JAMES POINT PORT: STAGE 1

JAMES POINT, COCKBURN SOUND

PUBLIC ENVIRONMENTAL REVIEW

APRIL 2001
JAMES POINT PORT
STAGE 1

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COCKBURN SOUND

PUBLIC ENVIRONMENTAL REVIEW

Prepared for:

JAMES POINT PTY LTD

Prepared by:

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APRIL 2001

REPORT NO. 00/059/6
EPA INVITATION TO MAKE A SUBMISSION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. If you are able to, electronic submissions e-mailed to the DEP Project Assessment Officer would be most welcome.

JPPL propose to construct a land backed berth and offshore breakwater, approximately 2 km north of James Point in Cockburn Sound, for the purpose of conducting commercial port operations (James Point Port: Stage 1). In accordance with the Environmental Protection Act, a PER has been prepared which describes this proposal and its likely effects on the environment. The PER is available for a public review period of 8 weeks from 30 April 2001 closing on 25 June 2001.

Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in the EPA’s report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements of the PER:

- Clearly state your point of view;
- Indicate the source of your information or argument if this is applicable; and
- Suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- Attempt to list points so that issues raised are clear. A summary of your submission is helpful;
• Refer each point to the appropriate section, chapter or recommendation in the PER;
• If you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering; and
• Attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

• Your name;
• Address;
• Date; and
• Whether you want your submission to be confidential.

The closing date for submissions is: 5:00 pm Monday, 25 June 2001.

Submissions should ideally be e-mailed to: cameron.sim@environ.wa.gov.au

OR addressed to:

The Environmental Protection Authority
Westralia Square
141 St George’s Terrace
PERTH WA 6000

Attention: Dr Cameron Sim
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• Port and Harbour Consultants: Hydrodynamic modelling, coastal processes, engineering design, figure production; and
• Western Shipping Pty Ltd: Safety and navigation issues.
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APPENDICES

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EXECUTIVE SUMMARY

JAMES POINT PTY LTD
In 1998, the State Government held a competitive tender process to select a proponent to develop a new port to serve the Perth metropolitan area. As a result of this process, James Point Pty Ltd (JPPL) was selected as the preferred proponent for the design, construction and operation of this port facility: to be located in the vicinity of James Point, Cockburn Sound (James Point Port). JPPL is a consortium of local groups with expertise in the design, operation and management of ports in Australia.

THE PROPOSAL
JPPL proposes to construct cargo wharves and associated cargo handling facilities to the north of James Point, Cockburn Sound, Western Australia. This Public Environmental Review (PER) document is in relation to the work required to build and operate Stage 1 of the James Point Port development, which is the first substantial stage of the overall proposed James Point Port.

The ultimate James Point Port will be constructed in stages over the next 10-20 years, with Stage 1 itself to be completed by 2003. The schedule of construction for the ultimate port will depend on commercial and contractual considerations, and all future aspects of the ultimate James Point Port proposal will be presented for environmental approval. In the assessment guidelines written by the Department of Environmental Protection (DEP) for the Environmental Protection Authority (EPA), the EPA requested that at Stage 1 the proponent provide preliminary impact assessment of the likely cumulative impact of the ultimate port development and other proposed developments. It was agreed by the EPA that this advice be submitted separate to this PER as it primarily addresses Stage 2 of James Point Port and proposed developments by others. Information on the ultimate development may be viewed at JPPL’s web site: http://kwinanaport.com

THIS DOCUMENT
This PER has been prepared to provide sufficient information to the EPA to allow assessment of Stage 1 of the project under the provisions of the Environmental Protection Act, 1986. The document is also written such that the public may understand the scope of the project and its impacts. JPPL encourage any member of the public to make comment on this project as set out in the ‘Invitation to Comment’ at the front of the document.

The proponent recognises that formal environmental impact assessment of the project is required because the project is large in scale and located in a region subject to a high level of community interest.

NEED FOR THE DEVELOPMENT
Studies of the capacity of the Fremantle Inner Harbour to service growth in trade have shown there are likely to be constraints on operations through local transport networks (with further impacts on adjacent residential areas) and cargo handling capacity. This recognition of the need for expansion of Western Australia’s port capacity to service the metropolitan area resulted in studies which found that the optimum site for an additional metropolitan port was in Cockburn Sound. This outcome is founded in the synergies with existing transport and industrial infrastructure, proximity to the metropolitan region and the industrial zoning of the land required.
STAGE 1 DEVELOPMENT

The Stage 1 development is the northern-most portion of the ultimate development and is designed to be commercially sustainable in its own right, regardless of whether any further stages of the development proceed. The key characteristics of the Stage 1 development are summarised in the table below and in the following figure. The project has been designed to meet operational and commercial requirements while minimising impacts on the environment during construction and operations.

Key characteristics of James Point Port: Stage 1

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<th>SCALE</th>
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<tr>
<td>Offshore breakwater</td>
<td>850 m long in 10 m deep water extending from approximately 200 m offshore to approximately 800 m offshore</td>
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<td>Dredging</td>
<td>Dredging of 1.24 million m$^3$, which involves dredging to a depth of 13.7 m relative to chart datum (CD) over an area of approximately 89.0 ha; deepening (to 13.7 m CD) and widening the existing Stirling channel; and, dredging a 3.8 ha berth pocket to 14.0 m CD. 22.0 ha of the area to be dredged is currently less than 10 m deep.</td>
</tr>
<tr>
<td>Reclamation</td>
<td>1.375 million m$^3$ to create approximately 28.5 ha of wharf with 1.24 million m$^3$ of the reclaimed area created with dredge material and the remaining 135,000 m$^3$ using imported clean fill. The reclamation will include reclamation of 19 ha seabed less than 10 m deep.</td>
</tr>
<tr>
<td>Berth</td>
<td>Approximately 1,200 m of land backed berth</td>
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COMMUNITY CONSULTATION

JPPL has actively consulted with Government and community stakeholders in the 18 months leading up to the lodgement of this PER. JPPL has been open and consistent in describing the project as a series of stages in the development of a large scale port at James Point and has used the consultation process to present all the components of the James Point Port plan. Further information about the project, including a summary of the overall plan, has been put on JPPL’s web-site: [http://kwinanaport.com](http://kwinanaport.com)

JPPL has maintained a database of the community groups, stakeholders and interested parties who have contacted JPPL in the past. JPPL will contact and offer to meet each of these parties. The meetings will allow discussion of the PER and JPPL to respond directly to any queries and invite submissions on the proposal.

TIMING

In its contract with the State Government, JPPL has committed to achieving completion of at least 600 metres of new land backed berth by November 2002. The final completion of Stage 1 is expected to occur within the next five years.

The timing commitments made to Government were made contingent on the timing of approvals and JPPL recognises that the construction schedule will depend on the timing of provision of environmental and planning approvals. The construction schedule will be revisited following the completion of the environmental impact assessment process.
PORT AND ENVIRONMENTAL MANAGEMENT

Under the terms of JPPL’s contract with the State Government, which is in the form of an Operating Agreement, there are provisions which require that JPPL:

- Promptly and diligently apply for and obtain all necessary approvals and licences under applicable environmental legislation for the construction and operation of the port;
- In constructing and operating the port and providing the port services, comply with all laws and the proper requirements of Government Agencies; and
- Set up, maintain, implement and monitor an Environmental Management System (EMS) for the operating life of the port.

There are provisions in place which prevent the assignment of the operating agreement or transfer of ownership without approval subject to conditions imposed by the Minister. A breach of the conditions of the Operating Agreement may result in cancellation of JPPL’s or any subsequent Operator's right to operate the port.

The Operator will also be held responsible for ensuring that third parties providing services within the port area meet the same standards as the Operator.

JPPL will prepare and implement an Environmental Management Programme (EMP) for the port under the umbrella of the EMS and will base environmental management practices on guidelines recommended by Association of Australian Port and Marine Authorities. Namely:

- Recognise environmental management as being amongst the highest corporate priorities and establish practices for conducting operations in an environmentally sound manner;
- Continue to improve corporate practices and environmental performance, taking account of the current legislation, Government policy, industry codes of practice, technical developments, the needs of port users and community expectations;
- Take voluntary steps, where it is considered possible and appropriate, to improve current environmental practice;
- Educate, train and motivate employees to conduct their activities in an environmentally responsible manner;
- Minimise the use of raw materials, toxic substances, energy, water, and other resources, as well as reducing the impacts of day to day operations;
- Encourage research on environmental issues associated with the port industry;
- Develop and maintain emergency response plans in conjunction with emergency services, relevant authorities and the community, consistent with current legislation and good practice;
- Promote the adoption of these principles by port users and contractors acting on behalf of the port and where appropriate, require improvements in their practices to make them consistent with those of the port;
- Promote good public relations and foster openness and dialogue with employees, relevant authorities and public, anticipating and responding to their concerns about potential environmental impacts arising from port development or operation; and
- Measure environmental performance, conduct environmental audits and publish this information internally and externally as appropriate.
ENVIRONMENTAL IMPACTS AND THEIR MANAGEMENT

The environmental impacts associated with Stage 1 of the James Point Port development and their management are summarised in the table at the end of this executive summary. The table puts the impacts and their management into the framework of factors for the project developed by the EPA and DEP.

Key environmental issues

The following environmental issues were identified as relevant to the project:

- Loss of coastal dune system and vegetation;
- Impact on coastal processes;
- Impacts on groundwater and surface water quality;
- Impact on circulation within the port area and Cockburn Sound and associated impacts on water quality;
- Deepening of the seabed within the port and associated impacts on water and sediment quality;
- Increased frequency of ship visits with associated contamination of sediments and waters and increased risk of exotic species introduction;
- Modification of marine benthic habitat, associated with dredging and reclamation;
- Increased public risk associated with port operations;
- Increased risk of oil spill and/or pollution events;
- Increased noise and odour associated with some aspects of port operations;
- Loss of recreational amenity;
- Impacts of construction, primarily issues associated with trucking and dredging; and
- Aboriginal and European heritage.

The EPA requested, that where applicable, any cumulative impacts between this and other projects or structures to also be considered.

Key environmental issues: impacts and their management

The conclusions reached in assessing the above issues can be summarised as follows:

Coastal dune system and vegetation

The project will result in the direct loss of a strip of 900 m of low coastal dunes, foredune herbland and degraded Quindalup dune vegetation. The nature of the impact is that there are limited means to mitigate or reduce the impact, however, construction and operations will be conducted such that impacts on adjacent vegetation are minimised.

The impact is cumulative in that other sections of the Cockburn Sound dunes near James Point have been lost or degraded by development. However, the dunes and vegetation are well represented elsewhere along the Perth metropolitan coastline and the area is not listed for conservation purposes and has been degraded by past human use pressures.

Coastal processes

A structure of this scale on the coast is certain to alter the local sediment transport processes. Investigations suggest that the greatest impact will occur north of the port due to the effect of reflected wave energy from the offshore breakwater, the trapping of sand moving south under the most penetrative storm conditions and the blocking of sand supplied to the area from the south during southerly conditions (ie seabreezes). The maximum effects will occur during north-west storm events when the wave height reaching the region is greatest.
The beach south of the port is more likely to be stable due to the protection of the region from significant wave energy by the port and also the existing offshore groynes to the south. However, the current supply of sand from the north will be interrupted by the port.

The development is sited in a low energy environment and the port is unlikely to result in unmanageable erosion problems. However, the local equilibrium beach shape is likely to change after the port is built. As part of the final design process, JPPL will undertake a detailed wave modelling study backed up by measurement of beach profiles and wave heights. This study will be used in designing the offshore breakwater to minimise the wave energy reflected back to shore. Beach profiles will be monitored before and after construction as set out in the Construction EMP. If required, JPPL will undertake coastal engineering measures to protect any property or facility threatened by erosion caused by the port.

**Surface water and groundwater**

The project will result in the creation of approximately 19 ha of hardstand wharf. The hardstand area will be constructed such that all surface drainage discharges to a filtration basin designed to trap and remove settleable material, grease and oil. The runoff will pass through sand filtration before returning to Cockburn Sound. The drainage design and filtration basin also provides a mechanism for limiting any contamination of the Sound resulting from spills. The port maintenance programme will include a schedule for monitoring and cleaning the filtration basin and also ensuring the surface water drainage system is working as intended. The final design of the surface water drainage system will be in accordance with current best practice and submitted to the DEP for approval as part of the works approval process.

The groundwater east of the site has been partly contaminated by the activities of past industrial users. The project will not involve the excavation of contaminated material and as such will not require soil remediation and treatment of groundwater. The berth face will have drainage built in to minimise the effect of the reclaimed area on local groundwater flows and elevations. The port will be operated such that the risk of spills is minimised and procedures to clean up spills will be detailed in an EMS. All hazardous materials will be stored in appropriate facilities and bunded storage will be available. The Stage 1 development will not result in any significant impacts on groundwater quality.

**Circulation of coastal waters**

JPPL has undertaken a numerical modelling investigation of the effects of the development on the circulation of the port area, adjacent waters and the wider Cockburn Sound. The initial modelling resulted in the modification of the port design to maximise the exchange of port waters with those of the Sound. The average residence time of water in the port under worst case (calm autumn) conditions will be of the order of 4 days.

An investigation of the impact of increased residence times on water quality in the port found there is likely to be a small increase in primary productivity within the port waters. The predicted increase in productivity (measured as chlorophyll a concentration) is small and highly unlikely to result in algal blooms or changes to phytoplankton assemblages such that dinoflagellates are dominant.

The Stage 1 development will have the greatest impact on circulation of the Sound under strong south-westerly conditions. Under these conditions there is a zone of reduced current speed north of the offshore breakwater. However, these changes produce a reduction of only about 10% of typical summer current speeds in this region of the Sound and constitute a minor impact on the overall circulation. Under calm conditions, the effect of the port is negligible. There is unlikely to be any impact on water quality north of the port.
Under south-westerly conditions the port would influence the dispersion of the Western Power cooling water discharge plumes. The gap between the breakwater and the shore acts to ‘jet’ water north along the nearshore zone and as such the Western Power discharge will be pushed offshore more rapidly and increase the rate of dissipation. Overall, the effects on the plume will be minor, resulting in temperature differences of the order of 0.5°C from existing levels.

The port will not affect circulation such that the water quality of the eastern margin or the main portion of Cockburn Sound is compromised due to increased residence times.

Dredging
The final operating depth of the port will be 13.7 m, with a berth pocket dredged to 14.0 m. The water is currently about 10 m deep. The deepening of the water column will result in reduced frequency of vertical mixing of the waters in the port, however, this may be compensated for by regular ship movements (approximately one movement every two days). Reduced vertical mixing may result in lower dissolved oxygen concentrations in the bottom waters of the port. However, dissolved oxygen levels are currently not a concern and reduced frequency of mixing is unlikely to cause dissolved oxygen levels low enough to be of concern. JPPL will monitor the dissolved oxygen levels in the waters of the port and establish the degree of mixing caused by ship movements.

The dredging will occur in an area of sand and rubble habitat which has already been partially dredged. The dredging will result in the replacement of sand, rubble and silt habitat ranging from 2 to 10 m depth with sand, rubble and silt habitat at either 13.7 m depth (final depth) or 11.3 m depth (initial dredging depth).

Sediment quality
The increased number of ship visits to the port will provide a proportionate potential increase for localised contamination of the sediments in the port region with tributyltin (TBT) and other toxicants.

Port operations will be managed so that the input of contaminants is minimised. The levels of contaminants in sediments in the Perth coastal region are presently slightly elevated within areas of concentrated shipping activity (e.g. Fremantle Inner Harbour) but generally do not exceed national guideline levels, with the exception of TBT. A similar situation is expected to occur in sediments within the JPPL development.

JPPL will support the Commonwealth Government and International Maritime Organisation (IMO) Marine Environmental Protection Committee resolutions with respect to TBT and alternate use of antifouling paints. However, JPPL will not regulate visits from shipping using TBT or other antifouling compounds until appropriate Commonwealth legislation is in place.

JPPL will develop a programme to monitor the sediments for contaminants and marine organisms (probably the mollusc, \textit{Thais orbita}) in the vicinity for TBT contamination and signs of the reproductive disorder, \textit{imposex} (imposed sexual characteristics). This programme will be incorporated in the EMP for port operations.

Introduced species
At least 18 exotic marine organisms have become established in local coastal waters via discharge of ships’ ballast water or through being dislodged from ships’ hulls. Three Australian Ballast Water Management Advisory Council (ABWMAC) targeted pest species have been recorded in Cockburn Sound: the European fan worm \textit{Sabella} cf. \textit{spallanzanii}, the Asian date mussel \textit{Musculista senhousia} and the dinoflagellate \textit{Alexandrium tamarense}. 
Other established species have been recorded which do not pose any environmental or economic threat. Cockburn Sound has been visited by international shipping since the 1830’s and since the 1950’s has been a regular port of call for international vessels.

The proposal will not increase the number of ship visits to Perth coastal waters, however, it will result in shipping traffic, which previously berthed at Fremantle, berthing at James Point. The increase in international shipping traffic to Cockburn Sound will be approximately 100 ship visits per annum. This increase is small relative to approximately 1,700 total annual ship visits (including naval ships) to Fremantle and Cockburn Sound each year.

JPPL recognises the risk of exotic organisms being introduced to port waters from foreign vessels, and will detail a plan in the EMS which will include risk assessment, a monitoring program for introduced species and a contingency plan for the event that a previously unrecorded ABWMAC targeted species is introduced to port waters.

JPPL is committed to implementing the International Maritime Organisation (IMO), regulatory arrangements for ballast water, a Ballast Water Decision Support System, when those arrangements are adopted by the Australian Government.

The procedures for ballast water control, exotic species control and monitoring will be detailed in the EMS for Stage 1 of the James Point Port.

Hull and propeller cleaning, while the vessel is afloat, will be prohibited within the JPPL port area of control. Therefore, there is no risk of unwanted organisms being introduced as a result of this practice.

**Modification of marine benthic habitat**

Benthic habitat (seafloor which supports life) will be modified by the combined effects of dredging and reclamation. The proposal will result in burial of approximately 19 ha of shallow (<10 m) sandy habitat through reclamation of the wharf area and construction of an offshore breakwater. In addition, approximately 22 ha of shallow sandy habitat will be dredged to a depth of 13.7 to 14.0 m CD. There will be no seagrass or subtidal reef habitat directly affected by this development.

The project will meet the EPA’s objective of protection of remaining seagrass in the Sound. However, there will be deepening and burial of shallow sandy habitat which once supported seagrass. The scale of the loss of shallow sand habitat can be put into context: between 1967 and 1999, seagrass coverage in the Sound reduced from 2,929.4 ha to 660.0 ha and the total mapping area (seabed between the shoreline and 10 m depth) was 3,666.6 ha (DAL, 2000b). This means that in 1999, there is approximately 2,269.4 ha of shallow sandy seabed in the Sound where seagrass once grew. The implementation of this project will result in a 2% loss of this area of shallow sand habitat.

The breakwater and wharf front will provide approximately 3.0 ha of additional limestone subtidal reef habitat to the area which will become colonised by algae and sessile (attached) invertebrate fauna, and will attract additional marine life.

The construction of the project will be managed to minimise any increase in turbidity and impacts on sensitive habitats in Cockburn Sound. Shipping will enter and leave the port via existing, designated shipping channels and there will be no impact, additional to current impacts, on marine habitats after completion of the construction.

**Public risk**

Public risk can occur both during construction and operation of the Port.
During construction activities for the port there will be operations taking place which pose risk primarily to members of the work force. These operations will be managed by developing and implementing a Safety Management System to ensure acceptable levels of risk are achieved for all construction activities.

A preliminary quantitative risk assessment for the Stage 1 port operations was undertaken by conservatively assuming the risk levels would be the same as those calculated for Fremantle Port in the year 2010.

The Stage 1 risk levels were combined with the risks arising from the adjacent BP Kwinana Refinery. The refinery risk levels are for current operations plus future facilities with pressurised shipping and therefore represents the scenario with the highest risk levels from the refinery adjacent to the Stage 1 port. This provides a very conservative estimate of cumulative risk.

The risk values are expressed in terms of the risk to an individual, termed the Individual Risk per annum (IRPA). IRPA is defined as the frequency (per year) to which an individual may be expected to sustain fatal harm due to exposure to hazards. The acceptable risk criteria used are set by the EPA.

Residential zones—The 1.0 x 10\(^{-6}\) risk contour (the upper bound of acceptable risk for residential areas) extends approximately 1 km to the east of the port and some 1.35 km to the north. The nearest residential zones are approximately 2 km from the port and are therefore well outside the 1.0 x 10\(^{-6}\) per year risk contour.

Industrial facilities—The acceptable risk criteria for industries bordering the port is 50 x 10\(^{-6}\) per year. The fenceline risk levels from the development are less than 5 x 10\(^{-6}\) per year which are well within acceptable levels.

Cumulative risk level imposed on industry—The risk arising from the adjacent BP Kwinana refinery to the south of James Point Port: Stage 1 has been accounted for in order to estimate cumulative risk levels. The cumulative risk level imposed on other industries bordering the development does not exceed the criteria of 100 x 10\(^{-6}\) per year.

Buffer zone risk levels—The risk level imposed on buffer areas between the James Point Port and residential areas does not exceed the criteria of 10 x 10\(^{-6}\) per year.

The preliminary risk assessment suggests that the risk levels associated with James Point Port: Stage 1 will satisfy the Western Australian Environmental Protection Authority criteria. JPPL will plan, design, construct and operate the James Point Port: Stage 1 development in a manner that minimises risks to the public, neighbouring facilities and employees, and comply with all statutory requirements and industry standards. A quantitative risk analysis will be conducted and updated every two years or whenever a significant new trade is introduced.

**Pollution and oil spill prevention and clean up**

The prevention of pollution and oil spills and preparedness to act in the event of any incidents will form a vital part of JPPL’s management of the port.

JPPL will develop emergency procedures and safety management systems which will be integrated with the Kwinana Industries Mutual Aid plan and, where appropriate, State and FPA plans. JPPL will comply with the International Maritime Organisation (IMO) regulations governing marine pollution known as MARPOL 73/78. Australia is a full member of the IMO and a signatory to MARPOL 73/78.
JPPL will audit a vessel’s compliance with MARPOL 73/78 on entry to the port area in addition to any audits performed by regulatory authorities.

JPPL will ensure that appropriate waste disposal facilities are provided and used in accordance with current IMO and Australian guidelines.

Hull cleaning will be prohibited in waters controlled by JPPL. Bilge water will not be pumped to the sea in port areas, but may be transferred to a sludge tanker in accordance with the relevant legislation.

Vessels will be managed by pilots within the port area and only one vessel movement at a time will be permitted. These controls, including tug assistance where appropriate, will reduce the potential for vessel collision.

Hydrographic surveys will ensure that nominated underkeel clearance is maintained.

JPPL will have systems in place under the EMS to manage bunker transfer and to take all possible precautions to avoid a spill in the first place.

After the waters are excised from the jurisdiction of the FPA, JPPL will become the agency responsible for oil pollution control and enforcement in the waters (the Prime Agency) and will also be the agency responsible for the clean up of any oil spills (the Combat Agency). The Western Australian Marine Oil Pollution Emergency Management Plan will form the basis of JPPL’s plan.

JPPL will ensure the provision of resources, both human and equipment, to best combat a pollution event. Further, JPPL will, to the fullest extent possible, enter into formal mutual aid agreements with the appropriate authorities/agencies and industry.

All hazardous materials transported through the port will be handled in accordance with the requirements of the Explosives and Dangerous Goods Act 1961. Material Safety Data sheets will be obtained for all chemicals stored at the port and staff will be trained in their handling and use. Appropriate storage facilities (ie bunded areas) will be constructed as required.

**Environmental Quality Objectives for water quality**

The nature of the development is such that it will modify sediment characteristics, water quality and the local ecosystem. As part of this PER preparation process, the DEP have stated that they believe the port should be managed to meet a long-term level of protection for EQO 1 (Maintenance of ecosystem integrity) as level 3 (E3), as the DEP position is that all ports, marinas and harbours should be managed to meet this level of protection. The setting of Environmental Quality Criteria (EQC) for the EQOs and devising a strategy for their implementation is underway, following the process set out by the EPA. This process is scheduled to be completed in 2001, which is before the port will be built.

When the process has been completed, JPPL will commit to managing the port in accordance with the most appropriate long-term level of protection for EQO 1. Similarly, the boundaries of any zones will be set in consultation with the DEP at this time.

Regardless of final levels of protection and criteria, JPPL are committed to monitoring of sediment quality and the bio-availability of contaminants on an annual basis to allow any trends in contamination to be reported. The Commonwealth ban on TBT usage comes into effect in 2003 (refer Section 4.7), however, other toxicants maybe used in its place (eg. copper). JPPL have the intention of implementing best practice environmental management
for the port, however, there will be some forms of contamination (eg contamination associated with antifoulants) beyond JPPL’s immediate control.

Swimming and recreational boating in port waters will be prohibited for safety reasons and therefore port waters will not be directly managed to meet primary contact recreational criteria (EQO 3), although the port waters may still meet these criteria. The waters will be managed to meet secondary boating criteria (EQO 4), aesthetic criteria (EQO 5) (as appropriate for port waters and yet to be described in detail by EPA) and industrial water supply criteria (EQO 6).

**Noise**

Noise will emanate from the port during the construction and operational phases of the port life. Construction noise will be produced by pile driving, dredging and land-based mobile and stationary equipment. If the port attracts the livestock trade, the dominant noise during port operation will be from berthed livestock ships while operating ventilation systems. Other sources include the shore-based stockfeed loading systems and mobile equipment operations.

To predict noise levels, a study was undertaken using noise levels measured at similar operations at Fremantle in combination with modelling to predict future noise levels for a range of scenarios. Based upon the measured noise levels the most sensitive premises for the purpose of compliance evaluation were predicted to be located at the south-west of Hope Valley (Garden Road) and the north-west of Medina (corner of Medina Avenue and Ridley Way South).

Noise modelling of the construction phase predicted that during pile driving during the night, coincident with an exceedence of an assigned level elsewhere, may be considered a significant contributor to the exceedence of the noise level. In recognition of this potential to contribute to noise exceedence the proponent is committed to managing the noise from pile driving to levels as low as reasonably practical.

It is predicted that for the majority of the time during the operation phase, noise emissions from the proposed port would neither exceed the assigned noise levels, nor significantly contribute to any such exceedence. There are predicted infrequent cases in which noise emissions associated with ventilators on livestock vessels berthed at the port may marginally exceed the assigned night level in the south-west of Hope Valley or may exceed evening and night assigned levels. Although the port operator has no legal control of noise emissions from vessels berthed at the port, the port operator will liaise with the vessel operators with the objective of mitigating potential noise exceedence.

The conclusions reached from the components of evaluation, modelling and analysis, coupled with the conservative approach to the noise study, predict the impact of noise from the port on the surrounding area will be negligible.

**Odour**

The port will cater for a wide range of cargoes of which livestock is the only class requiring assessment for odour impacts. Most of the livestock trade will be sheep, although other livestock may also be handled. Furthermore, a livestock holding facility has also been proposed in the vicinity of the port and this is the subject of a separate environmental assessment.

Recognising the proximity of the port and livestock holding facility and the common issue of livestock odour, the evaluation of odours has been based upon the potential cumulative impact of sources of odour from both the port and the livestock holding facility. However, it should be noted that both proposals (the port and the livestock holding facility) are sustainable
without the other. For example, if the livestock pens were built and the port did not proceed, the facility would be used as the staging area for livestock sent to Fremantle, conversely, if the livestock facility did not proceed while the port did, the port would receive livestock in a similar manner to Fremantle.

The port will meet the EPA odour objectives through a range of design considerations and operational practices, including:

- Siting the port on the central, western margin of the Kwinana Heavy Industrial Area which is abutted to the east by a wide air-quality buffer zone. The separation distance of approximately 2 km to the nearest residential area is twice the EPA's guideline of 1 km for livestock holding yards;
- Designing and constructing the facilities to maximise loading rates and therefore minimising the duration that sheep ships are in port. This is one of the benefits from the proximity of the proposed livestock holding facility if it proceeds; and
- Maintaining good housekeeping on the wharf by prompt cleaning following livestock loading. The proponent for the livestock holding facility has also committed to best practice design and operation of that facility to minimise odour emissions to the extent reasonably practical.

A quantitative odour modelling study was undertaken to establish the extent and concentration of odour from the port and adjacent livestock holding. The assessment was based upon conservative assumptions of odour emissions, assuming a larger number of sheep (250,000) than are anticipated to be continually present and by adopting an odour emission rate per sheep that was conservatively high.

The region where odour levels exceed residential criteria is fully contained within the industrial area and does not reach the existing buffer zone. It is predicted to extend east to Morley Street, north to the Kwinana Power Station and south to the northern loop of Mason Road. The modelling study found that that residential areas, such as the nearest at Hope Valley, will not experience odours which could impact upon amenity.

There will be occasions on which the odour of sheep will be distinct in the industrial area immediately adjacent to the port. The odour will be highly recognisable and is not threatening (as some industrial odours are perceived to be). The odour associated with the port will not unreasonably impact upon amenity within the adjacent industrial area.

The beaches adjacent to the port are not authorised for public access and therefore, odour is not considered to be an issue affecting recreational beach use.

**Recreational amenity**

Due to risks associated with adjacent industry, public access is currently prohibited or restricted to the beach area which will be incorporated into the proposal. Currently, unauthorised use is made of the sandy beach located north of the northern BHP Transport jetty, mainly for exercising of horses. This beach will be reclaimed and the area will become part of the port facility.

The proposed port waters are currently restricted waters and recreational craft are prohibited from the area. The same restrictions will apply following the construction of the port.

**Construction impacts**

The primary impact of construction will be the approximately 72,000 truck movements required to cart fill and armour to the site over an 18 month period. The core and armour material is likely to be obtained from an established quarry at Hope Valley. The truck route
proposed is via Postans Rd, Abercrombie Rd, Anketell Rd, Patterson Rd and Beard St (subject to consultation with the Town of Kwinana). This construction schedule amounts to about 153 additional daily truck movements (based on six day week). The volumes of heavy traffic on the designated routes are already high and the increased number of trucks associated with construction will not result in a significant increase in volumes on the main roads. Where trucks will not be using main roads, the roads will largely be through the industrial area.

Any sand fill required will be brought from Baldivis and the proposed route is via the Old Mandurah Rd, Patterson Rd, and Beard St. This also is subject to discussion and agreement with Town of Kwinana and City of Rockingham.

The berth may be built using either sheet piling or tubular piling. Construction of a sheet piled berth will generate noise, however, sheet piling is generally driven by vibration and does not generate significant noise impacts. There will be percussive noise associated with driving tubular piles if this method is employed. JPPL will not undertake pile driving outside the hours of 7 am to 7 pm Monday to Saturday or on Sunday or a Public Holiday unless there is a specific Noise Management Plan produced which will need to be approved prior to such operations by the Chief Executive Officer of the DEP. JPPL will, in managing noise levels to as low as reasonably practicable, only undertake piling outside of the above hours if there is no other way to meet project schedule constraints.

**Aboriginal and European heritage**

The project is unlikely to have any impact on Aboriginal heritage, however, the local Aboriginal community will be consulted prior to commencement of construction. Procedures for dealing with skeletal or archaeological material uncovered during construction will be prepared as part of the Construction EMP.

The project will not have any impact on any sites of European heritage, including shipwrecks.
<table>
<thead>
<tr>
<th>EPA FACTOR</th>
<th>EPA OBJECTIVE</th>
<th>EXISTING ENVIRONMENT</th>
<th>POTENTIAL IMPACT</th>
<th>ENVIRONMENTAL MANAGEMENT</th>
<th>PREDICTED OUTCOME</th>
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<tbody>
<tr>
<td>Marine biota and associated habitat: Impact from dredging</td>
<td>Maintain the ecological function, abundance, species diversity and geographic distribution of marine biota and habitat, consistent with objectives identified in Perth Coastal Waters Environmental Values and Objectives (EPA 2000a) and EPA Bulletin 907.</td>
<td>Majority of benthic habitat is sand, some of which would have supported seagrass meadows prior to 1967. There is no seagrass habitat inside the boundaries of the proposed James Point Port: Stage 1. Deeper areas consisted of silt, sand and rubble.</td>
<td>Loss of shallow sandy benthic habitat due to seabed removal. Increased turbidity during dredging may reduce light availability in surrounding areas.</td>
<td>The dredging will be undertaken such that plumes of suspended material are minimised. The effects of dredging on the light climate of the closest sensitive habitats (seagrass meadows) will be monitored. The monitoring programme and associated contingency plans will be developed in consultation with the DEP as part of the Construction Environmental Management Programme (EMP).</td>
<td>No impact on sensitive habitats in the region (seagrasses) from dredging. Loss of 22 ha of shallow bare sand habitat (&lt;10 m deep) due to dredging.</td>
</tr>
<tr>
<td>Marine biota and associated habitat: Impact from land reclamation and other construction activities</td>
<td>Maintain the ecological function, abundance, species diversity and geographic distribution of marine biota and habitat, consistent with objectives identified in Perth Coastal Waters Environmental Values and Objectives (EPA 2000a) and EPA Bulletin 907.</td>
<td>Majority of benthic habitat is sand, some of which would have supported seagrass meadows prior to 1967. There is no seagrass habitat inside the boundaries of the proposed James Point Port: Stage 1. Deeper areas consisted of silt, sand and rubble. Inshore region is sand bottom leading to sandy beach.</td>
<td>Loss of shallow sandy benthic habitat due to burial. Increased suspended sediment due to reclamation has the potential to reduce light availability to surrounding areas. Limestone armour rock will create approximately 3.0 ha of artificial reef habitat.</td>
<td>The reclamation activities will be undertaken in a manner which minimises the extent and duration of plumes of suspended material. The effects of reclamation on the light climate of the closest sensitive habitats will be monitored. The monitoring programme and associated contingency plans will be developed in consultation with the DEP as part of the Construction Environmental Management Programme (EMP).</td>
<td>No impact on other sensitive habitats in the region (seagrasses) due to reclamation. Loss of 19 ha of shallow bare sand (&lt;10 m deep) due to reclamation. Limestone armour will be colonised by marine flora and fauna associated with local reefs.</td>
</tr>
<tr>
<td>Marine biota and associated habitat: Impact from operations</td>
<td>Maintain the ecological function, abundance, species diversity and geographic distribution of marine biota and habitat, consistent with objectives identified in Perth Coastal Waters Environmental Values and Objectives (EPA 2000a) and EPA Bulletin 907.</td>
<td>Majority of benthic habitat is sand, some of which would have supported seagrass meadows prior to 1967. There is no seagrass habitat inside the boundaries of James Point Port: Stage 1.</td>
<td>Increased turbidity in the port area due to increased shipping activity. Imposex in some marine fauna caused by TBT.</td>
<td>JPPL will adhere to IMO and Commonwealth guidelines on antifoulants. Molluscs and sediments will be monitored for the effects of TBT.</td>
<td>No impact on light sensitive environments as shipping activity will be restricted to existing channels and the new port area is not adjacent to sensitive habitats. Increased ship visits to James Point may cause increase in</td>
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<tr>
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<td><strong>Coastal processes and littoral drift</strong>: Impact of construction activities and permanent modification to coastal strip at James Point</td>
<td>Maintain the stability of beaches and the integrity, function and environmental values of the foreshore area. Minimise the impact of foreshore erosion down drift of the port facilities and demonstrate that the proposed works will not result in the need for increased beach renourishment or other erosion protection methods.</td>
<td>Sediments are contaminated with metals and tributyltin (TBT). Southerly and south-westerly wind patterns transport sand north along the beach, northerly and north-westerly winds and swell (usual associated with winter) transport sand south along the beach. Transport volumes are low, estimated to be in the order of 10’s of thousands of m$^3$ in each direction.</td>
<td>Alter the existing sediment transport regime and alter local erosion and depositional patterns during and after construction. Affect the stability of local beaches during and after construction.</td>
<td>A structure of this scale on the coast is certain to alter the local sediment transport patterns. Management will focus on minimising, measuring and managing changes. Numerical modelling will be used to fine tune the design of the offshore breakwater to reduce the wave energy reflected towards beach north of the port. A beach profile monitoring programme will be implemented which will allow early detection of trends in erosion and accretion. JPPL may then implement coastal engineering solutions if warranted.</td>
<td>The port will tend to trap sand moving in both directions. The amount of sand will not affect the viability of the port. The offshore breakwater will change the distribution of wave energy reaching the shore to the north of the port during and after construction. This may change the local beach shape to the north. The amount of sand transported south to James Point may also reduce. Minor shore protection measures may be required.</td>
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<tr>
<td><strong>Dunes</strong>: Impact of land reclamation and other construction activities</td>
<td>Maintain the integrity, function and environmental values of the dune system of the Cockburn Sound Coast.</td>
<td>The site contains a mostly intact foredune and primary dune system.</td>
<td>Loss of 900 m of coastal dune system.</td>
<td>The construction and operation of the project will be conducted so as to minimise further loss of coastal dune system additional to that lost to reclamation.</td>
<td>Loss of 900 m of coastal dune system.</td>
</tr>
<tr>
<td><strong>Terrestrial vegetation</strong>: Impact from land reclamation and other construction activities</td>
<td>Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.</td>
<td>The vegetation is not regionally significant. Much of the remnant dunefield and associated Quindalup Complex vegetation of the project area has been degraded by a variety of factors including weed invasion, clearing, fire frequency, erosion and human use pressure.</td>
<td>Loss of degraded Quindalup dune complex vegetation.</td>
<td>The construction and operation of the project will be conducted so as to minimise loss of coastal vegetation additional to that lost to reclamation.</td>
<td>Loss of degraded Quindalup dune complex vegetation.</td>
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<td><strong>Introduction of exotic organisms</strong>: Ballast water management</td>
<td>Minimise the risk of introduction of unwanted marine organisms consistent with the AQIS guidelines for ballast water management and</td>
<td>There are approximately 18 exotic species currently established in Perth’s coastal waters. The number of ships visiting James Point will increase, resulting in an increased risk of exotic species introduction at James Point.</td>
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<td>A ballast water management plan will be prepared for the port in accordance with AQIS guidelines.</td>
<td>Increased risk of further introduction of exotic species to James Point region.</td>
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<td>ANZECC Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance.</td>
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<td>Audit vessel logs to ensure that, where appropriate, ballast water exchange at sea has taken place. Hull cleaning or bilge water discharge to port will not be permitted. JPPL will monitor port for introduced species.</td>
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<td><strong>Groundwater quality:</strong> Construction works and ongoing operations</td>
<td>Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance, are protected consistent with draft WA Guidelines for Fresh and Marine Waters (EPA, 1993) and objectives defined in <em>Perth Coastal Waters Environmental Values and Objectives</em> (EPA 2000a).</td>
<td>Heavy industrial activity over the past 50 years has resulted in contamination of groundwater in the vicinity of the proposal. No impact on levels of contaminants in groundwater or on groundwater flows.</td>
<td>The berth face will incorporate drainage so that current groundwater flows to the Sound are not significantly impeded. The Stage 1 development will not need to extract local groundwater to operate. The construction of the Stage 1 development will not require excavation below groundwater level. JPPL will undertake a survey of contaminant levels in the groundwater on the site prior to construction.</td>
<td>The Port will not significantly disturb local groundwater flows or concentration of contaminants.</td>
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<td><strong>Surface water quality:</strong> Construction works and ongoing operations</td>
<td>Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected consistent with draft WA Guidelines for Fresh and Marine Waters (EPA, 1993) and objectives defined in <em>Perth Coastal Waters Environmental Values and Objectives</em> (EPA 2000a).</td>
<td>There are currently no significant surface water bodies on the site or surface water discharges to the Sound from the site. Increase in surface runoff flowing to Sound due to an increase in impermeable surface area. Deterioration in quality of surface runoff due to operation onshore cargo transfer activities.</td>
<td>The wharf area has been designed such that all surface water runoff will pass through an oil trap and then a sedimentation basin before returning to the port waters. Spills of contaminants onto the wharf will be managed under the James Point Port: Stage 1 Environmental Management System (EMS). The EMS will outline contingency measures to contain and clean-up spills.</td>
<td>Slight increase in amount of surface water runoff entering the Sound. Maximum impact on water quality likely during first winter rains. No significant impact on water quality during normal operations. Spills will be managed in accordance with the James Point Port: Stage 1 EMS and an Oil Spill contingency plan.</td>
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<td>Marine water and sediment quality: Port structure</td>
<td>Maintain or improve marine water and sediment quality consistent with Environmental Quality Objectives (EQOs) and Environmental Quality Criteria (EQCs) defined in the Southern Metropolitan Coastal Waters Study (DEP, 1996a) and Perth Coastal Waters Environmental Values and Objectives (EPA 2000a).</td>
<td>Water column in the vicinity has slightly elevated productivity compared to the main part of Cockburn Sound due to nitrogen rich point source and groundwater discharges south of James Point.</td>
<td>Increased residence time may increase productivity in port waters. Deeper waters may reduce frequency of vertical mixing. Calmer waters and slight increase in productivity within the port likely to increase organic content of sediments within the port.</td>
<td>The boundaries and level of protection for the long term ecological quality objectives (EQO1) for waters of the port will be set in consultation when the criteria and implementation strategy are finalised. JPPL, in consultation with the DEP, will derive water and sediment quality criteria for the port and the waters adjacent to the port as part of the EMS.</td>
<td>There will be an increase in productivity in the port waters. Productivity is low and this slight increase in productivity is such that algal blooms will not become a management issue. For example, nutrient loads to the port are much lower than nutrient loads to the Jervoise Bay Northern Harbour and the waters of the port are flushed more rapidly.</td>
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<tr>
<td>Marine water and sediment quality: Dredging-turbidity</td>
<td>Manage turbidity levels from construction to protect agreed environmental values (as outlined in Perth Coastal Waters Environmental Values and Objectives, EPA 2000a).</td>
<td>Turbidity levels are low due to low energy environment and sand size sediments. Sediments contain nutrients which may be released to the water column when sediments are disturbed and phytoplankton cysts which may germinate when resuspended.</td>
<td>Resuspension of sediments causing increase in number of phytoplankton cysts brought up into water column and possibly increasing nutrient concentrations. Resuspension of suspended sediment has the potential to reduce light availability (increase turbidity) to surrounding areas (see above).</td>
<td>Water quality will be monitored during dredging in accordance with a plan presented in the Construction EMP which will be developed in consultation with the DEP. The plan will include monitoring of nutrients, phytoplankton species, and impacts on light at the closest light sensitive habitats.</td>
<td>No long term impact on the surrounding environment.</td>
</tr>
<tr>
<td>Marine water and sediment quality: Impact of increased shipping operations.</td>
<td>Maintain or improve marine water and sediment quality consistent with Environmental Quality Objectives (EQOs) and Environmental Quality Criteria (EQCs) defined in the Southern Metropolitan Coastal Waters Study (DEP, 1996a) and Perth Coastal Waters Environmental Values and Objectives (EPA 2000a).</td>
<td>Phytoplankton species in vicinity of James Point are typical of the region. Sediments adjacent to the BHP transport jetties show evidence of contamination, with elevated levels of TBT, copper, and mercury.</td>
<td>Increased ship visits to the area may increase the risk of introducing exotic phytoplankton species. Shipping activity is likely to cause further contamination of sediments.</td>
<td>JPPL will implement a monitoring programme for introduced species. Hull cleaning and bilge water discharge will be prohibited in port waters. Regulation of ballast water discharge will be undertaken by AQIS, JPPL will provide all</td>
<td>Slight increase in the risk of further introduced species at James Point. The low magnitude of this risk can be established by considering that Fremantle and Cockburn Sound currently receive about 1,700 international ship visits each year, whereas the port will attract about 100 extra ships per year. There will be more ships entering Cockburn Sound to...</td>
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<td>Contamination: Dredge Spoil</td>
<td>Contaminated material should be treated and/or disposed of in a manner which adequately controls the infiltration of water in the material, and the formation and seepage of leachate from the material.</td>
<td>Material to be dredged will meet the DEP criteria for clean landfill, as with the exception of copper levels in a surface sample taken next to the BHP No. 1 jetty, all relevant criteria are met.</td>
<td>No impact.</td>
<td>No further management required.</td>
<td>No impact.</td>
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<td>Contamination: Liquid and solid waste – construction and on-going operations</td>
<td>Ensure wastes associated with construction and on-going port operations are managed in accordance with the waste management hierarchy (i.e. avoid, minimise, recycle, treat and dispose), and where this is No waste generated in existing environment.</td>
<td>Port activities will generate waste.</td>
<td>Waste management will be addressed in JPPL EMS.</td>
<td>Waste generation and disposal managed and monitored in accordance with EMS for port operations.</td>
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<td>Contamination: Additional fill material</td>
<td>Ensure additional fill required for reclamation works is of acceptable standard, compatible with intended end use and surrounding environment and consistent with appropriate criteria.</td>
<td>The reclamation works will require approximately 137,000 m³ of imported fill material.</td>
<td>No impact.</td>
<td>The fill will be sourced from locations where the quality is known. These locations will be confirmed with the DEP for approval prior to commencement of construction.</td>
<td>No impact due to additional fill requirements.</td>
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<tr>
<td>Contamination: Oil spill</td>
<td>Minimise the impacts of fuel or oil spillage during ship movements and refuelling (if applicable).</td>
<td>The majority of Cockburn Sound, including the proposed port location, forms the Fremantle Port Authority (FPA) Outer Harbour. There is an oil spill contingency plan in place for this region, the FPA is the designated Prime Agency and Combat Authority.</td>
<td>The risk of significant oil spills is very low. Increase in shipping visits will result in a slight increase in this risk.</td>
<td>The FPA will remain the Prime Agency with control of the port waters until control of such waters is vested in JPPL. Following this, JPPL will become the designated Prime Agency and Combat Authority. JPPL will, to the fullest possible extent, enter into formal mutual aid agreements with the appropriate agencies and industries and become involved in exercises with FPA and industry where appropriate.</td>
<td>Slight increase in, what is already, a low risk of oil spills in Cockburn Sound with increase in ship visits. The low magnitude of this risk can be established by considering that Fremantle and Cockburn Sound currently receive about 1,700 international ship visits each year, whereas the port will attract about 100 extra ships per year.</td>
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<td>Air: Particulate/Dust Emissions (Construction)</td>
<td>Protect the surrounding land users such that dust and particulate emissions will not adversely impact upon their welfare and amenity or cause health problems by meeting the Guidelines for the Prevention of Dust and Smoke Pollution from Land Development Sites in WA and the Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1999.</td>
<td>The industrial area surrounding the proposed Port site contains extensive areas of open space. Closest industries include: • HISmelt direct reduced iron plant. • BHP Transport bulk storage. The nearest residential area to the James Point site is Hope Valley, approximately 2 km to the north-east.</td>
<td>Close proximity to the coast and strong sea breeze conditions produce potential for land preparation work to create dust and for dust deposition on neighbouring industrial properties. Due to the proposed location and separation distances, no potential impacts on residential areas.</td>
<td>Vegetation retention: the layout of port facilities and construction areas will have regard to maximising retention of existing vegetation. Vegetation clearing: no cleared vegetation will be burned. Dust Suppression: standard dust suppression measures for land preparation to be implemented. These may include hoses, sprinklers and water trucks. Stabilisation: areas temporarily disturbed during construction</td>
<td>Adoption of the proposed management practices will prevent any significant dust impact on industrial neighbours. Due to the separation distances, there will be no dust impact on residential areas.</td>
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<tr>
<td><strong>Air: Particulate/Dust Emissions (Operations)</strong></td>
<td>Protect the surrounding land users such that dust and particulate emissions will not adversely impact upon their welfare and amenity or cause health problems by meeting the Guidelines for the Prevention of Dust and Smoke Pollution from Land Development Sites in WA and the Environmental Protection (Kwinana)(Atmospheric Wastes) Policy 1999.</td>
<td>The industrial area surrounding the proposed Port site contains extensive areas of open space. The nearest residential area to the James Point site is Hope Valley, approximately 2 km to the north-east.</td>
<td>Potential dust emissions if there is a failure of the stock feed material handling equipment.</td>
<td>An Air Quality Management Plan will be prepared as part of the EMP.</td>
<td>No unacceptable particulate impacts. Due to the location there will be no impact on residential areas.</td>
</tr>
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<td><strong>Noise: Construction</strong></td>
<td>Ensure noise impacts emanating from proposed dredging, reclamant and other construction activities comply with statutory requirements and acceptable (and appropriate) standards.</td>
<td>Industrial area. Nearest residence approximately 2 km away.</td>
<td>Noise created by transport, pile driving, dredging and general construction activities.</td>
<td>Under the provisions of the Environmental Protection (Noise) Regulations, construction activities are not subject to regulations prescribing adherence to Assigned Levels.  Modelling predicts that construction activities will satisfy assigned noise levels at noise sensitive premises. Under down-wind conditions, construction emissions may be considered a ‘significant’ contributor should a cumulative exceedence occur at Hope Valley. Construction work will be managed in accordance with Best Practice, as set out in Section 6 of AS 2436-1981 ‘Guide to Noise Control on Construction, Maintenance and Demolition Sites’. Construction transport will occur via agreed heavy transport routes.</td>
<td>Construction noise emissions will not exceed the assigned levels but may contribute to cumulative exceedence under down-wind conditions.</td>
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<td><strong>Noise: Port operations</strong></td>
<td>Ensure noise impacts emanating from on-going operations comply with statutory requirements and acceptable (and appropriate) standards.</td>
<td>The James Point Port: Stage 1 will be located on the western seaboard of the Kwinana Industrial Area, surrounded by major infrastructure, and heavy industry. Shipping jetties are common along this section of coast, including two established at this location - BHP No. 1 and No. 2. Immediately north is the Alcoa jetty and to the south is the BP Refinery jetty and the FPA Bulk Cargo Jetty.</td>
<td>Noise will be generated by: • Equipment on ships in port particularly the ventilation systems on livestock vessels; • Fixed land-based, material conveying equipment; • Mobile port equipment; and • Trucks servicing the port trade.</td>
<td>Modelling has been undertaken to estimate the potential sound pressure levels which might be produced by the port and the appropriate assigned levels which should be satisfied at noise sensitive premises. Noise emissions from livestock feed loading equipment will be controlled so as not to be a significant contributor to cumulative noise in residential areas. A noise monitoring programme and review process will be established as part of the Port EMP. The Port will establish a complaint registration and investigation system for any noise complaints. The Port will also actively participate in an appropriate community consultation forum to keep the community informed on port operations and to remain aware of community concerns. The Port operators will liaise with the owners of any vessel which consistently contributes to an exceedance of the assigned residential noise levels and unreasonably impacts amenity.</td>
<td>Due to the separation between the port and the nearest residences (~2 km) the potential for noise exceedence is minimal. Under adverse meteorological conditions and presence in port of a noisier ship, night-time adjusted, assigned levels may be marginally exceeded at Medina. If the operations at Fremantle were moved to James Point, there would be a substantial net improvement in noise impacts on residential areas. Noise modelling predicts that at noise sensitive premises: • Operations of the port will comply with assigned levels during the day and evening with the possibility of exceeding 0.2% of the night time at Hope Valley; • Were the assigned levels being exceeded due to other sources, the port might be considered a significant contributor 1% of the time in the evenings and 0.8% at night time at Hope Valley and 0.1% of the night time at Medina; and • Although improbable, were the noise emission from the port considered tonal at Hope Valley, then the...</td>
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<td>Noise: Transport</td>
<td>Minimise the impact to noise sensitive premises from increased traffic movement.</td>
<td>The catchment area for James Point Port: Stage 1 is well serviced with primary roads and connections to the Kwinana Freeway. The primary roads in closest proximity to the port are mostly not through residential areas and therefore have limited impact on noise sensitive premises.</td>
<td>Road transport patterns will change as cargo previously directed to Fremantle is handled through James Point. This will result in an increase in truck movements on Patterson, Anketell, Thomas and some roads servicing the Kwinana Industrial area. James Point Port: Stage 1 will have the positive environmental effect of removing trucks and associated noise from the residential areas on route to Fremantle.</td>
<td>The port operator has limited capacity to influence the transport arrangements of third parties using the port services. Transport companies hauling the type of freight handled by a seaport will use established, major truck routes.</td>
<td>An increase in truck movements on primary roads leading into James Point Port: Stage 1, but principally not through residential areas. A corresponding decrease in the number of trucks passing through the residential areas, into the Fremantle Port.</td>
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<td>Odour: Transport, handling and storage of cargo</td>
<td>Odours emanating from the proposed development should not adversely affect the welfare and amenity of other land users. Ensure compliance with acceptable standards and that all reasonable and practicable measures are taken to minimise adverse impact of odorous gases. Ensure that odour emissions, both individually and cumulatively, meet appropriate standards.</td>
<td>The port is located in the central west of the Kwinana Industrial Area. The nearest residential area to the port site is approximately 2 km to the east. An Air Quality Buffer Zone has been designated to the east of the industrial area, under provisions of the Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1999.</td>
<td>Livestock export through the port will generate odours, as will the temporary holding of stock at the adjacent Livestock Holding Facility. Although the two projects are independent, cumulative odour impact has been assessed for the James Point Port: Stage 1 proposal.</td>
<td>Location: the port will be located on the western margin of the heavy industrial area, consistent with the land zoning and regional planning. The industrial area is flanked to the east by the Air Quality Buffer Zone. Residential separation: residences currently exist within the Kwinana Air Quality Buffer Zone and the proposal recognises these as constituting the nearest residences to be affected.</td>
<td>Compliance with EPA guidelines for separation of stock handling facilities and residential areas. Modelling predicts no unacceptable odour impact at the nearest residences within the Air Quality Buffer Area. Odours will be experienced at James Point Port: Stage 1, the Livestock Holding Facility and immediate neighbouring industrial operations.</td>
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<td>Light overspill</td>
<td>Manage potential impacts from light overspill and comply with acceptable standards.</td>
<td>The port is located in the central west of the Kwinana Industrial Area. The port site is remote from residential areas and surrounded by 24 hour a day operations.</td>
<td>Light spill to sensitive premises is improbable due to separation distances.</td>
<td>Lighting will be designed to maximise light where required and minimise overspill. Managed under Part V of the <em>Environmental Protection Act, 1986</em> and with regard for AS4282 Interim Standard – control of the Obtrusive Effects of Outdoor Lighting.</td>
<td>No adverse impact is anticipated.</td>
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<td>Recreation and commercial: Beach access.</td>
<td>Ensure that public access to and regional and recreation use of mainland foreshores and beaches is maintained, consistent with proposals developed and approved by planning agencies.</td>
<td>Beach is currently used for exercising horses and occasional recreational activities. However, use of the beach for these activities is unauthorised.</td>
<td>900 m of beach will be lost.</td>
<td>Recreational access to the region between BP and Western Power will continue to be restricted.</td>
<td>No change in authorised recreational amenity.</td>
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<td>Recreation and commercial: Fishing and commercial activities</td>
<td>Ensure that shipping operations do not compromise commercial activities including fisheries, within the Sound.</td>
<td>Unauthorised vessels and boats are not permitted in the proposed port waters. Shipping currently moves through the region via the Stirling and Calista Channels. Mussel farming is conducted south of the port.</td>
<td>Slight increase in shipping movements along existing shipping channels.</td>
<td>To maintain public safety, restrictions an access to port waters will be enforced. Fishing groups will be briefed on the restrictions applying to the port waters and the anticipated increase in ship movements within the Sound.</td>
<td>No impact.</td>
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<td>Recreation and commercial: Boating</td>
<td>Ensure that port activities and shipping operations do not compromise reasonable boating and other existing or potential recreational activities, within the Sound.</td>
<td>Unauthorised vessels and boats are not permitted in port waters. Shipping currently moves through the region via the Stirling and Calista Channels.</td>
<td>Increased shipping movements along existing shipping channels.</td>
<td>To maintain public safety, restrictions to port waters will be enforced. Boating groups will be briefed on the restrictions applying to port waters and the anticipated increase in ship movements within the Sound.</td>
<td>No impact.</td>
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<td><strong>Heritage: Aboriginal culture and heritage</strong></td>
<td>(i) Ensure that the proposal complies with the requirements of the <em>Aboriginal Heritage Act 1972</em>; and (ii) Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.</td>
<td>The project lies within the region subject to registered native claim WC98/58, Gnaarla Karla Booja. Cockburn Sound is part of an Aboriginal site concerning the mythology about the creation of the islands in Perth’s coastal waters. Aboriginal burial sites are commonly found in dunes along the West Australian coast.</td>
<td>Dredging activity will disturb Cockburn Sound. Coastal dunes will be buried by reclamation.</td>
<td>Prepare Aboriginal Heritage Management Plan. Local Aboriginal groups will be consulted prior to commencement of construction. Any ground disturbing work will be monitored for skeletal or archaeological material.</td>
<td>Appropriate response in the event that any items of archaeological significance are found. Consultation with local Aboriginal groups prior to construction.</td>
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<tr>
<td><strong>Heritage: Maritime shipwrecks</strong></td>
<td>Ensure that offshore shipwreck sites are protected to the satisfaction of the Maritime Museum of WA.</td>
<td>Cockburn Sound contains a number of shipwrecks. However, the West Australian Maritime Museum has indicated that there are no wrecks within port waters.</td>
<td>No impact.</td>
<td>No management required.</td>
<td>No impact.</td>
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<td><strong>Risk (Public health and safety): Port construction</strong></td>
<td>Ensure that risks from other hazardous facilities in the Kwinana Industrial Area are catered for during the construction programme.</td>
<td>The port is adjacent to an existing risk generating premises, the BP refinery. The region is a zoned heavy industrial area.</td>
<td>Increase in risk due to construction activities.</td>
<td>During construction activities for James Point Port: Stage 1 there will be operations taking place which pose risk primarily to the work force. These operations will be managed by developing and then implementing a Safety Management System. This will be used to ensure acceptable levels of risk are achieved for all operations.</td>
<td>Acceptable levels of risk for construction.</td>
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<td><strong>Risk (Public health and safety): Port operations</strong></td>
<td>Ensure that risk is assessed and managed to meet the EPA’s criteria for individual fatality risk off-site and the Department of Mineral and Energy’s requirements in respect of public safety.</td>
<td>The port is adjacent to an existing risk generating premises, the BP refinery. The region is a zoned heavy industrial area.</td>
<td>Increase in risk due to operations.</td>
<td>Engineering controls and management systems and procedures will be developed to minimise the potential for a release of toxic or hazardous material and to reduce the consequences of such a release should it occur. These controls will be documented in the port safety plan and emergency response plan.</td>
<td>In general, the risk levels associated with James Point Port: Stage 1 satisfy the EPA criteria. The cumulative risk level imposed on other industries bordering James Point Port: Stage 1 does not exceed the criteria of 100 x 10⁻⁶ per year.</td>
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<td>Risk (Public health and safety): Transport of goods to and from the port facility</td>
<td>Ensure that public risk associated with implementation of the proposal is as low as reasonable achievable in accordance with EPA Guidance No. 2.</td>
<td>The region is subject to a high frequency of heavy transport movements.</td>
<td>Increased transport of all types of goods (including dangerous goods) within the vicinity of the port.</td>
<td>JPPL is not responsible for transport outside the port boundaries. The road and rail transport of Dangerous Goods is governed by the Australian Code for the Transport of Dangerous Goods by Road and Rail (sixth edition) as approved by the Ministerial Council for Road Transport and endorsed by the Australian Transport Council. The Competent Authority in Western Australia is the Department of Minerals and Energy Explosives and Dangerous Goods Division.</td>
<td>No impact.</td>
</tr>
<tr>
<td>Management: Management Responsibility</td>
<td>Ensure that a clear defined management structure is in place which delineates responsibilities for on-going management and monitoring of the environmental health of the port area.</td>
<td>N/A</td>
<td>N/A</td>
<td>JPPL has in place a draft management structure. This structure will be finalised in the EMS document.</td>
<td>Port operations managed to meet environmental, operations, health and safety requirements. Responsibility for each facet of operations clearly delineated.</td>
</tr>
<tr>
<td>Cumulative impacts</td>
<td>Ensure that appropriate measures are taken to implement the advice and recommendations provided by the EPA in Bulletin 907 to Cockburn Sound is subject to a number of existing, pending and possible future development pressures.</td>
<td>The development may act cumulatively with other proposed developments on the eastern margin of Cockburn Sound to affect the</td>
<td>As agreed with the EPA, JPPL will provide advice separate to this PER to the EPA on the cumulative impacts of future developments.</td>
<td>The port will interact with BP and Western Power discharges to the Sound, however, the port will not increase the impact of the discharges.</td>
<td></td>
</tr>
</tbody>
</table>

