# Appraisal drilling programme for Wonnich field south-west of the Montebello Islands

Apache Energy Limited

Report and recommendations of the Environmental Protection Authority

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## Summary

Apache Energy Limited (the proponent) proposes to carry out a program of appraisal drilling on the Wonnich petroleum field within permit area TP/8. This report provides the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for the Environment on the environmental factors, conditions and procedures relevant to the proposal.

In the EPA's opinion, giving appropriate consideration to the information in this report and submissions referenced in Appendix 2, the following are the environmental factors relevant to the proposal:

- oil (from spill incidents)
- coral reefs;
- island shorelines;
- mangroves; and
- turtles and dugongs.

Assessment of the proposal has involved considering potential oil spill risks, including both the probability of a spill and the potential environmental consequences. The EPA has concluded that, with appropriate management, the risks would be extremely low and it is most unlikely that the EPA's environmental objectives would be compromised.

In the EPA's opinion, if the proposal is implemented, it should be subject to conditions and procedures as summarised below:

*Conditions*

(a) drilling is to be restricted to the period 1 June to 31 August in any year.

(b) before drilling the Wonnich appraisal wells, the proponent is to commission an independent environmental audit of the drilling rig and its operations, to the requirements of the EPA on advice from the DME.

(c) the proponent is to put in place legally-binding contract requirements with the drilling contractor to achieve environmental best practice (as to be agreed), to the requirements of the EPA on advice from the DEP and the DME.

(d) to assist oil spill contingency planning, the proponent is to further validate the oil spill trajectory model by continuous field data for a period of two weeks, including surface water movements, before drilling commences. Appropriate modifications are to be made to oil spill response strategies if there are any significant variations from the current oil spill trajectory predictions, to the requirements of the EPA on advice of the DME and the DEP.

(e) the proponent is to develop a rig refuelling procedure, such that refuelling would only be carried out under conditions where any spillage would be carried away from sensitive environments, to the requirements of the EPA on advice of the DEP and the DME.

(f) the proponent is to prepare and implement an appropriate communication strategy to inform the public about the environmental risks from the proposed project and about the risk management measures to be put in place, to the requirements of the EPA.

(g) the proponent's commitments as set out in the CER, and as subsequently modified during the assessment process, to be made legally enforceable.

(h) in order to manage the relevant environmental factors and EPA objectives contained in this Bulletin, and subsequent environmental Conditions and Procedures authorised by the Minister for the Environment, the proponent is required to prepare, prior to implementation of the proposal, an environmental management system, including an environmental management program, in accordance with recognised environmental management principles, such as those in Australian Standards AS/NZS ISO 14000 series.

*Procedures*

(a) an oil spill contingency plan has been prepared and has been approved by the DME under the provisions of the *Petroleum (Submerged Lands) Act.* As is normal practice, before approving the contingency plan, the DME sought advice from the DEP and the State Committee for Combating Marine Oil Pollution.

(b) As a condition of approval of the oil spill contingency plan, the DME will require the proponent to carry out a simulated trial of the plan, up to and including deployment of oil spill combat equipment. The DME also will require the proponent to carry out a successful field trial of the oil spill boom at the project site before drilling commences.

(c) the DME will require the proponent to take out adequate oil spill insurance to cover damages to Third Parties and cost of oil spill clean-up operations, to meet the requirements of the *Petroleum (Submerged Lands) Act.*

The EPA submits the following recommendations:

Recommendation 1

That the Minister for the Environment note the report on the relevant environmental factors, including the EPA objectives for each factor (Section 3).

Recommendation 2

That the Minister for the Environment note that the EPA has concluded that, if implemented according to the EPA's recommended conditions and procedures (Section 4), the risk of adverse impact from the proposed project would be extremely low and it is most unlikely that the EPA's objectives would be compromised.

Recommendation 3

That the Minister for the Environment set the conditions and procedures detailed in Section 4 of this report.

*Other advice*

Comparative risk

The EPA considers that the overall ecological risk from oil spills from the proposed short-term appraisal drilling project are extremely low and are comparable with accepted human health and safety risks.

EPA policy on offshore petroleum drilling

The EPA's policy on petroleum drilling near coral reefs and other environmentally sensitive areas is at present being revised and will be released shortly. The revised EPA policy document will include a general framework for environmental risk assessment for drilling proposals close to coral reefs, mangroves and other environmentally sensitive environments.

Information requirements for an oil production proposal

This assessment has addressed oil appraisal drilling on the Wonnich field. Any proposal to undertake production drilling for oil on the Wonnich field would require a separate environmental impact assessment.

In the case of the Wonnich appraisal project, drilling would occur over a short period only and oil spill risks are extremely low. However, in a production operation, production would be carried out over a number of years and there is therefore the potential for higher risks. Therefore, for an oil production proposal on the Wonnich field, there would be a need for additional risk information, particularly information on tertiary and quaternary risks.

Disposal of oil recovered from marine oil spills

The EPA notes that the oil spill contingency plan for the Wonnich oil appraisal project refers to requirements for disposal of recovered oil, in the unlikely event that there is an oil spill from the project. The EPA is of the view that the general issue of disposal of oil recovered from marine oil spills, whether the spills are from the offshore exploration and production industry, or, as is more likely, from shipping incidents, is an important issue which should be addressed by the State Committee for Combating Marine Oil Pollution.

Recommendation 4

That the Minister for the Environment note the EPA's other advice (Section 5).

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## Tables



## Appendices

## 1. Introduction and background

Apache Energy Limited, the proponent, proposes to carry out an appraisal drilling program on the Wonnich field south-west of the Montebello Islands (Appendix 1: figure 1). The appraisal drilling program is designed as a follow-up to an exploration well (Wonnich-1) drilled by Ampolex (the previous permit operator) in 1995. The Wonnich-1 well, which was assessed by the EPA in Bulletin 780, was drilled without incident and made a discovery of gas and oil.

On 16 November 1995 Apache Energy Limited referred its proposal to the EPA to determine the level of environmental assessment required.

The proposal falls within an environmentally sensitive area as defined by the EPA (Bulletin 679) and within an area recommended as a marine reserve (Marine Parks and Reserves Selection Working Group, 1994). The coral reefs, lagoons, intertidal areas and mangroves of the Montebello Islands are judged to be of high conservation significance. The intertidal margins of the Montebello Islands are a 'C-class' conservation park under the Conservation and Land Management Act. The EPA therefore determined that the proposal should be formally assessed as a Consultative Environmental Review (hereafter called the "CER").

The CER (Apache Energy Limited, 1996a) was released for a four week public review period ending 19 February 1996. A list of organisations which made submissions is given in Appendix 2.

At the request of the EPA, the proponent also submitted a supplementary report on oil spill risk (Apache Energy Limited, 1996b) and a draft oil spill contingency plan (Apache Energy Limited, 1996c).

## 2. The proposal

### Appraisal drilling program on the Wonnich field

The proponent (Apache Energy Limited) proposes additional drilling on the Wonnich oil and gas field as a follow-up to the Wonnich-1 exploration well drilled by Ampolex in August 1995. The Wonnich-1 well was drilled without incident and showed that gas is present in the field in commercial quantities. The primary purpose of the proposed additional drilling is to prove reserves of oil. The proposal is summarised in Table 1.

The follow-up drilling would be 1.5 km closer to the Montebello Islands than the original Wonnich-1 well (Appendix 1: figure 1). The drill rig would be located 1 km west of one of the string of coral patch reefs (collectively called "the western barrier reef" or "the west fringing reef") which lie to the west of the Montebello Islands. The drill rig would be located in about 20 m of water and two wells (Wonnich 2 and 3) would be drilled. Wonnich 3 would be drilled directionally to a depth of 2.3 km under the nearest coral patch reef. Figure 2 (Appendix 1) is a cross sectional diagram showing the location of the proposed wells.

### Physical disturbance from rig placement and anchoring

The sea floor at the project location consists of a sandy substrate with very little attached marine life (Apache Energy Limited, 1996a). Physical impacts from rig positioning and vessel anchoring would be very localised and transitory.

### Drill cuttings

Drill cuttings (the rock chips from the drilling operation) would be disposed of down hole, except for the first 16.3 $m^3$ which would be disposed of on the sea floor (Apache Energy Limited, 1996a).

**Table 1. Summary of proposal**

| | |
|---|---|
| Type of rig | Jack-up drilling rig. |
| Rig location | Approx 1 km west of Montebello barrier reef. |
| Depth of wells | The vertical well will be 2,400 m deep and the deviated well will be 2,330 m deep. |
| Depth of water | About 20 m. |
| Duration of project (drilling period) | Approximately 25 days. |
| Refuelling | The greatest chance of an oil spill is during rig refuelling. The proponent proposes refuelling the rig once during the program. Refuelling would be carried out under conditions such that any spillage would be carried away from sensitive areas. Dry break couplings would be used, so that, in the event of a hose failure, spillage would be limited to the contents of the hose (200 litres) only. The fuel hose will be wire reinforced. |
| Production testing | The proponent has made a commitment to use only "closed chamber" production testing. This will remove the potential for spillage from burning-off during production testing. |
| Drilling fluids | A low toxicity water-based fluid would be used for the vertical well. A low toxicity synthetic ester-based drilling fluid would be used for the deviated well. |
| Oil spill contingency plan | A detailed site-specific oil spill contingency plan has been approved by DME.<br><br>Chemical dispersants cannot be used at this location because of proximity to coral reefs.<br><br>A special oil spill combat boom suitable for open water conditions will be on site.<br><br>A dedicated oil spill combat vessel and trained crew will be on site throughout the project. |
| Characteristics of Wonnich crude oil | Light volatile crude oil, API gravity 38°. Laboratory testing shows that the oil would evaporate rapidly and would not form a stable emulsion or "mousse". The oil is of low density and therefore will not sink. Physically dispersed droplets of Wonnich crude will have a strong tendency to return rapidly to the sea surface. |
| Toxicity of Wonnich crude oil | Independent laboratory tests indicate that both fresh and weathered Wonnich crude oil is "moderately toxic" to shrimps, fish and sea urchins. There is no information about toxicity to corals. The toxins in Wonnich crude are primarily low molecular weight polycyclic aromatic hydrocarbons (PAHs). |

### Drilling fluids

The drilling fluids (muds) would be either water- or ester-based. Such fluids are of low toxicity and degrade readily. After completion of drilling, the ester-based fluids would be returned to the manufacturer for recycling (Apache Energy Limited, 1996a).

### Lighting

For safety reasons, there is a requirement for bright lighting on board the drilling rig. This can attract birds, fish, turtles and other marine life. There is anecdotal evidence that this may result in increased predation of young turtles by birds, fish and sharks. However, if, as proposed in the CER, the project is carried out in winter (outside the turtle breeding season), this problem will be avoided.

### Formation water

Only insignificant amounts of formation water will be produced from the appraisal drilling project and will be disposed of to the sea (Apache Energy Limited, 1996a). The total amount produced is expected to be no more than 160 litres (Dr I Stejskal, Apache Energy Limited, *pers. comm.*).

### Oil (from spill incidents)

The primary potential source of environmental impacts from the proposal is oil spillage (fuel oil or crude oil) from equipment and operations. This factor is discussed further in section 3.2 below.

### Oil spill contingency plan

Under the petroleum legislation administered by the Department of Minerals and Energy (DME), all petroleum exploration and production projects are required to have a workable oil spill contingency plan. Following extensive consultation with the Department of Environmental Protection (DEP), the DME gave approval to the oil spill contingency plan for the Wonnich appraisal proposal on 21 April 1997. The key elements of the plan are as follows:

- chemical dispersants cannot be used at this location because of proximity to coral reefs;
- a specialist oil spill combat vessel and trained crew would be on site throughout the project;
- in the event of an oil spill moving towards the Montebello Islands, an oil spill boom would be deployed to deflect oil away from sensitive areas such as mangrove and mudflat areas. The proponent has selected the Seacurtain Offshore Reelpak boom (a boom suitable for use in open water conditions) as the most suitable for this location. 400 metres of boom will be available;
- the DME will require the proponent to carry out a successful simulated test of the oil spill plan including deployment of oil spill combat equipment; and
- in addition, before drilling commences at the Wonnich appraisal site, DME will require the proponent to carry out a successful trial deployment of the boom under actual field conditions.

## 3. Environmental factors

### 3.1 Relevant environmental factors and risk

*Relevant environmental factors*

In the opinion of the EPA, based on the submissions, information and material listed in Appendices 2 and 3, the following are the environmental factors relevant to the proposal:

- oil (from spill incidents)
- coral reefs;

- island shorelines;
- mangroves; and
- turtles and dugongs.

The relevant environmental factors are discussed in sections 3.2 to 3.6 below.

*Use of environmental risk in this report*

The EPA policy on offshore oil drilling (EPA, 1993) states that:

> 'In areas of the highest sensitivity, proposals may not be considered acceptable unless it can be shown that any associated risks are small and any impacts are manageable'.

The Wonnich appraisal drilling location is within an area designated as an "environmentally sensitive area" by the EPA (EPA, 1993) and inside an area recommended as a marine reserve (Marine Parks and Reserves Selection Working Group, 1994). The drilling location is close to sensitive marine habitats of high conservation significance, including coral reefs and intertidal areas. The EPA has therefore assessed the proposal through a consideration of environmental risk and other technical issues.

The concepts of risk assessment and management are well established for human health and safety applications. However, the application of risk assessment and management to the environmental effects of oil spills is still in its infancy. A definition of environmental risk, following Warner (1993), is as follows:

> Environmental risk is a measure of potential threats to the environment taking into account, firstly, the probability that events will cause or lead to environmental degradation, and, secondly, the potential severity of that degradation.

For the purposes of this report, and following usual risk considerations, oil spill risk has been considered in terms of four levels of risk, namely:

- primary risk: the probability of an oil spill, and the volume of that spill at source, from the drilling operations and equipment failure;
- secondary risk: the probability of an oil spill travelling on the water surface and reaching a sensitive part of the environment;
- tertiary risk: the probability that the sensitive part of the environment will suffer degradation, and the form and extent of that degradation; and
- quaternary risk: the probability that sensitive parts of the environment will recover from the influence of the oil, and the form and extent of that recovery.

The primary and secondary risks can be estimated quantitatively, but there is insufficient information to quantify the tertiary and quaternary risks and they can only be estimated qualitatively. However there is little comparative data available to assess the acceptability of the risk.

## 3.2 Oil (from spill incidents)

### Aspects of oil (from spill incidents)

*International experience*

Apache Energy Limited (1996a, 1996b) has estimated the probability of oil spills from an offshore exploration drilling operation based on the international data on oil spills for operations of this type. The North Sea and Gulf of Mexico oil spills databases are sufficiently extensive to determine risk probabilities for various categories of spill for operations equivalent to that proposed.

Reports produced for the proponent by DNV Technica (DNV Technica, 1996a,b) identified a number of potential sources of spillage from offshore drilling, including spills from well head valve leakage or valve overflow. Such incidents occur in production wells only and are therefore not considered further here. Based on technical advice from the proponent, the DME and an independent consultant, there are six potential sources of oil spillage from exploration drilling:

- burning-off during production testing;
- refuelling incident;
- diesel storage on rig;
- rupture of fuel tank on support vessel;
- loss of well control (a "blow-out");
- partial loss of well control (a "kick")

The six potential oil spill sources are considered further below.

*Burning-off during production testing*

The Department of Minerals and Energy (DME) has advised that one of the main sources of small spills (of the order of 1000 litres) from offshore exploration / appraisal wells is spillage from burning-off during production testing. The DME has advised that risk from production testing could be significantly decreased by using "closed chamber" methods only (ie. storage of the oil in tanks on the rig rather than burning). The EPA notes that the proponent has made a commitment to use such "closed chamber" methods only.

*Refuelling incident*

A spill of diesel fuel could occur as a result of a hose failure while the rig is being refuelled on site. The proponent has made a commitment to use "dry break" hose couplings so that, should a hose failure occur, any spillage would be limited to the contents of the hose only. This would amount to no more than 200 litres only (Dr I Stejskal, Apache Energy Limited, *pers. comm.*). In addition, the proponent has made a commitment to use wire reinforced hose and to refuel only under wind and tide conditions such that any spillage should be carried away from sensitive environments. These precautions would significantly reduce the overall risk from this source. The probability curve for rig refuelling incidents, based on the international data, is given in Figure 4 (Appendix 1).

*Diesel use and storage on rig*

There is potential for spillage from diesel use and storage on rig. Based on the international data (Figure 4, Appendix 1; Table 2, below), the overall probability of such an incident causing a spill of 80,000 litres during the proposed drilling program is about $7.0x10^{-5}$ during the 25 day drilling period. This is same as about 1 chance in 14,400 during the drilling period.

The main source of significant diesel spillage from the rig would be from rupture of the rig's fuel tank from vessel collision. Such an incident could not occur in the proposed project as the rig fuel tank would be situated too high above the sea surface to be perforated during a collision. In addition, the rig is double skinned and is therefore further protected from possible impact.

*Rupture of fuel tank on support vessel*

Another potential source of significant diesel spillage is rupture of a fuel tank on a support vessel as a result of collision with the rig or as a result of vessel sinking or grounding. No quantitative data are available on the probability of such incidents involving vessels. For the purposes of risk analysis, the proponent has assumed that the probability is the same as that for diesel storage on the rig.

**Table 2. Possible scenarios for primary oil spill risk from drilling operations / equipment failure.**

| Event | Rupture of fuel transfer hose | Rupture of fuel tank on support vessel | Loss of well control (blow-out) during production testing |
|---|---|---|---|
| Type of spillage | Diesel fuel | Diesel fuel | Wonnich crude |
| Assumed quantity of spillage (based on advice from Apache Energy and DME). | 200 litres | 80,000 litres | 600,000 litres |
| Probability (based on the international data). | $2.0 \times 10^{-2}$ during the 25 day drilling period | $7.0 \times 10^{-5}$ during the 25 day drilling period | $4.0 \times 10^{-5}$ during the 25 day drilling period |
| Notes | Maximum size of spillage expected to be no more than 200 litres since proponent will use "dry break" hose couplings. | Probability estimates for this category are based on probabilities for spills from diesel storage on rigs. | The actual probability of a blow-out is considerably lower since the formation is not over pressured and there is no shallow gas layer. |

*Blow-out*

The worst case scenario would be a complete loss of well control (blow-out) resulting in a large oil spill. Such an event is extremely unlikely and could only occur if all blow-out preventers and other safety mechanisms were to fail. The probability curve for blow-out incidents during drilling of exploration wells, based on the international data, is given in Figure 5 (Appendix 1). The international data indicate that the probability that a blow-out of 600,000 litres would occur during the proposed program is about $4.0 \times 10^{-5}$ (see Table 2 below). This is the same as about 1 chance in 25,000 during the program.

