WOODSIDE PETROLEUM DEVELOPMENT PTY. LTD.
NORTH WEST SHELF DEVELOPMENT PROJECT

REPORT AND CONCLUSIONS
BY THE
ENVIRONMENTAL PROTECTION AUTHORITY

SEPTEMBER 1979

DEPARTMENT OF
CONSERVATION & ENVIRONMENT
WESTERN AUSTRALIA

BULLETIN No. 69

90812/12/79—200—0

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HON. MINISTER FOR INDUSTRIAL
DEVELOPMENT

Your Ref.
Our Ref. 143/77

The Environmental Review and Management Programme prepared by Woodside Petroleum Development Pty. Ltd., for the North-West Shelf Development Project has been considered by the Environmental Protection Authority following submissions by the public and Government Departments.

Please find attached the Authority's report and recommendations as requested in your letter of 14 May, 1979.

C. F. PORTER
CHAIRMAN

P. R. ADAMS, Q.C.,

PROFESSOR A. R. MAIN

3 SEPTEMBER, 1979.

CONTENTS

1. INTRODUCTION AND SUMMARY

The environmental assessment of the North West Shelf Development has proved to be a far lighter task than the magnitude of the project might indicate. The Authority is able to report that there are no overwhelming environmental constraints which might lead the State to consider the project unfavourably.

As with the Yeelirrie project the Authority has been asked by various groups in the community to make judgements as to the acceptance or otherwise of the broad issue of the development of the resource. It is our belief that this is a matter for the State Government in consultation with the Commonwealth and in this case the Minister for National Resources has approved its use and means of distribution.

The Company has produced an Environmental Review and Management Programme, within the framework of a feasibility study running parallel streams of environmental, economic and technical investigation. It has, in our opinion addressed the major areas of environmental impact. If there is a criticism to be made of the ERMP it is that insufficient consideration has been given to the impact of this major development on the existing, well-developed community. Most major developments in the Pilbara have taken place in isolation with only a very small indigenous population, if any. This development cannot be considered in that light because of the existing infrastructure of Dampier and Karratha. This deficiency is revealed in too brief descriptions of safety and port development and operation, and in the rationale for the location of the construction workforce, its composition and effects on existing communities.

During the assessment period the matters relating to the construction phase workforce and the safety aspects of storage and distribution of liquefied natural gas received considerable attention. This resulted firstly in the Authority requesting the Company to provide more information on the workforce and its disposition and planning. Secondly in the decision of the State to commission the firm of chemical engineering consultants Cremer and Warner Ltd. of London, who are recognised as expert in risk analysis and the hazard assessment of industrial plant, to examine and report on safety and port operations.

In order to assist the EPA in its understanding of the project we visited the proposed sites for the land based developments and made a boat inspection of Searipple Passage, Mermaid Sound, Withnell Bay and King Bay. Additionally, to gauge local reaction, discussions were held with the Roebourne Shire Council and a public meeting convened in Karratha.

Although there was little criticism of the possible physical effects, the general feeling was a disquiet about the social asepcts of the proposal. This may be taken as an indication that the social issues have not as yet been fully clarified.

The EPA is confident that the project may be managed during the construction and operation phases with acceptable impacts on the environment.

2. THE PROPOSAL

The North West Shelf Joint Venture is currently carrying out a feasibility study of the North West Shelf Development Project. The Project comprises offshore gas/condensate production facilities, a marine pipeline and on onshore complex at South Withnell Bay to produce natural gas, liquefied natural gas (LNG) and condensate.

Woodside Petroleum Development Pty. Ltd. has undertaken an environmental analysis of the Project and has prepared an ERMP.

2.1 Offshore Production

North Rankin Gas Field

The North Rankin gas field lies in about 125 m of water some 130 km north west of the Dampier Archipelago. The natural gas (major components are methane 86%; ethane 5.5%; propane 2% and carbon dioxide 3%) is trapped in thick beds of coarse sandstone which occur in layers about 3 km below the sea floor. The gas saturated sandstone beds have a cumulative thickness of up to 500 m and extend over an area of about 50 km^2.

Production Platforms

It is proposed to exploit the North Rankin gas reservoir by means of two steel piled, production platforms spaced approximately 4 km apart, over the gas field. Platform design details are still being developed. It is expected that up to 30 production wells will be drilled from each platform, requiring the use of up to 550 cubic metres (m^3) of drilling mud for each production well. The mud comprises inert clays, barium sulphate, organic and inorganic chemicals in seawater.

Gas flowing from the reservoir will undergo initial treatment on the platforms before it is piped ashore. The processing includes the removal of sand, free water and condensate, followed by cooling to condense out additional water and hydrocarbons in the form of condensate. To reduce hydrate formation and corrosion of the submarine pipeline, the water content of the gas is reduced further by glycol dehydration methods.

The platforms will each have a capacity to produce a continuous daily average of about 19 million m^3 of raw gas.

Offshore pipeline

A submarine pipeline system, approximately 135 km long and 1 m in diameter, will carry platform processed gas and condensate to the treatment plant. A pipeline route close to the Angel and Gidley Islands has been nominated, thus avoiding the iron ore carrier anchorage area and the shipping approach channel. The line crosses the approaches to the Port about 8 km outside the existing Port limits, with a water depth of approximately 30 m.

The pipeline will be protected against possible damage from ocean forces, grounding of vessels and bottom trawling fishing operations. Protection measures include reinforced concrete weight coatings surrounding the pipe, pipeline burial, corrosion protection systems and various anchoring systems.

Preliminary studies have concluded that protection for the first 30 km of the pipe from the shoreline - designated as a shipgrounding, anchor dropping and shipping zone - will be by means of burial in trenches 1-2 m deep and coverage by backfill. The pipeline section 30-130 km offshore - within the fish trawling zone - will be buried to a depth of about 0.3 m, except for about a 10 km length where hard material is close to the sea bottom. Protection and stability in these segments will be provided by anchor systems.

For the section from 130 km to the platforms the pipeline will be buried in soft sediments. Additional protection against mechanical damage to the pipeline from dropping of ships anchors will be by designating specific locations where anchoring is permitted plus the adoption of procedures and positioning systems to give accurate anchor placement.