James Point Pty Ltd aims to plan, design, construct and operate the James Point Port: Stage 1 development in a manner that minimises risks to the public, neighbouring facilities and employees, and complies with all statutory requirements and industry standards. A detailed risk analysis will be undertaken within two years of the starting trade through the port.
<table>
<thead>
<tr>
<th>EPA FACTOR</th>
<th>EPA OBJECTIVE</th>
<th>EXISTING ENVIRONMENT</th>
<th>POTENTIAL IMPACT</th>
<th>ENVIRONMENTAL MANAGEMENT</th>
<th>PREDICTED OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>manage long term impacts in the Sound.</td>
<td>The EPA has recommended that long term impacts of development in the Sound are managed through the consideration of the cumulative impact of the development and adjacent developments.</td>
<td>environment to a greater extant than if the developments did not act cumulatively.</td>
<td>This PER addresses cumulative impacts of the Stage 1 development and existing developments.</td>
<td>The port will not act cumulatively with the Jervoise Bay Northern Harbour due the distance between the two developments.</td>
<td>The risk contours associated with the port will combine with those from the BP refinery.</td>
</tr>
<tr>
<td>Ensure that environmental values and objectives defined in the EPA Position Document Perth Coastal Waters Environmental Values and Objectives (EPA 2000a) are maintained and protected.</td>
<td>Ensure that appropriate consideration is given to cumulative impacts of land-based activities, with particular reference to noise, odour and waste/emissions management.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations:

ANZECC–Australia and New Zealand Environment and Conservation Council
AQIS–Australian Quarantine Inspection Service
BP–British Petroleum
BHP–Broken Hill Propriety Ltd
FPA–Fremantle Port Authority
DEP–Department of Environmental Protection
EMP–Environmental Management Plan
EMS–Environmental Management System
EPA–Environmental Protection Authority
EQC–Environmental Quality Criteria
EQO–Environmental Quality Objective
IMO–International Maritime Organisation
JPPL–James Point Pty Ltd
TBT–tributyltin
1. **INTRODUCTION**

1.1 **PURPOSE OF THIS DOCUMENT**

This document presents the proposal by James Point Pty Ltd (JPPL) to construct a land-backed berth and offshore breakwater immediately north of James Point, Cockburn Sound, WA (James Point Port: Stage 1, Figure 1.1). It is intended that James Point Port: Stage 1 will be profitable and sustainable in its own right, however, the project also forms the first stage of a long term plan for development at James Point.

This Public Environmental Review (PER) document is designed to present all relevant information to the public concerning the proposal and investigations undertaken to establish the likely environmental impact of the Stage 1 development. JPPL welcomes public comment on the proposal, comment should be provided as set out in the invitation at the beginning of this document.

1.2 **PROPONEENT**

The proponent for the project is JPPL, who can be contacted as follows:

James Point Pty Ltd  
PO Box 140  
NORTH FREMANTLE WA 6159  

Attention: Mr Bryn Martin  
Telephone: (08) 9433 5100  
Facsimile: (08) 9433 5122  
Email: jamespt@echidna.id.au  

*Note: During the eight week public review period, submissions regarding this proposal should be sent to the Environmental Protection Agency (EPA) as set out in the invitation at the beginning of this document.*

1.3 **TIMING**

It is hoped that approval for the project will be obtained in September 2001. JPPL is likely to commit to achieving completion of at least 600 metres of new land backed berth by November 2002. The final completion of Stage 1 is expected to occur over the next five years.

1.4 **CONSULTATION**

JPPL has consulted with a wide range of industry, community groups, Local Government Authorities and Parliamentary representatives.

JPPL will meet with the same groups once the PER is released. The purpose of the meetings will be to discuss the PER, respond to any queries raised by any of the groups and invite comment on the proposal. JPPL also proposes to hold an open day in the Town of Kwinana during the public release period for this PER.

The details of public consultation undertaken are provided in Section 14.
James Point Port Facilities: Stage 1

James Point Port Limits

Figure Area

Cockburn Sound

Garden Island

Point Peron

Cockburn Road

Rockingham Road

Patterson Road

Mandurah Road

Office Rd

Dixon Road

James Point

Mangles Bay

Collie Head

Careening Bay

Gage Roads

Buchanan Bay

Carnac Island

Woodman Point

Warden Island

Garden Island

Rous Head

BP Refinery

Western Power

Mason Road

Stirling Channel

James Point Port Facilities: Stage 1

James Point Port Limits

Garden Island

Point Peron

Cockburn Sound

Gage Roads

Buchanan Bay

Carnac Island

Woodman Point

Warden Island

Rous Head

BP Refinery

Western Power

Mason Road

Stirling Channel

James Point

Mangles Bay

Collie Head

Careening Bay

James Point Port Facilities: Stage 1

James Point Port Limits

Garden Island

Point Peron

Cockburn Sound

Buchanan Bay

Carnac Island

Woodman Point

Warden Island

Rous Head

BP Refinery

Western Power

Mason Road

Stirling Channel

James Point

Mangles Bay

Collie Head

Careening Bay

James Point Port Facilities: Stage 1

James Point Port Limits

Garden Island

Point Peron

Cockburn Sound

Buchanan Bay

Carnac Island

Woodman Point

Warden Island

Rous Head

BP Refinery

Western Power

Mason Road

Stirling Channel

James Point

Mangles Bay

Collie Head

Careening Bay

James Point Port Facilities: Stage 1

James Point Port Limits

Garden Island

Point Peron

Cockburn Sound

Buchanan Bay

Carnac Island

Woodman Point

Warden Island

Rous Head

BP Refinery

Western Power

Mason Road

Stirling Channel

James Point

Mangles Bay

Collie Head

Careening Bay
1.5 ENVIRONMENTAL APPROVAL PROCESS

The following is based on information provided to the public by the EPA.

1.5.1 Overview

The environmental impact assessment process is aimed at protecting the environment by ensuring development is environmentally sound and sustainable. Proponents are required to inform the EPA and the community what the development is, what the expected environmental impacts are, and how they plan to manage the project so the environment will be protected. They also are required to commit to the environmentally responsible implementation of their proposals.

Environmental impact assessment provides a way in which independent environmental advice can be given to the Government so it can properly decide whether project should be allowed to proceed on the basis of a range of advice covering political, environmental, economic, social and cultural issues. Environmental impact assessment is aimed at resolving questions of ‘how to’ manage projects so the environment is protected rather than to say ‘yes’ or ‘no’ to development.

The EPA provides independent advice to the Government and the community on ways to ensure environmentally acceptable development. The Government decides whether it accepts that advice.

1.5.2 Aims of the process

Environmental protection in Western Australia is based on a value that captures the hopes and aspirations of most people. It is that:

"The world should be a good place in which to live, and to make a living, for all of us, and for our children and theirs."

Environmental impact assessment, therefore, is designed to ensure that the environment is looked after when new development proceeds. The process runs in parallel with project development so that designers and planners can incorporate environmental protection and developers can commit themselves to continuing, responsible environmental management.

The process also is designed to:

- Ensure that Governments get timely and sound environmental advice before they make decisions;
- Encourage and provide opportunities for public involvement in the environmental aspects of proposals before decisions are made;
- Ensure that proponents take primary responsibility for protecting the environment affected by their proposals;
- Encourage environmentally sound proposals which minimise adverse environmental impacts and maximise environmental benefits;
- Provide for continuing environmental management; and
- Promote environmental awareness and education.

1.5.3 The process

The EPA in Western Australia is a five member independent advisory board that recommends to the Government whether projects are environmentally acceptable. It
does not decide whether projects should proceed. That task is properly left with the Government.

The first formal step of environmental assessment is the referral of a proposal to the EPA for a determination as to the level of assessment required. The proposal document includes a brief description of the project, the likely environmental impact and how that impact will be managed.

The EPA has several options for dealing with a proposal referred for assessment. It may:

- Decline to assess it because it is considered environmentally insignificant;
- Assess it ‘in house’ and provide public advice (known as an Informal Review with Public Advice);
- Issue a works approval and license;
- Assess it ‘formally’ as an Environmental Protection Statement (EPS), Public Environmental Review (PER), or Environmental Review and Management Programme; or
- Assess it as Proposal is Unlikely to be Environmentally Acceptable (PUEA).

Formal assessments require varying degrees of environmental and public review and evaluation. All formal assessments are reviewed and evaluated by the EPA who advise the Government on environmental acceptability. The Government then decides whether to approve.

This proposal was referred to the EPA and in this case, the level of assessment was set as PER with an eight week public review period and this was advertised in the *West Australian* to allow appeals on the levels of assessment. There were no appeals from the public on this level of assessment.

**1.5.4 Public Environmental Review**

PER is used for proposals with either major public interest or potential for significant environmental impact. In these cases, the EPA issues a detailed, project-specific list of guidelines which should be examined by the proponent in its PER. The guidelines provided for the Stage 1 proposal are attached as Appendix 1.

The PER process is designed to ensure that people are told about proposed developments, have a say, and are heard before decisions are made. People having an interest in, or living near, a proposed development often have important local knowledge which can contribute to better environmental management.

The EPA will provide a summary of issues raised during the public review of the PER documents. All submissions received by the EPA will be treated as publicly available unless specifically marked confidential. Proponents then must provide a written response to the issues, including commitments to their management where appropriate. The issues and the proponent's response to them are published by the EPA in its report and recommendations to the Minister for the Environment.

**1.5.5 EPA recommendations**

In its assessment of a proposal, the EPA will consider issues raised by the public, specialist advice from Government agencies, the proponent's response to those issues, the EPA’s own research and, in some cases, research provided by other expert agencies. The EPA takes about six weeks on average to assess a proposal after the
The proponent has responded to issues raised during public review. The time varies, of course, depending on the complexity of issues and the level of assessment. At the end of an assessment, the EPA reports and makes recommendations, which include suggested environmental conditions, to the Minister for the Environment. This advice indicates whether the EPA considers the proposal to be environmentally acceptable and, if so, whether environmental conditions should be imposed. The Minister makes the final decision on whether a proposal may proceed.

Following Ministerial approval, approvals for the work to commence and licences for operations are issued by the Department of Environmental Protection (DEP) under Part V of the *Environmental Protection Act 1986* (the Act). Part V is administered by the DEP for prescribed activities and does not form part of the impact assessment process.

### 1.5.6 EPA guidelines for assessment

These guidelines are provided for the preparation of the proponent’s environmental review document (refer Appendix 1). The specific environmental factors to be addressed are identified in Part A. The generic guidelines for the format of an environmental review document are provided in Part B.

Many of the environmental issues and potential impacts related to industrial development in Cockburn Sound have been identified in the following key EPA publications:

- The Marine Environment of Cockburn Sound - Strategic Environmental Advice to the Minister for the Environment under Section 16e of the *Environmental Protection Act 1986*. (EPA Bulletin 907, October 1998);
- Report and Recommendations of the EPA with respect to the Southern Harbour development (EPA Bulletin 908, October 1998); and
- Report and Recommendations of the EPA with respect to the Northern Harbour development, Lots 165 and 168 Cockburn Road, Henderson (EPA Bulletin 947, September 1999).

Furthermore, draft Environmental Quality Objectives (EQOs) and Environmental Quality Criteria (EQCs) for Perth Coastal Waters were developed and defined within the Southern Metropolitan Coastal Waters Study (DEP, 1996a). EQOs have now been identified in the EPA position document on EQOs for Perth Coastal Waters, *Perth Coastal Waters Environmental Values and Objectives* (EPA, 2000a).

The EPA considered that it was appropriate to assess this Stage 1 proposal in the context of an understanding of the combined impacts of the whole project (Stage 1 and 2) in terms of hydrodynamics, coastal processes, water quality and habitat change. Furthermore, the EPA considered that it would also be appropriate to provide advice to Government in parallel with the Stage 1 assessment which considers the combined impacts of the potential overall development at James Point in relation to existing, approved and future developments in Cockburn Sound. To achieve this, the EPA proposed the following three phase assessment strategy.

### Stage 1 Assessment

JPPL have prepared this PER which describes the impacts of Stage 1 of the proposal, including the consideration of methods to avoid, minimise or mitigate impacts. The EPA will use the statements and strategic advice provided in Bulletin 907, and
identified values and objectives in the EPA position document (EPA, 2000a), to assist in the assessment/evaluation of this proposal.

**Cumulative Impacts**

JPPL will also prepare a separate assessment and report on the cumulative impacts of total ultimate development (Stage 1 and Stage 2) and other existing and approved developments in Cockburn Sound. This cumulative impact assessment is designed to provide the EPA with timely strategic advice.

1.5.7 **Cockburn Sound Management Council**

The State Government has recently established the Cockburn Sound Management Council (CSMC), which will be responsible for preparing and implementing the Cockburn Sound Environmental Management Plan drawn up under an Environmental Protection Policy for Cockburn Sound. The EPA has indicated that the proponent will need to develop an Environmental Management System (EMS) for the operation of James Point Port: Stage 1 which is consistent with future environmental management objectives for Cockburn Sound.

JPPL has briefed the newly formed CSMC and will continue to work closely with the CSMC.
2. **PROJECT BACKGROUND**

This proposal for James Point Port: Stage 1 is a significant step in the evolution of the shipping industry in Western Australia which has arisen out of the growth and policies which have brought the industry to its current healthy position.

For historical and geographical reasons it is important to examine the proposal in light of the development of the Fremantle Port, currently the only port serving the metropolitan area. Much of the following information is based on a recent economic impact study published by the Fremantle Port Authority (FPA, 2000).

2.1 **FREMANTLE PORT**

Fremantle Port is Western Australia’s largest general cargo port. It handles around 93 percent by value of the State’s seaborne imports and 34 percent by value of the State’s seaborne exports. Total trade throughput in 1998/99 was 23.5 million tonnes, with bulk cargoes accounting for 83 percent of this traffic. Container traffic, which totalled around 275,000 twenty-foot equivalent units (teus) in 1998/99, has grown at an average annual rate of 11 percent since 1991/92. A total of 1,771 commercial vessels called at Fremantle Port (comprising the Inner and Outer Harbour) in 1998/99.

The harbour is divided into two regions: the Inner Harbour at Fremantle and the Outer Harbour, located 20 km to the south at Kwinana in Cockburn Sound, with a small land holding at Kwinana but incorporating 383 km$^2$ of water. The Outer Harbour waters comprise the majority of Cockburn Sound including the eastern seaboard from Woodman Point south to Rockingham (refer Appendix 2).

2.1.1 **Fremantle Port (FPA Inner Harbour)**

The economic impact study (FPA, 2000) confirmed that Fremantle Port is one of the State's most significant individual sources of jobs and revenue, directly and indirectly accounting for an estimated 5,792 jobs and $728 million in economic output annually.

The Inner Harbour accounted for 67 percent of the total economic impact of the FPA, although it handled only 18 percent of the total cargo tonnage at the port. The traffic handled at the Inner Harbour comprises containerised and general cargoes, which have a relatively high impact per tonne.

2.1.2 **Cockburn Sound (FPA Outer Harbour)**

The primary services provided by the FPA in the Outer Harbour are the bulk trades, services to private jetties and the provision of channels to accommodate commercial shipping.

The following operations in Cockburn Sound are serviced through the FPA:

- Alcoa’s Alumina Refinery Jetty;
- BHP Transport’s Steel works Jetty No 2;
- BP Refinery’s Oil Refinery Jetty;
- Co-operative Bulk Handling Limited’s Kwinana Grain Jetty; and
- FPA’s Bulk Cargo Jetty Berths 1 and 2.
The FPA study found that in 1998/99 the Outer Harbour contributed 33 percent of the port’s total economic impact and the bulk cargoes handled in the Outer Harbour accounted for about 83 percent of the port’s trade volume.

2.1.3 The need for an additional port

Studies of the capacity of the Inner Harbour to service trade into the future have shown the likely emergence of severe constraints on operations through local transport networks (with further impacts on adjacent residential areas) and cargo handling capacity (FPA, 1995). The need to expand the capacity to service the metropolitan area and associated studies found that an additional port should be established in Cockburn Sound.

In 1998, the State Government held a competitive tender process as part of a initiative for the development of a new port to serve the metropolitan Perth area. James Point Pty Ltd (JPPL) was selected as the preferred proponent for the design, construction and operation of a port facility at James Point, Cockburn Sound.

2.2 THE JAMES POINT DEVELOPMENT

2.2.1 James Point Pty Ltd (JPPL)

JPPL is the Government appointed tenderer to build and operate a new port at James Point. JPPL is obliged under its contract with Government to complete Stage 1 of the development within two years or, if extensions are granted, within a period up to a maximum of five years from execution of the contract. The commencement of construction is also subject to the purchase of land and achieving planning and environmental approval.

2.2.2 Prior approvals

On 22 October 1999, JPPL received Works Approval from the DEP (under part V of the Act) to undertake the widening and refurbishment of the existing BHP Transport #1 Jetty. This work has now been superseded by the Stage 1 port proposal.

2.2.3 Project overview

The James Point Port: Stage 1 development as described in this document is the first substantial stage in the development of a new port facility at James Point, Cockburn Sound. The James Point Port: Stage 1 development is designed to be economically viable without any further development.

JPPL undertook investigation, analysis and design prior to tendering for the development, this took into account:

- Operational practicalities;
- Economic feasibility;
- Potential to construct the development in economically viable stages;
- Needs of bulk solid, bulk liquid, general and container cargo as well as special needs such as hazardous cargo and project driven development;
- Land availability, suitability and values;
- Road and rail access;
- Regional planning; and
- Potential environmental impacts.
The JPPL proposal provides a suitable option for port facilities at Kwinana as it:

- Provides for a realistically staged development with a relatively low cost initial stage (James Point Port: Stage 1);
- Is sensibly sited within the Kwinana Heavy Industry Strip;
- Is likely to be environmentally acceptable;
- Creates a substantial part of its own land requirements;
- Makes effective use of existing facilities and infrastructure;
- Provides practical solutions for effective road/rail interfaces; and
- Is compatible with Regional Planning and with the recommendations of the Towards Optimising Kwinana Report.

James Point Port: Stage 1 will provide significant benefits to users:

- It will provide competition in the provision of port facilities with the result being improved responsiveness to customers needs, efficiency in service delivery and competitiveness in pricing;
- The facilities and operational procedures will be best practice;
- Facilities will be tailored to the needs of specific trades and the opportunity to take a coordinated approach to the transport chain will lead to efficiencies beyond the port boundaries (e.g. scrap metal export and steel import);
- Industries requiring port land will have a cheaper and potentially more convenient option than is presently available; and
- In the event that the development can attract industries such as livestock export, they will have access to a more suitable site than Fremantle with reduced social impact and lower land and transport costs.

Western Australia will benefit from the development for the following reasons:

- The creation of a more competitive import/export environment through the introduction of a second major operator;
- The identification and development of a suitable alternative to the FPA option for port facilities at Naval Base/Kwinana without the need to commit public funds;
- The proposed facility will be easily assimilated into Regional Plans; and
- The construction of proposed facility in the heart of the Kwinana Industrial Strip will have significantly less impact on the community concerns than the alternative options of extending the FPA Bulk Cargo Jetty or constructing port facilities at Naval Base.

### 2.2.4 Shipping access and pilotage

Shipping access to James Point Port: Stage 1 will be through the FPA Outer Harbour via Deepwater, Success, Parmelia and Stirling Channels (refer Figure 1.1).

Under current legislation, pilotage through FPA controlled waters is provided by the FPA (through a pilotage subcontract) and charges for the service are levied by the FPA. Upon excision of control of the Stage 1 waters from FPA’s control, JPPL will be able to supply its own competitive pilotage service with the FPA role limited to the non-commercial areas of licensing and approving the service through its waters based on issues of experience, competency, reliability and safety.
2.2.5 **Approach to environmental management**

From the beginning of the initial tender process, JPPL has demonstrated a commitment to undertake the environmental management of the project in line with current best practice. JPPL recognised the importance of addressing the environmental issues in their tender document by commissioning an independent preliminary environmental impact assessment for their proposal (DAL, 1998).

JPPL intends that the proposed port development will be based on sound environmental principles and will be planned, designed, constructed and operated to meet the philosophy and principles of sustainable development. JPPL is fully committed to undertaking the proposed port development and its operation in accordance with best practice environmental standards.

This has been demonstrated to date with JPPL liaising on a regular basis with the DEP and EPA on the proposal and undertaking early community consultation regarding the project. JPPL recognises that the advantages of developing a port on a ‘greenfield’ site include the ability to create an entity which:

- Will be sympathetic to current knowledge of the local marine environment;
- Will be managed throughout via an Environmental Management System; and
- Will foster close consultation with Government, local stakeholders and the community.

It is JPPL’s aim to be able to confidently market the development as a ‘green-port’, being a port operated in accordance with best practice environmental management procedures and constructed in a manner which reflects this approach.

2.2.6 **Preferred location**

The long term need for duplicating or moving the services provided at the Inner Harbour has resulted in studies to determine the optimum location for such a venture. These studies have identified the area immediately north of James Point, Cockburn Sound as the most suitable (FPA, 1995, Dames & Moore, 1996).

2.2.7 **Planning**

Relevant planning schemes for the area are the Town of Kwinana Town Planning Scheme No. 2 (KTPS); and the Metropolitan Region Scheme (MRS).

The current zoning of the land above the high water mark under KTPS is General Industrial, and under MRS the current zoning is Industrial. These zonings are applicable to the intended use of the land and no change to these zonings will be required. However, the area offshore is zoned as Waterway and an application will be lodged to change the zoning of the waters which are to be reclaimed to Industrial.

2.2.8 **Community considerations**

The proposed James Point development is located within the Kwinana Heavy Industry Strip. A number of significant community exposure issues which are presently associated with Fremantle Inner Harbour and the Bulk Cargo Jetty will be reduced in impact or be non-existent when the proposed facility becomes operational. Some of these are:

- Proximity to residential and recreational areas;
- Traffic through built up residential and commercial areas;
• Odour;
• Noise; and
• Visibility.

2.2.9 Road and rail access

The proposed location has ready access to the Intra and Interstate Rail Networks. It can be serviced by frequent train schedules and by long trains without the impediments or inconvenience of level crossings on roads (as is the case with the Bulk Cargo Jetty and the Grain Jetty), or the need to traffic through the west and north precincts of Fremantle.

Similarly, the proposal conveniently links to the State and National Road Network (including links to designated long vehicle routes) without the need to travel through built up commercial and residential areas.

2.2.10 Land availability and values

The ultimate development (comprising Stage 1 and Stage 2) will eventually occupy over 150 hectares of land designated for primary port purposes.

It will also stimulate the use of land in the Heavy Industry Buffer zone east of Rockingham Road, by industries indirectly related to and which benefit by reasonable proximity to Port facilities.

Typical land values in the area of the proposed port are approximately one third of the values of land adjacent to the Inner Harbour. Even allowing for the fact that land prices will inevitably increase when port facilities are established, the land will be considerably cheaper than equivalent land associated with the Inner Harbour, and will be highly attractive to industries wishing to site adjacent to the port.
3. PROPOSAL FOR STAGE 1 DEVELOPMENT

3.1 DESCRIPTION OF STAGE 1 PROPOSAL

The ultimate project may involve a series of stages, however, at this time the proponent is only seeking environmental approval for Stage 1 and as such the impacts of the Stage 1 development are the sole focus of this assessment. Stage 1 is likely to be constructed over the order of five years and future substantial stages are not envisaged to be required for five years or more. The full development concept can be seen on the JPPL website (www.kwinanaport.com) and has been subjected to a preliminary environmental impact assessment separate to this document.

The project general arrangement is shown overlaying an aerial photograph in Figure 3.1, the road and rail elements are shown in Figure 3.2.

3.1.1 Phasing of Stage 1

It is likely that the Stage 1 development will itself be constructed in two phases. The phasing will depend on the nature of the dredge material and the timing of the outcome of negotiations to acquire land backing Reclamation Area 2A.

Phase 1

Firstly, the southern 600 m of Reclamation Area 1 will be reclaimed with the spoil generated from dredging to 11.7 m. This will fulfil the JPPL contract with Government. If investigations reveal that dredging to 13.7 m is ‘easy’, then dredging to 13.7 m will be undertaken immediately with spoil going to the northern portion of Reclamation Area 1 (Figure 3.1). If there is limestone or difficult dredging (requiring larger dredging plant than is available locally) then dredging will stop at 11.7 m. Additional fill may need to be imported to blend with the dredge spoil to improve the quality of the fill or to complete reclamation of the southern portion of Reclamation Area 1 if dredging stops at 11.7 m.

Phase 2

The second phase will consist of reclamation of the remainder of Reclamation Area 1 and Reclamation Area 2A using fill obtained by dredging to 13.7 m (if not undertaken as part of Phase 1) and imported fill if required (Figure 3.1).

3.1.2 Land requirements

JPPL has entered into an agreement with LandCorp to acquire the required amount of land backing the port to the north. JPPL is in the process of negotiating with BHP Transport to obtain the land backing the port to the south.

3.1.3 Cargoes

It is anticipated that cargoes handled through the port will include those listed below.

Exports

Livestock trade:
- Live sheep and cattle;
- Bulk fodder pellets;
- Bagged fodder; and
- Stores and miscellaneous cargo associated with the livestock trade.
STAGE 1 CONCEPTUAL LAYOUT

PORT LIMITS

Berthing Pocket -45m

L.P.G. Gas

Proposed Channel dredging to -13.7m

Reclamation Area 2A

Reclamation Area 1

Berthing Pocket -45m

LandCorp

James Point Pty Ltd

JAMES POINT PORT FACILITIES : STAGE 1

Figure 3.1

p:\work\land\postnov99\059\reports\per\oc\00\09\icon\lay.dgn
PORT LIMITS

POSSIBLE FUTURE RAIL LOOP

Figure

ENVIRONMENTAL DRAFTING (08) 9278

Tue 17 Apr 01

POSSIBLE RAIL SIDING WITH BULK DISCHARGE FACILITY

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James Point Pty Ltd

JAMES POINT PORT FACILITIES : STAGE 1

ROAD AND RAIL ELEMENTS

OF THE STAGE 1 DEVELOPMENT

3.2
Bulk trades:

- Grain;
- Sand (silica and/or mineral); and
- Scrap metal.

General cargo:

- Containers (minor quantities associated with general cargo vessels);
- Bulka bags (various products); and
- Project cargo/machinery.

**Imports**

Bulk trades:

- Fertilizer products;
- Grain/grainmeal;
- Cement clinker; and
- Petroleum coke.

General cargo:

- Steel products/merchant bar and plate; and
- Project cargo/machinery.

### 3.1.4 Cargo handling

All of the above cargoes are currently handled through the Port of Fremantle, either through the Inner or Outer Harbour. The handling methods proposed for the Stage 1 port will be based on conventional systems, with particular emphasis on the control of spillage onto the berths or into the water. All of the Port's cargo handling operations will be carried out in accordance with legislation in force from time to time. The following legislation in particular will apply:

- Marine and port authority acts and regulations;
- *Navigation Act 1912*;
- Marine orders including the International Maritime Organisation (IMO) protocols (Marine Pollution 73/78);
- Marine Order 23 Equipment Miscellaneous and Safety Measures;
- Marine Order 25 Equipment Lifesaving;
- Marine Order 32 Cargo Handling Equipment and Safety Measures;
- Marine Order 33 Cargo and Cargo Handling – Grain;
- Marine Order 34 Cargo and Cargo Handling - Solid Bulk Cargoes;
- Marine Order 41 Cargo and Cargo Handling Dangerous Goods;
- Marine Order 43 Cargo and Cargo Handling Livestock;
- Marine Order 44 Convention Containers;
- Marine Order 45 Non Convention Containers;
- IMDG Dangerous Goods;
- ADGC Road and Rail Transport of Dangerous Goods;
• Occupational Safety and Health Regulations 1996;
• AS 3846/1995 Transport, Handling and Storage of Dangerous Goods in Port Areas; and

Exports

Livestock trade—livestock will be loaded out of the proposed livestock holding facility or directly from road transport. Stock races will be provided and arranged to:

• Streamline loading procedures;
• Ensure the security and safety of animals;
• Minimise stress on animals during loading; and
• Contain animal manure.

Immediately following loading, manure will be collected and disposed of offsite: either as a garden product or, to one of several treatment plants available. Current indications are that existing garden product suppliers are keen to obtain access to the manure generated by the livestock trade.

Bulk fodder will be loaded by covered belt conveyors, or air blowers fed directly from trucks. Loading methods will be designed to minimise spillage and a combination of berth construction and surface cleaning methods will be designed to prevent any loss into the waters of Cockburn Sound.

Bagged fodder will be loaded by shore based and/or ship's cranes. The bags minimise potential spillage and in the event that a bag is accidentally broken, the cleaning procedures will ensure collection of the spilled product, preventing any loss into the waters of Cockburn Sound.

In the detailed design for the port, special care and provisions will be taken to ensure that manure and other spillages are contained within the wharf area and prevented from entering the water.

Bulk trades—bulk products will be loaded by conventional methods such as covered conveyors. Standard methods will be employed for the control/collection of spillage, dust suppression and containment with particular emphasis on dust control and extraction at each transfer point. Equipment and berth design will be to best practice standards.

General cargo—general cargo will be handled using ship or shore based cranes in compliance with Statutory requirements and marine orders. Cargo with the potential for spillage is product carried in Bulka bags and any spillage would be the result of an accidental break or tear in a bag. Containment and collection methods would be the same as for bulk products.

Dangerous goods will be handled in accordance with the Australian Standard for Transport, Handling and Storage of Dangerous Goods in Port Areas (AS 3846/1995).

Imports

Bulk trades—bulk products are initially likely to be offloaded using grabs attached to ship or shore based cranes. Future developments may lead to the introduction of either pneumatic or mechanical continuous discharge methods. The product will be
discharged into hoppers for either direct transfer to trucks or onto covered conveyor lines for transport to storage.

The methods used are likely to be similar to those currently employed at the Fremantle Port Authority, Bulk Cargo Jetty and the BHP Bulk Jetty at Kwinana, with particular attention being paid to dust and spillage control, clean-up, collection and prevention of spilled product entering the waters of Cockburn Sound.

General cargo—general cargo will be handled using ship or shore based cranes in compliance with Statutory requirements and marine orders. Cargo with the potential for spillage is product carried in Bulka bags and any spillage would be the result of an accidental break or tear in a bag. Containment and collection methods would be the same as for bulk products.

Dangerous goods will be handled in accordance with the Australian Standard for Transport, Handling and Storage of Dangerous Goods in Port Areas (AS 3846/1995).

### 3.1.5 Livestock

James Point Livestock Pty Ltd has prepared a separate PER for a livestock holding pen for livestock export (Environmental Risk Solutions (ERS), 2000a). Obtaining the right to develop a livestock export holding facility is completely independent of this proposal. If the livestock facility application to trade livestock is unsuccessful, the current proposal will still proceed if approved, similarly, if the current proposal does not proceed and the livestock application is successful, then livestock may be exported from the Fremantle Inner Harbour. However, DEP has requested that this PER consider combined impacts and management of all existing and proposed operations associated with Stage 1, with particular regard to noise, odour and management of waste emissions. As such, the odour and noise associated with the livestock holding yard is included in the assessment in this PER.

### 3.2 QUANTITIES AND CONSTRUCTION METHODOLOGY

The ultimate Stage 1 development will comprise:

- Construction of an offshore breakwater approximately 850 m long extending from approximately 200 m offshore to approximately 800 m offshore;
- Dredging of 1.24 million m³ comprising: dredging to a depth of 13.7 m over an area of approximately 53.6 ha and dredging to a depth of 14.0 m over an area of approximately 3.8 ha immediately adjacent to the berths;
- A total of 1.375 million m³ of reclamation to create approximately 1,200 m of berth face and 19 ha of hardstand wharf;
- Berth face construction using sheet piling or piled concrete deck;
- Wharf paving; and
- Services, crane rails, fendering and bollards etc.

The main portion of the works will be the dredging, reclamation and construction of the offshore breakwater.

### 3.2.1 Dredging and reclamation

The dredging quantities are based on Figure 3.1, with Stirling channel and ship turning area in the port dredged to a depth of 13.7 m CD and the berth pocket dredged to 14.0 m CD. It is likely that dredging will be undertaken in two stages, the
first stage will involve dredging to 11.7 m CD and the second stage will involve dredging to the final design depths. It is not anticipated that any blasting will be required.

The dredge material will be used to fill the land-backed berth and additional clean sand fill will be obtained from sources of known quality, most probably from Baldivis.

The offshore breakwater will consist of limestone core material armoured with limestone boulders. The limestone will be sourced from existing quarries located at Hope Valley. It will be necessary to construct a temporary causeway from the shore to the northern end of the breakwater to allow efficient transport of fill and armour offshore. This temporary causeway will be in place for approximately 6 months. The dredging and reclamation quantities for the entire Stage 1 development are shown in Table 3.1.

Table 3.1 Stage 1 development: dredging and reclamation quantities

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1 Reclamation and dredging:</strong>&lt;br&gt;Reclamation 600 m of land backed wharf</td>
<td></td>
</tr>
<tr>
<td>Dredging to 11.7 m</td>
<td>450,000</td>
</tr>
<tr>
<td>Imported sand fill</td>
<td>137,000</td>
</tr>
<tr>
<td>Seawalls-Core</td>
<td>268,000</td>
</tr>
<tr>
<td>Seawalls-Armour</td>
<td>67,000</td>
</tr>
<tr>
<td><strong>Phase 2 Reclamation and dredging:</strong>&lt;br&gt;Reclamation of Reclamation Area 1 and Reclamation Area 2A</td>
<td></td>
</tr>
<tr>
<td>Dredging to 13.7 m:</td>
<td>788,000</td>
</tr>
<tr>
<td>Seawalls-Core</td>
<td>670,000</td>
</tr>
<tr>
<td>Seawalls-Armour</td>
<td>167,500</td>
</tr>
<tr>
<td><strong>Offshore Breakwater</strong></td>
<td></td>
</tr>
<tr>
<td>Permanent-Core</td>
<td>395,500</td>
</tr>
<tr>
<td>Permanent-Armour (6-10 t)</td>
<td>81,200</td>
</tr>
<tr>
<td>Permanent-Armour (1.5-3.5 t)</td>
<td>60,200</td>
</tr>
<tr>
<td>Temporary-Core</td>
<td>28,500</td>
</tr>
<tr>
<td>Temporary-Armour (6-10 t)</td>
<td>8,300</td>
</tr>
<tr>
<td>Temporary-Armour (1.5-3.5 t)</td>
<td>6,200</td>
</tr>
</tbody>
</table>

3.2.2 Methodology

The commencement of the construction is subject to planning and development approvals. The sequence of construction would be as follows:

**Dredging and reclamation**

The mobilisation of the dredging equipment will be immediately the approvals are in place. The reclamation will proceed with the importation of fill from a land source to construct the settling ponds and the balance of fill required. The dredging completion will be programmed to coincide with the early part of the berth construction.

**Berth construction**

The Berths will be constructed progressively as the reclamation advances. The type of construction will be determined as the design is developed and could either be a sheet piled wall or suspended concrete deck type.
**Offshore breakwater**

The construction of the offshore breakwater will not necessarily coincide with the commencement of the first phase of Stage 1. It will be dependent on the development of trade using the Stage 1 cargo being handled and the sensitivity of the vessel type to wave motion.

**Pavement areas**

The back of berth pavement areas will be phased in to start with the deep ground compaction of the area immediately to the rear of the berth structure. The services for the berths and the support areas will be established during this stage of the construction.

**Road and rail access**

Construction of road and rail access will be the final phase of the Stage One construction programme. It will be programmed for completion as the Berths are commissioned.

**Timing**

The Stage One programme will cover a period of 12 to 18 months, with the bulk of the dredging and reclamation undertaken in the initial 8 months.

**3.2.3 Construction transport**

To the west of Rockingham Road it is proposed that transport routes for construction and operations will initially be via Beard Street, Leath and Barter Roads, and when Anketell Road is extended it is anticipated that the Anketell Road extension will be the primary access into the port.

To the East of Rockingham Road, the major roads will be utilised wherever possible. Where possible, JPPL will ensure that the Freeway, Thomas Road and Anketell Road are the primary access routes for both construction and operations.

The core and armour material is likely to be obtained from an established quarry located at Hope Valley. The truck route proposed is via Postans Road, Hope Valley Road, Abercrombie Road, Anketell Road, Rockingham Road and Beard Street. This route is subject to consultation and agreement with the Town of Kwinana.

Imported sand fill will be brought from Baldivis and the proposed route is via the Old Mandurah Road, Rockingham Road, and Beard Street. This also is subject to consultation and agreement with the Town of Kwinana and City of Rockingham.

**3.3 CURRENT AND FUTURE SHIPPING MOVEMENTS**

In 1999/00 there were 708 ship movements (or about 360 ship visits) in the FPA Outer Harbour, excluding naval vessels. There are presently about 100 ship visits per annum to the BHP facility. Over a five year period the number of ship visits to the port area is expected to increase to about 240 per annum. Of this increase it is anticipated that 120 to 130 visits will be new traffic for the JPPL Stage 1 development. The balance of the increase will be due to increased numbers of bulk vessels visiting the BHP facility. The shipping visiting the BHP facility will use the Stirling Channel and enter the port waters but it will not berth at the James Point wharf.
3.4 NAVIGATION MANAGEMENT ARRANGEMENTS

Navigation and berthing at the facility will be controlled by the FPA Management Plan until the port waters are excised from FPA’s control, after which time the waters will be under the control of JPPL. The process of excision and transfer of responsibility for these waters is conducted through the Department of Transport and does not form a part of the environmental impact assessment process.
4. EXISTING MARINE ENVIRONMENT

4.1 COASTAL LANDFORMS

4.1.1 Regional setting

The coastal environment of south-western Australia can be separated into five sectors (Searle & Semeniuk, 1985), each with its own processes of sedimentation, erosion and sediment transport. The area dealt with in this PER lies within the northern part of the sector that stretches from Cape Bouvard (approximately 20 km south of Mandurah) to Trigg Island (approximately 20 km north of Fremantle). This sector of coastline is dominated by marine-derived deposits of calcium carbonate that are consolidated (limestone) or unconsolidated (sands).

The shoreline is comprised of sandy beaches and limestone rocky shores and headlands. Offshore, aligned roughly parallel to the shore is a chain of limestone reefs and islands (eg. Carnac, Garden and Penguin Islands) known as the Garden Island Ridge. This feature is the remnant of a coastal limestone dune system laid down during the Pleistocene epoch, 0.5–3 million years ago. Inshore of, and between the reefs and islands, the seabed is covered by carbonate sands generated from erosion of the Pleistocene sediments. Sands carried in the water are deposited by wave action along interference lines of the prevailing swell waves, which are diffracted around the reefs and islands. This action has produced sandy shoals at right angles to the coast that separate the coastal basins.

These sand banks form the northern or southern sills of the four coastal basins of Gage Roads, Owen Anchorage, Cockburn Sound and Warnbro Sound. Cockburn Sound is also bounded at its southern end by a rockfill causeway that was built in 1971–1973 connecting Garden Island with the mainland. The causeway is interrupted by two trestle bridges (one 305 m long, and one 610 m long), through which limited ocean exchange occurs.

As a result of the protection of the Garden Island Ridge, the metropolitan beaches generally experience relatively low wave energies and the shoreline within Cockburn Sound is further sheltered by Garden Island.

4.1.2 Beach morphology

A sandy beach fringes the foreland of James Point. On the northern flank, the beach has a north-westerly aspect and on the southern flank the beach has a westerly aspect. James Point is located in the lee of Garden Island and, prior to the construction of the Garden Island causeway, was exposed to a combination of mild south-westerly and north-westerly conditions.

Two forces have generated the local coastal morphology: southerly wind systems that set-up longshore sediment transport through local wind waves and longshore currents during the spring and summer months; and, north-west storm systems, long period swell waves, local wind waves and wind driven currents. The relative contributions of the event types, such as swell, winter storms, severe storms and the sea breeze cycle are in a close balance, with a net southerly trend leading to the accretion at James Point.

The loss of extensive seagrass meadows from the eastern margin of Cockburn Sound between 1967 and 1973 was believed to have accelerated erosion in the region 1971
(Environmental Resources of Australia, 1972). Between 1971 and 1973, the construction of the Garden Island Causeway reduced the wave energy arriving at James Point from the south-west by up to 75% (Hsu, 1992). This altered the energy distribution arriving at the Cockburn Sound shoreline, with proportionally more energy now arriving from the north-west, reinforcing the southerly movement of sediment.

Examination of the vegetation line since the construction of the Causeway between Naval Base and James Point has shown the shoreline to be stable with episodes of local change (Andrews, 1979). This has been pronounced at James Point due to the relatively higher concentration of wave energy relative to the majority of the coastline.

Severe erosion of the small sand cliffs at James Point has been observed since 1953 and has been attributed to the passage of north-west storms (Hsu, 1992). The low pressure associated with these storms raises the water level, allowing wave attack to occur higher up the beach line, resulting in the erosion of the sand cliffs behind the primary dunes. When sand is eroded from these cliffs it is moved onto the beach and then subsequently offshore or alongshore. After a storm, sand cannot be returned to the cliff face and the erosion is permanent. To prevent further erosion of the beach at James Point, breakwaters were constructed to increase the beach width and therefore reduce the effect of the storm surge (Figure 4.1, Figure 4.2, and Figure 4.3).

Figure 4.1 Aerial photograph of James Point indicating locations of the offshore breakwaters used to stabilise the headland
4.1.3 Marine features

The bathymetry of the region is shown in Figure 1.1. Immediately offshore of James Point there is a narrow (700 m) sandy shoal which has a water depth less than 5 m. At the western edge of this shoal the water depth drops off rapidly to ca. 20 m to form the Cockburn Sound basin which is composed of homogenous calcareous mud and silt. Towards the north, there is a broad (ca. 3.5 km wide) shallow (<10 m) shelf between the shoreline and a line drawn approximately northwards from James Point to a point approximately 800 m west of Woodman Point (Figure 1.1). This broad shelf is composed of a veneer of sandy sediments and limestone platform and it is anticipated that this shelf is underlain by a basement of Pleistocene limestone at a depth of approximately 15 m below sea level (Gozzard, 1983).

The Stirling Channel and associated basin at the eastern end of the channel was dredged in 1967 and the Calista Channel linking the Stirling basin with the natural basin to the north was dredged in 1968 (Figure 1.1). These areas were dredged to a depth of approximately 11.7 m to enable shipping entry to the Alcoa and BHP jetties. There has been no requirement for maintenance dredging since these channels were first dredged.

4.2 COASTAL PROCESSES

4.2.1 Wave climate

The wave climate in Cockburn Sound is dominated by short period (<8s), wind generated waves. Garden Island provides a barrier to incident swell waves from the south-west, and as little as 5% of the swell energy penetrates to southern Cockburn Sound (DEP, 1996a). However, the degree of shelter is dependent on the incident
wave direction and location within Cockburn Sound. The gap between Carnac Island and Garden Island allows some west and north-west swell to reach James Point while the Southern Flats and the Causeway combine to prevent most south-west swell from reaching James Point. Numerical modelling of the transformation of wave energy into Cockburn Sound suggests that 95% of south-west swell energy is attenuated prior to arriving at James Point, while approximately 80% of north-west swell energy is attenuated (DAL, 1998).

### 4.2.2 Sediment transport

A sequence of six aerial photographs of the James Point region taken in period 1953-1998 was used to examine shoreline change at James Point, providing an overview of trends in sediment transport.

Prior to 1953, the coastline at James Point was in a close to natural state, however, significant shoreline modifications have occurred since this time as a result of industrial growth at Kwinana. Construction of the BP oil refinery began shortly before the earliest available aerial photograph (November 1953) and these works included a large trestle jetty, a small boat haven, a solid cooling water intake jetty which extended 200 m beyond the shore and a cooling water outlet north of James Point. The cooling water intake jetty intercepted longshore sediment transport and from 1963–1973 the beach immediately north of the intake prograded at a rate of approximately 6 m per year. By the mid-1970s, the shoreline progradation to the north of the intake was of sufficient concern to BP that they constructed three breakwaters to the north of the cooling water intake.

These breakwaters rapidly accumulated sediment and were saturated within 5–10 years. Storm activity combined with high storm surge levels between 1981 and 1991 resulted in the erosion of the sandy cliff foreshore north of James Point. Four additional breakwaters were constructed in 1992 to protect the sandy cliffs from further erosion. Presently, all six groynes are saturated with sand and the shoreline to the north of the intake is continuing to prograde. The beach face is approximately 40 m east of the BP intake; however, the aerial photographs suggest significant shallowing near the intake mouth.

Examination of the aerial photographs indicates that the shoreline immediately north and south of James Point has remained relatively stable. BHPT constructed two open jetties to the north of James Point (BHPT No. 1 jetty between 1953 and 1963 and BHPT No. 2 jetty between 1963 and 1973). These jetties have had minimal impact on the shoreline position.

Analysis of aerial photographs between 1973 and 1999 has shown that there is relatively large seasonal sedimentation around the Western Power intake and outfall infrastructure. During conditions when northward transport is dominant (summer months) the sedimentation is to the north of the outfalls and intakes and to the south of this infrastructure during the winter months.

The examination of the photography suggested that net sediment transport was to the south. The sand moves along the beach north of James Point and becomes trapped at James Point.

### 4.3 HYDRODYNAMICS

An assessment of the potential impact of the Stage 1 development on the waters of Cockburn Sound requires an understanding of the hydrodynamics of Cockburn
Sound. Comprehensive reviews of the hydrodynamics of the regions are provided by Hearn (1991a), D’Adamo (1992) and DEP (1996a) and much of the information is relevant to processes in the vicinity of James Point.

The Perth coastal waters lie on the Australian continental shelf on the eastern side of the Indian Ocean Basin. Mid and outer shelf waters (from the Five Fathom Bank until the shelf break at approximately the 200 m isobath) are strongly influenced by the presence of the Leeuwin Current (Godfrey and Ridgeway, 1985, Thompson, 1987, Smith et al., 1991), a warm, low salinity and low nutrient current that flows poleward along the shelf and causes a seasonal variation in mean sea level up to 0.2 m (Pearce et al., 1985; Pattiaratchi and Buchan, 1991). Although the Leeuwin Current is occasionally observed to influence the waters of Cockburn Sound as eddies move in close to shore (WNI, 2000) the importance of the Leeuwin Current on the hydrodynamics of Cockburn Sound is minor compared to the effect of wind forcing.

The circulation processes in Cockburn Sound are driven over time-scales ranging from daily to annual by winds (including storm events), the tides, estuarine discharges, differential heating and cooling, meteorological influences, seiches, continental shelf waves, submarine groundwater discharge and ocean currents.

4.3.1 Wind and currents

Currents in Cockburn Sound are primarily a result of wind forcing. The synoptic wind climate of Perth is controlled by the annual variation in the location of the mid-latitude anticyclonic belt. The influence of local-scale effects is also of considerable importance, in particular the diurnal sea breeze cycle that occurs during summer. During summer the winds are typically quite persistent and 50% of winds occur in the 5–9 m/s range. In winter, winds are more variable with occasional calms and strong storm winds, and 50% of winds have a velocity of 2–7 m/s. During summer the dominant wind direction is south to south-west, whereas in winter the dominant wind direction is westerly, though northerly winds frequently occur. By way of example, the general characteristics of the wind in the Perth Metropolitan area are shown in Figure 4.4. At any given time, conditions at James Point will be slightly different to those at Perth, however, in terms of overall seasonal characteristics, the patterns are similar. It should be noted that modelling of air quality and water circulation at James Point, described in later sections, was undertaken using more appropriate wind data.

