MANDURAH CHANNEL DREDGING

DEPARTMENT OF MARINE AND HARBOURS

Report and Recommendations by the Environmental Protection Authority

Parts 1, 2 and 3

Department of Conservation and Environment
Western Australia

Bulletin 231 August 1986

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Report and Recommendations

by the

Environmental Protection Authority

Part 1

Department of Conservation and Environment

Western Australia

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PREFACE

The proposals to dredge the Mandurah Channel and its vicinity fall into three distinct segments. Each of the three proposals has a different objective, has been costed separately by the Department of Marine and Harbours, and has different environmental issues to address. The timetabling of the three proposals is also different.

The Authority has decided to carry out the assessment in three phases in order to accommodate the dredging timetable of the Department of Marine and Harbours and to ensure that the purposes of the proposals are clarified. The three Authority reports will be as follows:

1. a report addressing the dredging of a navigable channel through the entrance sand bar. This is the subject of this report. ((a) on Figure 1).

2. a report to be prepared within a few weeks addressing the dredging of Fairbridge Bank and the Ocean Entrance. ((b) on Figure 1).

   This will follow provision of additional information by the proponent.

3. a report to be prepared within months addressing the dredging of Sticks and Porpoise Channels. ((c) on Figure 1). More detail is required from the proponent, particularly on the nature of spoil disposal.

Following the preparation of the third report, the three reports will be combined and issued as a single report.

1. INTRODUCTION

The Public Environmental Report (PER) on the Mandurah Channel Dredging provided a brief description of a proposal to dredge Fairbridge Bank and the Ocean Entrance commencing late 1985, and a proposal to dredge the Sticks Channel/Porpoise Channel in Peel Inlet.

The PER did not address the dredging of a navigable channel through the ocean sandbar which is normally carried out as part of the Department of Marine and Harbours' annual maintenance programme. The Authority makes comment on this proposal only as it is seen as part of the total package of dredging operations.

This assessment report addresses only the dredging of a navigable channel through the sandbar.

2. THE PROPOSAL

The Department of Marine and Harbours will be providing a navigable channel through the ocean entrance sandbar as part of its annual maintenance programme. (Figure 2).

That Department has indicated that approximately 12 to 15 000 cubic metres of material will be removed using a dragline situated on the end of the breakwater. The material removed wil be stockpiled to the south of the training wall for removal, probably at some later date. In previous years the stockpiled material has been trucked through the town and disposed of on the northern beaches.

3. ASSESSMENT

3.1. BIOLOGICAL IMPACTS

The dragline dredging is designed to create a void in the sand which supplies the bar, so that over a period of a few weeks a channel will form. Because dredging only in the surf zone is involved there will be no significant biological impacts from the dredging exercise itself.

In previous years the dredge spoil material was disposed of on the northern beaches, and biological impacts were minimal.

3.2. LOCAL ISSUES

Any impacts of the proposed disposal on the northern beaches can be adequately managed by liaison between the Department of Marine and Harbours and the Local Authority.

4. CONCLUSIONS

The ocean dredging is a regular maintenance operation which is necessary for the safety of the boating public.

The Authority believes that this proposal will not have any significant biological impacts. Local impacts can be managed by liaison between the Local Authority and the Department of Marine and Harbours.

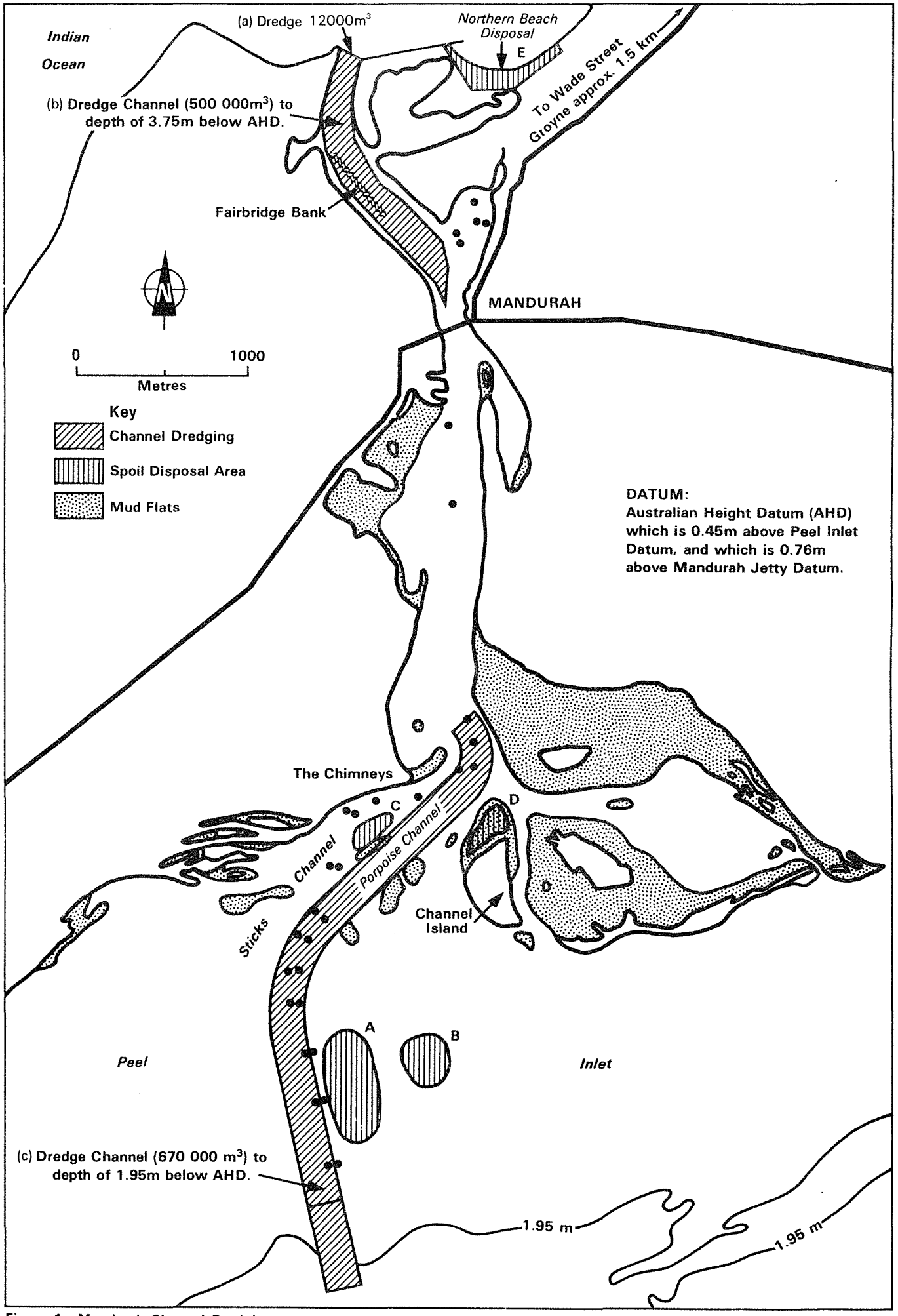

Figure 1 Mandurah Channel Dredging

MANDURAH CHANNEL DREDGING

DEPARTMENT OF MARINE AND HARBOURS

Report and Recommendations
by the
Environmental Protection Authority

Part 2

Department of Conservation and Environment
Perth, Western Australia
Bulletin No 231 November 1985

PREFACE

The proposals to dredge the Mandurah Channel and its vicinity fall into three distinct segments. Each of the three proposals has a different objective, has been costed separately by the Department of Marine and Harbours, and has different environmental issues to address. The timetabling of the three proposals is also different.

The Authority has decided to carry out the assessment in three phases in order to accommodate the dredging timetable of the Department of Marine and Harbours and to ensure that the purposes of the proposals are clarified. The three Authority reports will be as follows:

1. a report addressing the dredging of a navigable channel through the entrance sand bar. This was covered in the Part 1 report issued in October, 1985, ((a) on Figure 1).

2. a report addressing the dredging of the Fairbridge Bank and the Ocean Entrance which is the subject of this report ((b) on Figure 1).