It is most unlikely that a blow-out would occur in drilling on the Wonnich formation. This is because a blow-out typically occurs when drilling encounters a formation where the hydrocarbons are under considerable pressure (an "over-pressured formation"). The DME has advised that it is known that the Wonnich formation is <u>not</u> over-pressured, therefore the probability of a blow-out is significantly lower than indicated by the international data.

In the history of the Australian industry, there have been six blow-outs, the last in 1984 (Volkner *et al*, 1994). All were gas/condensate blow-outs and none resulted in any significant oil spill (Volkner *et al*, 1994). Modern drilling equipment and techniques mean that a blow-out is extremely unlikely. An independent review of the environmental implications of the offshore oil and gas industry (Swan *et al,* 1994) notes that:

> 'The risk of a blow-out occurring in Australia during the 1990s is very low due to improved technology...Extensive seismic surveys and site analyses are carried out before actual drilling to minimise the possibility of encountering over-pressured sediment strata. The composition of the drilling fluids (mud) is constantly monitored to ensure the pressure is neither too high, which would damage the rocks being drilled, or too low which could allow fluids (gas, water or oil) in the rock to blow-out at the surface. Should a blow-out appear imminent the driller is warned through monitoring equipment and blow-out preventers and automatic shut-in valves can be activated to close off the hole.'

As is standard practice in the offshore oil and gas industry, the rig to be used for the Wonnich appraisal program would use monitoring equipment, blow-out preventers, and automatic shut-in valves.

The DME has further advised that, even in the event that a blow-out did occur, it is most unlikely that significant amounts of oil would reach the surface. DME advises that a blow-out on the Wonnich formation could only produce significant oil to the surface during production testing on the oil-bearing strata. Even in that instance, gas and formation water would very quickly flow preferentially into the well and cut off the oil stream.

*Partial loss of well control ("kicks")*

A "kick" is the influx of hydrocarbons into the well bore caused by the reservoir pressure being greater than the well bore hydrostatic pressure. DME has advised that this type of incident is extremely unlikely because it is known that the Wonnich formation is not over-pressured. Another potential source of kicks is the presence of shallow gas. However it is known that there is no shallow gas in the Wonnich formation. For these reasons, this potential source of spillage is not considered further in this assessment.

*Australian offshore industry experience*

There have been few significant oil spill incidents in the history of the Australian offshore exploration and production industry. Up to 1994, the total amount of oil reported spilled from the Australian offshore industry was 96,500 litres. Most of this was from small spills and there were no reported environmental effects (Volkner *et al,* 1994).

*Western Australian offshore industry experience*

Apache Energy Limited (1996a; 1996b) has reviewed the West Australian oil spill database compiled by the DME, and showed that there was a total of 249 exploration, appraisal and production wells drilled during the period 1990 to 1996. These were drilled over 7,922 drilling days. During this period, there were three recorded oil spills from offshore wells, resulting in spills of 208 litres, 159 litres and 300 litres. These were caused, respectively, by a split fuel transfer hose, a holed fuel transfer hose and a support vessel collision with an oil rig.

In addition, there were 14 reported incidents arising from production testing, with an average spill volume of 1060 litres released into the sea. The majority of those 14 incidents were from a single operation in Commonwealth waters.

*Apache experience in the area*

Apache Energy Limited (and its predecessors) has an 11 year history of operations in shallow waters less than 20 metres deep adjacent to the Montebello, Lowendal and Barrow Islands, mostly within an environmentally sensitive area as defined by the EPA (1993). Since the discovery of the Harriet oil field in 1983, Apache and its predecessors have drilled 48 offshore wells over 1348 drilling days in the licence areas TL/1, 5 and 6, TP/8 and WA-192-P.

During this time there was only one incident from Apache operations, when approximately 300 litres of diesel fuel was spilled in 1992 as a result of a support vessel colliding with a rig and causing a ruptured fuel tank. There was no significant environmental impact.

*Risk minimisation*

Regulations under the petroleum legislation administered by the DME require a detailed safety risk analysis (called "the Safety Case") to be carried out for all drilling rigs. This involves a detailed independent assessment of the rig's equipment (including blow-out preventers) and operations to ALARP ("as low as reasonably practicable") standard. While this process focuses on human safety, of necessity it will also reduce the environmental risk from oil spills to ALARP standard.

*Public submissions*

Appendix 1 gives a list of organisations which made submissions on the proposal. The EPA notes that there is public concern about the proposed project and the potential effects of oil spills on the marine environment. Greenpeace, the Conservation Council of Western Australia, and the Australian Nature Conservation Agency (ANCA) expressed concerns about oil spill risk and potential environmental consequences.

The EPA recognises that there is public concern about petroleum drilling near environmentally sensitive areas such as the Montebello Islands. The EPA believes that the public perception of risks from the offshore oil industry is mainly based on publicity surrounding oil spills from shipping (eg the *Exxon Valdez* and *Kirki* incidents).

A comprehensive independent scientific review of the environmental effects of the offshore oil and gas industry (Swan *et al*, 1994) concluded that the amounts of oil spilled by the exploration and production industry in Australia are small and likely to have only negligible impacts on the marine environment. This position is contrary to some public submissions and to influential newspaper and television reports.

## Assessment

Oil spills arise from drilling operations and equipment failure. The most likely sources of oil spills have been identified (Table 2).

For the purposes of the assessment of the relevant environmental factor "oil (from spill incidents)", the EPA has defined the relevant area to be a circle of 500 metres radius centred on the drilling rig.

The EPA's objective with respect to the environmental factor "oil (from spill incidents)" is to ensure that the risk of an oil spill is extremely low, that actions are taken to reduce identified risks, and that drilling operations and equipment are at the level of international best practice for drilling in environmentally sensitive areas.

The EPA notes:

- the proposed drilling location is close to coral reefs and other sensitive environments of high conservation value;
- public submissions (Appendix 2) have expressed concerns about the potential for environmental impacts on the sensitive environments of the Montebello Islands;
- the public perception is that an operation of this type is likely to result in an adverse oil spill incident;
- a large oil spill from the drilling operations or equipment failure could only occur as a result of a ruptured fuel tank on a support vessel or a blow-out during drilling operations;
- the probability of a blow-out from the proposed project is extremely low. Based on the international data (Table 2), the probability that a blow-out of 600,000 litres will occur during the 25 day drilling program is $4.0 \times 10^{-5}$ for the drilling period. Standard drilling techniques and safety equipment used in Australia, including compulsory use of blow-out preventers, would result in the probability being still lower;
- furthermore, the characteristics of the Wonnich reservoir mean that it is very unlikely that a blow-out would occur. Even in the event that a blow-out did occur, it is most unlikely that significant amounts of oil would reach the surface;
- a potential source of small oil spills is oil burn-off oil during production testing. The proponent has made a commitment to use "closed chamber" testing only methods only and thereby avoid the potential for spillage from this source;

- another potential source of small oil spills is rig refuelling. The proponent has made a commitment to use dry-break couplings, to use wire reinforced fuel hose, and to carry out refuelling only under conditions where any spillage should be carried away from the sensitive environments of the Montebello Islands. This would greatly reduce the overall risk from this source;
- under the requirements of the petroleum legislation administered by DME, the proponent is required to reduce oil spills risks from operations and equipment failure to ALARP ("as low as reasonably practicable") standard;
- the rig to be used for the project will not have operated in Western Australia previously. Therefore the proponent has made a commitment that, before drilling the Wonnich appraisal wells, the rig will drill in another, less environmentally sensitive, location off Western Australia to demonstrate that the rig crew, equipment and operations are at the level of international best practice;
- the proponent has made a number of specific commitments to protect the environment and manage risks;
- the proponent has a good environmental record to date.

Having particular regard to:

- the potential sources of oil spillage from an operation of this type;
- the extremely low probability of a significant oil spill from the proposed project;
- the proposed management actions, which will include managing risks to "ALARP" standards under the supervision of the DME;
- the proponent's good environmental record to date and specific commitments to manage risk and protect the environment.

It is the EPA's opinion that its objective with respect to the environmental factor 'oil (from spill incidents)' can be met provided that:

- the proponent's commitments to be made legally enforceable;
- the proponent is to commission an independent environmental audit for the rig and its operations before drilling commences at the Wonnich appraisal site;
- the proponent is to put in place legally-binding contract requirements with the drilling contractors to ensure environmental best practice (to be agreed); and
- the proponent is to implement an environmental management system.

The EPA acknowledges that, even with these precautions, there remains a very small finite probability that an oil spill incident may occur. However, in the unlikely event that a spill should occur, it is most likely to be of small volume only.

The EPA recognises that, in view of the proximity of the drilling location to coral reefs and other sensitive environments, there is public concern about the potential for environmental impacts. The EPA also recognises that there is a public perception that an operation of this type is likely to result in an adverse oil spill incident. The EPA recommends that:

- the proponent prepare and implement an appropriate communication strategy to inform the public about the environmental risks from the proposed project and about risk management measures to be put in place.

## 3.3 Coral reefs

### Aspects of the coral reefs

A coral reef comprises a complex community of organisms including corals, sponges, molluscs, fish, crustaceans, algae and many other forms of marine life. The following assessment therefore considers not just corals, but the coral reef community as a whole.

*Conservation values of the Montebello reefs*

The report of the Marine Parks and Reserves Selection Working Group (1994) noted that:

> 'The extensive development of barrier reef, back reef, patch reef, pavement patch reef and lagoonal habitats in such close proximity is a feature of the Monte Bello Group without parallel in Western Australia.' (Part III, page 44).

A report by the West Australian Museum (Berry, P F, 1993) noted that the marine invertebrate fauna of the Montebello Islands is diverse and includes at least 150 species of reef building corals, 170 species of echinoderms (starfish, sea urchins and their relatives), and 85 species of crustaceans. There is an exceptional diversity of molluscs, with 633 species recorded (Berry, P F, 1993). The fish fauna is also highly diverse with 457 species recorded (Marine Parks and Reserves Selection Working Group, 1994).

In recognition of the marine conservation significance of the area, the report of the Marine Parks and Reserves Selection Working Group (1994) recommended that:

> 'the waters encompassing the Montebello Islands, southwards to the channel separating the group from the Barrow-Lowendal groups, be declared a Class A marine reserve for public recreation and protection of fauna and flora, ideally with boundaries located at the limit of State territorial waters along the western and northern sides and following the edge of the sublittoral ridge on the eastern side.'

In addition, the Australian Heritage Commission proposes to list the Montebello Islands marine area (including the coral reefs) on the Register of the National Estate (K Bossard, Australian Heritage Commission, *pers. comm.*).

There are no species of coral known to be endemic to (ie. unique to) the Montebello Islands (Apache Energy Limited, 1996b). This is expected since most species of corals (and many other species of marine life) on the North West Shelf are widespread tropical Indo-Pacific species.

A survey by the Australian Institute of Marine Science (AIMS) found a number of new species of sponges in shallow water (less than 10 metres deep) in the northern lagoon of the Montebello Islands (Dr R McCauley, AIMS, *pers. comm.*). These sponges have not been found elsewhere, however further survey work would be needed to determine whether they are unique to the Montebello Islands (Dr J Hooper, Queensland Museum, *pers. comm.*; Dr R McCauley, AIMS, *pers. comm.*). No sampling for sponges has been carried out on the western reefs of the Montebello Islands or on the sea floor in the project location (Dr R McCauley, AIMS, *pers. comm.*).

*Conservation values of reef adjacent to the project site*

The closest coral reef to the project location is the patch reef about 1 km to the east (Figure 1, Appendix 1). Another similar reef is located about 5 km almost due south of the project location. A channel approximately 15 m deep separates the two reefs. The reefs form part of the string of patch reefs to the west of the Montebello Islands which have been collectively referred to as "the western barrier reef" (Berry, P F, 1993) or the "west fringing reef" (Apache Energy Limited, 1996b).

Surveys carried out for the proponent (Apache Energy Limited, 1996b) indicate that the seaward (western) side of the reef is dominated by algae (*Halimeda* species and a variety of other species). There is reported to be very little coral growth on the seaward side of the reef (Apache Energy Limited, 1996b). The reef crest is mainly bare limestone and is exposed at most low tides (Apache Energy Limited, 1996b). Behind the reef crest is a zone of seasonal large brown algae of the genus *Sargassum* (M Forde, consultant, *pers. comm.*).

The proponent's field surveys showed there were good stands of branching coral (*Acropora* spp) on the lagoon (eastern) side of the reef. There is no estimate available of the total area of live coral cover on the reef, nor of the total area of intertidal coral cover (Apache Energy Limited, 1996b).

Another, smaller, patch reef is located 5 km south of the drilling location (Figure 1, Appendix 1). This reef is similar to the reef to the east, but is entirely subtidal (Dr I Stejskal, Apache Energy, *pers. comm.*)

**Secondary risk - risk of an oil spill reaching the coral reefs**

The proponent has estimated the risk of an oil spill reaching the adjacent coral reefs (the secondary risk) using a computer model (Apache Energy Limited 1996a, and 1996b). Figure 6 (Appendix 1) is a habitat map for the coral patch reef closest to the Wonnich appraisal drilling location. Figures 9 to 10 (Appendix 1) show the locations of impact for worst case oil spill trajectory predictions for spills of 80,000 and 600,000 litres respectively. There is insufficient information available to be able to estimate the proportion of coral reef which could be impacted in the worst case (Dr I Stejskal, Apache Energy Limited, *pers. comm.*).

The model predictions are based on drilling the well under prevailing conditions in the period June to August inclusive, on the basis that drilling at that time should reduce the consequences of an oil spill. The winds at that time are predominantly from the east and could be expected to move an oil spill offshore and away from the Montebello Islands. The predictions are for a period of 48 hours and include neap and spring tides and a wide range of wind conditions (Dr I Stejskal, Apache Energy Limited, *pers. comm.*).

The proponent has carried out some field recording of currents in the area using an Acoustic Doppler Current Profiler (ACDF) deployed at one metre intervals from approximately 3.5 metres below the water surface to approximately 3 metres above the sea floor. Data were recorded over periods of approximately 24 hours. The results are broadly consistent with model predictions.

Further data recording in the field is required to validate the model for this location. Standard text books (eg Godin, 1972) indicate that, in areas where tidal currents are important, field recording over a minimum of two weeks would be required to adequately validate a model. Also, since oil floats at the water surface, there is a need to document surface water movements. Therefore, until additional field recording is carried out, there is a measure of uncertainty about the reliability of the proponent's oil spill trajectory predictions.

The computer trajectory predictions indicate:

- under winter wind conditions, there is a low probability that oil would reach either the patch reefs or the shore of the Montebello Islands (Apache Energy Limited, 1996a; 1996b).
- a spill would be more likely to reach the shore than the nearby coral reefs (Apache Energy Limited, 1996a; 1996b).
- because of prevailing currents, it is more likely an oil spill would contact the coral patch reef 5 km to the south, rather than the reef 1 km to the east (Apache Energy Limited, 1996b, figures 3.19 and 3.20).

The secondary risk estimates are taken as the combination of the probability of a spill occurring (ie. primary risk) and the probability that a spill would reach the reefs when they are exposed at low tide. This method of estimating secondary risk does not take account of possible impacts on the reefs resulting from oil being dispersed into the water column by the action of breaking waves (see further discussion below under "tertiary risk").

Furthermore, the method does not take into account the possibility of an oil spill passing over the reefs on a rising (flood) tide, and then being carried back onto the reefs by the subsequent falling (ebb) tide. This may result in significant impacts on corals since the corals grow predominantly on the east (landward) side of the reef (Apache Energy Limited, 1996b). Against this must be balanced the fact that, under these circumstances, the oil would have weathered for an additional 6 hours or more so that the quantity of oil remaining would be reduced. Wonnich crude oil is a light oil which evaporates readily (Figure 8, Appendix 1).

The overall risks to the coral reefs, based on possible oil spill scenarios, are summarised in Table 3 below. The proponent's oil spill response strategy, as detailed in the oil spill contingency plan, is summarised in Appendix 3.

**Table 3. Possible oil spill risk scenarios for coral reefs.**

| Incident | Rupture of fuel transfer hose | Rupture of fuel tank on support vessel | Loss of well control (blow-out) during production test |
|---|---|---|---|
| Type of spillage | Diesel | Diesel | Wonnich crude oil |
| Assumed quantity of spillage at source (based on advice from Apache Energy and DME) | 200 litres | 80,000 litres | 600,000 litres |
| Primary risk - probability of a spill at source (based on international database) | $2.0x10^{-2}$ during the 25 day drilling period | $7.0x10^{-5}$ during the 25 day drilling period | $4.0x10^{-5}$ during the 25 day drilling period<br>Actual primary risk of a blow-out is considerably lower (refer section 3.1). |
| Secondary risk - Estimated probability that a spill will occur and contact coral reef, exposed at low tide | Not estimated | $5.3x10^{-6}$ during the 25 day drilling period | $8.0x10^{-6}$ during the 25 day drilling period |
| Estimated total quantity of oil reaching reefs/shore, allowing for evaporation/ dispersion | 65 litres | 13,000 litres | 104,000 litres |
| Tertiary risk - estimated impacts | Potential for limited impacts only. | Severe impacts to the two adjacent patch reefs if exposed by low tide.<br>There would probably still be significant impacts even if the reefs were submerged at high water. | Severe toxic impacts to two nearest patch reefs and to coral areas south of Hermite Island. |
| Quaternary risk - estimated time to recover | Any impacts would be limited only. Recovery within 1-2 years. | Recovery would take several years, depending on extent of damage. | On the available information, it is difficult to predict the rate of recovery from a large spill of Wonnich crude oil. |

Source: data provided by Apache Energy Limited and information from Swan *et al*, 1994.