In the vicinity of James Point, the net drift is northward during summer in response to the prevailing south to south-westerly winds. Current velocities range up to 0.2 m/s during average conditions and are strongest offshore from James Point. During winter, and periods of calm the current velocities drop to below 0.1 m/s. The shallow inshore region is expected to have strong depth-averaged wind-driven flows, however, the increased influence of bottom friction would result in relatively rapid reduction in flows after the onset of calm conditions (Hearn, 1991b). These decay times are estimated to be around 12–24 hours and are an important consideration when assessing circulatory response due to the onset of calm conditions.
Astronomical tides, seiches, meteorological influences, and continental shelf waves

The tidal range is between 0.1 and 0.9 m in Cockburn Sound but is typically around 0.5 m. The tides are predominantly diurnal, with the major diurnal constituents (K1 and O1) having 2–3 times the amplitude of the semi-diurnal M2 and S2 constituents. Sea level is also influenced by the passage of anticyclonic pressure systems, storm surges and other long period forcings, including seiching and continental shelf waves (DEP, 1996a).

Seiching in Cockburn Sound is the result of the sea level oscillating in response to a disturbance such as a change in wind forcing. The natural seiching period is directly related to the physical dimensions of Cockburn Sound. Although seiching contributes variations to the sea level of 0.1 m in Cockburn Sound, current velocities as a result of seiching are generally small to negligible.

Sea level is also influenced by the passage of anticyclonic pressure systems, including storm surges and other long period forcings, including continental shelf waves (DEP, 1996a). These influences are dependent on both local and remote meteorological forcing. Low frequency oscillations, such as continental shelf waves, are able to penetrate Cockburn Sound (Hearn, 1991a) and can contribute approximately 0.1 m/s to ambient current velocities.

Baroclinic effects

Baroclinic circulation arises when waters of differing densities are adjacent to one another, with the fresher water flowing over the denser water. A local example of a significant density effect is the flow of seawater up the Swan-Canning system along the estuary bed while fresh water flows the opposite direction toward the sea.

Density effects are important in the main basin of Cockburn Sound (depth ca. 20 m) where horizontal density differences can typically be up to 1 kg/m³, and in the
absence of strong vertical mixing (typically driven by winds), vertical density differences can be up to 0.5 kg/m³.

In Cockburn Sound, horizontal density differences are the result of groundwater discharge; differential evaporation and cooling between Cockburn Sound and adjacent waters; estuarine inflow from the Swan River Estuary; cooling water discharges and differential cooling between nearshore waters and deeper basin waters. These baroclinic circulation forcing mechanisms influence regions ranging from the entire Cockburn Sound Basin (differential evaporation and cooling between Cockburn Sound and adjacent waters, Swan River discharge) to the nearshore region (differential heating and cooling, groundwater discharge, cooling water discharge).

Groundwater discharge occurs along the eastern coastline of the Sound in the range 0–8.0 m³/day/m (Appleyard, 1994; PPK, 2000). The variability in flows arises due to strong seasonality of flows related to recharge and sea levels (maximum flow in spring and minimum flow in autumn) and also to significant variability in the hydraulic conductivity of the coastline. While groundwater was not considered important to the overall circulation within Cockburn Sound it has been noted that it may be of importance locally in the nearshore regions (D’Adamo, 1992; DAL, 2000a). Previous conductivity-temperature-depth (CTD) surveys conducted in the nearshore have shown localised patches of water with salinities up to 1.5 lower than sea water (HGM, 1997) with groundwater flows having a significant impact on the hydrodynamics and ecology of the Jervoise Bay Northern Harbour.

Differential evaporation and cooling between Cockburn Sound and adjacent waters occurs due to the restriction in water exchange caused by the bathymetry. Limited exchange means that significant horizontal density gradients arise as the differing bathymetry of each water body dictates that each responds to heating and cooling differently. The DEP (1996a) reported that, in terms of seasonal averages, the water in Cockburn Sound was denser than surrounding waters in autumn and that this density gradient was reversed in winter and spring.

Swan River flow into Cockburn Sound has been documented by the DEP (1996a). As the inflow penetrates Cockburn Sound, density currents are established as a result of the horizontal density gradients between the relatively fresher water of the inflow and of the ambient Cockburn Sound water.

Near James Point, the BP cooling water outlet discharges warm water onto the beach, the discharge is manifested in Cockburn Sound as a thin surface layer, which is quickly diluted by wind mixing and wave action.

Immediately offshore of James Point there is a wide shelf that extends north from James Point to Woodman Point. This shoal has a water depth of approximately 10 m and moderate wind events are sufficient to fully mix these inshore waters. Past data show that the shallow shoal north of James Point was generally well mixed even during periods when the central basin was vertically stratified (D’Adamo, 1992). Maximum vertical stratification along the eastern shoreline of Cockburn Sound generally occurred during periods of high Swan River discharge in late winter (D’Adamo, 1992).

A survey was undertaken to measure the extent of the cooling water discharges from Western Power and BP on the 18th of May and the 24th of May 2000. This work was part of the validation process for the numerical modelling exercise described later in this document. It was found that the extent and strength of the Western Power plume
was greater than that of the BP plume, which is to be expected given the lower discharge from BP.

Differential heating and cooling occurs in the nearshore waters as a result of changes in water depth. Shallow water responds more quickly to changes in air temperature and surface heating or cooling than a deeper water column. The different time response between deeper and shallower water results in horizontal density differences and the water starts to circulate under the effect of gravity.

4.3.4 Seasonal patterns

Three distinct hydrodynamic regimes have been identified in Cockburn Sound: ‘winter-spring’, ‘summer’ and ‘autumn’ (DEP, 1996a).

During the winter-spring period, the dynamics of the Sound are strongly influenced by the passage of storm systems and intermittent calms. Using available wind data, D’Adamo (1992) suggested that vertical stratification could occur in the deep central basin 85% of the time during the ‘winter-spring’ period and that during winter storm events the winds are strong enough to fully mix the central basin of Cockburn Sound. During the winter, water temperatures in Cockburn Sound are typically around 16°C to 18°C and salinities are around 34 pss to 35 pss (DEP, 1996a).

During summer, wind is the dominant mechanism governing circulation within Cockburn Sound and waters are generally well mixed and the net flow direction in the Sound is northwards. Modelling of Cockburn Sound indicated that the strongest wind driven currents occur on the shallow bank immediately offshore of James Point (DEP, 1996a). During the summer, water temperatures in Cockburn Sound are typically around 23°C to 25°C and salinities are around 36 pss to 37 pss (DEP, 1996a).

During autumn, the waters are not mixed as often due to the lower wind strength. Also in autumn, the waters of Cockburn Sound are typically denser than the adjacent coastal waters and prevented from moving outside the Sound by the shallow sills at the northern and southern entrances. CTD surveys conducted by DAL and CWR in May 2000 during calm conditions revealed that the water column in the vicinity of James Point was well mixed away from the influence of the cooling water discharges from BP and Western Power. Autumn water temperatures in the vicinity of James Point are typically 17°C to 23°C and salinities values of 35 pss to 37 pss (D’Adamo and Mills, 1995e).

In general, the region of north of James Point is well mixed for extended periods of time due to the shallowness of the region landward of the 10 m isobath north of James Point. This is in contrast to the basin region (depth >10 m) of Cockburn Sound which may experience extended periods of stratification.

4.4 Benthic habitats

Following the widespread loss of seagrasses in Cockburn Sound in the period 1967 to 1981, the benthic habitats of Cockburn Sound have been mapped by Cambridge and McComb (1984), Hillman (1986), LeProvost Dames and Moore (1996), DEP (1996a) and D. A. Lord & Associates (2000b). Cambridge and McComb (1984) and Hillman (1986) found patches of mussels on old seagrass fibre on the shallows off James Point, with the nearest patches of live seagrass (predominantly Posidonia sinuosa) more than 2 km north to north-west of James Point on shallow areas to the north of Stirling Channel. The Cockburn Cement Limited (Cockburn) and SMCWS
habitat mapping exercises also distinguished patches of seagrass meadow in the same area (DEP, 1996a; Cockburn, 2000).

The previous studies were based on spot dives for groundtruthing, and did not provide a detailed, accurate map of habitats in the vicinity of James Point. Therefore, in September 1998 satellite imagery (panchromatic data from the Systeme Probatoire de Observation de la Terre, or SPOT) was scanned to produce a spatially rectified image of the vicinity of James Point, and this, in conjunction with 1998 aerial photography of the area, was used to determine transects for groundtruthing of habitat types. Field surveys were carried out in September 1998 by personnel from Murdoch University’s Department of Biology, and consisted of underwater manta board tows along the transect lines, with observations recorded every minute. Position fixing was carried out using standard Global Position Fixing (GPS) equipment. The habitat map of the James Point area produced from this study is shown as Figure 4.5.

The map shows regions at depths greater than 10 m as unmapped. This is because the aerial photography does not penetrate the water column to depths much greater than this. The ‘unmapped’ region directly adjacent to the Stage 1 development has been dredged to a depth of approximately 11.7 m for use by shipping (refer Section 4.1). The underwater ground-truthing associated with the mapping exercises found that seagrass habitat to tends to be confined to depths less than 10 m in the Sound as growth below this depth is generally light limited. The dive transect observations across the basins and channels used for shipping found sand and rubble habitat supporting Anenomes, Sea stars, Sea pens, Blue manna crabs and occasional clumps of brown algae (refer Appendix 2).

The predominant habitats in the area mapped were sand (in shallow areas), sand and silt (in deeper areas), or shell rubble deposits on sand (especially close to the shore of the BP groynes). The fauna observed were invertebrates such as anemone, sea pens, sea stars, sea squirts and polychaete worms; Blue Manna crabs; and fish included a Port Jackson Shark, Pink Snapper, Southern Shovelnose Ray and blennies. Dense patches of seagrass and patches of reef were found in shallow areas north of Stirling Channel. The main seagrass species was identified as Posidonia sinuosa, although Posidonia angustifolia is known to occur in these patches. The species observed in the survey are listed in Appendix 2.

The results of the 1998 survey were incorporated in and corroborated by a detailed and rigorous mapping exercise of Cockburn Sound and Owen Anchorage undertaken in 1999. This study was jointly funded by Cockburn Cement Limited, Department of Commerce and Trade, Department of Resources Development, the Navy, Fremantle Port Authority, Kwinana Industries Council, Water and Rivers Commission, Water Corporation, JPPL and the DEP (DAL, 2000b). The rectified aerial image produced for this study is shown as Figure 4.6, the image clearly shows the distribution of seagrass and reef habitat in the shallow regions and the lack of seagrass in the vicinity of James Point. The most recent study has concluded that the total seagrass area in Cockburn Sound has remained relatively stable since 1981.
JAMES POINT PORT FACILITIES: STAGE 1

BENTHIC HABITATS IN THE VICINITY OF JAMES POINT

Source: NGIS
Figure 4.6 Aerial photograph mosaic of Perth’s southern coastal waters showing distribution of marine habitat, dark areas in shallow waters are generally seagrass or reef habitat (source DAL, 2000b)
4.5 WATER QUALITY

4.5.1 Nitrogen

A feature of Perth coastal waters, including those of Cockburn Sound, is that they generally contain very low concentrations of nitrogen. Thus in local coastal waters, the growth of algae (primary production) and animals which feed on the algae (secondary production) is usually strongly limited by the supply of nitrogen, particularly in summer. For this reason, management measures regarding nutrient inputs to local coastal waters are usually focussed on the amount of nitrogen entering the system and the effect on productivity.

4.5.2 Development of draft water quality objectives for Cockburn Sound

Significant increases in nitrogen inputs to Cockburn Sound increases productivity in the water column. The increase in plant biomass in the water column decreases the penetration of light (increases the light attenuation coefficient: a measure of water clarity) and increases the growth of epiphytic algae on seagrass. The dramatic effect of large increases in water column productivity due to increases in anthropogenic nitrogen loads was seen in Cockburn Sound with the extensive loss of seagrasses in the 1970s primarily due to light starvation.

In the SMCWS (DEP, 1996), the DEP established draft water quality criteria which were designed to be protective of seagrass at depths of 11 to 14 m in Cockburn Sound. The selected water quality parameters were phytoplankton biomass measured as chlorophyll a concentration (chl a) and light attenuation coefficient (K_d). The DEP reports the status of Cockburn Sound in terms of summer averages of the chlorophyll a and light attenuation figures to the Auditor General on an annual basis (DEP, 2000).

It is instructive to briefly examine how the draft criteria for light attenuation (0.08 log_{10}/m) and chlorophyll a (0.8 µg/l) were derived.

The light attenuation criteria was derived on the basis of modelling the minimum light requirements for seagrass (*Posidonia sinuosa*) survival at depths of 11 m to 14 m. Masini et al (1995) found that for long-term seagrass survival, at least 5% of the photosynthetically active radiation immediately below the water surface should reach the epidermis of the leaf. The light reaching the epidermis is attenuated in the water column by any colour, absorption or scattering and by any epiphytic algal growth on the leaf. Masini et al (1995) suggested that a low level of epiphyte growth on seagrasses was equivalent to a reduction in light transmission of 30% while moderate epiphyte growth was equivalent to a reduction in light transmission of 45%. By working backwards from a minimum requirement of 5% of surface light, the light attenuation coefficients for various depth and epiphyte loading scenarios shown in Table 4.1 can be derived. In the SMCWS, the light attenuation coefficient for survival of *P. sinuosa* at depths less than 14 m with a low level of epiphyte loading was selected as an appropriate draft criteria for Cockburn Sound (ie K_d=0.08 log_{10}/m) and is presented as an interim target in the annual DEP reports to the Auditor General. If survival of *P. sinuosa* at 10 m depth was selected then criteria for light attenuation may have been in the range 0.10 to 0.11 log_{10}/m. Most of the loss of seagrass in the Sound occurred on the flat eastern margin between James Point and Woodman Point which is typically 8 to 10 m deep (DAL, 2000b).
Table 4.1  Maximum water column light attenuation coefficients ($K_d$) for the long-term survival of $P$. sinuosa at various depths with various epiphyte loadings (based on Masini et al. 1995)

<table>
<thead>
<tr>
<th>DEPTH OF SEAGRASS (m)</th>
<th>MAXIMUM LONG-TERM $K_d$ For Moderate Epiphyte Load (log$_{10}$/m)</th>
<th>MAXIMUM LONG-TERM $K_d$ For Low Epiphyte Load (log$_{10}$/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0.10</td>
<td>0.11</td>
</tr>
<tr>
<td>14</td>
<td>0.07</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Note: The values in this table have been generated for this document using the methodology outlined by Masini et al (1995), they are not previously published values.

The interim target for productivity in Cockburn Sound, measured as chlorophyll $a$ concentration, was set on the basis of a linear relationship between mean chlorophyll $a$ concentration and mean light attenuation. A strong linear relationship between chlorophyll $a$ and light attenuation has been observed by many other workers in marine and freshwaters (eg Harris, 1986 and Kirk, 1994). Cary et al. (1995) derived a relationship between the mean summer chlorophyll $a$ and mean summer light attenuation coefficient for waters of Cockburn Sound, Owen Anchorage and Warnboro Sound for summers from 1977/78 through to 1993/94. The relationship $K_d=0.0524+0.0326$Chl $a$ was found to fit the data with an $r^2$ value of 0.877 (ie the correlation between the data was significant). Using the values of $K_d$ in Table 4.1, the associated Chl $a$ concentrations in Table 4.2 can be derived. The value associated with seagrass survival at 14 m depth with low levels of epiphyte loading (0.8 $\mu$g/L) was the value chosen by the DEP as the interim target for the waters of Cockburn Sound and is presented in the annual DEP reports to the Auditor General.

Table 4.2  Maximum water column chlorophyll $a$ (chl $a$) concentration for the survival of $P$. sinuosa at various depths with various epiphyte loadings (based on Masini et al. 1995)

<table>
<thead>
<tr>
<th>DEPTH OF SEAGRASS (m)</th>
<th>MAXIMUM LONG-TERM WATER COLUMN Chl $a$ FOR MODERATE EPIPHYTE LOAD (µg/L)</th>
<th>MAXIMUM LONG-TERM WATER COLUMN Chl $a$ FOR LOW EPIPHYTE LOAD (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1.6</td>
<td>1.8</td>
</tr>
<tr>
<td>14</td>
<td>0.7</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Note: The values in this table have been generated for this document using the methodology outlined by Masini et al (1995), they are not previously published values.

There are many factors influencing the linear regression between light and chlorophyll and the slope of the regression is generally taken to be dependent on phytoplankton size (Edmondson 1980), cell chlorophyll $a$ content (Agustí and Philips 1992), refractive index and geometry (Kirk 1994). The coefficient (0.0326) derived by Cary et al. (1995) is slightly higher than the range of coefficient values (0.0067-0.029) cited by Kirk (1994) in a review of 13 studies. Examination of the relationship between chlorophyll and light in different data sets from Cockburn Sound by DAL suggest that other coefficient values may be equally valid and yet produce different chlorophyll criteria.

The DEP recognise the difficulties in developing such criteria and the process of developing final ecological water quality criteria for Cockburn Sound is in place and it is possible that additional parameters and relationships will be included.

4.5.3 Nitrogen Loads to Cockburn Sound

The first comprehensive inventory of contaminant loads to the coastal waters of Perth was conducted by Martinick et al (1993), this work has been subsequently updated by Muriale and Cary (1995) and Hine (1998). The inorganic nitrogen loads shown in Figure 4.7 have been derived from the work by Muriale and Cary (1995) for loads from 1970 to 1990 and subsequently from Hine (1998) with specific
updates using environmental reports by individual organisations (Kwinana Nickel Refinery 1999, Wesfarmers 1999, and PPK 2000 (for Jervoise Bay groundwater loads). The loads in this chart are subject to varying degrees of error, in some cases of up to ± 100% (refer below). The DEP requested that the loads from the old Woodman Point Wastewater Treatment Plant outfall to Cockburn Sound are not included as the nitrogen load from this source is likely to have been transported north out of the Sound to Owen Anchorage.

Figure 4.7 Estimated external inorganic nitrogen loads to Cockburn Sound

The primary external inputs of nitrogen to Cockburn Sound are from point source discharges (e.g. Wesfarmers-CSBP outlet), groundwater inflows, and the atmosphere. The point source discharges are located within 3 km north and south of James Point and the highest groundwater nitrogen loads enter Cockburn Sound from the coastal strip extending 3 km south of James Point and also at Jervoise Bay (DEP, 1996a).

The concerted effort to reduce direct discharges of nitrogen to the Sound has resulted in substantial decreases in point source loading to the Sound over the past decade and contaminated groundwater is now the primary source (Appleyard, 1994; DEP, 1996a). There are presently considerable efforts underway to decrease the amount of nitrogen in the main sources of groundwater contamination (e.g. at KNR and Jervoise Bay).

The nitrogen loads from groundwater to Jervoise Bay are approximately 360,000 ± 315,000 kg/year/km (over ~2 km, PPK 2000) and loads to the region immediately south of James Point are approximately 14,600–29,250 kg/year/km (over ~1 km, Appleyard 1994) while region to be occupied by the proposed port experiences a groundwater loading of the order of 3,150 kg/year/km (Appleyard, 1994). The loading to the port area is elevated above background, however, it is two orders of magnitude less than the loading to the Jervoise Bay Northern Harbour and an order of magnitude less than the loads immediately south of James Point (primarily due to KNR groundwater and Wesfarmers-CSBP outlet).

It is estimated that deposition of nitrogen from the atmosphere to the water surface contributes approximately 20 tpa of nitrogen to Cockburn Sound.
Sediments are also an important contributor to the overall nutrient load to Cockburn Sound, and Bastyan and Paling (1995) estimated that sediments contributed between 398 and 1,552 tpa of nitrogen. The sediments are not included in the above calculations as the sediments are an ‘internal source’ rather than an external source of nitrogen.

The sediments and water column contain a large store of nitrogen which acts to buffer the effects of anthropogenic inputs. An order of magnitude estimate of the stores may be derived. For sediments, assuming an average sediment nitrogen content of 1,560 mg/kg, water content of 40%, and bulk density of 1,245 kg/m$^3$ (Bastyan and Paling 1995) in the top 10 cm of sediment over the area of the Sound (~9.2x10$^7$ m$^2$) gives a sediment total nitrogen store of the order of magnitude of 10,000 tonnes. In the water column, an average TN concentration of 180 µg/L (Hale and Paling, 2000) in a volume of 1.61x10$^9$ m$^3$ gives a total nitrogen store in the water column of the order of magnitude of 300 tonnes.

4.5.4 Water quality in Cockburn Sound

In order to establish the impact of the efforts to reduce nitrogen loads (and phosphorus loads) to the Sound, weekly monitoring of summer water quality in Cockburn Sound has been undertaken for at least eight sites (4, 5, 6a, 7, 8, 9, 10 and 11 in Figure 4.8) every one to three years since the summer of 1982/1983. These regular monitoring exercises have been funded by the DEP, local industry, and the Department of Environmental Science at Murdoch University (Hale and Paling, 1999).

The parameters monitored include: organic and inorganic forms of nitrogen and phosphorus, chlorophyll, light attenuation, salinity, temperature and dissolved oxygen.

Mean summer (i.e. average of all summer surveys over all eight sites) light attenuation, chlorophyll $a$ (chl $a$), total nitrogen (TN) and dissolved inorganic nitrogen (DIN) concentrations for Cockburn Sound (Hale and Paling, 2000) are shown plotted against corresponding estimates of anthropogenic nitrogen inputs in Figure 4.9, Figure 4.10, Figure 4.11 and Figure 4.12. The standard deviation has also been included with each point to indicate the variability of the underlying data.

It is interesting to note that the response in mean chl $a$ concentration and mean light attenuation has not followed the reduction in external nitrogen load to the Sound in a highly correlated manner (Figure 4.9, Figure 4.10).

The mean TN and DIN concentrations in the water column have tended to follow the decreasing trend of the external nitrogen loading until the early 1990s. After this time, the TN concentrations have reached levels similar to or marginally higher than those found in other West Australian regional coastal waters unaffected by nitrogen loads (TN in waters offshore of Bunbury were typically ~ 130 µg/L (Water Corporation, 2000); TN in waters offshore of Perth are typically ~130 to 180 µg/L away from any wastewater outfalls (DAL, 1999)). The DIN concentrations are still marginally higher than mean levels typically found in Perth’s local waters (~5-10 µg/L; DEP 1996a).

Qualitative evidence suggests algal blooms along the eastern margin and in Mangles Bay used to be relatively common in the 1970s (Figure 4.13; Chiffings, 1979; Department of Conservation & Environment, 1979). Spring and summer blooms of the scale seen in the 1970s are no longer observed, however, smaller blooms still
occur in the Jervoise Bay Northern Harbour (Figure 4.14) and in the vicinity of site 9A in northern Mangles Bay (J. Hale, pers. comm.; Halpern Glick Maunsell, 1998). The two regions where blooms are still observed are both known for the locally high levels of nitrogen in groundwater. The suggestion is that water quality of the Sound as a whole has stabilised and improved, however, this improvement is not immediately apparent in the presentation of the results of the two selected water quality indicators.

Figure 4.8  Cockburn Sound summer water quality monitoring sites (source: Hale and Paling, 1999)
Figure 4.9  Average summer chlorophyll a concentrations (± std dev) in Cockburn Sound versus annual inorganic nitrogen load estimates

Figure 4.10  Average summer light attenuation coefficient (± std dev) versus annual inorganic nitrogen load estimates
Figure 4.11 Average summer total nitrogen (TN) concentration (± std dev) versus annual inorganic nitrogen load estimates

Figure 4.12 Average summer dissolved inorganic nitrogen (DIN) concentration (± std dev) versus annual inorganic nitrogen load estimates
Figure 4.13  View south, looking from Jervoise Bay to Rockingham, of an algal bloom on the eastern margin of Cockburn Sound in the 1970s (source: DEP, 1979)

Figure 4.14  Local algal bloom in Jervoise Bay Northern Harbour, January 1998
The following broad statements may be applicable to the water quality of the Sound:

- The nutrient cycle in the Sound is now subject to different controls to those found prior to the 1950s. Nutrients in the sediments previously taken up by seagrasses and epiphytes are now likely to end up in the water column and be taken up by phytoplankton, returning to the sediments when the plankton die or are grazed. Primary production (plant growth through nutrient uptake) now tends to occur in the water column rather than on the seabed.

- Although dramatically altered from pre-1950s conditions, the ecosystem is now in a better and more stable state than it was in the 1970s (i.e., phytoplankton blooms substantially reduced in scale) as concentrations of DIN have significantly decreased. However, large stores of nitrogen in the sediments and groundwater are likely to continue to keep chlorophyll concentrations above those found in the open ocean. Blooms are likely to continue to occur south of James Point and in the Jervoise Bay region (DAL, 2000a) due to locally high groundwater loads.

- Water quality surveys are consistently indicative of higher productivity on the eastern margin than elsewhere in the Sound (refer Section 4.5.5; also, DEP, 1996a; DAL 1998; Hale and Paling, 2000). As such, averaging water quality parameters over the entire Sound for each summer results in loss of information due to the significant differences in quality between sites.

**4.5.5 Water quality in the region of James Point**

The primary factor affecting the productivity of the water at the Stage 1 development port is the nitrogen in the groundwater and in the point sources near the shoreline immediately south of James Point, as currents in this location are typically northwards (DEP, 1996a) which will bring the nutrient rich water up past James Point.

The Cockburn Sound water quality monitoring sites nearest to the Stage 1 development are:

- Site 10, off the CBH jetty, about 4 km south of James Point; and
- Site 9, off the BHPT No. 2 jetty, about 1 km north of James Point.

Data are also available from 1996/97 onwards for site 9A, off the FPA bulk cargo jetty; and for 1998/99 and 1999/2000 for two sites immediately off James Point, one in water ~7 m deep (JPA), and one in water ~16 m deep (JPB) (refer Figure 4.8).

Site 9A is close to two of the major anthropogenic inputs of nitrogen to Cockburn Sound: groundwater containing ammonium sulphate emanating from the Kwinana Nickel Refinery (KNR) site; and, nitrogen rich discharge from the Wesfarmers CSBP Ltd industrial wastewater outlet. Typical water circulation patterns (DEP, 1996a) suggest that the greatest impact on summer water quality of nitrogen inputs from these two sources will occur in the region north, towards the BHP jetties (site 9).

Mean nutrient and chlorophyll a data for Cockburn Sound sites during the 1999/2000 summer survey are shown in Table 4.3. Elevated ammonium (NH₄) and dissolved inorganic nitrogen (DIN) levels are evident at site 9A (also at site 6A, the entrance to the Jervoise Bay Northern Harbour). Chlorophyll a levels at Sites 9 and 9A are about 2.6 times the levels in the middle of the Sound (Site 8) and 1.6 times those 4 km further north (Site 7), indicating that the KNR/CSBP inputs cause a localised
increase in primary production along several kilometres of coastline to the north. Impacts to the south appear to be less, but this cannot be confirmed statistically.

Table 4.3 Mean water quality parameter values for sites near James Point for the summer of 1999/2000 (Hale and Paling, 1999)

<table>
<thead>
<tr>
<th>SITE</th>
<th>NO₃ (µg/L)</th>
<th>NH₄ (µg/L)</th>
<th>DIN (µg/L)</th>
<th>TN (µg/L)</th>
<th>FRP (µg/L)</th>
<th>TP (µg/L)</th>
<th>Chl. a (µg/L)</th>
<th>Light att. (log/m)</th>
<th>DO bottom (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 4</td>
<td>4.2</td>
<td>8.1</td>
<td>12.3</td>
<td>157</td>
<td>4.7</td>
<td>32</td>
<td>0.6</td>
<td>0.100</td>
<td>6.83</td>
</tr>
<tr>
<td>Site 5</td>
<td>3.6</td>
<td>9.4</td>
<td>13.0</td>
<td>168</td>
<td>4.3</td>
<td>34</td>
<td>0.8</td>
<td>0.105</td>
<td>6.69</td>
</tr>
<tr>
<td>Site 6A</td>
<td>11.6</td>
<td>10.2</td>
<td>21.8</td>
<td>200</td>
<td>3.6</td>
<td>35</td>
<td>1.5</td>
<td>0.118</td>
<td>6.83</td>
</tr>
<tr>
<td>Site 7</td>
<td>3.8</td>
<td>5.9</td>
<td>9.7</td>
<td>186</td>
<td>3.7</td>
<td>36</td>
<td>1.5</td>
<td>0.125</td>
<td>7.11</td>
</tr>
<tr>
<td>Site 8</td>
<td>3.6</td>
<td>7.9</td>
<td>11.5</td>
<td>167</td>
<td>4.4</td>
<td>33</td>
<td>0.9</td>
<td>0.101</td>
<td>6.86</td>
</tr>
<tr>
<td>Site 9</td>
<td>4.5</td>
<td>8.4</td>
<td>12.8</td>
<td>192</td>
<td>5.2</td>
<td>39</td>
<td>2.4</td>
<td>0.128</td>
<td>6.73</td>
</tr>
<tr>
<td>JPA</td>
<td>4.6</td>
<td>7.8</td>
<td>12.4</td>
<td>186</td>
<td>4.0</td>
<td>35</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JPB</td>
<td>4.8</td>
<td>7.8</td>
<td>12.6</td>
<td>186</td>
<td>3.8</td>
<td>35</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site 9A</td>
<td>6.5</td>
<td>18.4</td>
<td>24.9</td>
<td>208</td>
<td>5.4</td>
<td>42</td>
<td>2.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site 10</td>
<td>4.1</td>
<td>11.4</td>
<td>15.5</td>
<td>185</td>
<td>4.9</td>
<td>37</td>
<td>2.1</td>
<td>0.110</td>
<td>5.97</td>
</tr>
<tr>
<td>Site 11</td>
<td>4.3</td>
<td>8.8</td>
<td>13.1</td>
<td>181</td>
<td>4.7</td>
<td>36</td>
<td>1.9</td>
<td>0.110</td>
<td>6.55</td>
</tr>
</tbody>
</table>

* nitrate + nitrite (NOₓ), ammonium (NH₄), dissolved inorganic nitrogen (DIN = NOₓ + NH₄), total nitrogen (TN), filterable reactive phosphate (FRP), total phosphorus (TP), chlorophyll a (chl. a), light attenuation (att.), and bottom dissolved oxygen (DO).

Both KNR and Wesfarmers CSBP have implemented schemes which have dramatically reduced their nitrogen inputs in recent years and loads have declined from approximately 820 tonnes in 1990 to an estimated 175 tonnes/annum in 2000 (KNR, 1999; Wesfarmers Ltd, 1999). Changes in Chlorophyll at sites 9, 9A and 10 over this period—along with data from the JPA and JPB sites for the last two years—are shown in Figure 4.15. Trends are similar to those evident at the Cockburn Sound scale (refer Figure 4.9), in that declines in chlorophyll a levels are slight (and cannot be confirmed as statistically significant) compared to the reductions in nitrogen inputs that have occurred. The data in Figure 4.15 also suggest there is no difference in water quality in the nearshore area between sites 9 and 10, which are either side of the Stage 1 development.

![Figure 4.15 Changes in chlorophyll a levels at sites 9, 9A, 10, JPA and JPB](image-url)
4.5.6 **Phytoplankton species**

In summer, the Cockburn Sound phytoplankton assemblage is dominated by diatom species (primarily the genera: *Chaetocerous*, *Leptocylindrus*, *Nitzschia* and *Rhizosolenia*) with occasional dominance by dinoflagellates (primarily the genera: *Ceratium*, *Dinophysis*, *Mesopora*, *Scrippsiella* and *Prorocentrum*) species in late summer/autumn. The nitrogen-fixing cyanobacteria, *Trichodesmium* (*Oscillatoria*) *erythraea*, is a common sight on the surface of waters offshore of Perth in late summer and it is occasionally moved into Cockburn Sound by wind and currents. In winter, there have been occasional episodes of silicoflagellate blooms dominated by *Dictyocha octonaria* (DEP, 1996a). The species present and their mode of succession are equivalent to that observed elsewhere in Perth’s coastal waters.

None of the blooms observed in the Jervoise Bay Northern Harbour to date has been classified as harmful, however, there remains the potential for harmful blooms while nitrogen loads to the harbour remain high and for this reason ongoing phytoplankton monitoring programmes are in place (DAL, 2000a). The Department of Commerce and Trade has also implemented a groundwater management programme with the aim of reducing nitrogen loads to the harbour. Higher phytoplankton densities are most closely associated with areas of high nitrogen input on the eastern margin of the Sound, i.e. adjacent to contaminated groundwater flows or direct anthropogenic loading.

Generally, the phytoplankton assemblage of the broader Sound is indicative of a trophically stable and healthy environment, with stable levels of phytoplankton biomass in the most part of Cockburn Sound, albeit slightly elevated above those found in waters offshore.

4.5.7 **Dissolved oxygen**

The summer monitoring programmes (e.g. Hale and Paling, 1999) have shown that the dissolved oxygen (DO) concentrations in the bottom water (refer Table 4.3) were generally lower than the concentrations in the surface waters. The bottom water DO concentrations at sites 10 and 11 were lower than sites 4, 5, 6, 7, 8, 9, NC and SC. Bottom DO concentrations near James Point (at Site 9) varied from 6.1 to 7.4 mg/L on 16 occasions over summer 1998/99. The lowest recorded concentration was 4.3 mg/L in bottom water at Site 10. The monitoring suggests there has been no significant trend of change in DO concentrations since 1985 when measurements commenced. At current levels, DO levels are not an environmental issue of concern.

4.5.8 **Contaminant inputs**

Estimates of total contaminant inputs to Cockburn Sound for 1997 were collected by the DEP (Hine, 1998), and are shown in Table 4.4. The data in Table 4.4 must be used with some caution as they are subject to an unknown degree of error. Not all industrial discharges are regularly tested for a full suite of metals (attention is usually focussed on contaminants of concern), and estimates for some metals in groundwater (e.g. arsenic, cadmium, chromium, mercury, polycyclic aromatic hydrocarbons [PAHs]) are not included at all. Conversely, considerable over-estimation is also possible for some discharges, as some load estimates are calculated using contaminant measurements that are at or near detection limits (in which case the accepted protocol is to use a concentration of one half of the detection limit) multiplied by very large flows (e.g. in the case of the BP Refinery outfall).
Table 4.4  Estimated total annual inputs of chemicals into Cockburn Sound in 1997 (DEP, unpublished data)

<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>1997 LOAD (kg/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>29</td>
</tr>
<tr>
<td>Cadmium</td>
<td>20</td>
</tr>
<tr>
<td>Chromium</td>
<td>108</td>
</tr>
<tr>
<td>Copper</td>
<td>827</td>
</tr>
<tr>
<td>Iron</td>
<td>3,821</td>
</tr>
<tr>
<td>Lead</td>
<td>649</td>
</tr>
<tr>
<td>Mercury</td>
<td>15</td>
</tr>
<tr>
<td>Zinc</td>
<td>5,279</td>
</tr>
<tr>
<td>Phenol</td>
<td>481</td>
</tr>
<tr>
<td>Total oil</td>
<td>3,177</td>
</tr>
<tr>
<td>Fluoride</td>
<td>651,330</td>
</tr>
<tr>
<td>Suspended solids</td>
<td>78,320</td>
</tr>
<tr>
<td>Total dissolved solids</td>
<td>4,300,000</td>
</tr>
</tbody>
</table>

Industrial wastewater is discharged south of James Point from the Wesfarmers CSBP outfall and the Tiwest Joint Venture outfall. The BP Refinery (Kwinana) Pty Ltd cooling water outfall also discharges within the proposed port development area. These three outfalls are the major industrial point sources of contaminants to Cockburn Sound, as follows:

- The Wesfarmers CSBP outfall is a source of chromium (108 kg/yr), copper (216 kg/yr), iron (2,616 kg/yr), lead (349 kg/yr), mercury (15 kg/yr) and fluoride (646,000 kg/yr);
- The Tiwest outfall is a source of suspended solids (42,000 kg/yr); and
- The BP Refinery outfall is a source of arsenic (29 kg/yr, although the load estimates are based on very low concentration measurements), copper (365 kg/yr) and zinc (3,928 kg/yr) and suspended solids (36,000 kg/yr), and the only estimated source of phenol and total oil.

Although the above three outfalls are the primary point source contributors of contaminants to Cockburn Sound, the actual loads involved are relatively small. This is reflected in the fact the SMCWS found that levels of cadmium, chromium, lead, nickel and mercury in filter feeding mussels throughout Cockburn Sound were below detection limits, and although concentrations of aluminium, arsenic, copper, iron, manganese, and zinc were slightly higher in mussels harvested along the eastern shore of Cockburn Sound than in other areas of Cockburn Sound, they were still well below draft EQCs proposed for the EQO of ‘Maintenance of aquatic life for human consumption’ (DEP, 1996a).

4.6 SEDIMENT QUALITY

Sediments in Cockburn Sound are predominantly calcareous (i.e. they have a high level of calcium carbonate): sand size fractions predominate on the shallow margins, and fine silty sediments predominate in deeper areas (water depth greater than 10 m).

The physical and chemical characteristics of the sediments to be dredged during Stage 1 were sampled and analysed in May 2000. The location of the sites sampled are shown in Figure 4.16, and physical properties, organic content and contaminant levels are given in Table 4.5, Table 4.6 and Table 4.7 respectively. In the tables, samples are designated by their site location and a suffix ‘s’ or ‘d’, where the suffix ‘s’ means the sample was collected from the top 2 cm of the sediment, the suffix ‘d’ means the sample was collected from a depth of 10 cm. Samples were not collected
from deeper than 10 cm as surface samples should generally provide the most obvious indication of contamination.

Table 4.5 Grain size and settling rates of sediments to be dredged in Stage 1

| SITE NO. | MEDIUM TO COARSE SANDS  
| (0.2-<2.0 mm) | FINE SANDS  
| (0.06-<0.2 mm) | SILT PLUS CLAY  
| (<0.06 mm) | 50TH PERCENTILE SETTLING RATE  
| (MM/S) |
|-----------|------------------|------------------|------------------|------------------|
| JPS1s     | 10.0             | 28.0             | 62.0             | 0.7              |
| JPS2s     | 13.9             | 48.2             | 37.8             | 5.6              |
| JPS3      | 14.4             | 48.9             | 36.7             | 5.8              |
| JPS3d     | 28.1             | 43.1             | 28.8             | 4.6              |
| JPS4s     | 12.8             | 54.4             | 32.8             | 110.0            |
| JPS5s     | 18.7             | 34.0             | 47.4             | n/a              |
| JPS5d     | 25.1             | 34.7             | 40.3             | n/a              |
| JPS6s     | 8.9              | 58.2             | 41.8             | n/a              |
| JPS7s     | 9.3              | 41.3             | 49.5             | n/a              |
| JPS8s     | 82.2             | 15.9             | 1.9              | n/a              |

Table 4.6 Nutrient levels in sediments to be dredged in Stage 1

| SITE NO. | TOTAL ORGANIC CARBON  
| (% C) | TOTAL PHOSPHORUS  
| (mg P/g) | TOTAL KJELDAHL NITROGEN  
| (mg N/g) |
|----------|------------------|------------------|------------------|
| JPS1s    | 1.5              | 0.65             | 1.7              |
| JPS2s    | 0.8              | 0.71             | 1.9              |
| JPS3s    | 1.7              | 0.74             | 2.3              |
| JPS3d    | 1.2              | 0.67             | 1.9              |
| JPS4s    | 1.7              | 0.75             | 2.3              |
| JPS5s    | 2.2              | 0.91             | 2.9              |
| JPS5d    | 1.9              | 0.81             | 2.3              |
| JPS6s    | 1.8              | 0.80             | 2.3              |
| JPS7s    | 1.3              | 0.77             | 2.2              |
| JPS8s    | <0.4             | 0.39             | 0.2              |

Table 4.7 Contaminant levels in sediments to be dredged in Stage 1 (May, 2000)

| SITE NO. | % silt & clay | As  
| (mg/kg) | Cd  
| (mg/kg) | Cr  
| (mg/kg) | Cu  
| (mg/kg) | Pb  
| (mg/kg) | Hg  
| (mg/kg) | Ni  
| (mg/kg) | Zn  
| (mg/kg) | TBT*  
| (ng/g)  |
|----------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1SQG-Low | -            | 20.0    | 1.5     | 80.0    | 65.0    | 50.0    | 0.15    | 21.0    | 200.0   | 5.0     |
| 1SQG-High| -            | 70.0    | 10.0    | 370.0   | 270.0   | 220.0   | 1.00    | 52.0    | 410.0   | 70.0    |
| JPS1s    | 62.0         | 4.9     | <2.0    | 24.0    | 11.0    | 33.0    | 0.08    | 9.2     | 29.0    | 2.6     |
| JPS2s    | 37.8         | 3.9     | <2.0    | 21.0    | 13.0    | 36.0    | 0.09    | 8.8     | 45.0    |
| JPS3s    | 36.7         | 3.9     | <2.0    | 24.0    | 13.0    | 37.0    | 0.10    | 9.9     | 47.0    |
| JPS3d    | 28.8         | 5.6     | <2.0    | 23.0    | 17.0    | 37.0    | 0.14    | 9.9     | 68.0    |
| JPS4s    | 32.8         | 6.4     | <2.0    | 29.0    | 28.0    | 43.0    | 0.16    | 13.0    | 105.0   | 3.47    |
| JPS5s    | 47.4         | 5.6     | <2.0    | 27.0    | 21.0    | 39.0    | 0.17    | 9.5     | 65.0    | 3.00    |
| JPS5d    | 40.3         | 4.8     | <2.0    | 24.0    | 18.0    | 38.0    | 0.16    | 9.0     | 40.0    | 1.95    |
| JPS6s    | 41.8         | 1.4     | <2.0    | 12.0    | 1.4     | 33.0    | 0.01    | 5.7     | 3.6     | 1.28    |
| JPS7s    | 49.5         | 4.1     | <2.0    | 22.0    | 12.0    | 35.0    | 0.18    | 8.6     | 35.0    | 2.54    |
| JPS8s    | 1.9          | 6.6     | <2.0    | 29.0    | 34.0    | 41.0    | 0.23    | 10.5    | 90.0    |

All data in ppm. Values that exceed 1SQG-Lows are shown shaded. *Normalised to 1% total organic carbon (TOC) as per ANZECC (1998) guidelines.
JAMES POINT PORT FACILITIES: STAGE 1

SITES SURVEYED FOR
SEDIMENT CONTAMINANT LEVELS, MAY 2000

Reference

JPS5 Sediment contaminant level sampling site
Eight of the ten sites surveyed were predominantly composed of fine sands, with high silt plus clay fractions of 28.8% to 47.4%. Site JPS8s was predominantly medium to coarse sand and site JPS1s was predominantly silt. In addition, settling rate determinations indicated that if the fine sand sediments were resuspended in the water column, 50% would settle from surface waters to the seabed (assuming a port depth of 13.7 m) in approximately 30 minutes while the finer fractions would take up to several days to settle out.

As well as contaminant data, Table 4.7 has the National Interim Sediment Quality Guidelines (ISQGs) prepared by the Australian and New Zealand Environment and Conservation Council and the Agricultural Rural Management Council of Australia and New Zealand (ANZECC/ARMCANZ, 2000). The ANZECC/ARMCANZ ISQGs are based on guidelines originally developed by Long and Morgan (1991) and subsequently refined by Long et al. (1995), from data on estuarine and coastal sediments in the USA. Long and his coworkers derived an effects range low (ERL = 10th percentile of effects range data) and effects range median (ERM = median, or 50th percentile of effects range data) for each chemical. The ISQG-Lows equate to ERLs, values below which toxicity effects are highly unlikely; and the ISQG-Highs equate to ERM s, values above which toxicity effects are likely to occur. The DEP have also used the values of Long et al. (1995) for proposed sediment environmental quality criteria (EQC) in Perth coastal waters: ERL values for a high level of ecosystem protection, and ERMs for a moderate level of ecosystem protection (DEP, 1996a). The ISQG-Lows and ISQG-Highs differ slightly from some of the ERLs and ERM s of Long et al. (1995), but the ANZECC guidelines are shown in Table 4.7 as it is expected that Western Australia will adopt the national guidelines when they are released. The ANZECC/ARMCANZ (2000) guidelines for environmental protection are also identical to ANZECC (1998) interim ocean disposal guidelines (for dredged sediments).

The results reflect the fact that the region has been affected by past industrial activity with levels of TBT and metals above local background levels (refer to Warnboro Sound data in Table 4.8). Levels of mercury were slightly above the ISQG-Low value at five sites but still much lower than the ISQG-high value. Sediments were also analysed for polycyclic aromatic hydrocarbons, but results are not shown as all sites had levels below detection limits.

Levels of contaminants in sediments between James Point and the BHPT No. 2 jetty were also previously analysed as part of a May 1999 sediment survey commissioned by the Kwinana Industries Council (including three sites funded by JPPL), and are shown in Table 4.8. Data for the Warnbro Sound basin found in this survey are provided as an indication of the level of metals typical of uncontaminated sediments in deeper areas. Sediments were also analysed for polycyclic aromatic hydrocarbons, but results are not shown as all sites had levels below detection limits. The impact of shipping operations is reflected in the elevated TBT levels at the BHP No. 2 jetty.

The data in Table 4.7 and Table 4.8 indicate that although some localised and very minor contamination of sediments has occurred, the levels are generally below those at which adverse environmental effects may occur. Three exceptions are: The slight elevation of mercury levels in the area to be dredged; the elevation of copper found adjacent to the BHP No. 2 jetty; and elevation of TBT found 100 m west of the BHP No. 2 jetty. However, for copper and mercury, testing of acid volatile sulphide (AVS) levels in these sediments (as per ANZECC/ARMCANZ guidelines) strongly suggests that these metals would be bound to the sediments in biologically unavailable forms, and are not an environmental concern. For example, the AVS
levels at the BHPT No. 2 Jetty site (Table 4.8) were 6 µmol/g.dw while the concentration of simultaneously extractable metals (SEM) (Cd, Cu, Ni, Pb, Zn) was 1.19 µmol/g.dw, the ratio of AVS to SEM is 5.1. The ANZECC guidelines suggest that if the metals are to be biologically available this ratio should be less than 1, but present AVS levels imply the metals are bound in forms which are not bioavailable.

**Table 4.8 Contaminant levels in sediments in the vicinity of James Point, May 1999**

<table>
<thead>
<tr>
<th>SITE NO.</th>
<th>% silt/clay</th>
<th>As</th>
<th>Cd</th>
<th>Cr</th>
<th>Cu</th>
<th>Pb</th>
<th>Hg</th>
<th>Ni</th>
<th>Zn</th>
<th>TBT *</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISQG-Low</td>
<td>-</td>
<td>20</td>
<td>1.5</td>
<td>80</td>
<td>65</td>
<td>50</td>
<td>0.15</td>
<td>21</td>
<td>200</td>
<td>5</td>
</tr>
<tr>
<td>ISQG-High</td>
<td>-</td>
<td>70</td>
<td>10</td>
<td>370</td>
<td>270</td>
<td>220</td>
<td>1.00</td>
<td>52</td>
<td>410</td>
<td>70</td>
</tr>
<tr>
<td>DEP Clean Landfill criteria</td>
<td>-</td>
<td>20</td>
<td>3</td>
<td>50</td>
<td>60</td>
<td>300</td>
<td>1.0</td>
<td>60</td>
<td>200</td>
<td>N/A</td>
</tr>
<tr>
<td>BHPT No. 2 jetty</td>
<td>30.8</td>
<td>6.4</td>
<td>0.25</td>
<td>36</td>
<td>100</td>
<td>14</td>
<td>0.19</td>
<td>9.2</td>
<td>55</td>
<td>&lt;1</td>
</tr>
<tr>
<td>100 m west of BHPT No. 2 jetty</td>
<td>58.2</td>
<td>4.6</td>
<td>0.21</td>
<td>30</td>
<td>34</td>
<td>15</td>
<td>0.12</td>
<td>8.2</td>
<td>46</td>
<td>25.7</td>
</tr>
<tr>
<td>500 m west BHPT No. 2 jetty</td>
<td>21.9</td>
<td>3.8</td>
<td>0.12</td>
<td>21</td>
<td>14</td>
<td>7.3</td>
<td>&lt;0.1</td>
<td>5.5</td>
<td>23</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Area within 400 m of BP cooling water outlet</td>
<td>0.6 to 5.2</td>
<td>&lt;0.5 to 1.1</td>
<td>&lt;0.1</td>
<td>5.6 to 11</td>
<td>1.4 to 3.4</td>
<td>&lt;1 to 1.6</td>
<td>&lt;0.1</td>
<td>0.8 to 8.3</td>
<td>2.6 to 7.8**</td>
<td></td>
</tr>
<tr>
<td>250 m west and 100 m north of James Pt beacon</td>
<td>35.2</td>
<td>3.1</td>
<td>&lt;0.1</td>
<td>29</td>
<td>11</td>
<td>7.2</td>
<td>&lt;0.1</td>
<td>7.0</td>
<td>26</td>
<td>&lt;1</td>
</tr>
<tr>
<td>James Pt beacon</td>
<td>0.4</td>
<td>1.5</td>
<td>0.17</td>
<td>8.4</td>
<td>1.7</td>
<td>&lt;1</td>
<td>&lt;0.1</td>
<td>1.1</td>
<td>2.6</td>
<td>&lt;1</td>
</tr>
<tr>
<td>400 m east of James Pt beacon</td>
<td>1.2</td>
<td>0.7</td>
<td>&lt;0.1</td>
<td>6.6</td>
<td>1.6</td>
<td>0.8</td>
<td>&lt;0.1</td>
<td>1.0</td>
<td>1.9</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Warnboro Sound basin</td>
<td>3.8 to 9.2</td>
<td>6.8 to 8.9</td>
<td>&lt;0.1</td>
<td>10 to 17</td>
<td>2.1 to 2.5</td>
<td>2.8 to 4.9</td>
<td>&lt;0.1</td>
<td>1.9 to 3.0</td>
<td>4.2 to 7.1</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

All data in ppm. Values that exceed ISQG-Lows are shown shaded. *Normalised to 1% total organic carbon (TOC) as per ANZECC (1998) guidelines. **Couldn’t be normalised as TOC too low.

The data in Table 4.7 and Table 4.8 also indicate that the material dredged for the James Point development can be used as fill onshore as, with the exception of copper levels in a surface sample taken adjacent to the BHP jetty, it meets all the DEP guideline criteria for clean landfill material (DEP, 1996b).

If the groundwater contamination study shows that contaminated groundwater flows into the port region, JPPL will undertake further sampling and testing of sediments in the region, including testing of samples obtained from greater depths.

### 4.7 TRIBUTYLTIN (TBT)

The majority of the world’s shipping fleet uses self polishing co-polymer paints in which the major active ingredient is tributyltin (TBT). These TBT based systems are extremely reliable, offering shipowners a five year protection system against biofouling and exotic species translocation. The major drawback with TBT is that it is a hormone disruptor, affecting marine and estuarine biota in locations where ships dock or are maintained.

As such, the occurrence of TBT in the sediments of Cockburn Sound is of greater environmental concern to the DEP than other metal contaminants. In Cockburn Sound, TBT was found at particularly high levels next to ship berthing and ship maintenance facilities (DEP, 1996a).

Antifouling practices have improved in recent years, and the use of TBT in Australia is regulated in most states. Some countries have already banned the use of TBT.
In November 1991, WA State legislation banned the use of organotin anti-fouling paints on boats under 25 m, and restricted its use to low-leaching paints on boats over 25 m. The SMCWS (DEP, 1996a) noted that the legislation appears to have been effective in preventing further TBT contamination of coastal areas frequented by small recreational boats, but TBT levels ‘...have continued to increase in areas associated with the use and maintenance of large vessels suggesting that the current source of TBT to the sediments of Perth southern coastal waters is principally from the hulls of commercial ships, some of which are not subject to State legislative restrictions’.

ANZECC have prepared a code of practice for antifoulants (Hyder Consulting, 2000) which will apply to the use of all products designed to keep marine vessels and structures free of marine organisms. Also, many countries (including Australia) are actively investigating alternative, more environmentally sensitive antifoulants, particularly silicone based products that act via a non-stick surface that inhibits attachment of biota. The combination of these two activities is expected to result in a considerable reduction in TBT contamination of Australian coastal areas within the next few years.

The current Commonwealth Government position is to ban TBT use on all vessels from 1 January 2006. However, the Commonwealth Government has also specified in Australia’s Oceans Policy that it will comply with any ban put in place by the IMO. The IMO has recently announced that it will ban application of TBT to ship’s hulls from January 2003, as such, the Commonwealth Government is preparing to meet the 2003 date for the ban.

4.8 FISHERIES

According to the most recent ‘State of the Fisheries Report’ (Fisheries WA, 1999), there are four managed fisheries which operate wholly and two managed fisheries which operate partly within Cockburn Sound. The Cockburn Sound (Mussel, Crab, Fish Net, and Line and Pot) Managed Fisheries operate entirely within Cockburn Sound, while the West Coast Beach Bait (Fish Net) and the West Coast Purse Seine Managed Fisheries operate partly within Cockburn Sound.

Crabbing is the largest commercial fishery in Cockburn Sound and catches have been growing since the late 1970s. In addition to the mussel aquaculture farms within Cockburn Sound there are three wild catch commercial licences for the collection of mussels within Cockburn Sound. The beach bait fish netting principally targets three species of bait fish: pilchards, anchovies, scaly mackerel and white bait. The primary finfish species commercially targeted are: Australian herring, sea garfish, tailor, trevally, King George whiting, yellow tail and pink snapper. Australian herring contributed to 44% of the commercial finfish catch.

Commercial and recreational fishing is not permitted in the restricted waters adjacent to James Point.

4.9 RECREATION

Cockburn Sound is one of the most popular recreational water bodies in Western Australia, catering for various water-based activities. These include: boating, diving, swimming and fishing and the foreshore area and public beaches are popular
locations for family activities. The sheltered fishing areas in close proximity to the
Perth metropolitan area are very popular for recreational fishing. Target finfish
species include: tailor, Australian herring, trevally, King George whiting, garfish,
yellowtail, scad, snapper and mulloway.

The land area backing the proposed Stage 1 development is a combination of
Government owned land reserved for port purposes and privately owned land
located within the Kwinana industrial zone. Public access to the area proposed for
the port is restricted. There is regular unauthorised use of the beach area north from
the BHPT #1 Jetty for horse swimming.

