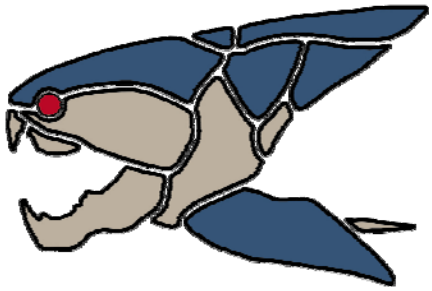
INPEX BROWSE LIMITED
ICHTHYS GAS FIELD DEVELOPMENT



DRAFT

ENVIRONMENTAL SCOPING / GUIDELINES DOCUMENT

FOR THE ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME AND ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED ICHTHYS GAS FIELD DEVELOPMENT

Invitation to Comment

The Proposal

INPEX Browse Ltd. as operator of offshore permit area WA-285-P, propose to develop the Ichthys gas field by exporting two phase hydrocarbons via a subsea pipeline to a processing facility on the Maret Islands in the Bonaparte Archipelago off the north-west coast of Australia.

The processing facility would primarily produce Liquefied Natural Gas (LNG), with Liquefied Petroleum Gas (LPG) and condensate by-products, which would be transported to markets via sea.

The licence for WA-285-P is held jointly by INPEX Browse Ltd and Total E&P Australia, a subsidiary of Total S.A. INPEX is a Japanese oil and gas company headquartered in Tokyo, which has substantial interests in Australian and international oil and gas projects. Total S.A. is a French oil and gas company with operations in over 130 countries.

Assessment Process

The Commonwealth Minister for the Environment and Water Resources determined that the proposal requires the preparation of an Environmental Impact Statement (EIS) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The Western Australian Environmental Protection Authority (EPA) determined that the proposal requires assessment under the Environmental Protection Act 1986 (EP Act) at the level of Environmental Review and Management Programme (ERMP).

The Commonwealth and Western Australian governments have agreed to a coordinated parallel environmental assessment process such that an integrated EIS/ERMP document, which satisfies the requirements of both jurisdictions, must be submitted to both agencies and released for public comment. An 'Environmental Scoping Document for the ERMP' and 'Guidelines for an EIS' are now required by the Western Australian and Commonwealth governments respectively, to set the terms of reference for the Environmental Impact Assessment (EIA).

INPEX has been advised by the regulators that one document (the 'scoping/guidelines document') can be submitted to the Western Australian and Commonwealth governments.

This Draft Environmental Scoping/Guidelines Document is provided for public review for a period of four (4) weeks commencing 12th March 2007. INPEX will subsequently consider all comments submitted as part of this public review process and respond to the regulators prior to submission of the final document.

Submissions

The EPA prefers submissions to be sent electronically using the submission form on the EPA's website at www.epa.wa.gov/submissions.asp

Alternatively they can be posted to:

Environmental Protection Authority

PO Box K822

Perth WA 6842

Attention: Peter Walkington

Public submissions close on Tuesday 10 April 2007.

Contact

Requests for hard or electronic copies, or any enquiries regarding the submissions may be addressed to:

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Copies may also be downloaded from the Inpex website at **www.inpex.co.jp**

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1. INTRODUCTION

The proposal to develop the Ichthys Field was referred to the Commonwealth and Western Australian governments in May 2006. The Commonwealth Minister for the Environment and Water Resources determined that the proposal will require the preparation of an Environmental Impact Statement (EIS) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The Western Australian Environmental Protection Authority (EPA) determined that the proposal requires assessment under the Environmental Protection Act 1986 (EP Act) at the level of Environmental Review and Management Programme (ERMP).

The Commonwealth and Western Australian governments have agreed to a coordinated parallel environmental assessment process such that an integrated EIS/ERMP document, which satisfies the requirements of both jurisdictions, must be submitted to both agencies and released for public comment. An 'Environmental Scoping Document for the ERMP' and 'Guidelines for an EIS' are now required by the Western Australian and Commonwealth governments, respectively, to set the terms of reference for the Environmental Impact Assessment (EIA).

INPEX has been advised by the regulators that one document (the 'scoping/guidelines document') can be submitted to the Western Australian and Commonwealth governments.

Consequently, this scoping/guidelines document addresses both Western Australian and Commonwealth environmental impact assessment requirements, but some requirements contained herein may fall under one jurisdiction only, or both. It is not implied that regulators will consider any material that is outside of their jurisdiction.

1.1 Purpose of Document

The purpose of a scoping/guidelines document is to assist proponents and regulators in identifying issues which should be addressed in an environmental impact assessment, and the actions and investigations required to address any such issues. To place the proposed scope in context, this document also provides background to the proposed development of the Ichthys Field, including an outline of the broad development concept and the development alternatives considered before referring the proposal to government.

1.2 Structure of this Document

This document has been developed in accordance with the Western Australian EPA's publication 'Guide to Preparing an Environmental Scoping Document' (EPA 2004a), which provides guidelines regarding what an Environmental Scoping Document should address. The structure of this document is as follows:

- Section 1: Introduction and identification of the proponent
- Section 2: Description of the proposal, including key components of the preferred option, explanation of project alternatives and a development schedule.
- Section 3: Description of the regional setting in terms of the biophysical and socio-economic context.

- Section 4: Outline of the environmental impact assessment process, including an overview of the regulatory framework, schedule of activities undertaken to date (including both environmental and stakeholder engagement activities), timing for the planned environmental impact assessment activities and an outline of the study team.
- Section 5: Description of the key interactions, issues and technical scope of work associated with the environmental impact assessment.

1.3 Identification of Proponent

INPEX Browse Ltd. is the operator for the proposed development of the Ichthys Field in permit area WA-285-P R1 (Figure 1.4-1). The licence for WA-285-P R1 is held jointly by INPEX Browse Ltd and Total E&P Australia, a subsidiary of Total S.A.

INPEX is a Japanese oil and gas company headquartered in Tokyo, which has substantial interests in Australian and international oil and gas projects. Total S.A. is a French oil and gas company with operations in over 130 countries.

1.4 Key Contact and Address of Proponent

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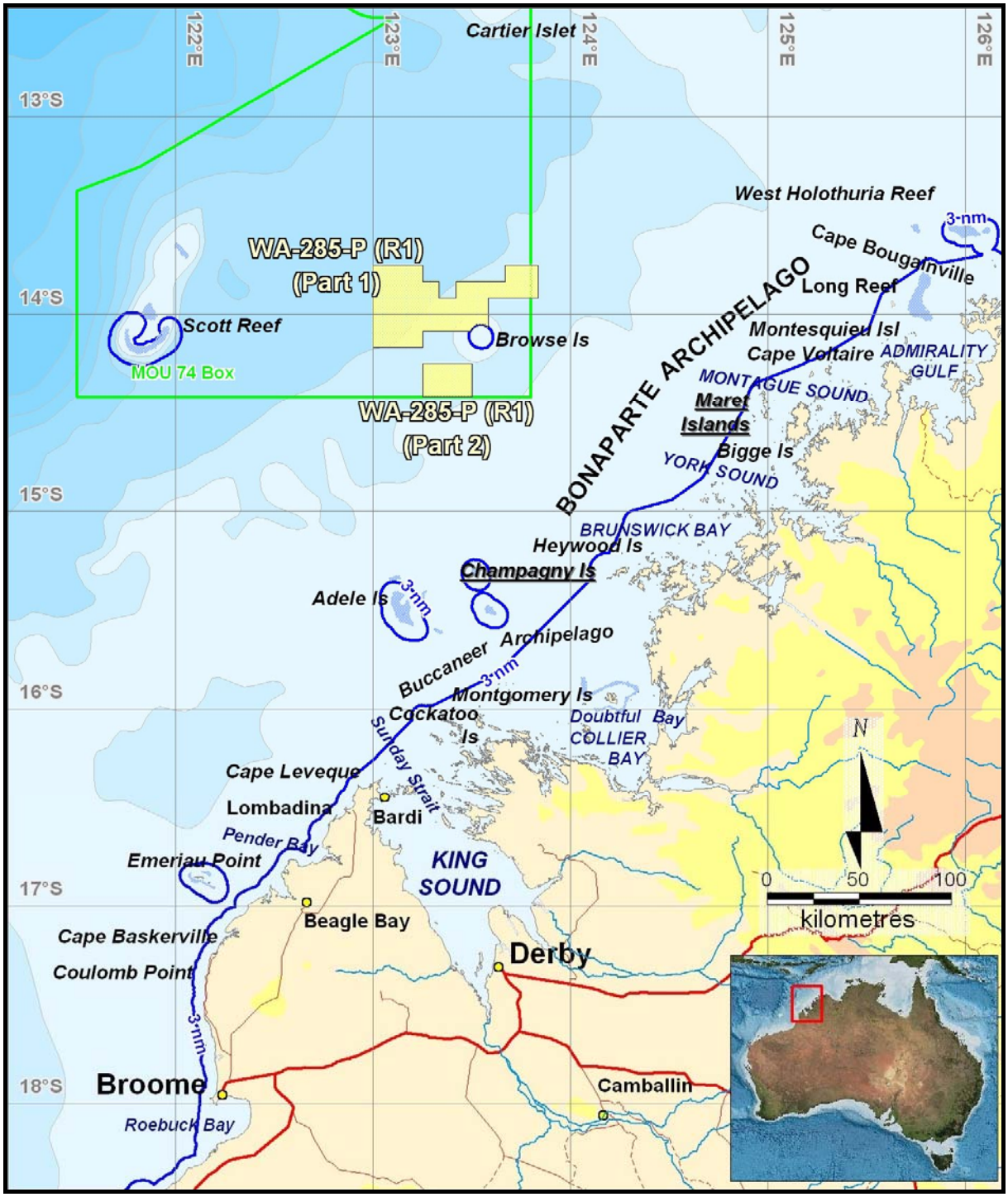

Figure 1.4-1: Location of WA-285-P

2. DESCRIPTION OF THE PROPOSAL

2.1 Project Concept

INPEX is proposing to develop the Ichthys Field to produce condensate, Liquefied Petroleum Gases (LPGs) and Liquefied Natural Gas (LNG) for export. Initial production will be sold into Japan and other export markets as required. Hereafter, the Ichthys Field Development is referred to as the 'Project'.

The exploration permit WA-285-P area lies within Commonwealth waters in the Browse Basin on the north-west shelf of Western Australia, approximately 440 km north of Broome and 800 km south-west of Darwin (Figure 1.4-1). The permit encompasses an area of approximately 3041 km^2 with water depth ranging from 90 to 340 m. The permit is held by a joint venture between INPEX Holdings Inc. and Total E&P Australia, a subsidiary of Total S.A. It is operated by INPEX.

At an appropriate time in the development schedule, a portion of WA-285-P will be subject to acquisition of a production licence and will convert to a production area. A location, No. 3 SL/03-05, was granted in May 2004 and extended for a further two years in May 2006. INPEX will commence the production licence application process in quarter 1 of 2008.

The Ichthys Field measures approximately 40 km by 20 km and consists of two reservoirs, Brewster Member and Plover Formation. Estimates of the recoverable (P_{50}) hydrocarbon resource indicate over 269 000 Mm^3 (9.5 Tcf) of gas, and 49.6 GL (312 MMbbls) of condensate. The estimated CO_2 content averages 8.5% in the Brewster Member and 17% in the Plover Formation.

At this point, it is proposed that the Project will be undertaken in two phases:

Phase 1 - initial field development and onshore development

- LNG: 2 x 3.8 Mtpa (+/- 10%) trains
- Condensate: 88,000 bopd
- LPG: 5,300 tonnes per day

Phase 2 - debottlenecking and expanding the capacity

- Condensate
- LNG: 2 x 3.8 Mtpa trains to 2 x 5.5 Mtpa (+/- 10%) production capacity (up to a maximum of 12 Mtpa)
- Condensate: 127,000 bopd
- LPG: 7,700 tonnes per day

The commencement of operations with 2 x 3.8 Mtpa trains and subsequent upgrade to 2 x 5.5 Mtpa is reflective of the anticipated production profile and the ability of the two initially installed LNG trains to be upgraded to accept increased throughput without triggering the need for an additional train.

Subsequent to Phase 2, the onshore processing capacity may need to be further expanded to process additional gas discoveries.

The operating life of the Project is expected to extend beyond 30 years. Onshore facility expansion will extend the life of the Project.

2.2 Key Project Components

The Project proposal includes the transport of two-phase gas from the Ichthys Field via a subsea pipeline to the onshore processing facilities proposed to be located on the Maret Islands, off the Kimberley coast. The exact route of the subsea export pipeline is yet to be determined, but will approximate a direct route from the offshore facility to South Maret Island and accommodate any subsea obstructions found during the route survey. The proposed subsea pipeline route from the field to South Maret Island is illustrated in Figure 2.2-1.

