boat Harbour</td>
<td>Phase 1</td>
<td>4</td>
</tr>
<tr>
<td>Priority 3</td>
<td>Sandbrook Inlet</td>
<td>Phase 3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Brooklyn Boat Harbour</td>
<td>Phase 2</td>
<td>6</td>
</tr>
<tr>
<td>Priority 4:</td>
<td>Mooney Mooney Point</td>
<td>Phase 4</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Sandbrook Inlet</td>
<td>Phase 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mooney Mooney Point</td>
<td>Phase 3</td>
<td></td>
</tr>
</tbody>
</table>

Phase 1 works at Sandbrook Inlet which consist of converting moorings to a fore and aft configuration, where possible, could be implemented immediately with no capital costs. These works would provide about an additional 114 moorings to cater for excess demand.

Mooney Mooney Point provides the only sufficiently wide expanse of flat foreshore land on which to establish a major boat ramp facility in the area. A six lane ramp which incorporates the existing lane would provide improved waterway access compared to some of the sub-standard ramps in the area and would cater for demand to 1997. The improved boat launching facilities would be constructed in two phases, consisting of three lanes and associated facilities in each phase.

The highest priority need within the Boat Harbour is the conflict in waterway and land usage in the south western corner. In this area the cruise, fishing, and recreational craft vie for manoeuvring area in the harbour while patrons suffer a severe lack of parking and access to the waterway. In staging improvements to this corner, additional land area is required to achieve a sufficient spread of activities. Therefore in Phase 1 all the dredging and landfill would be undertaken making it necessary to provide new berths for the fishing vessels and an area for relocation of the cruise vessel facilities. Also the new unloading facilities for the fishing vessels would be constructed.

It is critical that parking be provided in the Causeway West Park to enable these relocated facilities to operate effectively. Parking would be constructed in Phase 2 (Sandbrook Inlet).
but further park improvements would be left for a later stage. The cost of the initial improvements within the Boat Harbour could be reduced by delaying the construction of the pedestrian boardwalk and government authorities building. A temporary demountable building could be provided initially (Phase 1a) for the government authorities along with berths on the visitor jetty. It is recommended that Phase 1a be implemented initially as the deletions are not critical to the effectiveness of the Phase 1 Boat Harbour improvements. Also, it would allow the possible relocation of government facilities, in the medium term, to the proposed Hawkesbury River Marina on the site of Don's Boats and Hawkesbury River Boat Hire.

Phase 3 (Sandbrook Inlet) would significantly improve the access to the waterway with the completion of Brooklyn Park. Also, with dredging of the navigation channel, larger recreational craft could reach the park, wharf and other facilities.

The remaining phases could be constructed as funds permit or as demand for the facilities is verified.

Hence, assuming Phase 1 Sandbrook Inlet would proceed immediately and not rely on capital funds, the recommended staging of works and estimated costs are indicated in the table below.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cost $M</th>
<th>Phases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.4</td>
<td>Mooney Mooney Point</td>
</tr>
<tr>
<td>2</td>
<td>2.7</td>
<td>Boat Harbour Sandbrook Inlet Phase 1a</td>
</tr>
<tr>
<td>3</td>
<td>1.8</td>
<td>Boat Harbour Sandbrook Inlet Complete Phase 1</td>
</tr>
<tr>
<td>4</td>
<td>0.3</td>
<td>Boat Harbour Phase 2</td>
</tr>
<tr>
<td>5</td>
<td>0.4</td>
<td>Mooney Mooney Point Phase 2</td>
</tr>
<tr>
<td>6</td>
<td>2.5</td>
<td>Sandbrook Inlet Phase 4</td>
</tr>
<tr>
<td>7</td>
<td>0.5</td>
<td>Mooney Mooney Point Phase 3</td>
</tr>
</tbody>
</table>

The suggested relative timing of the above stages is not meant to be fixed especially if opportunities arise which may accelerate the development with significant cost savings.

6.9.3 Source of Funding

The infrastructure works for development in the Brooklyn Waterway may be funded by various combinations of State Government and Council programs and private developers. The possible sources of funding for the works have been identified in the following sections. It would be necessary to make application to the relevant government authorities to ascertain the extent of funding available for these works under the appropriate programs.
State Government Programs

(a) NSW Waterways Program

The NSW Waterways Program has been initiated to enhance the quality and number of recreational boating facilities in NSW. The Waterways Program addresses these needs through a capital works program administered by the Public Works Department and through a user management program administered by the Maritime Services Board. Capital works projects funded under the Program include mini ports, boat launching ramps, marinas, waterway improvements such as dredging, and public wharves. Boat launching ramps, waterways improvements and public wharves require a 25 percent financial contribution from the local authority.

For the proposed developments in both Sandbrook Inlet and the Brooklyn Boat Harbour opportunities exist for funding of many of the proposed facilities. Such works include:

- **Mini Ports Development** (wholly funded by the State Government)
- **Waterways Improvements** (funded to 75 percent by the State Government)
- **Public Wharves** (funded to 75 percent by the State Government)
- **Boat Ramps** (funded to 75 percent by the State Government)
- **Aids to Navigation** (wholly funded by the State Government)

For the proposed developments in both Sandbrook Inlet and the Brooklyn Boat Harbour opportunities exist for funding of many of the proposed facilities. Such works include:

- works including capital dredging and reclamation, roadways and site landscaping (applicable to Brooklyn Boat Harbour Development)
- works including dredging and reclamation, provision of foreshore improvements such as landscaping, parking, and other access related facilities (applicable to dredging navigation channels in Sandbrook Inlet and the passive recreation areas at Brooklyn Park, Causeway West Park and M‘Kell Park)
- works including construction of public wharves including navigation dredging in the immediate vicinity of the wharf (applicable to public wharf structures in Sandbrook Inlet, Brooklyn Boat Harbour and at Mooney Mooney Point)
- includes the boat ramp at Mooney Mooney Point
- provides day and night marks of channels and hazards to navigation
(b) **Fishing and Government Facilities Program**

This Program supports the commercial fishing industry by constructing and maintaining port facilities in keeping with the needs of the NSW fishing fleet. The program provides for major infrastructure capital works including the construction of breakwaters, training walls, mooring jetties, car parks, and power and water supplies. It is not the policy of the Program to provide or maintain fishing or fish handling equipment or slipways.