4.10 MARITIME SHIPWRECKS

Cockburn Sound contains a number of shipwrecks and Dr Mike McCarthy of the
Maritime Museum has been consulted regarding the possibility of wrecks in the area
of the proposed port. The Museum has confirmed that there are no known
shipwrecks in the area.
5. EXISTING TERRESTRIAL ENVIRONMENT

5.1 GEOLOGY

The site comprises approximately 1,200 m of beach frontage north of James Point (Figure 3.1). The site is entirely situated on Safety Bay Sand (SBS) of Quaternary age which extends 1,500 m inland from the site, and comprises calcareous medium grained quartz sand with abundant shell debris of shallow marine, coastal plain and aeolian origin. Elsewhere in the region, the upper (undifferentiated) dune sand passes into the Becher Sand, comprising grey fine-grained sand and a basal grey/green silty and shelly clay, however this unit is absent in bores to the south-east and north-east of the site. The SBS overlays the Tamala Limestone and varies appreciably in thickness locally.

The Tamala Limestone comprises an upper unit of pale yellow medium to coarse grained sand decomposed from the lower limestone, comprising a pale yellow/brown variably cemented fine to coarse grained lime sand with shell debris (calcarenite). The Tamala Limestone thins towards the coast, and is underlain by thin (<1.8 m) Quaternary Rockingham Sand, comprising very coarse-grained sand and clay beds, which occurs below the low water mark south of James Point.

The superficial sequence is underlain by the Pinjar member of the Leederville Formation of Cretaceous age, comprising interbedded sandstones, siltstones and shales.

5.1.1 Bore records

Bore records from within a 2 km radius of the site were obtained from the Water and Rivers Commission (WRC) AqWABase database and examined for information relevant to this development. Three bores are located within 465 m due east of the site which terminate at shallow depth within the SBS at between 6 and 6.3 m below ground level (mBGL). Two further bores are located approximately 612 m east of the site within the Australian Iron & Steel Pty Ltd site. These were completed for production purposes to a depth of 25.6 mBGL. The geology encountered has been interpreted (Geological Survey of Western Australia, 1986) as follows:

- 0–2 m: Safety Bay Sand;
- 2–6 m: Tamala Limestone (LS1);
- 6–17 m: Tamala Limestone (S7); and
- 17–25.6+: Limestone (not identified).

The sequence between 2–18.29 mBGL is described as clay, fine sand and shells, limestone (3.66–6.1 m), with grey silt or sand to 18.29 m. This description is more consistent with the Safety Bay Sand/Becher Sand units than with the Tamala Limestone, which is interpreted here to occur at a depth of 18.29 mBGL. This is consistent with other bore data obtained in nearby sites (Barker & Associates, 2000). The Leederville Formation was recorded at a depth of 28 mBGL in a bore approximately 920 m east of the site.
5.2 HYDROGEOLOGY

5.2.1 Safety Bay Sand

Groundwater is present within superficial deposits and underlying aquifer units within the sedimentary sequence. Unconfined groundwater within the superficial SBS is present at approximately 3–4 mBGL in a WRC monitoring bore approximately 335 m south of the site, and 2.7–2.9 mBGL in bores 465 m east of the site.

Values of hydraulic conductivity for the local SBS aquifer from small-scale field tests are reported as 0.65–1.5 m/day (Dames & Moore, 1998), although these are low in comparison to values quoted in Davidson (1995) of 10–50 m/d (average 15 m/d).

Estimated water table elevations in metres above Australian Height Datum (mAHDD), based on recorded maximum water levels, are shown in Figure 5.1. Groundwater flow is west to north-west at the site, with an approximate hydraulic gradient of 0.002 m/m. At the coast in this region, the groundwater generally flows through the sand above underlying seawater intrusion and out into the Sound at the shoreline. Further north there are regions of relatively higher flows where the Tamala Limestone aquifer is directly exposed to the coast. The higher flows are due to the formation of solution ducts in the limestone which creates a considerably higher transmissivity than the sand.

5.2.2 Tamala Limestone

Groundwater within the underlying Tamala Limestone is semi-confined by the basal silty clay of the SBS where it is present and laterally continuous, and downward leakage from the SBS aquifer is reported to occur locally (Rockwater, 1989). This may reduce the volume of groundwater flow that may be intercepted by the JPPL Stage 1 berth face that will be piled down to the Tamala Limestone. The Tamala Limestone comprises cavernous (karst) limestone and lime cemented sands, and is highly permeable, with a quoted hydraulic conductivity of 100 to >1,000 m/d, and an average of 800 m/d (Davidson, 1995).

5.3 GROUNDWATER QUALITY

Available data on groundwater quality was obtained from the WRC AqWABase database. Groundwater within the SBS aquifer is generally fresh, becoming brackish near the coast and locally inland where water quality has been impacted by human activity. A saline wedge occurs near the coast, where the aquifer is in hydraulic continuity with seawater, with saline water extending beneath the fresh water. Movement of the saline interface inland has occurred locally due to groundwater abstraction.

The WRC has provided comment that the applicable protected beneficial uses of groundwater along the Kwinana Industrial Strip are for reticulation and industrial purposes only.
REGIONAL GROUNDWATER CONTOURS

Source: HydroSolutions Pty Ltd (May, 2000)
5.3.1 Historical groundwater contamination

A number of potential sources of groundwater contaminants are located near to the development area (listed in Table 5.1). This information has been based on the published groundwater contaminant map for Perth (GSWA, 1988, Sheet 2033-I-SW), part of which is reproduced in Figure 5.2.

Table 5.1 Known or Inferred Groundwater Contamination Sources within 2 km of JPPL development

<table>
<thead>
<tr>
<th>POTENTIAL SOURCE OF GROUNDWATER CONTAMINATION (Figure 5.2)</th>
<th>ACTIVITY</th>
<th>OWNER/OPERATOR</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 Aluminium production</td>
<td>Alcoa of Australia</td>
<td>1.8 km north</td>
<td></td>
</tr>
<tr>
<td>29 Aromatic injector plant</td>
<td>Unknown</td>
<td>1.6 km north-east</td>
<td></td>
</tr>
<tr>
<td>31 Power Station</td>
<td>Western Power</td>
<td>0.8 km north</td>
<td></td>
</tr>
<tr>
<td>33 Fibreglass manufacture</td>
<td>Transfield Construction Pty Ltd</td>
<td>0.6 km north-east</td>
<td></td>
</tr>
<tr>
<td>34 Pipe Manufacture</td>
<td>Tubemakers of Australia</td>
<td>0.4 km north-east</td>
<td></td>
</tr>
<tr>
<td>35 Insulation Engineering</td>
<td>Unknown</td>
<td>0.6 km east</td>
<td></td>
</tr>
<tr>
<td>36 Steel Pipe Manufacture</td>
<td>Tubemakers of Australia</td>
<td>0.3 km east</td>
<td></td>
</tr>
<tr>
<td>37 Wire Production</td>
<td>Australian Wire Industries</td>
<td>0.8 km east</td>
<td></td>
</tr>
<tr>
<td>38 Iron Products</td>
<td>BHP</td>
<td>0.4 km east</td>
<td></td>
</tr>
<tr>
<td>41 Gas Production</td>
<td>BOC Gasses</td>
<td>2 km south-east</td>
<td></td>
</tr>
<tr>
<td>44 Petroleum Refinery</td>
<td>BP Refinery (Kwinana) Pty Ltd</td>
<td>0.5 km south</td>
<td></td>
</tr>
<tr>
<td>45 Chemical Manufacture</td>
<td>Air Liquide</td>
<td>2 km south-east</td>
<td></td>
</tr>
<tr>
<td>46 Chemical Manufacture</td>
<td>Wesfarmers LNG</td>
<td>2 km south-east</td>
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</tr>
<tr>
<td>47 Chemical Manufacture</td>
<td>Nufarm Ltd</td>
<td>2 km south-east</td>
<td></td>
</tr>
</tbody>
</table>

Additional data relating to licences for prescribed premises with the potential to cause pollution issued by the DEP under the Environmental Protection Act, 1986 was obtained from the DEP Kwinana Branch in May 2000. A total of 31 licences are current within an approximate 2 km radius of the site.

It has been estimated that there are potentially more than 70 groundwater contaminant plumes within the Kwinana area. Although no data are currently available for groundwater quality upgradient of the Stage 1 location, there are several potential sources that may give rise to groundwater contamination in this area, and it is assumed there is a high probability that groundwater flowing through the site will contain contamination.

At present, land tenure issues are still being negotiated and when this process is complete JPPL will undertake a detailed survey of the local groundwater quality prior to construction as part of the environmental management plan to be approved by DEP.

5.4 SURFACE WATER

The Stage 1 development is located at and beyond the existing shoreline. Landward, the ground surface is relatively flat, with an elevation of around 4 m AHD although there are some dune sand features with minor relief (to 9 m AHD) to the west of Riseley Road, adjacent to the north of the wharf area.

There are no natural drainage features adjacent to the site, reflecting the high infiltration capacity of the underlying sandy soils. Run-off from the sealed road surfaces in this area is to the soil either side of the roadway.
### Table: Potential source of groundwater contamination

<table>
<thead>
<tr>
<th>Number</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>Aluminium production</td>
</tr>
<tr>
<td>29</td>
<td>Aromatic injector plant</td>
</tr>
<tr>
<td>31</td>
<td>Power station</td>
</tr>
<tr>
<td>33</td>
<td>Fibreglass manufacture</td>
</tr>
<tr>
<td>34</td>
<td>Pipe manufacture</td>
</tr>
<tr>
<td>35</td>
<td>Insulation engineering</td>
</tr>
<tr>
<td>36</td>
<td>Steel pipe manufacture</td>
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<td>37</td>
<td>Wire production</td>
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<td>Petroleum refinery</td>
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<tr>
<td>45</td>
<td>Chemical manufacture</td>
</tr>
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<td>46</td>
<td>Chemical manufacture</td>
</tr>
<tr>
<td>47</td>
<td>Chemical manufacture</td>
</tr>
</tbody>
</table>

Source: HydroSolutions Pty Ltd (May, 2000)
Currently a stormwater drainage channel from the BHP sites runs through the site, exiting to Cockburn Sound immediately north of the BHP No. 1 jetty.

5.5 VEGETATION COMMUNITIES

The James Point area falls within the Drummond Botanical District which forms part of the Swan Coastal Plain Subregion (Beard, 1990). The remnant vegetation present in the project area belongs to the Quindalup Vegetation Complex which occurs on the coastaly distributed Quindalup Dunes (Beard, 1979; Heddle et al., 1980).

A number of vegetation associations occur within the Quindalup complex of the project area. These are described in the following accounts and mapped in Figure 5.3. It should be noted that an asterisk in the following accounts denotes introduced flora species.

**Backbeach herbland**

The backbeach assemblage is dominated by a community of low, herbaceous species including Marram Grass *Ammophila arenaria*, Couch *Cynodon dactylon*, *Pelargonium capitatum*, *Senecio lautus*, *Spinifex longifolius*, *Oenothera drummondii*, *Tetragonia decumbens*, *Trachyandra divaricata*, *Sonchus oleraceus* and *Isolepis nodosa*. This association occurred along the upper margin of the beach behind the northern groynes (groynes 4, 5 and 6) and immediately north of the BHP No. 1 jetty. The beach spits which have developed in the lee of the northern-most BP groynes are at an early stage of this process, being vegetated only by the colonists *Spinifex hirsutus* and *C. dactylon*. In the areas north of the BHP No. 1 jetty, the vegetation includes species that typically colonise later in the dune succession process such as *Lepidosperma gladiatum* and *Scaevola crassifolia* - suggesting these areas are somewhat older.

**Foredune herbland**

The foot of the foredune is typically colonised by scattered *Cakile maritima* and *Euphorbia paralias*, which grades inland into a low open scrub of *Acanthocarpus pressii*, *Carpobrotus virescens*, *O. drummondii*, *Pelargonium capitatum*, *S. longifolius*, *T. decumbens* and *T. divaricata*. Annual weed invasion was moderate to high in most areas, including *Arctotheca calendula*, *Euphorbia terracina*, *Erharta longiflora*, *B. maxima*, *C. dactylon* and *O. pes-caprae*. This association occurred on James Point and towards the northern end of the study area (see Figure 5.3). Some sections of the foredune in this northern area are substantially degraded by erosive processes and are vegetated almost entirely with exotics, principally *A. arenaria*, *P. capitatum* and *T. divaricata.*
Figure 5.3

James Point Pty Ltd
JAMES POINT PORT FACILITIES : STAGE 1
TERRESTRIAL HABITATS
IN THE VICINITY OF JAMES POINT

Reference
- Backbeach herbland
- Foredune herbland
- Primary dune Acacia Shrubland
- Lepidosperma gladiatum sedgeland
- Acacia rostellifera shrubland and thickets
- Degraded Acacia rostellifera thickets
- Plantings

James Point Pty Ltd
JAMES POINT PORT FACILITIES : STAGE 1
TERRESTRIAL HABITATS
IN THE VICINITY OF JAMES POINT

Reference
- Backbeach herbland
- Foredune herbland
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- Degraded Acacia rostellifera thickets
- Plantings

James Point Pty Ltd
JAMES POINT PORT FACILITIES : STAGE 1
TERRESTRIAL HABITATS
IN THE VICINITY OF JAMES POINT
**Primary dune low Acacia shrubland**

The primary dune parallels the shoreline and occurs in four sections of the project area. Remnant Acacia Shrubland vegetation is principally only intact on the primary dune in two of these locations: in the area of James Point located between the tree windbreak and the Mason Road drain; and, at the northern end of the project area immediately south of the Barter Road carpark. The vegetation consists of a medium height mixed Acacia dominated shrubland, including Acacia coxhearsis, Acacia lasiocarpa, Acacia littorea, Acacia saligna, Acacia rostellifera, Alyxia buxifolia, Atriplex cinerea, Hardenbergia comptoniana, Olearia axillaris, Rhagodia baccata, S. crassifolia and *T. divaricata. The understorey of this shrubland typically comprises an exotic dominated open herbland of *C. dactylon, *Avena barbata, *Bromus driandrus, *Briza maxima, *Oxalis pes-caprae and S. lautus. The northern end of the dunefield at James Point is delimited by the Mason Road drain and has been planted with Casuarina equisetifolia and Melaleuca lanceolata. The Casuarinas are mature trees while the Melaleucas are only shrubs at present.

The primary dune ridge still exists in two other locations, but the shrub strata are largely absent, having been replaced by exotics or plantings. The continuation of the primary dune ridge into the BHP site has been planted with Marram Grass *A. arenaria on its seaward slope, whereas the crest levels off on to the refinery site and is dominated by a herbland of introduced species including *A. barbata, *B. driandrus, *C. dactylon, *O. pes-caprae and *Erharta longifolia. East of this dune crest a row of C. equisetifolia has been planted for windbreak and landscape purposes. No native shrub species were observed in this area. The primary dune continues north of the BHP refinery boundary into largely degraded southern portion of the remnant vegetation area west of Riseley Road (see Figure 5.3). Here, the seaward face of the primary dune is dominated by S. lautus, *T. decumbens and *T. divaricata which merges into a community of *A. arenaria, S. crassifolia and Spinifex longifolius along the dune crest.

**Lepidosperma gladiatum sedgeland**

This association consists of a dense sedgeland comprised entirely of Coastal Sword Sedge Lepidosperma gladiatum interspersed with numerous Spyridium globulosum shrubs. The sedgeland has developed in lee of the primary dune on James Point in an area of level, low-lying moist ground, and in similar deep swale in the area immediately south of the Barter Road carpark (see Figure 5.3). The size and development of these swales, combined with just two species comprising the entire assemblage, make the association unusual. Its local occurrence was restricted to these two locations along the section of the coastline affected by the proposal.

**Acacia rostellifera shrublands and thickets**

On James Point and in the area immediately south of the Barter Road carpark, the leeward part of the primary dune features more substantial vegetation, including shrubland and dense thickets dominated by Acacia rostellifera, with other species including Rhagodia baccata, L. gladiatum, A. pressii, Cassytha racemosa and Clematis microphylla, over a weed dominated open herbland of *A. barbata, *E. terracina, *O. pes-caprae and *Fumaria capreolata. This association occurred immediately behind the primary dune line and surrounded swales containing Lepidosperma gladiatum sedgeland association (see Figure 5.3). The eastern margin of these swales is typically delimited by a secondary dune ridge, vegetated with Acacia rostellifera shrubland also including Leucopogon parviflorus, Melaleuca acerosa and A. cochlearsis in this area.
Degraded Acacia rostellifera thickets

A large area of Acacia rostellifera thickets north of the BHP Refinery has been extensively degraded by clearing, materials extraction, spoil dumping, vehicle access and weed invasion (see Figure 5.3). The vegetation in this area consists of a scattered and patchy cover of A. rostellifera thickets which are still dense where they occur. Other native remnant vegetation consists of scattered occurrences of A. saligna, A. preissii, M. acerosa and L. gladiatum. The majority of the understorey consisted of exotics including *Pennisetum setaceum, *Scabiosa atropurpurea, *Solanum nigrum, *Stenotaphrum secundatum, *Salsola kali, *A. barbata, *B. driesch, *S. olacea, *T. divaricata, *E. terracina and *E. longifolia. Taller exotics including Fennel *Foeniculum vulgare and Tree Tobacco *Nicotinia glauca occurred in isolated patches, while several of the remnant A. rostellifera thickets were substantially degraded by mature Coastal Teatree *Leptospermum laevigatum and Brazilian Pepper *Schinus terebinthifolia.

Landscape plantings

East of the Acacia rostellifera shrublands and thickets which occur on the secondary dune ridge of James Point is a narrow strip devoid of shrubs which supports an annual weed herbland typical of the area. Immediately east of this strip is a thicket of mature trees which were planted in three rows. The western row is Melaleuca lanceolata, the middle row Callitris preissii (mostly dead) and the eastern-most row is Agonis flexuosa. East of these plantings is a grassed area adjoining the BP refinery car park.

The area north of Barter Road, adjacent to the power station, has also been planted in degraded areas behind the primary dune ridge. Plantings here include a mixed row of Eucalyptus gomphocephala, Calothamnus quadrifidus, Melaleuca acerosa and Agonis flexuosa.

Threatened flora

A search of the Department of Conservation and Land Management (CALM) threatened flora database indicated that two rare species are known to occur in the locality. These were Dodonaea hackettiana and Grevillea olivacea, both of which are listed as Priority Four species. This status indicates that they are considered to have been adequately surveyed and, while being rare, are not currently threatened by any identifiable factors. Both species are relatively distinctive tall shrubs and their presence could be expected to be established with a degree of confidence during field survey. However, neither species was recorded from the project area during the current survey.

5.5.2 Fauna

Assessment of potential fauna habitats in the project area indicates that the most likely sites to support populations of native fauna are in the vicinity of James Point and the area north of the BHP refinery. Native mammals that may persist in the area include the Southern Brown Bandicoot Isoodon obesulus fusciventer and the Western Grey Kangaroo Macropus fuliginosus, but no evidence of these species’ presence was recorded during the field survey. However, given the extensive rabbit activity and recent heavy rainfall it is possible that the characteristic diggings of I. Obesulus may have been obscured. The Southern Brown Bandicoot is known from several populations in nearby areas including the Brownman Open Space (Draft Bushplan Site 346) (HGM, 1997), Woodman Point (How et al., 1996) and the Kwinana IP14 Industrial Park (HGM, 1995). Given its apparent ability to persist in most Perth
coastal bushland remnants where reasonable understorey habitat exists, the species is considered likely to occur in the area.

A number of introduced mammals utilise the remnant habitats of the project area, including the Rabbit *Oryctolagus cuniculus*, the Fox *Vulpes vulpes* and Cats *Felis catus*, all of which were identified from scats or tracks. The House Mouse *Mus musculus* and the European Black Rat *Rattus rattus* are also likely to occur in the area.

The intact areas of Quindalup dunefield habitat are likely to support a low to moderate diversity of reptile species. How *et al.* (1996) identify a diverse reptile fauna associated with Quindalup dune systems in the Perth metropolitan area, including several species such as *Lerista lineata*, *Hemiergis quadrilineata*, *Pletholax gracilis* and *Neelaps calanotus*, that are largely restricted to these dunes in the region (Bush *et al.*, 1995; How *et al.*, 1996). However, surveys of the 170 ha Woodman Point Quindalup dunes recorded a comparatively low species richness of only 14 reptiles, with many fossorial (burrowing) dune species apparently absent (How *et al.*, 1996). Given this, and the relatively small area of good condition remnant habitat, the project area is likely to support a substantially reduced subset of this reptile fauna only.

A larger number of bird species are likely to utilise the project area including shorebirds, such as Pied Oystercatchers *Haematopus longirostris*, Silver Gulls *Larus novaehollandiae*, Australian Pelicans *Pelecanus conspicillatus* and the Caspian Tern *Sterna caspia*, and coastal heath and shrubland species, such as the Splendid Fairy Wren *Malurus splendens*, the Willy Wagtail *Rhipidura leucophrys*, Singing Honeyeaters *Meliphaga virescens*, and Silveryeyes *Zosterops lateralis* (Blakers *et al.*, 1984; Schodde and Tidemann, 1990; How *et al.*, 1996; HGM, 1997).

**Threatened fauna**

Several species of fauna listed by CALM as Schedule or Priority Fauna may have distributions that include the James Point locality. These include the Western Brush Wallaby *Macropus irma* (Priority 4) and the Southern Brown Bandicoot *Isoodon obesulus* (Priority 4). The Southern Brown Bandicoot may still persist in the James Point area, but it is considered unlikely that the area is large enough to support a population of the Western Brush Wallaby. A small population of this species was noted at Hepburn Heights by How *et al.* (1996) as one of the last known in the Perth Metropolitan area.

Australia is signatory to the Japan - Australia and China - Australia Migratory Bird Agreements (JAMBA and CAMBA), which aim to protect migratory birds in these countries. Several JAMBA and CAMBA bird species may utilise the nearshore habitats of the James Point area, including the Great Egret *Egretta alba*, the Eastern Reef Egret *Egretta sacra*, White-bellied Sea Eagle *Haliaeetus leucogaster*, the Ruddy Turnstone *Arenaria interpres*, the Caspian Tern *Sterna caspia* and the Crested Tern *Sterna bergii*. However, it is likely that the habitat resources of the James Point area are used on a transitory basis only by these species and the area is not a recognised migratory bird foraging or breeding site.

**5.6 NATIVE TITLE AND ABORIGINAL HERITAGE ISSUES**

The PER guidelines prepared by the DEP required an identification of environmental factors relevant to the proposed development. Aboriginal cultural and heritage sites of significance were included as an 'environmental factor' to be identified.
5.6.1 Native title claims

Inquiries made to the National Native Title Tribunal indicate that the project area is located within an area covered by only one registered native title claim (Gavin Jackson Pty Ltd, 2000). This claim is WC98/58 – Gnaarla Karla Booja. The area is, however, subject to another claim, WC95/86 – Ballaruk, which has failed the registration test and has been referred to the Federal Court. Summary details of each of these claims are provided below.

**WC98/58 – Gnaarla Karla Booja**

The Gnaarla Karla Booja Native Title Claim passed the registration test on 17 September 1998. The area subject to the Gnaarla Karla Booja Native Title Claim is bounded by the north-western point of Garden Island, Corrigin to the east, Kojonup to the south and Capel to the west. It can be appreciated, therefore, that the proposed port development at James Point lies just within the northern boundary of this claim.

The current status of this claim is uncertain and this may have implications under ‘future acts’, which are difficult to define at this stage. Despite this, the Gnaarla Karla Booja claim is still valid under the old Act (i.e. before 30 December 1998).

**WC95/86**

The Ballaruk Native Title Claim was lodged on 28 December 1995 and was accepted by the Tribunal on 24 December 1996. The Ballaruk Native Title Claim failed the registration test on 1 June 1999 and has now been referred to the Federal Court. The area subject to the Ballaruk Native Title Claim includes the land and waters generally within a 60 mile (97 km) radius of Perth, being the Whadjuk Territorial boundary.

**Implications of claims**

It is quite probable that Native Title has been extinguished within the areas of the proposed JPPL development as most of the land has probably been held freehold at some stage. There may, however, be Native Title issues with regard to the sea and the sea bed, though it is also possible that Native Title has also been extinguished by the Fremantle Port Authority Act and other legislation relating to the use of the sea and the seabed.

Under the terms of the contract with JPPL, the State Government will take responsibility for Aboriginal heritage and Native Title issues, this may include the process of consultation.

5.6.2 Previously recorded Aboriginal sites

The State Register of Aboriginal Sites, which is held in the Heritage and Culture Division of the Aboriginal Affairs Department, was searched for Aboriginal sites located within a 5 km radius of the proposed port development area. Only one site is recorded in the Register (Table 5.2).

### Table 5.2 Registered Aboriginal Sites in proposed port area

<table>
<thead>
<tr>
<th>SITE IDENTIFICATION NUMBER</th>
<th>SITE NUMBER</th>
<th>SITE NAME</th>
<th>SITE TYPE</th>
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</thead>
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<tr>
<td>4148</td>
<td>S01266</td>
<td>NATGAS 127</td>
<td>Stone artefact scatter</td>
</tr>
</tbody>
</table>

**Site No. 4148 NATGAS 127 (S01266)**

This site was recorded in February 1981 during the archaeological survey of the Dampier to Perth gas pipeline. It is located on sand dunes on the south side of
Thomas Road near Bingfield Road, and is described as an artefact scatter of seven ‘crudely flaked’ calcrete artefacts exposed over an area of 100 m x 100 m.

**Indian Ocean S02169**

A second site, which is known to the researchers from previous work but which did not appear in the results of the register search, is S02169. This site is designated as the ‘Indian Ocean’ in the register system and corresponds to the area of water between the mainland and Rottnest, Carnac and Garden Islands and Cockburn Sound. S02169 will, therefore, be impacted upon by the proposed dredging of the Port.

The site was reported by S.H. Brown in 1983 and was added to the interim register of Aboriginal sites in 1985. The site concerns Aboriginal mythology about the creation of the islands, especially Rottnest. There are two versions of the myth on the site file, one recorded by Armstrong in 1836 and the other by Moore in 1884.

**Implications of no registered archaeological sites**

No registered archaeological sites have been identified within the project area itself, except for the possibility of the Indian Ocean site (S02169), which may be impacted upon by the proposed dredging operations. It should be noted, however, that the James Point area has never been systematically surveyed for Aboriginal sites, although nearby areas were investigated during an archaeological survey of the Dampier to Perth gas pipeline in the early 1980s. The desktop survey has shown that one Aboriginal site, a small scatter of stone artefacts is, or certainly was, present within 3 km of the project area. Unfortunately, it is not known whether this site has been destroyed by subsequent development in the area.

The proximity of both archaeological and ethnographic sites to water sources in the metropolitan area is a notable feature of site records held in the State register. In contrast, there is very little archaeological evidence for use of the coast. This is despite available historical evidence, which describes large groups of Aboriginal people congregating on the coast and estuaries during summer and autumn, when fish and other aquatic resources were abundant. The lack of hard evidence for occupation and use of the coast must in part be explained by the intensive development that has taken place along most of the metropolitan coastline. It should be noted, however, that Aboriginal burial sites are commonly found in Holocene coastal dunes all along the West Australian coast. As such any ground disturbing work undertaken in coastal dunes as part of the James Point Port: Stage 1 development will be monitored in case buried skeletal material, or subsurface archaeological material is uncovered during excavation.

It is emphasised that the State Register of Aboriginal Sites is not a reliable planning tool. The absence of entries for a given area cannot be taken as a true indication that it is free of Aboriginal sites. A field survey of the proposed development area will be undertaken, regardless of whether the proposed works impinge on previously registered sites.

**5.6.3 Statutory obligations**

**Native title issues**

Given that the Ballaruk Native Title claim (WC95/86) has failed the registration test, these claimants no longer have the right to negotiate and the necessity for an Indigenous Land Use Agreement (ILUA) no longer exists. The Ballaruk group still
retain the right to be consulted, however, under the Western Australian *Aboriginal Heritage Act 1972*.

As the status of the Gnaarla Karla Booja Native Title claim (WC98/58) is as yet uncertain, it may be necessary to negotiate with these claimants should the proposed development impinge on the Native Title rights and interests that this group assert.

It is quite likely that Native Title has been extinguished within the land-based areas of the proposed development as most of this land has probably been held as freehold at some stage. The Gnaarla Karla Booja Group may, however, retain the right to negotiate over the proposed dredging of Stage 1 and the reclamation of the James Point flats and the construction of deepwater berths west of James Point.

**Indigenous heritage and culture issues**

While no registered archaeological sites have been identified within the project area itself, except for the possibility of the Indian Ocean site, it is important to realise that the project area has never been systematically surveyed for Aboriginal sites. Given this situation, it cannot be stated with any certainty that Aboriginal sites do not exist within the proposed development area.

To ensure that JPPL do not inadvertently commit an offence under Section 17 of the Act, an Aboriginal heritage survey will be undertaken of the proposed development area prior to construction.

**5.6.4 Summary of implications**

It is likely that Native Title has been extinguished within the land-based areas of the proposed development as most of this land has probably been held as freehold at some stage. There may, however, be Native Title issues with regard to the sea and the seabed where proposed dredging operations and construction of deep water berths are to occur. As this development may fall within the purview of future acts, which has implications under the *Native Title Act (C'wealth) 1993* the State Government will seek legal clarification in relation to this issue.

With regard to Aboriginal Heritage matters, appropriate surveys and consultations with interested Aboriginal groups and individuals will be undertaken in order to ascertain whether there are any Aboriginal sites on the land which it intends to develop and in order to ensure that a breach of the *Aboriginal Heritage Act 1972* does not occur.

**5.7 SOCIAL**

Stage 1 of the James Point Port is proposed to be located to the west of Riseley Road on the central western margin of the Kwinana Industrial Area (KIA).

Industrial zoned land extends approximately one and a half kilometres to the east of the Port site, three kilometres to the north and considerably further to the south. Currently, to the east beyond the industrial area the land is zoned rural, including the settlement of Hope Valley three kilometres to the north-east. Roughly overlaying this area is an air quality buffer zone established under the EPA's Environmental Protection (Kwinana) (Atmospheric Wastes) Policy. Its purpose is to maintain a buffer between industrial atmospheric discharge sources and areas planned for human habitation, so as to permit responsible industrial activity while preserving the highest standards of air quality in residential areas.
Following the ‘FRIARS’ planning process (WAPC, 1999), the State Government has determined that the optimum future land-use will be to extend the Kwinana Industrial Area to the east in the vicinity of Hope Valley and Wattleup, permitting general and light industrial development to the east of that again. This decision will result in industrial use replacing rural and residential.

The nearest urban zoned land to the Port is Medina, in the Town of Kwinana approximately four kilometres to the south-east and Wattleup, discussed above, a similar distance to the north-east.
6. COASTAL ENVIRONMENT: IMPACTS AND MANAGEMENT

6.1 METHODOLOGY
The potential impact of the completed Stage 1 port on shoreline stability was examined by:

- Undertaking a desktop review of the history of coastline change in the region and the key factors affecting sand transport;
- Calculating reflected wave heights from the offshore breakwater; and
- Estimating the longshore sediment transport at various sites along the coast in the vicinity of James Point.

Longshore sediment transport is the process by which sediment is moved along beaches through the action of waves arriving at an oblique angle. Sediment transport also occurs perpendicular to the beach, which acts to distribute sediment across the beach profile.

6.2 PRELIMINARY ANALYSIS AND SEDIMENT TRANSPORT MECHANISMS
An investigation of aerial photography over annual and decadal time scales suggested that the net sediment transport along the coast near James Point is relatively small.

The Stage 1 development will prevent sediment from moving north past the port. This sediment flux previously balanced southward sediment transport, therefore immediately north of the port there is likely to be net southerly transport of sediment. This is likely to result in accretion of sand to the north of the port.

The region immediately south of the Stage 1 development has been stabilised by offshore breakwaters. There is unlikely to be any impact on the stability of James Point due to the close proximity of these breakwaters to James Point, the reduced longshore sediment transport in this region, and the additional protection of the proposed offshore breakwater.

Minor changes to the beaches between the development and James Point will occur as the result of both trapping of sand moving north and reflection off the south end of the land-backed berth. Minor, localised and seasonal erosion is also expected at the down-drift end of the reclaimed area (land backed seawall), which will be the northern end in summer and the southern end in winter (van Rijn, 1998).

The effect of the Stage 1 development on local wave climate is two-fold. The offshore breakwater will reflect waves arriving from the north-west which will increase the northerly sediment transport north of the breakwater. Opposing this, the shielding of waves arriving from the south-west will act to reduce northerly transport north of the breakwater.

Therefore, to the north of the port, the net transport and beach stability, will be determined by the competing influences of wave reflection and reduced northerly sediment transport. These impacts are investigated in more detail in the following section.
6.3 EFFECT OF OFFSHORE BREAKWATER ON SEDIMENT TRANSPORT

6.3.1 Impact on beaches to the north due to reflected waves

The construction of the offshore breakwater close to the shoreline with an orientation approximately perpendicular to the north-west suggests that beaches to the north will be affected to some degree by wave reflection from the structure. Waves from the north-west will provide the worst conditions in terms of reflected waves reaching beaches to the north.

The beaches to the north are narrow, and there is historical evidence to suggest that in regions such as James Point, significant erosion can occur, causing loss of the beaches. As such, reflected waves from the proposed offshore breakwater are an important environmental concern.

A review of data collected with a non-directional wave recorder located at the entrance to Stirling Channel indicated that during storm events significant wave height ($H_s$) approaches 1.25 m and the significant wave period ($T_s$) generally ranges from 2 to 7 seconds. To provide an extreme estimate of potential impacts associated with reflection from the offshore breakwater, waves arriving from the north-west with height 1.5 m and period 10 seconds were modelled to describe a severe storm event.

The offshore breakwater was modelled as a conventional rubble mound structure with a reflection coefficient ($K_r$) ranging between 0.3-0.6. The reflection coefficient is the ratio of the reflected wave height over the incident wave height. The magnitude of reflected storm waves was estimated at four sites, 200 m to 1,700 m north of the northern extent of the landbacked berth (A, B, C and D: Figure 6.1 and Table 6.1).

Table 6.1 Reflected wave height as proportion of incident wave height

<table>
<thead>
<tr>
<th>SITE</th>
<th>DISTANCE NORTH OF BREAKWATER (m)</th>
<th>REFLECTED WAVE HEIGHT (m)</th>
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</thead>
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<tr>
<td></td>
<td></td>
<td>$K_r = 0.3$</td>
</tr>
<tr>
<td>A</td>
<td>200</td>
<td>0.11</td>
</tr>
<tr>
<td>B (Western Power)</td>
<td>600</td>
<td>0.16</td>
</tr>
<tr>
<td>C</td>
<td>900</td>
<td>0.17</td>
</tr>
<tr>
<td>D</td>
<td>1,700</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Table 6.1 shows the estimated reflected wave heights at the four sites arriving at the shoreline in a severe storm event.

The modelling suggests, that, during storms, there is the potential for reflected waves of 10-30% of the incoming wave height to reach the shoreline up to 1,700 m north of the structure. However, this type of effect will be rare as incoming waves will generally be higher frequency and attenuation at breakwater will be significant.

In summary, the wave reflection study found:

- The offshore breakwater is likely to result in an increase in northerly transport;
- Any increase in northward sediment transport due to reflected wave energy will be smaller than the dominant southward sediment transport during north-westerly swell conditions;
• Although changes in transport magnitude may be small, the impact to the coastline may be significant due to the narrow beaches, and potential disruption of replenishment from the south; and
• The impacts will be related to the wave energy and the worst impacts will occur during storm events.

6.3.2 Impact of offshore breakwater on longshore sediment transport

Numerical modelling techniques were used to investigate the effect of the offshore breakwater on longshore sediment transport. JPPL implemented an arrangement to share data with Cockburn Cement Limited (Cockburn) to access past wave climate data and sediment transport modelling results within Cockburn Sound (Cockburn, 2000).

Net annual longshore sediment transport rates at three offshore sites to the north of the proposed port development (Figure 6.1) were calculated using calculations based on incoming wave energy (CERC, 1984).

Contributions to the sediment transport budget along the coastline were estimated from a range of representative conditions throughout the year. These conditions were categorised as swell, sea breeze and winter storms.

An analysis was undertaken to investigate the effect of the port in blocking sediment transport from the south. This was undertaken through calculating the relative change between model results for the pre and post development scenarios.

The modelling suggests that southerly sediment transport rates were 17,500 m$^3$/year at Site 1, 25,000–32,000 m$^3$/year at Site 2 and 24,000–38,000 m$^3$/year at Site 3. The ranges at Site 2 and Site 3 represent estimates for a range of year types (calm, typical and energetic). The results are based upon the breakwater reflecting 30% of the incident wave height.

If the port completely blocks the northerly transport in a typical year, then approximately 17,500 m$^3$ of sediment will accumulate adjacent to the offshore breakwater.

The accumulation pattern for this sediment will be estimated during the detailed design stage by undertaking a numerical modelling study to provide better estimates of longshore deposition and cross-shore bed evolution. A maintenance strategy for removal of sand build up if it starts to affect navigation or flushing of the port will be detailed in the Operations EMP.

The sediment transport modelling did not incorporate the effects of the jetties and outlet canals in the stretch of coastline to the north. These features act to impede the longshore sediment transport and are likely to localise the impact of the offshore breakwater. The modelled accretion values are upper estimates of the potential impact and further detailed modelling during the design phase will be utilised to establish management plans to accommodate this effect.

At Site 2 (Kwinana Power Station), if the port blocks off northerly transport, sediment transport of approximately 25,000–32,200 m$^3$/yr to the south is expected to occur. Similarly, at Site 3, transport may be 20,100–38,000 m$^3$/yr to the south.
SITES USED IN COASTAL PROCESS STUDY

James Point Pty Ltd

JAMES POINT PORT FACILITIES : STAGE 1

Figure 6.1
By way of comparison, the typical summer seabreeze component of sediment transport along the open metropolitan coastline is 100,000 m$^3$/year (Masselink, 1996) which is approximately three times the estimated transport at Site 3.

Erosion may occur to the north of the port due to reduced supply of sand to the region from the south. However, the beaches between Site 1 and Site 3 contain infrastructure that will inhibit changes in sediment transport to the north of Site 3 such as the Alcoa Jetty and particularly the Western Power cooling water discharge canals.

Sedimentation at the Kwinana Power Station is due to the cooling water discharge canals forcing offshore movement of sand travelling alongshore. As the longshore current moves offshore into relatively deeper water beyond the wave breaking and swash zone, wave action is unable to keep the sediment load suspended. The sediment load in the offshore region is deposited until the depth is shallow enough for wave action to keep the sediment load suspended.

As a result of the Stage 1 development it is likely there will be a decrease in the amount of sand deposited, both onshore and offshore at the Western Power outfalls and intakes.

### 6.4 IMPACTS OF CONSTRUCTION

The construction of the breakwater will require a temporary groyne (~200 m long) to be built from the northern end of the reclaimed area out to the northern end of the breakwater. This temporary breakwater will remain in place for 6 to 9 months. There will be an impact on local coastal processes, which is separate from the impact of the completed port, for this period.

The temporary breakwater will not significantly alter the impacts on net longshore sediment transport described above as the reclaimed area will have the greatest impact. However, the temporary breakwater will reflect additional north-westerly wave energy into the beach immediately north of the reclamation area. This will potentially alter the beach shape in the region between Western Power and the port. As part of the preparation of the construction EMP, JPPL will undertake additional modelling and design the alignment and profile of the temporary breakwater so that wave reflection onto the beach is minimised.

### 6.5 SUMMARY OF IMPACTS

The Stage 1 development is likely to have the following impacts on coastal processes:

- The development is situated in a very low energy environment, as such, the effects of altered wave reflection and refraction patterns will be greatest during severe events when incident waves are largest;
- The largest waves will arrive from the north-west. Under these conditions net sediment transport will be to the south, reflected wave energy will be to the north and both processes will affect the existing shoreline equilibrium, including the region around the Kwinana Power Station cooling water discharges;
- The beaches to the south of the Stage 1 development will generally be unaffected due to the breakwaters at James Point and the additional protection of the proposed offshore breakwater;
Highly localised changes to the beaches south of the development may occur as the result of both trapping of sand moving north and wind-wave reflection off the south end of the land-backed berth;

Under prevailing south-west conditions, transport to the north will be blocked by the development. As a result net sediment transport to north should decrease; and

Construction of a temporary breakwater is likely to increase the reflected wave energy arriving at the beach north of the port.

6.6 MANAGEMENT

As part of the final design process, JPPL will undertake a detailed wave modelling study backed up by measurements of beach profiles and wave heights in the vicinity of James Point with the aim of establishing the port and temporary breakwater configuration that will have minimum impact on the beaches adjacent to the development.

A management programme will be included in the Operations EMP. The programme will include the following:

- Results of detailed sediment transport modelling;
- Actions to reduce impacts;
- Beach profile monitoring programme; and
- A wave measurement programme to validate and calibrate the sediment transport model.

In the past, beach stability has been achieved at James Point with a series of offshore groynes such that sand accumulates between the groynes and the beach forming a tombolo. This technique has been implemented because once the upper beach is eroded there is no new supply of sand to replace it. If monitoring suggests that the port is causing irrevocable and significant loss of the shoreline, then the use of similar structures as a management tool will be investigated.

6.7 COASTAL PROCESSES: CUMULATIVE IMPACT

The port will act cumulatively with the groynes offshore of BP to further reduce sand transport to the north, the low energy of the environment means that the impact on the beach to the north is not likely to be significant. The port will have an impact on the local beach shapes and potentially impact on the beach adjacent to the Western Power cooling water discharges. The cumulative effect of structures in the region on beach profiles will be greatest during storms or large north-west swells. JPPL will monitor the beach profiles in the region and implement remedial works if required.

The addition of developments along the eastern margin of the Sound will reduce the net flow of sand alongshore both north and south.
7. IMPACTS ON CIRCULATION: HYDRODYNAMIC MODELLING

7.1 APPROACH

The potential influence of the Stage 1 development on the movement of water in the vicinity of the development was established using proven hydrodynamic modelling techniques. The approach taken can be summarised as follows:

- **Model selection**: reviewed suitable candidate models, selected on basis of previous application and currency;
- **Model input data collection**: obtained reliable meteorological and bathymetric data to ‘drive’ the model;
- **Model set-up**: chose the region to be modelled and dimensions of horizontal and vertical units (cells) such that features of interest would be well represented;
- **Setting boundary conditions**: the forcing conditions at the model boundaries in open ocean (the open boundaries) required careful work to capture the effects of forcings which operate on a much larger scale than the domain modelled and yet which may influence the dynamics of the modelled domain (e.g. Leeuwin Current and tidal effects);
- **Model testing**: the model was run under a variety of boundary conditions and grid configurations to ensure that the model was numerically stable and to assess possible model limitations;
- **Model calibration**: forcing data were applied for periods of time where model output items (e.g. current speeds, temperature and salinity) had also been physically measured in the field. Model friction parameters were then adjusted to ensure ‘best fit’ between modelled and measured information;
- **Peer review**: prior to implementation of the model runs for James Point, the model selection, set-up and calibration process was submitted to two of Australia’s foremost hydrodynamic modellers for peer review;
- **Incorporation of peer review comments**: the comments of the peer reviewers were used to further improve the ability of the model to reflect the hydrodynamics of the region;
- **Modelling of scenarios**: a sequence of model simulations were run for various physical configurations with a variety of meteorological forcing conditions, reflecting the seasonal changes;
- **Interpretation of model results**: the results were then used to form an assessment of likely impacts of the Stage 1 development on circulation and water quality in Cockburn Sound; and
- **Cumulative impact assessment**: the model was run with other possible development configurations in the generation of advice to the EPA regarding the likely cumulative impacts of developments along the eastern margin of Cockburn Sound (not part of this PER).

7.2 MODEL SELECTION

The selection of the most appropriate numerical model was as important as the application of the model itself. This was dependent on the oceanographic characteristics of the site and the nature of the impacts to be assessed. It was also desirable that the model was versatile and well established.
Following a review of a number of potential models the Environmental Fluid Dynamics Code (EFDC) was selected for application to this project. The model has been widely used in the United States for a variety of environmental assessments, and importantly, has gained credibility with the US EPA and other regional authorities. Also of note, the hydrodynamic component of the model is similar in many aspects to the Princeton Ocean Model (also known as the POM or the Blumberg model). POM was previously applied to Cockburn Sound by the DEP (DEP, 1996a) and formed the basis of the hydrodynamic assessment in the Southern Metropolitan Coastal Waters Study (DEP, 1996a).

7.3 MODEL DOMAIN AND BATHYMETRY

The required spatial and temporal resolution was dictated by the level of detail required to first resolve the oceanography and secondly the geometry of the existing and post-construction options, including any staging of port development. An adequate representation of the bathymetry, shallow bank regions, coastline and the shipping channels was critical if the model was to be flexible enough to investigate the various stages of the proposed development and others in the region.

A portion of the base model grid is shown in Figure 7.1. The key features can be summarised as follows:

- Grid alignment to 350º to match the topography and shipping channel;
- Domain extends beyond Fremantle to the north, Warnbro Sound to the south and is bound by Rottnest Island at the NW corner. The domain is bounded immediately to the west of Five Fathom Bank;
- Central Cockburn Sound is resolved by 250 m x 250 m cells, suitable in this relatively uniform basin;
- The existing FPA shipping channel has been resolved with two grid cells approximately 100 m wide that are bound by the 10 m contour. This is representative of the mid-batter location on the channel;
- The region around James Point is resolved by a 100 m grid cell size;
- The model includes the Swan River mouth at Fremantle Harbour; and
- Coarser resolution cells have been applied at the boundary to assist in removing the influence from the model interior.

The full bathymetric grid was generated from the 100 m resolution data set generated by the Department of Transport for the Perth Coastal Waters Study (PCW data set). Detailed survey information was provided by Cockburn Cement for Owen Anchorage and Parmelia Bank and high resolution survey data provided by JPPL was used to refine the computational grid. The grid sizes and regions of focus were dictated by the need to focus on the eastern margin of the Sound, while maintaining a suitable, yet computationally efficient resolution elsewhere. Figure 7.2 shows the base case bathymetry in the James Point region, overlain by the Stage 1 components. The Stage 1 scenario is shown in Figure 7.3.
Figure 7.1 Computational Domain – Cockburn Sound portion

Note: The DEP current meter locations are also shown as are the Garden Island Causeway and the Jervoise Bay Northern Harbour breakwaters. Note the fine model resolution in the vicinity of James Point.
Figure 7.2 EFDC model grid in James Point region for existing conditions

Note: Each rectangular patch is a model cell. Locations of relevant intakes and outfalls are shown, as are the footprints of the JPPL Stage 1 development.

Figure 7.3 Bathymetric map of post-construction condition

Note the specification of the proposed breakwater as a thin ‘wall’.
Vertically, the model is divided into 12 layers, each specified as a percentage of the local water depth. In this way the model ‘follows’ the bottom topography, resulting in a smooth representation of the system. The vertical spacing of model layers is presented in Table 7.1, together with some examples of the resolution for two typical depths. Overall the model grid had approximately 10,000 wet cells in each layer and 120,000 cells in total.

Table 7.1 Computational model layers – sigma coordinate system

<table>
<thead>
<tr>
<th>LAYER POSITION</th>
<th>LAYER NUMBER</th>
<th>% THICKNESS</th>
<th>WATER DEPTH: 5m LAYER THICKNESS (m)</th>
<th>WATER DEPTH: 20m LAYER THICKNESS (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom</td>
<td>Layer 1</td>
<td>10%</td>
<td>0.50</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Layer 2</td>
<td>10%</td>
<td>0.50</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Layer 3</td>
<td>10%</td>
<td>0.50</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Layer 4</td>
<td>10%</td>
<td>0.50</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Layer 5</td>
<td>10%</td>
<td>0.50</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Layer 6</td>
<td>10%</td>
<td>0.50</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Layer 7</td>
<td>10%</td>
<td>0.50</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Layer 8</td>
<td>10%</td>
<td>0.50</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Layer 9</td>
<td>5%</td>
<td>0.25</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Layer 10</td>
<td>5%</td>
<td>0.25</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Layer 11</td>
<td>5%</td>
<td>0.25</td>
<td>1.0</td>
</tr>
<tr>
<td>Surface</td>
<td>Layer 12</td>
<td>5%</td>
<td>0.25</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Thin physical barriers, such as the Jervoise Bay breakwaters and the Garden Island Causeway, were represented in the model by a series of masks that restrict the flow through specific computational cell faces. This removed the requirement to represent any barrier via a dry or land cell, which can often be many times the physical dimension of the real structure.

### 7.4 BOUNDARY CONDITIONS AND FORCINGS

Figure 7.4 shows the general layout of the model domain with respect to boundary and forcing conditions.

#### 7.4.1 Elevation

A direct specification of the surface elevation along the boundaries was implemented through the prediction of tidal time-series based on constituents derived for Rottnest Island, being the western-most region of the domain. An alongshore lag in the tide has also been incorporated on the western model boundary, based on available data from local stations to the north and south of the model domain.

#### 7.4.2 Velocity

Perhaps the most important limitation of the EFDC model is in the velocity boundary conditions. EFDC allows no tangential flow component along the boundaries, requiring all flow to pass through normally. Tests have shown that the influence of this constraint is negligible within approximately 5 km of the model boundary. Calibration of the model showed that in the region of interest the model represented flow adequately.

#### 7.4.3 Temperature and salinity

Constant values for temperature and salinity at the boundaries were applied, and these were also constant over the depth. Variation at the boundary was included but only where variation occurred over periods greater than one day.
7.4.4 Model forcing

In addition to the initial and boundary conditions the following forcing drove the model:

- Wind;
- Industrial discharges;
- Atmospheric heat fluxes; and
- Along shelf pressure gradient.

Wind data

Long term historical wind data were available for both Mandurah and Swanbourne. Swanbourne wind data was selected for this study due to its proximity to the site. The selections of the representative wind conditions are discussed in more detail in the Section 7.8. The wind was applied as a constant forcing over the domain, neglecting topographical influences and spatial variations.

Cooling water discharges

The existing discharges at BP and Western Power were included in the baroclinic autumn simulations. The locations of these discharges are shown in Figure 7.2. All discharges were defined as constant throughout the simulations using publicly available values for BP and provided by Western Power. The characteristics of the discharges are shown Table 7.2.
Table 7.2 Characteristics of the cooling water discharges

<table>
<thead>
<tr>
<th>NAME</th>
<th>FLOW (m³/s)</th>
<th>TEMP. (°C)</th>
<th>SAL (PSS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP</td>
<td>5.10</td>
<td>+15</td>
<td>+0</td>
</tr>
<tr>
<td>WP-A+B</td>
<td>18.40</td>
<td>+12</td>
<td>+0</td>
</tr>
<tr>
<td>WP-C</td>
<td>10.16</td>
<td>+12</td>
<td>+0</td>
</tr>
</tbody>
</table>

The Western Power discharge has two outlet channels for cooling water named AB and C. The AB discharge is released from the northern channel and Stage C approximately 60 m to the south. The discharges were implemented in adjacent model cells. The flow rates and overheats were provided by Western Power and these represent the design peak loading conditions. In reality, the discharge is typically much less than this, and varies according to demand (DAL, 2001). The intakes were also included in the model – these are approximately 200 m offshore and located near the seabed. Thus the model allows for the possibility of recirculation of cooling water.

The existing BP discharge essentially consists of four pipes that spill directly onto the beach. The discharge is therefore expected to form a thin lens on the surface, as was found in a recent survey undertaken for Western Power (DAL, 2001). The intake is located on the southern side of James Point (see Figure 7.2) at the end of a 200 m groyne. The flow rates and overheats were sourced from Hearn (1991b).

**Atmospheric heat fluxes**

EFDC includes an atmospheric heat exchange sub-model that is based on the NOAA (National Oceanographic and Atmospheric Administration) Geophysical Fluid Dynamic Laboratory’s formulation (Rosati and Miyakoda, 1988). The heat exchange model is forced by appropriate meteorological data such as air temperature, cloud cover, relative humidity, incoming shortwave radiation, atmospheric pressure and wind speed.

**Leeuwin Current**

Over the length of the model domain the Leeuwin Current can be represented by either a pressure gradient or an alongshore inflow. An alongshore pressure gradient representation has been chosen for this application. Generally the influence of the Leeuwin Current is restricted to the west of Garden Island due to the reef offshore reef and island systems inhibiting movement of the Leeuwin Current into Cockburn Sound. The alongshore pressure gradient is not expected to have a significant influence on modelled flows within Cockburn Sound. The predominantly wind driven circulation and shallowness of Cockburn Sound relative to the deeper mid and outershelf regions combine to dominate the effect of the alongshore pressure gradient. It has been included for completeness. A value of 1.25 x 10⁻⁶ m/s² has been adopted (Thompson, 1987; Smith et al., 1991; Gersbach, 2000) for the alongshore pressure gradient.

**7.5 INITIAL CONDITIONS**

Initial conditions for surface elevation, temperature and salinity had to be set for each model simulation. Surface elevation was initialised at mean sea level (MSL, +0.6 m CD), with the starting time of the simulation selected such that the boundary elevations were also approximately at MSL. Temperature and salinity was set constant throughout the domain, based on typical seasonal averages for the summer simulations (e.g. D’Adamo, 1992), and the measured data for the autumn simulations. Basin and regional scale gradients in these properties were neglected, allowing local impacts to be more easily identified. Table 7.3 summarises the initial
conditions. The boundary values for temperature and salinity were maintained at these values (constant over depth) throughout the simulation, subject to the interior flow boundary condition.

Table 7.3 Representative initial conditions

<table>
<thead>
<tr>
<th>WATER PROPERTY</th>
<th>SUMMER</th>
<th>AUTUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>24.0</td>
<td>19.0</td>
</tr>
<tr>
<td>Salinity</td>
<td>36.5</td>
<td>35.3</td>
</tr>
</tbody>
</table>

7.6 MODEL PARAMETERS

For reference, the principal model parameters are given in Table 7.4 below.

Table 7.4 Model parameters

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coriolis Parameter</td>
<td>$7.7 \times 10^{-5}$ s$^{-1}$ (southern hemisphere orientation)</td>
</tr>
<tr>
<td>Number of vertical layers</td>
<td>12</td>
</tr>
<tr>
<td>Horizontal Momentum Diffusivity</td>
<td>$10 m^2/s$, constant</td>
</tr>
<tr>
<td>Vertical Eddy Viscosity/Diffusion</td>
<td>Mellor-Yamada Scheme</td>
</tr>
<tr>
<td>Along shelf pressure gradient</td>
<td>$1.25 \times 10^6 m/s^2$</td>
</tr>
<tr>
<td>Time-step</td>
<td>40s</td>
</tr>
</tbody>
</table>

7.7 MODELLING PROGRAMME

The schedule of modelling undertaken for the Stage 1 development is shown in Table 7.5. For completeness, the table includes simulations undertaken for JPPL Stage 2 cumulative impact assessment, though this work does not form part of the PER.