2.2 Onshore Treatment and Distribution

The onshore facilities will produce the following products from the raw gas stream:

(i) LNG for export,

(ii) pipeline quality gas for the Western Australian market, and,

(iii) condensate for bulk shipment.

Annual production rates are expected to be up to 6.5 million tonnes of LNG, 3,800 million m^3 of sales gas and 1.7 million tonnes of condensate.

The Joint Venturers have nominated South Withnell Bay, about 10 km north east of Dampier, as the preferred location for the onshore complex and for the LNG product loading terminal.

The treatment plant has four main components:

- inlet receiving station
- LNG process plant
- domestic gas plant
- condensate stabiliser plant.

In the liquefaction process the temperature of the raw gas is reduced to minus $160^{o}C$, when it condenses into a liquid at atmospheric pressure corresponding to a volume of 1/600 of the gas. The LNG plant contains the following units:

- acid gas removal unit
- dehydration unit
- liquefaction unit
- fractionation unit
- storage and loading facilities
- utilities plant.

The LNG will be stored in four double-wall insulated metal tanks, each with a capacity of about 65,000 m^3. The tanks are to be built on stable bedrock and be surrounded by an earth bund. LNG will be pumped through loading pipelines into LNG tankers at the loading jetty.

The condensate will be stored in two steel tanks, each of 70,000 m^3 capacity, and will be pumped also to tankers at the loading jetty.

Utilities

The onshore complex is to be self supporting for utility services such as a fuel gas system, steam and electricity generation, fresh water production, and also a nitrogen manufacturing unit for refrigerant and purging. The treatment plant will require also large quantities of cooling water involving a sophisticated once-through seawater circulating system pumping 150,000 m^3/hr and with an intake from Mermaid Sound. Residual coolant will be discharged back into Mermaid Sound via Noname Creek at a nominal 10^{o}C elevation in temperature.

All the aqueous discharges, including process plant drainage, ballast water, general service and stormwater, domestic waste water and residues from the process water treatment facilities are to be integrated and discharged through the main cooling water outfall. Under normal operating conditions the mean levels of contaminants in the cooling water discharge are not expected to be greater than the concentrations listed below:

Residual chlorine	0.5	mg/l*
Organophosphate anti-scaling agent	0.04	mg/l
Trisodium phosphate	0.002	mg/l
Oil	0.2	mg/l

The main atmospheric discharges under normal operation of the main complex will be restricted to:

- Carbon dioxide and trace concentrations of hydrogen sulphide

* Footnote: mg/l = milligrams per litre

- flue gases from gas turbine exhaust, steam generators, drier regeneration furnances and incinerators

- combustion gases from flare pilot gas and flare purge gas.

Carbon dioxide, from all plant sources, will be discharged at a rate of 246,000 N m^3/hr.* Gaseous hydrocarbons will be emitted from the three acid gas removal units at a rate of 380 N m^3/hr.

2.3 Shipping and Port Facilities

The export of LNG requires a fleet of specialised tankers, because it will be carried at atmospheric pressure at temperatures of minus 160°C. The number and size of tankers required will depend on market destinations. If all the LNG is exported to Japan then there would be a need for seven LNG tankers each with a capacity of 125,000 m^3, comprising five individual cargo tanks of 25,000 m^3 capacity. LNG tankers that will be used for this project will conform to international shipping design standards.

Condensate will be shipped in conventional oil and petroleum tankers, of up to 60,000 tonnes maximum cargo weight.

The Authority is aware that two schemes are under consideration for the shipment of stabilised condensate. The first scheme, (and only scheme discussed in the ERMP) would incorporate a condensate berth adjacent to the LNG berth. The other scheme would use a single buoy mooring system located some 6 km north north-west from the land base of the jetty.

The trestle type loading jetty is to be approximately 2 km long. Present port plans provide for a 8 km dredged channel 250-300 m wide to a depth of 14 m below ISLW*, plus a turning basin.

The LNG loading system is to consist of two delivery lines with a total capacity to pump up to 10,000 m^3 of LNG/hour, thus permitting tankers to load in about 12 hours, with a total ship turn around time of about 24 hours. The outward annual shipping movements are expected to be of the order of 120 and 50 for LNG and condensate tankers respectively.

2.4 Infrastructure

Service area/supply base

The preferred site for the establishment of the service

* Footnote: N m^3/hr = gas emission flow rate corrected to standard temperature (0°C) and pressure (1 atmosphere

ISLW = Indian Spring Low Water. Is approximately the lowest tide of the year in the Eastern Indian Ocean.

area/supply base is at a site near Phillip Point. The base is to provide facilities for servicing the supply vessels that will attend the offshore production platforms. It will also provide facilities for offshore construction and it may provide support for future offshore exploration. The land backed wharf is to be about 180 m long and will require a low tide water depth of 5-6 m. Approach channels to the wharf will need to be dredged.

Transport routes

Land access to the LNG plant will be by means of a sealed two lane roadway. A rockfill causeway will be constructed across the tidal flats at King Bay and the road will then follow the line of the north/south valley. Access roads to the construction campsite and the service area at King Bay will branch off this main roadway. Service corridors for water, power and communication cables will parallel these roads.

Communication tower

A communication system to provide radio links with the production platforms, telephone communications between land based operations and Karratha, and VHF coverage during construction of the submarine pipeline, is to be established on a high point some 3 km north east of the LNG plant. Access to the tower is to be by means of a gravel road.

Workforce

The precise constitution and size of the workforce has not been determined at this stage. However, the developer estimates that over a construction period of 4-5 years numbers will build up to 3,500 people. There is no projection of numbers in each year.

When construction is complete the workforce will diminish to a constant 500 people.

The proponent describes the development of a construction camp for some 2,400 single people and 400 married persons near Hearson Cove on the Burrup Peninsula, requiring a series of dwelling modules, a caravan park and a range of services. Proposals are made to build 400 houses in Karratha and to house married persons in caravan parks there, if necessary.

3. ENVIRONMENTAL ASSESSMENT

3.1 Offshore Production

Production platforms

Exploitation of the North Rankin gas resources will be undertaken subject to :

(i) the Commonwealth Petroleum (Submerged Lands) Act 1967-74 and,

(ii) the State Petroleum (Submerged Lands) Act 1967-70.