For the proposed development in the Brooklyn Boat Harbour opportunities exist for partial funding of dredging and land reclamation in the vicinity of the fishing vessel mooring jetty and the fish unloading and fuelling berth, and for establishing parking areas for use by the fishermen, that is in the vicinity of the proposed mooring jetty. Funding may also be available for construction of the fishing vessel mooring jetty.

The Fishing and Government Facilities Program also provides for the design and construction of State Government water related facilities and associated infrastructure.

Opportunities exist for funding of the proposed mooring jetty, port administration building, storage compound, parking areas and surrounding landscaping in McKell Park to provide facilities for MSB, Fisheries and Water Police.

(c) **Roads Programs**

Hornsby Shire Council may make application to the Department of Main Roads (DMR) for funding assistance in the construction and upgrading of certain roads. Such programs include the Urban Local Roads Program, for which full funding is available from the DMR for qualifying roads, Special Works Subsidy for which funding to 50 percent of the construction costs for qualifying roads is available from the DMR, and the Tourist Roads Program.

Under the Tourist Roads Program the road for which funding is sought must be designated as a tourist road, which in general would be a road leading to a scenic spot or point of interest. Upon ministerial approval funding for such road construction or improvement would be shared equally between Council and the DMR. Hornsby Shire Council is in the DMR Blacktown Division which includes Baulkham Hills Shire, Blacktown City, Hawkesbury Shire, Hornsby Shire and Penrith City. Within these areas only one tourist road exists.

It should be noted that the report in no way commits the NSW Government or any instrumentality to the implementation of any or all of the works described above.

**Private Development**

Funding may be available from private developers for commercial development and associated infrastructure works. A number of entrepreneurial opportunities may exist to lure private funding of the improvement works. The SRA is organising the sale of a parcel of land at the east end of Long Island. As part of any future development in the area the developer could be required to contribute to any costs for the upgrading and future maintenance of the access road along the causeway.

For the proposed Kangaroo Point tourist complex, any surplus dredge material could be placed in the proposed area for the Causeway West Park. This would assist to reduce improvement costs for the park. Also on either of the Causeway West or Brooklyn Parks,
developers may be enticed to undertake formation of the park for either use of part of the parkland or land elsewhere for commercial purposes.

The sediments proposed to be dredged from Sandbrook Inlet for the navigation channel contain considerable quantities of saleable sand (pers comm Mr A C Leard, Lands Dept). Hence the navigation channel dredging could be offered by tender to contractors and royalties used to offset costs of landfill improvements.

Another possibility may be that the reclaimed land on the foreshores of McKell Park, available following Stage 2 works, could be used for commercial purposes in return for road and park improvements. The commercial usage could be designed in such a way as to allow free public access to the foreshore.

An area has been allocated for cruise vessel facilities. The provision of the land and waterway area at an attractive rental could be an avenue for attracting commercial development of these facilities.

6.9.4 Summary

The recommended development plans for the Brooklyn Boat Harbour, Sandbrook Inlet and Mooney Mooney Point detail a strategy for catering for the existing and future needs of the fishing industry, commercial and recreational craft, tourists and local residents. The strategy generally involves planning and works to rationalise existing and future facilities into common areas with improvement of other areas to enable use to their full potential. A feasible program for staging of works has been formulated on an assessment of need and practicality for the division of works. This assessment was subjective and should be reviewed with time to assess if the premises for deciding the need for facilities has changed. There are a number of possible sources of funds for the recommended works including local and State government and private developers. As such, the works are feasible and should result in significant benefits to the fishing industry, boat users, local commercial activities, tourists and the local economy.
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FIGURE 1

STUDY AREA
(SEE FIGURE 2)

MAIN NORTHERN RAILWAY

PACIFIC HIGHWAY

SWANSEA
Lake Macquarie

Tuggerah
Lake

GOSFORD

BROOKLYN

ASQUITH
HORNSBY

WINDSOR BRIDGE

SYDNEY
Port Jackson

Broken Bay
Palm Beach

Botany Bay
Port Hacking

NEwCASTLe
NOTES
1 ALL DEPTH CONTOURS ARE IN METRES BELOW INDIAN SPRING LOW WATER.
1:40 000 AUS CHART 204 BASED ON R.A.N. SURVEYS TO 1952, CORRECTED TO 1986, AND P.W.D. SURVEYS TO 1954.
DISTANCE UPSTREAM FROM HAWKESBURY RIVER ENTRANCE AT BROKEN BAY
FIGURE 5

NOTE
ALL DEPTH CONTOURS ARE IN METRES
BELOW INDIAN SPRING LOW WATER

BROOKLYN BOAT HARBOUR
LAYOUT OF EXISTING FACILITIES
FIGURE 6

HAWKESBURY RIVER FISHERMEN'S CO-OPERATIVE FISH AND PRAWN PRODUCTION
BROOKLYN WATERWAY
EXISTING OYSTER LEASES AND OYSTER DEPOTS

FIGURE 7
TOTAL OYSTER PRODUCTION IN NEW SOUTH WALES 1931-1985
PEAT Is.

MOONEY MOONEY POINT

KANGAROO POINT

Sandbrook Inlet

Hawkesbury River

Prominent Island

Hawkesbury River Railway

ALISON POINT

FIGURE 12

LITTLE WOBBY BEACH

Legend

Prominent vegetation

Prominent landforms

Major vantage points

BROOKLYN WATERWAY VISUAL FEATURES
FIGURE 14

WATER SUPPLY SYSTEM SERVICING THE BROOKLYN WATERWAY
Brooklyn Boat Harbour
Planning Principles

**Legend**
- **Planning Precincts**
- **Highway/Prescribed Land**
- **Residential/Land Bridge Required**

**Existing Facilities**
- Government facilities
  - Recreational, fishing, and water police
  - Information and administration building
- Existing jetties
  - Marine works (existing or renewed)
- Fisherman's cooperative jetty
  - Open and upgrade as appropriate
- Tourist ferries
  - Consider provision of additional ferry berths and mooring facilities
- Public wharf
  - Upgrade and extend park facilities
- Road access to Long Island
  - Open and upgrade existing road

**Other Considerations**
- Support functions
  - Servicing, Kingsford, and public services
- Signboards
- Adjacent commercial and industrial areas

**Development**
- Consider development of existing business
- Provide advertising and residential
  - Parking of commuters
  - Improve car parking
- Land use review
  - Consider adjunct facilities