Table 7.5 Simulation summary

<table>
<thead>
<tr>
<th>SCENARIO</th>
<th>DEVELOPMENT COMPONENTS</th>
<th>SUMMER</th>
<th>AUTUMN</th>
<th>DISCHARGES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Existing</td>
<td>JPPL1</td>
<td>JPPL2</td>
<td>SH</td>
</tr>
<tr>
<td>Calibration</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Validation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>JP-1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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</tr>
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</tr>
<tr>
<td>JP-3*</td>
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<tr>
<td>JP-6*</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

NH Jervoise Bay Northern Harbour
SH Jervoise Bay Southern Harbour
JPPL1 James Point Stage 1
JPPL2 James Point Stage 2

7.7.1 Initial set-up and calibration of model with field data

The model was calibrated (model internal parameters tuned so that output matched measured data) and validated (model output compared against data different to that used for calibration, without tuning of parameters, to ensure that model is performing adequately) to provide confidence in the results for the modelling of post-construction scenarios. A baroclinic validation exercise was conducted to assess the models ability to represent the Western Power and BP discharges adjacent to the James Point site.
7.7.2 **Comparative modelling of the base case vs. Stage 1 bathymetry**

Potential impacts were assessed by identifying the changes in flushing rates, local circulation patterns and residual transports for the Stage 1 development relative to the base case. The ‘base case’ model runs included the Jervoise Bay Southern Harbour development, which is scheduled for construction to begin shortly.

7.8 **REPRESENTATIVE WIND CONDITIONS**

Wind data were chosen on the basis that they represented typical conditions experienced in summer and autumn. It was important to use real wind data as simulation under constant forcing conditions does not take important natural variability into account. It is therefore important to include variation in long term simulations lasting more than a couple of days.

The selection of typical, or representative, summer conditions involved an analysis of the past five years of wind data from the Bureau of Meteorology’s Automatic Weather Station at Swanbourne.

The baroclinic modelling of the autumn cases utilised a complete meteorological data set, including, air temperature, humidity, atmospheric pressure and wind data. The mean wind speed at Swanbourne during this period was found to be less than the long term mean wind speed for autumn. This implies that wind driven flows will be weaker, and flushing estimates may be considered conservative.

Summary characteristics of the wind data selected to represent summer and autumn conditions are shown in Table 7.6.

**Table 7.6 Summary of wind characteristics for the representative seasonal model scenarios**

<table>
<thead>
<tr>
<th>SEASON</th>
<th>SELECTED PERIOD</th>
<th>MEAN SPEED</th>
<th>MAX SPEED</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>17-30 Jan, 1998</td>
<td>5.7 (5.4)</td>
<td>10.4 (12.6)</td>
<td>Typical summer sea/land breeze system, with rare northerly components. Some periods of sustained easterly winds included.</td>
</tr>
<tr>
<td>Autumn</td>
<td>12-28 May, 1997</td>
<td>3.4 (4.6)</td>
<td>7.0 (15.9)</td>
<td>Includes the representative prolonged period of calm to moderate easterly winds.</td>
</tr>
</tbody>
</table>

7.9 **CALIBRATION**

The model calibration simulation was undertaken with parameter values similar to those used by the DEP (1996a). The calibration confirmed the model performance relative to the DEP model and provided confidence in its extension to the broader study.

The DEP supplied current meter records from autumn of 1992 and concurrent wind data collected at Naval Base for calibration purposes. The locations of the current meters are shown in Figure 7.1. The base grid incorporating the Perth coastal waters bathymetry set was used, and the calibration simulation undertaken for a period of 28 days. The results for each of the locations are shown in Figure 7.5 and Figure 7.6.

At Location SDC5 (on the eastern shelf), to the north of James Point, the results compare well with measured currents and are comparable with the results obtained by DEP (1996a). This is not unexpected given that both models are functionally equivalent in the treatment of wind forcing.
Figure 7.5 Model calibration results at SDC5 – eastern margin (see Figure 7.1)

Note: The solid red lines are the modelled values while the blue dots are the measured values.

Figure 7.6 Model calibration results at SDC4 – northern Cockburn Sound (see Figure 7.1)

Note: The solid red lines are the modelled values while the blue dots are the measured values.
At other locations, the fit between measured and modelled data was not as good. However, the same problem was found by DEP (1996a), who concluded that baroclinic influences may have been of importance at that time particularly at site SDC4.

It was concluded that the model was at least as accurate as the model used by the DEP in previous work. The calibration process was externally reviewed by two national experts in numerical modelling (Dr J. Hunter and Dr C. Hearn) and it was considered doubtful that further efforts to improve the barotropic calibration would lead to a significant improvement in representing the circulation mechanisms of importance to this study.

7.10 BAROCLINIC VALIDATION

The model calibration exercise demonstrated that the model performed well on the eastern margin of Cockburn Sound for predominantly well mixed (barotropic) conditions. As the James Point site is adjacent to several thermal wastewater outfalls, which induce circulation driven by density gradients, the performance of the model under baroclinic (refer glossary) conditions is also important. A field programme was undertaken during May 2000 to provide data for use in the model validation exercise.

Figure 7.7 shows the model and field results for May 24, 2000. The model data presentation is a snapshot of the temperature field approximately 0.5m below the surface at 1200 hours. The field data shows the composite image from surface records (0.25 – 0.75 m below the surface) from the period 1010-1400 hrs. Also shown on Figure 7.7 are the three transect lines for the sections presented from Figure 7.8 to Figure 7.13.

![Figure 7.7 Model (left) and Field (right) data comparison of near-surface temperature, May 24 1200hrs](image)

Note: Field data collected between 1010-1219 hrs. Left panel also shows numbered transect lines where data were collected.
The modelled horizontal extents of the BP and Western Power plumes were similar to the measured extents. Each plume is shown to be quite distinct at this time, with the temperature difference well represented by the model from regions near the outfalls (within 50 m) to the extent of the field survey.

A direct comparison between measured vertical profiles of temperature and modelled profiles are shown from Figure 7.8 to Figure 7.13. The extents of the plumes in the horizontal and vertical dimensions are in agreement with the field data, demonstrating that the model provides a good representation of the thermal influences of the plumes in three-dimensions.

This was a true validation exercise in that the previously calibrated version of the model was not adjusted in any way to better fit the measured data. The number of model layers was increased after the barotropic calibration following inspection of the field data (as discussed previously), which suggested that the top 2–3 m of the water column would contain most of the discharge signal.
Figure 7.8 Validation simulation, temperature contours along field Transect 1 May 24 1200hrs

Figure 7.9 Field data, temperature contours, Transect 1 May 24 1010-1219 hrs
Figure 7.10  Validation simulation, temperature contours along field Transect 2 May 24 1200 hrs

Figure 7.11  Field data, temperature contours, Transect 2 May 24 1010-1219 hrs
Figure 7.12 Validation simulation, temperature contours along field Transect 2 May 24 1200 hrs

Figure 7.13 Field data, temperature contours, Transect 2 May 24 1010-1219 hrs
7.11 MODEL RESULTS

7.11.1 General circulation and transport

The typical seasonal circulation patterns have been presented in earlier studies (Hearn, 1991a; D’Adamo 1992; Mills and D’Adamo, 1995; DEP, 1996a). Winds, together with strong topographical steering, tend to be the dominant forcing factors in the region.

Model results show that during summer, the persistent southerly winds drive the coastal flow to the north, particularly in the shallow regions (Figure 7.14). Within Cockburn Sound, the depth-averaged flow is characterised by two well-defined circulation cells, which is in agreement with the previous work. These cells form north and south of James Point where distinct anticlockwise and clockwise gyres are evident (Figure 7.14). This suggests that during the summer period, the influence of changes to the coast north of James Point might be naturally restricted to the northern body of water in the Sound.

Figure 7.14 Typical surface current patterns under typical Summer (left panel) and Autumn (right panel) conditions

During autumn and winter, the winds are more variable, resulting in a more random current system, punctuated by strong southerly and south-easterly flows during the passage of storms and weaker frontal systems. The right hand panel of Figure 7.14 shows typical current vectors during a calm period in May, 2000, which was preceded by several days of predominantly easterly winds.

7.11.2 Flushing of James Point Port: Stage 1

The flushing performance of the Stage 1 concept was investigated for the summer and autumn conditions discussed in Section 7.8. Figure 7.15 shows the location of the points in the model from which output data were extracted for analysis.
Simulations for the existing (inclusive of the Department of Commerce and Trade’s proposed Southern Harbour) and the James Point layout were conducted, with the James Point Port: Stage 1 precinct initialised at the start of the model run with a tracer concentration of 10 arbitrary units. The initial distribution is shown on the right panel of Figure 7.15. Modelling of a conservative tracer (refer Glossary) allows the flushing process to be easily estimated, as the change in concentration with time within the proposed port can be compared with the change in concentration in time of same parcel of dye without the port.

Calculation of the e-folding time provides a measure of how well the region is flushed (refer Glossary). This value refers to the time at which the initial concentration is reduced to 37% of the initial concentration value. This method is a standard means of measuring the residence time of a water body.

Figure 7.16 and Figure 7.17 show the decay of dye tracer concentrations within the Stage 1 Port basin and at the same point under existing conditions (Point 2, see Figure 7.15) for summer and autumn simulations respectively. Results are presented for Point 2 as the longest residence times of the three points within the Stage 1 Port were measured here. The figures show time-series for four model layers at depths of: 0.0–0.7 m, 2.8–4.2 m, 5.6–7.0 m and 12.6–14.0 m CD, which correspond to vertical layers 12 (surface), 7, 5 and 1 (bottom).
Figure 7.16  Time-series of dye concentration, central James Point Port: Stage 1 – Summer simulation

Figure 7.17  Time-series of dye concentration, central James Point Port: Stage 1 – Autumn simulation
During summer, the predominant southerly winds drive water northward, through the nearshore gap in the offshore breakwater. As a result, the introduction of the James Point Port: Stage 1 only results in a minimal increase in the residence time at Point 2, shown to be approximately 6 hours and the port will be fully flushed in approximately one day.

The autumn simulations showed that the daily heating and cooling of the water column, combined with the Western Power and BP cooling water discharges and lighter, more variable winds would result in increased residence times and larger differences in residence times between the surface and bottom waters. The impact of the port on residence times at the surface is quite minor, with at most a 12 hour increase in the e-folding time and surface waters fully flushed within 2 to 3 days with and without the port. At the bottom, the influence is greater with an increase of approximately 1–2 days in the e-folding time, meaning the bottom waters are fully flushed in approximately 5–6 days, compared to 4 days under existing conditions.

Overall, the model predicts that there will be a minor increase in the flushing time (e-folding time) of the port following construction of JPPL Stage 1. The effect on flushing time is predicted to be less than 12 hours in summer, and approximately 1–2 days for the bottom waters during autumn. It should be noted that these results do not include the effects of regular shipping movements within the port which will tend to promote mixing and exchange of the port.

### 7.11.3 Impact on Western Power and BP discharges

The James Point Port development is close to the Western Power and BP cooling water discharges and it is likely to have some effect on the dispersion of the thermal plumes. Effects will be most apparent on the Western Power plume due to its location and magnitude of discharge. The measured and modelled extents of the plumes under existing conditions are shown in Figure 7.7.

The offshore breakwater acts to funnel northward moving water into the shore. This causes an increase in speed of northward flowing currents immediately adjacent to the shore and reduced currents immediately north (in the lee) of the breakwater. To investigate the potential impact on Western Power discharges, modelled surface and bottom temperatures were examined for two sites: Site 4, 750 m offshore from the Western Power discharge, and Site 9, 200 m offshore from BP’s discharge (refer Figure 7.15).

The range of temperatures for both sites after development was found to be within the predicted range for existing conditions. Table 7.7 shows the mean temperatures for each scenario at both sites over the autumn simulation period. The application of a matched-pair significance test shows that a very small (<0.2°C), but significant effect on the mean temperatures will be generated by the Stage 1 development, with temperatures decreasing at Site 4 and increasing at Site 9.

### Table 7.7 Temperature response at Sites 4 (Western Power) and 9 (BP)

<table>
<thead>
<tr>
<th>SITE</th>
<th>MEAN TEMP. (°C)</th>
<th>STD DEVIATION (°C)</th>
<th>DIFFERENCE IN MEAN TEMP. (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EXISTING</td>
<td>STAGE 1</td>
<td>EXISTING</td>
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Note: Mean derived from full duration of autumn simulation.
To illustrate the scale of influence of the development on the Western Power and BP cooling water discharges, a plot of the maximum temperature difference in the surface layer between the existing and post development cases over a 16-day autumn simulation has been generated. The result is shown in Figure 7.18. The red regions represent an increase in temperature following construction, while blue represents a temperature decrease; all temperature changes are within ±1°C (i.e. small). It is important to note that the result is only the outcome of a 16 day modelling period and as such the extent of the changes is indicative only. However, the overall picture is expected be similar for all scenarios, with the main area of increased temperature (circled) resulting from the offshore breakwater restricting the southerly spreading of the plume and the increased current speed nearshore forcing the plume offshore. The blue (cooler) region to the south is also attributable to this reorientation and reduced southerly penetration of the thermal plume, however, it is important to note that the extent is also an artefact of the conditions modelled. For example, in the simulation used to generate Figure 7.18, a period of southerly winds drove the Western Power Plume southwards. This means that when the difference between existing and post-development is calculated we see the effect extending south.

Figure 7.18 Difference between maximum temperatures for existing and post-JPPL Stage 1 configuration for autumn simulation period

Note: Red represents an increase in maximum temperature and blue a decrease.

Essentially, the impact on the dispersion of the Western Power and BP plumes is minor. The port will reorientate the Western Power plume and subsequently lead to minor increases in mean surface temperatures offshore and to the north of the discharge location. These changes will be less than 0.5°C in general and longer-term averages suggest that the differences will be less than 0.2°C. The port will not have
a marked impact on the BP plume. There will not be any significant ecological impacts caused by this slight change in temperature distribution.

The modelling and field studies suggest that operation of the outlet under existing conditions result in the temperature exceeding ambient temperatures by 2°C for 50% of the time over a region of 900 to 1000 m from the source under calm autumn conditions, which under the draft EPA EQO would match a moderate level of ecosystem protection (E3).

It is interesting to compare this to the EPA (2000) report which suggests that a low level (E4) of ecosystem protection should apply to all points within 700 m of the discharge; a moderate level (E3) of ecosystem protection should apply to points within approximately 900 m of the discharge and beyond this high level of protection should generally apply.

The scale of the E3 zone is not dissimilar to that proposed by EPA. However, the ecological impact is unlikely to be such that level of ecosystem protection should be low (meaning large change in rates of production; and/or large changes in abundance of marine life; and/or changes in water quality parameters beyond the limits of natural variation) at any point outside the initial mixing zone.

The discharge only causes change in temperature substantially beyond the limits of natural variation within the order of 50 to 100 m of the discharge. Further, this impact is restricted to the upper portion of the water column.

The discharge of cooling water from Western Power appears to have very limited impact on the marine environment. This is because the point at which discharge occurs is natural sandy habitat with relatively low levels of biodiversity, abundance and productivity of marine life. Further, the discharge is rapidly diluted such that water temperatures are in within the natural range (~16 to 23°C) for Cockburn Sound.

The Stage 1 development may have a slight impact on the selection of a zone where E3 level of protection may be set for the Western Power discharge, it will not have any impact on the location of boundaries for E4. JPPL will work with Western Power and the Cockburn Sound Management Council during the preparation of the Environmental Protection Policy for Cockburn Sound to ensure that boundaries for EQOs are set using the most relevant information.

7.11.4 Influence at the regional scale

From the summer and autumn circulation predictions, the effect of the port on depth average currents within Cockburn Sound was calculated. The results are presented in terms of the change induced by the development on the existing mean currents (Figure 7.19). The scale shows changes of up to 0.1 m/s in magnitude with positive values (green to red in Figure 7.19) implying an increase in residual current speed following construction.
Changes in current speeds greater than 0.01 m/s are shown in blue and are confined to the eastern margin of Cockburn Sound. Green and yellow colour differences over Cockburn Sound reflect insignificantly small changes (<0.01 m/s). The development creates a shadow in the lee of the offshore breakwater to the north, reducing currents by an average of 0.02-0.03 m/s over 3 km in a zone alongshore. The offshore distance of this zone is controlled by the breakwater gap, and the size of the shadowed region increases in proportion to the strength and persistence of southerly and south-westerly winds. The residence time of water immediately north of the offshore breakwater was found to increase only by a matter of hours (PHC, 2001). For summer conditions, the residence time was found to increase from about 4 hours to about 6 hours, while under calm autumn conditions the residence time increased from 6 hours to 10 hours.

There is no significant change the direction of currents outside the immediate vicinity of the Stage 1 development. The gyre in the northern part of the Sound remains relatively unchanged and mean currents continue to move north along the eastern margin.

The results show a small increase in the speed of alongshore current near the Western Power outfall, restricting the southerly spread of the plume into the port. Overall the impact is to reduce the mean alongshore current between the JPPL and Southern Harbour developments. These changes are of the order of 10% of the typical summer current speeds in the region and the currents remain able to travel distances of several kilometres per day. The overall impact is considered to be minor in terms of the circulation and exchange on the eastern margins of Cockburn Sound.
7.12 MIXED LAYER DEPTH ANALYSIS

7.12.1 Introduction

A mixed layer depth (MLD) analysis was required to assess the influence of deepening the seabed in the James Point Port: Stage 1 on water quality. The MLD is generally referred to as the depth of water below the surface where there are no changes in salinity and temperature. The bottom of the MLD is either the sea floor or a point in the water column at which temperature or salinity starts to change with increasing depth.

The water column is termed stratified if there are vertical variations in temperature and salinity in the water column. A vertically stratified water body acts to decouple processes occurring in the surface from the water lower in the water column. This may have important consequences for water quality. For example, significant stratification may inhibit the vertical penetration of oxygen from the surface to the bottom of the water column, resulting in low dissolved oxygen levels at the seabed.

The MLD can be considered as the result of an energy balance, with the components of the energy balance categorised into two groups. The first group contains sources of energy that act to stratify the water column. In Cockburn Sound these are solar heating, discharges of relatively heavier or lighter water than the receiving fluid and currents that bring in either relatively heavier or lighter fluid. Acting to inhibit the formation of a stratified water column are the forcing mechanisms of the second group. These can be wind energy acting to stir the water column, stirring at the bottom of the sea floor as a result of tidal currents and, cooling or heating from the surface or the base of the water column respectively.

The important mechanisms that will govern the depth of the mixed layer in the vicinity of James Point are wind mixing, solar heating, cooling of the water surface at night and the heated effluent discharges from Western Power and BP.

7.12.2 Previous investigations

Investigations of the vertical mixing of Cockburn Sound have been undertaken by Hearn (1991a) and D’Adamo and Mills (1995a and 1995b). These investigations found a seasonal pattern to the MLD based on seasonal wind patterns.

The summer regime is characterised by regular wind mixing of the water column, extending to the deepest point of the Sound (ca. 20 m) with a frequency of approximately once every two days (D’Adamo and Mills, 1995a).

Autumn is characterised by weaker winds with vertical mixing over the full depth of Cockburn Sound restricted to storm events. The MLD is generally restricted to the upper 10–15 m of the water column and is the result of overnight cooling.

Winter is characterised by a regular MLD depth of up to 15 m due to cooling during the night and weak wind mixing. Regular storm events act to vertically mix the water column fully to the deepest point in the Sound approximately 4–6 times per month.

In the context of stratification within Cockburn Sound, the Eastern Margin (depths less than 10 m) between James Point and Woodman Point is generally well mixed (MLD extends over the depth of the water column) for the majority of the year. This is because the shallow depth of the region allows the wind and night time cooling to
penetrate through the whole water column and prevent stratified conditions throughout the year (D’Adamo and Mills, 1995a).

7.12.3 Mixed layer depth analysis

By dredging to −13.7 m (CD), the frequency of mixing is likely to decrease. To estimate the change in the vertical mixing frequency, a mixing depth analysis was conducted using methodology similar to that described by D’Adamo and Mills (1995c). This analysis allowed a relative comparison of the periods for which the entire water column within the port would not be vertically mixed before and after dredging.

The analysis used three hourly meteorological data to model the surface heat exchange (cooling at night and heating during the day) and wind mixing. The data sources are listed in the Table 7.8. The sea surface temperature (SST) was estimated by fitting an annual sinusoidal least squares curve to temperature data collected offshore from Jervoise Bay Northern Harbour between 1998 and 2000. The range of temperatures represented by the curve were found to agree well with previous estimates of the SST range (DEP, 1996a).

Table 7.8 Meteorological data used for the MLD analysis

<table>
<thead>
<tr>
<th>METEOROLOGICAL VARIABLE</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud Cover</td>
<td>Perth Airport</td>
</tr>
<tr>
<td>Wind</td>
<td>Scarborough</td>
</tr>
<tr>
<td>Air Temperature</td>
<td>Scarborough</td>
</tr>
<tr>
<td>Dew Point Temperature</td>
<td>Scarborough</td>
</tr>
<tr>
<td>Mean Sea Level Pressure</td>
<td>Mandurah</td>
</tr>
<tr>
<td>Sea Surface Temperature</td>
<td>Jervoise Bay</td>
</tr>
</tbody>
</table>

Note: All data at least three hourly averages during 1995 except for the sea surface temperature (SST). SST was synthesised from data measured intermittently over three years.

The heat balance at the surface of the water column was calculated using a methodology similar to that used by Friehe and Schmitt (1976).

Estimates of the difference in density in summer between the surface and bottom waters on the eastern margin were obtained using results for density differences in central Cockburn Sound presented by D’Adamo and Mills (1995b). As stratification on the eastern margin, bounded by Woodman Point to the north, the 10 m isobath to the west and James Point to the south, is generally weak, usage of the central Cockburn Sound values provided a conservative representation of the degree stratification on the eastern margin (a greater vertical density difference results in greater stratification and decreased vertical mixing).

The field data described in Section 7.10 showed that stratification on the eastern margin, near the Western Power discharge, during an extended period of calm conditions was represented by a vertical density difference of 0.15 kg/m³ between surface and bottom waters. This value was used to represent autumn conditions.

The results of the analysis are shown in Charts (a) to (c) in Figure 7.20. Remembering that the eastern margin of Cockburn Sound is less than 10 m deep, Chart (a) implies that the water column is generally mixed to at least this depth. However, the frequency of mixing decreases rapidly for depth greater than 10 m. Therefore, if the water column is deepened, then the frequency of the MLD extending throughout the water column significantly decreases.
Figure 7.20 Daily average MLD (a), occurrences of the MLD less than the water column for a depth of 10 m (b) and 14 m (c) for the port

The MLD is greater than 15 m for much of the summer period (days 0-50 and 300-365), while during the autumn and winter-spring months the frequency of durations for which the MLD depth is greater than 14 m are lower than during the summer months. This was also observed by D’Adamo and Mills (1995a and 1995b).

An analysis for the 1995 data indicates that there were nine occasions when the MLD was less than 14 m for longer than three days (Chart (c)). In comparison there were no occasions where the MLD depth did not extend to 10 m (the existing depth) for periods greater than 3 days (Chart (b)). The duration of three days was selected as a
lack of mixing for less than this time was considered as unlikely to have a significant
effect on dissolved oxygen levels near the seabed (Bastyan and Paling, 1995).

7.12.4  Effects of ship movements

It is forecast that within five years of construction there will be approximately 240
ship visits each year to the port area, of these about 100 will be berthing at the James
Point wharf. This equates to 200 ship movements in and out of the main part of the
port each year, or about one movement every two days.

Typically, the ships will be 160 m long and have a displacement of 25,000–35,000
tonnnes (~24,500–34,150 m$^3$ of seawater). The movement of the ships within the port
and the action of the propeller is likely to act to mix the bottom waters of the port.
However, the effect is difficult to quantify and as such, JPPL will implement a
monitoring programme to confirm the frequency of mixing of the bottom waters and
the dissolved oxygen status after commencement of operations.

7.13  CONSTRUCTION

The construction of the offshore breakwater will require a temporary breakwater
(~200 m long) to be built between the northern end of the reclaimed area and the
northern end of the offshore breakwater. This will result in a short-term (6 to 9
months) decrease in shore-parallel flows adjacent to the shoreline in slightly higher
residence times for the enclosed port region in the period leading up to the removal
of the causeway.
8. MARINE ENVIRONMENT: IMPACTS AND MANAGEMENT

8.1 ENVIRONMENTAL QUALITY OBJECTIVES AND ENVIRONMENTAL QUALITY CRITERIA

As a result of studies in Cockburn Sound and adjacent waters, the DEP’s Southern Metropolitan Coastal Waters Study (SMCWS) concluded by proposing that the Environmental Protection Authority (EPA) develop an Environmental Protection Policy (EPP) for Perth’s coastal waters (DEP, 1996a). Once approved by the Minister for the Environment the EPP will have the full force of law through the Environmental Protection Act. The DEP also proposed draft Environmental Quality Objectives (EQOs) and Environmental Quality Criteria (EQC) for inclusion in the EPP. The Environmental Values and EQOs have been revised and finalised in extensive discussions with community/user groups (CSIRO, 1998), and were released by the EPA in February 2000 (EPA, 2000a). Derivation of the EQC and the strategy for their implementation has commenced and may be completed in 2001.

EQOs represent the goals of an environmental management programme and relate to both ecological (i.e. maintenance of biodiversity and ecosystem integrity) and cultural values (i.e. maintenance of community uses and aspirations) of natural systems. Ecological EQOs are fundamental management goals whereas cultural EQOs are, by definition, negotiable and generally derived from a balance between existing and future uses after due consideration of economic, social or political factors.

The final EQOs comprised one ecological EQO (EQO 1) and five social EQOs (EQOs 2–6), and are as follows:

1. **EQO 1. Maintenance of ecosystem integrity.** Ecosystem integrity, considered in terms of structure (e.g. the biodiversity, biomass and abundance of biota) and function (e.g. food chains and nutrient cycles), will be maintained throughout Perth’s coastal waters. The level of protection of ecosystem integrity shall be high (E2) throughout Perth’s coastal waters, except in areas designated E3 (moderate protection) and E4 (low protection).

2. **EQO 2. Maintenance of aquatic life for human consumption.** Seafood will be safe for human consumption when collected or grown in all of Perth’s coastal waters except areas designated S2.

3. **EQO 3. Maintenance of primary contact recreation values.** Primary contact recreation (e.g. swimming) is safe in all of Perth’s coastal waters except areas designated S3.

4. **EQO 4. Maintenance of secondary contact recreation values.** Secondary contact recreation (e.g. boating) is safe in all of Perth’s coastal waters except areas designated S4.

5. **EQO 5. Maintenance of aesthetic values.** The aesthetic values of Perth’s coastal waters will be protected except in those areas designated S5.

6. **EQO 6. Maintenance of industrial water supply values.** Perth’s coastal waters will be of suitable quality for industrial water supply purposes except in areas designated S6.

EQC are the benchmarks upon which a decision or judgement may be made concerning whether EQOs for a given environment have been met. Where agreed EQOs are not achieved, a management response will be implemented to ensure EQOs are achieved within a timeframe agreed with the DEP. The criteria for the
ecological EQO (EQO 1) and some cultural EQOs (e.g. EQO 2) will be determined on the basis of technical information. Criteria for other cultural EQOs, such as the maintenance of aesthetic values, will be determined in a more subjective manner.

Environmental quality management areas will be defined according to which EQC are applied to meet the management goals set by agreed EQOs for that area. The boundaries around areas will be defined in accordance with what changes are seen to be acceptable. This involves two major steps: i) defining what constitutes change; and ii) determining limits for acceptability.

For the five social EQOs (EQOs 2–6), the EQOs are either protected or they are not (e.g. for EQO 3 it is either safe to swim, or it is not). For EQO 1 various levels of protection have been defined to allow for the impacts of various levels of human use, as follows:

1. Level 1 (E1). Total protection. No detectable changes from natural variation. (such areas are likely to be small and rare in Western Australia, and in fact anywhere in the world, because humans have some impact on most coastal waters).
2. Level 2 (E2). High protection. Some small changes from natural variation allowable (representing the large majority of Perth’s coastal waters).
3. Level 3 (E3). Moderate protection. Moderate changes from natural variation allowable (areas of environmental quality intermediate between E2 and E4).
4. Level 4 (E4). Low protection. Large changes from natural variation allowable.

### 8.2 IMPACTS ON WATER QUALITY DURING CONSTRUCTION

#### 8.2.1 Issues

The reclamation of the berth areas and the construction of the breakwater will generate the following water quality issues:

- Highly visible turbidity plumes due to tipping of rock armour and fill (Figure 8.1);
- Dust from tipping also settles on water surface causing visible ‘stain’;
- Potential for increased turbidity causing stress on adjacent marine flora due to reduced light availability;
- Potential for additional release of nutrients to the water column; and
- Increased residence time of waters within the Stage 1 port and immediately north while the offshore breakwater is being constructed as a temporary breakwater will first be constructed to reach the northern end of the offshore breakwater and then removed on completion.

Stage 1 will involve dredging of 1.24 million m$^3$ of sediment. The dredge is likely to be a ‘cutter-suction’ type dredge, which tends to produce less turbidity than other types of dredge as dredged material is pumped directly from the seabed to the reclamation site.
The issues associated with dredging include:

- Potential for increased turbidity causing stress on adjacent marine flora due to reduced light availability;
- Settling of resuspended sediment on adjacent habitat containing marine flora;
- Release of nutrients to the water column;
- Release of contaminants to the water column; and
- Surface water runoff and potential for spills on the wharf construction site.

### 8.2.2 Significance of impacts

#### Benthic habitat

The closest marine flora which could be affected by a reduction in light climate or smothering by sediment are the seagrasses 2 km north-west of the development (refer Figure 4.6 and DAL, 2000b). There are also seagrasses adjacent to the coast 4.5 km north, immediately south of the proposed Jervoise Bay Southern Harbour development.

Seagrass and macroalgal habitats may be affected when the light climate is reduced for extended periods. The modelling results suggest that the seagrasses to the north-west are not directly ‘downstream’ of the work and are unlikely to suffer any adverse impact on light climate during the construction. The seagrasses to the north on the coast are directly ‘downstream’ of the development, but sufficiently far away that impacts will be minimal. However, a monitoring program will be implemented during reclamation and dredging which measures the extent of plumes generated by construction and also measures impact on light climate at nearby light sensitive habitats and the duration of the impact.

Smothering of sensitive habitat is extremely unlikely given the large distance of the habitat from the site. The time taken for a parcel of water to travel 2 km up the eastern margin of the Sound is of the order 5 to 10 hours and only the finest material will still be in suspension 2 km away.
**Productivity**

The following factors may result in a short-term increase in levels of productivity within and adjacent to the port:

- Nutrient levels in the vicinity may increase with the additional suspended sediments in the water column due to dredging, however, the construction material will consist primarily of crushed and rock limestone which will not contain any significant quantities of nitrogen and phosphorus;
- Residence times will start to increase as the temporary breakwater and breakwater are constructed; and
- Phytoplankton cysts in the sediments may be brought up into the water column in larger than usual numbers.

There is unlikely to be any significant water quality problems associated with increased productivity in the port region caused by construction activities. The primary issue of concern will be the increased turbidity in the region and the associated impact on the light climate. The increase in turbidity is more likely to result in reduced productivity in the water column because of the reduced light availability.

The construction of the temporary breakwater will only result in a short term increase in local residence times and it is highly probable that residence times in the port will remain below 5 days even when the temporary breakwater is in place and the offshore breakwater is complete. Presently, construction of a similar style of breakwater in 10 m water depth for the Jervoise Bay Southern Harbour development is progressing at about 50 m per week. This is indicative of likely progress on the JPPL development with a construction period of 15 to 20 weeks required for the offshore breakwater. Following completion of the offshore breakwater, the temporary causeway between the offshore breakwater and land is likely to be removed within four weeks.

**Contaminants**

The contaminants measured in the surface sediments are unlikely to be released to the water column in significant concentrations during dredging as they are mostly bound to the sediments. The sediments sampled for this PER were taken from the surface where contamination is likely to be highest. However, further sediment sampling will be undertaken to confirm this.

**Social**

The construction will result in aesthetic impacts through the whitish turbidity plumes which will be generated by the reclamation and the dredging. Recreational boats will not be allowed to enter Port waters during construction or operations for safety reasons.

**8.2.3 Management of impacts**

**Turbidity**

Management of the water quality during construction will focus on ensuring plumes from dredging and reclamation activities do not impact on adjacent sensitive environments.

The dredging contractor will be informed that minimisation of turbidity during construction is an significant issue in the initial tender documents and the
Construction EMP will form part of the dredge contract documentation. JPPL will monitor the turbidity, suspended sediment concentration, and size and orientation of plumes generated during construction. If it is found that construction activity is causing plumes which are likely to be reaching light sensitive habitats, a contingency monitoring programme will be implemented at these affected habitats. Fortunately, there has been some detailed work done on the minimum light requirements of local seagrasses (Masini et al., 1995) and any contingency monitoring programme will be based on ensuring that any impacted habitats are receiving ample light for survival. If contingency monitoring suggests that light requirements are not being met or that impacts are in anyway unacceptable then further plans to reduce impacts will be implemented. These are likely to include: deployment of silt curtains, reassessment of dredge operating procedures and reassessment of dredging plant.

Phytoplankton blooms are most likely to occur in the months when the water is warmest and as such phytoplankton monitoring will form part of the Construction EMP if the dredging work takes place between November and March. The monitoring will be designed to provide adequate warning in the event of a potentially harmful algal bloom.

The turbidity management plan, contingency habitat monitoring and phytoplankton monitoring programmes will be detailed in the Construction EMP prepared in consultation with the DEP.

The management and monitoring programs will include the following key elements:

- Prior to dredging, if the onshore groundwater contamination study suggests that contaminated groundwater is likely to be in the region to be dredged, further sediment sampling will be undertaken to establish whether deeper sediments are contaminated;
- Any contaminated sediments will be appropriately disposed of onshore, with the method of disposal depending on the degree of any contamination;
- Turbidity monitoring to determine extent and characteristics of the plumes;
- Turbidity, light and suspended sediment monitoring above nearby light sensitive habitats;
- Establishment of criteria (including duration) for acceptable levels of impact;
- Phytoplankton monitoring if dredging work is conducted over the summer months;
- Collaborative summer monitoring of water and sediment quality in the James Point region through contribution to the Kwinana Industries Council summer monitoring program;
- A system of regular reporting of results to the DEP; and
- Contingency plans for managing impacts if agreed criteria are exceeded.

8.3 IMPACTS ON WATER QUALITY AFTER CONSTRUCTION

The investigation of the potential impact of the development on water quality was conducted on the assumption that nitrogen loading and associated primary productivity is the key issue with the primary factors affecting the productivity of the water at the Stage 1 development port being the nitrogen load from the groundwater, the nitrogen load from sediments within the port and the quality of water to the south of the port, which is generally the ‘source’ water for the port as currents in this location are typically northwards (DEP, 1996a). To a greater or lesser degree, the following impacts may occur:
• Increased residence times within the port region may result in increased nutrient concentrations and corresponding increases in phytoplankton production;
• An increase in deposition of organic material may result due to: increased residence times, calmer waters and any increase in production of phytoplankton;
• Increased organic build-up in the sediments may increase sediment nutrient release in the port area and productivity in the water column;
• Deepening of the waters may decrease the frequency of vertical mixing of the water column, potentially resulting in reduced dissolved oxygen concentrations near the sediment and promoting ammonium fluxes from the sediments if oxygen levels become low enough; and
• Shipping and loading activity will increase the potential for contamination of port waters.

8.3.1 Parameters of concern

As discussed in Section 4.5, the primary parameters of concern to the DEP in Cockburn Sound are light attenuation coefficient and chlorophyll a concentration because of the connection between these parameters and the availability of light for seagrass growth. Chlorophyll a provides an integrated measure of the productivity of the water column (phytoplankton growth). The phytoplankton in the region will have the greatest response to changes in dissolved inorganic nitrogen (DIN) concentration as this is generally the nutrient limiting growth. For this reason, the potential for the port to increase DIN concentrations by capturing any groundwater inflow from the coast and increasing residence times is considered to be an issue of concern: although there are no seagrasses in the vicinity there is a risk of algal blooms if DIN availability increases substantially. For example, the Jervoise Bay Northern Harbour captures a significant groundwater nutrient load and has a relatively high residence times (5 to 12 days) which has resulted in blooms in the harbour for each of the past four summers, with mean chlorophyll a concentrations in the harbour reaching up to 32 µg/L (HGM, 1998; Figure 4.14).

8.3.2 Residence times of the Stage 1 development

Autumn conditions

The numerical simulations under calm autumn conditions (when residence times are longest) showed that the impact of Stage 1 on flushing time (e-folding time: refer Glossary) at the surface is small, with surface waters fully flushed within 2 to 3 days under existing conditions and after the port is built. The impact of the port is greater on the bottom waters (water within 0.5 m of the seabed), with an increase of approximately 1–2 days, meaning the bottom waters are flushed in approximately 5–6 days, compared to 4 days under existing conditions. The modelling suggests that the average (in time and space) residence time of the port waters under calm autumn conditions will be less than 4 days.

Summer conditions

Under typical summer conditions, the region of the proposed port currently flushes in about 6 hours due to the northerly current. After the construction of the port the region will still flush in less than one day.

It has been found that, in general, if the mean residence time of the waters of a harbour or marina is of the order of 2 to 4 days then water quality issues arising from
a lack of flushing are unlikely to occur (US Army Corps of Engineers, 1993). The design of James Point Port: Stage 1 has been deliberately modified to maximise through flow with the large opening to the south capturing the net flow and the narrow opening to the north causing a slight throttling effect and rapid flushing of the entire port region.

### 8.3.3 Predicted water quality within the port

After an assessment of available data (e.g. DAL, 2000a; Hale and Paling, 1999) it was decided that a reasonable approach to estimating the long-term impacts on water quality would be to use an equilibrium (or ‘box’) model for the Stage 1 port using mean summer dissolved inorganic nitrogen as the modelled constituent, the results from more sophisticated techniques would be subject to the similar degrees of error due to the difficulty in obtaining accurate values for input parameters for any technique used.

Although DIN is rapidly taken up by phytoplankton and other marine flora, an assessment of average summer DIN concentrations at sites around the Sound and in Jervoise Bay (HGM, 1998; Hale and Paling, 2000) shows that average DIN concentrations are consistently high in regions where chlorophyll levels are high (ie there is some degree of correlation between the two parameters).

The ratio of chlorophyll \(a\) to carbon and of carbon to nitrogen in phytoplankton is relatively uniform (50C:1Chl \(a\), and 41C:1N; by mass) and if it is conservatively assumed that all available DIN is utilised by phytoplankton, the chlorophyll \(a\) concentration will be approximately 0.117 times the predicted DIN concentration. This approach provides a guide to potential water quality in relative, rather than absolute, terms: relationships between chlorophyll \(a\) and water quality parameters (DIN, light attenuation, TN) in the Sound are not consistent or always strong. To assist in the interpretation, results are compared with measured data from the Jervoise Bay Northern Harbour and the James Point region.

The nitrogen in the groundwater and released from sediments is assumed to be all DIN, the background DIN in the ‘source’ waters for the model is assumed to be 12.5 µg/L (average of average summer concentrations at sites JPA and JPB; Table 4.3). The sediment nitrogen release rates were based on those measured by Lavery et al (1993) for sediments from Warnboro Sound and Shoalwater Bay (26.5 mg N/m²/d and 2.4 mg N/m²/d respectively) as part of the Perth Coastal Waters study. The rate for the relatively organically rich Warnboro Sound sediments was found to be comparable to those published for muddy, organically rich sediments elsewhere in the world and the rate for Shoalwater sediments was found to be comparable to published rates for coarse, carbonate sediments. It is envisaged that the organic content of the sediments in the port will increase over time from low (possibly 2-5%) to slightly elevated (possibly 7-10%) compared to organic content typically found on the eastern margin of the Sound (4-7%; DEP 1996a). As such both release rates have been used in the calculations as characterising upper and lower values. On the basis of the work done by Appleyard (1994), it has been assumed that 3.15 tpa/km enters the Sound at the Port and the length of coastline impounded by the Port is assumed to be 1.2 km. The estimated groundwater load to the region is assumed to have an error of ±50%.

The input parameters for the equilibrium model are shown in Table 8.1. The model assumes that all input parameters remain constant in time. Because of the limitations of this type of model, the output is given as a range based on the middle, maximum and minimum values of the input parameters, with the most likely outcome
somewhere between the upper and lower estimates. The values are applicable for mean summer and calm autumn conditions.

**Table 8.1** ‘Box-model’ input parameter values for long term change in ecological parameters within port waters, values are for summer conditions

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>RANGE/VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td></td>
</tr>
<tr>
<td>Volume of water enclosed by Stage 1 Port</td>
<td>4,820,000 m$^3$</td>
</tr>
<tr>
<td>Groundwater TN load into port</td>
<td>1.9–5.7 tpa</td>
</tr>
<tr>
<td>Sediment TN load from enclosed sediments</td>
<td>0.32–3.5 tpa</td>
</tr>
<tr>
<td>Residence time</td>
<td>1–4 days</td>
</tr>
<tr>
<td>DIN concentration in source waters south of port</td>
<td>12.5 µg/L</td>
</tr>
<tr>
<td>Existing mean Chl. a concentration south of port</td>
<td>2.0 µg/L</td>
</tr>
</tbody>
</table>

**Table 8.2** Equilibrium model results

<table>
<thead>
<tr>
<th>Residence Time (from typical summer to calm autumn) (days)</th>
<th>Sediment DIN load (tpa)</th>
<th>Groundwater DIN load (tpa)</th>
<th>Equilibrium DIN existing conditions (residence time = 6 hrs) (µg/L)</th>
<th>Equilibrium DIN Stage 1 conditions (µg/L)</th>
<th>Conversion of DIN to chl a, existing conditions. Chl a (µg/L)</th>
<th>Conversion of DIN to chl a, Stage 1 conditions. Chl a (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.316</td>
<td>1.9</td>
<td>13</td>
<td>14</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>1</td>
<td>0.316</td>
<td>3.8</td>
<td>13</td>
<td>15</td>
<td>1.6</td>
<td>1.7</td>
</tr>
<tr>
<td>1</td>
<td>0.316</td>
<td>5.7</td>
<td>14</td>
<td>16</td>
<td>1.6</td>
<td>1.9</td>
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<td>1.9</td>
<td>14</td>
<td>16</td>
<td>1.6</td>
<td>1.8</td>
</tr>
<tr>
<td>1</td>
<td>3.49</td>
<td>3.8</td>
<td>14</td>
<td>17</td>
<td>1.6</td>
<td>1.9</td>
</tr>
<tr>
<td>1</td>
<td>3.49</td>
<td>5.7</td>
<td>14</td>
<td>18</td>
<td>1.7</td>
<td>2.1</td>
</tr>
<tr>
<td>2.5</td>
<td>3.49</td>
<td>1.9</td>
<td>14</td>
<td>20</td>
<td>1.6</td>
<td>2.3</td>
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<td>3.49</td>
<td>3.8</td>
<td>14</td>
<td>23</td>
<td>1.6</td>
<td>2.7</td>
</tr>
<tr>
<td>2.5</td>
<td>3.49</td>
<td>5.7</td>
<td>14</td>
<td>25</td>
<td>1.7</td>
<td>3.0</td>
</tr>
<tr>
<td>2.5</td>
<td>0.316</td>
<td>1.9</td>
<td>13</td>
<td>16</td>
<td>1.5</td>
<td>1.8</td>
</tr>
<tr>
<td>2.5</td>
<td>0.316</td>
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<td>5.7</td>
<td>14</td>
<td>21</td>
<td>1.6</td>
<td>2.4</td>
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<tr>
<td>4</td>
<td>3.49</td>
<td>1.9</td>
<td>14</td>
<td>24</td>
<td>1.6</td>
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<tr>
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<td>3.8</td>
<td>14</td>
<td>29</td>
<td>1.6</td>
<td>3.4</td>
</tr>
<tr>
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<td>14</td>
<td>33</td>
<td>1.7</td>
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</tr>
<tr>
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<td>0.316</td>
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<td>13</td>
<td>17</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>4</td>
<td>0.316</td>
<td>3.8</td>
<td>13</td>
<td>22</td>
<td>1.6</td>
<td>2.5</td>
</tr>
<tr>
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<td>0.316</td>
<td>5.7</td>
<td>14</td>
<td>26</td>
<td>1.6</td>
<td>3.0</td>
</tr>
</tbody>
</table>

The model results shown in Table 8.2 suggest that the chlorophyll a concentrations in the port will be approximately 10 to 130% higher than those currently found in the region and that concentrations of 1.6 to 3.0 µg/L may be expected (± error, see below). By way of comparison and assessment of the validity of the DIN to chlorophyll conversion model, the average summer DIN and chlorophyll concentrations are shown for a number of sites in Cockburn Sound as well as the estimated chlorophyll levels based on the average DIN concentration (Table 8.3). As Table 8.3 shows, the accuracy of the approach is at best moderate, as the efficiency with which DIN is converted to chlorophyll depends on a range of other parameters such as availability of other nutrients, light, temperature, phytoplankton species, mixing and phytoplankton numbers. For example, the DIN concentration in the Jervoise Bay Northern Harbour is usually so high that the growth of phytoplankton is limited by the availability of phosphorus, hence the wide variance between estimated and actual chlorophyll a. An examination of the likely N:P ratios in the Stage 1 port (assuming typical ortho-P concentrations of 4.0 µg/L, refer Table 4.3) suggests that ratios will be below 7 (by mass) for all but the two highest loading scenarios. This implies that DIN uptake will be relatively efficient within the port. The technique appears to best approximate chlorophyll levels in regions where chlorophyll levels
are likely to be moderate. The results in Table 8.3 suggest the overestimate of chlorophyll is possibly up to 90% and, more importantly, the underestimate is possibly of the order of 40%. This means the chlorophyll a concentrations in the port should be in the range of 0.8 to 4.2 µg/L.

Table 8.3  Typical errors arising from estimating mean summer chlorophyll on the basis of mean DIN values

<table>
<thead>
<tr>
<th>SITE</th>
<th>Mean DIN (µg/L)</th>
<th>DIN range (µg/L)</th>
<th>Mean chl. a (µg/L)</th>
<th>Chl a range (µg/L)</th>
<th>Chl a based on mean DIN</th>
<th>% chl a error cf. measured mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 4#</td>
<td>12.3</td>
<td>8.6–22.3</td>
<td>0.6</td>
<td>0.2–0.9</td>
<td>1.4</td>
<td>140</td>
</tr>
<tr>
<td>Site 5#</td>
<td>13.0</td>
<td>8.1–28.7</td>
<td>0.8</td>
<td>0.5–1.5</td>
<td>1.5</td>
<td>90</td>
</tr>
<tr>
<td>Site 6A#</td>
<td>21.8</td>
<td>11.1–66.9</td>
<td>1.5</td>
<td>0.5–3.2</td>
<td>2.6</td>
<td>70</td>
</tr>
<tr>
<td>Site 7#</td>
<td>9.7</td>
<td>6.6–16.7</td>
<td>1.5</td>
<td>0.9–2.8</td>
<td>1.1</td>
<td>-24</td>
</tr>
<tr>
<td>Site 8#</td>
<td>11.5</td>
<td>5.1–28.8</td>
<td>0.9</td>
<td>0.4–2.0</td>
<td>1.3</td>
<td>50</td>
</tr>
<tr>
<td>Site 9#</td>
<td>12.8</td>
<td>6.5–35.0</td>
<td>2.4</td>
<td>1.1–4.3</td>
<td>1.5</td>
<td>-38</td>
</tr>
<tr>
<td>JPA#</td>
<td>12.4</td>
<td>7.0–19.6</td>
<td>2.0</td>
<td>1.2–4.1</td>
<td>1.5</td>
<td>-27</td>
</tr>
<tr>
<td>JPB#</td>
<td>12.6</td>
<td>7.0–23.9</td>
<td>2.0</td>
<td>1.1–5.4</td>
<td>1.5</td>
<td>-26</td>
</tr>
<tr>
<td>Site 9A#</td>
<td>24.9</td>
<td>8.0–87.0</td>
<td>2.4</td>
<td>1.2–4.6</td>
<td>2.9</td>
<td>21</td>
</tr>
<tr>
<td>Site 10#</td>
<td>15.5</td>
<td>8.0–39.1</td>
<td>2.1</td>
<td>1.1–3.7</td>
<td>1.8</td>
<td>-14</td>
</tr>
<tr>
<td>Site 11 #</td>
<td>13.1</td>
<td>7.6–31.5</td>
<td>1.9</td>
<td>0.7–4.4</td>
<td>1.5</td>
<td>-19</td>
</tr>
<tr>
<td>Jervoise ## Bay</td>
<td>12.6</td>
<td>5.7–39.4</td>
<td>1.5</td>
<td>0.3–3.0</td>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>Northern ## Harbour (inside)</td>
<td>149.4</td>
<td>14.0–523.4</td>
<td>6.7*</td>
<td>0.6–40.3</td>
<td>17.47</td>
<td>161</td>
</tr>
</tbody>
</table>

# based on 1999/2000 summer data. ## based on all data from 1997 on. * phytoplankton growth in the Northern Harbour is limited by the availability of phosphorus (refer text).

The predicted increase in productivity (increase in chlorophyll) remains relatively small and is highly unlikely to result in local algal blooms or change the phytoplankton species assemblage from that currently found in the region through any change in nutrient concentrations. However, it is acknowledged that international shipping may bring new species to the port (refer Section 8.5). The water quality in region presently does not meet draft DEP chlorophyll or light criteria for Cockburn Sound (DEP, 1996a) and the water quality in the port will not meet these criteria. However, as the criteria were developed with the intention of protecting seagrass and there are no seagrasses within the port this is not considered to be a significant issue as the chlorophyll concentrations are still well within levels found in coastal embayments (1–10 µg/L). Further, the draft chlorophyll and light criteria and the manner in which they were derived (refer Section 4.3) will be reviewed as part of the preparation of an EPP for Cockburn Sound.

8.3.4 Organic build up and sediment nutrient release

The creation of calmer, deeper waters with a slight increase in residence times compared to adjacent waters is likely to result increased deposition of fine organic material. Although not in itself harmful, increased organic content in the sediments increases the sediment nutrient release rates and sediment oxygen demand. A programme of sediment monitoring for James Point Port: Stage I will include regular monitoring of organic content and sediment nutrient levels. Initially, because of the effect of dredging, there will be a lower percentage of organic material in the port sediments than in adjacent waters.

8.3.5 Vertical mixing and dissolved oxygen

The deepening of the port area to –13.7 m CD will reduce the frequency of vertical mixing which, coupled with a potential increase in productivity may act to reduce dissolved oxygen concentrations. If dissolved oxygen levels fall to less than
ca. 1 mg/L the release of ammonium from the sediments may be substantially increased. Additionally, if dissolved oxygen levels fall below 5 mg/L, fish are likely to become stressed, however, as the decrease is limited to the bottom waters, fish will generally swim up or away from the region. Sessile organisms will be affected and may die if dissolved oxygen levels are below ~4 mg/L for long periods. Additionally, the toxicity of some compounds increases significantly with decreasing dissolved oxygen (ANZECC/ARMCANZ, 2000).

The lowest recorded readings of dissolved oxygen in Cockburn Sound have occurred in late summer near the seabed of the deepest parts of the Sound (~20 m) and in the Northern Harbour (Bastyan et al., 1994; DAL 2000a). The lowest readings occur in the bottom part of the water column due to the combined effects of respiration, oxygen demand from the sediments and lack of mixing with the aerated surface waters. Lowest levels tend to occur in the morning just before sunrise when the effect of lack of oxygen production from photosynthesis by phytoplankton and benthic flora is maximum. Maximum and minimum dissolved oxygen concentrations tend to occur over summer when biomass is greatest and hence production during the day is greatest and demand due to respiration is also maximum.

In the Northern Harbour, after the collapse of phytoplankton blooms with chlorophyll a concentrations of the order of 17 to 30 µg/L, recorded oxygen concentrations in the bottom waters fell to approximately 3 mg/L (DAL, 2000a) and levels lower than this are likely to have occurred just before dawn. These low levels are a result of the oxygen uptake which occurs when the phytoplankton decays on the harbour floor, consumed by bacteria. These events are considered to be the ‘worst case’ for waters on the eastern margin of Cockburn Sound. Lower dissolved oxygen levels have been recorded in the deeper sections (~20 m) of the Sound, particularly in Mangles Bay (Bastyan et al., 1994; DEP, 1996a). These low levels tend to be more prolonged, and rather than lasting a few hours they tend to last until the bottom waters have been mixed, which may be of the order of days to weeks for these deeper waters.

The approach taken to determine whether the development will result in acceptable dissolved oxygen levels was to establish the change in the frequency of mixing due to the increased depth, as detailed in Section 7.12. By increasing the depth of the port region to nearly 14 m, there will be a distinct reduction in the frequency of vertical mixing of the water column, with mixing to a depth of 14 m likely to occur 70–75% throughout the year. Mixing will not occur to the full depth of the port during periods when wind speeds are less than approximately 3 m/s, however, these conditions are only likely to occur for periods of longer than three days in autumn (Hearn, 1991a; D’Adamo and Mills, 1995b).

It was found for the sediments of Mangles Bay (at ~ 20 m depth), that if the water column is not mixed for the order of 10 days, the sediment oxygen demand is likely to cause depletion of oxygen in the bottom 0.5 m of water (DEP, 1996a). In natural systems, the sediment oxygen demand is generally related the organic content and the sediment in the Mangles Bay area contains approximately 9% organic material, this is slightly higher that than the organic content typically found in the sediments on the eastern margin (4-7%; DEP, 1996a) although it is lower than the organic content of sediments within the Jervoise Bay Northern Harbour (10-15%; HGM, 1998). If the sediments of Mangles Bay are considered to be representative of sediments which maybe found in the James Point development some years after commissioning then dissolved oxygen levels near the bottom (~ 14 m depth) may
drop to 4–5 mg/L if the water column is not mixed after 3 to 4 days. This level of dissolved oxygen concentration will not cause significant increase in sediment ammonium release and will not cause mortality of fauna. If dissolved oxygen levels drop below 2 mg/L, then both mortality and increased ammonium release rates may be expected.