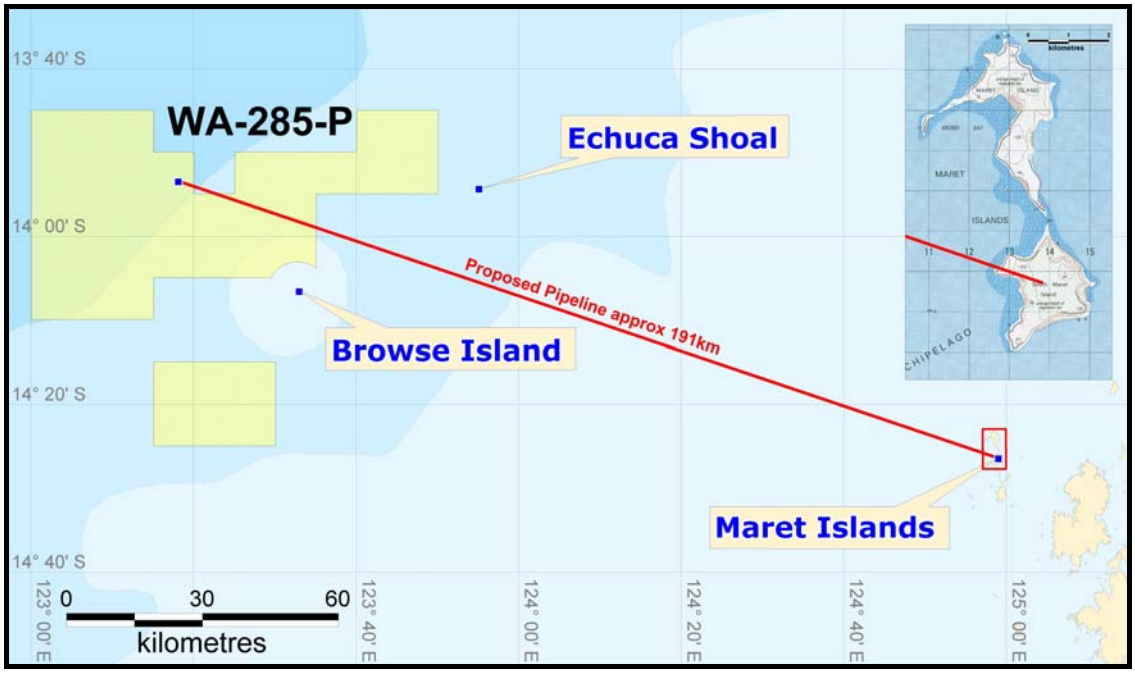

Figure 2.2-1: Proposed pipeline route and key locations

The offshore development concept consists of a number of drilling centres (subsea wells and manifolds), with infield flowlines and flexible risers for submarine transfer of the reservoir fluid to an offshore semi-submersible Central Processing Facility(s) (CPF). Dehydrated two-phase gas will be exported to the Maret Islands via a subsea pipeline. The offshore development concept is illustrated in Figure 2.2-2.

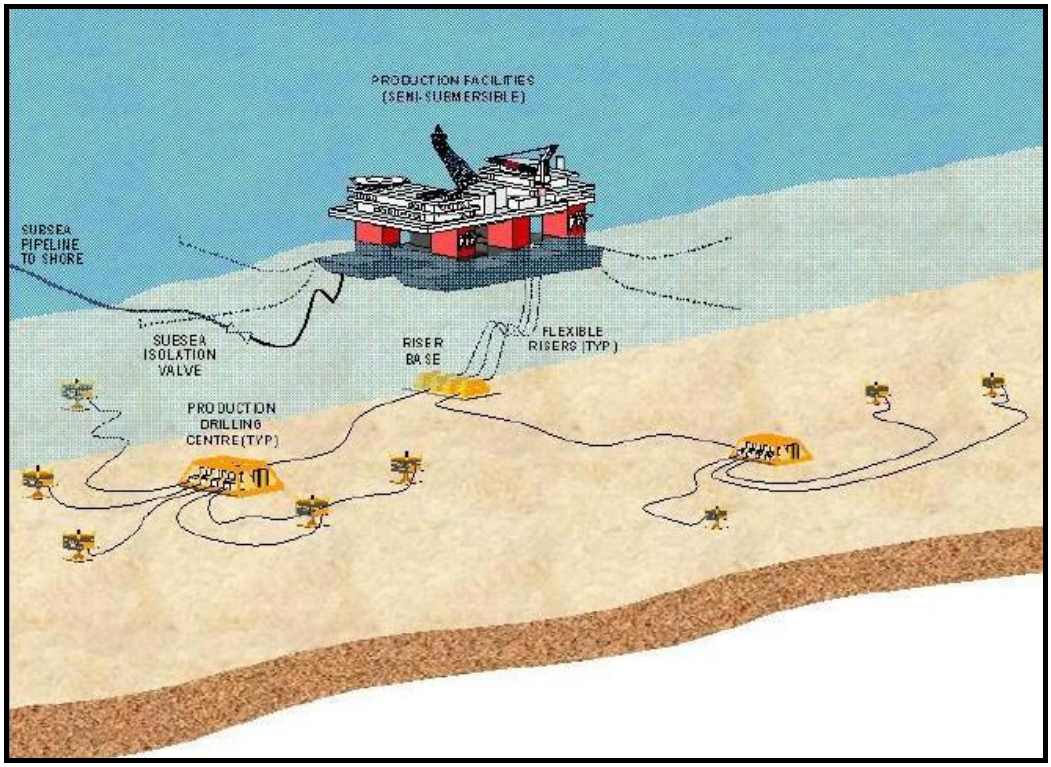

Figure 2.2-2: Indicative schematic of offshore facilities

An alternative CPF concept involves the installation of a fixed structure (Tension Leg Platform (TLP), jacket, etc.) in the permit area, or the installation of a fixed platform in shallow water (100–120 m) approximately 35 km to 50 km from the field. This would be located in Commonwealth waters adjacent to the subsea pipeline route to the onshore processing facility. Additional CPFs and looping of the subsea pipeline may be required for the full development of the field.

The preferred location for the onshore facilities of the proposed development is the Maret Islands (North and South) in the Bonaparte Archipelago of the Kimberley Coast. Champagny Island to the south-west of the Maret Islands is an alternative site for the Project (see Section 2.5).

The proposed onshore processing facilities consists of the slug catcher, gas treatment plant (condensate and LPG extraction, CO_2 removal) and LNG plant, with the slug catcher and gas treatment plant being integrated upstream of the LNG plant. The current proposed capacity of the phase 1 LNG Plant will extend up to 7.6 Mtpa comprising two trains each with a capacity of 3.8 Mtpa (+/- 10%). The proposed site plan for the onshore facilities is illustrated in Figure 2.2-3.

The Project will come under Commonwealth jurisdiction for offshore facilities and the offshore component of the subsea gas export pipeline, and Western Australian jurisdiction for nearshore (i.e. within 3 nautical miles of the coast) and onshore facilities.

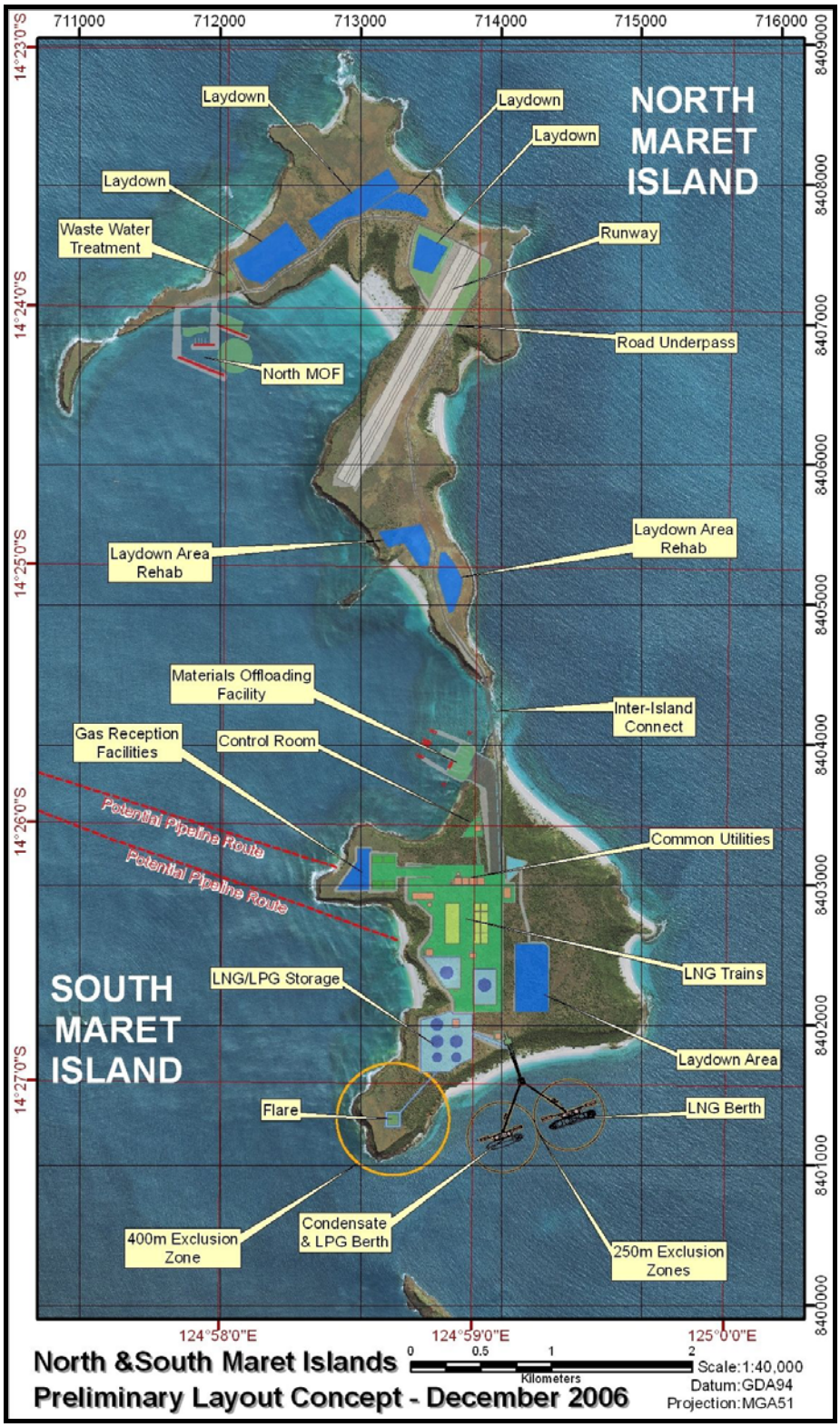

Figure 2.2-3: Proposed site plan for Phase 1 onshore facilities at the Maret Islands

The main components of the Ichthys Field Development include:

- Subsea wells and manifolds tied back to the CPF
- Subsea export pipeline to shore (approximately 200 km)
- Onshore pipeline

- Onshore processing facilities
- Phase 1 – 2 x 3.8 Mtpa (+/- 10%)
- Phase 2 – expansion of capacity to 2 x 5.5 Mtpa (+/- 10%)
- Onshore storage for condensate, LPG and LNG
- Potential near-shore LNG storage facility
- Materials offloading facility (MOF)
- Product offloading jetty(s) (POJ)
- Port
- Airstrip
- Accommodation and associated infrastructure
- Interconnect between South and North Maret Islands.

Details of these components were similarly provided in the referral documents provided to the Commonwealth Department of the Environment and Water Resources (DEWR, and formerly the Department of the Environment and Heritage) (referral # 2006/2767) and the Western Australian EPA in May 2006.

Design of the facilities will address risks associated with credible climate change scenarios in order to capture the possibility of severe weather events.

2.3 Project Development Schedule

Table 2.3-1 is an outline of the key dates associated with Project design, construction and operation.

Table 2.3-1: Project Development Schedule

Development Stage	Start	End
Concept Selection	2Q 2006	1Q 2007
FEED	1Q 2007	3Q 2008
FID	4Q 2008/1Q 2009	
Initial Development Drilling	1Q 2010	3Q 2011
Construction and Commission	1Q 2009	3Q 2012
Production	4Q 2012	TBA

2.4 Justification of Proposal and Preferred Option

Exploration and development of petroleum reserves is undertaken by the private sector, in accordance with laws and policies which are administered and developed by the various Commonwealth and Western Australian government departments.