The exercise of powers and performance of functions of these two Acts is by means of an administrative arrangement between the Commonwealth and State Governments. Both drilling and production operations will be undertaken in accordance with programmes approved by the W.A. Department of Mines.

Approximately 30 tonnes of rock cuttings will be produced from each well and be discharged into the sea. These cuttings are expected to provide an artificial reef below each platform and will ultimately support a more diverse, although localised marine fauna.

Approximately 450 tonnes of drilling mud will be discharged into the sea during the drilling of each well. This is standard petroleum drilling practice for deep sea locations. No measureable ecological consequences are expected since rapid dispersal will be achieved as a result of the strong water currents and the depth of the water column.

The levels of hydrocarbons present in formation waters are not expected to exceed an average oil content of 30 mg/l, which is regarded as an acceptable discharge level. Biogradable and non-biodegradable refuse will be disposed of according to Commonwealth and State Government regulations and local environmental conditions.

Measures to prevent gas blow-outs and ship collisions are thorough and should not engender undue concern. Recent publicity afforded to the uncontrolled blow-out from the Mexican exploration well, Ixtoc 1, highlights the enormous environmental damage that can result from such an accident. Whereas the Mexican well was spilling oil at a rate of 7,500 tonnes/day, the estimated spill of condensate from a blowout event from a North Rankin well would only be of the order of 600 tonnes/day. Of this quantity, more than half would be dissipated by evaporation to the atmosphere.

Offshore pipelines

The construction, operation and maintenance of the submarine pipeline is to be undertaken in accordance with the Standards Association of Australia Submarine Pipeline Codes and subject to the requirements of the Petroleum (Submerged Lands) Acts.

The nominated route within the Archipelago is not in conflict with existing anchorage zones or major shipping channels.

Installation of the pipeline will disturb the bottom living fauna along a corridor approximately 20 m wide between the onshore plant and the offshore platforms. This is considered to be an inevitable, but minor impact on the marine life. The total area of seafloor to be affected is insignificant compared to the total area of similar habitat in the locality.

Initial testing of the pipeline for leaks involves the use of seawater containing additives, including corrosion inhibitors, an oxygen scavenger and bacteriacides. In view of the fact that the additives are toxic to marine life, there is a need for consultation with the Department of Conservation and Environment in regard to the discharge of the test solution.

Fish trawling operations will present a potential hazard to the pipeline. As Joint Venture commercial fishing on the North West Shelf is already underway and more fishing activity can be expected, there is a need for the platforms and pipeline to be marked on international charts. The gas field and pipeline could also be identified by buoys having radar transmitter units.

The Cremer and Warner report has reviewed the safety aspects of the pipeline. It concluded that the corrosion protection, cement covering, trenching and routine maintenance outlined in the ERMP are sufficient to ensure safe operation.

3.2 Onshore Treatment Plant

Site selection

Factors considered in the selection of a suitable site for the onshore complex included:

- the requirements of a marine terminal (sheltered deep waters close to the LNG plant)
- the physical requirements of the plant site (an area 100-200 ha as level as possible, with stable foundations and above the storm surge level)
- safety and environmental aspects
- access to large quantities of high quality cooling water
- access to township, industrial and community facilities

The proponent has exmined twelve sites for location of the onshore complex. Of these sites, only the South Withnell Bay and Searipple Passage localities fulfil the requirements for the marine terminal and the plant site.

Detailed investigations, including oceanographic, topographic, environmental and engineering studies, have been made of the South Withnell Bay and Searipple Passage localities. The relative value of these two localities was then assessed in terms of the impacts of dredging, discharge of cooling water and effects on landscape, flora, fauna and Aboriginal sites.

In the final analysis the South Withnell Bay site was selected as the preferred location for the onshore complex.

The major objections to the alternative Searipple Passage site are:

1. the cooling water system would require a solid fill causeway across Searipple Passage thus having major effects on the marine flora and fauna due to changes to water exchange patterns.

2. the requirements of extensive dredging for a shipping channel with the probable consequential stress to corals.

3. the necessary road access would mean uncontrolled entry to most of the Peninsula and thereby threatening Aboriginal sites, and, important terrestrial plant and animal communities.

3.3 South Withnell Bay Site

The proposed site for development is predominantly rocky hills and spinifex, with some coastal dunes, watercourses and mangrove communities located at the mouth of Noname Creek and the southern headland of Withnell Bay. There will be a permanent and substantial modification to about 100 ha of land at South Withnell Bay. This is an inevitable consequence of the establishment of the onshore complex. The plant site does not support rare or threatened vegetation units.

None of the vertebrate fauna recorded during the environmental investigations are classified as rare or have a restricted distribution.

Cooling Water Discharges

Of all the plant operations the continuous discharge of a large volume of heated and contaminated cooling water is considered to have the greatest environmental effect. It will have a major impact on the nearshore environment, resulting in significant increases in water temperatures. In the vicinity of Withnell Bay the background water temperatures will be elevated 2-3^{o}C between October and April and surface temperature 'plumes' a further 3.5-5^{o}C. An elevation of 6-8^{o}C above recorded summer water temperatures of 32-34^{o}C, which is already close to the lethal limit for corals, will cause mortality of mangroves and marine organisms, including corals. This effect may extend

up to a kilometre each side of the discharge point. But in our view this penalty is acceptable in relation to the importance of the project, and it represents only a minor impact on the marine biota found in the Dampier Archipelago.

Atmospheric emissions

It is unlikely that there will be any problems associated with the steam generation plant and the flare systems. However, there is some concern over the emissions of carbon dioxide from the Acid Gas Removal Units. Little information is given on the discharge of 30,000 N m^3/hr of carbon dioxide, which could be called a 'cold' emission at 40^{o}C. There may be merit in utilising a common flue to mix the carbon dioxide emission with the flue gases from the steam generation plant. It should be recognised that satisfactory dispersion of carbon dioxide will minimise the nuisance value of the trace of hydrogen sulphide.

Little mention is made of ongoing maintenance to the plant which will be situated in a hostile environment, adjacent to the sea. Metal surface preparation prior to repainting will probably be by dry silica sandblasting. Such operations invariably give rise to a general dust nuisance. Care will need to be taken to avoid health risk to operators.