Note: The estimates for primary risk are based on the international database for reported oil spills from the offshore petroleum industry and assuming a 25-day project duration during winter.

The proponent has advised (Dr I Stejskal, Apache Energy Limited, *pers. comm.*) that weather forecasts for the project will be provided by the Bureau of Meteorology, as is normal practice. Weather forecasts are provided to offshore petroleum operators on the North West Shelf on a twice daily basis. Forecasts are for a 3 day period and include predictions of wind strength and direction and sea state. For the Montebello Islands area, forecasts are area-specific and are based on continuous recording from weather stations on Varanus Island and Barrow Island.

**Tertiary risk - possible impacts of oil coming in contact with coral reefs**

*General*

A comprehensive scientific review commissioned by the Australian petroleum industry (Volkman *et al*, 1994) notes that there has been very little scientific research on the effects of oil pollution on coral reefs. It is known that the effects of oil pollution on corals may include sub-lethal effects involving tissue damage, growth and behavioural effects (Volkman *et al*, 1994; Table 7.7, page 590). Observed rates of recovery of reef communities from damage (natural or otherwise) differ widely, and complete recovery from extensive damage may take several to many decades (Volkman *et al*, 1994; Table 7.7, page 590).

In general, the environmental impacts from an oil spill depend on a range of factors, including weather, sea and tide conditions; type of oil; toxicity of the oil; whether the oil is fresh, weathered or in 'mousse' form; and the nature of the environment (IPIECA, 1992).

Should an oil spill reach a reef exposed at low tide, there can be severe acute impacts on corals and other marine life in the intertidal zone (National Research Council, 1985; IPIECA, 1992). The impacts of acute oil pollution (oil spills) on sub-tidal or submerged corals are usually minimal (National Research Council, 1985). However, while there may be little apparent damage to sub-tidal or submerged corals, an oil spill can result in death of other coral reef organisms such as crustaceans and sea urchins (National Research Council, 1985; IPIECA, 1992).

Weather and sea conditions at the time of a spill are critical. Waves breaking on a reef or shoreline will create droplets of oil that are distributed in the water column and come into contact with marine life (IPIECA, 1992). Oil that is immersed, solubilised or dispersed in water has a much greater effect than oil floating at the surface (Apache Energy Limited, 1996b).

Seasonal factors also need to be considered. An oil spill at the time of the annual mass coral spawning could have a significant impact on coral spawn floating at the water surface. However, if drilling at the Wonnich appraisal site were to be restricted to the period June — August inclusive, as proposed in the CER, the time of coral spawning would be avoided altogether. (In Western Australia, the main annual coral spawning event occurs 7 to 10 days after the full moon in March).

Apache Energy Limited (1996b, Appendix 3, Section 3.2.2) notes that the largest oil spill in history, the Gulf War oil spill of 1991, resulted in only minor impacts on coral reefs. Field surveys by scientists from Greenpeace and UNESCO showed that, while there were severe impacts on intertidal mudflats, salt marshes and algal flats, there were minimal impacts on coral abundance, cover or growth (Greenpeace, 1992; Saenger, 1994; Vogt, 1995a; Vogt, 1995b).

However the fact that the Arabian Gulf reefs apparently suffered only slight damage from this massive oil spill is probably mainly due to the fact that corals in that region, unlike those on the NW Shelf, are almost exclusively sub-tidal, so that the oil passed over them, causing minimal apparent damage (Dr P Harrison, UNESCO, *pers. comm.*). In addition, the presence of micro-organisms adapted to degrading petroleum hydrocarbons, together with high ambient temperatures and bright sunlight causing high rates of photo-oxidation, all contributed to rapid evaporation and degradation of the oil (Saenger, 1994).

*Predicted impacts from proposed project*

In the event of a spill of 200 litres of diesel from a refuelling incident, there is potential for some limited impacts on coral reefs. According to the proponent's oil spill trajectory predictions (Apache Energy Limited 1996a), in the worst case, an oil spill could reach the adjacent reefs in 7.75 hours. While diesel evaporates rapidly (Figure 7; Appendix 1), there would still be a substantial proportion (approximately 65 litres) of the spill remaining.

In the event of a spill of 80,000 litres of diesel from rupture of a support vessel fuel tank, the proponent estimates that, allowing for evaporation, a cumulative total of 13,000 litres could reach the coral reefs and island shorelines. Figure 9 (Appendix 1) shows the probable locations of impact under worst case conditions for a spill of that size. There would be severe impacts on the two adjacent patch reefs if they were exposed by low tide at the time of the spill. If the reefs were covered by high water, there would probably still be significant impacts as a result of the action of surf breaking on the reefs and dispersing oil into the water column.

The worst case event would be a blow-out (complete loss of well control) during production testing. As discussed in section 3.2, such an event is extremely unlikely. Furthermore, even if such an event did occur, the oil stream would be cut off very quickly by ingress of gas and formation water. However, for the purpose of this assessment, the proponent has assumed that an amount of Wonnich crude oil of volume 600,000 litres could be spilled in such an incident and has developed oil spill trajectory predictions accordingly. Figure 10 (Appendix 1) shows the predicted impact areas for the worst case scenario in the event that oil were to contact reefs and/or shoreline. The predicted locations of impact are limited to the two closest patch reefs, the coast at the southern end of Hermite Island and the small islets to the south of Hermite Island.

Wonnich crude oil is a light volatile crude (API gravity 38$^0$). Laboratory testing shows that the oil would evaporate rapidly (Figure 8, Appendix 1) and would not form a stable emulsion or "mousse" (unpublished results from Batelle Consultants). The oil is of low density and therefore will not sink. Physically dispersed droplets of Wonnich crude will have a strong tendency to return rapidly to the sea surface. This physical property of the spilled oil is protective of the marine environment, because damage to sub-tidal ecosystems, such as coral reefs, is usually greater from physical coating with oily residues than from dissolved petroleum hydrocarbons (Jackson *et al*, 1989; Volkman *et al*, 1994). The main impacts from a large spill of Wonnich crude would therefore be from the toxic components in the oil rather than from the oil physically smothering marine life.

The toxic components of Wonnich crude oil have been identified as primarily low molecular weight (2 ring) polycyclic aromatic hydrocarbons (PAHs). Independent laboratory tests on a range of marine species, including shrimps, fish and sea urchins, indicate that weathered Wonnich crude oil is "moderately toxic" to marine life (unpublished results from Batelle Consultants). There is no information on the toxicity of the oil to corals or sponges as there are as yet no established experimental protocols for testing oil toxicity on these organisms (Dr I Stejskal, Apache Energy Limited, *pers. comm.*)

## Quaternary risk - potential for recovery

*General*

A useful definition of ecological recovery has been advanced by Baker *et al* (1990):

> "Recovery is marked by the re-establishment of a healthy biological community in which the plants and animals characteristic of that community are present and functioning normally. It may not have the same composition and age structure as that which was present before the damage, and will continue to show further change and development. It is very difficult to say whether an ecosystem that has recovered from an oil spill is the same as, or different from, that which would have persisted in the absence of the spill."

The rate of ecological recovery from an oil spill incident is affected by a number of factors, including the potential for "re-oiling" resulting from chronic contamination of sediments, the potential for toxic contamination of marine organisms and marine food chains, and the ability of the ecosystem to recover from natural disturbances (eg cyclone damage). Another relevant factor is the method of oil spill clean-up (if any) applied. These factors are discussed below.

*Potential for chronic oil contamination of sediments*

An oil spill may result in chronic (long-term) contamination if oil becomes entrapped in fine sediments. Such entrapped oil may gradually release petroleum hydrocarbons over a period of months or years thereby causing ongoing pollution. Chronic oil pollution can have significant effects on coral health and reproduction (Jackson *et al* 1989; Loya and Rinkevitch, 1987).

In the unlikely event of a large oil spill from the Wonnich project, there is very little potential for such chronic oil contamination to the coral reefs. This is due to the nature of the oil (either diesel or Wonnich crude, both of which are light volatile oils). In addition, the reef adjacent to the Wonnich location is in an open, wave-exposed location with only a thin veneer of coarse calcareous sand (Apache Energy Limited, 1996b). It is therefore unlikely there would be oil entrapment in sediments. Available information indicates that the reef 5 km to the south is very similar (Dr I Stejskal, Apache Energy Limited, *pers. comm.*).

*Potential for contamination of marine life*

The toxic components of Wonnich crude oil are primarily low molecular weight PAHs (see discussion above). PAHs are also present in diesel oils. Volkner *et al* (1994) provide detailed information on the extent to which PAHs cause persistent contamination of marine organisms. They note that PAHs do not progressively increase in concentration up marine food chains (that is, they do not "biomagnify") because fish and all higher invertebrates have enzymes that can rapidly metabolise PAHs and assist with their excretion. However they note that "...as a general rule, the PAHs exhibit a persistence in aquatic biota and therefore would be expected to bioaccumulate."

*Natural recovery from cyclone damage*

Cyclones are common in the area and the shallow and intertidal communities are therefore adapted to physical perturbation. The report of a marine biological survey of the Montebello Islands by the Western Australian Museum notes that:

> 'The area is prone to tropical cyclones - an average of 1.8 a year passed within approximately 1° of the Montebellos over the last 16 years. The biota, particularly (that) of shallow and intertidal areas is therefore subject to frequent natural perturbation. Communities are consequently likely to be either resilient or transient. An example of the latter is the tabular *Acropora* (branching coral) on the barrier reef flat, the distribution and percentage of which appears to be particularly dynamic, probably as a result of cyclones.' (Berry, 1993, page 17).

The report concludes that:

> 'Intertidal and shallow water communities are probably adapted to frequent perturbation by cyclones and could be expected to recover quickly in the event of an oil spill.'

However it should be borne in mind that the effects of an oil spill are likely to be qualitatively different from those of a cyclone. This is because, while a cyclone causes direct physical damage and smothering by sediment, an oil spill would result in both smothering of marine life by oil and chemical contamination.

*Oil spill clean-up*

The use of inappropriate clean-up methods (eg direct application of chemical dispersants or hot water to shorelines or reefs) can actually impede ecological recovery (Volkner *et al*, 1994). The proponent is aware of this and has plans in place for appropriate clean-up strategies in the very unlikely event that an oil spill should occur and should impact coral reefs. The proponent's oil spill response strategies for various scenarios are summarised in Appendix 3.

*Monitoring ecosystem recovery*

The proponent's oil spill contingency plan (Apache Energy Limited 1996c) lists proposed endpoints for environmental monitoring in the extremely unlikely event that there should be an oil spill from the proposed project.

### Assessment

The report of the Marine Parks and Reserves Selection Working Group (1994) concluded that the Barrow, Lowendal and Montebello islands, together with the sub-littoral ridge on which they stand, comprise a geomorphological and ecological unit which is unique on the West Australian coast and which may be regarded as a "distinctive coastal type".

Accordingly, the EPA's opinion is that the relevant area for assessing the impact of the proposal on the relevant factor "coral reefs" is the Montebello-Lowendal-Barrow Islands complex. The Montebello-Lowendal-Barrow Islands complex is shown in Figure 3 (Appendix 1).

The EPA's objective with respect to the relevant environmental factor "coral reefs" is to maintain the abundance, biodiversity, productivity and geographic distribution of the marine life of the coral reefs.

The EPA notes:

- the proximity of the drilling location to coral reefs and other sensitive environments;
- public concerns about the potential for environmental impacts;
- the public perception that an operation of this type is likely to result in an adverse oil spill incident.
- the primary risk of an oil spill from drilling operations or equipment failure is very low and will be further reduced consistent with "ALARP" (as low as reasonably practicable) standards (see section 3.2);
- drilling would only be carried out in the period June-August inclusive, so that, in the very unlikely event that a spill does occur, it is likely to be carried away from the Montebello Islands. The probability of an oil spill reaching reefs or other sensitive areas will therefore be further reduced;
- a specific oil spill contingency plan for the project area has been approved by DME. Under the plan, a special oil spill boom, oil spill combat vessel and trained crew will be on site throughout the project. In the very unlikely event that an oil spill were to occur and were to move in the direction of coral reefs or other sensitive areas, an oil spill boom would be used to deflect oil away from the sensitive areas. With these measures, the probability of oil reaching these sensitive areas would therefore be reduced still further;
- in the very unlikely event that, despite all precautions, a large oil spill were to occur and were to reach the coral reefs, there are likely to be severe environmental impacts. In the case of a large diesel spill, ecological recovery would take several years at least. Based on the available information, it is difficult to predict the rate of recovery from a large spill of Wonnich crude oil.

Having particular regard to:

- the proximity of the drilling location to coral reefs and other sensitive environments;
- the potential sources of oil spillage from an operation of this type;
- the extremely low probability of a significant oil spill from the proposed project;
- the proposed management actions, which will include managing risks to "ALARP" standards under the supervision of the DME;
- the proponent's good environmental record to date and specific commitments to manage risk and protect the environment.

It is the EPA's opinion that its objective for the environmental factor "coral reefs" is unlikely to be compromised provided that:

- the proponent's commitments are made legally enforceable.
- the proponent to further validate the oil spill trajectory model, before drilling commences, by continuous field observations over a period of two weeks. Computer predictions should also be checked by regular recording of surface water movements during this period. The proponent to make appropriate modifications to oil spill response strategies if there are any significant variations from the current oil spill trajectory predictions.
- before drilling commences at the Wonnich appraisal site, the proponent to carry out a successful trial deployment of the oil spill boom.
- the proponent to develop a rig refuelling procedure, such that refuelling would only be carried out under conditions where any spillage would be carried away from sensitive environments.
- the proponent to implement an environmental management system.

The EPA acknowledges that, even with these precautions, there remains a very small finite probability that an oil spill incident may occur. However, in the unlikely event that a spill should occur, it is most likely to be of small volume only.

The EPA recognises that, in view of the proximity of the drilling location to coral reefs and other sensitive environments, there is public concern about the potential for environmental impacts. The EPA also recognises that there is a public perception that an operation of this type is likely to result in an adverse oil spill incident. The EPA recommends that:

- the proponent prepare and implement an appropriate communication strategy to inform the public about the environmental risks from the proposed project and about risk management measures to be put in place.

The EPA also notes that the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has made a detailed submission commenting on the design of the environmental monitoring program. The EPA agrees that detailed monitoring is required and is of the view that the environmental monitoring program proposed by the company, including collection of detailed baseline data (Apache Energy Limited, 1996a; 1996b), is appropriate.

## 3.4 Island shorelines

### Aspects of the island shorelines

The closest land to the project location is the south-west shoreline of Hermite Island (Figure 1, Appendix 1). The shore is rocky and consists of a low limestone cliff cut by a tidal platform (Berry, 1993). A conspicuous zone of rock oysters (*Saccostrea cucculata*) occurs on the limestone cliff (Berry, 1993). At the southern tip of Hermite Island is the conspicuous embayment of Claret Bay which contains a stand of mangroves. Another sensitive locality, Sherry Lagoon, is located to the east of Claret Bay. A number of smaller rocky islands occur off the southern tip of Hermite Island.

The extensive shallow water lagoon formed by the Montebello Islands is important as the only marine environment of this type and size in north-west Australia. The island-lagoon formation also provides the most sheltered marine habitat known for this part of the continent (IUCN, 1988). A report by the West Australian Museum (Berry, 1993) notes that:

> 'The total shoreline of infratidal land within the Montebellos group is approximately 210 km in length and significantly longer if the margins of intertidal areas, particularly the western barrier reef, are included. An extensive, shallow intertidal zone is therefore contained within a relatively small area, making it more vulnerable to cyclones or oil spillages than the intertidal zone on a straighter coastline such as is typical along much of the Pilbara coast.'

Berry (1993) also notes that the area is particularly productive:

> 'The high tidal range and resultant exchange of water within the protected lagoons, embayments, and channels provides a physical energy subsidy that contributes towards high biological productivity, resulting in an unusual abundance of some animals, for example predatory reef fishes. Very large populations of cormorants (hundreds) and terns (thousands) are also indicative of high biological productivity.'

The Montebellos provide habitat for at least 26 species of seabirds and waders (Serventy and Marshall, 1964; Burbidge 1971). Thirteen species of birds listed on one or both of the China-Australia Migratory Bird Agreement and the Japan-Australia Migratory Bird Agreement have been recorded at the Montebello Islands. The Department of Conservation and Land Management (CALM) has advised that the Montebello Islands are one of the most important tern (mainly bridled terns, *Sterna anaethetus*) nesting areas in Western Australia. The islands are also a breeding place for the beach thick knee (*Escacus magnirostris neglectus*) which is nationally vulnerable (Burbidge, 1971; Marine Parks and Reserves Selection Working Group, 1994).

**Secondary risk - risk of oil spill reaching island shorelines**

The proponent's oil spill trajectory predictions show that, despite the greater distance to the shore, there is a greater risk of oil reaching the island shore than reaching the coral reefs (Dr I Stejskal, *pers. comm.*). This is apparently because strong currents would transport oil through the channel between the two nearest patch reefs and towards the island shore.

Furthermore, even under east or south-east wind conditions, the model predicts that, on a flood (rising) tide, an oil spill could be carried over the reefs and towards the island shore (Apache Energy Limited, 1996a, Appendix 6, scenario 5). Under a scenario of south-east to south-west winds, the model predicts extensive oil contact with both the reefs and western shoreline of the Montebello Islands (Apache Energy Limited, 1996a, Appendix 6, scenario 7).

According to the model, an oil spill from the project location could reach the southern shore of Ah Chong Island in 7 hours, and could reach Wild Wave Lagoon on the western shoreline of Hermite Island in 8 hours (Apache Energy Limited, 1996a, Table A6.2).

The overall risks to the island shorelines, based on possible oil spill scenarios, are summarised in Table 4 and in figures 9 and 10 (Appendix 1). The proponent's oil spill response strategy, as detailed in the oil spill contingency plan, is at Appendix 3.