As the permit holder and operator for the Ichthys Field, INPEX has an obligation to undertake exploration of its permit area, verify the nature and extent of the reserves within this area, and if resources are found, investigate the manner in which it can make these reserves available to gas buyers. Having found reserves of gas and condensate at the Ichthys Field, INPEX is now preparing design and development concepts which allow for the production of condensate, LPG and LNG. The

development concept proposed, as described in Sections 2.1 and 2.2, provides for the optimal development of the available reserves, and delivery of product to market.

The development concept proposed is influenced by potential development sites and vice versa. A number of criteria were used through different stages of site selection studies (as described in Section 2.5). Human safety is the paramount evaluation criterion influencing both project concept design and location with other factors such as (but not limited to) access (including land tenure), physical environment (including environmental sensitivity), development and commercial considerations, also taken into consideration.

One of the key objectives in meeting INPEX's safety criterion is minimising the number of personnel required offshore. Simplification of the offshore processing and treatment of reservoir fluids is essential to achieving this objective. Therefore, INPEX has selected a processing strategy that involves dehydrating (water removal only) the reservoir fluids and sending the gas, LPG and condensate to the downstream land-based plant for further processing and treatment.

Transport of the condensate in liquid phase can result in condensate molecules aggregating to form accumulations of liquid in the pipeline, commonly called 'slugs'. These slugs increase in size and have significant momentum at the end of the pipeline, and must be safely dispersed prior to sending the condensate to facilities for treatment and storage. The larger the slug is, the greater the technical difficulty in handling it safely.

INPEX has conducted a number of technical studies using computer modelling to compare the length of pipeline to the predicted slug size that can be safely handled at the downstream plant. These studies indicated that a pipeline length of less than 250 km is necessary to keep the predicted slug size within acceptable safe limits (at a diameter of 0.8–1 m), based on the field's high condensate to gas ratio. Extending the pipeline beyond a maximum of 250 km results in a predicted slug size that is unacceptably large and would require consideration of removal and storage of condensate at the offshore location.

Removal of condensate at the offshore location requires significant additional processing/storage facilities and extra personnel with the associated increase in safety risk. Therefore, to maintain INPEX's and the industry's standard safety philosophy, as site selection studies progressed, the onshore plant site selection process was constrained by the requirement to be within 250 km of the Ichthys Field.

Based on all of the site selection criteria and studies (described in section 2.5), the Maret Islands were chosen as the preferred location for the proposed development. The combination of both islands provides sufficient area to locate the plant facilities, but would require the construction of an interconnect between the islands.

In terms of contiguous land available to site the onshore gas processing facilities and proximity to the gas field, Champagny Island ranked higher than the Maret Islands, but its status as an Aboriginal Reserve presents uncertainties regarding access to the Island.

2.5 Project Site Alternatives

Site selection to build onshore gas processing facilities for the development of the Ichthys Field has been undertaken over a number of years, commencing with desktop mapping and research in 2002 and followed up by physical site inspections and detailed studies.

During the site selection screening study, a large number of potential sites in the Kimberley region were assessed and ranked in terms of their suitability for development of an onshore gas plant. Sites ranged from fully offshore development concepts (for example, Echuca Shoal), island sites (e.g. Cockatoo Island), and mainland sites (e.g. Beagle Bay). Criteria used in this phase of site selection included:

Access:

- Land tenure (current and historical)
- Native Title claims and their status
- Road, sea and air access.

Physical environment:

- Environmental sensitivity
- Water depth, tides and currents
- Topography and geomorphology
- Existing infrastructure.

Development considerations:

- HSE management factors
- Proximity to Ichthys Field
- Technological risk
- Hydrocarbon storage
- Constructability and operability.

Commercial and marketing issues:

- Domestic gas
- Synergy with downstream opportunities
- Public opinion.

This desktop screening identified a number of potential sites including a number of islands, and mainland sites such as Battery Point, Beagle Bay, Deepwater Point, Emeriau Point and Cape Voltaire. After field confirmation of desktop studies, sites were ranked according to the criteria. The seven highest ranking sites, in order, were:

- Cockatoo Island
- Koolan Island
- Maret Islands (North and South)

- Echuca Shoal
- Cape Leveque/Deepwater Point
- Emeriau Point
- Beagle Bay.

At this stage of the assessment (2002), Cockatoo Island was the preferred location.

Site selection screening was reviewed in 2004 employing refined selection criteria that included specific and technical requirements for onshore gas processing facilities. These criteria included:

- Distance from Ichthys Field (less than 250 km)
- Available land area and land tenure
- Topography and geotechnical requirements
- Terrestrial and marine environmental impact
- Constructability and operability
- Infrastructure requirements.

This phase of the site selection process (Phase 2) focussed on the three highest ranking sites from Phase 1, that is, Cockatoo Island, Koolan Island and North and South Maret Islands. At this stage, INPEX included Cassini Island and Champagny Island in the site selection process. Cassini Island was included because additional information revealed that the island had been previously considered as a suitable site for an oil development by a third party and was within the specified distance range from the Ichthys Field. Champagny Island, which had previously been excluded from consideration due to its status as an Aboriginal Reserve was re-included due to other attributes it potentially offers, although recognising that its status as an Aboriginal Reserve may still pose an impediment to development. The location of these sites is shown in Figure 2.5-1.

Further analyses of these sites were conducted including field site assessments. Site assessment activities included an aerial flyover, marine survey and a land-based walk around, except for Champagny Island as it is an Aboriginal Reserve.

Table 2.5-1 below summarises why the other highest ranking sites from Phase 1 (2002) were eliminated from further consideration during Phase 2 investigation.

Table 2.5-1: Phase 1 Site Elimination Summary

Site	Reason for exclusion from further consideration
Cape Leveque/Deepwater point, Beagle Bay and Emeriau Point	- Extensive civil works required - Presence of mangroves - Extensive dredging required with associated environmental impacts - Presence of ecotourism activities (Beagle Bay, Emeriau Point)
Echuca Shoal	- Technical difficulties of development on a shoal wholly submerged at low tide

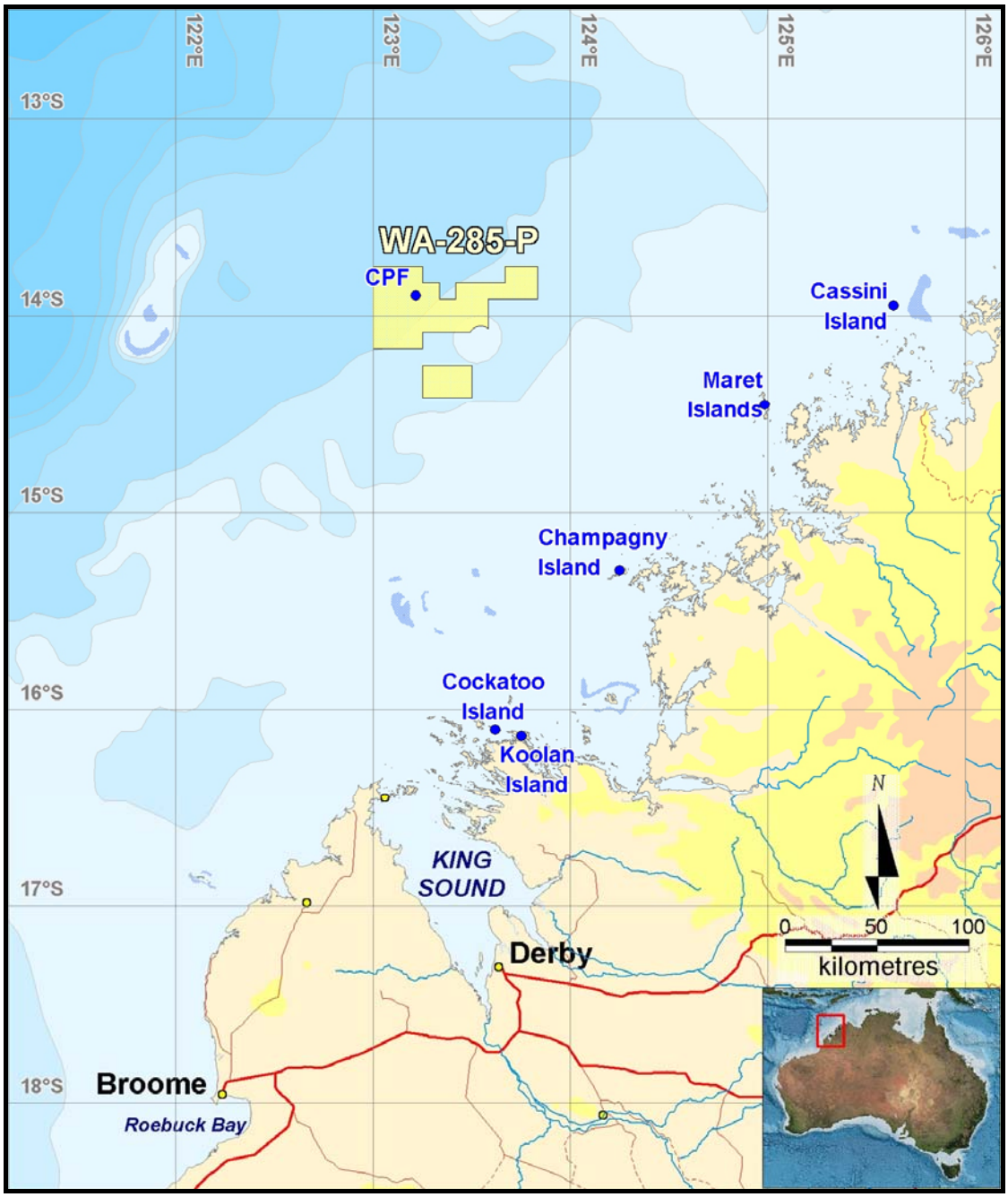

Figure 2.5-1: Potential Development Sites (Phase 2)

During and following phase 2 of the site selection process, the following sites were eliminated as summarised in Table 2.5-2.

Table 2.5-2: Phase 2 Site Elimination Summary

Site	Reason for exclusion from further consideration
Cockatoo Island	- Geotechnical information on foreshore and near harbour geology demonstrated that the site was geotechnical unsuitable for a gas processing facility - Rise in iron ore prices extended life of existing facilities
Koolan Island	- Resumption of mining activities
Cassini Island	- Insufficient area to support an LNG development - Distance from Ichthys Field
Champagny Island	- Aboriginal Reserve poses significant access and tenure difficulties

Based on the evaluation against selection criteria, and the information available at the time, the Maret Islands (North and South) were selected as the preferred option for a number of key reasons as described below.

1. The islands are unallocated Crown Land, noting EPA and CALM recommendations in 1980 and 1991 respectively (refer to Section 3.2.4). As such, there are no identified conflicts with either existing uses, tenure or conservation imperatives which would prevent or be a restriction to development.

2. The islands together present enough land to accommodate all of the facilities required for the plant including all associated infrastructure such as airstrip and accommodation areas. In addition the islands are relatively flat, which means that it is feasible to construct the plant and associated facilities with a lesser need for significant civil works, therefore assisting in minimising the potential impact associated with the construction of the facilities.

3. There is deep water nearshore, indicating that dredging of turning basins and navigation channels will not be required to facilitate product offloading. This is of significant environmental and economic benefit to the project. The fact that waters adjacent to the island are navigable also indicates that tanker operations will be safe and efficient, once again a mitigating factor in reducing potential environmental impacts.

4. The islands are within the 250 km radius identified as being important in the management of risks associated with the transport of gas, and therefore meet the design and safety criteria associated with the development concept.

5. From a regional perspective, the development of the gas processing facilities at this site by a single operator has the potential be expanded to take gas from multiple fields for processing.

3. REGIONAL SETTING

3.1 Introduction

The tropical monsoonal climate of the Kimberley regions is characterised by a hot and humid summer from November to April. The region typically experiences two or three cyclones per year during this period. About 90% of the region's rainfall occurs during this season when low pressure systems and unstable air dominate the weather pattern. From May to October, high pressure systems, and a predominantly south-easterly airflow from the continent's interior, dominate such that the weather is typified by sunny days and cooler nights.

The Kimberley coast, the northern-most region of Western Australia, is characterised by a broad continental shelf dotted with reefs, banks, shoals, and nearshore islands, often fringed with coral reefs (Burbidge et al. 1991). Large tidal variations, commonly with 10 m ranges, along the coast and high-volume discharges from rivers in summer significantly influence the coastal environment of the region.

The coastline is remote and mostly inaccessible with little supporting infrastructure. Population density is sparse, with the exception of Broome to the south, and remote coastal communities such as Derby and Kalumburu.

Oceanic processes offshore of Western Australia are influenced by several factors including dominant south-easterly winds, cyclones, seasonal influences from the Indian Ocean and the Indonesian Throughflow. The Leeuwin Current originates in this area, flowing south along the Western Australian coastline.