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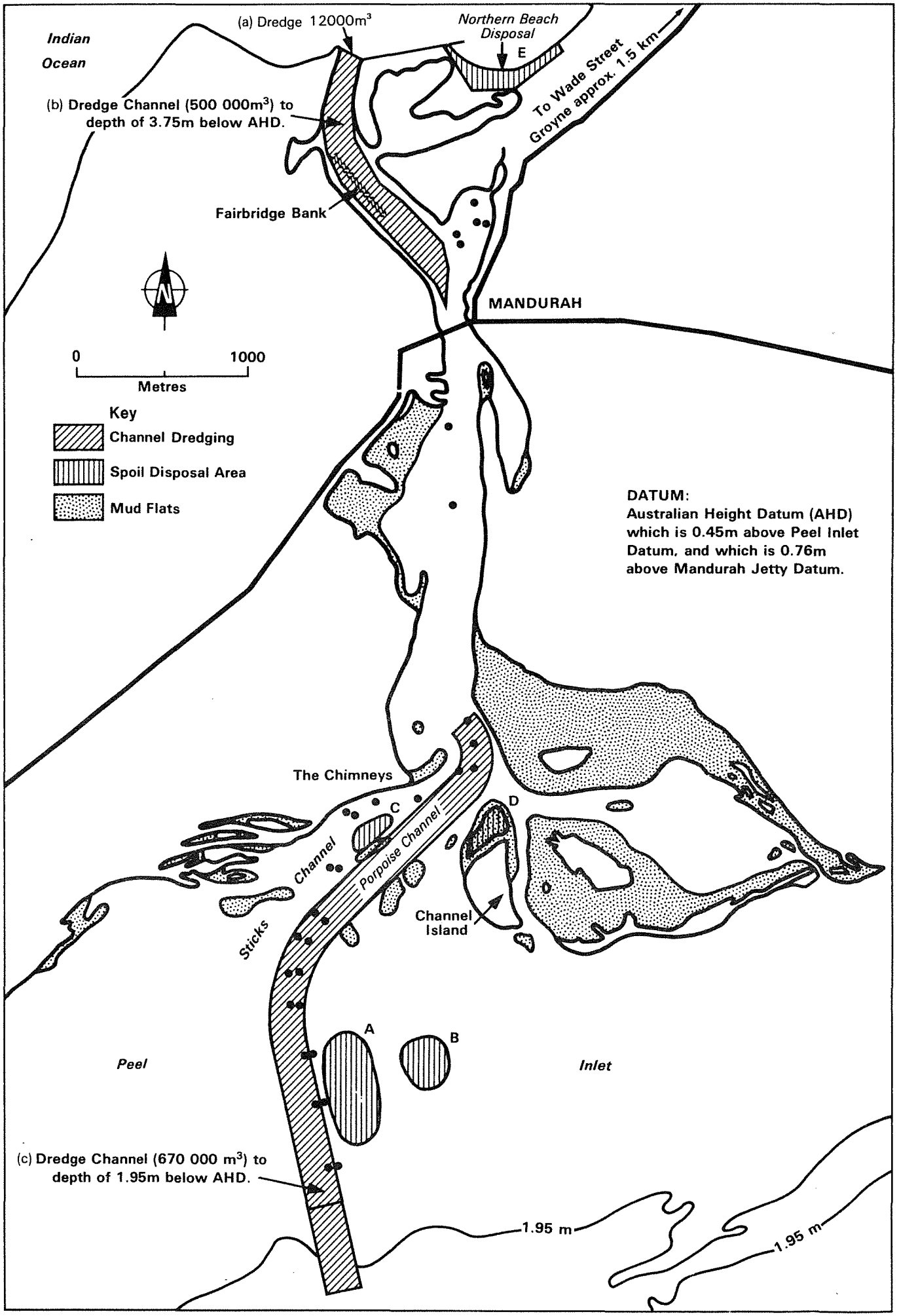

Figure 1 Mandurah Channel Dredging

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1. SUMMARY AND RECOMMENDATIONS

The Authority has assessed the biophysical and socio-environmental effects of the dredging of the Fairbridge Bank and Ocean Entrance channel at Mandurah and has found them to be acceptable. The Authority does not favour the spoil disposal method outlined in the Public Environmental Report and makes the following recommendation (for discussion, see Section 5 of this assessment report):

RECOMMENDATION 1

The EPA recommends that the gross amount of spoil to be disposed of should be reduced by maximising use of dredge spoil in areas requiring fill. Disposal of material excess to these requirements should meet the following criteria:

- **stockpiles should only be constructed as short-term storage and must not create a nuisance from sandblasting;**
- **disposal should not involve transportation by vehicles along the beaches;**
- **disposal on the beaches should not occur during the peak-use, summer periods;**
- **any marine disposal should preferably not occur over seagrass or reef and preferably occur in the surf zone in an area to the northeast of the Mandurah Channel;**
- **disposal should be carried out in such a way as to facilitate beach replenishment.**

2. INTRODUCTION

The Public Environmental Report (PER) on the Mandurah Channel Dredging provided a brief description of a proposal to dredge Fairbridge Bank and the Ocean Entrance, commencing late 1985, and a proposal to dredge the Sticks Channel/Porpoise Channel in Peel Inlet to commence March 1987, for completion in March 1988.

This assessment report addresses only the dredging of the Fairbridge Bank and Ocean Entrance (the downstream end of the channel). The Public Environmental Report indicates that the proposal would consist of dredging and disposal of 500 000 cubic metres of material from the Fairbridge Bank and Ocean Entrance. The work would cost $ 2 320 000 (in 1985 dollars).

A total of 11 written submission was received during the public review period. The Authority has considered all these in the preparation of its Assessment Report, wherever relevant. The Authority made itself available to receive oral submissions from the public by being

available in Mandurah on 2 October, 1985. A list of all individuals making submissions is given in the Appendix.

3. THE PROPOSAL

The aim of the proposed dredging works discussed in the Public Environmental Report is to improve the navigability of the Mandurah Channel and to assist in the marine flushing of Peel Inlet. However, there would be virtually no improvement to the flushing of Peel Inlet unless the Sticks Channel dredging is also carried out. When the choke at the Mandurah Channel entrance end and the choke at the Sticks Channel end are both removed the improvement in flushing will result from increased flows through the Channel of 24 to 30% (summer) and 10 to 40% (winter). In the long term these dredging works could contribute to a reduction in the growth of the large floating weed in Peel Inlet. It would appear that there would be minimal benefit to flushing of Peel Inlet from the dredging of Fairbridge Bank and the ocean entrance alone. In order to realise a significant improvement in the water quality of Peel Inlet, dredging at both ends of the entrance channel would be required.

3.1 DREDGING OPERATIONS

A total of 500 000 cubic metres of material would be dredged from this section using a floating, cutter suction type dredge. Other plant would be lengths of large diameter pipeline including floating, submerged and land pipe sections. In-line booster pumps could be required to provide the capacity to dispose of spoil over long distances.

The dredge would operate for at least 10 hours per day, six days per week from late December 1985 through to February, 1987.

3.2 DREDGE SPOIL DISPOSAL

The 500 000 cubic metres to be dredged consists of fine to medium-grained sands near the Mandurah traffic bridge, through to medium to coarse-grained sands near the entrance.

The method of spoil disposal described in the PER would be to pump spoil directly to an area near the ocean marina where it would be temporarily stored in bunded stockpiles up to 3 metres high. It would then be moved by trucks or scrapers and dispersed along the northern beaches, as far as Wade Street groyne, to replenish the beaches.

3.3 LIFETIME OF THE PROPOSAL

Fairbridge Bank has built up as a result of incursions from the ocean and will recur unless this is managed. Sand by-passing is one method of management.

4. IMPACT ASSESSMENT

4.1 BIOPHYSICAL IMPACTS

4.1.1 Turbidity

Loss of clarity of water (muddying of water) during dredging would occur but effects would be transient as the sediment would rapidly sink. Water clarity would be restored within a time frame of minutes to a few hours after cessation of dredging. Impacts from increased turbidity would effect organisms. Although many estuarine organisms are adapted to some variation in turbidity, prolonged turbid conditions could be detrimental. Potential effects of turbidity on organisms are:

- reduction of photosynthesis in plants;
- abrasion damage to gills of some aquatic organisms;
- temporary loss of fish from some areas as they move to non-turbid areas;
- reduction of available food supply to carnivores because of reduced visibility; and
- damage to organisms in non-dredged areas by smothering with settling sediment.

In the case of the Fairbridge Bank and Ocean Entrance dredging all these impacts would be geographically constrained and would be temporary in nature and not of major significance.

4.1.2 Impacts on Fish and Crustaceans

The Mandurah Channel is the migration route for a large suite of migratory species that make use of the Estuary for part of their life cycles.

There are two main sources of potential disturbance from dredging, namely:

- avoidance of disturbed area, and short-term behavioural changes by migrating organisms because of noise and physical disturbance; and
- entrainment by the dredge of adult and larval fish and crustaceans.

Figure 2 shows the migration patterns of the major commercial fish and crustaceans over their annual cycles. This illustrates that it would be impossible to avoid impingement on migrating species during a protracted dredging operation such as is proposed.