**Tertiary risk - potential oil spill impacts on the island shore**

Should significant quantities of oil contact the island shorelines there would be impacts (lethal and sub-lethal) on the rock oysters and other intertidal and shallow water marine life. The severity of impacts would depend on the extent and severity of oiling, and the extent of residual toxicity in the oil.

Potential impacts on the migratory terns and other seasonal migrants could be avoided by drilling in winter (outside the birds' breeding season), as proposed in the CER. However, resident birds such as cormorants (*Phalacrocorax* spp), white breasted sea eagles (*Haliaeetus leucogaster*) and ospreys (*Pandion haliaetus*), and shore birds such as the beach thick knee (*Esacus magnirostris neglectus*) would be present year round and would be potentially vulnerable.

Sea birds and shore birds could be impacted directly by contact with oil, or indirectly by consuming fish or other prey contaminated with toxic components of the oil (Volkner *et al*, 1993). There is evidence that even a single dose of petroleum hydrocarbons ingested by a bird can result in altered yolk structure and reduced hatchability of eggs laid subsequently (Grau *et al*, 1977).

**Table 4. Possible spill risk scenarios for island shorelines.**

| Incident | Rupture of fuel transfer hose | Rupture of fuel tank on support vessel | Loss of well control (blow-out) during production test |
|---|---|---|---|
| Type of spillage | Diesel fuel | Diesel fuel | Wonnich crude oil |
| Assumed quantity of spillage at source (based on advice from Apache Energy and DME) | 200 litres | 80,000 litres | 600,000 litres |
| Primary risk at source (based on international database) | $2.0 \times 10^{-2}$ during the 25 day drilling period | $7.0 \times 10^{-5}$ during the 25 day drilling period | $4.0 \times 10^{-5}$ during the 25 day drilling period<br>Actual primary risk of a blow-out is considerably lower (see section 3.2). |
| Secondary risk - Estimated probability that spill will occur and will contact island shore | Spill would evaporate and disperse before contacting island shore. | $1.4 \times 10^{-5}$ during the 25 day drilling period | $8.0 \times 10^{-6}$ during the 25 day drilling period |
| Estimated total quantity of oil reaching reefs/shore, allowing for evaporation/ dispersion | Total 65 litres (very little if any would actually reach the island shore) | 13,000 litres | 104,000 litres |
| Tertiary risk - estimated impacts | Minimal if any impacts on island shore | Significant impacts to shallow marine life at southern end of Hermite I, and around the islets south of Hermite I.<br>Potential for significant impacts on local populations of shags and other resident sea birds. | Severe toxic impacts to shallow marine life at southern end of Hermite I, and around the islets south of Hermite I.<br>Potential for significant impacts on local populations of shags and other resident sea birds. |
| Quaternary risk - estimated time to recover | Any impacts on island shore would be minimal and transitory only | Recovery of marine life and sea bird populations would take several years at least. | On the available information, it is difficult to predict the rate of recovery from a large spill of Wonnich crude oil |

Source: data provided by Apache Energy Limited and information from Swan *et al*, 1994.

Note: The probability estimates are based on the international databases for reported oil spills from the offshore oil industry and assuming a 25 day project duration during winter.

### Quaternary risk - potential long-term consequences on the island shore

There is limited potential for long-term contamination of the rocky shoreline as there is little sediment in which oil could become entrapped. Wave action would be expected to clean oil from such a shore line within one to two years (Apache Energy Limited, 1996b). In addition, both diesel and Wonnich crude are light weight, volatile, buoyant oils. They would therefore have little tendency to coat shore lines or accumulate in sediments.

Recolonisation and recovery rates for rock oysters and other intertidal marine life would depend on the area affected and recolonisation rates of the various species impacted. Typically, the recovery of rocky shore communities from an oil spill is marked by enhanced growth of macro-algae resulting from the death of herbivores such as sea snails and sea urchins (Volkner *et al*, 1994). It may take a number of years for the intertidal community to return to "normal".

The flesh of surviving rock oysters and other bivalve molluscs would be contaminated to some extent with toxic fractions of the oil, in particular polycyclic aromatic hydrocarbons (PAHs). It is not possible to say how long such contamination would last or whether this is likely to result in significant contamination of the flesh of fish, birds and other animals which feed on the oysters and other molluscs.

Based on the above information, it is difficult to predict the rate of recovery of shoreline communities and sea bird populations from a large spill of Wonnich crude oil.

*Oil spill clean-up*

The use of inappropriate clean-up methods (eg direct application of chemical dispersants or hot water to shorelines) can actually impede ecological recovery (Volkner *et al*, 1994). The proponent is aware of this and has plans in place for appropriate clean-up strategies in the very unlikely event that an oil spill should occur and should impact the island shores. The proponent's oil spill response strategies for various scenarios are summarised in Appendix 3.

*Monitoring ecological recovery*

The proponent's oil spill contingency plan (Apache Energy Limited 1996c) lists proposed endpoints for environmental monitoring in the extremely unlikely event that there should be an oil spill from the proposed project.

### Assessment

As noted in section 3.2, the report of the Marine Parks and Reserves Selection Working Group (Marine Parks and Reserves Selection Working Group, 1994) concluded that the Barrow, Lowendal and Montebello islands, together with the sub-littoral ridge on which they stand, comprise a geomorphological and ecological unit which is unique on the West Australian coast and which may be regarded as a "distinctive coastal type".

Accordingly, the EPA's opinion is that the relevant area for assessing the impact of the proposal on the relevant factor "island shore" is the Montebello-Lowendal-Barrow Islands Complex. The Montebello-Lowendal-Barrow Islands complex is shown in Figure 3 (Appendix 1).

The EPA's objective in relation to the environmental factor "island shore" is to maintain the abundance, biodiversity, productivity and geographic distribution of the plants and animals of the island shore.

The EPA notes:

- the proximity of the drilling location to the island shores and other sensitive environments;
- the primary risk of an oil spill from drilling operations or equipment failure is very low and would be further reduced consistent with "ALARP" (as low as reasonably practicable) standards (see section 3.2);
- drilling would only be carried out in the period June-August inclusive, so that, in the very unlikely event that a spill does occur, it is likely to be carried away from the Montebello Islands. The probability of an oil spill reaching island shorelines or other sensitive areas would therefore be further reduced;

- a specific oil spill contingency plan for the project area has been approved by DME. Under the plan, a special oil spill boom, oil spill combat vessel and trained crew will be on site throughout the project. In the very unlikely event that an oil spill were to occur and were to move in the direction of sensitive areas, an oil spill boom would be used to deflect oil away from the sensitive areas. With these measures, the probability of oil reaching these sensitive areas would therefore be reduced still further.
- in the extremely unlikely event that a large oil spill were to occur and were to reach the Montebello Islands, the oil spill model predicts that the shorelines of the southern end of Hermite Island and of Ah Chong Island and adjacent small islets would be severely impacted. There would also be potential for significant impacts on local populations of shags and other resident sea birds;
- recovery of shoreline communities and sea bird populations from a large spill of diesel would take several years at least; and that
- based on the available information, it is difficult to predict the rate of recovery of shoreline communities or of sea bird populations from a large spill of Wonnich crude oil.

Having particular regard to:

- the potential sources of oil spillage from an operation of this type;
- the extremely low probability of a significant oil spill from the proposed project;
- the proposed management actions, which will include managing risks to "ALARP" standards under the supervision of the DME;
- the drilling would be carried out during the period June to August inclusive when any spillage should be carried away from sensitive areas;
- the proximity of the drilling location to coral reefs and other sensitive environments;
- the proponent's good environmental record to date and specific commitments to manage risk and protect the environment.

It is the EPA's opinion that its objective for the relevant environmental factor "island shores" is unlikely to be compromised, provided that:

- the proponent's commitments are made legally enforceable;
- to assist in oil spill contingency planning, the oil spill trajectory model to be further validated, before drilling commences, by continuous field observations over a period of two weeks. Computer predictions should also be checked by regular recording of surface water movements during this period. Appropriate modifications are to be made to oil spill response strategies if there are any significant variations from the current oil spill trajectory predictions.
- before drilling commences at the Wonnich appraisal site, the proponent to carry out a successful trial deployment of the oil spill boom.
- the proponent to develop a rig refuelling procedure, such that refuelling would only be carried out under conditions where any spillage would be carried away from sensitive environments.
- the proponent to implement an environmental management system.

The EPA acknowledges that, even with these precautions, there remains a very small finite probability that an oil spill incident may occur. However, in the unlikely event that a spill should occur, it is most likely to be of small volume only.

The EPA recognises that, in view of the proximity of the drilling location to coral reefs and other sensitive environments, there is public concern about the potential for environmental impacts. The EPA also recognises that there is a public perception that an operation of this type is likely to result in an adverse oil spill incident. The EPA recommends that:

- the proponent prepare and implement an appropriate communication strategy to inform the public about the environmental risks from the proposed project and about risk management measures to be put in place.

The EPA also notes that the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has made a detailed submission commenting on the design of the environmental monitoring program. The EPA agrees that detailed monitoring is required and is of the view that the environmental monitoring program proposed by the company, including collection of detailed baseline data (Apache Energy Limited, 1996a; 1996b), is appropriate.

## 3.5 Mangroves

### Aspects of the mangroves

Several pockets of mangroves and associated salt marshes and mudflats occur along the coastlines of the Montebello Islands (see Figures 1 and 3, Appendix 1). The main mangrove areas are located on the eastern side of Hermite Island, on the opposite side of the island from the project location. This includes the mangroves within Stevenson Passage (a blind channel which penetrates 8 km into the interior of Hermite Island). A report by the Western Australian Museum (Berry, 1993) states that there is a small stand of mangroves in Claret Bay at the southern tip of Hermite Island. These mangroves are the closest to the project location. There are also mudflats in Sherry Lagoon to the east of Claret Bay.

Three of the species of mangroves recorded at the Montebello Islands, the rib-fruited orange mangrove (*Brugueira exaristata*), the yellow-leaved spurred mangrove (*Ceriops tagal*), and the spotted leaved red mangrove (*Rhizophora stylosa*), are close to the southern limit of their biogeographic range (Semenuik *et al*, 1978).

### Secondary risk - risk of oil spill reaching mangrove areas

The main areas of mangroves are situated on the eastern side of Hermite Island and therefore far from the project site. There is no quantitative estimate of the probability of an oil spill from the project site reaching the main mangrove areas, but, based on the proponent's trajectory predictions, the probability would be very low indeed. The trajectory predictions indicate that, in the very unlikely event of a large oil spill from the project, there is a chance of oil reaching the southern end of Hermite Island in winter (Figures 9 and 10, Appendix 1). Therefore, in the very unlikely event of a large oil spill, there is potential for oil to reach the mangroves in Claret Bay and the mudflats in Sherry Lagoon.

The proponent's oil spill response strategy for protection of mangroves, as detailed in the oil spill contingency plan, is at Appendix 3. The proponent's oil spill contingency plan states that mangrove and mudflat areas would be given the highest priority for protection. In the event that an oil spill were to occur under conditions such that oil could reach these areas, the contingency plan calls for the oil spill boom to be deployed so as to deflect oil away from mangrove and mudflat areas.

### Tertiary risk - potential impacts of an oil spill

Mangroves can be killed by oil covering the trees' breathing pores or by toxicity of substances in the oil, especially lower molecular weight aromatic compounds (such as the PAHs in Wonnich crude), which damage cell membranes in the sub-surface roots. This in turn impairs the normal salt exclusion process, and the resulting influx of salt is a stress to the plants (IPIECA, 1993).

The organisms among and on the mangrove trees are affected in two ways. First there may be heavy mortalities as a direct result of the oil. For example, oil may penetrate burrows in the sediments, killing crabs and worms, or coat molluscs on the sediment surface and aerial roots. Second, dead trees rot quickly, leading to loss of habitat for organisms living in the branches and canopy of the trees, and in the aerial roots (IPIECA, 1993).

Salt marshes and intertidal mudflats are also particularly sensitive to oil pollution (IPIECA, 1991). Impacts include death of salt marsh plants and death of crabs, worms and other fauna. Oil may enter burrows of marine animals, killing the occupants, and leading to chronic contamination of sub-surface sediments.

### Quaternary risk - potential long-term consequences

If fine sediments in mangrove areas or other sheltered areas were to be impacted by oil, there is potential for long-term (chronic) pollution. The CER (Apache Energy Limited, 1996a) notes that:

'Mangrove communities typically occur in sheltered areas of low wave energy, making retention of oil within the sediments a potentially long-term problem. The retention of oil in the substrate may result in chronic exposure to oil due to the flushing of retained oil out of the sediment over each tidal cycle. The burrows of organisms and the roots of trees also act as a conduit for light oils, allowing the penetration of oil deep into the sediment.

'In open, aerobic sediments, the loss of light oil appears to take about 18 months (Woodside, 1989). However, in areas where the sediments are anaerobic, with a high organic content and poorly flushed, degradation is slow and oil persists over 20 years or more (Burns *et al*, 1994). Re-emergence of young trees will be unlikely until at least the toxic components of the oil are lost. Estimates of recovery rates range from tens to hundreds of years to regain a mature forest (Burns *et al*, 1993).' (Apache Energy Limited, 1996a, Appendix 7, page 6 ).

Recruitment of new mangrove trees at the Montebellos would be especially slow because of the distance of the islands from other mangrove areas on the mainland (Berry, 1993). Rehabilitation of an oil-affected mangrove or salt marsh areas would be difficult and expensive and would involve replacing contaminated sediments and replanting mangroves and other plants (IPIECA, 1993).

*Oil spill clean-up*

The use of inappropriate clean-up methods (eg direct application of chemical dispersants or hot water to mangrove areas) can actually impede ecological recovery (Volkner *et al*, 1994). The proponent is aware of this and has plans in place for appropriate clean-up strategies in the very unlikely event that an oil spill should occur and should impact mangrove or mudflat areas. The proponent's oil spill response strategies for various scenarios are summarised in Appendix 3.

*Monitoring ecosystem recovery*

The proponent's oil spill contingency plan (Apache Energy Limited 1996c) lists proposed endpoints for environmental monitoring in the very unlikely event that there should be an oil spill from the proposed project.

### Assessment

In the EPA's opinion, the relevant area for assessing the impact of the proposal on the relevant factor "mangroves" is the Montebello-Lowendal-Barrow Islands Complex. The Montebello-Lowendal-Barrow Islands complex is shown in Figure 3 (Appendix 1).

The EPA's objective in relation to the environmental factor "mangroves" is to maintain the biodiversity, productivity and geographic distribution of the mangroves, salt marshes and mudflats.

The EPA notes:

- the proximity of the drilling location to sensitive environments;
- public concerns about the potential for environmental impacts;
- the public perception that an operation of this type is likely to result in an adverse oil spill incident;
- the primary risk of an oil spill from drilling operations or equipment failure is very low and will be further reduced consistent with "ALARP" (as low as reasonably practicable) standards (see section 3.2);
- drilling would only be carried out in the period June-August inclusive, so that, in the very unlikely event that a spill does occur, it is likely to be carried away from the Montebello Islands. The probability of an oil spill reaching sensitive areas will therefore be further reduced; and
- a specific oil spill contingency plan for the project area has been approved by DME. Under the plan, a special oil spill boom, oil spill combat vessel and trained crew will be on site throughout the project. In the very unlikely event that an oil spill were to occur and were to move in the direction of mangroves or other sensitive areas, an oil spill boom would be used to deflect oil away from the sensitive areas. With these measures, the probability of oil reaching sensitive areas would therefore be reduced still further.
- in the extremely unlikely event that a large oil spill were to occur and were to reach the island shoreline, the oil spill trajectory model predicts that the stand of mangroves at Claret Bay, and the mudflats within Sherry lagoon, could be severely impacted. However, based on the available trajectory predictions, there is very little chance that oil would reach the main areas of mangroves and mudflats on the eastern side of Hermite Island;
- if significant quantities of diesel or Wonnich oil were to reach mangrove areas there would be direct mortality of mangrove trees from absorption of toxic compounds through the roots. Oil would also enter burrows of marine animals, killing the occupants, and leading to chronic contamination of sub-surface sediments.
- recovery of mangrove communities where extensive oil contamination has occurred could take tens or even hundred of years. Rehabilitation of oil-affected areas would be difficult and expensive and would involve replacing contaminated sediments and replanting mangroves and other plants.

Having particular regard to:

- the potential sources of oil spillage from an operation of this type;
- the extremely low probability of a significant oil spill from the proposed project;
- the proposed management actions, which will include managing risks to "ALARP" standards under the supervision of the DME;
- the drilling would be carried out during the period June to August inclusive when any spillage should be carried away from sensitive areas;
- the proximity of the drilling location to mangroves and other sensitive environments;
- if an oil spill were to reach mangrove areas, there is potential for significant long-term environmental impacts; and
- the proponent's good environmental record to date and specific commitments to manage risk and protect the environment.

It is the EPA's opinion that its objective with respect to the relevant environmental factor "mangroves" is unlikely to be compromised, provided that:

- the proponent's commitments are made legally enforceable;
- to assist in oil spill contingency planning, the oil spill trajectory model is further validated, before drilling commences, by continuous field observations over a period of two weeks. Computer predictions should also be checked by regular recording of surface water movements during this period. Appropriate modifications are to be made to oil spill response strategies if there are any significant variations from the current oil spill trajectory predictions.
- before drilling commences at the Wonnich appraisal site, the proponent to carry out a successful trial deployment of the oil spill boom.
- the proponent to develop a rig refuelling procedure, such that refuelling would only be carried out under conditions where any spillage would be carried away from sensitive environments.
- the proponent to implement an environmental management system.

The EPA acknowledges that, even with these precautions, there remains a very small finite probability that an oil spill incident may occur. However, in the unlikely event that a spill should occur, it is most likely to be of small volume only.

The EPA recognises that, in view of the proximity of the drilling location to sensitive environments, there is public concern about the potential for environmental impacts. The EPA also recognises that there is a public perception that an operation of this type is likely to result in an adverse oil spill incident. The EPA recommends that:

- the proponent prepare and implement an appropriate communication strategy to inform the public about the environmental risks from the proposed project and about risk management measures to be put in place.