3.2 Biophysical Environment

3.2.1 Marine Environment

Permit WA-285-P R1 is located within the MOU74 Box (Figure 1.4-1), which is an area of approximately 50 000 km^2 within the Australian Fishing Zone. The Commonwealth Government manages the marine resources of the MOU74 Box with a memorandum of understanding (MOU) between the Australian and Indonesian governments allowing for the continued traditional fishing by Indonesian fishing vessels. Traditional fishing activities in the area mainly focus on *beche de mer* and trochus.

Features of the marine environment in the vicinity of the proposed development area include Echuca Shoal and Browse Island. Echuca Shoal is located approximately 70 km east of the proposed location of the CPF and is characterised by a diverse assemblage of corals including Porites, Faviids, and Acroporids. Soft corals include small sea whips (*Junceella*) and members of the genera *Dendronephthya*, *Sacrophyton* and *Sinularia*. All taxa are common in tropical Western Australian reefs. Browse Island is a sand and limestone cay situated on a limestone reef and coral reef and covers an area of 13 hectares. Browse Island is located approximately 35 km from the proposed CPF. The remnants of historical phosphate mining on Browse Island have left a significantly disturbed surface. The island represents an important turtle nesting site, particularly for the green turtle (*Chelonia mydas*). Browse Island is classified a Class C Nature Reserve for the conservation of fauna.

Preliminary field surveys in the vicinity of the Ichthys Field (September 2005) indicate that the sandy seabed is barren, which are prone to strong currents and mobile sediments in areas with depths ranging from 90 to 200 metres. Benthic communities are sparsely distributed in shallower waters, depending on the substrate ranges from mud to rippled sand, low semi-exposed pavement and upstanding reef features. Soft substrates appear to support a low diversity and sparse array of epi-benthic organisms, primarily small gorgonians, sponges, and tube worms. Hard substrates support diverse assemblages which include small sea whips, sponges, gorgonians, crinoids, and black corals. Infauna surveys identified 117 nominal species across ten phyla of varying abundance. Infauna assemblages are characterised by polychaete worms (Annelida) and crustaceans (Arthropoda).

It is possible that 15 threatened marine species, 30 migratory species, 72 listed marine species, and 24 cetacean species may occur in the proposed development area. The listed species include various species of pipefishes, seahorses, sea snakes, turtles and crocodiles.

Species of migratory marine species are known to occur within the region. The annual migration of the humpback whale (*Megaptera novaeangliae*) is possibly the most significant. Cetacean surveys will be designed to clarify the extent of whale activity in the proposed development area.

The nearshore marine environment of the Maret Islands is subject to ongoing surveys, and as such information continues to be collated and examined. Preliminary site investigations by INPEX show the presence of an extensive intertidal pavement supporting massive coral types on the seaward slope and sand flats and intertidal reef supporting turf with low macro-algae landward. On the southern and eastern sides of the islands, Acropora dominated coral communities predominate.

Inshore waters and sandy beaches of islands in the Kimberley region are considered important habitat for turtle species. The green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), flatback turtle (*Natator depressus*) and loggerhead turtle (*Caretta caretta*) are thought to nest at beaches throughout the region. To date, preliminary investigations indicate the presence of green and flatback turtles at the Maret Islands, and on nearby islands including Albert, Montelivets, Prudhoe and Lamark.

3.2.2 Terrestrial Environment

The Bonaparte Archipelago is characterised by hundreds of sandstone and basaltic islands. The Maret Islands are typical of the mesa-type outer basaltic islands which are overlain with hard laterite volcanics with little potential to harbour groundwater.

There is virtually no soil on North Maret Island and very little on South Maret Island. The surface of both islands is very rocky with broken laterite exposed at ground level. Interspersed between the broken laterite is massive unbroken laterite at the surface.

North Maret Island has large open spaces of spinifex hummock grassland with some pockets of woodland in the centre (and wider) part of the island.

Observed flora species included the long fruited bloodwood (*Corymbia polycarpa*, previously *Eucalyptus polycarpa*). This tree is the dominant woodland species on

the plateau and occurs in extensive stands along the central-western side of the island.

Other species include: *Grevillea pyramidalis*, wattles (*Acacia* sp. [*retinervis?*]), *Commelina ensifolia*, spinifex (*Triodia* sp.), *Distichostemon hispidulus*, tropical lily (*Crinum flaccidum*) naked lady (*Sarcostemma viminale* ssp. *australe*), *Diospyros neritima*, *Gomphrena* sp., *Pandanus* (*spiralis*) and spear grass (*Heteropogon contortus*). Cliff and beach vegetation are particularly abundant on the western side of the island, with extensive development of sand dunes. Species observed include: lawyer vine (*Flagellaria indica*), *Gomphrena* sp., *Pittosporum* sp. (*moluccanum?*), coastal spinifex (*Spinifex longifolius*), beach morning glory (*Ipomea pes-caprae* ssp. *brasiliensis*), *Scaevola* sp., *Pouteria sericea* and *Ptilotus spicatus* ssp. *spicatus*.

The plateau vegetation on South Maret Island appears significantly different to North Maret Island only in terms of density and abundance. The vegetation features some small, isolated areas of open hummock grassland, however the majority of the island is covered with thick woodland that in some areas (e.g. the north and west sides) could be regarded as closed forest. The canopy in these areas is approximately 5 to 7 m high and the undergrowth extremely dense with vine thickets.

All the flora species listed above for North Maret were found on South Maret Island. *Eucalyptus* sp. and *Asparagus racemosus* have also been found on South Maret Island.

The reptile fauna on the Maret Islands appears to the most common fauna and energy source on the islands. Smaller lizards include species from the *Gekkonidae* (geckos), *Agamidae* (dragon lizards) and likely *Scincidae* (skinks) families. Unidentified species of sea snakes have been observed around the reefs of North Maret Island.

No native mammals or marsupials have been observed on the Maret Islands and no records of them have been found in a literature search of publicly available information. Anecdotal information (e.g. from the Western Australian Museum and the former Western Australian Department of Conservation and Land Management (CALM) – now Department of Environment and Conservation (DEC)) support this finding.

Subterranean fauna are unlikely to occur on the islands due to the volcanic–metamorphic characteristics of regional and island geology.

There is no evidence of permanent water on the Maret Islands. Aerial photography suggests the presence of a small number of minor ephemeral water drainage lines. The presence of groundwater is unlikely given the volcanic/metamorphic characteristics of regional and island geology.

3.2.3 Matters of National Environmental Significance

The EPBC Act Protected Matters Search Tool was accessed on 4 April 2006 and a report generated for the development area including Champagny and North and South Maret Islands, infield facilities and pipeline routes.

A summary of search outputs confirms there are no World Heritage Properties, National Heritage Places, Wetlands of International Significance or Threatened

Ecological Communities in the proposed development area. Fifteen threatened species, 30 migratory species, 72 listed marine species, and 24 cetacean species may occur in the development area. The listed species includes various species of pipefishes, seahorses, sea snakes, turtles and crocodiles. An historic shipwreck located at Browse Island also appears on the National Register of Estate. Refer to section 4.2 for a summary of the DEWR's decision on controlling provisions in relation to matters of national environmental significance for the Project.

3.2.4 Conservation Status

Due primarily to their remoteness, limited research has been conducted in the past on most Kimberley islands. The Maret and Champagny Islands are no exception.

The Maret Islands were recommended by the EPA that they be declared a Class B reserve for the Conservation of Flora and Fauna in 1980 [recommendation 7.2.3.4 in Conservation Reserves for Western Australia As Recommended by the EPA, System 7, (EPA 1980)]. CALM (Burbidge et al, 1991) furthered this position through the recommendation that several islands of the Kimberley, including the Maret Islands, be classified as conservation reserves primarily due to their undisturbed nature. . To date, the conservation status of the Maret Islands remains unchanged and little additional research has been conducted.

3.3 Social, Economic and Cultural Environment

3.3.1 The Kimberley Region

The major regional towns are Broome and Derby in the west, Kununurra and Wyndham in the north-east, and Halls Creek and Fitzroy Crossing in the central Kimberley. The current population of Broome is approximately 14 000 people and peaks during the tourist season. The majority of the Kimberley region is very remote with little accessibility to goods and services other than those established in townships. Despite much of the Kimberley region remaining undeveloped, the regional economy continues to grow, and is supported by increasingly reliable communications and transportation infrastructure.

3.3.2 Land and Sea Use

The Maret and Champagny Islands are subject to the Shire of Wyndham – East Kimberley Local Planning Strategy, under which no development is planned for these islands. Under the Shires' Strategic Planning Guide, the Maret Islands have been allocated as a Landscape Protection area and Champagny Island as an Aboriginal Use area.

The Maret Islands are currently uninhabited with no previous construction of any commercial, industrial or residential developments.

The proposed location of the offshore central processing facilities lies within the Ichthys Field area. The waters in this and the surrounding area are utilised by the Royal Australian Navy, Australian and Indonesian fishing operations, commercial shipping operations and other petroleum development enterprises.

3.3.3 Native Title

The Maret Islands are classified as vacant crown land and are subject to a Native Title claim (WC99/35 and Federal Court file number W6033/99). The Project would require negotiation of Native Title agreement with the Uunguu claimants.

Champagny Island is classified as Aboriginal Reserve land and is part of the Kunmunya Aboriginal Reserve administered by the Western Australian Aboriginal Affairs Planning Authority. This island is included in the Dambimangari Native Title claim (WC99/7 and Federal Court file number WAD6061/98), which was lodged with the National Native Title Tribunal (NNTT) in 1995 and formally registered in 1999. This claim was referred to the NNTT for mediation by the Federal Court but only limited mediation has occurred to date.

Discussions with the Western Australian Office of Native Title have identified that Consent Determinations proceedings will commence for the Uunguu claim in late 2006.

3.3.4 Cultural Heritage

There is a known Aboriginal Heritage site (reference: K00132), listed on the Department of Indigenous Affairs (DIA) register for South Maret Island.

Two known Aboriginal Heritage sites (references: K00179 and K00180) are listed on the DIA register for Champagny Island.

Observations made on the Maret Islands have confirmed the presence of several other structures. At this time, it is too early to confirm whether the origin of these structures is indigenous or non-indigenous.

4. OUTLINE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

4.1 Regulatory Framework

4.1.1 Environmental Legislation and Policy

Key legislation applicable to the environmental assessment and approval of this Project includes:

- EPBC Act 1999 (Commonwealth)
- EP Act 1986 (as amended) (WA).

There are also a number of Western Australian EPA Position and Guidance Statements that may be relevant to this project (Appendix A). Legislation and policy documents will be taken into account in the design and implementation of investigations and in the preparation of the EIS/ERMP.

Appendix A includes a comprehensive listing of the legislation, and of the EPA and DEC policy documents relevant to the Project.

4.1.2 Associated Project Approvals

There are a number of other approvals that will be required to facilitate the development of this project. These approvals include but are not necessarily limited to those listed in Table 4.1-1.

Table 4.1-1: Associated Project Approvals

Approval/Permit	Commonwealth Regulator	WA Regulator	Local Regulator
Access Authority		DoIR	
Land Tenure		DPI	
Heritage Clearance		DIA	
Vegetation Clearing Permit for preliminary geotechnical investigations		DEC	
Permits to drill wells	DITR	DoIR	
Pipeline Licences	DITR	DoIR	
Production Licence	DITR	DoIR	
Infrastructure licence		DoIR	
Works Approval – Part V		DEC	
Environmental Licence to operate – Part V		DEC	
Major Hazard Facility Approval		DoIR, DOCEP	
Port Gazettal		DPI	
Transport and storage of dangerous goods		DOCEP	
Planning/development Approval			Shire Wyndham East Kimberley
Health Approval		DOH	
Sea Dumping Permit	DEWR		
Sea Installations Permit	DEWR		
Safety Case Approval	NOPSA		
Security Plan	DOTARS		
Environmental Plan (Offshore, drilling, construction, operations)	DITR	DoIR	

4.2 Environmental Approval Schedule

4.2.1 Activities to Date

The formal EIA process began with referrals being submitted to the Commonwealth and Western Australian governments in early May 2006 (EPBC Reference: 2006/2767, INPEX referral to the EPA: Report No. DEV-EXT-RP-0002).

The Western Australian EPA advertised its intention to formally assess the proposal at the level of ERMP under Part IV of the EP Act on 22 May 2006.

The Commonwealth DEWR informed INPEX on 14 May 2006 that the project is a controlled action under the EPBC Act requiring the preparation of an EIS, with controlling provisions being:

- Listed threatened species and communities
- Listed migratory species
- Marine environment.