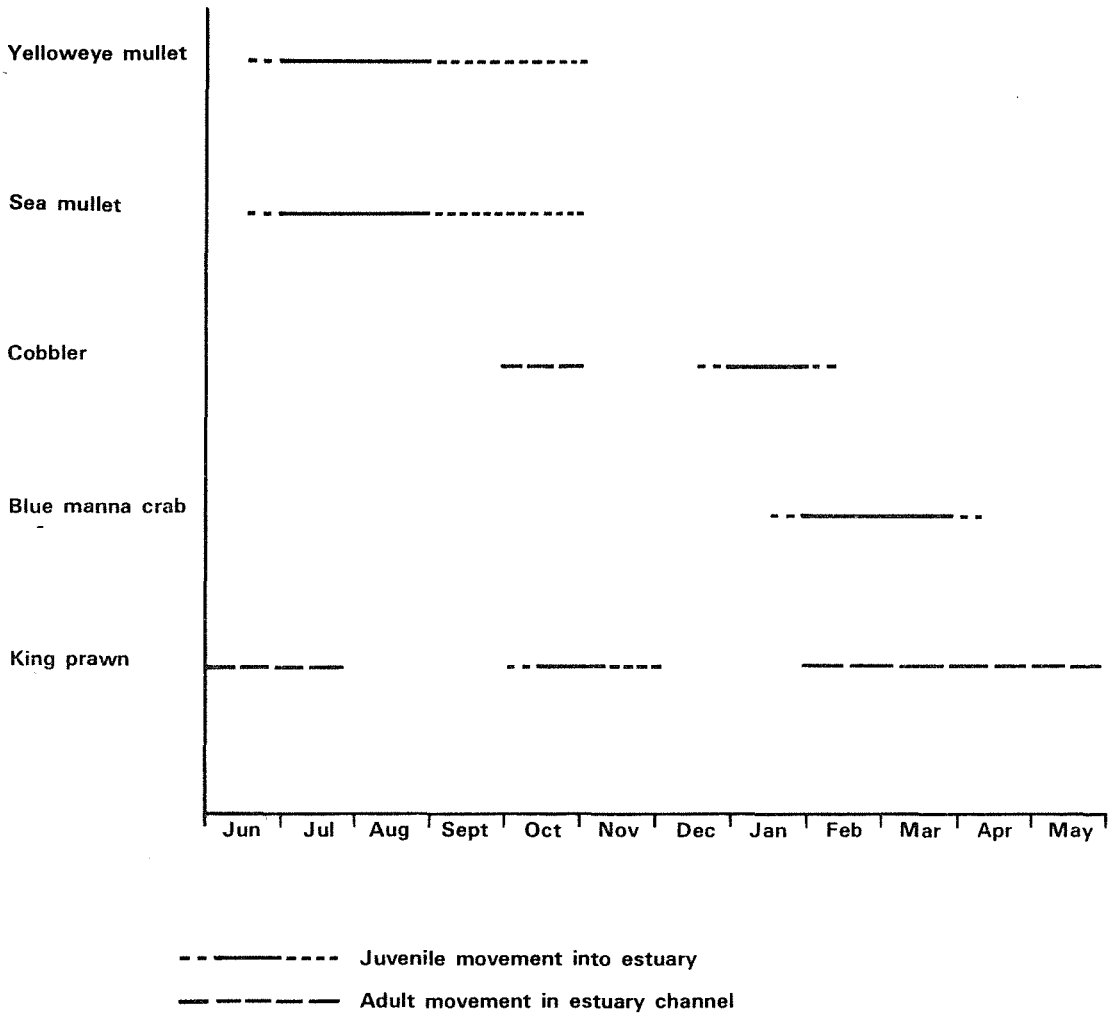

Figure 2 Seasonal Migration Patterns of Commercially Important Fish and Crustaceans into Peel Inlet.

Similar channel maintenance dredging has been carried out before without adverse long or short-term effects on fish being reported. Indeed, the catch per unit effort for significant commercial fish species caught in the Peel-Harvey from 1970 has increased markedly even though dredging has occurred during this period (Lenanton, Potter and Loneragan, 1985).

4.1.3 Impacts on Benthos

The benthic habitats of the Fairbridge Bank and downstream channel will be destroyed by removal of the surface sediment during dredging and by burial from spoil disposal.

No adverse effects on benthos have been reported following previous dredging exercises in the Sticks Channel.

4.1.4 Impacts on Flushing of Peel Inlet and Harvey Estuary

There will be virtually no improvement to the flushing of Peel Inlet from this dredging operation alone, because the choke at the Sticks Channel end would still restrict flushing.

Flushing of Peel Inlet would only be improved by completion of the Mandurah Channel entrance dredging and the Sticks Channel/Porpoise Channel dredging. Impacts on flushing of Harvey Estuary would be minimal.

4.2 SOCIO-ENVIRONMENTAL IMPACT ASSESSMENT

There would be considerable impacts on people from the proposed dredging and spoil disposal. The latter are discussed in Section 5 of this report.

4.2.1 Noise

The PER states that noise from the dredge and booster pumps would be regulated to ensure that it would not exceed acceptable limits (PER, 1985, p 6). It should be noted that the proposal is to have a dredge operating at least 10 hours per day, six days per week from December 1985 to February 1987.

4.2.2 Inconvenience

The storage and transport of large diameter pipes on land would be a physical and noise nuisance to residents and beach users. Pipes located on beaches, for example to disperse spoil near the Wade Street Groyne, could similarly be a nuisance.

4.2.3 Navigability

The navigability of the downstream section would be improved by the dredging of the channel and by removal of Fairbridge Bank.

Boats using the channel during dredging should not be inconvenienced as a section of the pipeline would be submerged to allow access past the dredge.

Prawn fishermen could experience some inconvenience during certain stages of the dredging.

4.2.4 Loss of Amenity at Fairbridge Bank

Fairbridge Bank is a popular site for crabbing and other recreational fishing activities and is within walking distance from the main residential areas. The shallow area would be lost, and as a result there could be more recreational pressure on alternative shallow areas, particularly close to town.

5. IMPACTS OF DREDGE SPOIL DISPOSAL

Potential impacts of dredge spoil disposal are dependent upon the method chosen. The gross amount to be disposed of can be reduced by maximising use of dredge spoil in areas requiring fill. Material excess to these requirements can be disposed of by a number of alternatives; several are outlined below:

- pipe to bunded stockpiles near the ocean marina and truck along the beach to the northern beaches for beach replenishment (as outlined in the PER);
- alternative location for stockpiles and trucking through residential areas for disposal on the northern beaches;
- pipe from bunded stockpiles or direct from the dredge along the beaches for direct disposal from a pipe in the vicinity of Wade Street groyne;
- piping and direct disposal at sea in an area to the northeast of the ocean bar so that beach replenishment occurs via normal sediment transport processes; and
- loading into barges from the dredge and subsequent marine dumping of spoil in an area to the northeast of the ocean bar.

The first three create maximum social disruption from traffic, noise, increased road hazard, increased costs of road maintenance and loss of recreational beaches from disposal activities on a 10 hours per day, six days per week basis from December 1985 to February 1987. The last two methods may be more expensive and may cause the invocation of the Commonwealth Environment Protection (Sea Dumping) Act 1981: they would create minimal social disruption and would have acceptable transient levels of ecological disturbance.

The Authority believes that it is unreasonable to expect the public to accept the level of disruption that would result from beach disposal using trucks or scrapers. Disposal on the beaches using a pipeline would be an improvement, although this would still be disruptive to beach users.

The Authority therefore recommends that:

RECOMMENDATION 1

The EPA recommends that the gross amount of spoil to be disposed of should be reduced by maximising use of dredge spoil in areas requiring fill. Disposal of material excess to these requirements should meet the following criteria:

- **stockpiles should only be constructed as short-term storage and must not create a nuisance from sandblasting;**
- **disposal should not involve transportation by vehicles along the beaches;**
- **disposal on the beaches should not occur during the peak-use, summer periods;**
- **any marine disposal should preferably not occur over seagrass or reef and preferably occur in the surf zone in an area to the northeast of the Mandurah Channel;**
- **disposal should be carried out in such a way as to facilitate beach replenishment.**

6. MONITORING

It would be advisable for the proponent to carry out and/or fund monitoring studies which would determine the impacts of the dredging operations.

The Authority would like to be kept informed of developments and of the monitoring results.

7. CONCLUSIONS

The Authority concludes that the biophysical effects of the dredging proposal are environmentally acceptable. However, the Authority believes that the method of spoil disposal proposed in the PER is unacceptable and that an alternative method of disposal should be devised.

8. REFERENCES

Lenanton, R.C.J., Potter, I.C., and Loneragan, N.R., 1985, The Response of the Fish and Crustacean Fauna and the Fishery to Options for Management of the Peel-Harvey Estuary. in Department of Conservation and Environment Bulletin 195, July 1985.

Stickney, R.R., and D. Perlmutter. 1975. Impact of intracoastal waterway maintenance dredging on a mud bottom benthos community. Biological Conservation, vol 7, 211

Windom, H.L. 1976. Environmental impacts of dredging in the coastal zone. CRC Critical Review in Environmental Control, March 1976.