3.4 Infrastructure

Service area/supply base

The nomination of the Phillip Point/King Bay area as the supply base has been made without reference to the value of this locality as an important recreational resource. The King Bay beach area, apart from Hearson Cove and Dampier town beaches, is the only recreational beach that is accessible by road to the Dampier/Karratha community. There is insufficient information presented in the ERMP about the suggested alternative locality for the supply base, namely a site just south of Noname Creek. The Authority sought clarification on these aspects during discussions with senior Company personnel. Additional information was given about the size of the supply vessels and the scope of the operations to be undertaken from the supply base, and hence the need for a sheltered, deepwater site.

The King Bay area is a superior locality in terms of protection from storm and cyclonic conditions. Even though extensive breakwaters would be required at the alternative site near Noname Creek, security during storms could not be guaranteed, as it could at King Bay. The wharf and storage area will only occupy a portion of the Bay, with the balance expected to be allocated to the State or other companies for land-backed wharf facilities.

Access Roads

An important factor requiring careful consideration in road construction on the Burrup Peninsula, relates to the identification and preservation of Aboriginal sites. A detailed survey of Aboriginal sites should be undertaken prior to detailed planning of the road networks. Particular attention should also be given to environmental aspects as they relate to road construction techniques and selection of borrow pits.

The gravel roadway that will service the communications tower will provide opportunities for unauthorised access to the northern part of the Peninsula. This is considered to be undesirable and use of this roadway needs to be strictly controlled.

Construction of the causeway across the King Bay tidal flats will need to be appropriately designed and built to ensure the continuance of the tidal flow.

3.5 Dredging Activities, Jetty Structures

The dredging of the shipping channel will mean the removal of 6.5 million tonnes of sediment and limestone, with the spoil being dumped on the seafloor, within about 2 km of the dredging operations. The seafloor of Mermaid Sound is described as comprising a poorly colonised limestone pavement and a sand-gravel-shell sediment containing minor amounts of silt. This latter habitat is known to support a population of crabs, prawns, burrowing fauna and demersal fish, and is occasionally trawled by commercial fishermen. The expected consequences of dredging include the direct destruction of the benthic fauna community within the area of operation of the dredge (approximately 500 ha).

The suspension of fine particulate matter will also have an adverse, although temporary, effect on adjacent plant and animal communities. Corals are known to be vulnerable to continued exposure of fine sediments. It has been predicted that dredging of the turning basin for the jetty head will have an adverse affect on the coral assemblages along the shoreline, perhaps as far north as Conzinc Bay. Since the biological component of this shoreline will also be under stress from the discharge of large volumes of heated waters, every effort should be made to minimise the impacts of dredging operations within the turning basin and at the service wharf area near Phillip Point.

Careful consideration needs to be given to the selection of dredge spoil areas. It is preferable that spoil be dumped into the deeper limestone pavement areas as disposal here would avoid the destruction of the sand-gravel-shell habitat that supports the limited commercial fishing operations.

The open trestle type loading jetty will not be an impediment to waterflow. However, it will be a physical obstruction to the movement of the small leisure craft using the eastern side of Mermaid Sound.

3.6 Safety aspects

The primary hazard of this development relates to the handling of LNG, which in gaseous form from 5 to 15% by volume with air is flammable. If a large quantity of LNG were to escape the liquid would rapidly vaporise and produce a vapour cloud initially denser than air. The gas vapour cloud may then move with the wind and may be ignited remote from the point of escape and a severe fire could result. The distance a vapour cloud will travel depends upon the prevailing atmospheric conditions.

The points at which LNG may escape are primarily in the plant, at the point of tanker loading and during tanker movement at sea within Mermaid Sound.

Because of the State's concern with the hazardous nature of LNG during its processing and handling, particularly on the possible effects on nearby populations at Dampier and Karratha and workers within the Project area, the Government commissioned the U.K. consultants Cremer and Warner Ltd. to provide an independent technical assessment of safety aspects.

The primary findings of this assessment were that South Withnell Bay is an entirely suitable site because the risk of fatality decreases from somewhat over one in a million years per head at the plant site boundary, to about one in ten million years at two kilometres from the plant. The risk at Hearson Cove and King Bay is estimated to be well within acceptable worldwide standards. The risk at Dampier and Karratha is negligible.

The consultants recommendations were particularly strong in relation to the need to control shipping movements to minimize hazards.

The management of the Dampier Port is vested in Pilbara Harbour Services Pty Ltd, a wholly owned subsidiary of Hamersley Iron Pty Ltd. This has been a satisfactory arrangement to the present time. However, the establishment of a major gas treatment industry in the same locality will generate substantially more port traffic. Future port activities, including consideration of safety aspects, will best be undertaken by an independent port authority. The EPA is aware of Government moves to establish such an independent port authority.

The Authority has noted the concern of local boating interests that the loading jetty, LNG plant and the service wharf will either deny or restrict access of small craft to the eastern portion of Mermaid Sound. It is proper that all shipping movements, including the restrictions applying to leisure boats, should be the direct responsibility of the port authority.

3.7 Aboriginal Sites

The Pilbara region is regarded by anthropologists and archaeologists in Australia as a most outstanding rock engraving province. It is said to contain a greater number and variety of figures than any other part of the continent. The Aboriginal Sites Department of the Western Australian Museum has undertaken surveys of Aboriginal sites within the proposed development areas on the Burrup Peninsula. Their findings, and recommendations have been presented in three reports.

It is important that the proponents continue to liaise with the Museum's Aboriginal Sites Department to ensure that their development activities are in accordance with the provisions of the Aboriginal Heritage Act, 1972.

3.8 Workforce

The brevity of the proponent's description of the location and nature of the construction workforce and its effect on the social and physical (biological) environment, is at odds with the major community response to the ERMP which expressed concern at the interference likely to result to the public amenity at Hearson Cove from the nearby construction camp.

As a result, the EPA asked the Company to present further information on its choice of the construction force campsite and the effects it thought the large temporary construction workforce might have on the present communities of Karratha and Dampier.