## 3.6 Turtles and dugongs

### Aspects of turtles and dugongs

*Turtles*

Two species of sea turtle, the green turtle (*Chelonia mydas*) and the hawksbill turtle (*Eretmochelis imbricata*), have been recorded nesting at the Montebello Islands (Serventy and Marshall 1964). CALM has advised that other turtle species which may occur in the area are the flatback turtle (*Chelonia depressa)*, and the loggerhead turtle (*Caretta caretta*).

The loggerhead turtle is listed under Schedule 1 (fauna rare or likely to become extinct) of the Wildlife Protection Act 1950, and as endangered under the Commonwealth Endangered Species Act 1992. The green and hawksbill turtles are not listed under the Wildlife Protection Act but are listed nationally as vulnerable and internationally (by the World Conservation Union) as endangered. The flatback turtle is an Australian endemic of uncertain conservation status (Dr R Prince, CALM, *pers. comm.*).

The green, hawksbill and loggerhead turtles are also protected under the Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention), to which Australia is a signatory.

The western reefs of the Montebellos are reported to be used by feeding turtles (Deegan, 1992). In addition, large numbers of turtles have been reported by several observers in most of the inter-island channels, the tidal lagoons and around the mangrove systems (Deegan, 1992). Adult green turtles are herbivores which feed on seagrasses and algae. Hawksbill turtles feed almost exclusively on sponges. Flatback and loggerhead turtles are carnivores which apparently eat a wide variety of marine animals (Dr R Prince, CALM, pers. comm.).

There are some small sandy beaches on the south-western shore of Hermite Island which are potential breeding sites for a small number of turtles. However, the major turtle breeding beaches are on the opposite (eastern) side of the archipelago on North West and Trimouille Islands (Apache Energy Limited, 1996b). Figure 3 (Appendix 1) shows the turtle nesting beaches at the Montebello Islands.

CALM has advised that, although sea turtles are widespread migratory species, breeding animals typically return either to the nesting beach where they originally hatched, or to nearby beaches. It is therefore likely there are genetically distinct sub-populations of turtles which breed on the beaches of the Montebello-Lowendal-Barrow Island complex.

*Dugong*

The dugong or sea cow (*Dugong dugon*), a herbivorous marine mammal, is listed under Schedule 4 (other specially protected fauna) of the Wildlife Protection Act 1950. Dugongs have been reported at the Montebellos, but there have been no systematic surveys of these animals in the area (Deegan, 1992). Dugongs are not known to breed around the Montebello Islands (Dr R Prince, CALM, *pers. comm.*). CALM has advised that, while it is not known if dugongs breed around the Montebello-Lowendal-Barrow island complex, it is likely there are individuals which are resident in the area.

**Secondary risk - risk of an oil spill reaching turtles, dugongs and their habitats**

The proponent's oil spill trajectory predictions and probability estimates for drilling in winter indicate a very small probability of an oil spill impacting the reefs or coastline of the Montebello Islands (see Tables 3 and 4). The proponent's trajectory predictions indicate that oil could not reach the main nesting beaches on the eastern side of the Montebello Islands within 48 hours (Dr I Stejskal, Apache Energy Limited, *pers. comm.*). However, a small beach on the east side of Ah Chong Island and used for nesting by hawksbill turtles (Figure 3, Appendix 1) could be impacted within that time period.

The turtle breeding season is in the summer months. Therefore both the turtle breeding aggregations and the emerging hatchlings would be avoided altogether by drilling during the winter months, as is proposed.

The proponent's oil spill response strategy, as detailed in the oil spill contingency plan, is at Appendix 3. The plan states that turtle nesting beaches would be given high priority for protection. In the very unlikely event that an oil spill were to occur, and conditions were such that oil could reach the nesting beaches, the plan calls for the oil spill boom to be deployed so at to deflect oil away from the beaches.

However, in the event an oil spill was to reach the reefs or coastal waters of the Montebellos during winter, there is potential for some individual turtles or dugong to come in contact with oil.

**Tertiary risk - potential impacts on turtles and dugongs and their habitats**

There is no published information about the impacts of oil spills on turtles and very little information about impacts on dugongs. Whales and dolphins have been observed to avoid surface oil slicks, and dugongs are presumed to be able to do so, although no information on their response to oil is currently available (Baker *et al*, 1990). Preen (1991) reported that, apparently by chance, dugongs were not affected by the massive oil spills during the Gulf War.

The APEA Review (Volkner *et al*, 1994) summarises known impacts of oil pollution on seals, dolphins and whales. Based on that information, and assuming the effects would be similar, Table 5 (below) lists possible impacts on turtles and dugongs. Table 5 also lists possible impacts on food sources based on known information on the biology of turtles and dugongs.

**Table 5. Possible oil spill impacts on sea turtles and dugongs**

| Type of impact | Effects |
|---|---|
| Surface fouling | Effects may include sticking flippers to the body, irritation of body opening and eyes, skin lesions.<br><br>Contact with the volatile and light fractions of oil may result in absorption into the circulatory system and may result in mild irritation to permanent damage to sensitive membranes of eyes, mouth and respiratory tract. |
| Inhalation | Inhalation of volatile toxic fractions could occur when the oil is fresh and unweathered. Consequently the threat from inhalation is likely to be greater during the first few days after a spill occurs.<br><br>Inhalation of volatile hydrocarbons may pose a greater threat than contact with the thick oil residue. Inhalation may cause narcotic effect. |
| Direct and indirect ingestion | Oil ingestion has the potential to cause direct and indirect effects including:<br><br>• irritation/destruction of intestinal linings;<br>• organ damage;<br>• neurological disorders; and<br>• bio-accumulation of hydrocarbon and/or derivatives.<br>In mammals, hydrocarbon derivatives could be passed to young during lactation. |
| Effects on food sources | Loggerhead, flatback and hawksbill turtles are carnivorous and their food resources could be affected if coral reefs or coastal shallows were severely impacted by oil.<br><br>Dugongs and adult green turtles are herbivorous and might be affected if seagrasses were severely impacted. |

### Quaternary risk - potential long-term consequences

Although some individual turtles or dugongs might be affected, it is unlikely that an oil spill from the proposed project would have significant long-term consequences for populations of turtles and dugong or their habitats.

In the very unlikely event that a large oil spill were to occur and oil were to reach the turtle nesting beaches, there is potential for long-term contamination of the beaches. Turtles nest above high water so that the actual turtle nesting areas would not be directly affected. However adult turtles and hatchlings would have to traverse oiled areas of sand. This would result in oiling of adults, and oiling and possible entrapment of juveniles.

### Assessment

The EPA's opinion is that the relevant area for assessing the impact of the proposal on the relevant factor "turtles and dugongs", is the Montebello-Lowendal-Barrow Islands Complex. The Montebello-Lowendal-Barrow Islands complex is shown in Figure 3 (Appendix 1).

The EPA's objective in relation to the relevant factor "turtles and dugongs" is to avoid impacts on turtles, dugongs, and their habitats, to meet the requirements of the Wildlife Conservation Act and the Commonwealth Endangered Species Act, and to adhere to national and international legal obligations.

The EPA notes:

- the proximity of the drilling location to sensitive environments;
- public concerns about the potential for environmental impacts;
- the public perception that an operation of this type is likely to result in an adverse oil spill incident;
- the primary risk of an oil spill from drilling operations or equipment failure is very low and will be further reduced consistent with "ALARP" (as low as reasonably practicable) standards (see section 3.2);
- drilling would only be carried out in the period June-August inclusive, so that, in the very unlikely event that a spill does occur, it is likely to be carried away from the Montebello Islands. The probability of an oil spill reaching sensitive areas will therefore be further reduced; and
- a specific oil spill contingency plan for the project area has been approved by DME. Under the plan, a special oil spill boom, oil spill combat vessel and trained crew will be on site throughout the project. In the very unlikely event that an oil spill were to occur and were to move in the direction of beaches or other sensitive areas, an oil spill boom would be used to deflect oil away from the sensitive areas. With these measures, the probability of oil reaching sensitive areas would therefore be reduced still further.
- even if a large oil spill were to occur and were to reach the coast waters of the Montebello Islands, some individual turtles or dugongs might be affected, however it is most unlikely that there would be significant long-term consequences for populations of turtles or dugongs or for their food resources.

Having particular regard to:

- the potential sources of oil spillage from an operation of this type;
- the extremely low probability of a significant oil spill from the proposed project;
- the proposed management actions, which will include managing risks to "ALARP" standards under the supervision of the DME;
- the proximity of the drilling location to habitats of turtles and dugongs and other sensitive environments;
- the drilling would be carried out during the period June to August inclusive when any spillage should be carried away from sensitive areas;
- the proponent's good environmental record to date and specific commitments to manage risk and protect the environment.

It is the EPA's opinion that its objective with respect to the relevant environmental factor "mangroves" is unlikely to be compromised, provided that:

- to assist in oil spill contingency planning, the oil spill trajectory model is further validated, before drilling commences, by continuous field observations over a period of two weeks. Computer predictions should also be checked by regular recording of surface water movements during this period. Appropriate modifications are to be made to oil spill response strategies if there are any significant variations from the current oil spill trajectory predictions.

- before drilling commences at the Wonnich appraisal site, the proponent to carry out a successful trial deployment of the oil spill boom.
- the proponent to develop a rig refuelling procedure, such that refuelling would only be carried out under conditions where any spillage would be carried away from sensitive environments.
- the proponent to implement an environmental management system.

The EPA acknowledges that, even with these precautions, there remains a very small finite probability that an oil spill incident may occur. However, in the unlikely event that a spill should occur, it is most likely to be of small volume only.

The EPA recognises that, in view of the proximity of the drilling location to sensitive environments, there is public concern about the potential for environmental impacts. The EPA also recognises that there is a public perception that an operation of this type is likely to result in an adverse oil spill incident. The EPA recommends that:

- the proponent prepare and implement an appropriate communication strategy to inform the public about the environmental risks from the proposed project and about risk management measures to be put in place.

## 4. Conditions and procedures

In the EPA's opinion, the proposal, if implemented, should be subject to the following conditions and procedures.

### 4.1 Conditions

(a) drilling is to be restricted to the period 1 June to 31 August in any year;

(b) before drilling the Wonnich appraisal wells, the proponent is to commission an independent environmental audit of the drilling rig and its operations, to the requirements of the EPA on advice from the DME;

(c) the proponent is to put in place legally-binding contract requirements with the drilling contractor to achieve environmental best practice (as to be agreed), to the requirements of the EPA on advice from the DEP and the DME;

(d) to assist oil spill contingency planning, the proponent is to further validate the oil spill trajectory model by continuous field data for a period of two weeks, including surface water movements, before drilling commences. Appropriate modifications are to be made to oil spill response strategies if there are any significant variations from the current oil spill trajectory predictions, to the requirements of the EPA on advice of the DME and the DEP;

(e) the proponent is to develop a rig refuelling procedure, such that refuelling would only be carried out under conditions where any spillage would be carried away from sensitive environments, to the requirements of the EPA on advice of the DEP and the DME;

(f) the proponent is to prepare and implement an appropriate communication strategy to inform the public about the environmental risks from the proposed project and about the risk management measures to be put in place, to the requirements of the EPA;

(g) the proponent's commitments as set out in the CER, and as subsequently modified during the assessment process, to be made legally enforceable;

(h) in order to manage the relevant environmental factors and EPA objectives contained in this Bulletin, and subsequent environmental Conditions and Procedures authorised by the Minister for the Environment, the proponent is required to prepare, prior to implementation of the proposal, an environmental management system, including an environmental management program, in accordance with recognised environmental management principles, such as those in Australian Standards AS/NZS ISO 14000 series.

## 4.2 Procedures

(a) an oil spill contingency plan has been prepared and has been approved by the DME under the provisions of the *Petroleum (Submerged Lands) Act*. As is normal practice, before approving the contingency plan, the DME sought advice from the DEP and the State Committee for Combating Marine Oil Pollution.

(b) As a condition of approval of the oil spill contingency plan, the DME will require the proponent to carry out a simulated trial of the plan, up to and including deployment of oil spill combat equipment. The DME also will require the proponent to carry out a successful field trial of the oil spill boom at the project site before drilling commences.

(c) the DME will require the proponent to take out adequate oil spill insurance to cover damages to Third Parties and cost of oil spill clean-up operations, to meet the requirements of the *Petroleum (Submerged Lands) Act.*

## 5. Other advice

*Comparative risk*

The EPA considers that the overall ecological risk from oil spills from the proposed short-term appraisal drilling project is extremely low and is comparable with accepted human health and safety risks.

*EPA policy on offshore petroleum drilling*

The EPA's policy on petroleum drilling near coral reefs and other environmentally sensitive areas is at present being revised.

EPA Bulletin 679 'Protecting the marine environment - a guide for the petroleum industry' was released as a public discussion paper in 1993 (EPA, 1993). The main purpose of Bulletin 679 was to provide guidance on the levels of environmental impact assessment for offshore petroleum proposals.

A number of submissions were received from the industry and from conservation groups in response to Bulletin 679. Industry's main concern with Bulletin 679 centred on the issue of exploration in marine parks and reserves and the statement that there would be a presumption against approval in these areas. Conservation groups expressed opposition to all petroleum drilling in marine reserves or any other environmentally sensitive locations.

A revised policy document on offshore petroleum exploration and development has been developed and will be released shortly. The revised policy document takes account of:

- submissions received on Bulletin 679;
- the "APEA review" (Volkman *et al*, 1994, 'Environmental implications of offshore oil and gas development in Australia - the findings of an independent scientific review');
- the report of the Marine Parks and Reserves Selection Working Group (1994), and
- the WA Government's 1994 'New Horizons in Marine Management' policy statement (Government of Western Australia, 1994).

The revised EPA policy document will include a general framework for environmental risk assessment for drilling proposals close to coral reefs, mangroves and other environmentally sensitive environments.

*Information requirements for an oil production proposal*

This assessment has addressed oil appraisal drilling on the Wonnich field. Any proposal to undertake production drilling for oil on the Wonnich field would require a separate environmental impact assessment.

In the case of the Wonnich appraisal project, drilling would occur over a short period only and oil spill risks are correspondingly low. However, in a production operation, production would be carried out over a number of years and there is therefore the potential for higher risks. Therefore, for an oil production proposal on the Wonnich field, there would be a need for additional risk information, particularly information on tertiary and quaternary risks.

*Disposal of oil recovered from marine oil spills*

The EPA notes that the oil spill contingency plan for the Wonnich oil appraisal project refers to requirements for disposal of recovered oil, in the unlikely event that there is an oil spill from the project. The EPA is of the view that the general issue of disposal of oil recovered from marine oil spills, whether the spills are from the offshore exploration and production industry, or, as is more likely, from shipping incidents, is an important issue which should be addressed by the State Committee for Combating Marine Oil Pollution.

## 6. Recommendations

The EPA submits the following recommendations:

Recommendation 1

That the Minister for the Environment note the report on the relevant environmental factors, including the EPA objectives for each factor (Section 3).

Recommendation 2

That the Minister for the Environment note that the EPA has concluded that, if implemented according to the EPA's recommended conditions and procedures (Section 4), the risk of adverse impact from the proposed project would be extremely low and it is most unlikely that the EPA's objectives would be compromised.

Recommendation 3

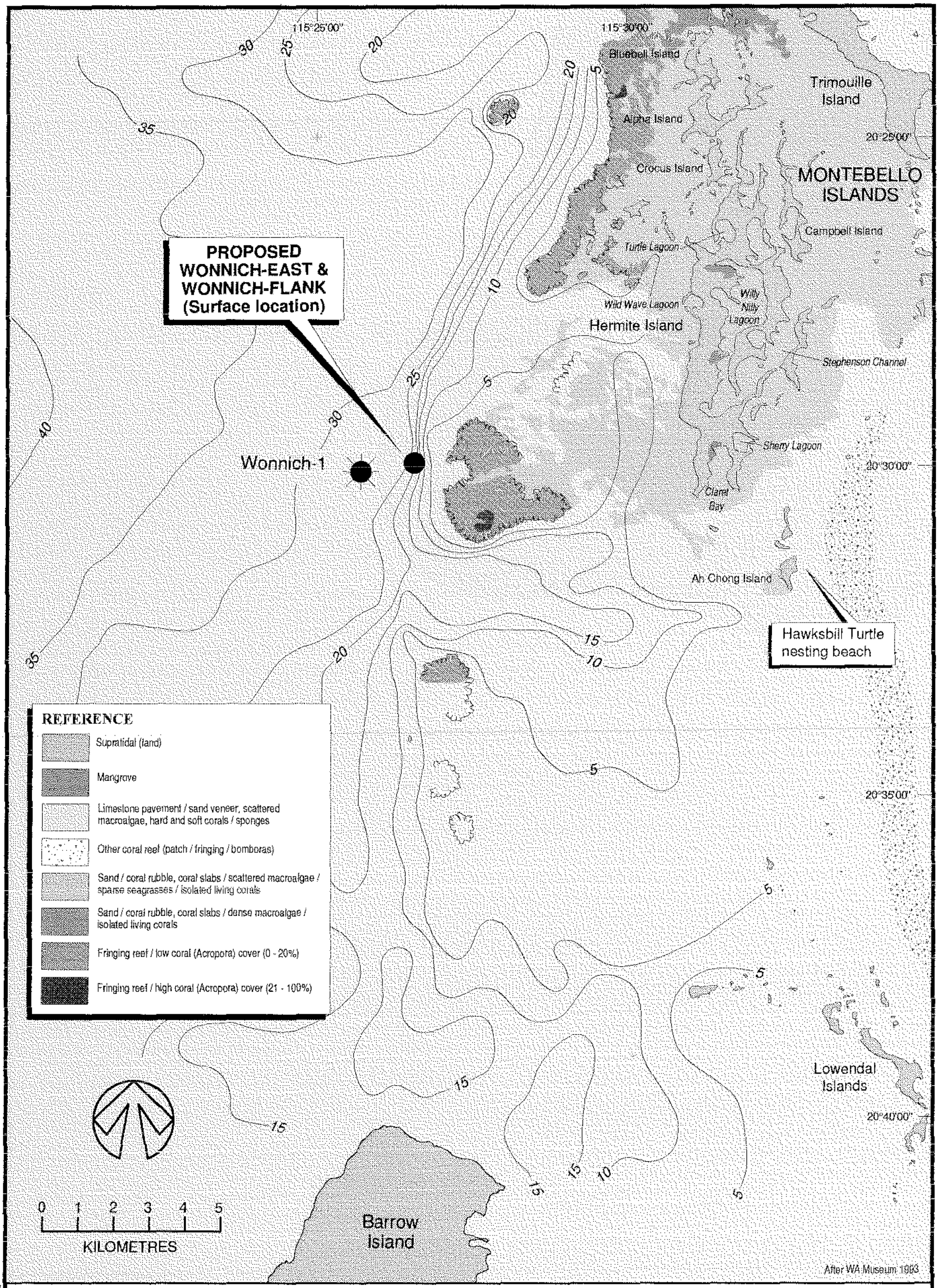
That the Minister for the Environment impose the conditions and procedures set out in Section 4 of this report.