8.3.6 Light availability at the bottom of the port
Calculations of light attenuation coefficient in the port using the chlorophyll a estimates in Table 8.2 and the relationship between light and chlorophyll derived by Cary et al (1995) suggests that the deepest part of the port (~14 m) will remain within the photic zone (1% of surface light available). It is considered unlikely that dissolved oxygen deficits will arise due to loss of photosynthetic benthic microalgae from the system. The vertical mixing should have a greater impact on the dissolved oxygen status of the port.

8.3.7 Impacts of operations on water quality
There is the potential for contamination of port waters due to operational activities. The discharge of oil, oily water, oil sludge, oily bilge water, sewage, poisons or scum into port waters is currently prohibited in FPA waters under MARPOL 73/78 (refer Glossary). When the James Point Port waters come under the control of JPPL the same provisions of MARPOL 73/78 will apply.

Shipping operations result in seawater containing phytoplankton cysts being moved around the world as ballast water and sessile organisms may be transported on hulls. It has been well documented that these vectors for exchange may bring species to a region where they have not previously been recorded. This issue is discussed in Section 8.5.

8.4 SEDIMENT QUALITY

8.4.1 Organic content
The dredging will initially ‘improve’ the quality of the sediment in the region as it will strip off any contaminated surficial sediments and organic matter and leave behind a clean sediment which will be largely free of organic material. In the years following dredging, the deeper water, the slight increase in flushing time and the reduced wave energy of the port area will result in accumulation of organic material on the port floor at higher rates than those at present.

If organic material builds up in the bottom of the port, it will be finer than the sands and will be more easily suspended. This may result in increased turbidity within the port during ship movements. The increased turbidity will generally be confined to the port precinct and will not cause impacts on any adjacent light sensitive marine habitat.

An increase in organic content will increase the nutrient store in the sediments and may result in a slight increase in productivity. The EMS will detail a programme for monitoring of the organic content of the sediments and the productivity of the overlying water column, the EMS will also detail contingency plans to manage the port if water and/or sediment quality problems arise.
8.4.2 **Tributyltin (TBT)**

Port operations will be managed so that the input of contaminants is minimised. Available data from the SMCWS (DEP, 1996a) indicates that the levels of most contaminants in sediments within areas of concentrated shipping activity (e.g. Fremantle Inner Harbour) are elevated but do not exceed ISQG-Lows, with the exception of TBT. A similar scenario is expected to occur in sediments within the JPPL development.

The greatest source of TBT is likely to be ships from other countries using antifouling paints manufactured without stringent controls. For this reason, routine monitoring of TBT levels in port sediments will be essential, and will be incorporated in the environmental management plan for port operation. Copper is also used as an antifoulant, and with the phasing out of TBT, leaching of copper may become a more significant issue (refer below).

JPPL will support the Commonwealth and IMO Marine Environmental Protection Committee (MEPC) resolutions with respect to TBT and alternate antifouling substances. JPPL will not allow in-water hull cleaning within waters under its control. However, JPPL will not have the authority to ban visits from shipping using TBT until such bans are in place by the Commonwealth. As such, JPPL will have no control over the contamination of sediments with TBT or other antifouling compounds. The level of ecological protection within the port will be established in consultation with the DEP when the process of preparing the implementation strategy and sediment quality criteria has been completed by the EPA.

One environmental benefit of effective antifouling is that it reduces the risk of transfer of exotic species on hulls and reduces their chance of survival in port waters.

JPPL will develop a programme to monitor the sediments and marine organisms (probably the mollusc, *Thais orbita*) in the vicinity for butyltin contamination and signs of the reproductive disorder, *imposex* (imposed sexual characteristics). It is important to recognise that there remains factors beyond the proponent’s control in terms of antifoulants, for example, potential for increased use of copper based paints following phasing out of TBT based paints. The sediment monitoring program will be used to track trends in sediment quality and any issues of concern will be brought the attention of the DEP.

8.4.3 **Metals and other contaminants**

The berthing of ships may result in an increase in levels of metals and hydrocarbons in the sediments within the port. Metal concentrations will be largely be out the control of JPPL as these will largely influenced by the leaching rates from hulls of visiting vessels, however, JPPL will not allow any hull painting or scraping to be undertaken in the port. The control of hydrocarbons and other pollutants will occur by ensuring loading and unloading operations will be conducted in accordance with best environmental practice and procedures detailed in the EMS for the port. The sediments in and adjacent to the port will be monitored on an annual basis for contamination by hydrocarbons and heavy metals.

8.5 **INTRODUCED SPECIES**

At least 18 exotic marine organisms have become established in local coastal waters via discharge of ships’ ballast water or through being dislodged from ships’ hulls (DEP, 1996a; CSIRO Centre for Research on Introduced Marine Pests (CRIMP), unpublished). Three Australian Ballast Water Management Advisory Council
(ABWMAC) targeted pest species have been recorded in the Sound: the European fan worm *Sabella cf. spallanzanii*, the Asian date mussel *Musculista senhousia* and the dinoflagellate *Alexandrium tamarense*. Other established species recorded, which do not pose any environmental or economic threat include the fish, *Tridentiger trigonocephalus*, the bryozoans *Bugula neritina*, *B. flabellata*, *Tricellaria occidentalis*, *Cryptosula pallasiana* and *Watersiproa subtorquata(?)*, the hydroid *Tubularia raphi*, and the ascidians *Asidiella aspersa* and *Ciona intestinalis*. Cockburn Sound has been visited by international shipping since the 1830s and since the 1950s has been a regular port of call for international vessels.

The proposal will not increase the number of ship visits to Perth coastal waters, however, it will result in shipping traffic, which previously berthed at Fremantle, berthing at James Point. International shipping traffic to Cockburn Sound will increase by approximately 100 ship visits per annum. However, this increase is small relative to approximately 1,700 total annual ship visits (including naval ships) to Fremantle and Cockburn Sound each year.

JPPL recognise that this will marginally increase the risk of additional exotic organisms being introduced to the vicinity of James Point. However, the level of risk to the broader Perth’s coastal waters will remain the same if the development does not go ahead, as current and future shipping will continue to use the FPA facilities.

### 8.6 MARINE HABITATS

The proposal will result in the loss of approximately 19 ha of shallow (<10 m) sandy habitat through reclamation of the wharf area and construction of an offshore breakwater. In addition, approximately 22 ha of shallow sandy habitat will be converted to deep sandy habitat when it is dredged to a depth of 13.7–14.0 m CD.

No seagrass or subtidal reef habitat will be lost due to direct impacts. The breakwater and wharf front will provide approximately 2.8 ha additional subtidal reef habitat to the area which will become colonised by algae and sessile (attached) invertebrate fauna, and will attract additional marine life to the area.

The 1998 EPA strategic environmental advice to the Minister for the Environment on Cockburn Sound (EPA 1998), in regard to marine habitats, concluded (on p22) that:

- ‘The EPA considers that it is paramount that any further loss of seagrasses in the Sound be avoided. Protection of the remaining seagrass meadows in the Sound is an objective of the EPA.’; and
- ‘The EPA considers that it is important to retain the sand banks and sandy margins of Cockburn Sound, where seagrass meadows once grew, so as not to lose future opportunities for seagrass re-establishment in the Sound.’

The project will meet the EPA’s objective of protection of remaining seagrass in the Sound. However, there will be deepening and burial of sandy habitat which once supported seagrass. The scale of the loss of sand habitat can be put into context: between 1967 and 1999, seagrass coverage in the Sound reduced from 2,929.4 ha to 660.0 ha and the total mapping area (seabed between the shoreline and 10 m depth) was 3,666.6 ha (DAL, 2000b). This means that in 1999, there is approximately 2,269.4 ha of shallow sandy seabed in the Sound where seagrass once grew. The implementation of this project will result in a 2% loss of this area of sand habitat.
8.7 FISHERIES
Cockburn Sound supports both commercial and recreational fishing. However, recreational and commercial fishing activities are presently restricted in the waters immediately adjacent to the proposed development. This restriction will remain in place. The construction and operation of the James Point Port: Stage 1 will not impact on mussel farms in Cockburn Sound, which are currently located adjacent to the CBH jetty to the north.

The construction of the limestone breakwater and wharf will provide additional fish refuge in the area.

8.8 CUMULATIVE IMPACT
The breakwater and reclaimed area may impact in a cumulative manner on the marine environment by acting in concert with other structures to change the circulation in excess of the changes which may be caused by each project individually. The degree to which this occurred was established by examining the extent of the influence the structure had on water movement adjacent to the port and determining whether this influence extended to other structures.

The results of a numerical modelling study suggested that the port did not act in a cumulative manner with the existing Jervoise Bay Northern Harbour or with the proposed Jervoise Bay Southern Harbour. The maximum extent of impacts away from the port occurred under summer seabreeze conditions, with current speed affected up to 3 km north along the coast, however, residence times of waters to the north remain low (~6 hours). Beyond this distance effects on current speeds were negligible. The port does affect the discharge of cooling water from Western Power, causing the plume to move offshore more rapidly than it does at present. This is likely to increase the rate of dispersion of the plume.

The nitrogen levels in the water due south of the port are elevated above those found elsewhere in the main body of the Sound due to direct discharge from the Wesfarmers CSBP site and groundwater discharge contaminated with ammonium sulphate from the Kwinana Nickel Refinery site. The net water movement north along the coast means the elevated nutrient levels occur for several kilometres north along the coast. Although there is likely to be a slight increase in productivity in the port (refer Section 8.3), the port will not significantly affect the productivity of the water at James Point or to the north of the port.

8.9 MANAGEMENT OF WATER AND SEDIMENT QUALITY
8.9.1 Proposed environmental quality objectives and criteria
The nature of the development is such that it will modify sediment characteristics, water quality and the local ecosystem. As part of this PER preparation process, the DEP have stated that they believe the port should be managed to meet a long-term level of protection for EQO 1 (Maintenance of ecosystem integrity) as level 3 (E3) as the DEP position is that all ports, marinas and harbours should be managed to meet this level of protection. However, the process of setting Environmental Quality Criteria (EQC) for the EQOs and devising a strategy for their implementation is yet to be completed. This process is being undertaken in the manner set out by the EPA (EPA, 2000a). JPPL are a stakeholder in the process and will subscribe to the final agreed outcomes.
The setting of criteria and the strategy for their implementation is scheduled to be completed in 2001, which is before the port will be built. JPPL will commit to managing the port in accordance with the most appropriate long-term level of protection for EQO1 when the process has been completed. Similarly, the boundaries of any zones will be set in consultation with the DEP at this time.

Regardless of final levels of protection and criteria, JPPL are committed to monitoring of sediment quality and the bio-availability of contaminants on an annual basis to allow any trends in contamination to be reported. The ban on TBT usage comes into effect in 2003 (refer Section 4.7), however, other toxicants maybe used in its place (eg. copper). JPPL have the intention of implementing best practice environmental management for the port, however, there will be some forms of contamination (eg copper and TBT associated with antifoulants) beyond JPPL’s immediate control.

Swimming and recreational boating in port waters will be prohibited and port waters will not be directly managed to meet primary contact recreational criteria (EQO3), however, the port waters are still likely to meet these criteria. The waters will be managed to meet: secondary boating criteria (E4), aesthetic criteria (E5) as appropriate for port waters (yet to be described in detail by EPA) and industrial water supply criteria (E6).

### 8.9.2 Water quality

The construction of the project will be managed to minimise any impacts of increased turbidity on sensitive habitats in Cockburn Sound as described above. During operations, the shipping will enter and leave the port via existing designated shipping channels, there will be no additional impact on marine habitat after completion of construction.

A significant spill could cause adverse impacts on surrounding marine habitat. The movement, unloading and loading of shipping will be conducted under strict protocols so as to minimise the potential for spills. An approved spill response plan will be in place prior to commencement of operations with protection of the marine environment a key aim of the plan.

The water quality of James Point Port: Stage 1 will be monitored on a regular basis in accordance with a programme detailed in the Operations Environmental Management Plan (EMP). The monitoring will include measurement of:

- Total and dissolved nutrients;
- Chlorophyll;
- Light attenuation;
- Phytoplankton species identification; and
- Vertical profiles of temperature, salinity and dissolved oxygen.

Regular ship movements will probably be a significant factor in stirring the dredged pocket of the port. Bastyan et al. (1994) found that ship movements temporarily increased dissolved oxygen levels adjacent to their sensors in the open regions of Cockburn Sound, where the volumes of water with low DO levels would have been greater than those in the port. A monitoring programme to test the efficiency of ship movements in mixing the port and maintaining acceptable dissolved oxygen levels will be incorporated in the Operations EMP.
Port operations will be managed to minimise the amount of nutrients or contaminants entering the port waters. Shipping activities bring the risk of spills: fuelling, loading and unloading operations will be conducted in accordance with best environmental practice and procedures detailed in the EMS for the port. The waters will be monitored for hydrocarbons and the sediments in and adjacent to the port will be monitored for contamination by heavy metals and TBT in a programme to be detailed in the Operations EMP.

8.9.3 Ballast water

The risk of transfer of exotic species may be assumed to be greater in those areas where vessels need to de-ballast prior to loading, e.g. Grain Jetty, Alcoa and in the case of container vessels, the Fremantle Inner Harbour.

JPPL is committed to implementing the International Maritime Organisation (IMO), regulatory arrangements for ballast water, a Ballast Water Decision Support System (BWDSS), when those arrangements are adopted by the Australian Government.

The essential components of the BWDSS will consist of:

- A ‘trigger mechanism’ such as the ballast water reporting form that provides notification, in advance of a ship’s arrival, and the need to run the BWDSS;
- A vessel tracking system;
- A biological risk assessment methodology based upon ‘target species’, which sources information on the port of origin and the known presence of risk species at that location and produces a risk assessment associated with the vessel discharging ballast water;
- Assessment of other non-biological risk factors;
- Information databases that hold information required by the BWDSS;
- Communication links between the required information sources, the risk assessment, and the decision maker; and
- A decision mechanism which associates the risk with the associated action and maintains an audit trail of the decision process.

The proposed BWDSS will link three main sources of information:

- Ship specification including name, IMO number, and ballast information including ballast capacity, number of tanks and other details;
- Detailed information on the source(s) and treatment of ballast water carried by an arriving vessel, including last three ballast sources, timing, location and methods of ballasting/de-ballasting; and
- Information on the chemical, physical, biological and management characteristics of the ports in which ballast water has been sourced and is to be discharged.

The BWDSS will be a dynamic system and is expected to meet the proposed IMO requirements. The full procedures will be documented in the James Point Port: Stage 1 EMS.

8.9.4 Hull cleaning

Hull and propeller cleaning, while the vessel is afloat, will be prohibited within the JPPL port area of control. Therefore, there is no risk of unwanted organisms being introduced as a result of this practice.
8.9.5  **AQIS and ANZECC guidelines**

The coordinated approach of ballast water control was an initiative chaired by AQIS, as the Commonwealth body responsible for barrier control.

JPPL’s EMS will comply with the relevant AQIS (1998) and ANZECC/ARMCANZ (2000) guidelines at the time of preparation. The EMS will be revised on a regular basis and include updates which reflect any changes to these guidelines.

8.9.6  **Sediment quality**

A programme of annual sediment monitoring for James Point Port: Stage 1 will include monitoring and reporting of concentrations of metals, hydrocarbons; butyltin compounds, organic content and nutrients as well as sediment particle size distribution.
9. TERRESTRIAL ENVIRONMENT: IMPACTS AND MANAGEMENT

9.1 CONSERVATION SIGNIFICANCE AND POTENTIAL IMPACTS

In terms of assessing conservation significance, vegetation types are considered here as the region equating to the Perth metropolitan region portion of the Swan Coastal Plain, while ‘local’ equates to the Cockburn Sound coastal strip. Quindalup dune systems in the Perth metropolitan region are generally poorly represented in existing conservation reserves and are often impacted by urban development given their coastal distribution (Griffin and Trudgen, 1994). Perth’s Draft Bushplan identifies that 11,598 ha of Quindalup Complex vegetation remains in the Perth metropolitan area, representing 48% of the original area (Government of Western Australia, 1998). Of this, 3,536 ha is currently on protected lands as defined by the Draft Bushplan, with the recommended additions proposed by the Draft Bushplan to increase this to 5,049 ha, or 21% of the original extent of Quindalup complex and 44% of what currently remains in the metropolitan area (Government of Western Australia, 1998). Locally, there has been extensive historical clearing of Quindalup Dunes for industrial and port development in the Cockburn Sound industrial strip. However, local areas such as Woodman Point (Draft Bushplan Site 341), Point Peron (Draft Bushplan Site 355) and Garden Island (Draft Bushplan Site 63) represent some 1,550 ha of local primarily Quindalup Dunes that have been retained for conservation purposes (Government of Western Australia, 1998).

The intact areas of vegetation of the project area represent Swan Coastal Plain floristic community types 29a (Coastal shrublands on shallow sands) and 29b (Acacia shrublands on taller dunes) (Gibson et al., 1994). Neither are listed by English and Blyth (1997) as Threatened Ecological Community types. A small portion of the James Point area is shown as Quindalup complex on the remnant vegetation mapping used in the Draft Bushplan, but the area was not considered significant enough to warrant a recommendation for Bushplan Site status (Government of Western Australia, 1998). Given this, and the findings of the field survey, none of the site is considered to be regionally significant. Much of the remnant dunefield and associated Quindalup Complex vegetation of the project area has been degraded by a variety of factors including weed invasion, clearing, fire frequency, erosion and human use pressure.

The cumulative impact of this loss of dunes and vegetation is that there have already been substantial losses of dunes and vegetation along the Cockburn Sound eastern margin. This is a necessary loss given the requirement for the State to grow its industrial base and the zoning of the land as suitable for heavy industry.

9.2 SURFACE WATER

The project will result in the creation of approximately 19 ha of hardstand wharf. It is proposed that all surface drainage enter a series of strip drains which then carry the runoff to concrete pipework which in turn discharges into a 20 m x 20 m filtration basin, 2 m deep. This basin has been designed to trap settleable material, grease and oil, hydrocarbons will be separated and the runoff will then pass through sand filtration before returning to Cockburn Sound. The drainage design and filtration basin also provides an excellent mechanism for limiting any contamination of the Sound resulting from spills. The port maintenance programme will include a schedule for monitoring and cleaning the filtration basin and also ensuring the surface water drainage system is working as intended.
JPPL will have procedures in place to clean spills and prevent pollutants from entering the port from the hardstand area (refer Section 13).

The project will impact in a cumulative manner on surface water flows in the area in that additional surface water flows will be directed to the Sound from hardstand areas. The volume of runoff will be of the order of 160,000 m$^3$ (190,000 m$^2$ multiplied by the annual average rainfall of 0.86 m) each year, this is about one quarter of the estimated annual groundwater discharge per kilometre to the area (670,000 m$^3$/yr/km; Appleyard, 1994). The effect of this is unlikely to have a significant effect on the water of the Sound, however, the quantity and quality of the runoff entering the Sound will be monitored.

The final design of the surface water drainage system will be in accordance with current best practice and submitted to the DEP for approval as part of the works approval process. The above drainage system will be additional to any system put in place to cater for livestock trade, which is the subject of a separate approval.

9.3 GROUNDWATER

At present there is no need for the Stage 1 port to abstract groundwater for dust control or other commercial uses. However, if some future trade emerges where groundwater will be required, JPPL will apply to the Water and Rivers Commission for appropriate groundwater allocation.

The port will not result in further contamination of groundwater on the site and a survey of the port site for groundwater contamination will be undertaken prior to construction.
10. SOCIAL ENVIRONMENT: IMPACTS AND MANAGEMENT

10.1 CONSTRUCTION

10.1.1 Trucks

The core and armour material is likely to be obtained from an established quarry at Hope Valley. The truck route proposed is via Postans Rd, Abercrombie Rd, Anketell Rd, Patterson Rd and Beard St. This route will be discussed and agreed with Town of Kwinana and presented in the Construction EMP.

Any sand required will be brought from Baldivis and the proposed route is via the Old Mandurah Rd, Patterson Rd, and Beard St. This also is subject to discussion and agreement with Town of Kwinana.

The primary impact of construction will be approximately 72,000 truck movements (i.e. to and from site) carting fill and armour to the site over an 18 month period, or an average of 153 trucks/day based on 6 day working week. The trucks used for cartage are likely to be single trailer 5 and 6 axle articulated trucks (Austroads classification: Classes 8 and 9). Vehicle class travel information collected for Patterson Rd in August, 1995 has been supplied by Main Roads WA (MRWA). These traffic numbers will have increased since the data were collected, however, the volumes provide some perspective on the relative level of increase likely to generated by the construction phase. Table 10.1 shows the MRWA data and the effect of superimposing 153 additional daily truck movements. It is apparent that the volumes of traffic on Patterson Rd are already very high and the increased number of trucks associated with construction is not a significant increase in volumes. The same situation is likely to apply to other main roads. Where trucks will not be using main roads, the roads will largely be through the industrial area.

<table>
<thead>
<tr>
<th>VEHICLE TYPE</th>
<th>DESCRIPTION</th>
<th>AUGUST 1995*</th>
<th>DURING CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short up to 5.5 m long</td>
<td>Cars, utilities, vans, m/cycles etc</td>
<td>29,335 91.2</td>
<td>29,335 90.8</td>
</tr>
<tr>
<td>Medium 5.5 m to 14.5 m</td>
<td>Short vehicles towing trailers, buses, 2, 3 or 4 axle trucks</td>
<td>2,062 6.4</td>
<td>2,062 6.4</td>
</tr>
<tr>
<td>Long 11.5 m to 19.0 m</td>
<td>3, 4, 5 and 6 axle articulated trucks</td>
<td>762 2.4</td>
<td>915 2.8</td>
</tr>
<tr>
<td>Medium combination 17.5 m to 36.5 m</td>
<td>B doubles and double road trains</td>
<td>5 0</td>
<td>5 0</td>
</tr>
<tr>
<td>Long combination Over 33 m</td>
<td>Triple road train</td>
<td>0 0</td>
<td>0 0</td>
</tr>
</tbody>
</table>

* Information supplied by MRWA.

10.1.2 Piling

The berth may be built using either sheet piling or tubular piling. Construction of a sheet piled berth will generate noise, however, sheet piling is generally driven by vibration and does not generate significant noise impacts. There will be percussive noise associated with driving tubular piles if this method is employed. JPPL will not
undertake pile driving outside the hours of 7 am to 7 pm Monday to Saturday or on Sunday or a Public Holiday unless there is a specific Noise Management Plan produced which will need to be approved prior to such operations by the Chief Executive Officer of the DEP. JPPL will, in managing noise levels to as low as reasonably practicable, only undertake piling outside of the above hours if there is no other way to meet project schedule constraints.

10.2 RECREATION

10.2.1 Beach use
Public access to much of the area to be incorporated into the proposal is restricted. Currently, unauthorised use is made of the sandy beach located north of the existing BHPT #1 jetty, mainly for exercising of horses. This beach will be reclaimed and the area will become part of the port facility. Public access will continue to be restricted to reduce unnecessary public risk.

10.2.2 Boating
The proposed port waters are currently restricted waters and recreational craft are prohibited from the area. The same restrictions will apply following the construction of the port.

10.3 PLANNING
The relevant planning schemes include:

- Town of Kwinana Town Planning Scheme No. 2 (KTPS); and
- Metropolitan Region Scheme (MRS).

The current zoning of the land above the high water mark under KTPS is General Industrial, and under MRS the current zoning is Industrial. These zonings are applicable to the intended use of the land and no change to these zonings will be required. However, the area offshore is zoned as Waterway and an application will be lodged to change the zoning of the waters which are to be reclaimed to Industrial.

The industrial area surrounding the proposed port site contains extensive areas of open space. Adjacent industries include:

- HIsmelt direct reduced iron plant;
- BHP Transport bulk storage; and
- Further to the east are extensive areas of waste disposal ponds under the control of Alcoa.

The nearest residential area to the James Point site is Hope Valley, approximately 2 km to the north-east, while to the north-north-east, and at a similar distance, is the Naval Base light industrial area.

The creation of a new cargo wharf will increase heavy vehicle traffic to the area. This trucking will take place through an existing heavy industrial area and provide a lower impact alternative to present trucking through the residential Fremantle area.
10.4 **PUBLIC SAFETY**

The Kwinana industries have developed a comprehensive public safety plan which incorporates the risks associated with the major industries in the area. The changes in level of risk caused by the development and associated management are presented in Section 11.

10.5 **LIGHT SPILL**

The project is sufficiently distant from residential areas that light spill will not be an issue. The area is already lit at night by other industrial activities (eg. BP refinery, Wesfarmers LPG, Western Power and Alcoa) and the operations of the Kwinana Port will not add significantly to any visual impact.

10.6 **NOISE**

The proponent's objective is that noise emanating from the James Point Port, during construction and operation, conforms to the provisions of the Environmental Protection (Noise) Regulations 1997 (the Noise Regulations). This will ensure that the Port does not impact unreasonably on the amenity of nearby premises—industrial, commercial or other noise sensitive premises.

A detailed acoustic modelling study has been performed (Herring Storer, 2001) using conservative assumptions (so as to over-estimate any potential impacts) to predict the potential noise effect of the Port, with particular reference to the most constraining noise sensitive premises at Hope Valley and Medina.

10.6.1 **Regulatory Criteria**

The Environmental Protection (Noise) Regulations 1997 prescribe noise levels for different types of premises, the exceedence of which is considered unreasonable, and constitutes an offence. The Regulations also make it an offence to significantly contribute to an exceedence of the assigned level, defined as when a noise from a premise exceeds a value which is 5 dB below the assigned level being exceeded at the point of reception.

The Noise Regulations recognise that the base levels assigned to noise sensitive premises are very low and may not realistically be achievable at some premises due to their proximity to pervasive ‘background’ sources. Accordingly, the Noise Regulations provide for adjusting the assigned levels to which those noise sensitive premises may be subject by applying an ‘Influencing Factor’. The adjustment formula is based upon proximity of major and secondary roads and the surrounding land uses. For the purpose of determining the adjustment to be made to the assigned levels for noise sensitive premises in Hope Valley, the surrounding land use is deemed to be Commercial in accordance with Schedule 3 Regulation 2(4)a.

Assigned levels adjusted for the Influencing Factors have been used in this evaluation to identify the most constraining locations and to determine compliance with the Regulations.

Noise evaluation has been restricted to that originating from the site. Noise from transport on roads is explicitly excluded from regulation under the provision S3(a) of the Noise Regulations. This of course does not preclude the EPA from considering any matter it so chooses as part of an impact assessment, but there are no published criteria against which to assess the acceptability of the impact. The DEP suggests there is a Preliminary Draft Guidance for EIA No. 14 - Road and Rail Transportation.
Noise, Version 3. However, the DEP has also advised that this document has not yet been released to the public and is still at the stage of internal review. It therefore does not yet constitute an EPA position on the subject and external parties do not yet know of its content. It is inappropriate to conduct an evaluation to a guidance not yet issued.

10.6.2 Noise Sources

Construction

Construction noise will be produced by pile driving, dredging and land-based mobile and stationary equipment. Sound power levels of the respective items used in the acoustic modelling are shown in Table 10.2. Noise levels adopted for all equipment were for the quietest reasonably available, as would be required under the Noise Regulations.

Operations

The dominant noise during Port operation will be from berthed livestock ships when operating ventilation systems (ie. after stock loading commences). Other sources include the shore-based stockfeed loading systems and mobile equipment operations. In addition to the operational noises associated with the port there will be noise associated with the sheep and the bellowing of cattle. This noise is considered not to be significant particularly as the nearest noise sensitive premises are within a rural area.

To provide a reliable basis for modelling, noise emissions from a range of livestock vessels currently using Fremantle Port were measured. The measured noise profiles were back-calculated, using a commonly accepted computer programme, to establish each vessel's acoustic characteristics and sound power level.

Vessel and shore-based equipment sound power levels used in modelling are shown in Table 10.2.

10.6.3 Acoustic Evaluation

An acoustic evaluation of the Stage 1 Port construction and operations was conducted by Herring Storer Acoustics (Herring Storer, 2001) and the full report of that work is available for inspection.

It was determined that for the purpose of compliance evaluation, the most constraining locations were noise sensitive premises at the south-west of Hope Valley (Garden Road) and the north-west of Medina (corner of Medina Avenue and Ridley Way South). Modelling was performed to determine the Port’s impact under various wind conditions, the highest level of noise being when the nominated receptors were directly down-wind.
Table 10.2 Sound power levels used in modelling, dB

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>OCTAVE BAND CENTRE FREQUENCY (Hz)</th>
<th>31.5</th>
<th>63</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1 k</th>
<th>2 k</th>
<th>4 k</th>
<th>dB(A)</th>
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<td><strong>Operational Noise</strong></td>
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<td></td>
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<td></td>
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<tr>
<td>Vessel 'Al Messilah'</td>
<td></td>
<td>110</td>
<td>115</td>
<td>125</td>
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<td>126</td>
<td>118</td>
<td>108</td>
<td>105</td>
<td>102</td>
<td>99</td>
<td>118</td>
</tr>
<tr>
<td>Vessel ‘Mawashi Tabuk’</td>
<td></td>
<td>110</td>
<td>126</td>
<td>117</td>
<td>132</td>
<td>118</td>
<td>113</td>
<td>109</td>
<td>104</td>
<td>126</td>
</tr>
<tr>
<td>Vessel ‘AI Kuwait’</td>
<td></td>
<td>115</td>
<td>123</td>
<td>113</td>
<td>115</td>
<td>105</td>
<td>104</td>
<td>104</td>
<td>104</td>
<td>118</td>
</tr>
<tr>
<td>Feed Blowers #</td>
<td></td>
<td>120</td>
<td>122</td>
<td>115</td>
<td>114</td>
<td>118</td>
<td>117</td>
<td>117</td>
<td>123</td>
<td></td>
</tr>
<tr>
<td>Air Slide Conveyors +</td>
<td></td>
<td>99</td>
<td>112</td>
<td>109</td>
<td>115</td>
<td>108</td>
<td>109</td>
<td>105</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>Feed Truck =</td>
<td></td>
<td>86</td>
<td>95</td>
<td>101</td>
<td>117</td>
<td>104</td>
<td>99</td>
<td>99</td>
<td>94</td>
<td>110</td>
</tr>
<tr>
<td>2 x Trucks =</td>
<td></td>
<td>111</td>
<td>105</td>
<td>105</td>
<td>107</td>
<td>98</td>
<td>95</td>
<td>90</td>
<td></td>
<td>104</td>
</tr>
<tr>
<td><strong>Construction Noise</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pile Driving =</td>
<td></td>
<td>114</td>
<td>116</td>
<td>118</td>
<td>120</td>
<td>119</td>
<td>124</td>
<td>124</td>
<td>122</td>
<td>130</td>
</tr>
<tr>
<td>Dredging =</td>
<td></td>
<td>95</td>
<td>100</td>
<td>101</td>
<td>110</td>
<td>101</td>
<td>98</td>
<td>95</td>
<td>92</td>
<td>105</td>
</tr>
<tr>
<td>General Mobile Equipment =</td>
<td></td>
<td>108</td>
<td>112</td>
<td>111</td>
<td>112</td>
<td>105</td>
<td>104</td>
<td>103</td>
<td>94</td>
<td>110</td>
</tr>
<tr>
<td>General Plant (Generators etc.) =</td>
<td></td>
<td>94</td>
<td>110</td>
<td>105</td>
<td>101</td>
<td>102</td>
<td>100</td>
<td>97</td>
<td>93</td>
<td>105</td>
</tr>
</tbody>
</table>

# Measured during the Nukairish Alsades measurements on 25 October 2000
+ Air slide conveyors measured on 25 February 2000 during feed loading on vessel Marineos
= Generic noise data used
* Sound power level for these ships can be used for guidance however not used in modelling due to unacceptable measuring conditions for the Nukairish Alsades (refer to individual report for more details) and wind speed during measurements only estimated for the Al Kuwait.

**Construction**

Construction noise is not directly regulated by the assigned levels within the Noise Regulations, however, certain management practices are required.

Predicted noise levels at Hope Valley and Medina are compared with the respective assigned levels in Table 10.3.

The noise predicted from construction of the Port is lower than the assigned levels at all times of the day. The predicted noise level at Hope Valley during pile driving is within 5 dB below the assigned night-time level. Therefore, if during pile driving at night-time there were to coincidently be an exceedence of the assigned level at the Hope Valley location due to other sources, the Port construction would be considered to be a significant contributor to that exceedence. Recognising this potential, the proponent is committed to managing the noise from pile driving to levels as low as reasonably practical.
Table 10.3 Comparison between predicted levels and assigned level construction noise

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>PREDICTED NOISE LEVEL, DOWNWIND</th>
<th>ASSIGNED NOISE LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WITH PILE DRIVING</td>
<td>WITHOUT PILE DRIVING</td>
</tr>
<tr>
<td>Hope Valley</td>
<td>44</td>
<td>32</td>
</tr>
<tr>
<td>Medina</td>
<td>28</td>
<td>14</td>
</tr>
</tbody>
</table>

Operation

The Stage 1 James Point Port is proposed to handle a range of cargoes and classes of ships at its three berths, although it will be rare that three ships would be in port concurrently. The highest operational noise levels are produced by livestock vessels from the high volume ventilation systems operated to maintain the welfare of the stock on-board.

For modelling purposes, it has been assumed that the worst case for noise emissions would be when the two noisiest measured livestock vessels (Table 10.2) were in port concurrently, with livestock on-board and their ventilation systems operating. The highest level of exceedence would be experienced under night-time atmospheric conditions, down-wind in Hope Valley.

Assuming that the livestock vessels measured and reported in Table 10.2 represent the mix of livestock vessels that will use the Port, modelling was performed for each of 16 wind vectors, for each vessel and each combination of two vessels. The predicted noise levels at Hope Valley and Medina for each vector were compared with the frequency with which the wind originated from that vector and the frequency that one and two vessels are expected to be in Port. The predicted levels were compared to the assigned levels at the two most sensitive locations and frequencies of exceedence predicted for the three periods of the day (daytime, evening and night-time) as defined in the Noise Regulations.

The evaluation also considered the frequencies that the noise emitted from the Port was predicted to exceed the level 5 dB below the assigned level for each period of the day, at the two most sensitive locations. This established the frequencies of occurrence that the Port might be considered a significant contributor, were there to be an exceedence at the time. This would require one or more other sources individually or cumulatively to cause or contribute to an exceedence.

Continuing the conservative approach, the modelling addressed the question as to the predicted frequency of exceedence at Hope Valley of the assigned levels and the assigned level minus 5 dB were the noise perceived as tonal and therefore the measured level penalised by a further 5 dB. The noise being perceived as tonal at a distance of over two kilometres is considered improbable by Herring Storer.

The predicted exceedences described above are shown in Table 10.4.
### Table 10.4 Total percentage of time an exceedence occurs

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SCENARIO</th>
<th>PERCENTAGE OF PERIOD ASSIGNED NOISE LEVEL EXCEEDED</th>
<th>PERCENTAGE OF PERIOD ASSIGNED NOISE LEVEL MINUS 5 DB(A) EXCEEDED *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DAY</td>
<td>EVENING</td>
<td>NIGHT</td>
</tr>
<tr>
<td>Location 1 Hope Valley</td>
<td>Non-tonal</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Tonal</td>
<td>0.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Location 2 Medina</td>
<td>Non-Tonal</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Tonal</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

* Percentage of time the Port would be considered a significant contributor should there be a cumulative exceedence of the assigned level.

# Refers to noise characteristics at residence. Where tonal, it is assumed the Mawasaki Tabuk (noisiest vessel) is tonal, hence worst case.

Note: Calculated numbers rounded to 1 decimal place for reporting in table.

Conservative modelling predicts that noise emitted from the Port operations:

- Will be below the assigned levels at Medina at all times and at Hope Valley below the assigned levels for daytime and evening, but possibly exceeding for 0.2% of the night-time;
- May exceed a level 5 dB below the assigned levels at Medina 0.1% of the night-time and at Hope Valley 1% of the evening hours and 0.8% of the night-time; and
- Were it perceived as tonal at Hope Valley, would exceed the assigned levels 1.5% of the evening hours and 0.7% of the night-time and would exceed the levels 5 dB less than the respective assigned levels 2.4% of the daytime, 2.2% of the evenings and 1.9% of the night-time.

As stated in section 10.6, this acoustic evaluation focussed mainly upon the potential impact on noise sensitive premises, as these were recognised as the most constraining for Port operations. Single point calculations were performed to predict with the greatest precision the levels of noise that might be experienced at those specific sensitive locations.

Predicted Port operations noise contributions across the general industrial environs surrounding the Port were also modelled for worst and typical cases with two livestock ships in port. The results were plotted as noise contours (Herring Storer, 2001) which, although not as precise at any specific location as single point calculations, provide an illustration of the predicted noise impact. For the worst case configuration these depict a 55 dB(A) contour extending slightly to the west of Riseley Road and south into the BHP site, but not to Mason Road.

On the basis of this worst case prediction and having regard to the low frequency at which the two noisiest ships will be concurrently in port with ventilation systems in operation, the frequency of on-shore winds and the rate of decay as noise propagates over distance it is concluded that the Port will comply with the assigned levels at the boundaries of the port area.

### 10.6.4 Noise Management

#### Construction

Construction will be conducted in accordance with a noise management plan having regard to the practices for the control of environmental noise set out in section 6 of the Australian Standard 2436-1981, Guide to Noise Control on Construction, Maintenance and Demolition Sites.
The noise modelling work performed by Herring Storer Acoustics predicted that construction noise emissions will comply with levels assigned in the Environmental Protection (Noise) Regulations 1997. When piles are being driven, the noise emission may exceed a value that is 5 dB below the assigned level at Hope Valley and therefore, were there to be a coincident exceedence of the assigned levels, be taken to be a significant contributor.

Consistent with the proponent's commitment to responsible control of construction noise, pile driving equipment and procedures will be the quietest reasonably available in the circumstance.

**Operations**

The Herring Storer Acoustics noise modelling predicted for the majority of the time, noise emissions from the proposed Port would neither exceed the levels assigned in the Environmental Protection (Noise) Regulations 1997, nor significantly contribute to any such exceedence.

There are predicted to be infrequent cases in which noise emissions from livestock vessels berthed at the Port may marginally exceed the assigned night-time level in the south-west of Hope Valley or may exceed values 5 dB below the respective evening and night-time assigned levels. In the latter instances, the Port emission would be considered a significant contributor should an exceedence exist at the noise sensitive premise.

The Port operator has no legal control of noise emissions from vessels berthed at the Port. Operations will be monitored to establish whether vessel noise does appreciably exceed the relevant assigned levels or significantly contribute with other sources to such exceedence. If noise levels attributable to particular vessels using the Port are unreasonably impacting the amenity of occupants of noise sensitive premises, the Port operators will liaise with the vessel operators with the objective of mitigating the impact.

Additionally, the Port operators will address any other practical options within its control to prevent unreasonable impact on noise sensitive premises.

The feed-blowers (used to load feed pellets onto livestock ships) currently used in Western Australia emit noise of a level which could significantly contribute to an exceedence of the relevant assigned night-time levels at the respective receptors in Hope Valley and Medina (i.e. within 5 dB of the assigned levels).

As part of detailed design, JPPL will review available equipment with regard to specifying the maximum source noise levels. Consideration will also be given to methods that may be used to attenuate the level of noise. Where possible, noise levels will be specified in invitations to tender on such equipment. The aim of this approach, which may only be undertaken during the detailed design phase of the proposal, will be to investigate engineering and/or procedural controls to reduce feed-blower noise below the level that could significantly contribute to an exceedence.

**10.6.5 Conclusion**

It is concluded that having regard to the precision of the noise modelling programme, the conservative approach taken to the analysis and the predicted percentage of exceedence, the acoustic impact of the Port on the surrounding area is negligible.
The Port operator has no legal control of noise emissions from vessels berthed at the Port. Operations will be monitored to establish whether vessel noise does appreciably exceed the relevant assigned levels or significantly contribute with other sources to such exceedence. If noise levels attributable to particular vessels using the Port are unreasonably impacting the amenity of occupants of noise sensitive premises, the Port operators will liaise with the vessel operators with the objective of mitigating the impact.

Additionally, the Port operators will address any other practical options within its control to prevent unreasonable impact on noise sensitive premises.

10.7 ODOUR

10.7.1 Background

Odour is anything detected by the sense of smell. Some odours are considered pleasant and others unpleasant. Under certain conditions odours can cause annoyance or even be offensive and impact adversely upon the amenity of the affected person.

The Western Australian EPA (EPA 2000b) recognises that a person affected by an odour that they consider unacceptable may be sufficiently annoyed to complain, and lists five influencing factors documented by the New Zealand Ministry for the Environment:

- Frequency of the odour occurrence;
- Intensity of the odour;
- Duration of the exposure to the odour;
- Offensiveness of the odour; and
- Location of the odour.

Sensitivity to odour varies between individuals, as do the odour characteristics that affect a person to the extent that their amenity is unreasonably adversely impacted.

It is the proponent's objective that odour emitted from the proposed port precinct not unreasonably impact upon the amenity of any person, whether working in the surrounding industrial area or resident in the more distant townships such as Hope Valley, Medina and Wattleup.

10.7.2 Sources

The port will cater for a wide range of cargoes (Section 3.1) of which livestock is the only class considered to require assessment as to its potential for odour impacts extending beyond the port premises. Most of the livestock trade will be sheep, although other livestock may also be handled.

Consideration has been given to the cumulative impact of other odour sources in the Kwinana Industrial Area. Interaction of odours may be such that they mask, cancel, add to or behave in a synergistic manner and this interaction may also vary for the same odour sources at different concentrations downwind from their sources. The only source that is considered to have an influence on the cumulative impact, or more specifically, add to those from the livestock loading operations are the odours from a proposed livestock holding facility which has been proposed to be located in the vicinity of the port and is the subject of a separate environmental assessment.
Recognising the proximity of these two facilities and the common livestock odour characteristic, the evaluation of odours from the port has been based upon the potential cumulative impact of the two sources.

However, it should be noted that both the port and the proposed livestock holding pens proposals are sustainable without the other proposal. For example, if the livestock pens were built and the port did not proceed, the facility would be used as the staging area for livestock sent to Fremantle, conversely, if the livestock facility did not proceed while the port did, the port would receive livestock in a similar fashion to that experienced at Fremantle.

10.7.3 Management

The proponent’s odour objective will be achieved through a range of design considerations and operational practices, including:

- Siting the port on the central, western margin of the Kwinana Heavy Industrial Area which is abutted to the east by a wide air-quality buffer zone. The separation distance of approximately 2 km to the nearest residential area is twice the EPA's guideline for livestock holding yards of 1 km (EPA, 1997);
- Designing and constructing the facilities to maximise loading rates and therefore minimising the duration that sheep ships are in port. This is one of the benefits from the proximity of the proposed livestock holding facility if it proceeds; and
- Maintaining good housekeeping on the wharf by prompt cleaning following livestock loading. The proponent for the livestock holding facility has also committed to world's best practice design and operation of that facility to minimise odour emissions to the extent reasonably practical.

10.7.4 Acceptability criteria

The objective for odour management of this proposal is to not cause unreasonable impact on the amenity of persons in surrounding areas. It is proposed that the acceptability impact on amenity is such that odour is not emitted an at a frequency, intensity and duration as to be offensive to the person experiencing the odour.

The EPA has stated (EPA, 2000b) that for an odour to contribute to annoyance it must be strong enough to have a ‘distinct’ (recognisable) odour, rather than just be ‘detectable’ under controlled conditions.

In relation to poultry farms the EPA has determined the distinct odour strength to be 7 Odour Units (OU). The EPA further stated that this guideline would be reasonably applicable to other odour emitting industries where the odour was generated by decomposition of organic material and would be most relevant to other volume sources such as feedlots.

In relation to determining the distance, frequency and duration of such events around an odour emitting premise to be confident of not contributing to annoyance, the EPA stated that the 1-hour average 7 OU concentration should be satisfied 99.9% of the time.

This guidance was provided for assessing the concentration of odour that was likely to maintain an acceptable amenity for the general population.
The proposed port is located in the Kwinana Industrial Area. The EPA has applied the principle that concentrations of air contaminants higher than residential standards are acceptable within the industrial area, for example the treatment of sulphur dioxide in the Revised Draft Environmental Protection (Kwinana)(Atmospheric Wastes) Policy and Regulations (EPA, 1999).

### 10.7.5 Impacts

A quantitative odour modelling study was undertaken to establish the extent and concentration of odour from the port and adjacent livestock holding facility (ERS, 2000b). The assessment was based upon conservative assumptions of odour emissions, assuming a larger number of sheep (250,000) than are anticipated to be continually present and by adopting an odour emission rate per sheep that was conservatively high.

The area inside the contour shown in Figure 10.1 designates where the odour, generated from the port with a laden 110,000 sheep ship at berth and the livestock holding facility containing 140,000 sheep, may exceed the concentration of 7 OU, and therefore be distinct more than 0.1% of the time. Similar model runs were undertaken with 250,000 sheep distributed in different proportions between the ship and the livestock facility and it was found there was minimal difference in the location of the 7 OU contour between scenarios.

The area is fully contained within the industrial area and does not reach the existing buffer zone. It is predicted to extend east to Morley Street, north to the Kwinana Power Station and south to the northern loop of Mason Road.

It is important to note that the odour concentration will not continuously exceed 7 OU in this area and, therefore, be presumed to be distinct. The contour shows the area within which dispersion model predicted that the 1-hour average concentration would be 7 OU for 0.1% of the time (e.g. more than 8 times in a year).

The model predicts that residential areas, such as the nearest at Hope Valley, are well beyond that area and are unlikely to experience odours which impact upon amenity.

It is acknowledged that immediately adjacent to the port, in the surrounding industrial area, there will be occasions on which the odour of sheep will be distinct. Persons within this area will generally be in an industrial workplace and are less likely to be sensitive to occasional sheep odour. The odour is highly recognisable and not threatening (as some industrial odours are perceived to be), and it is believed odour associated with the port will not unreasonably impact upon amenity within the industrial area.

The beaches adjacent to the port are not authorised for public access and therefore, odour is not considered to be an issue affecting recreational beach use.

### 10.8 ABORIGINAL HERITAGE

The project is unlikely to have any impact on Aboriginal heritage, however, the local Aboriginal community will be consulted prior to commencement of construction. Procedures for dealing with skeletal or archaeological material uncovered during construction will be prepared as part of the Construction EMP.
ERS

James Point Livestock Pty Ltd
James Point Livestock Holding Facility
Odour Modelling

7 OU Contour for 140,000 Sheep Holding Facility and 110,000 Sheep Ship

Figure
11. RISK: FACTORS AND ANALYSIS

11.1 FACTORS

11.1.1 Sea transport
The term ‘Dangerous Cargoes/Goods’ as used in this PER is defined as:

“Any cargoes including fuel, stores or other commodities whether packaged or in bulk, intended for carriage by sea having properties coming within the classes listed in the International Maritime Dangerous Goods Code (IMDG code).”

This definition also includes any bulk cargo which is not covered by the IMDG Code but which is subject to:

- The International Maritime Organisation’s (IMO) Code for the construction and equipment of ships carrying dangerous chemicals in bulk;
- The IMO Code for the construction and equipment of carrying liquefied gases in bulk; and
- The IMO Code of Safe Practice for solid bulk cargoes in so far as such a cargo constitutes a hazard to those in the port area or to the port environment.

The Australian Maritime Safety Authority (AMSA) is the responsible authority.

11.1.2 Road and rail transport
The road and rail transport of dangerous goods is governed by the Australian Code for the Transport of Dangerous Goods by Road and Rail as approved by the Ministerial Council for Road Transport and endorsed by the Australian Transport Council.

The responsible authority in Western Australia is the Department of Minerals and Energy, Explosives and Dangerous Goods Division.

11.1.3 Storage of dangerous goods in the port area
Dangerous goods will not generally be stored for more than three days in the port area, as this would be contrary to the function of the port, which is to facilitate a rapid change in transport mode. It is anticipated that dangerous goods will not be handled in significant quantities.

Notwithstanding, all dangerous goods passing through the port will be handled in compliance with the Australian Standard AS 3846-1998 (concerning the handling and transport of dangerous cargoes in port areas). In addition, guidance on qualitative, semi-quantitative and quantitative risk analysis to assess the suitability of alternative safety practices and dangerous cargo limitations will be sought from AS/NZS 4360 (Risk Management).

11.1.4 Port construction—risk to construction workers
In addition to the normal on site risks inherent in any construction activity, there are other risks which have the potential to impact on the proposed site. These scenarios are documented in the various plant quantitative risk analysis for the Kwinana Industrial Area (QRA/KIA).
The FPA’s Port Safety Study (DNV Technica, 1993) identified the following incidents to be of particular concern in the Outer Harbour.

(i) Fire or explosives involving Petroleum Products, Crude Oil, or flammable chemicals at the Oil Refinery jetty or the Bulk Cargo jetty.
(ii) Fire or explosion following a release of LPG at the BHP Transport jetty. This is the closest facility to the proposed port and LPG release occurs approximately four times a year.
(iii) Toxic release of Anhydrous Ammonium at the Bulk Cargo jetty.

11.2 RISK CALCULATIONS

11.2.1 Acceptance criteria

A ‘risk’ is defined as the likelihood of a specified event occurring within a specific time period or in specific circumstances. The risks from the Stage 1 development have been assessed against the Criteria for the Assessment of Risk from Industry (Western Australian Environmental Protection Authority, 1992). The criteria are presented Table 11.1 for reference.

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>ACCEPTABLE RISK OF OCCURRENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Zones.</td>
<td>One in a million per year or less. &lt; 1.0 x 10^-6 per year</td>
</tr>
<tr>
<td>‘Sensitive Developments’ (Such as hospitals, schools, child care facilities and aged care housing developments).</td>
<td>Between one half and one in a million per year. 0.5 x 10^-6 to 1.0 x 10^-6 per year</td>
</tr>
<tr>
<td>From Industrial Facilities.</td>
<td>Not to exceed fifty in a million per year at the site boundary for each individual industry. &lt; 50 x 10^-6 per year</td>
</tr>
<tr>
<td>Cumulative risk level imposed on an Industry.</td>
<td>Not to exceed one hundred in a million per year. &lt; 100 x 10^-6 per year</td>
</tr>
<tr>
<td>Non-Industrial activity located in buffer zones between industrial facilities and residential zones.</td>
<td>Not to exceed ten hundred in a million per year or lower &lt; 10 x 10^-6 per year</td>
</tr>
</tbody>
</table>

The risk values calculated for this facility are expressed in terms of the risk to an individual, termed the Individual Risk per annum (IRPA). IRPA is defined as the frequency (per year) to which an individual may be expected to sustain fatal harm due to exposure to hazards. A ‘Hazard’ is considered to be any situation which may result in harm, including death or injury to people or damage to property.

11.2.2 Assumptions

This preliminary risk study relies on some very conservative assumptions:

- James Point Port: Stage 1 will provide an alternative to the Fremantle Port and is not expected to attract more trade to James Point than is currently passing through Fremantle Inner Harbour. For the purpose of undertaking a preliminary risk assessment, it has been conservatively assumed that the trade (including the toxic and dangerous goods) would be equivalent to that currently passing or expected to pass through Fremantle;
- The basis used in this analysis was to assume that the risk levels calculated for Fremantle Port in the year 2010 and presented in the latest publicly available report (DNV Technica, 1993) apply for the James Point Port: Stage 1. These risk levels are based on the projected trade and traffic though Fremantle Port.
and as such represent the scenario with the highest risk levels. In using the projected Fremantle risk levels, the risks associated with the development are conservative as the trade at James Point Port: Stage 1 will not reach the trade levels projected for Fremantle in 2010; and

- The transposed Fremantle risk levels have been combined with the risks arising from the adjacent BP Kwinana Refinery (DNV, 1997). These risk levels are for the current plus future facilities with pressurised shipping. It thus represents the scenario with the highest risk levels from the refinery adjacent to the James Point Port: Stage 1 and is thus a conservative basis to use.

11.2.3 Risk calculations

The risk data from Fremantle (DNV Technica, 1993) and BP Kwinana (DNV, 1997) were modelled as 23 discrete source points and the total risks from these sources were summed at each point in a grid covering the proposed James Point Port: Stage 1 as defined on the proposal drawing.

The risk levels held in the grid were then plotted and overlaid on the proposal drawing. The results are presented below as Figure 11.1. It should be noted that although the layout shown in Figure 11.1 is superseded and does not directly apply to this proposal, the risk calculations remain the same.

![Figure 11.1 Total Proposed Site Individual Risk](image)

11.3 DISCUSSION OF RISK LEVELS

The risk levels for port operations (Figure 11.1) are compared below to the risk acceptance criteria given in Table 11.1.
11.3.1 **Construction**
During construction activities for James Point Port: Stage 1 there will be operations taking place which pose risk primarily to the work force. These operations will be managed by developing and then implementing a Safety Management System. This will be used to ensure acceptable levels of risk are achieved for all operations.

11.3.2 **Port operations**

*Residential zones*
The $1.0 \times 10^{-6}$ risk contour extends approximately 1 km to the east of the port and some 1.35 km to the north. The nearest residential zones are approximately 1.97 km from the port and are therefore well outside the $1.0 \times 10^{-6}$ per year risk contour.

*Sensitive developments*
There are no sensitive developments known to exist in the area between the $0.5 \times 10^{-6}$ to $1.0 \times 10^{-6}$ per year risk contours (1.6 km to 1.0 km from the port).

*From industrial facilities*
The fenceline risk levels from James Point Port: Stage 1 are less than $5 \times 10^{-6}$ per year. Therefore, the risk level imposed on other industries bordering the port does not exceed the criteria of $50 \times 10^{-6}$ per year.

*Cumulative risk level imposed on industry*
The risk arising from the adjacent BP Kwinana refinery to the south of James Point Port: Stage 1 has been accounted for in order to estimate cumulative risk levels.