APPENDIX

ENUMERATION OF POINTS RAISED IN PUBLIC SUBMISSIONS, ADDRESSING THE DREDGING OF FAIRBRIDGE BANK AND THE OCEAN ENTRANCE.

PUBLIC SUBMISSIONS

A total of 11 submissions was received during the public review period.

A list of issues raised in the submissions follows and is divided up into five major categories:

1. Estuarine Biology

2. Hydraulic Considerations

3. Amenity

4. Monitoring

5. Navigation

The Authority encloses this Appendix for information and passes no judgement on the validity of the points raised. The Authority has considered all these in the preparation of its Assessment Report, wherever relevant.

1. ESTUARINE BIOLOGY

- The combination of dredging of the estuary entrance channel and the use of slow-release fertilizer will eventually clean up the estuary ... making a Dawesville channel unwarranted.

- spoil should not be deposited in the estuary as it will decrease the area of fishing grounds and interfere with water flow.

- supports, in principle, dredging of the Mandurah Channel, as an increased interchange of water will improve water quality in the estuary.

- support the action proposed in both reports aimed at improving water quality throughout the estuary system.

- in view of the poor water quality and algae growth in the Peel-Harvey estuary ... fully support the Government's six-point action plan.

- support all six points ... except for the direct need to dredge the Mandurah Channel ... perhaps only later ... if necessary.

- disagree with proposed dredging as it "would have little effect on the Harvey Estuary, and hence the Nodularia problem would remain."

- dredging of (the Mandurah Channel) ... will lead to a vast improvement in the estuary.

HYDRAULIC CONSIDERATIONS

- The downstream and upstream sections should be dredged simulataneously, and completed about the same time, around 1987.

- the ocean entrance should be moved further west and the channel straightened.

- .. fully supports the proposal to dredge the Mandurah Channel.

- will the spoil placed at E (see Figure 2, PER) be subject to removal by longshore drift? If so will the mobilised material move westwards to contribute to the development of a blocking sand-bar at the mouth of the channel or, alternatively, will it move north-eastwards and contribute to any existing erosion or depositional problems associated with beaches?

- agree (with Mandurah Channel dredging) up to a certain point, but feel that a groyne at the ocean entrance could be more beneficial.

- the hydraulic efficiency of the existing entrance channel must be improved by dredging at Sticks Channel and at the entrance before the Dawesville Channel proceeds.

- a sand-bypass system will be necessary to keep the entrance open.

3. AMENITY

- Concern that dredging will interfere with professional prawning boats during the prawn season (February to May); last year congestion of prawning boats occurred, and areas upstream and downstream of the dredge could not be worked because of hazard to boats and avoidance behaviour by prawns.

- concern that cartage of 450 000 m^3 of sand along residential streets would result in a very significant reduction in pavement life, and that these would require reconstruction during the cartage operation;

- concern that structural damage to buildings could occur from vibration caused by truck movements.

- cartage of sand along the beach would disrupt recreation, and would present a danger to people, particularly children.

- cartage could be restricted to the period March to October, with no cartage on weekends during the hotter months of that period.

- in view of the problems associated with the trucking of large volumes of sand, the option of booster pumping of spoil to the disposal site should be closely examined.

- the Mandurah Ocean Marina requires dredging works to be commenced at the entrance this financial year.

- do not consider that the expenditure of more than $ 4 000 000 will alleviate the existing environmental problems ... and that the major benefits of dredging will accrue to the developers of canals on both sides of the channel.

- the proposal for ongoing cost-sharing with the Mandurah Shire Council ... is not acceptable, as such costs ... would be borne by the ratepayers .. as such dredging would be of benefit to the State as a whole.

4. MONITORING

- "We see an urgent need for continued and further testing of the complete system by your Civil Engineers, to inform you of future improvement and to draw your attention to eventual setbacks."

- the ecology of the system can be monitored by the Peel Inlet Management Authority during the proposed dredging programme.

- existing tide gauges in the Peel Inlet entrance channel will monitor the performance of the channel once changes have been made to it.

5. NAVIGATION

- It is of vital importance to keep the bar open during the September to November period.

- a groyne at Halls Head reef or a sand-bypass will be necessary to maintain an open ocean entrance.

- dredging (of Mandurah Channel) is necessary as a safety measure ... and to provide access to the Serpentine and Murray Rivers.

LIST OF WRITTEN SUBMISSIONS

1. Dudley Tuckey
   20 Leslie Street
   MANDURAH WA 6210

2. Peel-Preston Preservation Group

3. K.S. and Y.E. Cole
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   WANNANUP WA 6210

4. R. Pages-Oliver
   200 Dampier Avenue
   NOVARA WA 6210

5. Mr and Mrs M.G. and A.T. van Santen
   33 Halls Head Parade
   MANDURAH WA 6210

6. R.R. and W.J. Winfield
   35 Estuary View Road
   DAWESVILLE WA 6210

7. Shire of Mandurah
   PO Box 210
   MANDURAH WA 6210

8. Department of Mines
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   66 Adelaide Terrace
   PERTH WA 6000

9. Peel Inlet Management Authority
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   MANDURAH WA 6210

10. A.B. Toussaint
    Secretary, Mandurah Licensed
    Professional Fishermen's Assoc.
    Lot 2 Estuary Road
    DAWESVILLE WA 6210

11. Shire Clerk
    Shire of Murray
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    PINJARRA WA 6208

LIST OF PUBLIC CONTRIBUTORS AT EPA PUBLIC MEETING IN MANDURAH ON 2 OCTOBER 1985

1. Mr FP Michell
   129 Hestia Way
   San Remo
   MANDURAH WA 6210

2. Mr DC Tuckey
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   MANDURAH WA 6210

3. Mr A Cameron
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4. Ms A Nicholas
   20 Otway Street
   SWANBOURNE WA 6010

5. Mr L Howard
   29 Mistral Avenue
   FALCON WA 6210

6. Mr B Toussaint
   Professional Fishermen's Assoc.
   Old Coast Road
   DAWESVILLE WA 6210

7. Mr J Watts
   c/- Professional Fishermen's Assoc.
   Old Coast Road
   DAWESVILLE WA 6210

8. Mr Bill Joske
   Planner
   Shire of Murray
   PINJARRA WA 6208

9. Mrs Zaliski
   62 Peel Parade
   COODANUP WA 6210

10. Mrs R Richards
    67 Park Road
    MANDURAH WA 6210

11. Mr D Elkerbout
    Westralian Dredging
    Australian Shipbuilding Industries
    781 Cockburn Road
    COOGEE WA 6034

MANDURAH CHANNEL DREDGING

DEPARTMENT OF MARINE AND HARBOURS

Report and Recommendations
by the
Environmental Protection Authority

Part 3

Department of Conservation and Environment
Perth, Western Australia
Bulletin No 231 August, 1986

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PREFACE

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The Authority decided to carry out the assessment in three phases in order to accommodate the dredging timetable of the Department of Marine and Harbours and to ensure that the purposes of the proposals are clarified. The three Authority reports are:

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2. A report addressing the dredging of the Fairbridge Bank and the Ocean Entrance which is the subject of this report ((b) on Figure 1).

3. A report to be prepared within a few months addressing the dredging of Sticks and Porpoise Channels ((c) on Figure 1).

The first two have been reported on in Bulletin 231 Parts 1 and 2. The third is presented here.

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1. SUMMARY AND RECOMMENDATIONS

The Authority has assessed the biophysical and socio-environmental effects of the dredging of Sticks Channel/Porpoise Channel end of the Mandurah Channel and has found them to be acceptable as long as the proposed spoil islands are constructed in accordance with the criteria set out in the recommendations below.

The Authority has determined that the construction of islands from spoil in Peel Inlet at this juncture is acceptable because the purpose of the dredging is primarily to improve hydraulic flushing in Peel Inlet. In this instance the objective of the dredging is primarily environmental; a subsidiary social benefit would be improved navigability of the Sticks/Porpoise Channel. This contrasts with most dredging exercises which are primarily social with, frequently, environmental disbenefits.

RECOMMENDATION 1

The EPA recommends that the construction of spoil islands be in accordance with, amongst other things,the following criteria:

- **no disposal of spoil to be carried out at spoil disposal area D on the north of Channel Island or on any of the areas within System 6 Recommendation area C50;**

  <u>for habitat islands:</u>

- **islands should be stable.Erosion should be minimised by locating islands in low energy areas as shown in circulation patterns, and by optimum orientation in terms of prevailing winds and waves;**

- **islands should be placed so that human access and access by terrestrial predators is discouraged, and as far away from the dredged channel as is practicable;**

- **broad intertidal flats should be provided to maximise feeding areas for wading birds and to maximally inconvenience human access;**

- islands should be vegetated with a mixture of fringing samphire, sedges and grasses to minimise erosion and trees such as local Casuarina and Melaleuca cuticularis to provide roosting and nesting sites; and

- the islands should be large enough and carefully sculpted to provide a range of habitats.

for recreation island:

- the island should be stable and free from slumping. Erosion should be minimised by locating the island in a low energy area as shown in circulation patterns and by optimum orientation in terms of prevailing winds and waves;

- the island should be located close to Sticks Channel/Porpoise Channel to facilitate boat access on the western side only. Access from the eastern side facing the bird habitat should be discouraged;

- provide broad, sandy beaches;

- provide central trees for shade;

- the island should be sculpted to minimise colonisation by samphire;

- appropriate facilities should be provided which emphasise passive recreation activities; and

- people should be encouraged to take their rubbish away with them.