**Tourist Ferries**
- Consider provision of dedicated ferry berths and mooring facilities

**Commuter Runabout Berths**
- Consider provision of dedicated berth

**Tidewater**
- Support and upgrading as appropriate

**Figure 16**

**Legend**
- **Planning Precincts**
- **Highway/Prescribed Land**
- **Residential/Land Bridge Required**

**Existing Facilities**
- Government facilities
  - Recreational, fishing, and water police
  - Information and administration building
- Existing jetties
  - Marine works (existing or renewed)
- Fisherman's cooperative jetty
  - Open and upgrade as appropriate
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  - Consider provision of additional ferry berths and mooring facilities
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- Consider provision of dedicated ferry berths and mooring facilities

**Commuter Runabout Berths**
- Consider provision of dedicated berth

**Tidewater**
- Support and upgrading as appropriate

**Figure 16**
FIGURE 17

MOORING FREE AREAS TO ENHANCE VIEWS FROM PASSIVE RECREATION AREAS

NAVIGATION CHANNEL DREDGE, ELEVATION 23m BELOW NGW

PROPOSED FORE AND AFT MOORING AREAS

KANGAROO POINT TOURIST DEVELOPMENT LEASE

SANDBROOK INLET
PROPOSED NAVIGATION CHANNEL AND MOORING AREA
FIGURE 19

BROOKLYN BOAT HARBOUR
DEVELOPMENT OPTION 1
APPENDIX A

BROOKLYN AND SURROUNDING COMMUNITIES

A.1 Population Characteristics

Whilst population growth has declined (Table A.1), there has been an increase in the number of occupied dwellings in the Brooklyn area, in comparison with the Asquith/Brooklyn Precinct as a whole. Data from the 1981 census indicates that 13 percent of the population of the Brooklyn area is aged over 65. Figures for Asquith/Brooklyn Precinct and Hornsby Shire Council are 5.7 and 10 percent respectively.

Home ownership within the Brooklyn area at 41 percent is significantly higher than other areas within the Asquith/Brooklyn precinct which average 25 percent. The head only and head and spouse only family type represents some 60 percent of households within the Brooklyn area compared with 35 percent in the other areas of the Asquith/Brooklyn precinct and 44 percent in Hornsby Shire generally. Some 39 percent of the Brooklyn area population are in the work force compared to 42.5 percent of the population in other areas of the Asquith/Brooklyn Precinct, (Reference 2).

Some 52 percent of the workforce walk, take the train, bus or ferry to work. This compares to 42 percent of the workforce using similar transportation modes in the other areas of the Asquith/Brooklyn Precinct.
### TABLE A.1  
**ASQUITH/BROOKLYN - POPULATION TRENDS AND PROJECTIONS**

<table>
<thead>
<tr>
<th></th>
<th>Brooklyn Area</th>
<th>Asquith/Brooklyn Precinct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>including Dangar Island</em></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1. Census Population</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td>NA</td>
<td>16464</td>
</tr>
<tr>
<td>1971</td>
<td>1166</td>
<td>21256</td>
</tr>
<tr>
<td>1976</td>
<td>1282</td>
<td>24675</td>
</tr>
<tr>
<td>1981</td>
<td>1185</td>
<td>26626</td>
</tr>
<tr>
<td>1986*</td>
<td>1276</td>
<td>29798</td>
</tr>
<tr>
<td>Average Annual Growth Percent (76-81)</td>
<td>- 1.5</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>2. Occupied Dwellings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td>270</td>
<td>5863</td>
</tr>
<tr>
<td>1976</td>
<td>272</td>
<td>6824</td>
</tr>
<tr>
<td>1981</td>
<td>324</td>
<td>7606</td>
</tr>
<tr>
<td>1986*</td>
<td>350</td>
<td>8512</td>
</tr>
<tr>
<td>Average Annual Growth % (96-81)</td>
<td>3.6</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>3. Population Projections</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential zones (<em>hectares</em>)</td>
<td>30</td>
<td>118</td>
</tr>
<tr>
<td>Potential Allotments (<em>Dwellings</em>)</td>
<td>270</td>
<td>1965</td>
</tr>
<tr>
<td>Planning Horizon</td>
<td>**</td>
<td>1987-95</td>
</tr>
<tr>
<td>Additional Population at 3.5 persons/dwelling</td>
<td>945</td>
<td>6880</td>
</tr>
</tbody>
</table>

* Estimates based on new dwelling, commencement past 1981 census

** Maximum population for area zoned residential

*Source*  Hornsby Shire Council
APPENDIX B

WATER QUALITY

B1  WATER QUALITY CRITERIA

B1.1  State Pollution Control Commission

In 1980 the State Pollution Control Commission (SPCC) published an atlas classifying certain waterway areas in New South Wales (Reference 12). Although the lower Hawkesbury estuary is not classified in this publication, general descriptions of the various classes of waterway would suggest that a classification of "Protected Waters" be appropriate for Sandbrook Inlet as well as perhaps for Parsley Bay while "Controlled Waters" might be suitable for the Brooklyn Boat Harbour. Discharges of effluents into Protected Waters are limited to those with a quality similar to that required as a "raw" source of potable water, while for Controlled Waters, discharges are permitted subject to approved treatment for the removal of contaminants and to adequate dilution of the discharge being available in the receiving waters.

B1.2  Scales and Alach (1981)

Water quality criteria have been recommended by Scales and Alach for canal estate developments providing mainly recreational boating facilities. These developments might possibly accommodate fishing and swimming (Reference 13). Although these criteria are likely to be more stringent than those required for the Brooklyn Waterway, they are considered indicative of acceptable water quality (refer Table B.1).