The fenceline risk levels from James Point Port: Stage 1 are less than $5 \times 10^{-6}$ per year. Therefore, the cumulative risk level imposed on other industries bordering James Point Port: Stage 1 does not exceed the criteria of $100 \times 10^{-6}$ per year.

*Buffer zone risk levels*
The fenceline risk levels from James Point Port: Stage 1 are less than $5 \times 10^{-6}$ per year. Therefore, the risk level imposed on buffer areas between James Point Port: Stage 1 and residential areas does not exceed the criteria of $10 \times 10^{-6}$ per year.

11.3.3 **Risk management**
In general, the risk levels associated with James Point Port: Stage 1 satisfy the Western Australian Environmental Protection Authority criteria.

The risk levels will be reduced further during the detailed design of the port and its facilities when the underlying assumptions for analysis can be refined. Engineering controls and management systems and procedures will be developed to minimise the potential for a release of toxic or hazardous material and to reduce the consequences of such a release should it occur. These controls will be documented in the port safety plan and emergency response plan.

James Point Pty Ltd aims to plan, design, construct and operate the James Point Port: Stage 1 development in a manner that minimises risks to the public, neighbouring facilities and employees, and complies with all statutory requirements and industry standards. A quantitative risk analysis will be conducted and updated every two years or whenever a significant new trade is introduced.
12. PORT MANAGEMENT

12.1 OVERVIEW

JPPL have a contract with the State Government which is in the form of an Operating Agreement. Included in the agreement are provisions that require JPPL to:

- Promptly and diligently apply for and obtain all necessary approvals and licences as may be required by the DEP and/or the EPA under applicable environmental legislation for the construction and operation of the port;
- In constructing and operating the port and providing the port services comply with all laws and the proper requirements of Government Agencies; and
- Set up, maintain, implement and monitor throughout the term of the agreement (which effectively means the life of the port, because without the agreement the port cannot operate) an Environmental Management Plan for the James Point Port: Stage 1 approved by the Minister for Transport.

There are also provisions which prevent the assignment of the operating agreement or transfer of ownership without approval subject to conditions imposed by the Minister. A breach of the conditions of the Operating Agreement may result in cancellation of JPPL’s or any subsequent Operator’s right to operate the port.

The Operator will also be held responsible for ensuring that third parties providing services within the port area meet the same standards as the Operator, with independent audits implemented on a regular basis to inspect and review the management and operation of the port and the provision or performance of the services for the purpose of assessing compliance with the terms and conditions of the Operating Agreement.

In addition to the requirement to set up, maintain, implement and monitor an EMP for the port under the umbrella of an EMS, JPPL proposes to base its environmental management practices on the Environmental guidelines recommended by Association of Australian Port and Marine Authorities (AAPMA). These are:

- Recognise environmental management as being amongst the highest corporate priorities and establish practices for conducting operations in an environmentally sound manner;
- Continue to improve corporate practices and environmental performance, taking account of the current legislation, Government policy, industry codes of practice, technical developments, the needs of port users and community expectations;
- Take voluntary steps, where it is considered possible and appropriate, to improve current environmental practice;
- Educate, train and motivate employees to conduct their activities in an environmentally responsible manner;
- Minimise the use of raw materials, toxic substances, energy, water, and other resources, as well as reducing the impacts of day to day operations;
- Encourage research on environmental issues associated with the port industry;
- Develop and maintain emergency preparedness plans in conjunction with emergency services, relevant authorities and the community, consistent with current legislation and good practice;
• Promote the adoption of these principles by port users and contractors acting on behalf of the port and where appropriate, require improvements in their practices to make them consistent with those of the port;
• Promote good public relations and foster openness and dialogue with employees, relevant authorities and public, anticipating and responding to their concerns about potential environmental impacts arising from port development or operation; and
• Measure environmental performance, conduct environmental audits and publish this information internally and externally as appropriate.

12.2 MANAGEMENT STRUCTURE

The proposed management structure for operation of James Point Port: Stage 1 is shown in Figure 12.1.

![Figure 12.1 JPPL management structure](image-url)
13. POLLUTION CONTROL AND EMERGENCY RESPONSE

13.1 PLANNING

JPPL will develop emergency procedures and safety management systems which will be integrated with the Kwinana Industries Mutual Aid plan and where appropriate, State and FPA plans.

13.2 POLLUTION CONTROL: SHIPPING OPERATIONS

There are a number of mandatory international regulations for the prevention of pollution from ships. These regulations are known as MARPOL 73/78 (refer Glossary), which is one of the most significant international agreements on the subject of marine pollution. Australia is a full member of the IMO and a signatory to MARPOL 73/78.

MARPOL 73/78 contains detailed regulations covering the various sources of ship generated sources of marine pollution. These regulations are, in part, detailed in five annexes:

- **ANNEX I** Regulations for the prevention of pollution by oil;
- **ANNEX II** Regulations for the prevention of pollution by noxious liquid substances in bulk;
- **ANNEX III** Regulations for the prevention of pollution by harmful substances in packaged form;
- **ANNEX IV** Regulations for the prevention of pollution by sewage from ships; and
- **ANNEX V** Regulations for the prevention of pollution by garbage from ships.

AMSA audit compliance and currency of a vessel’s certificates as issued by the IMO, this is known as Port State control.

In addition, JPPL proposes to audit a vessel’s compliance with MARPOL 73/78 on entry to the port area.

Australia’s jurisdiction and marine environmental responsibilities extend to the economic exclusion zone (EEZ), 200 nautical miles (nm) offshore from Australian Territory and beyond the 200 nm EEZ where the continental shelf extends to the edge of the physical continental shelf.

The AMSA Act provides authorised inspectors to board any ship within Australian waters to:

- Inspect and test any machinery or equipment of the ship;
- Open and inspect any hold, bunker, tank, compartment and receptacle in the ship;
- Request the master to produce any documents (oil record book, garbage certificate of disposal etc);
- Examine and take samples; and
- Request any persons to answer questions.
The regulations provide for penalties and in some cases, vessel detention for non-compliance.

JPPL will implement and ensure the provision of appropriate disposal facilities in accordance with:

- The comprehensive manual on port reception facilities published by the IMO; and

Hull cleaning will be prohibited in waters controlled by JPPL. Bilge water will not be pumped to the sea in port areas, but may be transferred to a sludge tanker in accordance with the relevant legislation.

13.3 POLLUTION CONTROL: OIL SPILL PLANNING
JPPL considers there are three risk areas with respect to potential oil spills, these are:

- Collision between wharf and vessel;
- Grounding; and
- Bunker transfer.

**Collision**
Vessels will be managed by pilots within the port area and only one vessel movement at a time will be permitted. These controls, including tug assistance where appropriate, will reduce the potential for vessel collision.

**Grounding**
Hydrographic surveys will ensure that vessel entry and draft are consistent and that nominated underkeel clearance is maintained.

**Bunker transfer**
Bunker transfer spills are rarely greater than 10 tonnes and generally in the region of 0.3 tonnes. JPPL will put a system in place within the Port Safety Plan, to manage bunker transfer and to take all possible precautions to avoid a spill in the first place.

13.3.2 Responsibility—National Plan to Combat Pollution of the Sea by Oil and other Noxious and Hazardous Substances
The responsibility to combat oil spills rests with the designated prime agency for the affected waters. The prime agencies in Western Australia are:

- Within a port or harbour—the administrative authority of that port or harbour;
- Beaches and foreshores—the State Government, or Local Government Authority responsible for that area;
- Territorial seas or inland waters outside of a declared harbour—Transport WA;
- High Seas—Australian Maritime Safety Authority; and
- In exploration and production lease areas, subject to the Petroleum (Submerged Lands) Act 1967 and relevant State legislation—The Department of Minerals and Energy.
The Prime Agency is responsible for:

- Making arrangements to reimburse costs;
- Initiating legal proceedings; and
- Initiating prosecutions.

The waters encompassed by the JPPL development are currently part of the FPA Outer Harbour and until the area is excised from its jurisdiction, the FPA is the prime agency. When excised, the port operator will become the prime agency.

13.3.3 **Combat Authority**

The combat authority is the authority designated to provide resources, both human and equipment to best combat a pollution event. The Prime Agency may assume the function of the Combat Authority or may request another authority to act as a combat agency on its behalf. In the case of James Point Port: Stage 1, the FPA is the Combat Authority until the area is excised, after which time the port operator will become the Combat Authority.

The responsibilities of the Combat Authority are documented and endorsed by the State Emergency Management Advisory Committee (SEMAC).

JPPL proposes to ensure the provision of resources, both human and equipment, to best combat a pollution event. Further, JPPL will, to the fullest extent possible, enter into formal mutual aid agreements with the appropriate authorities/agencies and industry. Early discussions have taken place with the Department of Transport as to training and equipment that is best suited to the type of spill that is probable.

The Western Australian Marine Oil Pollution Emergency Management Plan will form the basis of JPPL’s plan.

13.4 **POLLUTION CONTROL: HAZARDOUS MATERIALS**

Hazardous materials will be transported through the port. All hazardous materials will be handled in accordance with the requirements of the *Explosives and Dangerous Goods Act 1961*. Material Safety Data sheets will be obtained for all chemicals stored at the port and staff will be trained in their handling and use. Appropriate storage facilities will be constructed to Department of Minerals and Energy specifications as required.

13.5 **POLLUTION CONTROL: WASTE MANAGEMENT**

The port operations will generate waste such as litter and oily waste. There is also the potential for spills.

JPPL will prepare a waste management strategy as part of the EMS. The strategy will include the following requirements:

- JPPL’s key aim will be to conduct operations such that waste production is minimised;
- Waste will be stored in an area that will contain spillage;
- Waste storage containers will be marked as required under the Dangerous Goods Regulation 1992;
• Handling of waste, including loading of waste onto waste transfer vehicles will be minimised;
• Procedures will be developed for cleaning up spills; and
• Suitable material for containing and absorbing spills will always be available and relevant personnel will be trained in their use.
Discussions related to environmental issues associated with the project commenced on 9 April 1999, when representatives of JPPL and DAL briefed the Chairman of the EPA. Since that time, JPPL has consulted with a wide range of industry, community groups, Local Government Authorities and Parliamentary representatives. Initial briefing consultations took place predominantly between May and October 1999 and were followed up with meetings, the majority of which occurred between August and November 2000.

Table 14.1 details the consultation undertaken to date, which includes a public meeting held in Rockingham on 26 February 2000.

**Table 14.1 Consultation meetings on proposed James Point Port development**

<table>
<thead>
<tr>
<th>DATE</th>
<th>GROUP</th>
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</thead>
<tbody>
<tr>
<td>9/4/99</td>
<td>Environmental Protection Authority</td>
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<tr>
<td>6/5/99</td>
<td>Tiwest</td>
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<tr>
<td>29/7/99</td>
<td>Kwinana Watchdog Group</td>
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<tr>
<td>23/8/99</td>
<td>Alcoa</td>
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<tr>
<td>24/8/99</td>
<td>Western Power</td>
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<tr>
<td>25/8/99</td>
<td>Cockburn City Council</td>
</tr>
<tr>
<td>31/8/99</td>
<td>BP</td>
</tr>
<tr>
<td>31/8/99</td>
<td>Kwinana Watchdog Group &amp; Com Net</td>
</tr>
<tr>
<td>13/9/99</td>
<td>Kwinana Town Council</td>
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<tr>
<td>13/9/99</td>
<td>Coogee Beach Progress Association (Phone briefing)</td>
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<tr>
<td>20/9/99</td>
<td>Com Net Annual General Meeting</td>
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<tr>
<td>22/9/99</td>
<td>Kwinana Industries Council</td>
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<tr>
<td>18/10/99</td>
<td>Rockingham Shire Council</td>
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<tr>
<td>9/12/99</td>
<td>Chamber of Commerce and Industry</td>
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<tr>
<td>12/1/00</td>
<td>Department of Transport &amp; Ministry for Planning</td>
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<tr>
<td>26/2/00</td>
<td>Public Meeting</td>
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<tr>
<td>29/2/00</td>
<td>Department of Environmental Protection</td>
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<tr>
<td>16/3/00</td>
<td>Environmental Protection Authority &amp; Department of Environmental Protection</td>
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<tr>
<td>17/3/00</td>
<td>BP &amp; Western Power</td>
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<td>22/3/00</td>
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<td>Alcoa</td>
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<tr>
<td>31/8/00</td>
<td>Kwinana Watchdog Group &amp; Com Net</td>
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<tr>
<td>20/9/00</td>
<td>Town of Kwinana (Combined briefing on port and livestock proposal)</td>
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<tr>
<td>25/9/00</td>
<td>Conservation Council (Combined briefing on port and livestock proposal)</td>
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<tr>
<td>26/9/00</td>
<td>Western Power</td>
</tr>
<tr>
<td>28/9/00</td>
<td>The Hon. Dr C Lawrence, MP, Member for Fremantle (Combined briefing on port and livestock proposal)</td>
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<tr>
<td>29/11/00</td>
<td>N R Marlborough, MLA, Member for Peel (Combined briefing on port and livestock proposal)</td>
</tr>
<tr>
<td>3/10/00</td>
<td>Kwinana Community &amp; Industries Consultation Forum</td>
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<tr>
<td>20/10/00</td>
<td>Portman Mining</td>
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<td>31/10/00</td>
<td>BP Aust</td>
</tr>
<tr>
<td>3/11/00</td>
<td>Cockburn Sound Management Council (Combined briefing on port and livestock proposal)</td>
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</table>

JPPL has maintained a database of community groups, stakeholders and interested parties and will contact each and offer to meet once the PER is released. The purpose of the meetings will be to discuss the PER, respond to any queries raised by any of the groups and invite comment on the proposal.

JPPL intend holding an open day regarding the project within the general area of the Town of Kwinana during the PER review period. JPPL will invite the public to provide their comments on the project to the DEP and submission forms will be supplied. Comments will be passed onto the DEP, the Kwinana branch of the DEP will also be invited to attend. Under the Environmental Approvals process, JPPL will prepare a public response to all submissions to the satisfaction of the DEP.
15. PROPOSENT COMMITMENTS

Throughout this document JPPL has made commitments to implement or undertake various activities to ensure that any environmental impacts associated with the project are manageable. Table 15.1 summarises the commitments and their objectives relative to the guidelines for the project issued by the EPA.

15.1 OUTLINE OF ENVIRONMENTAL MANAGEMENT

One of the core commitments is for JPPL to prepare a Construction EMP and an Environmental Management System (EMS) for James Point Port: Stage 1, which will incorporate an Operations EMP and will provide the template for the management of all aspects of the project. The Construction EMP has to be approved by the DEP prior to construction and the EMS has to be approved prior to commissioning of the port. The actions incorporated in the plans become binding on JPPL under the Ministerial conditions of approval. The plans will address the following key factors.

Construction EMP: which will address issues specific to the construction and commissioning of James Point Port: Stage 1 and will include:

- Plans for management of dredging activities;
- Plans to minimise impacts of breakwater and wharf construction on the marine environment;
- Plans for monitoring effects of construction on marine environment;
- Plans for minimising construction noise;
- Plans for minimising impacts on dunes and vegetation and rehabilitation of same;
- Plans for transport management;
- Plans for designated contractors areas and hours of operation; and
- Plans for safe operation of marine equipment.

EMS: which will address issues associated with the ongoing management of the Stage 1 development, including:

- Development of JPPL environmental policy;
- Definition of environmental aspects;
- Definition of legal and other statutory obligations;
- Establishment of operational controls;
- Definition of environmental objectives and targets;
- Outline of Operations EMP;
- Outline of procedures for non-compliance;
- Establishment of procedures for management review;
- Establishment of communications and public consultation procedures;
- Risk assessment;
- Coordination of operations within framework established by Kwinana Industries Coordinating Committee;
- Development of EMS documentation;
- Establishment of roles and responsibilities;
- Development of training programmes;
- Establishment of methods of document control;
• Establishment of monitoring and reporting procedures;
• Development of records and data storage; and
• Establishment of audit procedures.

The Operations EMP will address environmental issues associated with the ongoing management of the Stage 1 development, including:

• Water quality within and adjacent to the port;
• Sediment quality within and adjacent to the port;
• Coordination of management within a framework agreed with the Cockburn Sound Catchment Management Council and DEP;
• Contingency procedures to be followed in the event that water and sediment criteria are not met;
• Coastal processes: management of altered sediment transport patterns;
• Ballast water management;
• General management framework for remnant vegetation on site;
• Plans to minimise public risk;
• Operations management for health and safety; and
• Oil spill contingency planning.
**Table 15.1 Summary of proponent commitments**

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>ACTION</th>
<th>OBJECTIVE/S</th>
<th>TIMING</th>
<th>ADVICE</th>
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</thead>
<tbody>
<tr>
<td>1.1 Coastal processes</td>
<td>Undertake detailed sediment transport study to derive optimum Stage 1 port configuration with respect to minimising impacts on coastal processes.</td>
<td>To minimise the impact of the port and offshore breakwater on adjacent beaches and Western Power cooling water outfall.</td>
<td>Prior to commencement of construction.</td>
<td></td>
</tr>
<tr>
<td>2 Construction Environmental Management Programme (EMP)</td>
<td>Prepare and implement EMP for construction phase of the project which includes management plans for:  - Dredging and reclamation activities;  - Extraction and transport of limestone and fill;  - Minimising construction noise;  - Minimising dust associated with construction;  - Minimising impacts on dunes and vegetation and rehabilitation of same;  - Risk;  - Public safety;  - Aboriginal Heritage; and  - Groundwater quality.</td>
<td>To provide an effective framework for environmental management of the construction phase of the project, such that:  - DEP can audit commitments to environmental management made as outlined below;  - Detailed management plans for each commitment can be reviewed and approved by DEP prior to implementation;  - Any adverse impacts can be revealed in a timely manner; and  - Provide contingency plans to deal with any adverse impacts.</td>
<td>Prior to commencement of construction.</td>
<td>City of Cockburn, City of Rockingham and Town of Kwinana (Local Authorities)</td>
</tr>
<tr>
<td>2.1 Construction EMP: Dredge and Reclamation Management Plan</td>
<td>Prepare Dredge and Reclamation Management Plan which addresses the issues of:  - Additional survey for contaminated sediments;  - Addressing contaminated sediments if present;  - Minimisation of extent of plumes associated with dredging and reclamation;  - Timing and duration of dredging and reclamation;  - Monitoring and management of impacts of temporary causeway on coastal processes;  - Development of action criteria for protection of light sensitive habitats; and  - Development of turbidity monitoring programme.</td>
<td>Manage turbidity levels from construction to protect any sensitive habitats and agreed environmental values. Manage impacts on coastal processes such that beach erosion does not cause adverse impacts.</td>
<td>Prior to commencement of construction</td>
<td></td>
</tr>
<tr>
<td>2.2 Construction EMP: Dredge and Reclamation Management Plan</td>
<td>Implement Dredge and Reclamation Management Plan.</td>
<td>As per 2.1.</td>
<td>During construction</td>
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</table>
| 2.3 Construction EMP: Rock Armour and Fill Extraction and Transport Plan. | Prepare Rock Armour and Fill Extraction and Transport Plan to minimise impacts of transport activities on local residents which addresses the issues:  
• Transport route;  
• Duration of trucking activities;  
• Hours of transport; and  
• Suitability of source of fill and armour. | Minimise the impact to noise-sensitive premises from increased traffic movement.  
Ensure additional fill required for reclamation works is of acceptable standard, compatible with intended end use and surrounding environment, and consistent with DEP criteria for landfill. | Prior to commencement of construction. | Local Authorities |
| 2.4 Construction EMP: Rock Armour and Fill Extraction and Transport Plan. | Implement Rock Armour and Fill Extraction and Transport Plan. | As per 2.3. | During construction | Local Authorities |
| 2.5 Construction EMP: Noise Management Plan | • Prepare Noise Management Plan to minimise impacts of construction activities on nearby noise-sensitive locations. It will include, but not be limited to, the following:  
• Qualitative noise assessments will be conducted near closest noise sensitive premises during construction. If considered unduly intrusive quantitative noise measurement may be conducted;  
• Management response to unacceptable noise levels might include restrictions on times of day or wind directions under which pile driving is conducted; and  
• Establishment of a complaints mechanism to record and respond to any noise complaints from neighbours or the public. | Ensure noise impacts emanating from construction activities comply with statutory requirements and acceptable (and appropriate) standards. | Prior to commencement of construction. | Local Authorities |
| 2.6 Construction EMP: Noise Management Plan | Implement Noise Management Plan | As per 2.5. | During construction |  |
| 2.7 Construction EMP: Dust Management Plan | Prepare Dust Management Plan to minimise impacts of construction activities on dust levels away from the site. This addresses:  
• Dust control on trucks;  
• Procedures for dust control on site; and  
• Procedures for dust monitoring. | Protect the surrounding land users such that dust and particulate emissions will not adversely impact upon their welfare and amenity or cause health problems by meeting the Guidelines for the Prevention of Dust and Smoke Pollution from Land Development Sites in WA and the Environmental Protection (Kwinana)(Atmospheric Wastes) Policy 1999 | Prior to commencement of construction | DEP Pollution Prevention Division |
| 2.8 Construction EMP: Dust Management Plan | Implement Dust Management Plan | As per 2.7 | During construction |  |
## Stage One Development of Port Facilities at James Point, Kwinana (Assessment Number 1309)

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| 2.9   | Construction EMP: Dune and Vegetation Management Plan. | Prepare a Dune and Vegetation Management Plan which addresses the issues:  
- That construction impact on dunes is minimised beyond that required for reclamation; and  
- That construction impact on vegetation is minimised beyond that required for reclamation. | Keep loss of terrestrial vegetation and dunes to the minimum required to construct the port. Retain and protect remaining vegetation. | Prior to commencement of construction |
| 2.10  | Construction EMP: Dune and Vegetation Management Plan. | Implement Dune and Vegetation Management Plan. | As per 2.9 | During construction. |
| 2.11  | Construction EMP: Construction Risk Management Plan. | Prepare Construction Risk Management Plan to:  
- Identify hazards;  
- Develop a safety management system;  
- Develop emergency management system;  
- Develop induction process, and  
- audit the plan.  
Present the plan to Kwinana Industries Mutual Aid committee and regulators for approval. | Ensure that risks from neighbouring hazardous facilities in the Kwinana Industrial Area are considered during the construction programme. | Prior to construction. |
| 2.13  | Construction EMP: Public Safety Plan | Prepare Public Safety Plan which addresses the following:  
- Restriction of public access to the construction site;  
- Marine equipment complies with Department of Transport regulations; and  
- Public notification of any restrictions. | Maintain public safety during construction. | Prior to commencement of construction |
| 2.14  | Construction EMP: Public Safety Plan | Implement Public Safety Plan. | As per 2.13 | During construction |
| 2.15  | Construction EMP: Aboriginal Heritage Management Plan | Prepare Aboriginal Heritage Management Plan which addresses the issues of Aboriginal heritage and the uncovering of skeletal material or artefacts during construction.  
(i) Ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972; and  
(ii) Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area. | | Prior to commencement of construction |
| 2.16  | Construction EMP: Aboriginal Heritage Management Plan | Implement Aboriginal Heritage Management Plan | As per 2.15 | During construction |

DAL:JPPL:STAGE 1 PUBLIC ENVIRONMENTAL REVIEW
### Stage One Development of Port Facilities at James Point, Kwinana (Assessment Number 1309)

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</table>
| 2.17  | Construction EMP: Groundwater Quality Management Plan | Prepare a Groundwater Quality Management Plan which addresses the issues:  
- Survey to establish the groundwater quality within the port site; and  
- Check of berth design to ensure that groundwater flows and quality will not have an impact on the water quality in the port.  
Protect quality of the groundwater and ensure that any existing contamination does not affect the construction of the port.  
Determine whether further sediment sampling may be required if significant groundwater contamination is detected. | Prior to commencement of construction |  
| 2.18  | Construction EMP: Groundwater Quality Management Plan | Implement Groundwater Quality Management Plan. | As per 2.17 | During construction |
| 3     | Port Operations EMP | The proponent will prepare an Environmental Management Programme (EMP) for the operation phase which will address the following specific issues via separate management plans:  
- Water and sediment quality;  
- Coastal stability;  
- Ballast water;  
- Introduced species;  
- Oil spill planning;  
- Surface water quality;  
- Waste;  
- Risk;  
- Air quality;  
- Noise;  
- Odour;  
- Traffic; and  
- Community consultation.  
EMS which includes an effective EMP which provides a framework for environmental management of the port, such that:  
- DEP can audit commitments to environmental management made as outlined below;  
- Detailed management plans for each commitment can be reviewed and approved by DEP prior to implementation;  
- Any adverse impacts can be revealed in a timely manner;  
- Provide contingency plans to deal with any adverse impacts; and  
- The public may be kept informed of environmental management activity at the port. | Prior to commencement of operations. | Local Authorities |
### Stage One Development of Port Facilities at James Point, Kwinana (Assessment Number 1309)

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<tr>
<th>TOPIC</th>
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<th>OBJECTIVE/S</th>
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<th>ADVICE</th>
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</thead>
</table>
| 3.1 Port Operations EMP: Water and Sediment Quality Management Plan | Prepare a Water and Sediment Quality Management Plan which addresses the following issues:  
- Design monitoring programmes for contaminants in the sediments and sessile fauna in the vicinity of the development;  
- Design of water quality monitoring programmes which have the ability to measure long-term changes in water quality, including changes in productivity and dissolved oxygen status;  
- Setting of agreed water and sediment quality criteria and their boundaries;  
- Contingency planning to improve water quality if monitoring shows that agreed criteria are not met; and  
- Reporting procedures to DEP. | Maintain marine water and sediment quality consistent with agreed EQOs and EQC. | Prior to commencement of operations |  |
| 3.2 Port Operations EMP: Water and Sediment Quality Management Plan | Implement Water and Sediment Quality Management Plan for five years after completion of construction, after which time it will be reviewed in consultation with DEP. | As per 3.1. | For five years after completion of construction, after which time the programme will be reviewed. |  |
| 3.3 Port Operations EMP: Coastal Stability Management Plan | Prepare a Coastal Stability Management Plan which addresses the effects of the port on the local coastal processes, including:  
- Preparing a detailed design of the offshore breakwater such that reflected wave energy reaching the coast north of the development is minimised;  
- designing a coastal monitoring programme to measure impacts of the development on local beaches; and  
- development of contingency plans if impacts are unacceptable. | To minimise and manage the impact of the port on local coastal processes. | Prior to construction. | Local Authorities |
<p>| 3.4 Port Operations EMP: Coastal Stability Management Plan | Implement Coastal Stability Management Plan. | As per 3.3 | For five years after completion of construction, after which time the programme will be reviewed. | Local Authorities |
| 3.5 Port Operations EMP: Ballast Water Management Plan | Prepare a Ballast Water Management Plan which includes a Ballast Water Decision Support System. | To implement the International Maritime Organisation (IMO) and Commonwealth (AQIS and AMSA) arrangements for ballast water control. | Prior to commencement of operations | AMSA and AQIS |
| 3.6 Port Operations EMP: Ballast Water Management Plan | Implement Ballast Water Management Plan. | As per 3.5 | Prior to commencement of operations | AMSA and AQIS |</p>
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<tr>
<td>3.7</td>
<td>Port Operations EMP: Introduced Species Management Plan</td>
<td>Prepare a Introduced Species Management Plan for the monitoring and management of introduced species, including a contingency plan for the event that a previously unrecorded targeted species is found in port waters.</td>
<td>Manage the port such that early action may be taken in the event of the detection of new exotic species in port waters.</td>
<td>Prior to commencement of operations</td>
</tr>
<tr>
<td>3.8</td>
<td>Port Operations EMP: Introduced Species Management Plan</td>
<td>Implement Introduced Species Management Plan</td>
<td>As per 3.7</td>
<td>Prior to commencement of operations</td>
</tr>
<tr>
<td>3.9</td>
<td>Port Operations EMP: Oil Spill Management Plan</td>
<td>Prepare an Oil Spill Management Plan which will be under the umbrella of the State response plan and will include agreements of mutual cooperation with relevant organisations.</td>
<td>Minimise the impacts of fuel or oil spillage during port operations.</td>
<td>Prior to commencement of operations</td>
</tr>
<tr>
<td>3.10</td>
<td>Port Operations EMP: Oil Spill Management Plan</td>
<td>Implement Oil Spill Management Plan</td>
<td>As per 3.9</td>
<td>Prior to commencement of operations</td>
</tr>
<tr>
<td>3.11</td>
<td>Port Operations EMP: Surface Water Quality Management Plan</td>
<td>Prepare a Surface Water Quality Management Plan which will include procedures to monitor quality and quantity of runoff entering the Sound, maintain effectiveness of drains, contain and clean-up spills and minimise impact of surface drainage on port water quality.</td>
<td>Minimise and manage impact of surface water drainage on port water quality.</td>
<td>Prior to commencement of operations</td>
</tr>
<tr>
<td>3.12</td>
<td>Port Operations EMP: Surface Water Quality Management Plan</td>
<td>Implement Surface Water Quality Management Plan.</td>
<td>As per 3.11</td>
<td>Prior to commencement of operations</td>
</tr>
<tr>
<td>3.13</td>
<td>Port Operations EMP: Waste Management Plan</td>
<td>Prepare Waste Management Plan which will include procedures for on-site storage of waste and transfer of waste off-site.</td>
<td>To ensure port wastes are stored and transported in manner consistent with best practice. To minimise risk of spills and pollution.</td>
<td>Prior to commencement of operations</td>
</tr>
<tr>
<td>TOPIC</td>
<td>ACTION</td>
<td>OBJECTIVE/S</td>
<td>TIMING</td>
<td>ADVICE</td>
</tr>
<tr>
<td>-------</td>
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<td>--------</td>
</tr>
<tr>
<td>3.15</td>
<td>Port Operations EMP: Operations Risk Management Plan</td>
<td>Prepare Operations Risk Management Plan which will include:  - detailed assessment of port operating risk;  - procedures for minimisation of risk;  - contingency procedures for emergency events;  - assessment of combined on-site and off-site risks  - compliance with Kwinana Industries Coordinating Committee, ADGC, IMO, AMSA, and Department of Minerals and Energy procedures;  - service corridors so that cumulative risk is not increased;  - Monitoring of dangerous goods and transport routes by destination;  - Liaison with State Emergency Services for residual risk; and  - Procedures for review of quantitative risk assessment every two years.</td>
<td>Quantify, minimise and manage risks associated with port operations. Ensure that risk is assessed and managed to meet the EPA’s criteria for individual fatality risk off-site and the DME’s requirements in respect of public safety.</td>
<td>Prior to commencement of operations</td>
</tr>
<tr>
<td>3.17</td>
<td>Port Operations EMP: Air Quality Management Plan</td>
<td>Prepare Air Quality Management Plan which will include procedures to reduce the impact of the port operations on air quality. It will include, but not be limited to, the following:  - Material conveying: to the extent practicable, ‘Best Practice’ materials handling systems will be adopted;  - Dust collectors: will be installed and maintained on handling systems for dusty materials; and  - Housekeeping: good house-keeping procedures will be developed and applied to limit dust generation.</td>
<td>Protect the surrounding land users such that dust and particulate emissions will not adversely impact upon their welfare and amenity or cause health problems by meeting the Environmental Protection (Kwinana)(Atmospheric Wastes) Policy 1999.</td>
<td>Prior to commencement of operations</td>
</tr>
<tr>
<td>3.18</td>
<td>Port Operations EMP: Air Quality Management Plan</td>
<td>Implement Air Quality Management Plan.</td>
<td>As per 3.17</td>
<td>KICC</td>
</tr>
<tr>
<td>3.19</td>
<td>Port Operations EMP: Operations Noise Management Plan</td>
<td>Prepare Operations Noise Management Plan which will include procedures to ensure the impact of the port operations on noise sensitive premises is within acceptable levels.</td>
<td>Ensure noise impacts emanating from on-going operations comply with statutory requirements and acceptable (and appropriate) standards</td>
<td>Prior to commencement of operations</td>
</tr>
</tbody>
</table>
### Stage One Development of Port Facilities at James Point, Kwinana (Assessment Number 1309)

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>ACTION</th>
<th>OBJECTIVE/S</th>
<th>TIMING</th>
<th>ADVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.21 Port Operations EMP: Odour Management Plan</td>
<td>Prepare Odour Management Plan to reduce impacts on odour-sensitive premises. The plan will address, but not be limited to, the following: • Stock handling: feed and hygiene facilities and practices on the ships to minimise odour emissions; and • Loading rates will be optimised to minimise the time that stock transport ships are in port.</td>
<td>Odours emanating from the development should not adversely affect the welfare and amenity of other land users. Compliance with acceptable standards and that all reasonable and practicable measures are taken to minimise adverse impact of odorous gases. Odour emissions, both individually and cumulatively to meet appropriate criteria and not cause an environmental or human health problem.</td>
<td>Prior to commencement of operations</td>
<td></td>
</tr>
<tr>
<td>3.22 Port Operations EMP: Odour Management Plan</td>
<td>Implement Odour Management Plan.</td>
<td>As per 3.21</td>
<td>Prior to commencement of operations</td>
<td></td>
</tr>
<tr>
<td>3.23 Port Operations EMP: Traffic Management Plan</td>
<td>Prepare Traffic Management Plan which designates major road transport routes for the port to minimise impacts on noise-sensitive premises.</td>
<td>Minimise the impact to noise sensitive premises from increased traffic movement.</td>
<td>Prior to commencement of operations</td>
<td>Relevant Local Authorities</td>
</tr>
<tr>
<td>3.25 Port Operations EMP: Community Consultation Plan</td>
<td>Prepare Community Consultation Plan. The proponent may convene a community consultation group which would meet with the proponent regularly to provide guidance on the proponent’s strategy and also be updated on operations at the port. The plan will also include procedures for responding to and acting on complaints.</td>
<td>Keep the local community well informed regarding the operations of the port.</td>
<td>Prior to commencement of operations</td>
<td>Relevant Local Authorities</td>
</tr>
<tr>
<td>3.26 Port Operations EMP: Community Consultation Plan</td>
<td>Implement Community Consultation Plan.</td>
<td>As per 3.26</td>
<td>Prior to commencement of operations</td>
<td>Relevant Local Authorities</td>
</tr>
</tbody>
</table>

Abbreviations used in Table 15.1

- EMP–Environmental Management Plan
- ADGC–Australian Dangerous Goods Code
- AMSA–Australian Marine Safety Authority
- AQIS–Australian Quarantine Inspection Service
- CSIRO–Commonwealth Scientific and Industrial Research Organisation
- DEP–Department of Environmental Protection
- DME–Department of Minerals and Energy
- EMS–Environmental Management System
- FPA–Fremantle Port Authority
- IMO–International Maritime Organisation
- KICC–Kwinana Industries Coordinating Committee
- Transport–Department of Transport
<table>
<thead>
<tr>
<th>Glossary Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algae</td>
<td>Non-flowering aquatic plants. The larger plants of this group that occur in marine environments, are called seaweed and the microscopic plants that float in the water are called phytoplankton.</td>
</tr>
<tr>
<td>Anaerobic</td>
<td>Without oxygen.</td>
</tr>
<tr>
<td>Anthropogenic</td>
<td>Resulting from human activity</td>
</tr>
<tr>
<td>Aquatic</td>
<td>Growing or living in or near water.</td>
</tr>
<tr>
<td>Aquifer</td>
<td>A layer of rock or soil capable of holding or transmitting water.</td>
</tr>
<tr>
<td>Assemblage</td>
<td>Recognisable grouping or collection of individuals or organisms.</td>
</tr>
<tr>
<td>Bathymetry</td>
<td>Measurement of the changing ocean depth to determine the sea floor topography.</td>
</tr>
<tr>
<td>Beneficial uses</td>
<td>The ways a society uses or values an area (synonymous with environmental values).</td>
</tr>
<tr>
<td>Benthic</td>
<td>Bottom dwelling organisms.</td>
</tr>
<tr>
<td>Bioaccumulation</td>
<td>The accumulation of contaminants in organisms at levels above that of the ambient environment.</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>The variety of all life forms: the different plants, animals and microorganisms, the genes they contain and the ecosystems they form.</td>
</tr>
<tr>
<td>Biota</td>
<td>Defined as all plants, animals and microorganisms of a region.</td>
</tr>
<tr>
<td>Biomass</td>
<td>The living weight of a plant or animal population, usually expressed on a unit area basis.</td>
</tr>
<tr>
<td>Buffer zone</td>
<td>An area around a limited use zone to allow for gradations in environmental quality.</td>
</tr>
<tr>
<td>CD</td>
<td>Chart Datum. The plane or level to which surroundings (or elevations) or tide heights are referenced. Used to provide a safety factor for navigation and usually a level lower than mean sea level.</td>
</tr>
<tr>
<td>Chlorophyll a</td>
<td>A complex molecule that along with other similar molecules, is able to capture sunlight and convert it into a form that can be used for photosynthesis. All plants contain chlorophyll a and the concentration of this molecule in water is commonly used as a measure of phytoplankton biomass.</td>
</tr>
<tr>
<td>Colonisation</td>
<td>Movement of an organism into an area in which it was not previously present.</td>
</tr>
<tr>
<td>Compliance</td>
<td>The degree to which stated project goals or requirements are attained.</td>
</tr>
<tr>
<td>Conservative tracer</td>
<td>A substance (modeled or real) which is not lost to the system through chemical or biological process, e.g. an inert chemical dye will generally behave conservatively, while bacteria will not.</td>
</tr>
<tr>
<td>Contaminant</td>
<td>Any physical, chemical or biological substance or property which is introduced into the environment.</td>
</tr>
<tr>
<td>CTD</td>
<td>Acronym for Conductivity, Temperature and Depth. Conductivity is a measure of how salty the water is - the higher the conductivity the greater the salinity. The conductivity and temperature signals are combined to give salinity and all three signals are combined to give density relative to depth.</td>
</tr>
<tr>
<td>Diffusion</td>
<td>The transfer of substances along a gradient from regions of high concentrations to regions of lower concentrations.</td>
</tr>
<tr>
<td>Diurnal</td>
<td>Daily.</td>
</tr>
<tr>
<td>Ecological function</td>
<td>Combined characteristics and processes occurring within an area.</td>
</tr>
<tr>
<td>Ecology</td>
<td>Studies of the relations of animals and plants, particularly of animal and plant communities, to their surroundings.</td>
</tr>
<tr>
<td>Ecosystem</td>
<td>A community of organisms, interacting with each other plus the environment in which they live and with which they also interact.</td>
</tr>
<tr>
<td>Ecosystem integrity</td>
<td>The ability to support and maintain a balanced, integrative, adaptive community of organisms having a species composition, diversity and functional organisation comparable to that of natural habitat of the region.</td>
</tr>
<tr>
<td>e-folding time</td>
<td>A means of measuring the flushing of a water body with water sourced from outside the water body. The e-folding time is calculated by measuring the time taken for a conservative tracer (see above), initially located solely in the water body of interest to be diluted to 1/e (=0.368) of its original concentration.</td>
</tr>
<tr>
<td>Environmental quality criteria</td>
<td>The scientific benchmarks upon which a decision may be made concerning the ability of an environment to maintain certain designated environmental quality objectives.</td>
</tr>
<tr>
<td>Environmental quality objectives</td>
<td>The long-term goals of an environmental management programme in relation to the maintenance of the environmental (ecological and cultural) values of natural systems.</td>
</tr>
<tr>
<td>Environmental values</td>
<td>The ways a society uses or values an area (synonymous with beneficial uses).</td>
</tr>
<tr>
<td>Epiphyte</td>
<td>Plant that grows attached to the outside of another plant.</td>
</tr>
<tr>
<td>Eutrophic</td>
<td>Nutrient enriched (usually associated with deterioration of natural water bodies where nutrient enrichment occurs through man’s activities).</td>
</tr>
<tr>
<td>Eutrophication</td>
<td>An increase in the rate of supply of organic matter to an ecosystem caused by unnaturally high loads of nutrients to that system.</td>
</tr>
<tr>
<td>Fauna</td>
<td>Animals.</td>
</tr>
<tr>
<td>Flora</td>
<td>Plants.</td>
</tr>
</tbody>
</table>
Gyre Rotation, spinning motion. Used to describe large circular movement of water.

Habitat The place or environment occupied by individuals of a particular species, population or community; has physical, chemical and biological attributes conducive to the maintenance and propagation of those biota.

Heavy metals Such as zinc, copper, chromium which accumulate in sediments and tissues of biota, and may be passed-up in the food chain. Heavy metals can be toxic at high levels.

Hydrodynamic The movement or mixing of water as a result of applied forces, such as wind stress at the water surface.

Infauna Animals that live within the sediments of the sea floor.

Invertebrate Collective term for all animals which do not have a backbone or spinal column.

Light attenuation Light reduction (usually refers to a decrease in available light, which occurs with increasing depth of water).

Macroalgae Large algae; seaweed.

Mean Sea Level The average height of the higher waters over a 19-year period. For shorter observation periods, corrections are applied to eliminate known variations and reduce the results to the equivalent of a 19-year value.

Median A statistical measure equivalent to the middle measurement in an ordered set of data (there are as many observations larger than the median as there are smaller).

Molluscs Soft-bodied animals usually partly or wholly enclosed within a calcium carbonate shell.

Neap tides Sets of moderate tides, which recur every two weeks and alternate with spring tides.

Nutrients Elements or compounds essential for organic growth and development such as nitrogen and phosphorus.

Nutrient load The quantity in tonnes per annum of nutrients released into the marine environment.

Percentile A measure that divides a group of ordered data into hundredths by quantities.

Periphyton Mucous-like layer of microalgae, algal propagules, bacteria, microfauna and particulate matter commonly found coating seagrass leaves.

Phytoplankton Microscopic algae that float in the water column.

Species composition Number and abundance of different types of species in a habitat.

Species richness Number of different types of species in a habitat.

Spring tides Extreme high and low tides which alternate with neap tides and recur every two weeks.

Stratification Layering (vertical or horizontal) in a water property such as salinity or temperature.

Suspended solids Any solid substance present in water in an undissolved state.

Terrestrial Of the land.

Topography Detailed description of a land or sea surface represented for example on a map.

Trophic Energy level in a food chain.

Turbidity Measure of the clarity of a water body.

Vertical density gradient The change in density of a water body with increasing depth, with units (kg/m³)/m. The density gradient usually results from temperature or salinity differences.

Zone of influence An area where the influence of the project can be measured.

### 16.1 ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHD</td>
<td>Australian Height Datum (height datum for terrestrial elevations)</td>
</tr>
<tr>
<td>AMSA</td>
<td>Australian Maritime Safety Authority</td>
</tr>
<tr>
<td>ANZECC</td>
<td>Australian and New Zealand Environment and Conservation Council</td>
</tr>
<tr>
<td>APPMA</td>
<td>Association of Australian Port and Marine Authorities</td>
</tr>
<tr>
<td>BWDSS</td>
<td>Ballast Water Decision Support System</td>
</tr>
<tr>
<td>CALM</td>
<td>Department of Conservation and Land Management</td>
</tr>
<tr>
<td>CAMBA</td>
<td>China Australia Migratory Birds Agreement</td>
</tr>
<tr>
<td>CCL</td>
<td>Cockburn Cement Limited</td>
</tr>
<tr>
<td>CD</td>
<td>Chart Datum (datum for hydrographic surveys: approximately 0.76 m below AHD in Perth coastal waters)</td>
</tr>
<tr>
<td>CRIMP</td>
<td>Centre for Research on Introduced Marine Pests</td>
</tr>
<tr>
<td>CSMC</td>
<td>Cockburn Sound Management Council</td>
</tr>
<tr>
<td>DCT</td>
<td>Department of Commerce and Trade</td>
</tr>
<tr>
<td>DEP</td>
<td>Department of Environmental Protection</td>
</tr>
<tr>
<td>DIN</td>
<td>Dissolved inorganic nitrogen</td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved oxygen</td>
</tr>
<tr>
<td>EFDC</td>
<td>Environmental Fluid Dynamics Code</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Programme</td>
</tr>
<tr>
<td>EMS</td>
<td>Environmental Management System</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Authority</td>
</tr>
<tr>
<td>EPP</td>
<td>Environmental Protection Policy</td>
</tr>
<tr>
<td>EQO</td>
<td>Environmental quality objective</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
</tr>
<tr>
<td>EQC</td>
<td>environmental quality criteria</td>
</tr>
<tr>
<td>FRP</td>
<td>free reactive phosphorus</td>
</tr>
<tr>
<td>IMDGC</td>
<td>International Marine Dangerous Goods Code</td>
</tr>
<tr>
<td>IMO</td>
<td>International Maritime Organisation</td>
</tr>
<tr>
<td>IRPA</td>
<td>Individual Risk Per Annum</td>
</tr>
<tr>
<td>ISQG</td>
<td>Interim Sediment Quality Guidelines</td>
</tr>
<tr>
<td>JAMBA</td>
<td>Japan Australia Migratory Birds Agreement</td>
</tr>
<tr>
<td>JPPL</td>
<td>James Point Pty Ltd</td>
</tr>
<tr>
<td>KIC</td>
<td>Kwinana Industries Council</td>
</tr>
<tr>
<td>KTPS</td>
<td>Kwinana Town Planning Scheme</td>
</tr>
<tr>
<td>MARPOL 73/78</td>
<td>The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978, or relating thereto.</td>
</tr>
<tr>
<td>MEPC</td>
<td>Marine Environmental Protection Committee</td>
</tr>
<tr>
<td>MRS</td>
<td>Metropolitan Regional Scheme</td>
</tr>
<tr>
<td>MSL</td>
<td>Mean Sea Level</td>
</tr>
<tr>
<td>NH &amp; MRC</td>
<td>National Health and Medical Research Council</td>
</tr>
<tr>
<td>NH₄</td>
<td>ammonium nitrogen</td>
</tr>
<tr>
<td>NO₃₋</td>
<td>nitrate + nitrite-nitrogen</td>
</tr>
<tr>
<td>PAH</td>
<td>Polycyclic Aromatic Hydrocarbons</td>
</tr>
<tr>
<td>pH</td>
<td>measure of acidity</td>
</tr>
<tr>
<td>PCWS</td>
<td>Perth Coastal Waters Study</td>
</tr>
<tr>
<td>PER</td>
<td>Public Environmental Review</td>
</tr>
<tr>
<td>SMCWS</td>
<td>Southern Metropolitan Coastal Waters Study</td>
</tr>
<tr>
<td>SS</td>
<td>suspended solids</td>
</tr>
<tr>
<td>TBT</td>
<td>tributyltin, active ingredient of many anti-fouling paints</td>
</tr>
<tr>
<td>TN</td>
<td>total nitrogen</td>
</tr>
<tr>
<td>TP</td>
<td>total phosphorus</td>
</tr>
<tr>
<td>TSS</td>
<td>total suspended solids</td>
</tr>
<tr>
<td>WAPC</td>
<td>West Australian Planning Commission</td>
</tr>
<tr>
<td>WRC</td>
<td>Water and Rivers Commission</td>
</tr>
</tbody>
</table>

### 16.2 WEIGHTS AND MEASURES

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>percent</td>
</tr>
<tr>
<td>°C</td>
<td>degree celsius</td>
</tr>
<tr>
<td>cm</td>
<td>centimetre</td>
</tr>
<tr>
<td>cm/s</td>
<td>centimetres per second</td>
</tr>
<tr>
<td>ha</td>
<td>hectare</td>
</tr>
<tr>
<td>kg</td>
<td>kilogram</td>
</tr>
<tr>
<td>kg/m³</td>
<td>kilogram per cubic metre</td>
</tr>
<tr>
<td>km</td>
<td>kilometre</td>
</tr>
<tr>
<td>km/d</td>
<td>kilometres per day</td>
</tr>
<tr>
<td>kL</td>
<td>kilolitres</td>
</tr>
<tr>
<td>L/s</td>
<td>litre per second</td>
</tr>
<tr>
<td>m</td>
<td>metre</td>
</tr>
<tr>
<td>mm</td>
<td>millimetre</td>
</tr>
<tr>
<td>µm</td>
<td>micrometres</td>
</tr>
<tr>
<td>m/s</td>
<td>metres per second</td>
</tr>
<tr>
<td>m²</td>
<td>square metre</td>
</tr>
<tr>
<td>m³</td>
<td>cubic metre</td>
</tr>
<tr>
<td>mg/m³</td>
<td>milligram per cubic metre</td>
</tr>
<tr>
<td>m³/s</td>
<td>cubic metres per second</td>
</tr>
<tr>
<td>mg/L</td>
<td>milligram per litre</td>
</tr>
<tr>
<td>mL</td>
<td>millilitres</td>
</tr>
<tr>
<td>ML</td>
<td>megalitres (= million litres)</td>
</tr>
<tr>
<td>ML/d</td>
<td>megalitres per day</td>
</tr>
<tr>
<td>OU</td>
<td>Odour Units</td>
</tr>
<tr>
<td>pss</td>
<td>practical salinity scale</td>
</tr>
<tr>
<td>nm</td>
<td>nautical mile</td>
</tr>
<tr>
<td>t</td>
<td>tonne</td>
</tr>
<tr>
<td>tpa</td>
<td>tonne per annum</td>
</tr>
<tr>
<td>TEUS</td>
<td>twenty-foot equivalent units, used to measure shipping container handling</td>
</tr>
<tr>
<td>µg/g</td>
<td>microgram per gram</td>
</tr>
<tr>
<td>µg/L</td>
<td>microgram per litre</td>
</tr>
</tbody>
</table>
REFERENCES


Dames & Moore Pty Ltd, 1998. *Phase 2 Environmental Site Audit, Petrochemical Industries Company Limited Site, Lot 15 Mason Road, Kwinana, WA.* Prepared for Western Australian Land Authority (Landcorp), ref LMC/14740-028-071/DK:393-E384.I/DOC/PER.


Environmental Protection Authority, 2000a. *Perth's Coastal Waters, Environmental Values and Objectives.*


Halpern Glick Maunsell, 1997. *Industrial Infrastructure and Harbour Development Jervoise Bay—Public Environmental Review.* Prepared for the Department of
Commerce and Trade in association with LandCorp and Main Roads WA. December 1997.


Hearn C.J., 1991b. *A Numerical Model of Water Flow and Dispersion at James Point, Cockburn Sound, Western Australia.* Report prepared for Kinhill Engineers, Department of Geography and Oceanography, ADFA.


APPENDIX 1
EPA GUIDELINES FOR JAMES POINT STAGE 1 PROPOSAL
Appendix 1  EPA guidelines for James Point Stage 1 proposal

Environmental Protection Authority
Guidelines

STAGE ONE DEVELOPMENT OF PORT FACILITIES AT JAMES POINT, KWINANA
(Assessment Number 1309)

Part A  Specific Guidelines for the preparation of the Public Environmental Review
Part B  Generic Guidelines for the preparation of an environmental review document

Attachment 1  Project location map
Attachment 2  Example of long-term harbour development scenario in Cockburn Sound
Attachment 3  Example of the invitation to make a submission
Attachment 4  Advertising the environmental review

These guidelines are provided for the preparation of the proponent’s environmental review document. The specific environmental factors to be addressed are identified in Part A. The generic guidelines for the format of an environmental review document are provided in Part B.

The environmental review document must address all elements of Part ‘A’ and Part ‘B’ of these guidelines prior to approval being given to commence the public review.

1
Part A: Specific Guidelines for the preparation of the PER

1. The proposal

James Point Pty Ltd (JPPL) propose to construct and operate a port facility (consisting of a cargo wharf and associated cargo handling facilities) to the north of James Point, Cockburn Sound, Western Australia. The ultimate project may involve a number of stages, however, at this time the proponent is only seeking environmental approval for Stage 1 and therefore the impacts of Stage 1 are the focus of this assessment. Stage 1 comprises:

- Construction of approximately 1,300 m of land backed berth situated on and to the north of the existing BHP frontage with a reclamation area of 21.5 ha;
- Dredging of 911,000m$^3$ to a depth of 11.3m over an area of approximately 45 ha immediately offshore from the proposed berths; and
- Construction of a finger wharf approximately 120m wide and 240m long.

The details of the proposal also include 1,905,000m$^3$ of reclamation (requiring additional fill material), 215,000m$^2$ of hardstand wharf and 180,000m$^2$ of landbacked area to the wharf (see Attachment 1).

Cargoes that may be handled through the proposed port will include those already listed on the current licence for BHP No.1 Jetty (limestone, manganese, fertiliser (DAP, TSP, urea), soya bean, sugar, granulated slag, cement clinker, gypsum, petroleum coke, silica sand, LPG, alumina, mineral sands, clay, soda ash, coke breeze and coal). However, the assessment will also address issues associated with additional cargoes proposed through the port, which will include, but not be limited to, steel products, machinery and motor vehicles, scrap metal, grain, livestock, class 1,2,3,4,5,6,7,8,9 dangerous goods (as defined in the IMDGC), crude minerals, animal feeds, ammonium sulphate, potash, petroleum products (as defined in the IMDGC), sulphur and containerised cargoes. It is expected that the PER will address potential impacts associated with the proposed cargoes as appropriate.

The assessment will also address management of issues associated with the increased shipping activity that the upgrade will facilitate, including direct impacts of increased shipping movements and cargo handling, as well as the indirect impacts associated with increased land-based traffic generation.

A Works Approval application to upgrade the existing BHP No.1 Jetty to accept greater volumes of cargo under the existing licence is currently being processed by the DEP. JPPL has advised that a separate Works Approval and Licence application will be made for a livestock holding pen and use of BHP No.1 jetty for livestock export. Although the livestock operation may be referred as a Works Approval and Licence application, the PER will be required to consider combined impacts and management of all existing and proposed operations associated with Stage 1, with particular regard to noise, odour and management of waste emissions.
2. Assessment context

Many of the environmental issues and potential impacts related to industrial development in Cockburn Sound have been identified in the following key EPA publications:

- The Marine Environment of Cockburn Sound - Strategic Environmental Advice to the Minister for the Environment under Section 16e of the Environmental Protection Act 1986. (EPA Bulletin 907, October 1998);
- Report and Recommendations of the EPA with respect to the Southern Harbour development (EPA Bulletin 908, October 1998); and
- Report and Recommendations of the EPA with respect to the Northern Harbour development, Lots 165 and 168 Cockburn Road, Henderson (EPA Bulletin 947, September 1999).