4.2.2 Planned Activities

The Commonwealth and Western Australian governments will be assessing the project under a coordinated parallel assessment process.

An integrated EIS/ERMP document will be prepared which satisfies the requirements of both jurisdictions.

The EIS/ERMP will be prepared in accordance with this scoping/guidelines document, and the results of any technical investigations and consultation as outlined herein.

Once prepared, the draft EIS/ERMP must be approved for publication by the EPA and DEWR prior to it being made available for public review. Invitations for public comments relating to the draft report will be announced. Public comments will be due within the 12-week submission period. After the period for comment, INPEX will respond to the comments received, and will take them into account in finalising the EIS/ERMP.

Under the Commonwealth EPBC Act, the final EIS will then be provided to the Minister for the Environment and Water Resources. If the Minister accepts the submitted report, an assessment report will be prepared by DEWR. Following this, in accordance with Part 9, Division 1 of the EPBC Act, the Minister will decide whether to approve the proposal and attach any conditions required.

Under the Western Australian EP Act, the ERMP and INPEX's response to public submissions will then be assessed by the EPA. The outcome of the EPA's assessment is provided in its Report and Recommendations to the Minister for the Environment. The EPA's Report and Recommendations is open to public appeal for a statutory two-week period immediately upon its publication. Any appeals lodged are reviewed by an Appeals Convenor, who provides a report to the Minister on whether the appeals should be upheld or dismissed. Once appeals (if any) are determined, the Minister decides whether to approve the proposal, and what conditions are to be applied to the Project.

Table 4.2-1 provides a summary of the key steps of the environmental impact assessment process and associated timelines and key milestone dates. To enable this timeframe to be achieved, the field work associated with baseline data collection commenced in mid-2006 and will continue in parallel with the preparation of the EIS/ERMP documentation.

Table 4.2-1: Proposed Schedule of Environmental Assessment Activities

Stage of Assessment Process	Indicative Timeframe
Referral of project for environmental assessment	May 2006
Level of assessment set (EIS/ERMP)	May 2006
Scoping document provided to regulatory authorities and public exhibition period of 4 weeks	March 2007
Culmination of phase 1 studies and development of a preliminary draft EIS/ERMP document	July 2007
Final draft EIS/ERMP lodged for public review	February 2008
Public review period	March 2008–May 2008
Proponent response to public submissions and final EIS/ERMP completed	June 2008
Regulator report and recommendations (subject to appeal)	September 2008
Ministerial decision on project	October 2008

4.3 EIS/ERMP Objectives

The EIS/ERMP will provide information on:

- The project (including justification and alternatives)
- The existing environment
- The project's potential impacts at a local, regional and national level
- Proposed mitigation and management measures
- The significance and consequences of any residual impacts of development of the project.

The objectives in conducting the technical studies, investigations and consultation required to gather the above information, and in preparation of the EIS/ERMP documentation, are to:

- Gain an understanding of the existing environment and gather information to be used in the appropriate design and location of facilities in a manner which minimises potential impacts to as low as reasonably practicable
- Provide a source of information and a forum to allow for informed comment on the project by the public and interested groups

- Facilitate an environmental assessment of the project by the EPA and DEWR for provision of advice and recommendations to the ministerial decision-makers
- Provide a framework in which decision-makers can consider the environmental aspects of the proposal in parallel with economic, technical and other factors.

4.3.1 EIA Principles

The EIS/ERMP will be developed with due regard for the EPA defined EIA principles, defined in Table 4.3-1.

Table 4.3-1: EPA Principles for an EIA

Principle	Relevant Yes/No	If yes, consideration
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. Decisions on application of this precautionary principle, should be guided by: (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment (b) an assessment of the risk – weighted consequences of various options.	Yes	Conduct investigations to provide sufficient information to identify and ameliorate potential environmental impacts associated with the construction, operation and decommissioning of the Project.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	Yes	Potential environmental impacts are to be identified through appropriate field investigations and research, and measures put in place during design, construction, operation and decommissioning to remove these or minimise them to the lowest practicable level.
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Yes	Flora, fauna and marine surveys will be undertaken to characterise the existing environment and identify measures required to conserve its biological diversity and ecological processes.

Principle	Relevant Yes/No	If yes, consideration
4. Principles relating to improved valuation, pricing and incentive mechanisms (1) Environmental factors should be included in the valuation of assets and services. (2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. (3) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. (4) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.	Yes	The proponent will be responsible for identifying and managing all potential pollution, including the costs associated with these activities.
5. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Yes	Waste minimisation and management will be taken into account in the design, construction, operation and decommissioning of the project. This will be addressed in the EIS/ERMP.

4.4 Stakeholder Engagement

4.4.1 Consultation Activities to Date

INPEX has undertaken strategic stakeholder engagement to inform key national, state and local representatives of the project proposal, and to seek initial feedback. These stakeholders have included political representatives, agencies with a direct involvement in permitting and approvals, indigenous groups (primarily from a land access perspective) and the main community groups in the Kimberley region. Consultation with stakeholders has included verbal discussions supported with graphical presentations to ensure the audience has a clear understanding of INPEX's global and Australian business interests and the project proposal for the development of the Ichthys Field.

This preliminary level of stakeholder consultation has been designed to inform the development of a structured and comprehensive Stakeholder Engagement Plan which is currently under development. Preparation of this plan involves systematically identifying all potential stakeholders in the Kimberley region, Western Australia and Australia and beyond who may potentially have an interest in a project of this nature. Secondly, the preliminary consultation undertaken has informed the development of a list of known and potential issues. The Plan will include

developing frameworks and mechanisms to ensure these issues are addressed through the EIA process, and project design.

Issues raised at this point in time (in no particular order) include:

- Maximising economic development and employment opportunity in the Kimberley region
- Acknowledging and understanding the aspirations of Traditional Owners
- Ensuring project environmental disturbance is kept to a minimum
- Considering the needs for regional infrastructure development to support the Project
- Ensuring security of offshore and onshore facilities
- Providing access to sufficient skilled labour and other construction resources
- Assessing long term sustainability issues for the project
- Maximising local content and Australian industry participation
- Strategic planning for the broader Kimberley region.

Traditional Owners are considered key stakeholders in the consultation program and INPEX has begun an extensive program of engagement with them and their representative body. Consultations with the Kimberley Land Council (KLC) (representing the Dambimangari and Uunguu native title claimants) have taken place in regard to gaining access to various offshore islands in the Kimberley region. Consultation has been undertaken with the following parties:

- Kimberley Land Council: Discussions held about the process for engaging Traditional Owners in land access and co-existence agreements. The KLC is representing the Kimberley Traditional Owner groups and is a key stakeholder facilitating the opportunities for Traditional Owners from the Ichthys Project. INPEX is currently reviewing two potential land fall locations for an onshore gas processing facility and the KLC has facilitated introductory meetings and project briefings with the Traditional Owners concerning the two locations.
- Dambimangari Claimants: the Dambimangari Native Title claim includes Champagny Island. Discussions have been held with the Dambimangari claimants to outline the potential for an onshore gas processing plant development on Champagny Island, and the process by which access to an Aboriginal Reserve might be arranged. The KLC has been involved in these discussions.
- Uunguu Claimants: the Uunguu Native Title claim includes North and South Maret Islands in the Bonaparte Archipelago. Discussions have been held with the Uunguu claimants in a similar manner to those held with the Dambimangari.

Site visits to the Maret and Champagny Islands with representatives of Traditional Owner groups and the KLC have been facilitated by INPEX.

Details of Activities Undertaken to Date

Briefings have been held with Kimberley-based regional community representatives to outline the potential development of the Ichthys Field. These briefings have been delivered to a range of people including:

- The Hon. Carol Martin, MLA, Member for the Kimberley

- The Shire of Broome (Shire CEO and Councillors)
- The Broome Rotary Club
- Numerous local services providers (police, Port Authority, hospitals, transport service providers, etc).
- Non-Government Organisations: Environs Kimberley, Cultural Heritage and Environmental Advocacy Group for the Kimberley.

In addition, there have been ongoing progress briefings with Commonwealth and Western Australian government agencies and portfolio ministers, including:

- The Hon. Ian Macfarlane MP, Commonwealth Minister for Industry, Tourism and Resources
- The Hon. Alan J. Carpenter, MLA, Premier of Western Australia (and Minister for State Development and Energy)
- The Hon. John Bowler, MLA, Minister for Resources and Assisting Minister for State Development, Employment Protection
- The Hon. Ken Baston, MLC, (Member for Mining and Pastoral Region)
- The Hon. Shelley Archer, MLC, (Member for Mining and Pastoral Region)
- The Hon. Paul Omodei, MLA, Leader of the Opposition, (and Shadow Minister for Federal Affairs; Mines and Resources)
- Western Australian Department of Industry and Resources
- Commonwealth Department of Industry, Tourism and Resources (including Invest Australia).

A series of site orientation visits to the Maret Islands and surrounding area have also been provided for Commonwealth and State government officials from agencies including:

- Department of the Environment and Water Resources (Cwlth)
- Environmental Protection Authority (WA)
- Department of Environment and Conservation (WA)
- Office of Development Approvals Coordination (WA)
- Department of Industry and Resources (WA).

A range of strategic interviews have also been undertaken across the Kimberley region by a well-respected independent academic. The interviewer was not provided with project details, and was therefore able to objectively gauge reactions to a large ‘oil and gas’ project, and note expectations, issues and concerns. This information is being used as background for both the socio-economic study, and the Stakeholder Engagement Plan.

Ongoing dialogue with Non-Government Organisations (NGOs) has involved project briefings and discussions at various levels with the World Wide Fund for Nature (WWF), Conservation Council WA, Environs Kimberley, and Cultural Heritage and Environmental Advocacy.

4.4.2 Planning for Stakeholder Engagement

INPEX recognises that a range of stakeholders will have an interest in the full life cycle of the project – from decisions on site selection and design to monitoring during operation and eventual decommissioning.

As outlined, the development of a detailed Stakeholder Engagement Plan is in progress which will inform these activities. The process of developing this Plan is following a very structured process in order to understand all potential stakeholders, their areas of interest, and preferred modes of engagement.

Concurrently, a risk-based assessment process is being undertaken to provide focus to stakeholder engagement at this early stage of the project. By working through this process, INPEX is able to ensure those with the greatest level of interest in this stage of the project will be engaged on key issues of concern.

The Plan outlines a range of activities tailored to match the variety of stakeholders and their preferred methods of engagement. These activities will include one-on-one meetings, public forums, workshops, information campaigns through a variety of media, key stakeholder meetings and collaboration with representative bodies to provide information and seek feedback. A structured program of activities will be developed to ensure the process is proactive, and responsive to stakeholder needs. Different methods will be adopted as appropriate throughout the project development.

A focus of the Stakeholder Engagement Plan will be ensuring that key information and feedback received from stakeholders is included in strategic decisions, including the EIA process. Therefore, a management system is being developed to ensure that issues are captured, managed, and responses provided to stakeholders. This system will also focus on sharing of information between the various specialist areas on the project team.

Ongoing consultation will be undertaken with the KLC and Traditional Owners during the assessment phase of this proposal and over the life of the project.

Once the Stakeholder Engagement Plan has been finalised, more formal consultation activities will commence. This systematic process will ensure all stakeholders have the opportunity to be informed, to engage with INPEX on any key issues of concern, and respond to the findings of the EIA process as they become known. The testing for significance undertaken in the EIA process will factor in concerns of stakeholders where appropriate.

4.5 Resourcing and Peer Review

4.5.1 Study Team

Environmental impact assessment studies will be managed by INPEX and carried out by various teams of specialist consultants. Key INPEX personnel responsible for the environmental impact assessment are:

- Sean Kildare — Group Manager – External Affairs
- Greg Oliver — Environmental Manager
- Sean Reddan — Environmental Approvals Coordinator.

The primary consultants engaged in environmental studies and preparing the EIA document are:

- RPS-Bowman Bishaw Gorham (RPS-BBG), (primary ecological consultant)
- Environmental Resource Management Australia Pty Ltd (ERM), (Cultural Heritage and Light Studies)
- Sinclair Knight Mertz (SKM), (air quality studies)
- RPS Ecos (RPS-Ecos), (EIA Management, consultation and document preparation)
- Oz-Brij Communication (Editorial review and quality control).

4.5.2 Peer Review

In addition to the main study team outlined in Section 4.5.1, INPEX will arrange peer reviews for selected technical appendices during the collation of the EIS/ERMP. The appointment of individuals or organisations responsible for completing the peer reviews will be based upon technical expertise and comparable independence from the actual execution of the technical scope of work. The timing of the peer reviews will vary depending upon the particular study, with selected sections likely to be peer reviewed more than once during the course of the EIS/ERMP compilation. All peer reviews will be conducted prior to the public display of the EIS/ERMP and will be acknowledged in the report.