B1.3  Commonwealth Department of the Environment and Conservation

In 1974 the Commonwealth Department of the Environment and Conservation published a report compiling Australian water quality criteria for recreational uses, domestic water supplies, and freshwater and marine aquatic life (Reference 14). Recommended water quality criteria for supporting estuarine aquatic life for water quality parameters assessed in the field investigation are presented in Table B.2.
TABLE B.1  RECOMMENDED WATER QUALITY CRITERIA FOR CANAL ESTATE DEVELOPMENTS (REFERENCE 13)

Physical Factors

(a) Colour - reduction in light penetration not greater than 10% of normal

(b) Water temperature - protection of aquatic life can be ensured if water temperatures within 2°C of normal are maintained

(c) Turbidity - Secchi Disc Visible at minimum depth of 1.2 m

Dissolved Gases

(i) Oxygen
   - Absolute Minimum 4 mg/l
   - Recommended Minimum 5 mg/l

(ii) Carbon Dioxide - no direct standard

Nutrients

<table>
<thead>
<tr>
<th></th>
<th>Total Phosphorous</th>
<th>Maximum 0.5 mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrates</td>
<td>maximum 4 mg/l</td>
<td></td>
</tr>
</tbody>
</table>

Micro Organisms

Maximum 50 - 200 Faecal Coliform Organisms/100ml

Biochemical Oxygen Demand

BOD₅ - 3 mg/l Maximum

Hydrogen Ion Concentrations (pH)

6.5 to 8.3

Salinity

Sea Water 35,000 mg/l

Chlorophyll 'a'

10 g/l Maximum
TABLE B.2 RECOMMENDED WATER QUALITY CRITERIA FOR SUPPORTING ESTUARINE AQUATIC LIFE
(Reference 14)

Temperature

Not permitted to increase by greater than $2^\circ\text{C}$ over normal temperature due to artificial heat sources

pH

pH changes in marine waters in excess of 0.2 from normal values should be investigated for the cause of change

Suspended Solids

Although there are insufficient data available to allow quantitative criteria for finely divided (suspended) solids to be established to ensure the protection of Australian freshwater, estuarine and marine life information available for European freshwater fish suggests waters with non-filterable residue (suspended solids) concentrations below 80 mg/l should be capable of supporting moderate to good fisheries

Dissolved Oxygen

Concentrations sufficient to enable the organisms to survive, reproduce and grow adequately be 6.0 mg/l, except when temporary natural variations cause this value to be decreased

Toxic Metals

<table>
<thead>
<tr>
<th>Element</th>
<th>Concentration at which further investigation should commence (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium (Cd)</td>
<td>0.01</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>0.01</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>0.02</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>0.01 to 0.1</td>
</tr>
</tbody>
</table>

Note: With regard to assessing potential adverse impacts of toxic metals on oyster growth, an officer of the Fisheries Institute of the Department of Agriculture, NSW advised the investigation of these metal elements (pers comm 7 9 87)
B2 WATER QUALITY INVESTIGATIONS

Water Clarity

Throughout the Brooklyn Waterway, water clarity, as measured by light penetration (%t) and Secchi Disc reading (metres), was ascertained as being worse than that recommended for canal estate developments. This is ascribed to high turbidity resulting from the heavy rainfall experienced over the Hawkesbury-Nepean catchment in the weeks preceding the field investigation (refer to ‘Weather’ description on result sheets - Appendix B). Nevertheless, water clarity in Sandbrook Inlet (sampling stations 2, 3 and 4) was in fact better than that in the main Hawkesbury river channel (sampling stations 5 and 6).

It is noted that bottom water light transmission measurements at stations 4 and 5 should be disregarded. Samples obtained at these locations are considered to have been contaminated with bottom sediment.

Suspended Solids

The concentrations of suspended solids (SS) in surface waters are important primarily because of their effects on light penetration. The inhibition of light penetration restricts primary production. It is reported that virtually no light is transmitted beyond a depth of 0.08 m when SS concentrations reach 150 mg/l.

Surface water SS values throughout the Brooklyn Waterway as measured by this investigation did not exceed 18.3 mg/l (measured at station 5 - Hawkesbury River channel opposite Peat Island). This value is substantially lower than the recommended criteria for supporting estuarine aquatic life of 80 mg/l.

From a total of twenty-four SPCC observations conducted within the main Hawkesbury River channel passing through the Brooklyn Waterway (1979-1981), a mean SS concentration of 6 mg/l was determined. The higher levels measured by this investigation are ascribed to the substantial suspended sediment load following wet weather.

Water Temperature and Salinity

Water temperatures throughout the Brooklyn Waterway were shown to vary between 14.7°C and 15.9°C, a range acceptable for the protection of aquatic life (Reference 14). Although the normal (September) water temperatures for the Brooklyn Waterway could not be ascertained, the absolute and range of temperatures measured are considered to be satisfactory.

As would be expected in an estuarine environment, particularly given the preceding wet weather, salinity was found to increase with depth. A relatively substantial salinity gradient was found in the Brooklyn Boat Harbour but not deemed to be of concern. Poorly stratified water detected at the eastern end of Sandbrook Inlet is indicative of vertical mixing, a useful mechanism for maintenance of water quality.
Most surface fresh waters have a nearly neutral pH of 7. At the sea surface, pH normally varies from 8.0 to 8.3 depending on the partial pressure of CO$_2$ in the atmosphere, and the salinity and temperature of the water (Reference 14). Since in the water quality investigation salinity increased with depth, it is consistent to note that pH also increased with depth.

The measured pH values ranged from 8.26 to 8.65 with the higher values just above recommended values (Table B.1) No long term records were available to test for acceptable deviations from normal levels However, measured values would seem acceptable for oyster production as it has been noted that "oysters appear to survive best in brackish waters when the pH is about 7.0", and that "oyster larvae are reportedly killed in a few hours at pH 9.1" (Reference 14).

Dissolved Oxygen

Oxygen is a basic requirement for all forms of life In Reference 14 comment is made that "for protection of estuarine ecosystems, it is essential that the dissolved oxygen (DO) concentrations be sufficient to enable organisms to survive, reproduce and grow adequately". It is further stated that "any reduction of DO can reduce the efficiency of oxygen uptake by aquatic animals and hence reduce their ability to meet the demands of their environment"

The results of this investigation show DO levels to be quite satisfactory throughout the Brooklyn Waterway (ie 7.3 to 8.0 mg/l compared with a minimum requirement of 6 mg/l). As might otherwise be expected at the end of a tidal backwater, no significant depression in DO levels were indicated toward the eastern end of Sandbrook Inlet.

From a total of twenty-four SPCC observations conducted within the main Hawkesbury River channel passing through the Brooklyn Waterway (1979 - 1981), a mean DO saturation of 92% was determined with the 16 and 84 percentile values measured as 85% and 99% respectively (Reference 15). Besides a single bottom water measurement from the sampling location in the middle of Sandbrook Inlet, all of the field measurements taken during this investigation lie within this range.

Nutrients

The over enrichment of a waterbody by nutrients can result in its eutrophication - a process characterised by blooms in aquatic plants, reduced water clarity, and low DO levels. The major impact on the Brooklyn Waterway would be a general reduction in natural beauty and amenity uses. The impact on oyster productivity would also be adverse (Reference 14).