It seemed, prior to discussions, that the "Hearson Cove" camp would result in large numbers of single men moving into Dampier and Karratha for entertainment. The Company outlined subsequently, details of facilities to be provided at the campsite to make it self contained - sports facilities, canteens, libraries, religious venues, cinemas, shops - leading to our belief that the life of the existing communities will not be adversely effected. The Company also expressed the view that due to excessive travel times a significant economic burden would result if it had to transport large numbers of men between Karratha and Withnell Bay and that the men will be working long hours and travel would be tiring.

A number of people expressed the view that the single men workforce should be located in or adjacent to Karratha. It is our belief that the Karratha community would be disadvantaged to a greater extent by such a move.

We anticipate the construction camp will probably not disappear altogether, even though most living quarter modules may be removed toward the end of the construction phase.

As a consequence, it is possible there will always be an urban style of development on the Burrup Peninsula in this location. The management of the environment of the Peninsula, therefore, will require specific and careful attention. For example, incursions by four-wheel drive vehicles should be limited and fire controls instituted.

The possible impact of large numbers of single men using Hearson Cove also requires careful attention, although the Company is of the opinion that the long working hours of the construction workforce and its proposal to build an Olympic size swimming pool at the construction camp will result in minimal use of the beach.

3.9 Land Use Planning

We believe that the issues which have been highlighted and the valuable basic environmental data established during the study and assessment period have a broad application in further land use planning of the region and especially of the Burrup Peninsula. It seems possible that the Peninsula may be considered as an area for further industrial development in the future so that the issues of archaeological sites, recreation and ecology need to be carefully considered at an early stage.

In particular, communication and transport links within the Peninsula require sensitive treatment in regard to these issues.

4. CONCLUSIONS

After careful consideration of all the environmental issues involved in the proposed development, the Authority is pleased to report that the adverse impacts are minor or may be managed without great difficulty or expenditure. We recommend that the project proceeds in accordance with the ERMP prepared by the Company. The principal matters of concern are as follows:

1. The Safety Issue

Because of concern for the safety of those living in Dampier and using the Burrup Peninsula, should a major accident occur either at the processing plant or to a laden LNG tanker, the Department of Industrial Development commissioned Cremer and Warner Ltd. of London, internationally recognised consultants in hazard assessment, to review and report on all the safety factors.

Their report is re-assuring on this aspect. Although it is clear that the marine operation provides the greater risk, they believe this will be minimal if strict control of all shipping in the area be maintained.

No objection to the use of Withnell Bay for the gas processing plant can be entertained on the grounds of safety.

2. The Location of the Construction Camp North of Hearson Cove

Local concern was expressed at the choice of this site because of possible adverse impact on the beach at Hearson Cove, the only readily accessible beach in the area. The Authority initially shared this concern, together with a feeling that the temporary workforce would in any case be attracted to the facilities at Dampier and Karratha.

Accordingly, the Authority asked the Company to justify, the choice of this site rather than integration with the township of Karratha. However, it became clear from these discussions that the facilities which the Company proposed to develop at the campsite would be so substantial as to make it self-contained and thus minimise over-use either of the Hearson Cove beach or the townships of Dampier and Karratha.

In view of the long hours normally worked by construction workforce personnel and the distance of Karratha from Withnell Bay, we believe the choice of this site to be justified.

3. The Loss of Recreational Facilities

During their tour of the Burrup Peninsula, the Authority paid particular attention to the impact of the developments at Withnell Bay and King Bay on the general availability of recreational beach areas for small craft. It has concluded that the impact will be minor since there are many small sandy bays along the peninsula and on the off-shore islands. Only limited restrictions need to be imposed on small craft using Mermaid Sound.

4. The Impact on the Local Environment

The major impact is likely to be the effect of 150,000 m^3/hr of warm water, equivalent to an average 3½ times the cooling water discharge from the Kwinana Power Station, or 7 times the water consumption of Perth, on Noname Creek and the nearshore coral and marine biota. While localised damage to the mangrove communities and to the coral appears inevitable, these features are commonplace within the region. The environment in the immediate vicinity of the discharge is likely to re-adapt to the higher temperature regimes.

5. Management Requirements

The Authority has formed the view that the environmental impacts of the proposed development will be minor provided the Company proceeds with sensitivity and an understanding of the environmental issues.

To achieve this, we recommend that :

1. a qualified archeologist be employed by the Company during the construction phases to develop programmes, in conjunction with the W.A. Museum, to minimise the damage to Aboriginal sites and to ensure compliance with the Aboriginal Heritage Act, 1972.

2. the Company install gates and suitable fence barriers to restrict unauthorised use of the access road to the communication tower and any other service roads located north of Withnell Bay.

3. quarrying operations should not be undertaken within 200 m of the shoreline.

4. the Company consults with the Department of Conservation and Environment regarding the disposal of pipeline test solutions which may be toxic to marine fauna.

5. in order to minimise the impact of dredging on the near shore biological communities, the Company submit detailed dredging and spoil disposal plans to the EPA for approval.

APPENDIX 1

A REVIEW OF PUBLIC SUBMISSIONS RECEIVED ON THE NORTH WEST SHELF DEVELOPMENT PROJECT

CONTENTS

1. INTRODUCTION

A total of fourteen public submissions were received by the Department of Conservation and Environment and the Commonwealth Department of Science and the Environment in response to Australian-wide advertisements inviting public comment and review of the ERMP. The submissions are identified in Table 1.

Twelve submissions were transmitted to the Company for a formal reply to matters raised in the submissions as required by Commonwealth environmental legislation. Submissions No. 13, and 14 were received after the nominated closing time for public submissions and the Company was therefore not obliged to reply to these. However, all of the submissions have been considered by the EPA and have assisted in our evaluation of the ERMP.

The main thrust of the public comments relate to sociological and planning matters. In particular, the impacts of the construction workforce on the existing West Pilbara communities, the location of the construction camp near Hearson Cove and public recreation requirements were common themes. Only two of the submissions (Nos. 10, 12) were opposed to the project as outlined in the ERMP.

The following section elaborates upon the major areas of concern.

2. PUBLIC REVIEW OF THE ENVIRONMENTAL CONTENT OF THE NORTH WEST SHELF DEVELOPMENT ERMP

A review of the public submissions has identified twelve major areas of environmental concern. A brief outline of these is given in the following section of this report. A detailed breakdown of issues raised is depicted in Table 2 on page 24.