INPEX has already solicited the input of regulatory representatives from DEWR, EPA and DEC with regard to providing input into the technical scopes of work. This has been facilitated through numerous workshops, meetings and site visits to the Maret Islands. This liaison will continue throughout the EIA process.

5. ENVIRONMENTAL IMPACT ASSESSMENT SCOPE

5.1 Scope of Interactions

A preliminary review of project components and associated activities against environmental aspects, and factors (resources and receptors) susceptible to impacts (physical/biological/social) has been undertaken to identify the environmental issues and factors arising from the project and their relevant significance.

The preliminary assessment has been based on identifying the activities associated with construction, commissioning, operations and accidental events in three key study areas, as follows:

- Offshore infield Infrastructure: including the wells, infield flowlines, flexible risers, manifolds, pipeline end terminals (PLETs), CPF and export pipeline
- Intertidal zone Infrastructure: including the export pipeline landfall, port, jetty (LNG, LPG and condensate loading), MOF, island interconnect and shoreline defences
- Onshore infrastructure: including the onshore pipeline, processing facilities (including LNG plant and associated infrastructure), accommodation facilities and airstrip.

The categories of environmental aspects reviewed for all activities associated with the three key study areas are listed in Table 5.1-1.

Table 5.1-1: Categories of Environmental Aspects Described in Scoping Matrices (Figures 5.1.-1,2,3)

Aspects
Physical presence (permanent structure/activity)
Physical presence (moving or temporary structure/activity)
Noise emissions
Pollutant emissions to air
Dust emissions to air
Light emissions
Liquid wastes
Liquid emissions to land and sea
Seabed disturbance
Suspended solids
Solid waste
Energy usage
Raw material usage

This review is summarised in the interactions matrices represented in Figure 5.1-1 and Figure 5.1-2 and Figure 5.1-3.

Potential impacts associated with decommissioning will also be identified during the course of the environmental assessment studies and included in the EIS/ERMP.

The scoping matrices have been used to focus the proposed environmental investigations. The following sections provide discussion of potential issues/impacts (Section 5.2) and proposed studies (Section 5.3). The inter-relationship between these is described in Appendix B.

ENVIRONMENTAL FACTORS (RESOURCES AND RECEPTORS SUSCEPTIBLE TO IMPACTS)

ASPECTS

- Physical presence (perm) (P)
- Physical presence (moving / temp) (M)
- Noise emissions (N)
- Pollutant emissions to air (E)
- Dust emissions to air (D)
- Light emissions (L)
- Liquid waste (Li)
- Suspended Solids (SS)
- Solid waste (S)
- Energy usage (En)
- Raw material usage (R)

ACTIVITIES	Terrestrial Resources / Receptors									Marine Resources/Receptors										
	Physical		Biological			Human				Physical			Biological						Human	
	Geology, Soils and Hydrogeology	Surface and ground waters	Habitats	Fauna	Flora	Landscape and Visual	Cultural	Noise	Ambient Air Quality	Seabed	Hydrodynamics	Water Quality	Benthic fauna	Coral #	Fish	Seabirds	Marine Turtles	Cetaceans/Marine Megafauna	Cultural ^	Fishing and Navigation ^
CONSTRUCTION																				
General Construction Activity																				
Vessel movements*	S								E			Li				M,L	M	M,N		M
Exclusion zone																				M
Helicopter movements																M,N				M
Floatel operations**	S								E	M		Li			Li	L				M
Waste disposal / hazardous material usage	S								E			Li								
Preparation of the Seabed																				
Trenching/dredging/levelling										M,R	M,P	SS	P,SS		N,SS			N	M	M,P
Quarrying for rock fill***	R					R,D		N	E,D											
Spoil disposal										P	P	SS	SS,S		SS					M
Wells, infield flowlines, flexible risers, manifolds, PLETs****																				
Well drilling										P,SS,S		P,Li,SS	Li,SS,S		N,Li,SS			N	P	
Well testing												Li								
Drill cuttings disposal										P,SS,S		Li,SS, S	SS,S							
Subsea structure installation													SS,S				M	M,N	P	P
CPF installation																				
Fabrication******	R,S																			
Towing to site																				M
Installation										P	P	SS			P		L	N		M
Scour protection										P	P	SS	P,SS		P			N		M
Export Pipeline Installation																				
Pipelay barge operations	S									M		Li			Li					
Export pipeline welding and laying	S									P,M	P		P,SS		N		N	N	P	M
Rock berm installation										P	P	SS							P	
Pipeline NDT	S											Li			Li					
Precommissioning - hydrotesting of pipeline, flowline, CPF pipework																				
Filling			N, E	L				N	E								L			
Dewatering			N	L				N				Li,SS	Li,SS		Li		L			
Drying			N, E	L				N	E								L			
Nitrogen purging									E											
COMMISSIONING & OPERATION																				
General																				
Presence of structures										P	P		P		P	L				P
Helicopter movements																M,N				M
Support / supply / transfer vessels												Li			Li	L		M,N		M
Well, infield flow line and flexible riser operations																				
Routine operations										P										
Valve actuation												Li			Li					
CPF																				
Venting / Flaring									E							L				
Discharges (effluent, cooling water, PFW)												Li,SS			Li,SS		Li	Li,SS		
Facility maintenance	S								E			Li	Li,SS							
Energy generation	S								E			Li,SS,E								
Fuel / Chemical / Hazardous material usage	S								E			Li								
Solid waste disposal	S	S																		
Fire / emergency exercises												Li								
Export pipeline																				
Export pipeline operations										P										
Pigging	S											SS								
Accidential Events																				
Oil/Fuel/Chemical spillage	S								E	Li		Li			M,Li	M,Li	M,Li	M,Li		M,Li
Vessel collision/grounding	S								E	P,M,Li,SS,R		Li, SS	M,P,SS		M					M

* Vessels include dredgers, pipelay barges, tugs, pipe supply vessels, supply vessesls, diver support vessels

** Floatel potentially required until completion of commissioning

*** Assumes no offshore quarrying

**** 10 wells estimated at start up, drilling and tie-back campaign continues throughout operations phase

***** Fabrication assumed to be in overseas shipyard

An aspect of large magnitude

An aspect of small magnitude

^ Includes users of the MOU 74 Box

Assumption is that no corals will be impacted by offshore infield infrastructure.

Figure 5.1-1: Scoping Matrix – Offshore Infield Infrastructure

	ASPECTS											ENVIRONMENTAL FACTORS (RESOURCES AND RECEPTORS SUSCEPTIBLE TO IMPACTS)																			
												Terrestrial Resources / Receptors									Marine Resources/Receptors										
												Physical		Biological			Human				Physical			Biological						Human	
	Physical presence (perm) (P)	Physical presence (moving) (M)	Noise / vibration emissions (N)	Pollutant emissions to air (E)	Dust emissions (D)	Light emissions (L)	Liquid waste (Li)	Suspended Solids (SS)	Solid waste (S)	Energy usage (En)	Raw material usage (R)	Geology, Soils and Hydrogeology	Surface and ground waters	Habitats	Fauna	Flora	Landscape and Visual	Cultural	Noise	Ambient Air Quality	Seabed	Hydrodynamics	Water Quality	Benthic fauna	Coral	Fish	Seabirds	Marine Turtles	Cetaceans/Marine Megafauna	Cultural	Fishing and Navigation
ACTIVITIES																															
CONSTRUCTION																															
General																															
Trenching / rock cutting (seabed preparation)																			N	E	M,P	M,P	SS	P,SS	P,SS	N,SS		N	N	P,M	M
Quarrying (incl transporting of materials)																			N	E											
Blasting																			N		P,M	P	SS	P,SS	P,SS	N		N,L	N	P,SS	M
Concreting												S								E	P, S	P	SS	P,SS	P,SS					P,SS	M
Structure installation (including piling)																			N	E	P, M	P,M		P	P			N,L	N,L	P	M
Backfilling / rock berm installation (from quarry)^																			N	E	P	P,M	SS	P,SS	P,SS			N,L	N,L	P	M
Vessel movements / anchoring																				E	M		Li,SS			Li	M	N,L	M,N,L	M	M
Waste disposal												S	Li,S										Li								
MOF / port loading / unloading of materials & wastes**															L				N	D,E							L	L	L		
Export pipeline installation (intertidal zone)	As per offshore matrix																														
COMMISSIONING & OPERATION																															
General																															
Presence of structures												P			L		P				P	P	P	P		P	P,L	L			L,P
Infrastructure maintenance (including corrosion protection)												S											Li			Li					
Tanker loading																				E			Li				L	L	L		L
Outfall discharges																							Li	Li,SS							
Shipping movements*												S								E			Li,SS				L	M,N,L	M,N		M
* Includes tankers (LNG, LPG, Condensate), supply vessels																															
Accidental Events																															
Oil/Fuel/Chemical spillage												S								E			Li	Li	Li	Li	Li	Li	Li		Li
Vessel collision/grounding												S					P			E	P		Li, SS	Li,SS	Li,SS	Li,SS		P			M,P

An aspect of large magnitude

An aspect of small magnitude

^ assumes no excess marine sourced material to dispose of

** activites continue throughout construction and operations phase

Figure 5.1-2: Scoping Matrix – Intertidal Zone Infrastructure

ASPECTS	RESOURCES AND RECEPTORS SUSCEPTIBLE TO IMPACTS																														
	Terrestrial Resources / Receptors															Marine Resources/Receptors															
	Physical							Biological					Human			Physical			Biological								Human				
	Geology - Soils and Hydrogeology	Surface and ground waters	Habitats	Fauna	Flora	Landscapes and Visual	Cultural	Noise	Ambient Air Quality	Seabed	Hydrodynamics	Water Quality	Benthic fauna	Coral	Fish	Seabirds	Marine Turtles	Cetaceans/Marine Mammals	Cultural	Fishing and Navigation	Physical presence (temp) (P)	Physical presence (moving / lamp) (Mp)	Noise / Vibration emissions (N)	Pollutant emissions to air (E)	Dust emissions to air (D)	Light emissions (L)	Liquid Waste (Lf)	Suspended Solids (SS)	Solid Waste (S)	Energy usage (En)	Raw material usage (R)
ACTIVITIES																															
SUPPORT FACILITIES / LOGISTICS																															
Generic Activities																															
*Vehicle & machinery movements**													M,D	M,N		M,D		N	E									L			
*Influx of workers**																P,M,D	P,M														
*Fuel, hazardous material and chemical usage**											Li,S	Li,S							E												
Support Facilities																															
Floatel											S								E	M	M	Li,SS		SS			M,L	M			
*Accommodation and associated infrastructure operations**											P,S	P	P	P,N,L	P	P	P	N	E			Li,SS					L				
*Desalination plant**																			E			Li,SS		Li	Li		Li				
*Waste water treatment plant**											P,S	Li						N	E			Li,SS		Li	Li		Li				
*Airstrip - flight operations**														N,L				N	E							L	L	N		L	
*Power generation**														N				N	E												
CONSTRUCTION / PRE-COMMISSIONING																															
Generic Activities																															
Cleaning& area preparation												P,S	P	P,N	P	P,D	P	N	E,D			SS									
Cut and Fill											P,S	P,SS		N			P	N	E,D			SS									
Blasting											P,S	P	P,D	N			P	N	E,D								N	N			
Quarrying											P,S	P	P,D						E,D												
Transportation of bulk materials																			E									M			
General Infrastructure																															
Concrete plant operations											M,R	D,Li	M,D	N,L				N	E,D			Li					L				
Concrete placement											M,S	Li	D	L								Li					L				
Roadworks and runway installation											P,M,R		D	N,L					N,E,D												
Processing Facilities (LNG Plant, LPG and Condensate processing)																															
Formwork / reinforcement construction											S		D	L					E,D								L				
Welding and NDT											S			L								Li					L				
Outfall Installation																				P	P,M	SS									
Precommissioning - tanks, processing facility pipework																															
Hydrotesting (filling and dewatering)												Li	N					N	E			Li,SS	Li,SS	Li	Li						
Drying													N					N	E												
Nitrogen purging																			E												
COMMISSIONING & OPERATION																															
General Infrastructure																															
Presence of infrastructure											P		P	P,L	P	P	P										L	L			
Maintenance (including corrosion protection)											S	Li							E			Li									
Outfall operation																						Li									
Processing Facility commissioning (LNG Plant, LPG and Condensate processing)																															
Process facility commissioning												Li		N,L		L		N	E			Li					L	L	N		L
Flaring (routine and emergency)														N,L		L		N	E								L	L			L
Process cooling discharges																						Li									
Presence of structures											P		P	P,L		P,L											L	L			P
Routine operations											S	Li		N,L		L		N	E			Li					L	L			L
Liquid waste disposal including process effluent												Li										Li,SS									
Solid waste disposal											P,S					S															
Accidential Events																															
Oil/Fuel/Chemical spillage											S	Li	Li						E			Li		Li	Li	Li	Li	Li		Li	
An asepct of large magnitude																															
An aspect of small magnitude																															
** denotes an activity that occurs throughout construction and operations phase*																															

Figure 5.1-3: Scoping Matrix – Onshore Infrastructure

5.2 Summary of Environmental Factors, Key Impacts and Issues

Table 5.2-1 and Table 5.2-2 provide a summary of the key impacts and issues the Project may have on resources and receptors as identified in the process described in Section 5.1.