The nutrient concentrations as presented in the tables below are given as molecular concentrations (in micro-moles/litre). The molecular concentrations of the nitrogen and phosphorus compounds need to be multiplied by 14 and 31 respectively to yield equivalent mass concentrations (in micro-grammes/litre) in order that direct comparisons might be made with the recommended maximum in Tables B.1 and B.2.

The maximum measured mass concentration of total phosphorus (TP) and nitrates (NO$_3$) was 0.15 mg/l and 0.13 mg/l respectively, notably values 30% and 3% respectively of the recommended canal estate maxima. This is therefore quite satisfactory even without accounting for the increased nutrient loads anticipated during wet weather.
Although the nutrient criteria are easily satisfied, total nitrogen concentrations within Sandbrook Inlet are typically indicated as being 50% higher than those outside in the main Hawkesbury River channel.

A comparison of the available 1979 to 1981 SPCC data (Reference 15) with the data from this investigation indicates no adverse increase in nutrient concentrations within the main Hawkesbury River channel.

**Chlorophyll-a**

Chlorophyll-a is the green pigment within plants. The concentration of chlorophyll-a in water "is a measure of phytoplankton standing crop - ie. the amount of plant-life in the plankton at the time of sampling".

Chlorophyll-a concentrations throughout the Brooklyn Waterway as measured by this investigation satisfy the recommended water quality criteria for canal estate developments. Even so, the chlorophyll-a concentration measured at the eastern end of Sandbrook Inlet (7 mg/l) is approximately double that measured elsewhere in the study area.

SPCC measurements for the main Hawkesbury River channel passing through the study area conducted between 1979 and 1981 (Reference 15) indicate a mean chlorophyll-a concentration of approximately 7 mg/l. The measurements taken in the main river channel for this investigation show concentrations approximately half this value.

**Toxic Metals**

Conservative toxic metals, particularly those that may be accumulated by the Sydney Rock Oyster, are of great concern to water quality in Sandbrook Inlet. Low concentrations of such metals in the waterbody are not necessarily indicative of low levels in the estuarine environment. It is the total content in the ecosystem rather than the existing measured concentration that is important. Nevertheless, Reference 14 recommends indicative limiting concentrations for toxic metals at which further investigation should commence (refer Table B.2). Although no data regarding the impact of toxic metals on the Sydney Rock Oyster is available, an officer of the Fisheries Institute (Department of Agriculture, NSW) recommended assessing cadmium, copper, lead and zinc concentrations (pers. comm. 7/9/87). The measured concentrations of toxic metals in the Brooklyn Waterway were below levels for which further investigation is recommended.

The most common active toxin present in boat-hull anti-fouling coatings is copper. A more recent product which is reputed to be more effective and longer lasting (ie more toxic) utilises tri-butyl tin oxide (TBTO) as the active toxin.

Scientific literature has only recently begun to address the aquatic toxicity of TBTO, a substance shown to have had "detrimental effects" on the Pacific Oyster industry in France (Reference 16) and in fact TBTO has been banned in the UK and Europe. Measurement of TBTO concentrations requires highly specialised equipment which is presently being developed by the Fisheries Institute.
TABLE B.3 
TOXIC METAL CONCENTRATIONS MEASURED IN THE BROOKLYN WATERWAY

<table>
<thead>
<tr>
<th>Metal</th>
<th>Detection Limit (mg/l)</th>
<th>Maximum Measured Concentration (mg/l) and Sample Location</th>
<th>Further Investigation Required (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium</td>
<td>0.01</td>
<td>&lt;0.01 throughout</td>
<td>No</td>
</tr>
<tr>
<td>Copper</td>
<td>0.001</td>
<td>0.004 Bottom water, centre of Sandbrook Inlet</td>
<td>No</td>
</tr>
<tr>
<td>Lead</td>
<td>0.03</td>
<td>&lt;0.03* throughout</td>
<td>No</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.03</td>
<td>&lt;0.03 throughout</td>
<td>No</td>
</tr>
</tbody>
</table>

* The lead concentration presented for the surface water in the main Hawkesbury channel opposite Peat Island is considered incorrect.

Cadmium, copper, and zinc concentrations are shown to be below the maximum recommended concentrations in Table B.2. Although the detection limit for lead is above the maximum recommended concentration in Table B.3, communications with the Fisheries Institute (pers. comm. 26/10/87) suggest that, in the Sydney area in general, lead accumulations in oysters are not excessive. It would appear therefore that the toxic metal concentrations in the Brooklyn Waterway are sufficiently small at present to not adversely impact on water quality.

B3 TIDAL FLUSHING AND MIXING

True flushing time for Sandbrook Inlet can only be established fully using mathematical or physical modelling techniques. These analysis techniques were outside the study brief. Rather, a simple analytical method, the so-called Tidal Prism Method, has been used to calculate the lower limit flushing time $t_f$.

True flushing time has then been qualitatively interpreted in terms of flushing efficiency.
The lower limit flushing time $t_l$ is given by

$$t_l = \frac{T(V + P)}{P} \quad \text{(days)}$$

where $t_l$ = flushing time (days)

$T$ = tidal period (days)

$V$ = low water volume (m$^3$)

$P$ = tidal prism (m$^3$)

Given that the approximate length, breadth and depth of Sandbrook Inlet are 2.5 kilometres, 350 metres and 20 metres respectively and assuming an average tidal range of 1.1 metres with a tidal period of 12.3 hours, then the lower limit of flushing time equals approximately 1.5 days.

The true flushing time is equal to this lower limit flushing time divided by a flushing efficiency. For a flushing efficiency of 100%, true flushing time equals the lower limit value. Flushing efficiency increases with:

- increasing tidal penetration from the host water body (*Hawkesbury River*), through the ventilating channel, to the contained water body (*Sandbrook Inlet*),

- increasing wind, wave and riverine flow induced mixing over the flood tidal cycle,

- enhanced capacity of the host water body to remove the ejected ebb tidal waters from the entrance areas so as to limit their re-introduction on the next flood tide.