2.1 Sociological aspects

Five of the submissions referred to the inadequte treatment of sociological matters. The construction phase, with the expected large influx of single men, was identified as the principal concern.

The existing communities in the Pilbara were assessed as socially very fragile. There had been insufficient study or thought given to the likely impact of such a large, isolated, temporary workforce on the existing community, the construction workforce being anticipated as disruptive. An increase in delinquent behaviour was foreshadowed.

Submission No. 3 suggested that the definition of "Environment" under the Environmental Protection Act, 1972 be broadened to take into account sociological impacts.

2.2 Construction campsite

The question of relocating the construction campsite was raised in four submissions. A major objection to the campsite being located within 1½ km of Hearson Cove was that it would downgrade the only recreation beach outside Dampier townsite that is readily accessible by road to the people of Dampier and Karratha. It was claimed that the Hearson Cove area would become a private beach for the

construction workforce and therefore deprive long term residents of an important recreation area.

It was suggested that the construction workforce be accommodated in or adjacent to Karratha. This would encourage the development of joint facilities that would benefit the total community, and assimilation could be better provided for resulting in less social problems.

The submission from the West Pilbara Clergy Fraternal (3) outlined a number of specific needs of the construction campsite, if it were located near Hearson Cove. These included a welfare centre, bus service to neighbouring towns, on-site accommodation units for visitors, and staff to administer recreational facilities.

2.3 Planning matters

The tenor of a number of submissions was insufficient information about planning for the increased population. The project will bring a demand for additional education, recreation and leisure facilities and a need for expansion of organised youth activities. More information was sought on the accuracy of estimates of the consequential population.

The existing planning processes appear to be insensitive to local needs. So as to be more in accord with local aspirations, one submission (3) suggested that the formation of a 'local' group would assist in the co-ordination of community responses in regard to the provision of social and welfare facilities.

One submission (11) drew attention to the need for an overall plan for the region, including industrial needs.

2.4 Caravan parks

These will need to be constructed and maintained at a high standard, caravan parks constructed on the 'mobile home' concept being favoured. Supporting recreation, child care and shopping facilities are essential for each development.

It was considered that the establishment of a caravan park for married workers at the construction campsite near Hearson Cove would be a social disaster. It was also thought that the use of the caravan park currently under construction in Karratha for semi-permanent residents will increase vandalism in three neighbouring schools.

2.5 Aboriginal sites

More protection would be afforded to Aboriginal sites if the construction campsite was located outside the Burrup Peninsula. Every precaution should be taken to protect Aboriginal sites in the Withnell Bay area during construction and the employers should be advised of the importance of them. Further efforts should be taken to find local people who could provide information on the significance of the various sites.

2.6 Plant site

A question raised was whether the onshore gas treatment plant site at South Withnell Bay was selected on environmental or economic grounds.

2.7 Small craft

Concern has been expressed that the LNG plant, loading jetty and the safety requirements in the approach channels will impose restrictions on the movement of small craft in the Dampier Archipelago. In particular, clarification is sought on the affect of the project on access by small craft to Angel Island, Flying Foam Passage and Searipple Passage.

To avoid rough conditions in Mermaid Sound small boats need to stay close to the Peninsula shoreline. A suggestion has been put forward that small pleasure craft should be allowed beneath the LNG loading jetty within 400 m of the shore.

2.8 Cooling water discharge

The discharge of heated, contaminated cooling water will have uncertain effects on the marine environment.

The anticipated effect on the Dampier power station is unknown. However, existing generating plant capabilities could be limited if there is an increase in temperature at the power station inlet. There could also be potential problems due to weed or marine life fouling intakes.

It was queried whether the discharge of heated water would lead to fog conditions.

2.9 Air quality

The meteorological data presented are insufficient to establish the impact of the proposed development on air quality of the region.

There was no comment on the possible discomfort the hydrogen sulphide gas emission might have on Dampier and Karratha residents.

2.10 Port operations

The loading jetty, service wharf and channel locations are expected to impose significant congestion on existing Port operations. Expected increases in tug and ancillary vessel movements will restrict movement and access of small craft in Hampton Habour.

2.11 Safety aspects

Concern was expressed at the prospect of a gas vapour cloud, arising from an LNG spillage, passing over Dampier or Karratha, whilst the chance of a vapour cloud drifting in the direction of the ore carrier anchorages was queried.

The role and capacity of platform support vessels to attend to safety matters at the production platforms was also questioned.

There is a need for the State Government to maintain regular checks of the safety precautions and emergency requirements.

2.12 Energy policy

A re-assessment of an earlier Government decision to allow the export of significant quantities of gas and condensate was sought in three submissions. The ERMP should have canvassed the possibility of using a greater proportion of the resource for Australian domestic purposes.

3. TECHNICAL INADEQUACIES OF THE ERMP

A number of submissions criticised the ERMP, claiming technical inadequacies including such aspects as:

- the failure to include a comprehensive segment outlining the objectives, need and alternatives to the proposed action
- deficient treatment of sociological aspects
- insufficient information to gauge the impacts of cooling water discharges and atmospheric emissions.
- no evaluation of the proposal in terms of a cost/benefit analysis-

TABLE 1 LIST OF SUBMISSIONS

Submission Number	Name	Address
1	Karratha Senior High School Governing Council	Post Office, Box 289, Karratha, 6714
2	Gallaher, P.E.	387 Turner Way, Karratha, 6714
3	West Pilbara Clergy Fraternal	474 Crawford Way, Roebourne, 6718
4	Hamersley Iron Pty Limited	Hamersley House, 191 St. Georges Terrace, Perth, 6000
5	Lyons, T.	School of Environmental and Life Sciences, Murdoch University, Murdoch, 6153
6	De La Rue, C.J.	The Uniting Church in Australia for Australian Inland Mission Frontier Services. 72 Padbury Way, Karratha, 6714
7	Hollis, G.	Anglican Church, Parish of West Pilbara, Post Office Box 1, Dampier, 6713
8	Dampier Archipelago Recreation Advisory Committee	Post Office, Box 7, Dampier, 6713
9	Queensland Conservation Council, Inc.	Post Office, Box 238, North Quay, Brisbane, Queensland, 4000.
10	Australian Conservation Foundation	672B Glenferrie Road, Hawthorn, Victoria 3122
11	Institute of Engineers Australia - Dampier Group	G-40 Shakespeare Street, Karratha, 6714
12	Gas and Fuel Corporation of Victoria	Box 841Q, G.P.O., Melbourne, Victoria, 3001
13	CSIRO Division of Building Research, Remote Communities Environment Unit	Post Office, Box 56, Highett, Victoria 3190
14	Hampton Boat and Sailing Club Inc.	Post Office, Box 141, Dampier, 6713