RECOMMENDATION 2

The EPA recommends that the Peel Inlet Management Authority should oversee the construction of the islands. Vesting of the islands should be examined by the Environmental Protection Authority, in consultation with the Management Authority and other relevant agencies, and recommendations provided to the Minister for Lands.

2. INTRODUCTION

The Public Environmental Report (PER) on the Mandurah Channel Dredging provided a brief description of a proposal to dredge Fairbridge Bank and the Ocean Entrance, commencing late 1985, and a proposal to dredge the Sticks Channel/Porpoise Channel in Peel Inlet to commence March 1987, for completion in March 1988.

This assessment report addresses the dredging of the Sticks Channel/Porpoise Channel dredging (the upstream end of the Channel). The Public Environmental Report indicates that the proposal would consist of dredging and disposal of 670 000 cubic metres of material from the Sticks Channel/Porpoise Channel (Figure 1). The work would cost $1 700 000 (in 1985 dollars).

The dredging of the Ocean Entrance and Fairbridge Bank sections of the Mandurah Channel have been reported on in Parts 1 and 2 of Bulletin 231.

A total of 11 written submissions was received during the public review period. The Authority has considered all these in the preparation of its Assessment Report, wherever relevant. The Authority made itself available to receive oral submissions from the public by being available in Mandurah on 2 October, 1985. A list of all individuals making submissions is given in the Appendix.

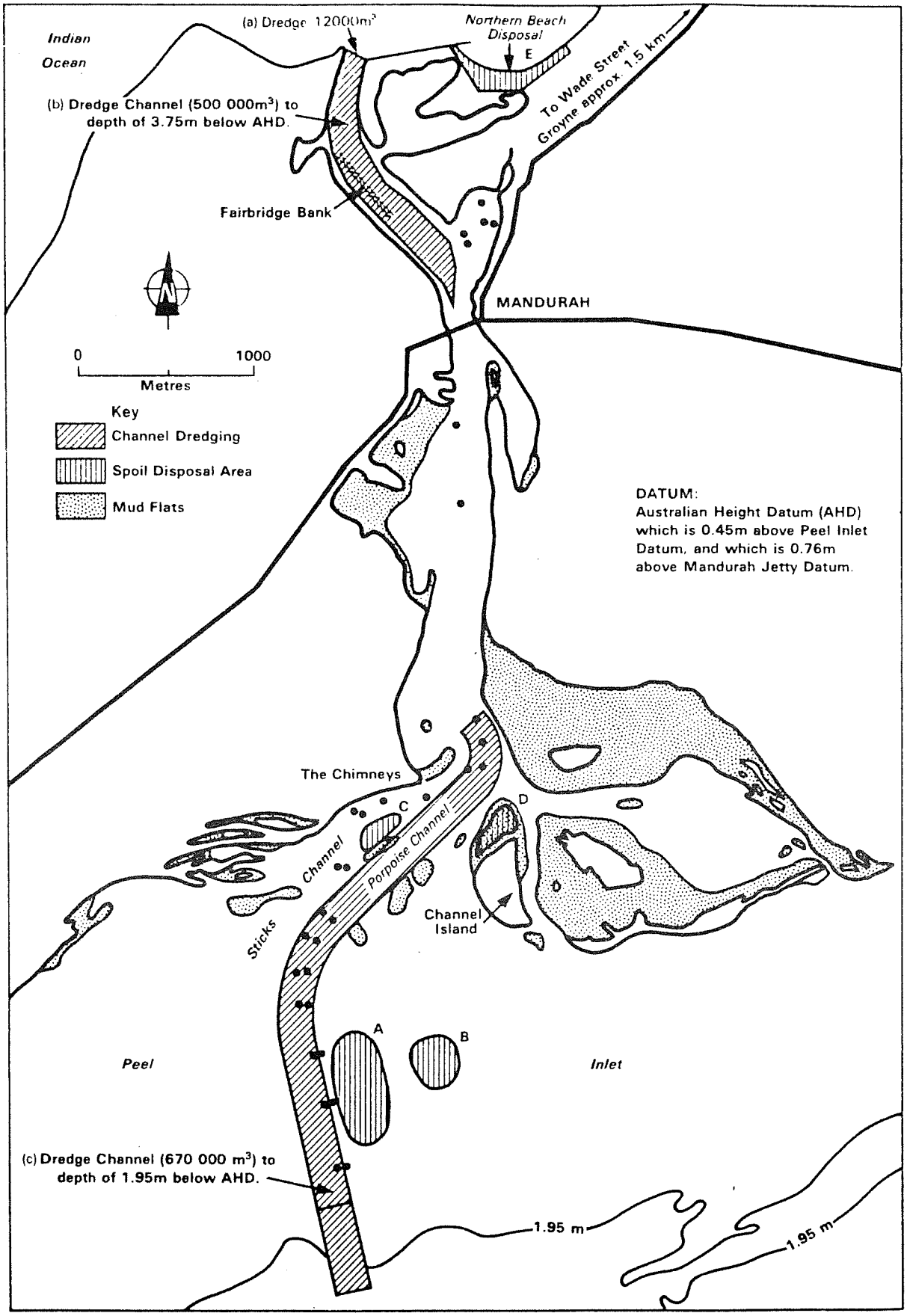

Figure 1. Mandurah Channel Dredging (Disposal areas as indicated in the PER)

3. THE PROPOSAL

The aim of the proposed dredging works discussed in the Public Environmental Report is to improve the navigability of Mandurah Channel and to assist in improving the marine flushing in Peel Inlet. Improvement in the flushing of Peel Inlet is predicted to occur following completion of the dredging of both the Fairbridge Bank/Ocean Entrance and the Sticks Channel sections, from increased flows through the channel of 24 to 30 percent (summer) and 10 to 40 percent (winter). In the long term these dredging works could contribute to a reduction in the growth of the large floating weed in Peel Inlet (see Section 4.1.4).

3.1 DREDGING OPERATIONS

A total of 670 000 cubic metres of material would be dredged from this section using a floating, cutter suction type dredge. Other plant would be lengths of large diameter pipeline including floating, submerged and land pipe sections. In-line booster pumps could be required to provide the capacity to dispose of spoil over long distances.

The dredge would operate for at least 10 hours per day, six days per week from about March, 1987 through to March, 1988.

3.2 DREDGE SPOIL DISPOSAL

Previous maintenance dredging contracts in this area have required the dredging of sand with clay pockets. However, spoil islands created from this material have a white, sandy appearance. (PER 1985, p5)

Spoil material would be pumped directly to the spoil disposal areas to create islands for bird habitat and recreation. The impacts of dredge spoil disposal are discussed in detail in Section 5 of this report.

4. IMPACT ASSESSMENT

4.1 BIOPHYSICAL IMPACTS

4.1.1 TURBIDITY

Loss of clarity of water (muddying of water) during dredging would occur but effects would be transient as the sediment would rapidly sink. Water clarity would be restored within a time frame of minutes to a few hours after cessation of dredging. Impacts from increased turbidity could affect organisms. Although many estuarine organisms are adapted to some variation in turbidity, prolonged turbid conditions could be detrimental. Effects of turbidity on organisms are:

- reduction of photosynthesis in plants, leading to their lowered growth or death;
- abrasion damage to gills of some aquatic organisms;
- temporary loss of fish from some areas as they move to non-turbid areas;
- reduction of food supply available to carnivores because of reduced visibility;
- damage to organisms in non-dredged areas by smothering with settling sediment; and
- overloading of filter feeders, eg mussels.

In the Sticks Channel/Porpoise Channel area, the very fine fraction from the dredging operations will persist longer than near the Ocean Entrance, because the lower water velocities in the Peel Inlet would disperse the turbidity plume more slowly. Monitoring of earlier dredging operations in Sticks Channel shows that recovery of benthic flora and fauna has occurred within 12 months (Waterways Commission pers. comm.). The impacts from turbidity identified above would be temporary in nature and not of major significance.

4.1.2 IMPACTS ON FISH AND CRUSTACEANS

The Peel Inlet end of the Mandurah Channel is the migration route for a large suite of migratory species that make use of the Estuary for part of their life cycles.