Table 5.2-1: Summary of Key Marine Impacts and Issues

Category	Factor (Resource/ Receptor)	Key Impacts and Issues	Assessment study (section 5.3)
Physical	Seabed & foreshore/intertidal zone	The seabed and the foreshore/intertidal zone can be directly impacted through the siting of infrastructure including the placement of subsea infrastructure such as wells, manifolds, rock berms, jetties, MOFs, pipelines and shoreline protection barriers which may alter its structure. As a result of this, biological resources on the seabed or in the foreshore/intertidal zone may be adversely affected.	Hydrodynamic modelling Water quality Marine ecological
	Hydrodynamics	Hydrodynamics have the potential to be impacted wherever permanent facilities such as the pipelines, jetty, island interconnect or other fixed structures are placed in a manner that alters natural hydrodynamic processes. This in turn has the potential to impact on biological resources.	Hydrodynamic modelling
	Water quality	Water quality can be impacted through the introduction of liquid discharges into the marine environment, and by creation of turbid plumes or brine. Discharges of routine vessel movements as well as from hydrocarbon processing on both the CPF and onshore facilities.	Water quality
Biological	Benthic fauna and flora	Benthic fauna has the potential to be impacted directly, (e.g. localised disruption through the construction and placement of facilities), and indirectly (e.g. by smothering or loss of light resulting from suspended sediments). Includes motile and non-attached species, and macroalgae and seagrass species.	Marine ecological: Corals and other benthic primary producers, and feeders
	Coral	Corals in the vicinity of the Maret Islands may be directly impacted through construction and placement of infrastructure, and will be susceptible to impacts from suspended solids, alterations to hydrodynamics, and pollution that could result from routine process discharges and inappropriate management of liquid wastes (including desalination brine) and spills.	Marine ecological: Corals and other benthic primary producers

Category	Factor (Resource/ Receptor)	Key Impacts and Issues	Assessment study (section 5.3)
	Fish	Fish have the potential to be impacted either directly through alterations in water quality as a result of construction and operational discharges into the marine environment, and/or through impacts to benthic organisms in the food chain, upon which they rely.	Marine and terrestrial ecological: Fish
	Seabirds	Seabirds could be impacted through a combination of light spill from offshore and onshore infrastructure, as well as from flaring. Seabirds would be susceptible in the case of an accidental event such as an oil spill. Seabirds may also be susceptible to noise and vibration.	Terrestrial ecological: Seabirds
	Marine turtles	Light spill from marine and terrestrial facilities may affect the nesting behaviour of sea turtles and the sea-finding success of turtle hatchlings. Accidental events such as spills or leaks similarly have the potential to impact turtles in the open sea. Turtles may also be susceptible to noise and vibration during drilling and any dredging and blasting or direct impact to beaches	Marine turtles
	Cetaceans and marine megafauna	Cetaceans and marine megafauna have the potential to be directly impacted as a result of noise and vibration emitted during construction and operational activities, or more uncommonly through a direct collision with project associated vessels.	Cetaceans and marine megafauna
Human /Social	Fishing, recreation and navigation	Impacts to humans are likely to be minimised by the establishment of safety exclusion zone around the offshore facilities as it will restrict or prohibit fishing and other non-asset related vessel movements. Some recreational activities in the region may be curtailed as a result.	Socio-economic
	Health risk (public and workforce)	Potential health risks associated with the Project are primarily limited to the (project's) workforce as a result of the isolated location of the facilities. Potential foreseeable risks are exposure to hazardous materials and chemicals that are required for the construction and operations, and exposure to process emissions and discharges or liquid and solid wastes generated through the project activities.	Human health risk management

Category	Factor (Resource/ Receptor)	Key Impacts and Issues	Assessment study (section 5.3)
	Ambient air quality	Emissions associated with onshore and offshore facilities have the potential to impact air quality in the immediate vicinity of the facilities and contribute to global emission profiles. Expected emissions include oxides of nitrogen and sulphur, hydrogen sulphide, carbon dioxide and particulates.	Air quality (including greenhouse gas emissions)
	Non–indigenous cultural heritage	Sites of maritime heritage, for example shipwreck sites, have the potential to be impacted by subsea infrastructure such as wells, manifolds, flow lines and export pipelines. These sites are typically avoided during the project design phase through careful route selection.	Cultural heritage (non-indigenous)

Table 5.2-2: Summary of Key Terrestrial Impact and Issues

Category	Resource/ Receptor	Key Impacts and Issues	Assessment study
Physical	Geology, soils and hydrogeology	The geology, soils and hydrogeology of the Maret Islands will be primarily impacted through cut and fill activities and the physical presence of the onshore infrastructure or in the event of accidental spills.	Geographic and hydrogeological
	Ground water	No groundwater reservoirs have been detected on the Maret Islands, but if they exist, they would be susceptible to accidental spills or leaks in the event of a major hydrocarbon release. Similarly if groundwater is present, there is a potential for stygofauna to be present.	Geographic and hydrogeological
	Surface water	There is no permanent surface water on the Maret Islands. Natural surface drainage channels have the potential to be impacted through cut and fill activities that will be required to site the onshore infrastructure. Run off may potentially have higher sedimentation loads as a result of the ground disturbance. Potential alterations to stormwater drainage patterns.	Geographic and hydrogeological

Category	Resource/ Receptor	Key Impacts and Issues	Assessment study
Biological	Protected areas	There are no registered protected areas or areas with specific conservation status within the vicinity of the Maret Islands. However, a longstanding (circa 1991) recommendation includes the Maret Islands in a regional Nature Reserve. Successive governments have not followed up on this recommendation.	Terrestrial fauna Terrestrial vegetation
	Habitats	A large proportion of the habitat of the Maret Islands will be removed/modified through the clearing and cut and fill activities required for the onshore infrastructure and facilities. Much of the remaining terrestrial habitat on the Maret Islands will be fragmented.	Terrestrial fauna Terrestrial vegetation Quarantine
	Fauna	The clearing of habitat on the Maret Islands to allow construction of the onshore infrastructure will either displace or kill some terrestrial fauna. It is similarly foreseeable that fauna unable to relocate will be reliant on the remaining habitat, which is likely to be fragmented. Fauna are also susceptible to noise and vibration impacts from construction and operations activities.	Terrestrial fauna
	Flora	Flora will be directly impacted through the clearing and earthworks activities associated with the construction phase of the onshore infrastructure. Secondary impacts due to construction/operational dust and altered drainage patterns are possible if properly managed.	Terrestrial vegetation
Human / Social	Landscape and visual amenity	The landscape and visual amenity will be modified from a natural landscape to a large industrial facility. Lighting of the facilities will be in accordance with the project's safety requirements; typical of large-scale industrial facilities. The isolated and undeveloped location of the Maret Islands minimises the number of potential human receptors, however there is a human perception of wilderness values for the general region, and will impact on landscape amenity in terms of potential tourism.	Visual amenity
	Non-indigenous cultural heritage	If non-indigenous heritage sites are identified on the Maret Islands, they have the potential to be directly impacted through the clearing and excavation activities required to enable the onshore facilities to be sited.	Cultural heritage (non-indigenous)

Category	Resource/ Receptor	Key Impacts and Issues	Assessment study
	Indigenous cultural heritage	Any indigenous cultural heritage (including site K000132 which is already on the Department of Indigenous Affairs' register), and any newly discovered/unregistered sites found on the Maret Islands have the potential to be disturbed as a result of the development. Destruction of some or all of these sites of cultural value would occur only after consultation with relevant Indigenous peoples.	Cultural heritage (indigenous)
	Ambient air quality (including greenhouse)	Refer to discussion in Table 5.2-1	Air quality (including greenhouse gas emissions)
	Local community	There is no local community in the vicinity of the Maret Islands and offshore licence block areas. However, there will be significant logistical support and supply of materials from the mainland via ports. The provision of project support services from these local areas is anticipated to have a positive impact on the local economies in these Kimberley region townships.	Socio-economic
	Health risk (public and workforce)	Due to the isolated location of the Maret Islands, members of the public are unlikely to be in the vicinity of the onshore infrastructure throughout construction and operations. Impacts to the workforce could arise from process emissions, discharges, hazardous materials and chemicals, and waste management activities associated with the processing facilities and the project support infrastructure.	Human health risk management
	Conservation Status	Islands of the West Kimberley (including the Maret Islands) have been recommended for consideration by government as a Nature Reserve in 1980 and 1991.	For information

5.3 Technical Scopes of Work

A number of environmental impact assessment studies have been commissioned to collect information to be used in the design, construction, operation and decommissioning of the project such that potential environmental impacts, as identified in Section 5.2, can be managed appropriately. Details regarding specific studies for the EIA are provided later in this section. (Additional comprehensive descriptions of the Technical Scopes of Work for the physical and biotic environments, as requested by the EPA, are provided in Appendix C).

The interrelationships between environmental factors, EPA environmental objectives, potential impacts, studies and proposed management measures are summarised in Appendix B.

Technical Scopes of Work have been developed with the involvement of various government agencies and industry experts. An Environmental Scope and Survey Methodology Review workshop was held on 31 August, 2006. The purpose of the workshop was to facilitate meaningful regulator and proponent review of the environmental scopes of work and survey methodologies. Pre-reading material which described study scopes had been distributed for all of the environmental impact assessments studies prior to the workshop. The workshop was led by INPEX and attended by representatives from both Commonwealth and Western Australian agencies, as detailed in Table 5.3-1.

Table 5.3-1: Agencies Present at the August Scoping Workshop

Commonwealth	State
DITR DEWR	DEC EPA ODAC

Subsequent workshops to further discuss technical scopes of work for four technical packages were held in October 2006, attended by representatives of DEC. Further scoping information was distributed prior to those workshops.

The workshops assisted in the development of the technical scopes of work described in this Environmental Scoping/Guidelines Document. Engagement of regulatory agencies will continue throughout the execution of the field surveys and completion of the EIS/ERMP.

5.3.1 Noise and Vibration Studies

Noise and vibration associated with construction and operation of the proposed offshore and onshore facilities have the potential to affect biotic and human receptors. Disturbance of natural behavioural patterns of marine and terrestrial fauna may affect the ability of some individuals to feed, migrate or breed. Vibration due to blasting and drilling during construction may affect subterranean habitats and landform stability. Marine noise due to drilling, dredging and blasting may affect the behaviour of marine fauna in the area.

Existing noise and vibration levels are expected to be low and the proposed facilities are expected to generate a higher level of noise and vibration. These changes need to be quantified such that the possible impacts associated with the proposal can be fully evaluated. Preliminary assessment of background noise in the vicinity of the development indicates low levels of noise and vibration and that birds and marine megafauna, such as cetaceans and turtles, are the most important and sensitive receptors in the proposed development areas. Noise monitoring is planned to support a formal noise and vibration assessment in accordance with the Environmental Protection (Noise) Regulations 1997, Environmental Protection Policy (EPP) for Ambient Air Quality in Western Australia, the Environmental Protection (Ozone Protection) Policy Approval Order 2000 and Air Quality Modelling Guidance Notes 2006 (Appendix A).

The surveys will provide the information needed to develop the management measures required to meet the EPA objective of maintaining the abundance,

diversity, geographic distribution and productivity of marine and terrestrial fauna at species and ecosystem levels.

Objectives

A range of survey methods, including field measurements of noise levels and detailed modelling and assessment will be used to:

- Characterise existing noise levels in the proposed development area
- Estimate noise emission levels
- Assess the potential impact of noise and vibration emissions on sensitive receptors from the project during construction and operations of both onshore and offshore infrastructure.

Timing

A literature review and field studies on potential noise and vibration impacts commenced in August 2006. A full assessment, under both wet and dry season conditions, will be completed by June 2007.

Additional scope details are provided in Appendix C.