TABLE 2

PUBLIC SUBMISSIONS - NORTH WEST SHELF DEVELOPMENT PROJECT - DETAILED BREAKDOWN

Submission No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Sociological aspects	x		x			x	x						x		5
Construction campsite	x	x	x										x	x	5
Planning matters	x		x	x		x					x			x	6
Caravan parks	x		x	x									x		4
Aboriginal sites		x							x						2
Plant site											x				1
Small craft								x						x	2
Cooling water discharge				x	x				x					x	4
Air quality				x	x						x				3
Port operations				x										x	2
Safety aspects			x	x				x	x						4
Energy policy			x							x		x			3
No cost/benefit analysis									x		x				2
Alternatives not adequately considered									x	x		x			3
Lack of data					x				x				x		3

APPENDIX II

SUMMARIES OF STATE GOVERNMENT DEPARTMENTAL SUBMISSIONS

CONTENTS

1. DEPARTMENT OF AGRICULTURE

Erosion

Small areas of foreshore sand could be rapidly destabilised if cleared or extensively used. These areas need to be protected. The remainder of the Burrup Peninsula appears to be very stable and presents no erosion hazard.

(a) Western Australian Herbarium

The document is rated as one of the best examined regarding the effects of a major development on the terrestrial environment.

A number of recommendations were made, particularly concerning rare species, baseline monitoring, reporting, access roads and fire protection.

Details are as follows:

i. Government Departments are to be notified if protection of the two undescribed species of *Cyperus*, and *Stackhousia viminea* and *Dodanaea peduncularis* is found to be impossible. The Company should then be obliged to fund the work necessary to see if other sites of occurrence are present and/or regenerate the species in a safe location.

ii. There needs to be a system of regular reporting to Government on monitoring aspects.

iii. Detailed vegetation mapping of sensitive areas should be undertaken.

iv. Access to the road leading to the communication facility must be carefully restricted and the road and adjacent land made secure by fencing and a locked gate.

v. Fire protection measures must not take the form of extensive hazard-reducing burns.

vi. Care is required in road construction so as to minimise detrimental impacts on the landscape.

vii. Base line monitoring of mangroves at the north end of Withnell Bay, should be undertaken, prior to the commissioning of the onshore treatment plant.

viii. There is inadequate knowledge of the marine flora of tropical W.A. A cautious approach to the management of the marine environment is recommended.

ix. A general recommendation that the Company be committed to specific objectives and programmes.

2. DEPARTMENT OF FISHERIES AND WILDLIFE

2.1 Marine aspects

Closer examination is required of the possible hindrance of the pipeline to trawling operations.

The pipeline test solution will contain extremely toxic substances. There needs to be an examination of the proposed discharge method.

Consideration should be given to controlling the introduction of foreign organisms from discharged ballast water.

Because of its continuous influence on the nearshore environment, the discharge of heated and contaminated cooling water is considered to be probably the most important process of the operation. To enable an evaluation of the validity of the modelling procedures used for predicting the maximum surface plume temperature rises, further information is sought on the methodology used.

A greater population will result in increased recreational pressures on fish and other fauna.

The Department stressed the importance of thorough monitoring prior to and following gas production.

The Department also provided detailed comments on technical aspects, including a segment on oil drilling and trawl fisheries.

2.2 Terrestrial aspects

Fauna

The Searipple Passage site for the onshore treatment plant is most undesirable from a wildlife conservation viewpoint. It would provide ready access to Dolphin Island, a "B" class reserve for the conservation of Flora and Fauna.

Flora

The ERMP highlights the floristic richness of the Burrup Peninsula - Dolphin Island Area.

The Department recommended that the northern end of the Peninsula be set aside as a reserve for conservation of flora and fauna. This would minimise the impact on Dolphin and adjacent islands and on Searipple Passage.

3. WESTERN AUSTRALIAN MUSEUM

3.1 Aboriginal Heritage Act

The recommendations contained in the three Museum reports are supported and have been endorsed by the Aboriginal Cultural Material Committee.

Dolphin Island, especially the western half is important and measures are being taken to protect this by the Aboriginal Heritage Act or by listing the area in the Register of the National Estate.

There is also a need to consider the indirect impacts of tourism. Developers should prepare management programmes to monitor areas where access will be provided.

3.2 Marine environment

Most sections are comprehensive. However, more precise quantitative data are needed for certain localities as a basis for future monitoring programmes. This is especially important for areas adjacent to the cooling water discharge point.

The increase in water temperature due to the discharge of heated and contaminated cooling water will cause mortality of marine organisms, including corals, along several kilometres of coast. As calms and onshore winds are prevalent during summer the effects of the discharge could be more widespread than the predictions indicate.

The Museum also suggested that the alternatives of discharging the cooling water, either into the middle of Mermaid Sound or into Nickol Bay, should be thoroughly investigated in the interests of preserving the diverse and interesting marine fauna of the Withnell Bay coastline.

3.3 Terrestrial environment

It is expected that perhaps 10 to 30 species of reptiles found elsewhere in the Pilbara might also be found on the Peninsula. The possibility should not be discounted that one or more species of these animals are endemic to the Burrup Peninsula.

4. DEPARTMENT OF INDUSTRIAL DEVELOPMENT

The ERMP presents a reasonable coverage of the impact the development will have on the West Pilbara region. Minor comments were provided relating to population statistics and projections.

5. PLANNING AND CO-ORDINATING AUTHORITY

The Planning and Co-ordinating Authority has previously recognised that the project will have an impact on the townships in the area, particularly Karratha, and it has received an interim report from its Townsites Development Committee on the implications of the project. The P & CA

has reviewed the findings of the Committee report and has concluded that there are no conflicts which cannot be resolved by proper planning.