There are two main sources of potential disturbance from dredging, namely:

- avoidance of disturbed area, and short-term behavioural changes by migrating organisms because of noise and physical disturbance, and

- entrainment by the dredge of adult and larval fish and crustaceans.

Figure 2 shows the migration patterns of the major commercial fish and crustaceans over their annual cycles. This illustrates that it would be impossible to avoid impingement on migrating species during a protracted dredging operation such as is proposed, particularly during the dredging of the Channel immediately north of Channel Island because of the narrowness of the Channel in this area.

Similar channel maintenance dredging has been carried out before without adverse long or short-term effects on fish being reported. Indeed, the catch per unit effort for significant commercial fish species caught in the Peel-Harvey from 1970 has increased markedly even though dredging has occurred during this period (Lenanton, Potter and Loneragan, 1985).

4.1.3 IMPACTS ON BENTHOS

The Peel Inlet dredging proposed would take place in shallow water where there is adequate light penetration and nutrients for benthic organisms. The benthic habitats of the dredged areas and the areas proposed for spoil disposal would be destroyed by removal of or placement of sediment. However, monitoring of earlier dredging operations in the Sticks Channel area has shown that recovery of benthic flora and fauna is very rapid (see Section 4.1.1) and that the species that return to disturbed areas are the same as those in adjacent undisturbed areas. (Waterways Commission, pers. comm.).

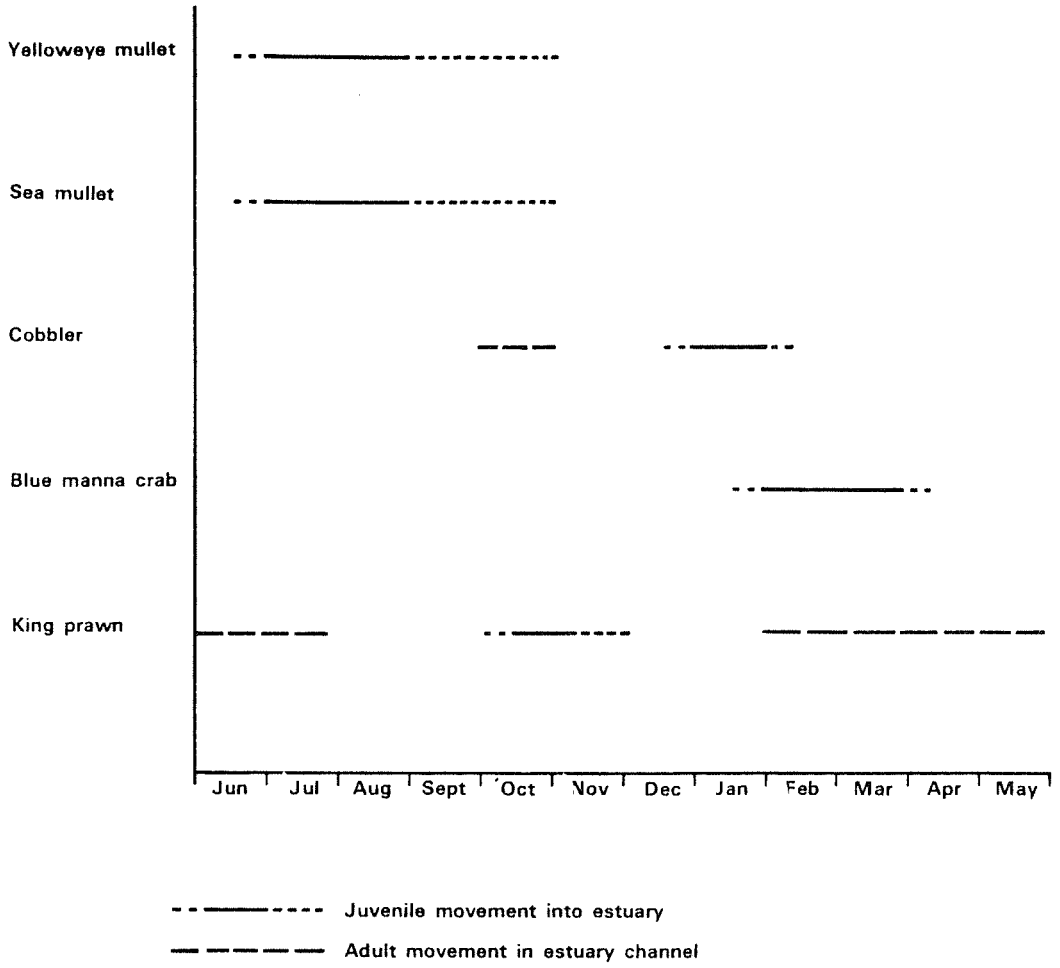

Figure 2. Seasonal Migration Patterns of Commercially Important Fish and Crustaceans into Peel Inlet.

Dredging and disposal of material in the deeper waters of the Swan Estuary has shown that in the deeper water environment, recovery of benthos is very slow or does not occur at all.

Formation of the spoil islands would result in loss of benthic habitats from the areas exposed at low tide, and creation of new benthic habitats on the island areas lying between low water and the pre-dredging bottom contour. In the latter case the recolonising benthic fauna would be species already represented in comparable habitats elsewhere in the Estuary.

Overall, there would be an increase in intertidal flat area in the Estuary. Such areas are of particular value to wading birds as feeding grounds.

4.1.4 IMPACTS ON FLUSHING OF PEEL INLET AND HARVEY ESTUARY

The combined effect of dredging of the ocean entrance, Fairbridge Bank and Sticks/Porpoise Channels is estimated to increase the flushing of Peel Inlet water to the sea by 15 to 25 per cent (Hodgkin et al., 1985) The increased level of phosphorus loss resulting from this increased flushing rate has not been determined, however, it would be enough to reduce the size and duration of Nodularia blooms in Peel Inlet (Hodgkin et al., 1985).

The improved flushing would increase water clarity in Peel Inlet and this could lead to a temporary increase in the abundance of large green algae. This would reduce over a period of years as estuary phosphorus levels gradually decline.

The dredging would have little impact on flushing in Harvey Estuary and on the retention of phosphorus therein. No reductions in Nodularia blooms in the Harvey Estuary would occur.

4.1.5 TERRESTRIAL IMPACT OF DREDGING

Disruption of or damage to sensitive terrestrial areas can result from movement of vehicles and pipes associated with dredging. Such sensitive areas in Peel Inlet are the existing islands and samphire marshes, both on the islands and mainland, and in particular those within System 6 Recommendation C50 (EPA, 1983).

Movement of vehicles and materials across these areas should be avoided.

4.2 SOCIO-ENVIRONMENTAL IMPACT ASSESSMENT

4.2.1 NOISE

The PER states that noise from the dredge and booster pumps would be regulated to ensure that it would not exceed acceptable limits (PER, 1985, p6). It should be noted that the proposal is to have a dredge operating at least 10 hours per day, six days per week from about March, 1987 to March, 1988.

Noise from the Mandurah Channel dredging should result in less inconvenience than that experienced from construction of the new traffic bridge and John Holland's canal development which are both current works.

4.2.2 INCONVENIENCE

The storage and transport of large diameter pipes on land could be a physical nuisance to the public and should be minimised. The pipes can also cause physical damage to property and the environment.

4.2.3 NAVIGABILITY

The navigability of the upstream section would be improved by the dredging of the Sticks/Porpoise Channels.

Boats using the channel during dredging should not be inconvenienced as access along the Sticks Channel would not be interrupted completely at any time during the dredging.

Any fishermen using the Sticks/Porpoise Channel for prawning could experience some inconvenience during certain stages of the dredging.

4.2.4 AMENITY

Dredging of the Sticks Channel/Porpoise Channel will increase amenity through the following beneficial impacts:

- improved flushing in Peel Inlet;

- long term reduction in large weed (although there is likely to be a short-term increase in large weed as a result of the improved water clarity);

- improved navigability of the Channel for boats;

- construction of an island using dredged material for use by recreational boat users for picnicking (see Section 5);

- construction of new spoil islands as wildlife habitats (see Section 5); and

- increase in the size of habitats listed in System 6 Recommendation C50 (EPA, 1983) by addition of man-made spoil islands (see Section 5).

5. DREDGE SPOIL DISPOSAL

Dredge spoil disposal can have negative impacts on hydraulic regime, circulation patterns and on flora and fauna, either within or beyond the dredged water body. Spoil disposal can also be used beneficially to provide access to otherwise inaccessible areas or to provide amenities for wildlife or the public.

The Public Environmental Report (PER, 1985) proposed a spoil disposal strategy based on the construction of four islands within the Peel Inlet water body as outlined below and shown in Figure 1:

". Spoil Island A: This island would be created by placing the spoil in shallow waters close to the channel. The finished level of the island would be as high as 5 m above Australian Height Datum (AHD).

. Spoil Island B: This island would be created as an intertidal salt marsh area, with a top level of approximately 0.2 m above AHD. A substantial expanse of water would be left between Islands A and B.