Recommendation 4

That the Minister for the Environment note the EPA's other advice (Section 5).

# Appendix 1

**Figures and detailed information**




# PROJECT LOCATION AND MARINE HABITATS OF THE SOUTHERN MONTEBELLO ISLANDS

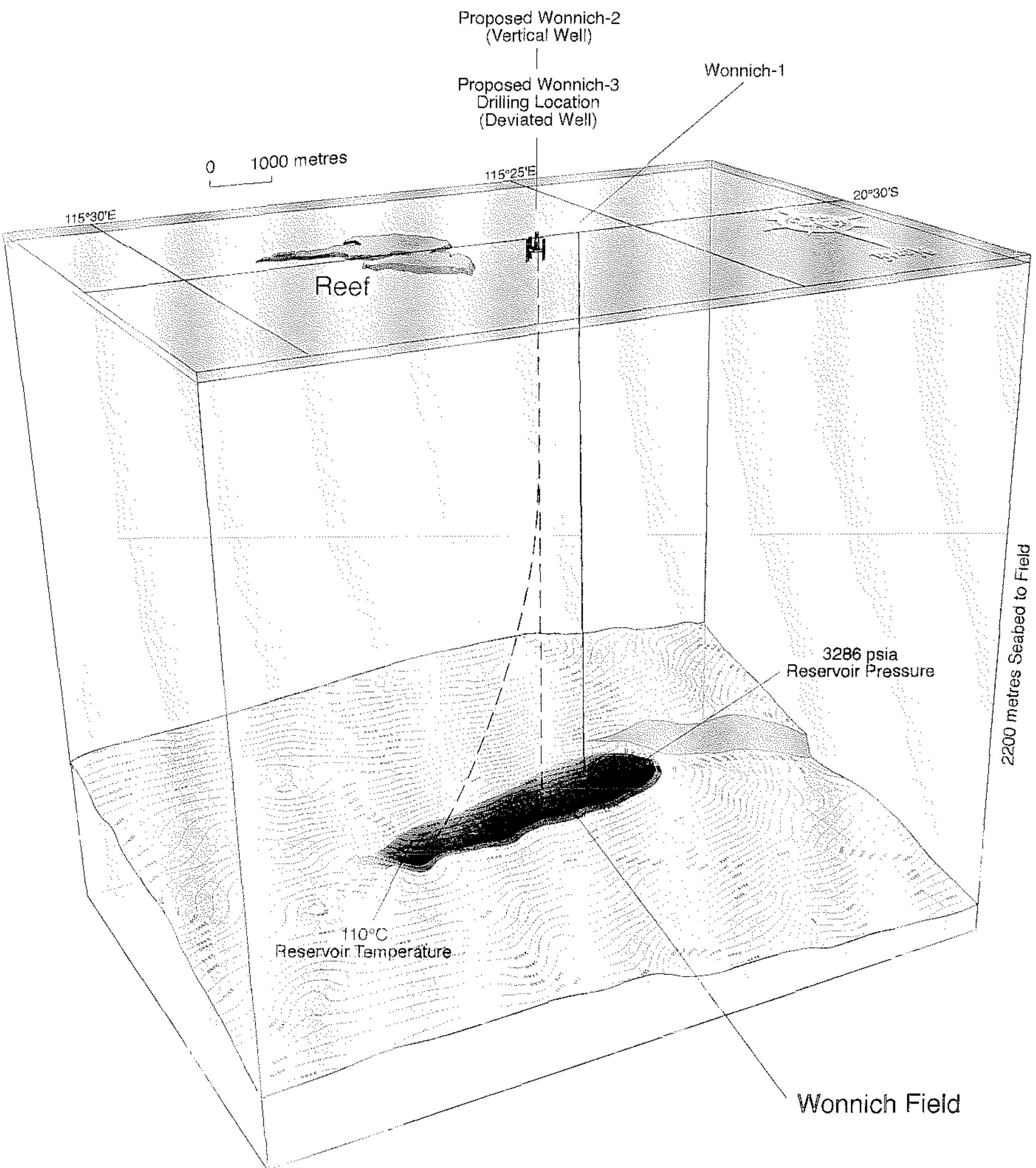
LEPROVOST DAMES & MOORE

FIGURE 1

Environmental Drafting (066) 48 6105

31479-002-367 R583 FIGA3_2.DGN 12/95

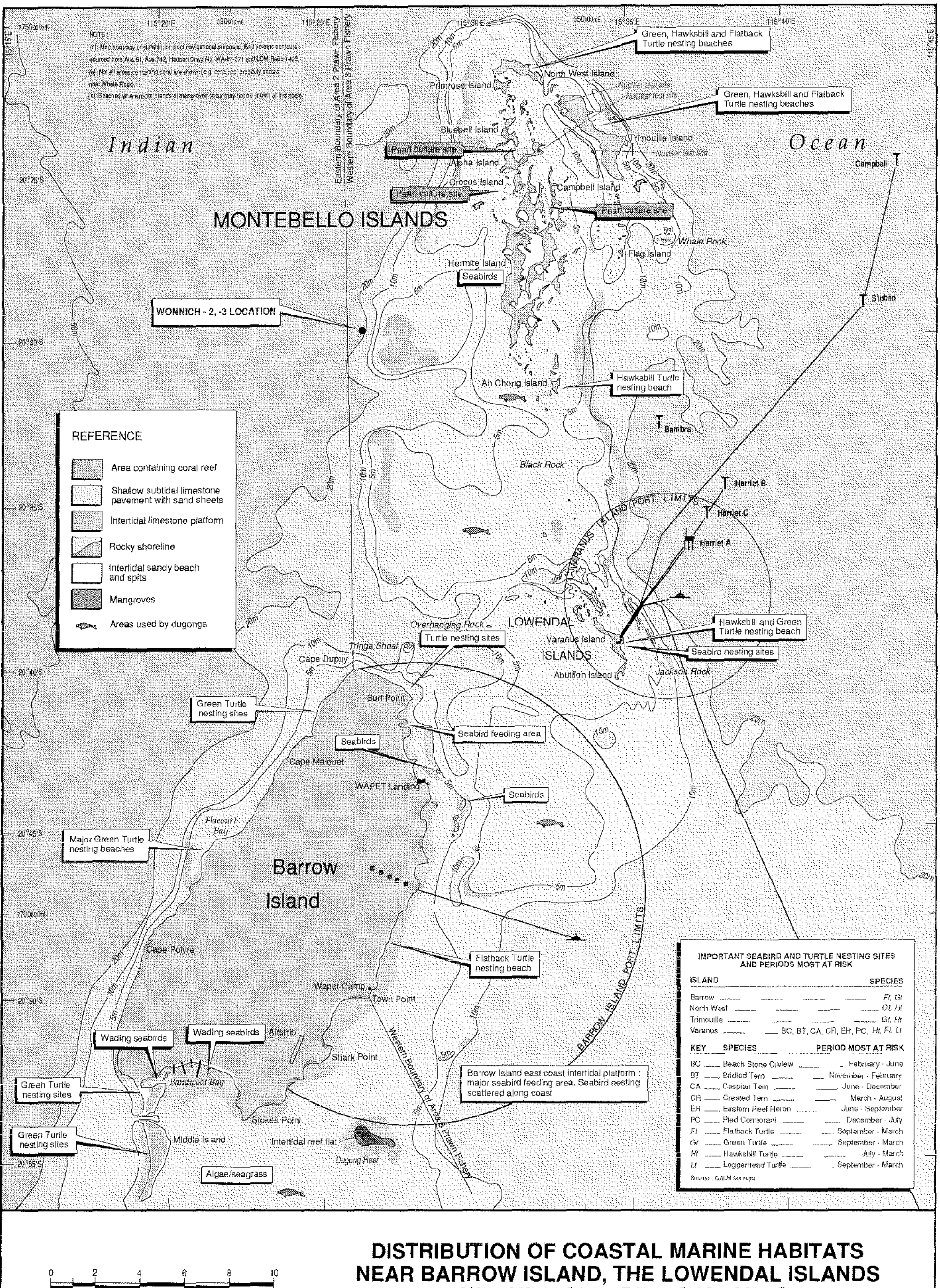
# PERSPECTIVE VIEW OF THE WONNICH FIELD LOOKING SOUTH-WEST




5x Vertical Exaggeration

Taken from MDu3589 Dated: 6 November 1996 MD.m3588(p1)