There are follow-up studies being undertaken in relation to the recreational needs of the region and development planning for the Peninsula.

The P & CA has also advised that the Director General of Transport has been requested to give consideration to draft Port Authority legislation.

6. PILBARA REGIONAL ADMINISTRATOR

6.1 Construction phase

The large influx of single males into Hearson Cove will bring sociological problems to the surrounding communities of Dampier, Karratha, Roebourne and Wickham.

The influx of 900 married families, and accommodating 600 of them in caravan parks will inevitably mean additional social problems. Welfare agencies will need to plan for an increase in the demand for services.

6.2 Recreational pressures

The expected increase in small boat ownership will mean additional demands for boat launching facilities and impose greater strains on the offshore islands. The ownership of four wheel drive vehicles is likely to place pressures on the Peninsula and adjacent coastal areas.

Public comment is that the construction camp will adversely affect existing recreational usage of Hearson Cove. The land-backed wharf planned for King Bay will prevent the use of Phillips Beach for recreational purposes.

6.3 Production phase

With good planning the changeover to the production stage should be implemented with little consequence on the existing communities.

6.4 Recommendations

i. In any agreement entered into between the State and the Company, the Company should provide some of the infrastructure and assist in provision of community services and facilities.

ii. Recreation reserves in the Archipelago, as outlined by the Dampier Archipelago Management Advisory Committee should be supported by the EPA and clarified prior to the proposed development.

iii. The application of the Off-Road Vehicles Act needs to be clarified in terms of administrative arrangements.

iv. Government Departments involved in sociological aspects and maintenance of law and order be invited

to comment from within the region on aspects directly concerning their activities prior to any agreement between the State and Company.

7. TOWN PLANNING DEPARTMENT

7.1 Housing (Construction Stage)

The Department is concerned about the caravan park accommodation. There will be a requirement for six additional caravan parks, for a short time. Doubts were expressed whether sufficient entrepeneurs can be found to build and operate as many caravan parks. Alternative accommodation arrangements for married workers will need to be worked out in advance. One alternative suggested to overcome this problem is for the State Housing Commission to build houses prematurely and to rent them.

As the caravan parks will be further away from schools than residential cells of Karratha, and further from recreation and shopping facilities, there will be a need for supplementary recreationa areas, kiosks and a bus service.

The Department is opposed to the development of a caravan park at the Hearson Cove construction campsite.

7.2 Housing (Operational Phase)

The proposals to house the Company workforce and the consequential workforce in Karratha, in planned residential areas, appears to be an entirely satisfactory arrangement.

7.3 Future industrial development

The Department has acknowledged the environmental value of the Burrup Peninsula and has therefore suggested that other industrial projects for the West Pilbara should be located away from the Peninsula.

8. STATE HOUSING COMMISSION

Part of the consequential increase in population during both construction and operation phases may need to be housed by the Commission. This may require 100-150 dwelling units.

9. PUBLIC HEALTH DEPARTMENT

9.1 LNG plant

Atmospheric emissions

There are no problems associated with the steam generation plant and the flare. Some concern has been expressed about the carbon dioxide emissions. It has been suggested that every effort should be made to utilise a combined flue. Suggestions were also made for ongoing maintenance of the plant.

Accidential emissions

Consideration should be given to the installation of an oxygen monitoring system in work areas.

Noise

The location of the plant precludes problems of noise nuisance to residents. Detailed planning should take account of noise abatement requirements.

9.2 Environmental Health Services

Construction phase

The campsite will need to be built and operated in accordance with Construction Camp Regulations. There are no problems anticipated with the water supply for the construction camp. However, the Company will be required to undertake bacteriological monitoring as required by the PHD. The proposals for package treatment wastewater plants have to be submitted to PHD for approval. The discharge pipe for surplus effluent is to be properly designed to prevent contamination of offshore recreation areas.

Operational

No environmental health difficulties are foreseen in constructing a dam on the Harding River to augment Karratha's water supply.

No difficulties are expected in dealing with increased volumes of sewage.

The existing arrangements for disposal of solid waste will need re-examination.

9.3 Personal Health Services

No additional hospital beds are required as a result of the project.

10. DEPARTMENT OF LANDS AND SURVEYS

The Roebourne Shire has requested the creation of a recreation reserve at Hearson Cove, to be vested in the Shire. Although supported by the Department, there are complications because Hamersley Iron Pty.Ltd.hold mining leases for this area.

The Department also clarified the reserve status of the islands of the Archipelago.

11. PUBLIC WORKS DEPARTMENT

The water supply sections are satisfactory. The PWD is to provide water supplies to the construction workforce at Karratha and on the Peninsula and the subsequent domestic supplies to operational personnel living in these areas.

Planning for wastewater facilities appears to be satisfactory. The installation of these facilities will require the approval of the Commissioner of Public Health before work commences.

The discharge of effluents into the ocean will not affect any of the surface or underground waters.

12. MAIN ROADS DEPARTMENT

Care is required in road construction because of the presence of Aboriginal sites. The main north-south road as shown on the map is located high on the slopes of the eastern side of the valley. This may be in conflict with a proposed railway alignment. Transport planning issues need to be clarified.

Government approval is required for the detailed location and design of roads. Construction techniques for roads and borrow pits in regard to environmental matters to be subject to Govenrment approval.

13. DEPARTMENT OF MINES

The ERMP is a comprehensive document and no objections are raised to the planned development.

14. HARBOUR AND LIGHT DEPARTMENT

Reference was made to discussions with the consultants Cremer and Warner Ltd.

15. DEPARTMENT OF LOCAL GOVERNMENT

There are no aspects of the ERMP which affect the responsibilities of the Department.

16. DEPARTMENT OF LABOUR AND INDUSTRY

Onshore constructions and port facilities, including the jetty, will be subject to the Construction Safety Act and the Machinery Safety Act.

Operations will be subject to the Machinery Safety Act and the Factories and Shops Act.

17. TRANSPORT COMMISSION

There are no conflicts with Commission responsibilities.

18. STATE ENERGY COMMISSION

SEC involvement is limited to the Dampier to Perth natural gas pipeline which is the subject of a separate ERMP.