Furthermore, draft Environmental Quality Objectives (EQO’s) and Environmental Quality Criteria (EQC’s) for Perth Coastal Waters have been developed and defined within the Southern Metropolitan Coastal Waters Study (1996). EQOs have now been identified in the EPA position document on EQOs for Perth Coastal Waters, *Perth Coastal Waters Environmental Values and Objectives* (EPA 2000).

The EPA considers that it is appropriate to assess the proposal (Stage 1) in the context of an understanding of the combined impacts of the whole Stage 1 and 2 project (in terms of hydrodynamics, coastal processes, water quality and habitat change). Furthermore, the EPA considers that it would also be appropriate to provide advice to Government in parallel with this assessment, considering the combined impacts of the potential overall development at James Point in relation to existing, approved and future developments in Cockburn Sound. To achieve these, the following three phase assessment strategy is proposed.

### Stage 1 Assessment

The PER is expected to describe the impacts of Stage 1 of the proposal (including the consideration of alternative designs to avoid, minimise or mitigate impacts). The EPA will use the statements and strategic advice provided in Bulletin 907, and identified values and objectives in the EPA position document *Perth Coastal Waters Environmental Values and Objectives*, to assist in the assessment/evaluation of this proposal. Therefore, the PER should address the environmental issues raised in Bulletin 907 and the EPA position document (taking into account the interactions of the proposal with existing and approved planned facilities). In particular, the PER will include:

- A project description of Stage 1;
- An assessment of direct impacts associated with Stage 1;
- An assessment of the extent of influence of Stage 1 infrastructure and construction activities;
- An assessment and report on the cumulative impacts of Stage 1 with existing and approved developments in Cockburn Sound; and
- An assessment of how Stage 1 will be managed in accordance with the Environmental Quality Objectives (EQOs) as defined in *Perth Coastal Waters Environmental Values and Objectives*. 
Combined and Cumulative Impact Assessment

In Bulletin 907 the EPA stressed that a better understanding of the marine ecological characteristics and processes in Cockburn Sound was required to enable confident prediction of the ecological response in the Sound to further development pressures. The EPA would expect that the environmental impact assessment investigations in relation to this proposal would make a significant contribution to that knowledge and understanding. It is therefore appropriate that the proponent should prepare a separate document that incorporates a description of all stages of the proposed port development, allowing the context of the current proposal being assessed to be clearly understood, and which outlines, at a preliminary level, the likely combined impacts of the ultimate port development (Stages 1 and 2, see attachment 1) in terms of hydrodynamics, coastal processes, water quality and impacts on ecological response in the context of the existing and approved port facilities in the Sound. This document should be available at the same time as release of the PER.

Future Development Scenario Impact Assessment

During the assessment, the EPA will commission additional work (complimenting that being undertaken by JPPL) on the overall cumulative impacts of port development in the Sound, considering existing, planned and likely future development, and provide advice on this matter further to Bulletin 907.

Cockburn Sound Management Council

The State Government has committed to establishing a management body for Cockburn Sound, the Cockburn Sound Management Council, which will be responsible for implementing a Cockburn Sound Environmental Management Plan drawn up under the proposed Environmental Protection (Cockburn Sound) Policy. It is therefore appropriate that the proposed management of construction activities and on-going operations of the new port proposal have due regard of such statutory policy, ensuring that the defined environmental values and objectives as set out in *Perth Coastal Waters Environmental Values and Objectives* are protected and maintained. As a minimum, it is expected that the proposed port will develop an appropriate environmental management system for operation, consistent with current best practice environmental management.

3. Community consultation

The EPA notes that JPPL has initiated public consultation through both open discussion and publication and distribution of the document *Kwinana Port – A Proposal to Develop and Operate a Private Port Facility at Kwinana* (JPPL, 1999). It is recommended that the proponent continues with this approach and conducts a range of public consultation throughout the environmental assessment process, including, but not limited to, direct liaison with key stakeholders and an open day to discuss the findings presented in the public review document.
### 2. Environmental factors relevant to this proposal

At this preliminary stage, the Environmental Protection Authority (EPA) believes the relevant environmental factors, objectives and work required is as detailed in the table below:

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>SCOPE OF WORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
<td>Site specific</td>
</tr>
<tr>
<td><strong>BIOPHYSICAL</strong></td>
<td></td>
</tr>
<tr>
<td>Marine biota and associated habitat (including seagrass, benthic and other marine floral and faunal communities)</td>
<td>Impact from dredging</td>
</tr>
<tr>
<td></td>
<td>Impact from land reclamation and other construction activities</td>
</tr>
<tr>
<td></td>
<td>Impact from operations</td>
</tr>
<tr>
<td>Coastal processes and littoral drift (including impacts on the seabed)</td>
<td>Impact of construction activities and permanent modification to coastal strip at James Point</td>
</tr>
<tr>
<td>Dunes</td>
<td>Impact of land reclamation and other construction activities</td>
</tr>
<tr>
<td>CONTENT</td>
<td>SCOPE OF WORK</td>
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<tr>
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<td>--------------</td>
</tr>
<tr>
<td><strong>Factor</strong></td>
<td><strong>Site factor</strong></td>
</tr>
<tr>
<td>Terrestrial vegetation</td>
<td>Impact from land reclamation and other construction activities</td>
</tr>
<tr>
<td>Introduction of exotic organisms</td>
<td>Ballast water management</td>
</tr>
</tbody>
</table>

### POLLUTION MANAGEMENT

| **Groundwater quality** | **Construction works and on-going operations** | Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance, are protected consistent with draft WA Guidelines for Fresh and Marine Waters (EPA, 1993) and objectives defined in *Perth Coastal Waters Environmental Values and Objectives* (EPA 2000). | Address and document the historical and current state of groundwater quality in the area. Assess and describe the potential pollutants, including nutrients and other contaminants, arising from construction and on-going operations associated with the proposal. Assess the likely impacts and proposed management measures/commitments and mechanisms to ensure ongoing monitoring and best practice management of operations, including stormwater and on-site drainage management. Consider cumulative impacts associated with the Stage 1 proposal and surrounding existing and/or approved development. |
| **Surface water quality** | **Construction works and on-going operations** | Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected consistent with draft WA Guidelines for Fresh and Marine Waters (EPA, 1993) and objectives defined in *Perth Coastal Waters Environmental Values and Objectives* (EPA 2000). | Address and document the historical and current state of surface water quality in the area. Assess and describe the potential pollutants, including nutrients and other contaminants, arising from construction and on-going operations associated with the proposal with particular regard to stormwater and spill management. Assess the likely impacts and proposed management measures/commitments and mechanisms to ensure ongoing monitoring and best practice management of operations, including stormwater and on-site drainage management. Consider cumulative impacts associated with the Stage 1 proposal and surrounding existing and/or approved development. |
**Table: Scope of Work**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Site factor</th>
<th>EPA objective</th>
<th>Work required for the environmental review</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marine water and sediment quality</strong></td>
<td>Dredging, construction and on-going operations</td>
<td>Maintain or improve marine water and sediment quality consistent with Environmental Quality Objectives (EQO’s) and Environmental Quality Criteria (EQC’s) defined in the <em>Southern Metropolitan Coastal Waters Study</em> (DEP, 1996) and <em>Perth Coastal Waters Environmental Values and Objectives</em> (EPA 2000).</td>
<td>Assess and describe the potential impacts within the proposed port precinct resulting from sediment disturbance or disposal of discharge water during dredging, reclamation and other construction operations, including the potential for phytoplankton blooms and impacts associated with release of other contaminants. Discuss potential impacts with reference to the EPA objectives and cumulative impacts already experienced in other parts of Cockburn Sound, as well as future planned development in the Sound. Assess and describe the potential impacts resulting from dredging on the flushing dynamics of the port precinct area, with particular reference to the potential for stratification, deoxygenation and increases in BOD with respect to nutrient physiochemistry, water quality and frequency of phytoplankton blooms. Assess and describe how the project will be managed to ensure that it will not lead to decreased water quality, increased risk of algae bloom and how this will be sustainably managed such that it will not lead to unacceptable impacts outside and inside the proposed port area. These studies will need to consider the Stage 1 proposal in the context of existing and/or approved development in Cockburn Sound. Assess and describe the potential impacts resulting from dredging on the flushing dynamics of the port precinct area, with particular reference to the potential for stratification, deoxygenation and increases in BOD with respect to nutrient physiochemistry, water quality and frequency of phytoplankton blooms. Assess and describe how the project will be managed to ensure that it will not lead to decreased water quality, increased risk of algae bloom and how this will be sustainably managed such that it will not lead to unacceptable impacts outside and inside the proposed port area. These studies will need to consider the Stage 1 proposal in the context of existing and/or approved development in Cockburn Sound. Assess and describe the potential impacts resulting from dredging on the flushing dynamics of the port precinct area, with particular reference to the potential for stratification, deoxygenation and increases in BOD with respect to nutrient physiochemistry, water quality and frequency of phytoplankton blooms. Assess and describe how the project will be managed to ensure that it will not lead to decreased water quality, increased risk of algae bloom and how this will be sustainably managed such that it will not lead to unacceptable impacts outside and inside the proposed port area. These studies will need to consider the Stage 1 proposal in the context of existing and/or approved development in Cockburn Sound.</td>
</tr>
<tr>
<td>Dredging-turbidity</td>
<td></td>
<td>Manage turbidity levels from construction to protect agreed environmental values (as outlined in <em>Perth Coastal Waters Environmental Values and Objectives</em>, EPA 2000).</td>
<td>Assess and describe monitoring and management measures/commitments during dredging, reclamation and other associated construction activities. Predict likelihood of dredge plumes and detail management measures as appropriate.</td>
</tr>
<tr>
<td>Impact of increased shipping operations.</td>
<td></td>
<td>Maintain or improve marine water and sediment quality consistent with Environmental Quality Objectives (EQO’s) and Environmental Quality Criteria (EQC’s) defined in the <em>Southern Metropolitan Coastal Waters Study</em> (DEP, 1996) and <em>Perth Coastal Waters Environmental Values and Objectives</em> (EPA 2000).</td>
<td>Assess and describe any likely contaminants resulting from increased shipping movements, including the potential for accumulation of TBT and heavy metals, as a result of activities associated with the Stage 1 proposal. Detail appropriate management measures consistent with the ANZECC Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance. Measures to consider ballast/bilge water management as appropriate.</td>
</tr>
<tr>
<td>Contamination</td>
<td>Dredge Spoil</td>
<td>Contaminated material should be treated and/or disposed of in a manner which adequately controls the infiltration of water in the material, and the formation and seepage of leachate from the material;</td>
<td>Assess and describe the nature and extent of any contamination (including TBT and heavy metals) within proposed dredge spoil with reference to accepted DEP criteria, and discuss the risk and suitability for use as landfill.</td>
</tr>
<tr>
<td>Liquid and solid waste – construction and on-going operations</td>
<td></td>
<td>Ensure wastes associated with construction and on-going port operations are managed in accordance with the waste management hierarchy (ie. avoid, minimise, recycle, treat and dispose), and where this is not possible, are contained and isolated from ground and surface waters, and that discharges meet the requirements of ANZECC (1992) and Draft Western Australia Guidelines for Fresh and Marine Waters.</td>
<td>Describe management measures/commitments and mechanisms to ensure that EPA objectives are met.</td>
</tr>
<tr>
<td>Additional fill material</td>
<td></td>
<td>Ensure additional fill required for reclamation works is of acceptable standard, compatible with intended end use and surrounding environment and consistent with appropriate criteria.</td>
<td>Assess and describe the nature of material and extent of any contamination (including TBT and heavy metals) within proposed additional fill material, with reference to accepted DEP criteria, and discuss the risk and suitability for use as landfill.</td>
</tr>
<tr>
<td>Oil spill</td>
<td></td>
<td>Minimise the impacts of fuel or oil spillage during ship movements and refuelling (if applicable)</td>
<td>Describe the oil spill contingency measures in place. Ensure responsibilities between Port owners and Fremantle Port Authority are clearly defined, and the proposed management of oil spills once the Port is gazetted.</td>
</tr>
</tbody>
</table>
## CONTENT

### SCOPE OF WORK

<table>
<thead>
<tr>
<th>Factor</th>
<th>Site factor</th>
<th>EPA objective</th>
<th>Work required for the environmental review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Particulate/Dust Emissions</td>
<td>Protect the surrounding land users such that dust and particulate emissions will not adversely impact upon their welfare and amenity or cause health problems by meeting the Guidelines for the Prevention of Dust and Smoke Pollution from Land Development Sites in WA and the Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1992.</td>
<td>Describe dust management measures to be undertaken during site preparation works, Describe management mechanisms to be implemented to control potential dust sources resulting from land clearing during construction. Detail potential on-going sources of dust and particulate emissions (including sources resulting from cargoes). Demonstrate the proposed management plans will prevent offsite impacts during operation of the port. Provide details of monitoring to be put in place to ensure that management measures are effective.</td>
</tr>
<tr>
<td>Noise</td>
<td>Construction</td>
<td>Ensure noise impacts emanating from proposed dredging, reclamant and other construction activities comply with statutory requirements and acceptable (and appropriate) standards</td>
<td>Ensure construction activities comply with the Environmental Protection (Noise) Regulations 1997, and instructions as provided in draft EPA Guidance No. 8. If likely to exceed accepted criteria, undertake modelling and develop appropriate management options such as buffer zones and/or hours of operation as appropriate.</td>
</tr>
<tr>
<td></td>
<td>Port operations</td>
<td>Ensure noise impacts emanating from on-going operations comply with statutory requirements and acceptable (and appropriate) standards</td>
<td>Undertake noise studies in accordance with EPA Guidance No.8. Demonstrate that the requirements of the Environmental Protection (Noise) Regulations 1997 can be met at the nearest relevant premises. If likely to exceed acceptable criteria, undertake noise modelling as required for all plant and equipment to be operated within the port under likely worst case weather conditions. Describe measures to avoid, minimise and mitigate impacts, including the definition of an appropriate buffer zone and relevant engineering controls, as required. Studies should provide an assessment of the cumulative effects of noise generation from the Stage 1 proposal with existing and/or approved premises where appropriate.</td>
</tr>
<tr>
<td></td>
<td>Transport</td>
<td>Minimise the impact to noise sensitive premises from increased traffic movement.</td>
<td>Identify noise sensitive premises that may be affected by increased traffic movements during the construction phase of the port or on-going servicing requirements during operational phases. Predict noise level increases where relevant and detail measures to be taken to ensure that vehicular traffic associated with construction and on-going operations will not impact unduly on nearby residences.</td>
</tr>
<tr>
<td>Odour</td>
<td>Transport, handling and storage of cargo</td>
<td>Odours emanating from the proposed development should not adversely affect the welfare and amenity of other land users. Ensure compliance with acceptable standards and that all reasonable and practicable measures are taken to minimise adverse impact of odorous gases. Ensure that odour emissions, both individually and cumulatively, meet appropriate criteria and do not cause an environmental or human health problem.</td>
<td>Detail potential odour sources. Demonstrate that unacceptable odour levels will not be experienced off site. Investigations should consider cumulative impacts as necessary to ensure that the proposal does not exacerbate impacts associated with existing and/or approved development. Describe measures to avoid, minimise and mitigate impacts, including the definition of an appropriate buffer zone.</td>
</tr>
<tr>
<td>Light</td>
<td>Manage potential impacts from light overspill and comply with acceptable standards</td>
<td></td>
<td>Assess and describe impacts of light spill and detail how light spill will be managed to prevent impact offsite.</td>
</tr>
<tr>
<td>CONTENT</td>
<td>SCOPE OF WORK</td>
<td></td>
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<tr>
<td>---------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Factor</td>
<td>Site specific factor</td>
<td>EPA objective</td>
<td>Work required for the environmental review</td>
</tr>
<tr>
<td><strong>SOCIAL SURROUNDINGS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreation and commercial</td>
<td>Beach access</td>
<td>Ensure that public access to and regional and recreation use of mainland foreshores and beaches is maintained, consistent with proposals developed and approved by planning agencies.</td>
<td>Assess and describe potential impacts to existing recreational use and access to mainland foreshores and beaches. Where the impacts of port operations are outside of that agreed by planning agencies, detail any management measures/commitments, required to mitigate that impact.</td>
</tr>
<tr>
<td></td>
<td>Fishing and commercial activities</td>
<td>Ensure that shipping operations do not compromise commercial activities including fisheries, within the Sound.</td>
<td>Assess and describe potential impacts to existing commercial activities, including fisheries. Detail any management measures/commitments required to mitigate that impact.</td>
</tr>
<tr>
<td></td>
<td>Boating</td>
<td>Ensure that port activities and shipping operations do not compromise reasonable boating and other existing or potential recreational activities, within the Sound</td>
<td>Assess and describe potential impacts to existing boating and other existing or potential recreational activities. Detail any management measures/commitments required to mitigate that impact.</td>
</tr>
<tr>
<td><strong>Heritage</strong></td>
<td>Aboriginal culture and heritage</td>
<td>(i) Ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972; and (ii) Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.</td>
<td>Assess and describe management commitments to be undertaken during earthworks and site preparation to ensure that any potential burial sites are identified and recovered, to ensure EPA objectives are met, and the proposal complies with the requirements of the Aboriginal Heritage Act 1972.</td>
</tr>
<tr>
<td></td>
<td>Maritime shipwrecks</td>
<td>Ensure that offshore shipwreck sites are protected to the satisfaction of the Maritime Museum of WA.</td>
<td>Identify the location of any shipwreck sites that may be impacted by the proposed reclamation works in consultation with the Maritime Museum of WA. If applicable, document an agreement with the Maritime Museum of WA that the methods used to protect historical shipwrecks are satisfactory.</td>
</tr>
<tr>
<td><strong>Risk (Public health and safety)</strong></td>
<td>Port construction</td>
<td>Ensure that risks from other hazardous facilities in the Kwinana Industrial Area are catered for during the construction program to demonstrate ALARP (EPA Guidance No.2).</td>
<td>Describe and assess risks which could affect the construction workers and develop response plans to mitigate risk.</td>
</tr>
<tr>
<td></td>
<td>Port operations</td>
<td>Ensure that risk is assessed and managed to meet the EPAs criteria for individual fatality risk off-site and the DMEs requirements in respect of public safety.</td>
<td>Assess and describe on-site and off-site risks associated with port operations, including the shipping, storage and transport of hazardous cargoes.</td>
</tr>
<tr>
<td></td>
<td>Transport of goods to and from the port facility</td>
<td>Ensure that public risk associated with implementation of the proposal is as low as reasonable achievable in accordance with EPA Guidance No.2.</td>
<td>Detail appropriate management strategies for port operations, including the handling, storage and transport of hazardous goods to and from the port facility consistent with EPA and DME requirements.</td>
</tr>
<tr>
<td>CONTENT</td>
<td>SCOPE OF WORK</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Factor</td>
<td>Site factor</td>
<td>EPA objective</td>
<td>Work required for the environmental review</td>
</tr>
<tr>
<td>Management</td>
<td>Management Responsibility</td>
<td>Ensure that a clear defined management structure is in place which delineates responsibilities for on-going management and monitoring of the environmental health of the port area.</td>
<td>Describe the proposed on-going management structure/system for the private port with reference to any existing conditions, and the management mechanisms which might convey responsibility for on-going management to future lessees or owners, to ensure that EPA and Government environmental objectives for the Cockburn Sound area are met. Environmental management strategies for the Port should consider an EMS and be in accordance with the principles of the management framework being applied to Perth’s coastal waters as defined in <em>Perth Coastal Waters Environmental Values and Objectives</em> (EPA 2000). Furthermore, they should be consistent with existing management frameworks, including requirements under the Fremantle Port Authority EMP and any proposed Cockburn Sound EPP.</td>
</tr>
<tr>
<td>Cumulative impacts</td>
<td>Ensure that appropriate measures are taken to implement the advice and recommendations provided by the EPA in Bulletin 907 to manage long term impacts in the Sound. Ensure that environmental values and objectives defined in the EPA Position Document <em>Perth Coastal Waters Environmental Values and Objectives</em> (EPA 2000) are maintained and protected. Ensure that appropriate consideration is given to cumulative impacts of land-based activities, with particular reference to noise, odour and waste/emissions management.</td>
<td>Undertake necessary studies, in consultation with DEP and other relevant agencies, to identify the impacts of the Stage 1 proposal on the environmental values of the Sound, taking into account the relationship between the proposal and the existing and/or approved uses of Cockburn Sound. The extent of influence of the Stage 1 development should also be considered in terms of any implications for the environmental performance* of other existing developments (*environmental performance in this case is the ability to meet agreed environmental quality criteria specified in any approved management plan for an existing harbour). The combined impacts of Stages 1 and 2 are to be addressed, at a preliminary level, in a supplementary investigation report. Impacts including reference to future planned uses of Cockburn Sound will be reported on by the EPA in an independent study commissioned by the EPA.</td>
<td></td>
</tr>
</tbody>
</table>

These factors should be addressed within the environmental review document for the public to consider and make comment to the EPA. The EPA expects to address these factors in its report to the Minister for the Environment. The EPA expects the proponent to take due care in ensuring any other relevant environmental factors which may be of interest to the public are addressed.
3. Availability of the environmental review

3.1 Copies for distribution free of charge

Supplied to DEP:

- Library/Information Centre ........................................... 9
- EPA members .................................................................. 6
- Officers of the DEP (Perth) .......................................... 9
- Officers of the DEP (Kwinana) ................................... 2

Distributed by the proponent to:

Government departments

- Department of Minerals and Energy............................. 1
- Department of Resources Development ....................... 1
- DOLA ........................................................................ 1
- Ministry for Planning .................................................. 1
- Fisheries WA ................................................................ 1
- Transport WA ............................................................ 1
- Fremantle Port Authority .............................................. 1
- Aboriginal Affairs ...................................................... 1
- Water and Rivers Commission ..................................... 1

Local government authorities

- Town of Kwinana ....................................................... 2
- City of Cockburn ....................................................... 1
- City of Rockingham ................................................. 1

Libraries

- J S Battye Library ........................................................ 3
- The Environment Centre ............................................. 2
- Cockburn ................................................................. 2
- Kwinana .................................................................... 2

Other

- Conservation Council of WA ...................................... 1
- COMNET ...................................................................... 1
- Marine and Coastal Community Network ...................... 1
- Kwinana Industries Council ....................................... 1
- Cockburn Powerboat Association .................................. 1
- RecFish West ................................................................ 1
- Coastal Waters Alliance ............................................. 1
- WA Fishing Industry Council ..................................... 1
- Aquaculture Council .................................................. 1
- Royal Australian Navy ................................................. 1
- Cockburn Sound Conservation Committee .................... 1
- Kwinana Watchdog Group ......................................... 1
3.2 Available for public viewing

- J S Battye Library
- Department of Environmental Protection Library
- City of Cockburn Public Library
- Town of Kwinana Public Library
- City of Rockingham Public Library

Could you please supply the project officer with an electronic copy of the document for use on Macintosh, Microsoft Word 98, and any scanned figures. Where possible, figures should be reproducible in a black and white format.
Part B: Generic Guidelines for the preparation of an environmental review document

1. Overview

All environmental reviews have the objective of protecting the environment. Environmental impact assessment is deliberately a public process in order to obtain broad ranging advice. The review requires the proponent to describe:

- the proposal;
- receiving environment;
- potential impacts of the proposal on factors of the environment; and
- proposed management strategies to ensure those environmental factors are appropriately protected.

Throughout the assessment process it is the objective of the Environmental Protection Authority (EPA) to help the proponent to improve the proposal so the environment is protected. The DEP administers the environmental impact assessment process on behalf of the EPA.

The primary purpose of the environmental review is to provide information on the proposal within the local and regional framework to the EPA, with the aim of emphasising how the proposal may impact the relevant environmental factors and how those impacts may be mitigated and managed.

The language used in the body of the environmental review should be kept simple and concise, considering the audience includes non-technical people, and any extensive, technical detail should either be referenced or appended to the environmental review. The environmental review document will form the legal basis of the Minister for the Environment's approval of the proposal and therefore should include a description of all the main and ancillary components of the proposal, including options where relevant.

Information used to reach conclusions should be properly referenced, including personal communications. Such information should not be misleading or presented in a way that could be construed to mislead readers. Assessments of the significance of an impact should be soundly based rather than unsubstantiated opinion, and each assessment should lead to a discussion of the management of the environmental factor.

2. Objectives of the environmental review

The objectives of the environmental review are to:

- place this proposal in the context of the local and regional environment;
- adequately describe all components of the proposal, so that the Minister for the Environment can consider approval of a well-defined project;
Part B - Generic Guidelines

• provide the basis of the proponent’s environmental management program, which shows that the environmental impacts resulting from the proposal, including cumulative impact, can be acceptably managed; and
• communicate clearly with the public (including government agencies), so that the EPA can obtain informed public comment to assist in providing advice to government.

3. Environmental management

The EPA expects the proponent to have in place an environmental management system appropriate to the scale and impacts of the proposal including provisions for performance review and a commitment to continuous improvement. The system may be integrated with quality and health and safety systems and should include the following elements:

• environmental policy and commitment;
• planning of environmental requirements;
• implementation and operation of environmental requirements;
• measurement and evaluation of environmental performance;
• review and improvement of environmental outcomes.

A description of the proposed environmental management system should be included in the environmental review documentation. If appropriate, the documentation can be incorporated into a formal environmental management system (such as AS/NZS ISO 14001). Public accountability should be incorporated into the approach on environmental management.

The environmental management program (EMP) is the key document of an environmental management system that should be adequately defined in an environmental review document. The EMP should provide plans to manage the relevant environmental factors, define the performance objectives, describe the resources to be used, outline the operational procedures and outline the monitoring and reporting procedures which would demonstrate the achievement of the objectives.

4. Format of the environmental review document

The environmental review should be provided to the DEP officer for comment. At this stage the document should have all figures produced in the final format and colours.

Following approval to release the review for public comment, the final document should also be provided to the DEP in an electronic format.

The proponent is requested to supply the project officer with an electronic copy of the environmental review document for use on Macintosh, Microsoft Word Version 6, and any scanned figures. Where possible, figures should be reproducible in a black and white format.

5. Contents of the environmental review document

The contents of the environmental review should include an executive summary, introduction and at least the following:
5.1 The proposal

A comprehensive description of the proposal including its location (address and certificate of title details where relevant) is required.

Justification and alternatives
- justification and objectives for the proposed development;
- the legal framework, including existing zoning and environmental approvals, and decision making authorities and involved agencies; and
- consideration of alternative options.

Key characteristics
The Minister’s statement will bind the proponent to implementing the proposal in accordance with any technical specifications and key characteristics in the environmental review document. It is important therefore, that the level of technical detail in the environmental review, while sufficient for environmental assessment, does not bind the proponent in areas where the project is likely to change in ways that have no environmental significance. Include a description of the components of the proposal, including the nature and extent of works proposed. This information must be summarised in the form of a table as follows:

---

1 Changes to the key characteristics of the proposal following final approval, would require assessment of the change and can be treated as non-substantial and approved by the Minister, if the environmental impacts are not significant. If the change is significant, it would require assessment under section 38 or section 46. Changes to other aspects of the proposal are generally inconsequential and can be implemented without further assessment. It is prudent to consult with the Department of Environmental Protection about changes to the proposal.
Table 1: Key characteristics (example only)

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life of project (mine production)</td>
<td>&lt; 5yrs (continual operation)</td>
</tr>
<tr>
<td>Size of ore body</td>
<td>682 000 tonnes (upper limit)</td>
</tr>
<tr>
<td>Area of disturbance (including access)</td>
<td>100 hectares</td>
</tr>
<tr>
<td>List of major components</td>
<td>refer plans, specifications, charts section immediately below for details of map requirements</td>
</tr>
<tr>
<td>- pit</td>
<td></td>
</tr>
<tr>
<td>- waste dump</td>
<td></td>
</tr>
<tr>
<td>- infrastructure (water supply, roads, etc)</td>
<td></td>
</tr>
<tr>
<td>Ore mining rate</td>
<td></td>
</tr>
<tr>
<td>- maximum</td>
<td>200 000 tonnes per year</td>
</tr>
<tr>
<td>Solid waste materials</td>
<td></td>
</tr>
<tr>
<td>- maximum</td>
<td>800,000 tonnes per year</td>
</tr>
<tr>
<td>Water supply</td>
<td></td>
</tr>
<tr>
<td>- source</td>
<td>XYZ borefield, ABC aquifer</td>
</tr>
<tr>
<td>- maximum hourly requirement</td>
<td>180 cubic metres</td>
</tr>
<tr>
<td>- maximum annual requirement</td>
<td>1 000 000 cubic metres</td>
</tr>
<tr>
<td>Fuel storage capacity and quantity used</td>
<td>litres; litres per year</td>
</tr>
<tr>
<td>Heavy mineral concentrate transport</td>
<td></td>
</tr>
<tr>
<td>- truck movements (maximum)</td>
<td>75 return truck loads per week</td>
</tr>
</tbody>
</table>

**Plans, Specifications, Charts**

Adequately dimensioned plans showing clearly the location and elements of the proposal which are significant from the point of view of environmental protection, should be included. The location and dimensions (for progressive stages of development, if relevant) of plant, amenities buildings, accessways, stockpile areas, dredge areas, waste product disposal and treatment areas, all dams and water storage areas, mining areas, storage areas including fuel storage, landscaped areas etc.

Only those elements of plans, specifications and charts that are significant from the point of view of environmental protection are of relevance here.

Figures that should always be included are:

- a map showing the proposal in the local context - an overlay of the proposal on a base map of the main environmental constraints;
- a map showing the proposal in the regional context; and, if appropriate,
- a process chart / mass balance diagram showing inputs, outputs and waste streams.

The plan/s should include contours, a north arrow, a scale bar, a legend, grid co-ordinates, the source of the data, and a title. If the data is overlaid on an aerial photo then the date of the aerial photo should be shown.
Other logistics
- timing and staging of project; and
- ownership and liability for waste during transport, disposal operations and long-term disposal (where appropriate to the proposal).

5.2 Environmental factors

The environmental review should focus on the relevant environmental factors for the proposal, and these should be agreed in consultation with the EPA and DEP and relevant public and government agencies. Preliminary environmental factors identified for the proposal are shown in Part A of these guidelines.

Further environmental factors may be identified during the preparation of the environmental review, therefore on-going consultation with the EPA, DEP and other relevant agencies is recommended. The DEP can advise the proponent on the recommended EPA objective for any new environmental factors raised. Minor matters which can be readily managed as part of normal operations for the existing operations or similar projects may be briefly described.

Items that should be discussed under each environmental factor are:

- a clear definition of the area of assessment for this factor;
- the EPA objective for this factor;
- a description of what is being affected - why this factor is relevant to the proposal;
- a description of how this factor is being affected by the proposal - the predicted extent of impact;
- a description of where this factor fits into the broader environmental / ecological context (only if relevant - this may not be applicable to all factors);
- a straightforward description or explanation of any relevant standards / regulations / policy;
- environmental evaluation - does the proposal meet the EPA’s objective as defined above;
- if not, environmental management proposed to ensure the EPA’s objective is met;
- predicted outcome.

The proponent should provide a summary table of the above information for all environmental factors, under the three categories of biophysical, pollution management and social surroundings:
### Table 2: Environmental factors and management (example only)

<table>
<thead>
<tr>
<th>Environmental Factor</th>
<th>EPA Objective</th>
<th>Existing environment</th>
<th>Potential impact</th>
<th>Environmental management</th>
<th>Predicted outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BIOPHYSICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vegetation community types 3b and 20b</td>
<td>Maintain the abundance, species diversity, geographic distribution and productivity of vegetation community types 3b and 20b</td>
<td>Reserve 34587 contains 45 ha of community type 20b and 34 ha of community type 3b</td>
<td>Proposal avoids all areas of community types 20b and 3b</td>
<td>Surrounding area will be fully rehabilitated following construction</td>
<td>Community types 20b and 3b will remain untouched. Area surrounding will be revegetated with seed stock of 20b and 3b community types</td>
</tr>
<tr>
<td><strong>POLLUTION MANAGEMENT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dust</td>
<td>Ensure that the dust levels generated by the proposal do not adversely impact upon welfare and amenity or cause health problems by meeting statutory requirements and acceptable standards</td>
<td>Light industrial area - three other dust producing industries in close vicinity. Nearest residential area is 800 metres</td>
<td>Proposal may generate dust on two days of each working week.</td>
<td>Dust Control Plan will be implemented</td>
<td>Dust can be managed to meet EPA’s objective</td>
</tr>
<tr>
<td><strong>SOCIAL SURROUNDINGS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual amenity</td>
<td>Visual amenity of the area adjacent to the project should not be unduly affected by the proposal</td>
<td>Area already built-up</td>
<td>This proposal will contribute negligibly to the overall visual amenity of the area</td>
<td>Main building will be in ‘forest colours’ and screening trees will be planted on road</td>
<td>Proposal will blend well with existing visual amenity and the EPA’s objective can be met</td>
</tr>
</tbody>
</table>

### 5.3 Environmental management commitments

The final stage of the Environmental Impact Assessment (EIA) process is reached when the Minister for the Environment issues the Ministerial statement for the project, which is a set of legally enforceable conditions and procedures for the implementation of the project. One of the standard procedures is a requirement for the proponent to implement the commitments which have been made (by the proponent) during the EIA process. It is accepted practice for a consolidated list of the proponent’s commitments to be attached to the Minister’s statement.
Commitment formatting

1. Commitment components

Commitments which address key environmental factors will be audited by the DEP, together with the environmental conditions. Unless the commitments are framed in a standard format, it may become difficult in practice to implement or audit them. By applying the principles of quality management, a standard format for the commitments has been arrived at. The format ensures that a chain of responsibility is established to facilitate compliance and that redundant, overlapping or non-enforceable commitments are avoided.

The required standard format for all commitments comprises a number of components as follows:

The proponent (who) will undertake an action (what, how, where) to meet an environmental objective (why) to a time frame (when), and on advice of somebody (to whom, eg. third party, government agencies such as Department of Conservation and Land Management, Department of Minerals and Energy, Water and Rivers Commission, Shire Council). With regard to ‘whom’ this need only be included if the expertise of a third party is relevant to implementing the commitment.

It is important for the consolidated list of commitments to be numbered correctly for easy reference in the implementation and auditing stages of the project. These should therefore be sequentially numbered 1, 2, 3, ... without use of subgroups such as 1.1, 1.2 or 2(i) or 2(a), 2(b).

2. Paragraph format

In applying the standard components (who, what, why, how, where, when, to whom) an example of a commitment in paragraph form is as follows:

*The proponent will prepare and implement a Dust Control Program which will minimise dust generation on-site and prevent dust emission from construction of the foreshore extension in order to protect the amenity of nearby land users. The Program will be prepared during the design (project planning) phase and will meet EPA dust control criteria (EPA, 1996), on advice of the Shire of Widgiemooltha. The approved Program will be implemented during the construction phase.*

However in writing the commitment in paragraph form, a confusing or clumsy sentence structure can result that may be difficult to interpret for future auditing purposes. Also it is difficult to verify that all components have been incorporated into every commitment. A paragraph format is therefore not the preferred format.

3. Tabular format

Due to the limitations of the paragraph format, it is preferable to format a commitment in tabular form. It is recommended that the table column headings be ordered as: ‘commitment number’, ‘topic’, ‘action’, ‘objective’, ‘timing’ and ‘advice’. However table headings can be re-ordered if necessary.
The example in paragraph form on page 1 can therefore be written in tabular form as per examples 1 and 2 below. Note that the tabular format makes it easier to ensure that no component of the commitment is left out and that each action is recognised as a separate commitment. This format also permits the inclusion of additional clauses or more precise wording of clauses which can be difficult in a sentence structure. It is acceptable for table columns to be re-ordered if necessary. Finally, the tabular format provides an immediate audit framework for use by the proponent and the DEP, enabling efficient administration of environmental approvals.

Examples 1 & 2.

*The proponent* is committed to the following:

<table>
<thead>
<tr>
<th>No.</th>
<th>Topic</th>
<th>Action (What/How/Where)</th>
<th>Objective/s (Why)</th>
<th>Timing (When)</th>
<th>Advice (To whom)</th>
</tr>
</thead>
</table>
| 1.  | Dust management        | Prepare a Dust Control Program for the foreshore construction site which addresses: 1) abc 2) xyz | Minimise dust during the construction phase  
Maintain the amenity of nearby land users  
To meet EPA dust control criteria | Pre-construction | Shire             |
| 2.  | Dust management        | Implement the approved Dust Control Program  
Achieve the objectives of Commitment 1 |  | Construction      | -                |

Example 3.

<table>
<thead>
<tr>
<th>No.</th>
<th>Topic</th>
<th>Action</th>
<th>Objective/s</th>
<th>Timing</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Fauna protection</td>
<td>Undertake a trapping programme for capturing and relocating the Southern Brown Bandicoots</td>
<td>Minimise impact on Southern Brown Bandicoots</td>
<td>Pre-construction (prior to commencement of ground disturbance)</td>
<td>CALM</td>
</tr>
</tbody>
</table>

Example 4.

<table>
<thead>
<tr>
<th>No.</th>
<th>Topic</th>
<th>Action</th>
<th>Objective/s</th>
<th>Timing</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Vegetation</td>
<td>Revegetate disturbed areas with vegetation types indigenous to the area</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• To minimise impact on local flora  
• To achieve the completion criteria stated in CER (Section 5.1.1) | Post-construction (progressively during operations) | Kings Park Board |

Example 5.

<table>
<thead>
<tr>
<th>No.</th>
<th>Topic</th>
<th>Objective</th>
<th>Action</th>
<th>Timing</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>Groundwater</td>
<td>Minimise impact on groundwater levels, surface water levels and surrounding vegetation</td>
<td>Groundwater drawdown shall not exceed 0.5 m at any boundary of the mine site</td>
<td>Operation</td>
<td>Water and Rivers Commission</td>
</tr>
</tbody>
</table>
Example 6.

<table>
<thead>
<tr>
<th>No</th>
<th>Topic</th>
<th>Action</th>
<th>Objective</th>
<th>Timing</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>Clean-up</td>
<td>Post-clean up activities will only proceed after demonstrating to (and gaining approval from) the DEP that the site clean-up criteria identified in the 1993 CER have been met</td>
<td>To achieve the soil quality objectives in the Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, Jan 1992</td>
<td>Post-clean up (On completion of cleanup and prior to commencement of post-cleanup activities)</td>
<td>--</td>
</tr>
</tbody>
</table>

### 5.4 Public consultation

A description should be provided of the public participation and consultation activities undertaken by the proponent in preparing the environmental review. It should describe the activities undertaken, the dates, the groups/individuals involved and the objectives of the activities. Cross reference should be made with the description of environmental management of the factors which should clearly indicate how community concerns have been addressed. Those concerns which are dealt with outside the EPA process can be noted and referenced.

### 5.5 Other information

Additional detail and description of the proposal, if provided, should go in a separate section.
Attachment 3

The first page of the proponent's environmental review document must be the following invitation to make a submission, with the parts in square brackets amended to apply to each specific proposal. Its purpose is to explain what submissions are used for and to detail why and how to make a submission.

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

[the proponent] proposes [the proposal]. In accordance with the Environmental Protection Act, a PER has been prepared which describes this proposal and its likely effects on the environment. The PER is available for a public review period of 8 weeks from [date] closing on [date].

Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government.

Why write a submission?
A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in the EPA’s report.

Why not join a group?
If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission
You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.
When making comments on specific elements of the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

**Points to keep in mind**

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: [date]

Submissions should be addressed to:
The Environmental Protection Authority
Westralia Square
141 St George’s Terrace
PERTH WA 6000

Attention: [Project Officer name]
Attachment 4

Advertising the environmental review

The proponent is responsible for advertising the release and arranging the availability of the environmental review document in accordance with the following guidelines:

Format and content
The format and content of the advertisement should be approved by the DEP before appearing in the media. For joint State-Commonwealth assessments, the Commonwealth also has to approve the advertisement. The advertisement should be consistent with the attached example. Note that the DEP officer’s name should appear in the advertisement.

Size
The size of the advertisement should be two newspaper columns (about 10 cm) wide by about 14 cm long. Dimensions less than these would be difficult to read.

Location
The approved advertisement should, for CER’s, appear in the news section of the main local newspaper and, for PER’s and ERMP’s, appear in the news section of the main daily paper’s (“The West Australian”) Saturday edition, and in the news section of the main local paper at the commencement of the public review period and again two weeks prior to the closure of the public review period.

Timing
Within the guidelines already given, it is the proponent’s prerogative to set the time of release, although the DEP should be informed. The advertisement should not go out before the report is actually available, or the review period may need to be extended.
Example of the newspaper advertisement

Proponent Name

Public Environmental Review

TITLE OF PROPOSAL

(Public Review Period: [date] to [date])

(Proponent) is planning to (brief description of proposal).

A Public Environmental Review (PER) has been prepared by the company to examine the environmental effects associated with the proposed development, in accordance with Western Australian Government procedures. The PER describes the proposal, examines the likely environmental effects and the proposed environmental management procedures.

Proponent has prepared a project summary which is available free of charge from the company’s office address.

Copies of the PER may be purchased for $10 from:
Company Name
Street
Suburb/Town WA Postcode
Telephone: (08) 9xxx xxxx

Copies of the complete PER will be available for examination at:

- Department of Environmental Protection
  Library Information Centre
  8th Floor, Westralia Square
  141 St Georges Terrace
  PERTH WA 6000
- Department of Environmental Protection
  Regional Office - if appropriate

Submissions on this proposal are invited by [closing date]. Please address your submission to:

Chairman
Environmental Protection Authority
8th Floor, Westralia Square
141 St Georges Terrace
PERTH WA 6000

Attention: [Project Officer name]

If you have any questions on how to make a submission, please ring the project officer, [Project Officer name], on (08) 9222 7xxx.
APPENDIX 2
JAMES POINT MARINE SURVEY
James Point Marine Survey

Emily Stewart
Murdoch University Fisheries Research

MURDOCH UNIVERSITY
PERTH, WESTERN AUSTRALIA

for
D.A. Lord & Associates

September, 1998
Introduction
A preliminary survey of the substrata in the vicinity of James Point in Cockburn Sound was performed along six transects. These transects encompassed shallow areas close to the shoreline, those deeper areas where dredging has occurred and areas along an offshore bank that extends north north-west from James Point. The aims of the survey were to identify the different types of substrata in the area and, in particular, to locate any underwater features such as seagrass beds or reef structures.

Materials and Methods
Underwater surveys were performed by divers using manta boards towed behind a vessel. The transects were followed using waypoints entered into a GPS while a diver recorded the predominant substratum every minute. Types of macrophytes, minor substrata features and any conspicuous fauna were also recorded. Samples of seagrass from two seagrass meadows were collected and identified to species by Mike Van Keulen of Murdoch University. Photographs were taken of the major substratum types.

Results
The survey has shown that the majority of the substrata in the vicinity of James Point is comprised of sand, silt or shell rubble deposits on sand. The substrata was sometimes coated with a very fine brown algae, and clumps of red and brown algae were occasionally seen growing from the sediment. The fauna observed during underwater tows included invertebrates such as anemone (actinarians), sea pens (pennutulaceans), sea stars (asteroids), sea squirts (ascidians) and polychaetes. Blue Manna Crabs (*Portunis pelagicus*), a Port Jackson Shark (*Heterodontus portusjacksoni*), Pink Snapper (*Pagrus auratus*), Southern Shovelnose Ray (*Aptychotrema vincentiana*) and benthic teleost species such as blennies (blennidae) were also sighted.

Exceptions to the above predominant substrate types were found along the bank that extends north-north west from James Point that was covered by Transect 3. A dense seagrass meadow (80% cover) that was 10m wide was found approximately 400 m south of the shipping channel (see map), while several patches of seagrass with similarly high coverage were found north of the channel towards the end of Transect 3, east along the beginning of Transect 4 and east along the end of Transect 6. All meadows appeared to be comprised of a *Posidonia* sp., and samples taken from the northern and eastern ends of Transects 3 and 6 respectively were identified as *Posidonia sinuosa* by Mike Van Keulen.

The northern end of Transect 3 and the eastern end of Transect 4 also supported outcrops of limestone reef up to 1.5 m high and occasionally greater than 5 m in width. In addition, rocky patches derived from limestone outcropping were evident approximately 300m south of the end of Transect 3.
Enclosures
Map of predominant substrate types
Table of substrate and fauna observations
### Transect 1
**Heading south west from jetty to James Point**

<table>
<thead>
<tr>
<th>Predominant Substrate</th>
<th>Substrate Types</th>
<th>Fauna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt</td>
<td>Fine algal cover and sand</td>
<td></td>
</tr>
<tr>
<td>Silt</td>
<td>Fine algal cover and sand</td>
<td></td>
</tr>
<tr>
<td>Silt</td>
<td>Fine algal cover and sand</td>
<td>Sand Dollars*</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Sand Dollars</td>
</tr>
<tr>
<td>Reef</td>
<td>Small flat isolated reef platform on sand substrate</td>
<td></td>
</tr>
<tr>
<td>Reef</td>
<td>Small flat isolated reef platform on sand substrate</td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Bivalves**</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Bivalves</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Bivalves</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones***</td>
</tr>
<tr>
<td>Sand</td>
<td>Scattered chlorophyta- <em>Ulva</em></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>Scattered chlorophyta- <em>Ulva</em></td>
<td></td>
</tr>
<tr>
<td>Reef</td>
<td>Small flat isolated reef platform on sand substrate</td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Clypeasteridae  **Bivalvia  ***Actiniaria*
**Transect 2**
Following 5m drop off heading north away from James Point

<table>
<thead>
<tr>
<th>Predominant Substrate</th>
<th>Substrate Types</th>
<th>Fauna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt</td>
<td></td>
<td>Polychaete tubes, Blue Manna Crab*</td>
</tr>
<tr>
<td>Silt</td>
<td></td>
<td>Polychaete tubes, Blue Manna Crab</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Polychaete tubes</td>
</tr>
<tr>
<td>Rubble</td>
<td></td>
<td>Polychaete tubes, Blue Manna Crab</td>
</tr>
<tr>
<td>Rubble</td>
<td></td>
<td>Polychaete tubes, Blue Manna Crab</td>
</tr>
<tr>
<td>Rubble</td>
<td></td>
<td>Polychaete tubes, Blue Manna Crab</td>
</tr>
<tr>
<td>Rubble</td>
<td></td>
<td>Polychaete tubes, Port Jackson Shark**</td>
</tr>
<tr>
<td>Rubble</td>
<td></td>
<td>Polychaete tubes</td>
</tr>
<tr>
<td>Rubble</td>
<td></td>
<td>Polychaete tubes</td>
</tr>
<tr>
<td>Rubble</td>
<td></td>
<td>Polychaete tubes, Blue Manna Crab</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Polychaete tubes, Sand dollars</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Polychaete tubes, Sand dollars</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Blue Manna Crab</td>
</tr>
</tbody>
</table>

*Portunis pelagicus  **Heterodontus portusjacksoni*
<table>
<thead>
<tr>
<th>Predominant Substrate</th>
<th>Substrate Types</th>
<th>Fauna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones</td>
</tr>
<tr>
<td>Sand</td>
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<tr>
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<td>Anemones</td>
</tr>
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<tr>
<td>Sand</td>
<td>Rocky</td>
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<tr>
<td>Sand</td>
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<td>Anemones, Bivalves, Polychaete tubes</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones, Bivalves, Polychaete tubes</td>
</tr>
<tr>
<td>Sand</td>
<td>Some rubble</td>
<td></td>
</tr>
<tr>
<td>Reef</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>Fine algal cover</td>
<td>Large colourful clusters of ascidians 1m² 50cm high*</td>
</tr>
<tr>
<td>Sand</td>
<td>Some rubble and fine algal covering</td>
<td>Pink Snapper**</td>
</tr>
<tr>
<td>Sand</td>
<td>Some rubble and fine algal covering</td>
<td>Anemones</td>
</tr>
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<td>Sand</td>
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</tr>
<tr>
<td>Sand</td>
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<td>Anemones</td>
</tr>
<tr>
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<td>Some rubble and fine algal covering</td>
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</tr>
<tr>
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<td>Anemones</td>
</tr>
<tr>
<td>Sand</td>
<td>Some rubble and fine algal covering</td>
<td>Anemones</td>
</tr>
<tr>
<td>Seagrass</td>
<td>Seagrass bed width: 10m, density: 80%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Posidonia sinuosa)</td>
<td>Ascidians</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubble</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubble</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Rubble | sand  
| Reef |  
| Sand | Blue Manna Crab  
| Sand | Some rubble and reef  
| Sand | Blue Manna Crab  
| Silt | Some Rhodophyta  
| Silt | Polychaete tubes  
| Silt | Some Rhodophyta  
| Silt | Polychaete tubes  
| Silt | Some Rhodophyta  
| Silt | Polychaete tubes  
| Rubble |  
| Silt | Some Rhodophyta  
| Reef | Polychaete tubes  
| Reef | Some rubble  
| Silt |  
| Limestone | Rubble from limestone outcrop with some reef  
| Limestone | Polychaete tubes  
| Reef | Some seagrass  
| Reef | (Posidonia sinuosa)  
| Seagrass | (Posidonia sinuosa)  
| Seagrass |  
| Seagrass | (Posidonia sinuosa)  
| Seagrass | (Posidonia sinuosa)  

* Ascidiaeae **Pagrus auratus ***Porifera
**Transect 4**

Most northern transect conducted heading east towards the coast

<table>
<thead>
<tr>
<th>Predominant Substrate</th>
<th>Substrate Types</th>
<th>Fauna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seagrass</td>
<td><em>Posidonia sp.</em></td>
<td></td>
</tr>
<tr>
<td>Seagrass</td>
<td><em>Posidonia sp.</em></td>
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</tr>
<tr>
<td>Silt</td>
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<td>Anemones</td>
</tr>
<tr>
<td>Silt</td>
<td>Some Rhodophyta</td>
<td>Anemones</td>
</tr>
<tr>
<td>Rubble</td>
<td>Some Rhodophyta and silt</td>
<td></td>
</tr>
<tr>
<td>Rubble</td>
<td>Some Rhodophyta and silt</td>
<td></td>
</tr>
<tr>
<td>Seagrass</td>
<td>Some Rhodophyta, silt, rubble and reef</td>
<td></td>
</tr>
<tr>
<td>Rubble</td>
<td>Some silt</td>
<td></td>
</tr>
<tr>
<td>Silt</td>
<td>Some rubble</td>
<td>Anemones</td>
</tr>
<tr>
<td>Rubble</td>
<td>Some silt</td>
<td>Anemones</td>
</tr>
<tr>
<td>Silt</td>
<td>Some rubble</td>
<td>Anemones</td>
</tr>
<tr>
<td>Rubble</td>
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<td>Silt</td>
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</tr>
<tr>
<td>Silt</td>
<td>Some silt</td>
<td>Anemones</td>
</tr>
<tr>
<td>Silt</td>
<td>Blue Manna Crab</td>
<td></td>
</tr>
<tr>
<td>Silt</td>
<td>Blue Manna Crab</td>
<td></td>
</tr>
<tr>
<td>Rubble</td>
<td>Blue Manna Crab</td>
<td></td>
</tr>
<tr>
<td>Rubble</td>
<td>Blue Manna Crab</td>
<td></td>
</tr>
<tr>
<td>Silt</td>
<td>Blue Manna Crab</td>
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</tr>
<tr>
<td>Silt</td>
<td>Blue Manna Crab</td>
<td></td>
</tr>
<tr>
<td>Silt</td>
<td>Some rocks</td>
<td>Anemones</td>
</tr>
<tr>
<td>Silt</td>
<td>Some rocks</td>
<td>Anemones</td>
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</tbody>
</table>
### Transect 5
Heading south parallel to the shore

<table>
<thead>
<tr>
<th>Predominant Substrate</th>
<th>Substrate Types</th>
<th>Fauna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reef</td>
<td>Some sand</td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td>Fine algal covering</td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones</td>
</tr>
<tr>
<td>Rubble</td>
<td>Some sand</td>
<td>Anemones, sea pens*</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones, sea pens</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones, sea pens</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones, sea pens</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Sea stars**</td>
</tr>
</tbody>
</table>

*Pennutulacea  **Asteroidea*
### Transect 6

**Heading east from coast to the bank**

<table>
<thead>
<tr>
<th>Predominant Substrate</th>
<th>Substrate Types</th>
<th>Fauna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones, Blue manna crab*</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones, Southern Shovelnose Ray**</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Sea stars, feather stars***</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Sea stars, Sea pens</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Algae</td>
<td>Scattered clumps of brown algae</td>
<td></td>
</tr>
<tr>
<td>Rubble</td>
<td>Some sand</td>
<td></td>
</tr>
<tr>
<td>Algae</td>
<td>Scattered clumps of brown algae</td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Anemones</td>
</tr>
<tr>
<td>Sand</td>
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<td>Anemones</td>
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<tr>
<td>Sand</td>
<td></td>
<td>Anemones</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td>Sea stars</td>
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<tr>
<td>Sand</td>
<td></td>
<td>Sea stars</td>
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<tr>
<td>Sand</td>
<td></td>
<td>Sea stars</td>
</tr>
<tr>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Algae</td>
<td>Scattered clumps of brown algae</td>
<td></td>
</tr>
<tr>
<td>Seagrass</td>
<td>Density: 75% (Posidonia sinuosa)</td>
<td></td>
</tr>
<tr>
<td>Seagrass</td>
<td>Density: 75% (Posidonia sinuosa)</td>
<td></td>
</tr>
</tbody>
</table>

*Portunis pelagicus  **Aptychotrema vincentiana  ***Crinoidea*
1. Sandy substrate at the southern end of Transect 3
2. Sandy substrate at the southern end of Transect 3
3. Sandy substrate at the southern end of Transect 3
4. Sandy substrate at the southern end of Transect 3 with small isolated reef platform
5. Reef environment along Transect 3 on the rise just south of the shipping channel (depth approximately 5m)
6. Reef environment along Transect 3 on the rise just south of the shipping channel (depth approximately 5m)
7. Reef environment along Transect 3 on the rise just south of the shipping channel (depth approximately 5m)
8. Seagrass beds at the northern end of Transect 3
9. Seagrass beds at the northern end of Transect 3
10. Seagrass beds at the northern end of Transect 3
11. Seagrass beds at the northern end of Transect 3