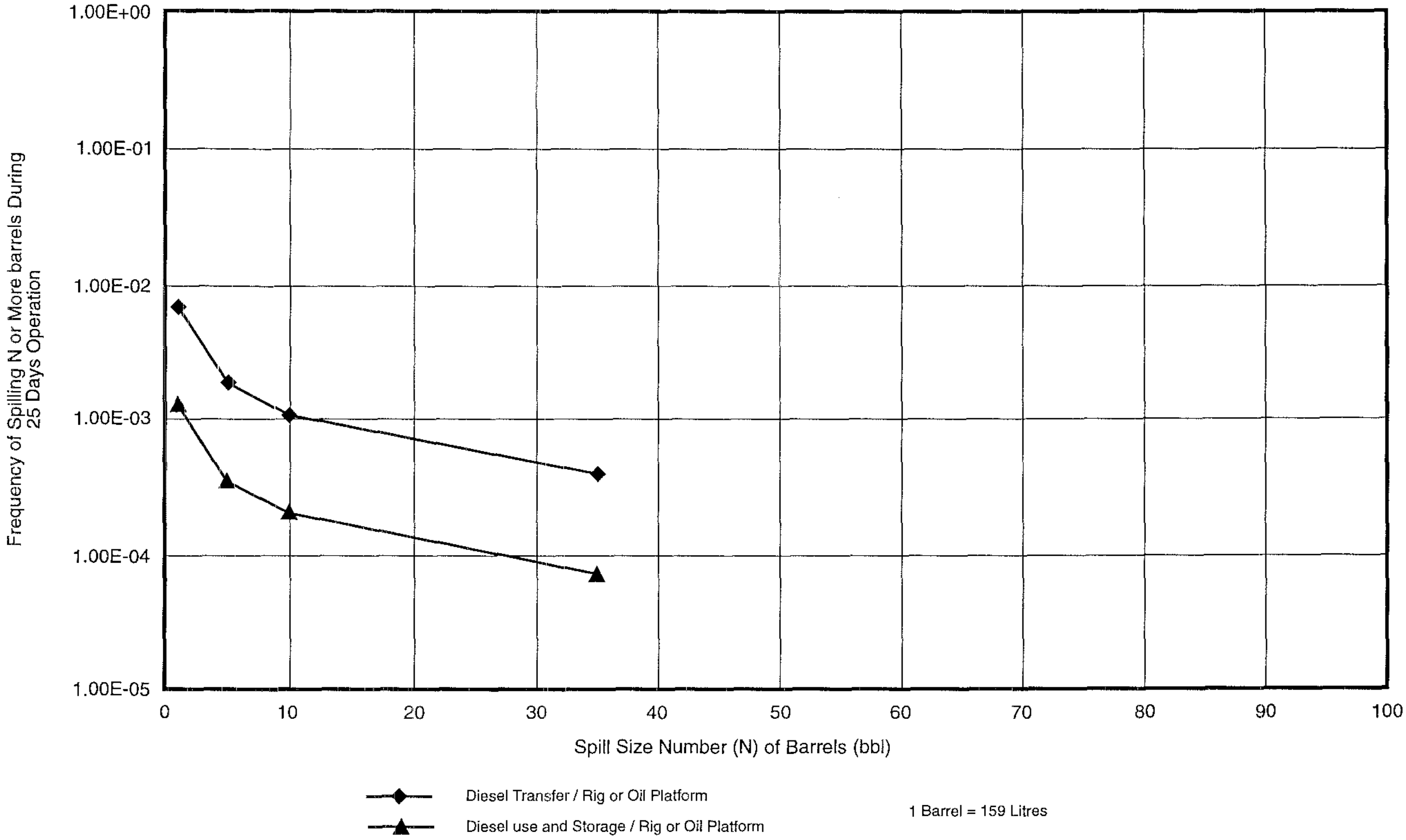
Figure 2




**DISTRIBUTION OF COASTAL MARINE HABITATS NEAR BARROW ISLAND, THE LOWENDAL ISLANDS AND THE MONTEBELLO ISLANDS**

**FIGURE 3**

# INDIVIDUAL SPILL SIZE V's FREQUENCY DISTRIBUTION CURVES

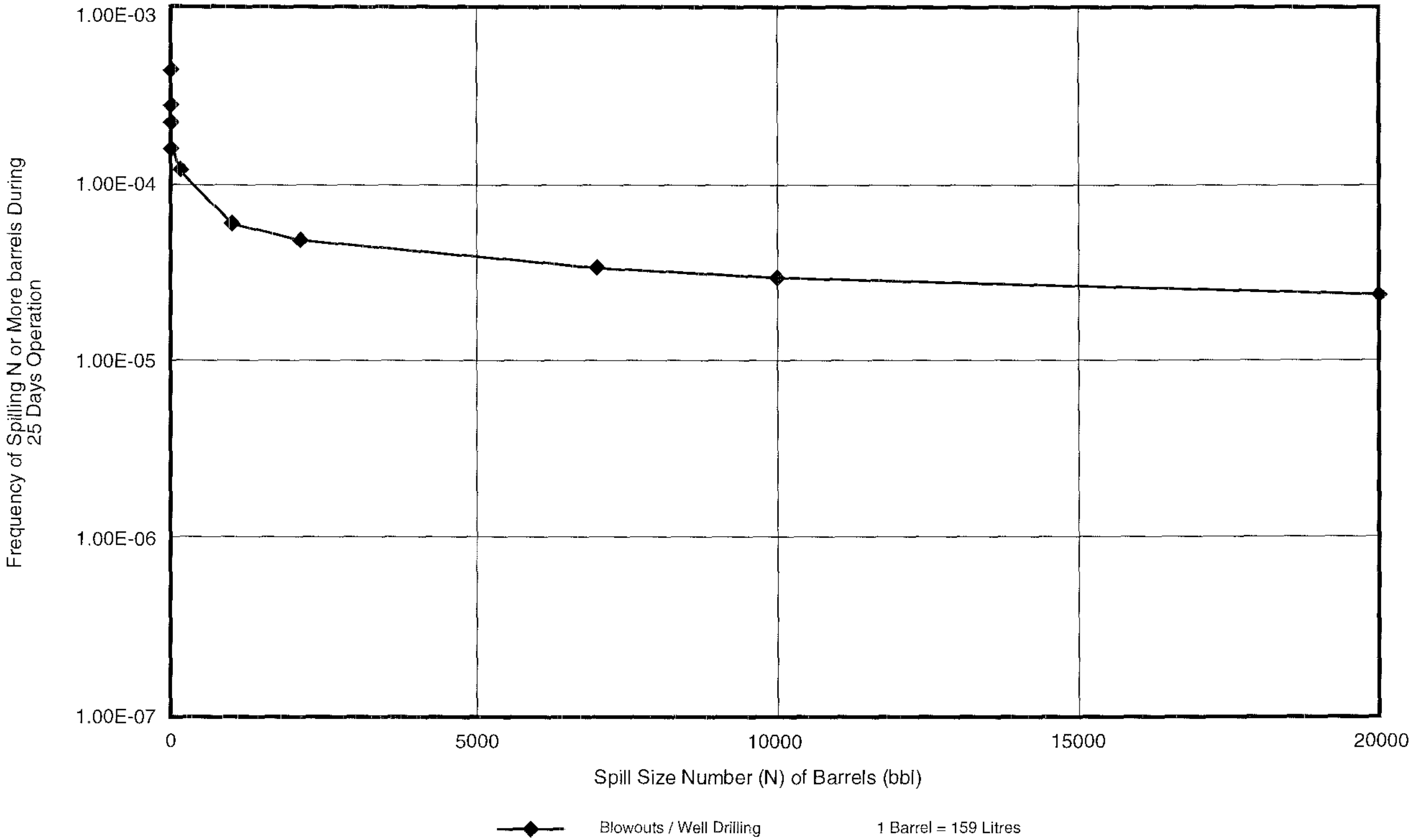



1 Barrel = 159 Litres

Date: 1 May 1997 ISm4466

Figure 4

# INDIVIDUAL SPILL SIZE V's FREQUENCY DISTRIBUTION CURVES




Date: 1 May 1997 ISm4467

Figure 5

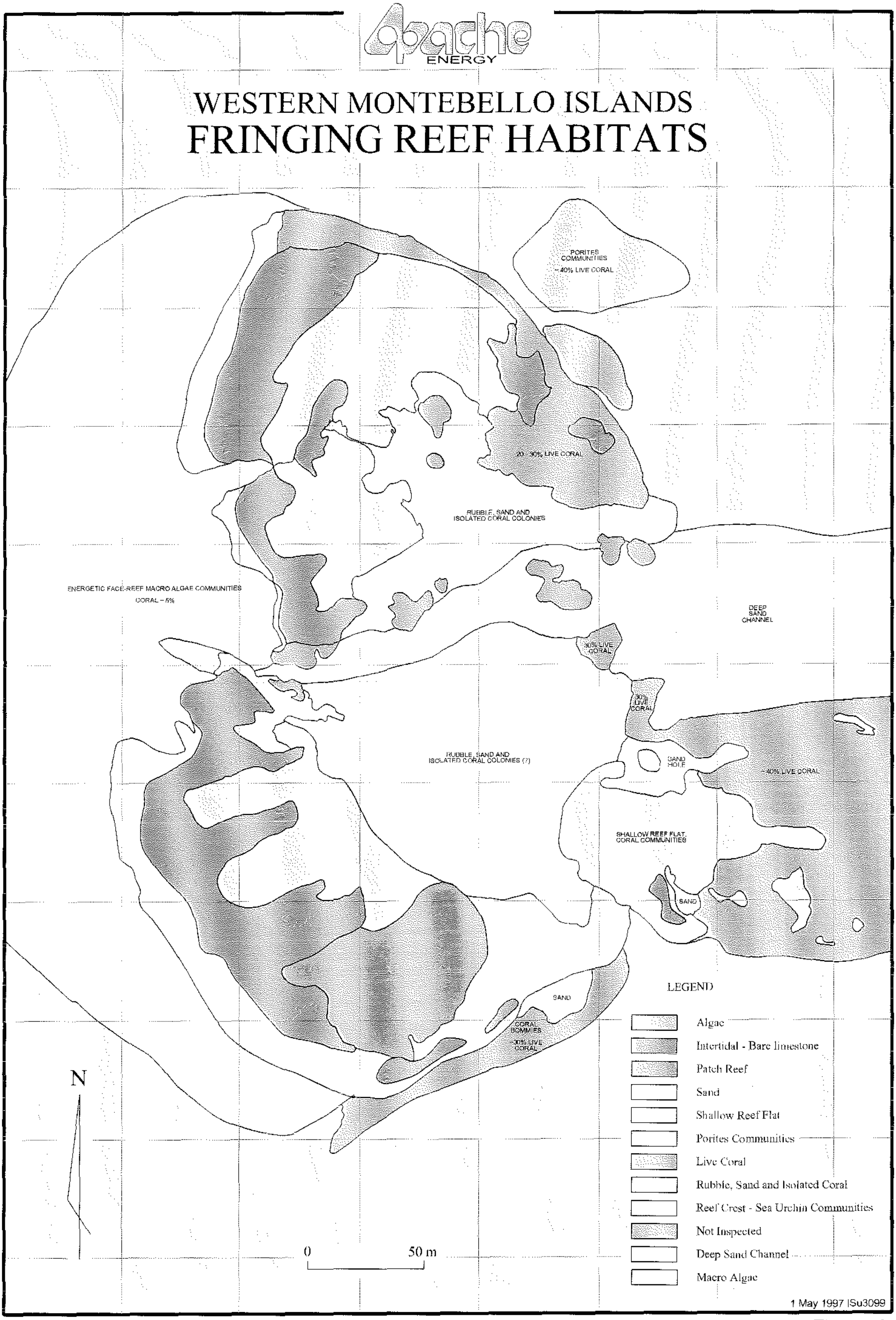
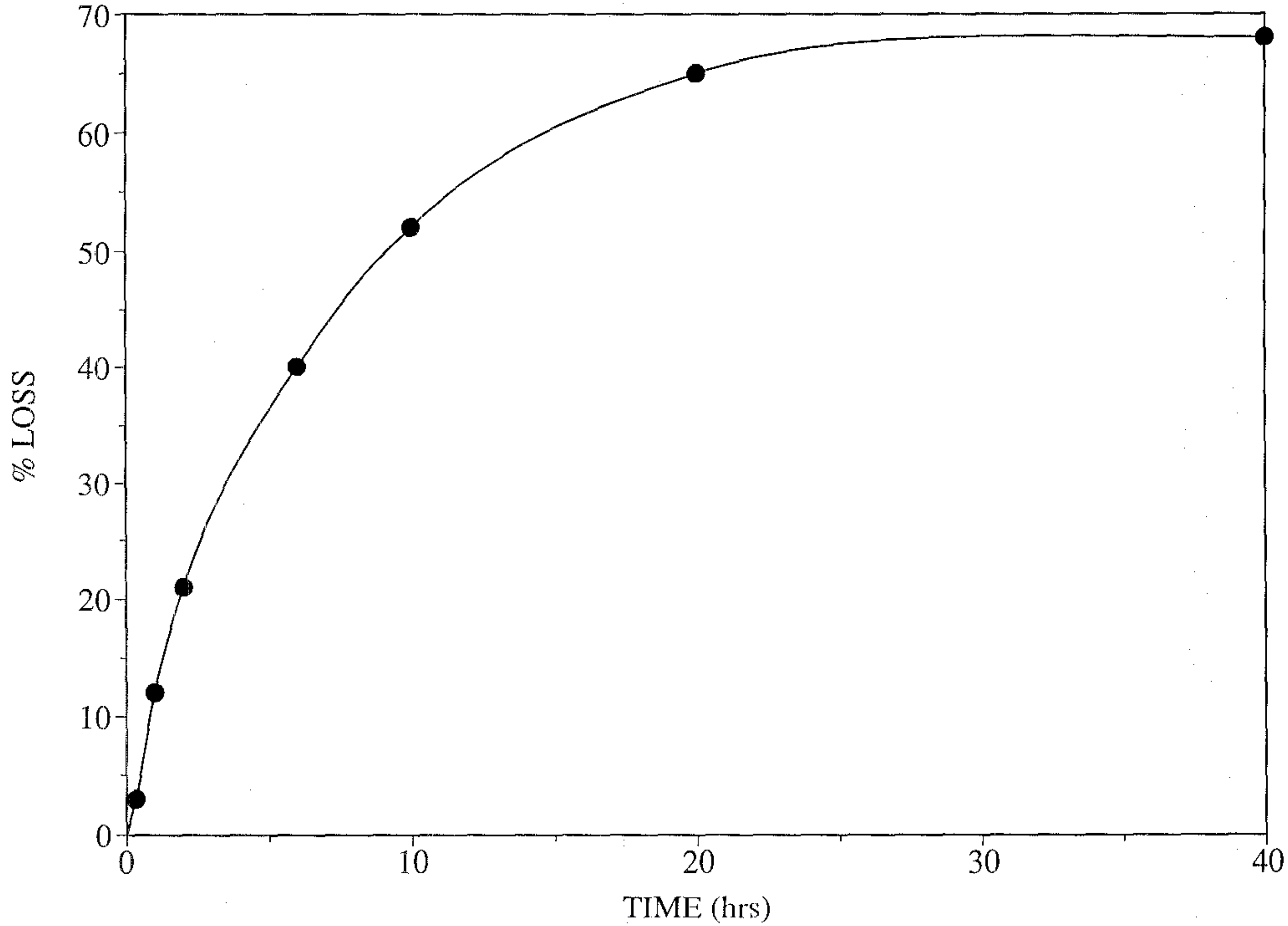

Apache ENERGY
WESTERN MONTEBELLO ISLANDS
FRINGING REEF HABITATS
PORITES COMMUNITIES
~40% LIVE CORAL
20 - 30% LIVE CORAL
RUBBLE, SAND AND ISOLATED CORAL COLONIES
ENERGETIC FACE-REEF MACRO ALGAE COMMUNITIES
CORAL ~ 5%
DEEP SAND CHANNEL
30% LIVE CORAL
30% LIVE CORAL
RUBBLE, SAND AND ISOLATED CORAL COLONIES (?)
SAND HOLE
~40% LIVE CORAL
SHALLOW REEF FLAT, CORAL COMMUNITIES
SAND
SAND
CORAL BOMMIES
~30% LIVE CORAL
N
0
50 m
LEGEND
Algae
Intertidal - Bare limestone
Patch Reef
Sand
Shallow Reef Flat
Porites Communities
Live Coral
Rubble, Sand and Isolated Coral
Reef Crest - Sea Urchin Communities
Not Inspected
Deep Sand Channel
Macro Algae
1 May 1997 ISu3099

Figure 6

# EVAPORATION RATE FOR DIESEL

## % LOSS V's TIME

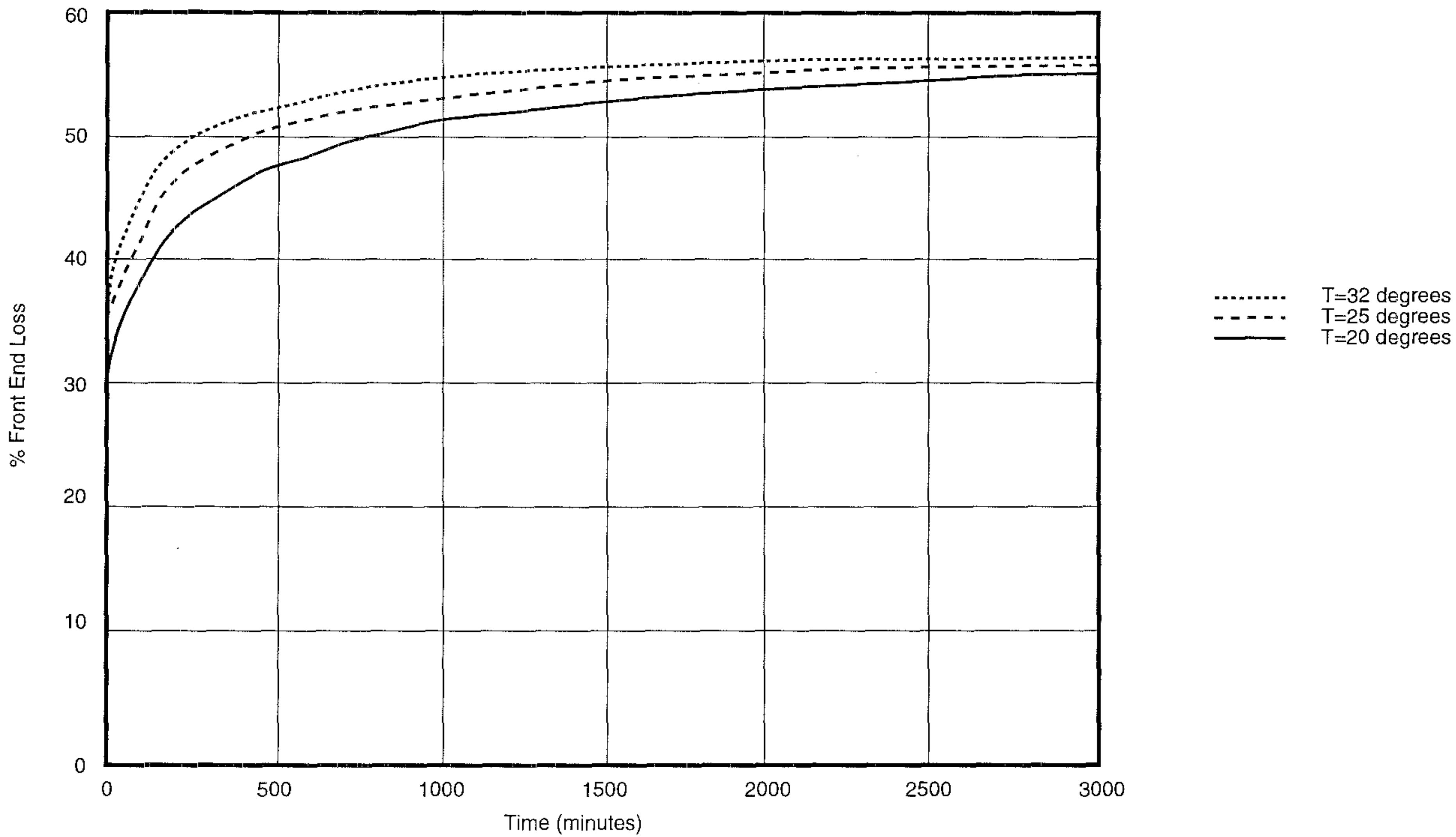



Date: 1 May 1997 SL.m3931

Figure 7

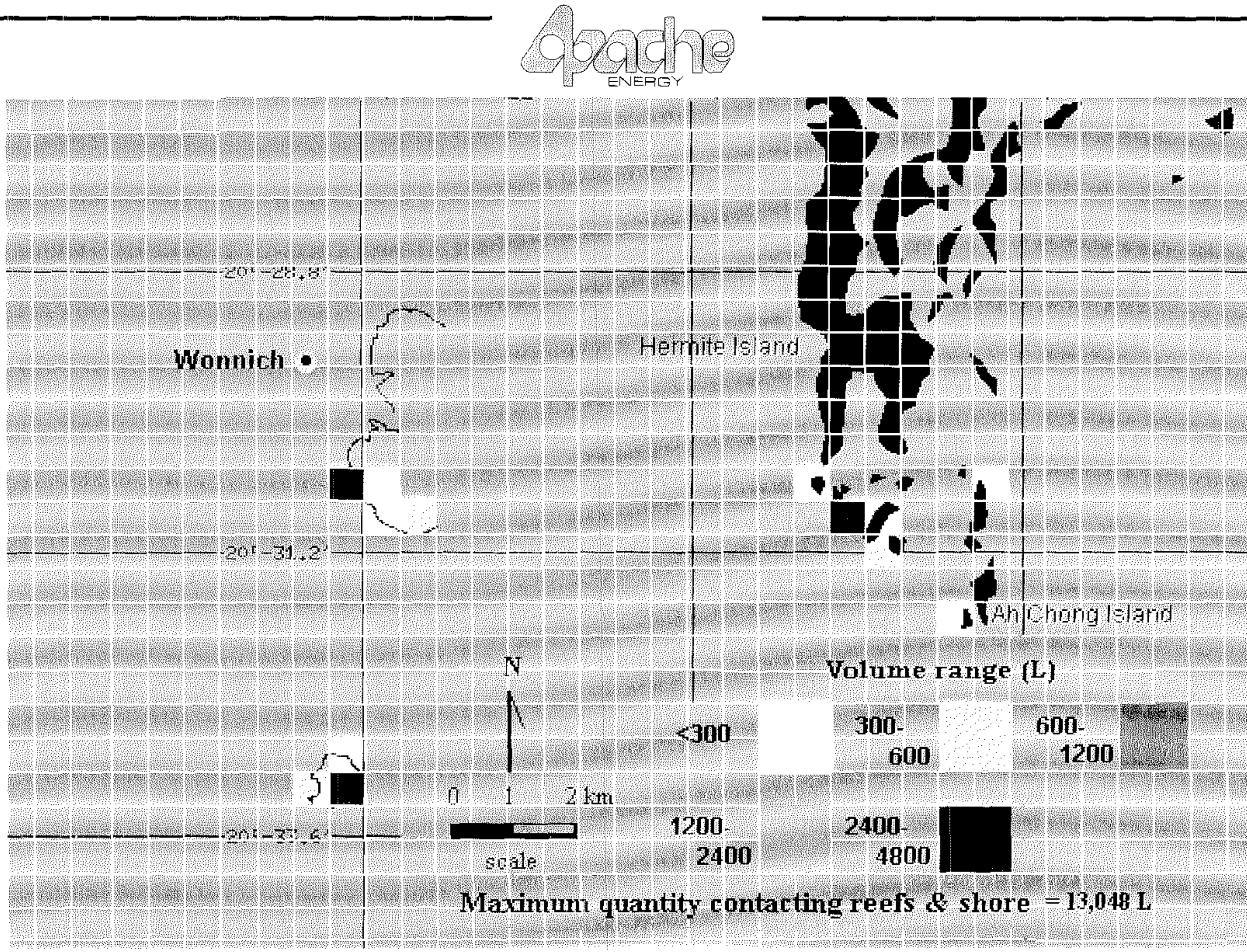
# ESTIMATED EVAPORATION CURVES FOR WONNICH OIL AT 20, 26 & 32°C

Weathering of Wonnich 1, DST 1, Crude Oil




Date: 1 May 1997 ISm4467

Figure 8

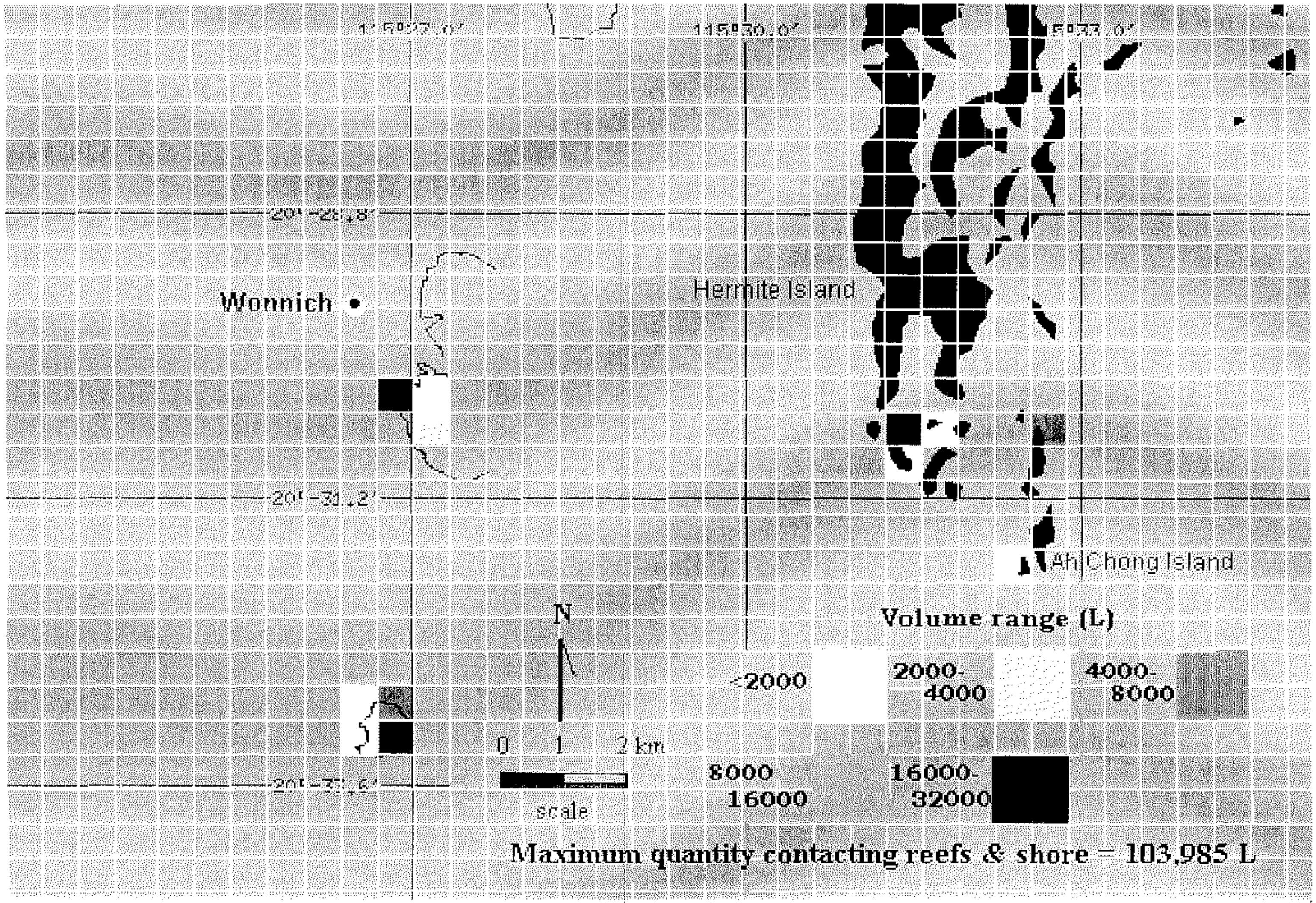



Predicted locations where diesel oil may contact reef or shore, showing the indicative volume of diesel which may arrive, during the worst case out of the 100 modeled spill trajectories for a 80, 000 L spill of diesel during June to August inclusive. The worse case was the spill trajectory where the most oil contacted shores and reefs.