. Spoil Island C: This would be created as an intertidal salt marsh area in the same manner as Spoil Island B.

. Spoil Area D: Spoil Area D would be filled to a top level of approximately 5 m above AHD. At this level, it should give the visual impression of being a continuation of the elevated areas at the northern end of Channel Island." (Source PER, 1985, p5).

Spoil islands have potential as bird habitats, if suitably constructed, located and revegetated. It has been estimated that in excess of 2 000 000 birds are nesting on dredged material or man-made sites in United States waterways, especially along the Atlantic and Gulf coasts. The primary wildlife needing islands as part of their life requirements in the USA are colonial nesting waterbirds, in particular pelicans, cormorants, darters, herons, egrets, ibises, spoonbills, gulls and terns (Soots and Landin, 1978). As many of these species have Australian equivalents in the Mandurah area, the potential benefit from provision of safe nesting areas is evident.

Spoil islands can also be designed to enhance recreational facilities for the boating public. However, as these two potential beneficial uses of spoil islands are substantially incompatible, it is important to design islands for habitat in such a way that access by humans and terrestrial predators is made very difficult.

The detailed design of islands for bird habitat should incorporate the following criteria to meet the objective of providing safe habitat for birdlife:

- islands should be stable. Erosion should be minimised by locating islands in low energy areas as shown in circulation patterns, and by optimum orientation in terms of prevailing winds and waves;

- islands should be placed so that human access and access by terrestrial predators is discouraged, and as far away from the dredged channel as is practicable;

- broad intertidal flats should be provided to maximise feeding areas for wading birds and to maximally inconvenience human access;

- islands should be vegetated with a mixture of fringing samphire, sedges and grasses to minimise erosion, and trees such as local Casuarina and Melaleuca cuticularis to provide roosting and nesting sites; and

- the islands should be large enough and carefully sculpted to provide a range of habitats (see Figure 3).

The disposal areas B, C and D were proposed as wildlife islands in the Public Environmental Report. Of these areas, area D is not recommended by the Authority as a disposal area because of loss of and disruption to the area which is incorporated within the area of System 6 Recommendation C50 (see Figure 4). Spoil areas B and C are acceptable in principle as long as the criteria above are adopted in the detailed design. The Authority is, however, concerned about stability aspects of island C in the location proposed in the Public Environmental Report.

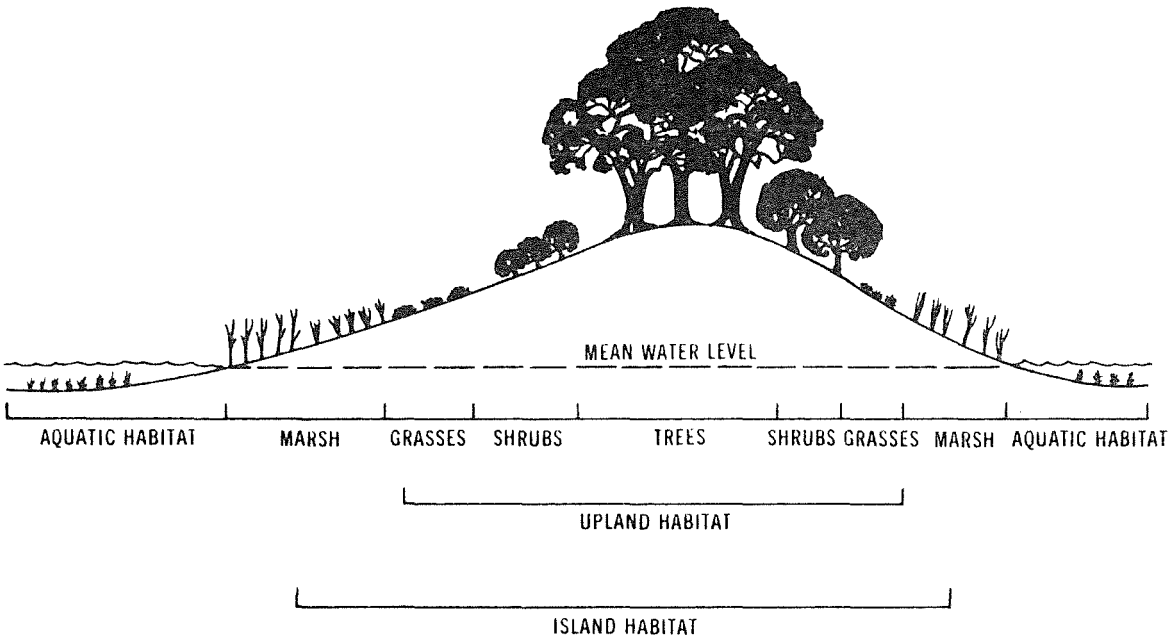

Figure 3. A hypothetical spoil island illustrating the diversity of habitat types that may be developed. (from Smith, 1978)

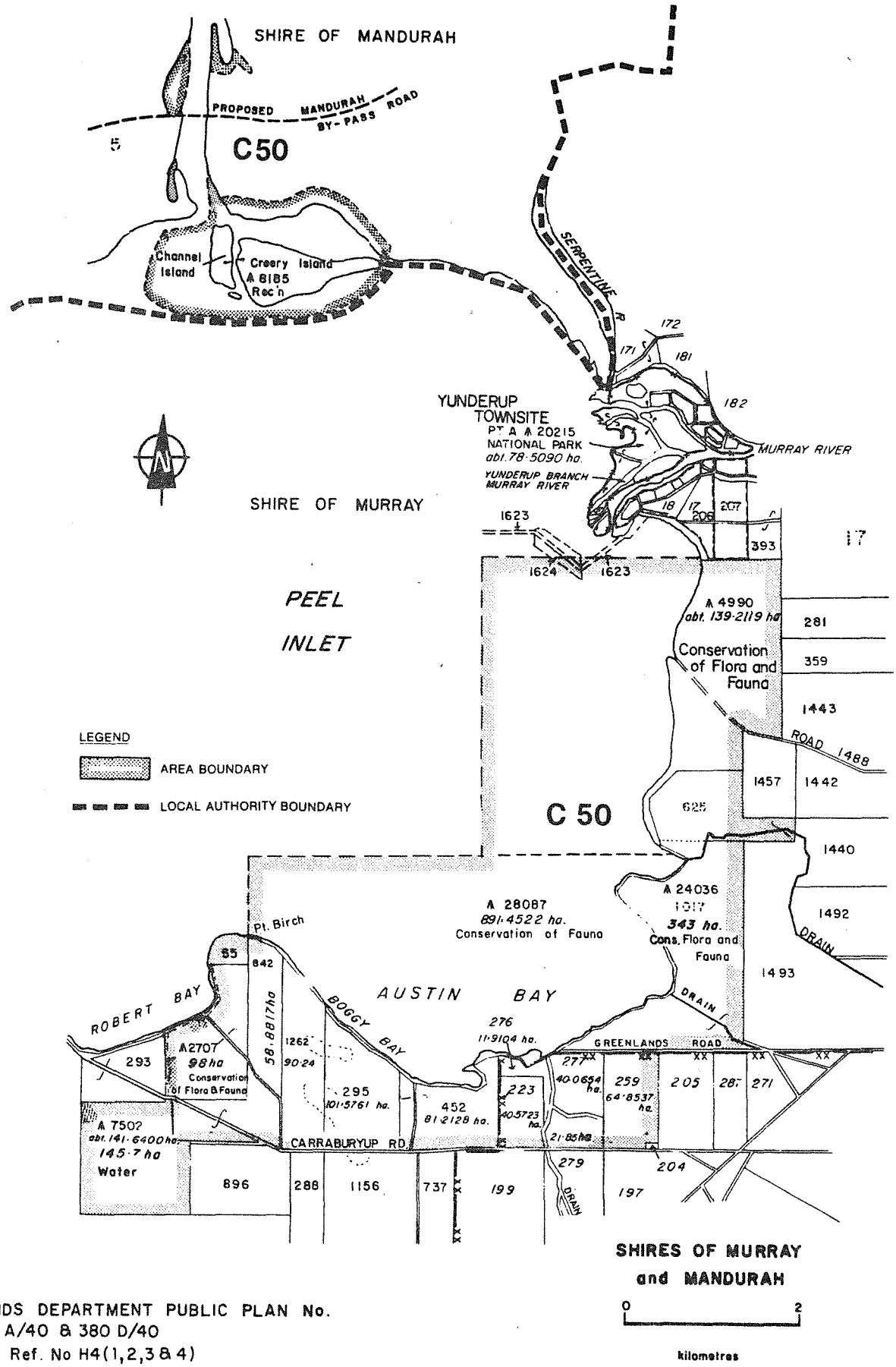

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Figure 4. System Six recommendation C 50.