Based on flow continuity through water area sections across the width of Sandbrook Inlet, it has been estimated that average tidal penetration would extend between 1.0 and 1.5 kilometres into Sandbrook Inlet or approximately half its length. Although mixing and removal of ejected ebb tidal waters from the entrance area have not been specifically quantified for Sandbrook Inlet, the extensive topographic wind-funnelling observed along the length of the Inlet (refer Section 3.6), and the fact that a major flowing river exists immediately outside the ventilating channel, both would contribute to providing a high flushing efficiency.
APPENDIX C
ZONING AND LAND USE

C.1 Hornsby Planning Scheme

<table>
<thead>
<tr>
<th>Zone and General Location</th>
<th>Development permitted with Council Consent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Residential</strong></td>
<td></td>
</tr>
<tr>
<td>Residential 'A1' 2(a1)</td>
<td>One dwelling house per allotment</td>
</tr>
<tr>
<td>Dangar Island</td>
<td></td>
</tr>
<tr>
<td>Residential 'A2' 2(a2)</td>
<td>One dwelling house per allotment, boatsheds and other purposes directly associated with fishing or oyster farming, child care centres, educational establishments, open space, places of worship, professional consulting rooms, flats/units of not more than two storeys construction for aged persons, utility installations and associated car parking</td>
</tr>
<tr>
<td>Generally each side of</td>
<td></td>
</tr>
<tr>
<td>Brooklyn road, village</td>
<td></td>
</tr>
<tr>
<td>of Brooklyn and escarpment</td>
<td></td>
</tr>
<tr>
<td>south of village of</td>
<td></td>
</tr>
<tr>
<td>Brooklyn</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Business</strong></td>
<td></td>
</tr>
<tr>
<td>General Business 3(a)</td>
<td>Shops <em>other than drive-in take away shops</em> not exceeding 1,000 square metres floor space and commercial premises not exceeding 1,500 square metres floor space, dwelling houses/flats used in conjunction with shops or commercial premises</td>
</tr>
<tr>
<td>Properties adjacent to</td>
<td></td>
</tr>
<tr>
<td>Brooklyn Road and Bridge</td>
<td></td>
</tr>
<tr>
<td>Street and those fronting</td>
<td></td>
</tr>
<tr>
<td>Dangar Road</td>
<td></td>
</tr>
</tbody>
</table>
Special Business 3(b)  
Properties between foreshore and access road to tidal baths  
Child care centres, clubs, commercial premises, dwelling houses used in conjunction with commercial premises, hotels, motels, open space, parking, places of assembly, public buildings, refreshment rooms, residential flat buildings above or attached to commercial premises, wholesale markets

Neighbourhood Business 3(c)  
Dangar Island  
Shops in a building or group of buildings to be used wholly or partly as dwelling houses and dwellings attached to and used in conjunction with such shops, open space, parking

Special Business 3(d)  
Kangaroo Point  
Boat launching ramps, boat sheds, caravan parks, hotels, kiosks, motels, open space parking, picnic grounds, service stations

Special Uses  
Special Uses 'A' 5(a)  
Private and public schools and church on Brooklyn Road and MWS&DB reserve on Dangar Island  
The particular purpose and purposes incidental or subsidiary to the main purpose and open space

Special Uses 'B' 5(b)  
Railways - Great Northern Railway and associated land extending from the Pacific Highway in the east to Long Island  
Any purpose
Open Space

Open Space Existing
Recreation 6(a)
Generally land south of
Great Northern Railway,
Long Island Nature Reserve
foreshore reserves and
parks

Showgrounds, agriculture,
buildings for the purpose
of bush fire hazard
reduction, gardening or
landscaping, caravan parks,
forestry, recreation areas

County Open Space
Escarption above
Brooklyn and area
adjacent to Mangroves
at Seymours Creek

Reserved for County Open
Space - development
permitted only with
consent.

C.2 Gosford City Council

Zone and General Location

Development permitted with
Council Consent

Special Uses

Special Uses 'A' 5(a)
Mooney Mooney Point
each side of the Freeway
including Peat Island

Mental Hospital and
purposes incidental or
subsidiary to the main
purpose and open space

Open Space Recreation 6(a)
Mooney Mooney Point
West of Freeway, Spectacle
Island Nature Reserve and
various other foreshore
areas and islands

Any purpose authorised by
Division 2 or 3 of
Part XIII of the Local
Government Act,
racecourses, showgrounds,
sports grounds,
agriculture, caravan parks,
drainage, forestry, mineral
sand mines, roads, utility
installations (*other than
gas holders or generating
works*)

Scenic Protection

Scenic Protection
Residential 7(c6)
Foreshore areas at Cogra
Bay, Little Wobby Beach

Agriculture, dwelling
houses, parks and gardens,
public and other reserves,
roads, utility
installations
APPENDIX D
ADMINISTRATION AND MANAGEMENT

The roles of the government agencies responsible for the administration and management of the Brooklyn Waterway are described below.

D.1 Hornsby Shire Council

The Brooklyn Waterway and foreshores are located within the Hornsby Shire Council area. The Council is responsible for all local planning, the provision and maintenance of infrastructure including roads and parking areas, and public facilities such as parks, swimming enclosures etc. The Council is also responsible for the maintenance of waterfront structures such as wharves and jetties. Through the establishment of the Hornsby Planning Scheme, the Council may control the development on foreshore lands. The Hornsby Shire Council administers the Brooklyn area through Council offices located in Hornsby.

D.2 Public Works Department

The Public Works Department is responsible for the development and implementation of public capital works throughout the State. Through the NSW Waterways Program, the Fishing Ports Program and the Government Facilities Program, the Department is responsible for development and construction of recreational boating and fishing port facilities on a statewide basis. Such works include public wharves and jetties, boat ramps, nearshore works such as dredging and reclamation and onshore works such as port administration facilities. The Brooklyn Waterway is under the jurisdiction of the Metropolitan North Regional Office.

D.3 Department of Lands

The Department of Lands own and administer all NSW Crown lands and waterways. The Department administers development on the waterway through the issuing of permissive occupancies and administration of leasing of Crown lands and has general guidelines for the siting of over water facilities (refer Section 3.17). Permissive occupancies are granted for both public and private facilities.

D.4 Maritime Services Board

The Maritime Services Board (MSB) is the owner and port authority responsible for the management and development of the State's four commercial ports at Port Jackson, Botany Bay, Newcastle and Port Kembla. It is also the responsible navigation authority for waterways throughout the State.

The boating services division of the MSB is responsible for the administration of all boating activities in the State. This work includes establishing and maintaining navigation aids, the registration of vessels and moorings, allocation and management of moorings, issuing of aquatic licences and review of permissive occupancies with respect to boating use and safety aspects.