Figure 9

2 May 1997 IS.m4474

Figure 10




Predicted locations where Wonnich crude oil may contact reef or shore, showing the indicative volume of oil which may arrive, during the worst case out of the 100 modeled spill trajectories for a 600, 000 L spill of Wonnich crude oil during June to August inclusive. The worse case was the spill trajectory where the most oil contacted shores and reefs.

# Appendix 2

**List of organisations which made submissions**

**Commonwealth Government Agencies**
Australian Nature Conservation Agency (ANCA)
Australian Heritage Commission (AHC)
Commonwealth Scientific and Industrial Research Organisation (CSIRO)

**State Government agencies**
Department of Conservation and Land Management (CALM)
Department of Environmental Protection (DEP)
Department of Minerals and Energy (DME)

**Non-government organisations**
Conservation Council of Western Australia Inc.

Greenpeace Australia Inc

# Appendix 3

**Proponent's oil spill response strategy**

**Extract from oil spill contingency plan.**
**(Reference: Apache Energy Limited, 1996c)**

## 6.2.5 Priority Classification, Protection and Clean-up. Summary Sheet. Drilling in June - August.

(see also strategies on following sheets)

| Location | Distance from rig | Habitat type | Ecological status | Spill response | Clean-up method | | |
|---|---|---|---|---|---|---|---|
| | | | | | Preferred | Possible | Avoid |
| West fringing reef | 1 km | Fringing coral reef | High | Containment and recovery of oil with booms and skimmers placed as close as possible to the rig. If weather permits, system of booms to be set up for deflection. Propeller wash for mechanical break-up of oil. | Natural cleansing. | | Dispersants. |
| Southern fringing reef | 6 km | Fringing coral reef | High | Containment and recovery of oil with booms and skimmers placed as close as possible to the rig. If weather permits, system of booms to be set up for deflection. Propeller wash for mechanical break-up of oil | Natural cleansing. | | Dispersants. |
| Claret Bay | 8.5 km | Enclosed sand/mud bay | High | Deflection of oil at southern part of bay towards rocky shores and open ocean. Close off bay at narrow section with booms. Absorbent booms laid out in front of mangroves. | Natural cleansing.<br><br>Sorbant materials to sop up excess oil. | Bioremediation. | Dispersants.<br><br>Mechanical clean-up.<br><br>Flushing. |

| Location | Distance from rig | Habitat type | Ecological status | Spill response | Clean-up method | | |
|---|---|---|---|---|---|---|---|
| | | | | | Preferred | Possible | Avoid |
| West shoreline of Hermite Island | 8 km | Rock cliffs | Low | Surveillance and monitor. | Natural cleansing. | Absorbent mats to sop up excess oil. | |
| Wild Wave lagoon | 9 km | Enclosed bay | Moderate | Close off mouth of lagoon with booms. Deflection of oil to north of lagoon. | Natural cleansing. | Bioremediation. | Dispersants.<br><br>Mechanical clean-up.<br><br>Flushing. |
| Sand beach south of Wild Wave Lagoon | 8.5 km | Sandy beach | Moderate | Deflection of oil to south of beach onto rocky shore and open ocean. Sand barriers. Natural cleansing. | Natural cleansing. | Bioremediation | Dispersant.<br><br>Mechanical clean-up. |
| Ah Chong Island | 10 km | Rock lined island with sand beach on east side | Moderate | Deflection away from sandy beach located on east side of island. | Natural cleansing. | Absorbent materials to sop up excess oil. | Dispersant. |
| Southern islets | 8.5-10 km | Rocky cliff islets | Moderate to low | Surveillance. | Natural cleansing. | Absorbent material to sop up excess oil. | |

# MONTEBELLO ISLANDS

# OIL SPILL RESPONSE STRATEGIES

**Area**: West fringing reef **Latitude**:

**Longitude**:

---

**Physical features**: Coral fringing reef. Areas of broken coral rubble. Live coral both intertidal and subtidal.

---

**Access**: Exposed at low spring tide. Waves breaking on west side of reef. East side protected. May be able to approach with shallow draft vessel.
**Water depth:** 0-10 m

---

**Ecological features**: Corals, algae, turtles, fish, invertebrates.

| | Value | Comments |
|---|---|---|
| Overall | High | |
| Spring | High | |
| Summer | High | |
| Autumn | High | |
| Winter | High | |

---

**Oil spill response**: Containment and recovery of oil at rig location with booms.
Diversion of oil away from reef on east side with smaller boom of absorbent materials.
Propeller wash to mechanically disperse oil.

---

**Clean-up methods**:

Preferred: Containment and recovery, natural cleansing.

Possible:

Prohibited: Dispersants.

---

**Monitoring endpoints**:

Hydrocarbons in water and sediments.
Corals: percentage cover, percentage live/dead, species presence
Algae: percentage cover, species presence.

# MONTEBELLO ISLANDS

# OIL SPILL RESPONSE STRATEGIES

**Area:** Southern fringing reef **Latitude:**

**Longitude:**

---

**Physical features:** Coral fringing reef. Areas of broken coral rubble. Live coral both intertidal and subtidal.

---

**Access:** Not exposed at low spring tide. Waves break over reef at low tide. May be able to approach with shallow draft vessel in calm waters.

**Water depth:** 0-10 m.

---

**Ecological features:** Corals, algae, turtles, fish, invertebrates.

| | Value | Comments |
|---|---|---|
| Overall | High | |
| Spring | | |
| Summer | | |
| Autumn | | |
| Winter | | |

---

**Oil spill response:** Containment and recovery of oil at rig location with booms.
Deflection of oil away from reef on east side with smaller boom of absorbent materials.
Propeller wash to mechanically disperse oil.

---

**Clean-up methods:**

Preferred: Containment and recovery, natural cleansing.

Possible:

Prohibited: Dispersants.

---

**Monitoring endpoints:**

Hydrocarbons in water and sediments.
Corals: percentage cover, percentage live/dead, species presence
Algae: percentage cover, species presence.

## MONTEBELLO ISLANDS

## OIL SPILL RESPONSE STRATEGIES

**Area:** Claret Bay **Latitude:**

**Longitude:**

---

**Physical features:** Enclosed bay, sand flats, rocky shores, sand beach, mangroves. May experience strong tidal currents.

---

**Access:** Helicopter, shallow draft vessel to entrance, dingy, foot.

**Water depth:** Within bay 1 m. 3 m just outside mouth of bay.

---

**Ecological features:** Mangroves, seabirds, turtles, invertebrates, fish.

| | Value | Comments |
|---|---|---|
| Overall | High | |
| Spring | | |
| Summer | | |
| Autumn | | |
| Winter | | |

---

**Oil spill response:** Containment and recovery of oil at rig locations.
Deflection of oil at southern end of bay towards the rocky shores and open ocean.
Close off bay at narrow section with booms.
Absorbent booms laid out in front of mangroves.

---

**Clean-up methods:**

Preferred: Natural cleansing. Absorbent materials to sop up oil.

Possible: Bioremediation.

Prohibited: Dispersants.

---

**Monitoring endpoints:**

Hydrocarbons in water and sediments.
Hydrocarbons in selected invertebrates (oysters, barnacles).
Mangrove attributes (chlorosis, defoliation).

# MONTEBELLO ISLANDS

# OIL SPILL RESPONSE STRATEGIES

**Area:** West shoreline of Hermite Island **Latitude:**

**Longitude:**

**Physical features:** Rocky cliffs of varying height and undercut.

**Access:** Helicopter.

**Water depth:** 0-3 m

**Ecological features:** Oysters, gastropods, barnacles, limpets, crabs.

| | Value | Comments |
|---|---|---|
| Overall | Moderate | |
| Spring | | |
| Summer | | |
| Autumn | | |
| Winter | | |

**Oil spill response:** Containment and recovery of oil at rig location.
Surveillance and monitor.

**Clean-up methods:**

Preferred: Natural cleansing.

Possible: Sop up excess oil with absorbent materials.

Prohibited:

**Monitoring endpoints:**

Hydrocarbons in rock oysters and barnacles.
Presence of taxa.
Abundances of common species.

# MONTEBELLO ISLANDS

# OIL SPILL RESPONSE STRATEGIES

**Area**: Wild Wave Lagoon

**Latitude**:

**Longitude**:

---

**Physical features**: Enclosed bay with narrow mouth. Mud/sandflats. Sand veneer on limestone. Rock cliff headlands. May experience strong tidal currents.

---

**Access**: Helicopter. Shallow draft vessel to entrance. Dingy. Foot.

**Water depth:** 5 m at entrance.

---

**Ecological features**: Invertebrates, seabirds.

| | Value | Comments |
|---|---|---|
| Overall | Moderate | |
| Spring | | |
| Summer | | |
| Autumn | | |
| Winter | | |

---

**Oil spill response**: Containment and recovery of oil at rig location.
Close off mouth of bay with booms.
Deflection of oil to north of bay.

---

**Clean-up methods**:

Preferred: Natural cleansing.

Possible: Sop up excess oil with absorbent materials.

Prohibited: Dispersants.

---

**Monitoring endpoints**:

Hydrocarbons in water and sediments.
Hydrocarbons in selected invertebrates.

# MONTEBELLO ISLANDS

# OIL SPILL RESPONSE STRATEGIES

**Area:** Sand beach south of Wild Wave Lagoon

**Latitude:**

**Longitude:**

---

**Physical features:** Sand beach. Exposed to west.

---

**Access:** Helicopter, shallow draft vessel, dingy, foot.

**Water depth:** 0-3 m

---

**Ecological features:** Turtle nesting November - March. Sparse invertebrates. Subtidal fish and algae.

| | Value | Comments |
|---|---|---|
| Overall | Moderate | |
| Spring | | |
| Summer | High | Turtle nesting |
| Autumn | | |
| Winter | Moderate | |

---

**Oil spill response:** Containment and recovery of oil at rig location.
Deflection of oil to south of beach onto rocky shore and open ocean. Creation of small sand barriers and catchment areas.

---

**Clean-up methods:** .

Preferred: Natural cleansing

Possible: Bioremediation.

Prohibited: Dispersants. Mechanical clean-up.

---

**Monitoring endpoints:**

Hydrocarbons in sediments.

# MONTEBELLO ISLANDS

# OIL SPILL RESPONSE STRATEGIES

**Area:** Ah Chong Island

**Latitude:**

**Longitude:**

---

**Physical features:** Limestone rocky shores. Sandy beaches. May experience strong tidal currents

---

**Access:** Helicopter, shallow draft vessel, dingy.

**Water depth:** 0.3 - 1 m

---

**Ecological features:** Seabirds, invertebrates, turtles.

| | Value | Comments |
|---|---|---|
| Overall | High | |
| Spring | | |
| Summer | High | Turtle nesting |
| Autumn | | |
| Winter | | |

---

**Oil spill response:** Containment and recovery of oil at rig location.
Deflection of oil away from sand beaches using shore booms.
Sand barriers.

---

**Clean-up methods:**

Preferred: Natural cleansing.

Possible: Bioremediation of sandy beaches.

Prohibited: Dispersants.

---

**Monitoring endpoints:**

Hydrocarbons in sediments.
Hydrocarbons in selected invertebrates (oysters, barnacles).

# MONTEBELLO ISLANDS

# OIL SPILL RESPONSE STRATEGIES

**Area:** Southern islets of Hermite Island **Latitude:**

**Longitude:**

**Physical features:** Rock cliff shores of varying height and undercut.

**Access:** Limited. Shallow draft vessel. Dingy.

**Water depth:** 2-3 m

**Ecological features:** Invertebrates, seabirds.

| | Value | Comments |
|---|---|---|
| Overall | Moderate | |
| Spring | | |
| Summer | | |
| Autumn | | |
| Winter | | |

**Oil spill response:** Containment and recovery at rig location.
Surveillance and monitoring.

**Clean-up methods:**

Preferred: Natural cleansing.

Possible: Absorbent materials to sop up excess oil on shores.

Prohibited: Dispersants.

**Monitoring endpoints:**

Hydrocarbons in selected invertebrates (oysters, barnacles).

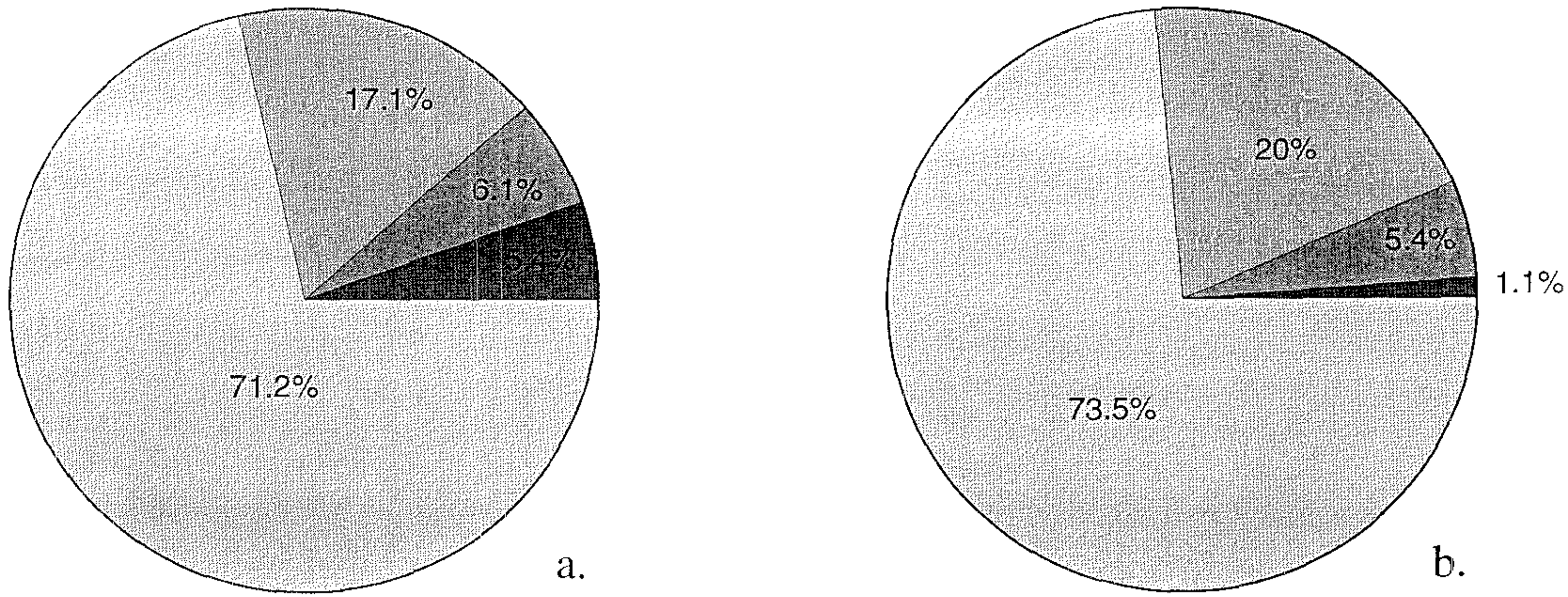
### 6.2.6 Boom Capability the Wonnich Drilling Location

Figure W6.9 (a) gives the potential frequency for the use of the Versatech Zoom Boom.

Figure W6.9 (b) describes the frequency with which different strategies might be adopted under the expected winter wind patterns. Winds from offshore and alongshore are expected approximately 73% of the time. Surveillance of the spill, with booms and other equipment on standby, would be an appropriate response. Moderate onshore winds are expected 20% of the time. At these times a containment boom would function to collect oil adjacent to the rig or reef.

For just over 5% of the time, winds are expected to be overly-strong for containment under open water conditions but booms could be placed in the lee of the reef to protect the shore, or to prevent oil from arriving across the back-reef. Very strong onshore winds (> 20 knots from NW to SW) are expected approximately 1% of the time. Under these conditions, the most appropriate strategy would be to place deflection booms at shoreline locations to protect lagoons, beaches or creek entrances in the expected path. Combinations of wind speeds and directions that may indicate the response strategy are summarised in Table W6.3.

# FREQUENCY DISTRIBUTION OF WIND CONDITIONS THAT MAY INFLUENCE THE POTENTIAL RESPONSES TO AN OIL SPILL




POTENTIAL FOR BOOM USE

- Boom functional
- Wind excessive but favourable
- Wind excessive but along shore
- Wind excessive and unfavourable

POTENTIAL STRATEGIES

- Surveillance with boom on standby
- Deploy boom adjacent to rig or reef
- Deploy boom in lee of reef
- Deploy shoreline deflection booms at lagoon and creek entrances

17 July 1996 SL.m3638

Figure W6.9

# Appendix 4

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