As a substitute for adding spoil to Channel Island (disposal area D in the PER) consideration should be given to building a bird habitat island to the west of Sticks Channel some distance into Peel Inlet.

The detailed design of the proposed recreation island should incorporate the following criteria to meet the objective of passive recreation:

- the island should be stable. Erosion should be minimised by locating the island in a low energy area as shown in circulation patterns and by optimum orientation in terms of prevailing winds and waves;

- the island should be located close to Sticks Channel/Porpoise Channel to facilitate boat access on the western side only. Access from the eastern side facing the bird habitat should be discouraged;

- provide broad, sandy beaches;

- provide central trees for shade;

- the island should be sculpted to minimise colonisation by samphire;

- appropriate facilities should be provided with emphasis placed on passive recreation activities, such as bird observation and picnicking; and

- people should be encouraged to take their rubbish away with them.

To achieve the objectives for the conservation and recreation values associated with the islands, the Authority believes that management plans for the islands should be prepared. This should occur prior to construction of the islands to ensure that the physical parameters of the islands meet the main objectives of the management plan.

The management plan for these areas should be integrated and consistent with the management objectives for adjacent lands identified in System 6 Red Book Recommendation C50. The shallow waters adjacent to the proposed islands should also be incorporated into the management plan (see System 6 Red Book Recommendation C50.3).

The Authority believes that it would be appropriate for the Peel Inlet Management Authority to oversee the construction of the islands, recognising their proposed purposes. Vesting of the islands should be examined by the Environmental Protection Authority, in consultation with the Management Authority and other relevant agencies, and recommendations made to the Minister for Lands.

The Authority makes the following recommendations on dredge spoil disposal and the creation of islands:

RECOMMENDATION 1

The EPA recommends that the construction of spoil islands be in accordance with, inter alia, the following criteria:

- **no disposal of spoil to be carried out at spoil disposal area D on the north of Channel Island or on any of the areas within System 6 recommendation area C50;**

  for habitat islands:

- **islands should be stable. Erosion should be minimised by locating islands in low energy areas as shown in circulation patterns, and by optimum orientation in terms of prevailing winds and waves;**

- **islands should be placed so that human access and access by terrestrial predators is discouraged, and as far away from the dredged channel as is practicable;**

- **broad intertidal flats should be provided to maximise feeding areas for wading birds and to maximally inconvenience human access;**

- **islands should be vegetated with a mixture of fringing samphire, sedges and grasses to minimise erosion and trees such as local Casuarina and Melaleuca cuticularis to provide roosting and nesting sites; and**

- the islands should be large enough and carefully sculpted to provide a range of habitats.

for recreation island:

- the island should be stable. Erosion should be minimised by locating the island in a low energy area as shown in circulation patterns and by optimum orientation in terms of prevailing winds and waves;

- the island should be located close to Sticks Channel/Porpoise Channel to facilitate boat access on the western side only. Access from the eastern side facing the bird habitat should be discouraged;

- provide broad, sandy beaches;

- provide central trees for shade;

- the island should be sculpted to minimise colonisation by samphire;

- appropriate facilities should be provided which emphasise passive recreation activities, and

- people should be encouraged to take their rubbish away with them.

RECOMMENDATION 2

The EPA recommends that the Peel Inlet Management Authority should oversee the construction of the islands. Vesting of the islands should be examined by the Environmental Protection Authority, in consultation with the Management Authority and other relevant agencies, and recommendations provided to the Minister for Lands.

6. MONITORING

It would be advisable for monitoring to be carried out so that the results can be used to check the validity of predictions from the mathematical modelling which has been used to predict the improved flushing of Peel Inlet. These findings could then be used to further enhance the predictive

modelling of solute transport (phosphorus) resulting from the Dawesville Channel and the interactions between the improved flushing characteristics of the dredged Mandurah Channel and the Dawesville Channel (see EPA Recommendation 4 in DCE Bulletin 243, (EPA, 1985)).

The responsibility for having the above monitoring carried out lies with the Department of Marine and Harbours. Results of monitoring should be made available quarterly to the Peel Inlet Management Authority and annually to the Environmental Protection Authority.

7. CONCLUSIONS

The Authority concludes that the biophysical effects of the dredging proposal, as described in the PER and modified in this report, are environmentally acceptable as long as the spoil islands are located and constructed in accordance with the criteria recommended in this assessment report..

The Authority believes that in the case of Peel Inlet the construction of islands could be carried out in such a way that the environment is protected and enhanced.

The Authority has determined that the construction of islands from spoil in Peel Inlet at this juncture is acceptable because the purpose of the dredging is primarily to improve hydraulic flushing in Peel Inlet. In this instance the objective of the dredging is primarily environmental; a subsidiary social benefit would be improved navigability of the Sticks/Porpoise Channel. This contrasts with most dredging exercises which are primarily social with, frequently, environmental disbenefits.

REFERENCES

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APPENDIX

ENUMERATION OF POINTS RAISED IN PUBLIC SUBMISSIONS, ADDRESSING THE DREDGING OF STICKS AND PORPOISE CHANNELS.

PUBLIC SUBMISSIONS

A total of 11 submissions was received during the public review period.

A list of issues raised in the submissions follows and is divided up into five major categories:

1. Estuarine Biology

2. Hydraulic Considerations

3. Amenity

4. Monitoring

5. Navigation

The Authority encloses this Appendix for information and passes no judgement on the validity of the points raised. The Authority has considered all these in the preparation of its Assessment Report, wherever relevant.

2. HYDRAULIC CONSIDERATIONS

- The downstream and upstream sections should be dredged simultaneously, and completed about the same time, around 1987.

- the ocean entrance should be moved further west and the channel straightened.

- .. fully supports the proposal to dredge the Mandurah Channel.

- will the spoil placed at E (see Figure 2, PER) be subject to removal by longshore drift? If so will the mobilised material move westwards to contribute to the development of a blocking sand-bar at the mouth of the channel or, alternatively, will it move north-eastwards and contribute to any existing erosion or depositional problems associated with beaches?

- agree (with Mandurah Channel dredging) up to a certain point, but feel that a groyne at the ocean entrance could be more beneficial.

- the hydraulic efficiency of the existing entrance channel must be improved by dredging at Sticks Channel and at the entrance before the Dawesville Channel proceeds.

- a sand-bypass system will be necessary to keep the entrance open.

- Sticks Channel should only be dredged if it is shown to be required after the other dredging has been carried out.

3. AMENITY

- Concern that dredging will interfere with professional prawning boats during the prawn season (February to May); last year congestion of prawning boats occurred, and areas upstream and downstream of the dredge could not be worked because of hazard to boats and avoidance behaviour by prawns.

- do not consider that the expenditure of more than $ 4 000 000 will alleviate the existing environmental problems ... and that the major benefits of dredging will accrue to the developers of canals on both sides of the channel.

- the proposal for ongoing cost-sharing with the Mandurah Shire Council ... is not acceptable, as such costs ... would be borne by the ratepayers .. as such dredging would be of benefit to the State as a whole.

- the major benefit of dredging the channels will accrue to the developers of canals on both sides of these channels ... costs of dredging and maintenance should be shared by the developers.

4. MONITORING

- "We see an urgent need for continued and further testing of the complete system by your Civil Engineers, to inform you of future improvement and to draw your attention to eventual setbacks."

- the ecology of the system can be monitored by the Peel Inlet Management Authority during the proposed dredging programme.

- existing tide gauges in the Peel Inlet entrance channel will monitor the performance of the channel once changes have been made to it.

5. NAVIGATION

. It is of vital importance to keep the bar open during the September to November period.

. a groyne at Halls Head reef or a sand-bypass will be necessary to maintain an open ocean entrance.

. dredging (of Mandurah Channel) is necessary as a safety measure ... and to provide access to the Serpentine and Murray Rivers.

6. SPOIL DISPOSAL

- spoil should not be deposited in the estuary as it will decrease the area of fishing grounds and interfere with water flow.

- will the spoil placed at E (see Figure 2, PER) be subject to removal by longshore drift? If so will the mobilised material move westwards to contribute to the development of a blocking sand-bar at the mouth of the channel or, alternatively, will it move north-eastwards and contribute to any existing erosion or depositional problems associated with beaches?

- the newly created spoil islands should be consolidated and vegetated.

- any further use of the spoil islands should be made in consultation with the Murray Shire Council.

- the main spoil island, being close to the main channel, will have more likelihood of being eroded and as such it may be necessary to (temporarily) wall the western and southern section of this island.

- will the spoil at artificial island A be subject to slumping or wash into the adjacent dredged channel as a result of waves generated by powerboats? If the answer is yes then the position of the spoil island should be moved to a greater distance from the channel. This also applies to islands C and D.

- dredge spoil islands should not be built in the estuary as the material will only be dissipated by wind and water movement and fill in the dredged channel.

- picnic facilities and toilets should not be provided on islands because of pollution and vandalism.

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