The Hawkesbury River is under the jurisdiction of the North/Western regional area. The regional office is located in Hornsby.
D.5 Gosford Shire Council

The centrelne of the main channel of the Hawkesbury River approximates the local government boundary between Gosford City Council and Hornsby Shire Council.

The roles of Gosford City Council are the same as that described for Hornsby Shire Council (refer Section E.1). In particular the Council is responsible for the maintenance of waterfront facilities such as the Mooney Mooney Boat Ramp.

D.6 Department of Planning

The Department of Planning (DOP) is responsible for the preparation of Regional Environmental Plans and State Environmental Planning Policies. The Minister for Planning is responsible for the gazettal of Local Environmental Plans prepared by local government.

The DOP is responsible, through the establishment and implementation of statewide planning policies for the direction of development throughout the Hawkesbury River. Any development at Brooklyn would thus be required to be within the framework of DOP planning policies for the Hawkesbury River and environs.

D.7 Department of Main Roads

The Department of Main Roads is responsible for the planning and development of highways throughout the State. The F3 Sydney Newcastle freeway is under the control of the DMR. Whilst the DMR is not responsible for the development or maintenance of the Brooklyn Road, funds for such development may be available under the DMR Roads Programs.

D.8 State Rail Authority

The State Rail Authority of NSW (SRA) is responsible for the management, development and construction of the State Railways. Through ownership and management of the rail right of way, including the causeway, the Hawkesbury River Station and associated land base, the SRA has a major impact upon future development of both the Brooklyn Boat Harbour and Sandbrook Inlet. The SRA, as land owner lease areas of railway land and hence the SRA property management section based in Sydney, has a direct input into future management of SRA foreshore areas. In addition the SRA has recently implemented a policy of disposing of surplus railway lands and is organising the sale of a portion of land at the east end of Long Island.

D.9 National Parks and Wildlife Service

The National Parks and Wildlife Service is responsible for the maintenance and control of National Parks throughout the State. The northern border of the Ku-ring-gai Chase National Park extends to just south of Brooklyn. Long Island west of the SRA railway line and Spectacle Islands are nature reserves whilst the Muogamarra Nature Reserve extends to just west of the F3 Freeway. The NPWS through its management of these areas has an impact upon the future use and development of the area. The NPWS administers the park and nature reserves surrounding the Brooklyn Waterway through the Northern Metropolitan office at Bobbin Head.
D.10 Water Police

A police station is located in the Brooklyn Township and is manned by seven officers. In addition to normal police duties the station also polices the Hawkesbury River between Spencer and Cowan Creek. All of the seven officers stationed in Brooklyn have been trained in water police work.

D.11 Department of Agriculture, Fisheries Division

The Department of Agriculture, Fisheries Division is responsible for the supervision of the fishing and oyster industries in the Brooklyn Waterway. Work undertaken by the Fisheries Division includes the policing of the fishery and enforcement of regulations, control of licensing of fishing and fishermen, fishing advisory service and resource management including the preservation of fishing habitats. The Fisheries Division also control the granting of oyster leases. Development of the Brooklyn Waterway which would impact upon the fishing and oyster industries would require consultation with the Fisheries Division.

D.12 State Pollution Control Commission

The State Pollution Control Commission (SPCC) is responsible for establishing and controlling environmental standards for existing and proposed developments throughout the State. The SPCC is responsible for granting statutory approval aspects of future developments such as dredging and land reclamation, treatment and disposal of waste waters and the treatment and disposal of sewage. Thus the Commission would have an input into the implementation of any proposed developments.

D.13 Department of Sport and Recreation

The Department of Sport and Recreation is responsible for the administration and promotion of sporting and recreational activities throughout the State. The Department has established 12 fitness camps in the State to supplement school activities and promote field studies and the fitness camp at Little Wobby is one such facility.

D.14 Tourism Commission

The Tourism Commission was formed to stimulate economic and social benefits for NSW through the development and promotion of tourism. As a function of this role the Commission provides assistance and encouragement to the private sector in the development of tourist facilities. The Commission is thus keen to promote other possible tourist related waterfront developments. In this respect the Tourism Commission is the government authority responsible for promoting the development of a marina and hotel complex south of Kangaroo Point at the western end of Sandbrook Inlet and has appointed a developer for the proposal.
APPENDIX E
COST ESTIMATES

Costs given below are based on conceptual development plans and hence are approximate only. Costs do not generally include building development or for provision of services. The costs are based on 1988 dollar values. A 15% allowance for investigation, design and construction supervision costs and a 25% contingency allowance have been included.

Brooklyn Boat Harbour

**Phase 1** Provision of public wharf, parking, road improvements, dredging and provision of berths and building for government authorities

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dredging</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- landfill</td>
<td>25,000 m$^3$</td>
<td>$3.00/m$^3$</td>
<td>75,000</td>
</tr>
<tr>
<td>- deep water disposal</td>
<td>30,000 m$^3$</td>
<td>$4.50/m$^3$</td>
<td>135,000</td>
</tr>
<tr>
<td><strong>Landfill and Grading</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25,000 m$^3$ @ $1.50/m$^3</td>
<td></td>
<td></td>
<td>38,000</td>
</tr>
<tr>
<td><strong>Bunds and Rock</strong></td>
<td>430 m</td>
<td>$900/m</td>
<td>387,000</td>
</tr>
<tr>
<td><strong>Dredging</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>220 m x 4 m @ $500/m$</td>
<td>440</td>
<td></td>
<td>440,000</td>
</tr>
<tr>
<td><strong>Public Wharf</strong></td>
<td>35 m x 5 m @ $1,000/m$</td>
<td>175,000</td>
<td></td>
</tr>
<tr>
<td><strong>Road Improvements</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- causeway road</td>
<td>300 m</td>
<td>$400/m</td>
<td>120,000</td>
</tr>
<tr>
<td>- turning circle</td>
<td>30 m x 20 m @ $40/m$</td>
<td>24,000</td>
<td></td>
</tr>
<tr>
<td><strong>Parking</strong></td>
<td>35 spaces @ $1,200</td>
<td>42,000</td>
<td></td>
</tr>
<tr>
<td><strong>Government Facilities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- administration building</td>
<td>15 m x 10 m @ $1,000/m$</td>
<td>150,000</td>
<td></td>
</tr>
<tr>
<td>- berths at jetty</td>
<td>20 m x 2 m @ $400/m$</td>
<td>16,000</td>
<td></td>
</tr>
<tr>
<td><strong>Investigation, Design &amp; Supervision (I,D,S,)</strong></td>
<td></td>
<td></td>
<td>$1,602,000</td>
</tr>
<tr>
<td>15%</td>
<td></td>
<td></td>
<td>240,000</td>
</tr>
<tr>
<td>Contingency 25%</td>
<td></td>
<td></td>
<td>400,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>$2,242,000</td>
</tr>
<tr>
<td>say</td>
<td></td>
<td></td>
<td>$2.3 million</td>
</tr>
</tbody>
</table>
Phase 1a  
Phase 1 with deletion of boardwalk and use a demountable building for the government office facilities

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demountable Building</td>
<td>$20,000</td>
</tr>
<tr>
<td>Visitor Berths</td>
<td></td>
</tr>
<tr>
<td>- jetty</td>
<td>$28,000</td>
</tr>
<tr>
<td>- mooring piles</td>
<td>$10,000</td>
</tr>
<tr>
<td>Boardwalk</td>
<td>$440,000</td>
</tr>
<tr>
<td>Administration Building</td>
<td>$150,000</td>
</tr>
<tr>
<td>Berths at Jetty</td>
<td>$16,000</td>
</tr>
<tr>
<td>Phase 1 cost</td>
<td>$1,602,000</td>
</tr>
<tr>
<td>I,S,D 15%</td>
<td>$160,000</td>
</tr>
<tr>
<td>Contingency 25%</td>
<td>$265,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1,479,000</strong></td>
</tr>
<tr>
<td>say</td>
<td>$1.5 million</td>
</tr>
</tbody>
</table>

Phase 2  
Improvement of Mckell Park, parking, road improvements and visitor berths

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Improvements</td>
<td></td>
</tr>
<tr>
<td>- Mckell Park</td>
<td>$40,000</td>
</tr>
<tr>
<td>- additional road</td>
<td></td>
</tr>
<tr>
<td>opp Co-op</td>
<td>$24,000</td>
</tr>
<tr>
<td>Parking Facilities</td>
<td></td>
</tr>
<tr>
<td>90 spaces @ $1,200</td>
<td>$108,000</td>
</tr>
<tr>
<td>I,S,D 15%</td>
<td>$26,000</td>
</tr>
<tr>
<td>Contingency 25%</td>
<td>$43,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$241,000</strong></td>
</tr>
<tr>
<td>say</td>
<td>$0.3 million</td>
</tr>
</tbody>
</table>
Sandbrook Inlet

Phase 1  Rationalisation of moorings to fore and aft where possible

Phase 2  Sufficient dredging to provide landfill for the Causeway West Park and partial improvement to navigation, access road and parking

Dredging
- mobilisation/
demobilisation  item  50,000
- landfill  70,000 m³ @ $3.00/m³  210,000

Causeway West Park
- landfill and grading  70,000 m³ @ $1.50/m³  105,000
- access road  500 m @ $400/m  200,000
- parking facilities  140 spaces @ $1,200  168,000
cars  800 m² @ $35/m²  28,000
- landscaping  0.5 ha @ $100/10m²  50,000
  (carpark only)
  L.S.D 15%
  Contingency 25%  811,000

Total  $1,135,000

say  $1.2 million

Phase 3  Landfill and improvements to Brooklyn Park

Dredging
(navigation channel in Inlet)
- mobilisation/
demobilisation  item  50,000
- landfill  65,000 m³ @ $3.00/m³  195,000

Brooklyn Park
- landfill and grading  65,000 m³ @ $1.50/m³  98,000
- landscaping  1 ha @ $200/10m²  200,000
- parking facilities  30 spaces @ $1,200  36,000
- timber jetties  3 off 20 m x 2 m  @ $400/m²  48,000
  (3 small jetties)
- interpretative  800 m @ $50/m  40,000
  trails

L.S.D 15%
Contingency 25%  667,000

Total  $934,000

say  $1.0 million
**Phase 4** Complete dredging of navigation channel to Causeway West Park and improve Causeway West Park

Dredging *(navigation channel to Causeway West Park)*
- mobilisation/demobilisation  
- deep water disposal  
- landscaping  
- public wharf  
- dinghy launching ramp and storage area  
- interpretative trails

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>item</td>
<td>260,000 m³</td>
<td>$4.50/m³</td>
<td>50,000 m³</td>
<td>$1,170,000</td>
</tr>
<tr>
<td>item</td>
<td>2 ha</td>
<td>$200/m²</td>
<td>2 ha</td>
<td>$400,000</td>
</tr>
<tr>
<td>item</td>
<td>30 m x 2 m</td>
<td>$600/m²</td>
<td>20,000 m²</td>
<td>$120,000</td>
</tr>
<tr>
<td>item</td>
<td>1,000 m</td>
<td>$50/m</td>
<td>1,000 m</td>
<td>$50,000</td>
</tr>
<tr>
<td>item</td>
<td></td>
<td></td>
<td></td>
<td>$1,726,000</td>
</tr>
</tbody>
</table>

I,S,D 15%  
Contingency 25%  
Total $2,417,000

Mooney Mooney Point

**Phase 1** Develop a 3 lane boat ramp incorporating the existing ramp and a minimum of 90 car and trailer parking spaces

Concrete ramp, roads, landscaping, amenities building, and picnic facilities

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 lanes</td>
<td>$80,000/lane</td>
<td>240,000</td>
<td></td>
</tr>
<tr>
<td>I,D,S 15%</td>
<td>$35,000</td>
<td>60,000</td>
<td></td>
</tr>
<tr>
<td>Contingency 25%</td>
<td>$335,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total $335,000

say $0.4 million

**Phase 2** Develop a duplicate 3 lane boat ramp as in Phase 1

Total $335,000

say $0.4 million
<table>
<thead>
<tr>
<th>Phase 3</th>
<th>Provision of berth for cruise vessel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jetty</td>
<td>20 m x 3 m @ $6,000/m^2*</td>
</tr>
<tr>
<td></td>
<td>L.D,S 15%</td>
</tr>
<tr>
<td></td>
<td>Contingency 25%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>say</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>$505,000</td>
</tr>
<tr>
<td></td>
<td>say</td>
</tr>
<tr>
<td></td>
<td>$0.5 million</td>
</tr>
</tbody>
</table>

* based on facility at Windsor