5.3.2 Light Studies

The Maret Islands are generally flat with localised areas of undulation. The coastline is typically either sandy beaches or laterite cliff faces. Vegetation communities range from low coastal scrub and grasslands to thick forest woodlands. This type of landscape character has medium to low absorptive potential for introduced light sources.

Preliminary marine and terrestrial surveys indicate that turtle nesting activity occurs on many of the beaches of the Maret and adjacent islands. Turtles are the primary light-sensitive receptor currently known to exist within the study area. Disruption to existing light levels due to the construction and operation of the proposed development are known to have adverse effects on both nesting patterns and hatchling survival.

Potential stressors include any artificial illumination of an equal or higher level than the reflection of stars and moonlight off the ocean. Impacts may involve disorientation of hatchlings, an increase in predation, and an increase in mortality.

Detailed mapping of the beaches and other key locations around the Maret Islands will enable a comprehensive assessment of existing light sensitive receptors. Investigations performed on the light sensitivity of receptors will provide information required for effective management of light pollution. The aspiration is to reduce the impact of artificial illumination to the point where it is reduced to an acceptable impact level to light sensitive receptors.

Inpex intends to establish world best practice in light management strategies to minimise negative impacts on turtles in the Maret Island area.

Objectives

Use research, consultation and desktop and field studies to:

- Determine the existing light levels of the onshore and nearshore study area and indicate nearby land uses and sensitive receptors
- Identify the light sensitive receptors in the proposed site area
- Benchmark project against similar facilities with comparable light-sensitive receptors
- Identify measures to minimize the potential impacts of estimated light emissions from the onshore plant, and nearshore marine facilities
- Assess the likely impact on sensitive receptors, including assessment against background levels, regulatory requirements, and identified performance indicators
- Assess light manipulation techniques should significant levels of light pollution remain following mitigation using all commercially acceptable means
- Model light levels that could reach turtles on nesting beaches.

Timing

Desktop studies commenced in July 2006, with the first field survey performed in August 2006. Light studies required for the EIA will be completed in June 2007 and will encompass both wet and dry seasons, and different stages of the lunar cycle.

Some additional scope detail is provided in Appendix C.

5.3.3 Air Quality Studies

Atmospheric emissions arising from the project will occur during construction and operation of the facilities. Operational emissions may be associated with both routine and 'non-routine' conditions.

Air quality emissions of principal concern are expected to include: oxides of nitrogen (NOx), oxides of sulphur, hydrogen sulfide, volatile organic compounds, carbon dioxide and particulates. These air quality emissions and changes to ambient air quality may potentially impact on workforce health and the surrounding environment including vegetation and fauna. Emissions associated with onshore facilities rather than offshore facilities are anticipated to be of relevance to the EIA. Due to the remote location and absence of other developments in the nearby area, air quality impacts are not expected to be of regional concern.

An air emissions study, supported by dispersion modelling, will be undertaken. Modelling will be consistent with the DEC's Air Quality Modelling Guidance Notes issued by the Western Australian Department of Environment (DoE 2006). Modelling will be used to demonstrate that the environmental objective for air quality (atmospheric emissions) is achievable. Nitrogen deposition modelling will also be undertaken and compared to trigger levels of concern for native vegetation.

Objectives

A combination of desktop reviews and field sampling will be used to:

- Determine baseline atmospheric conditions and air quality in the project area and other areas potentially impacted by the development
- Identify and model atmospheric discharges of potential concern from the various processing facilities

- Assess the potential impact of atmospheric discharges on air quality during the construction and operation phases of the project
- Identify appropriate technology to minimise emissions.

Timing

Baseline studies commenced in August 2006 and will include the installation of local meteorological monitoring facilities. These facilities will remain in place throughout the duration of the project. Baseline data gathering required for input into EIA will account for seasonal variation in local conditions, an essential input for the dispersion model.

5.3.4 Greenhouse Gas Emissions

INPEX and its Joint Venture Partner – Total Australia – have established a Greenhouse Taskforce to determine the most appropriate long-term strategy for management and mitigation of greenhouse gases.

Details of the ultimate strategic package of mitigation options will be addressed in meaningful detail in the EIS/ERMP at which stage the development options and concept design will be at a stage of maturity to address this issues in detail. Such strategies will take into account the advice of governments, particularly Guidance Statement Number 12, and Western Australian Government climate change policies and strategies which are expected to be released in 2007.

5.3.5 Waste Management

The volume and type of wastes being generated will vary throughout the lifecycle of the project. Wastes are most effectively managed through a combination of design and implementation considerations that minimise the volumes of waste at the source, thereby reducing the volumes that actually require storage, transport and disposal. The technical scope of work associated with waste management will focus upon the identification of the anticipated waste streams, the collaboration necessary within the design teams to minimise waste throughout design and the subsequent logistical requirements and infrastructure needed for the appropriate management of solid wastes.

Given the absence of waste management infrastructure in the vicinity of the Maret Islands, it is currently anticipated that the project's wastes will be temporarily stored at their point of generation (offshore facilities or onshore at the Maret Islands) prior to being returned to mainland for further treatment and disposal.

Objectives

The solid waste management study will be designed to:

- Develop a solid waste inventory (non-hazardous and hazardous) for each of the facilities
- Develop a waste management philosophy for integration into the project design
- Identify the logistical support and key infrastructure required to store, transport and dispose of the development's solid wastes

- Assess the impacts associated with the project's solid waste and develop the necessary mitigation measures and infrastructure needed to minimise the anticipated impacts throughout the project life.

Timing

A Solid Waste Management Strategy is in the process of being developed. An assessment of the capacity of existing waste management infrastructure and service providers in the west Kimberly region will commence in early 2007, with the impact assessment completed by June 2007.

5.3.6 Quarantine Management Studies

The current and historical uncontrolled access to the marine and terrestrial environments of the Maret Islands has rendered the islands at risk of introduction of non-indigenous species (NIS). Such introductions may have occurred by way of visitations to the islands for recreational and commercial purposes (e.g. fishing and tourism), or historically through visitations by South-East Asian fishers, and Traditional Owners from the mainland. The islands may also have been utilised during World War II for military purposes.

Given the historical lack of quarantine protection for the Maret Islands and surrounding marine environment, it is likely that NIS may already be present. The basis of quarantine management studies will be to establish the presence of any NIS in the proposed development area, and recommend quarantine management strategies appropriate to the quarantine status and environmental values of the region.

Ecological surveys referred to in Section 5.3 will provide information critical to the determination of quarantine management, and will establish the baseline for future quarantine management of the islands.

Objectives

The quarantine management study will:

- Establish a baseline of species presence for the Maret Islands and surrounding the marine environment
- Determine the presence of any pre-existing non-indigenous species
- Establish a framework for the assessment and management of quarantine risks to the Maret Islands associated with the construction and operation of the proposed Ichthys Development.

Quarantine Management Framework

INPEX has prepared a quarantine management framework to guide our approach to managing quarantine issues for the Maret Island region. The objectives of INPEX's quarantine management framework are to:

- Minimise the potential for the introduction of recognised pests and other species with a known invasive potential;
- Identify and manage quarantine risks associated with INPEX activities;

- Ensure INPEX personnel, Contractors and Subcontractors receive appropriate training and inductions in quarantine as required;
- Respond quickly and effectively to any quarantine emergency that arises; and
- Develop and maintain a positive quarantine culture.

The framework applies to areas where Project activities occur and the risk of introduction, establishment or spread of recognised pests and invasive species exists, including the following:

- The development footprint on the Maret Islands and the immediate environment surrounding the development footprint;
- Any other islands visited as part of Project activities (e.g. those visited for surveys);
- The waters surrounding the proposed Project areas (e.g. nearshore waters surrounding the islands, or marine parks or shoals traversed by Project vessels);

The framework applies to all Project activities that may present a risk of introducing recognised pests and invasive species. Such activities include those carried out during the following Project phases:

- Pre-installation surveys and investigations;
- Pioneering phase activities;
- Construction and installation activities;
- Commissioning activities;
- Operations activities; and
- Decommissioning activities.

These objectives will be implemented through the development of detailed Quarantine Management Plan(s) which will cover the following (as a minimum):

- Details on the planned activities and associated material pathways;
- Measures that will be implemented to reduce risks (including procedures, specifications, guidelines, etc);
- Management tools that will include checklists, flowcharts, sign-off forms, etc; and
- Framework of the Environmental Management System that quarantine will be managed under (including responsibilities, training and awareness, incident response, records, reporting requirements, monitoring, etc).

Timing

The quarantine study will rely on information provided in the terrestrial and marine ecological studies as part of this environmental impact assessment to establish a baseline species presence database.

Preliminary quarantine studies will commence in early 2007 and will continue until June 2007 when the ‘wet’ season ecological surveys are complete. The species presence database will be continually updated through ongoing environmental

survey and monitoring efforts. A quarantine management plan will be developed for inclusion in EIA documentation in the third quarter of 2007.

5.3.7 Marine Physical Environment Studies

Oceanographic Discharge Modelling

Accidental spills of hydrocarbons or other chemicals and unplanned discharges of wastewater, may affect water quality and consequently the health of the receiving marine environment.

Hydrodynamic modelling of the fate and behaviour of discharges of wastewater from the proposed facilities to the marine environment is required to facilitate assessment of potential impacts of the discharges and formulation of effective management and mitigation strategies. The modelling will focus on the discharges predicted to have the greatest environmental impact on the receiving waters.

It will be necessary to investigate the likely trajectories, fates and consequences of production discharges and accidental spills to the marine environment during the development and production stages. These discharges will include (but not be limited to):

- Produced formation water
- Grey water and sewage (nearshore)
- Hydrotest water from dewatering of the export pipeline
- Sediment suspended by dredging of a pipeline trench and disposal of the spoil
- Sediment suspended by propeller-wash set up by export tankers
- Accidental spills of liquid hydrocarbons into the sea.

The modelling will determine the likely dilution and dispersion behaviour of selected waste discharges from the offshore field and the mainland coast. The behaviour of accidental spills will be examined through spill modelling based on a number of possible scenarios, including a spill of various sizes from the offshore field, from along the pipeline route and from the nearshore Maret Islands.

The output from the dispersion model will be used in conjunction with the marine studies program to predict impacts to the receiving environment. The modelling data will also be used in formulating ongoing monitoring and management recommendations.

Surveys will be undertaken to collect tidal measurements and current measurements, and tracking buoys required for ground-truthing the trajectory model have been deployed. These studies are required to improve the accuracy of the models and also data is used to validate the model predictions against real time datasets.

The survey and modelling approach is also designed to provide the information needed to provide guidance on the management measures required to meet management targets and guidelines. INPEX will engage regulators in the development of management targets and objectives.

Objectives

A range of survey methods, including field measurements of hydrological characteristics, meteorological datasets, detailed modelling and assessment will be used to:

- Predict the hydrodynamic circulation over the wider study area and local Islands using a validated three-dimensional hydrodynamic model
- Predict the exposure risk from accidental hydrocarbon releases (trajectory, dispersion and weathering of hydrocarbons spills) using a validated 3-dimensional oil spill fates and effects model
- Predict potential deposition and erosion of sediment in sensitive areas such as beaches and benthic primary producer habitats through coastal transport modelling
- Predict the fate of sediments released from dredging, dredge spoil disposal and propeller-wash using a validated 3-dimensional spill fates and effects model
- Provide model output data, as described in Appendix C, to support the assessment of potential impacts arising from accidental hydrocarbon spills associated with the project.

Timing

Hydrodynamic modelling commenced in August 2006 and field validation data were collected in October 2006. The modelling and validation required to inform the assessment of risks to marine receptors will be completed by June 2007.

Additional scope details are provided in Appendix C.

Marine Water Quality and Sediment Studies

Discharges to the marine environment during construction, commissioning and operations of the proposed facilities will affect the quality of the receiving waters around the facilities. Water quality will be affected by drilling, dredging, rock dumping, hydrotesting, formation water discharge, vessel wastes, floatel wastes (if required), facility wastes and cooling water. Effluents and discharges will include nutrients, hydrocarbons, biocides, suspended sediments, drilling cuttings and fluids and warm water. In addition to planned discharges, there is potential for accidental spills of hydrocarbons and other chemicals.

Changes in water quality from these discharges may affect the ecological function of the receiving environment through physiological or toxicological impacts and through physical impacts such as smothering and light reduction. Discharges could lead to a range of effects from minor decreases in productivity to death of members of benthic and pelagic communities. Preliminary water quality surveys have been conducted at the offshore infield area. Water quality is known to be affected by seasonal changes in ocean current through-flow and rainfall.

Sediments are considered a sink for marine contaminants and a baseline study of natural contaminant concentrations in sediments will be undertaken. Due to the remoteness of the development area, baseline water and sediment contaminant concentrations are expected to be low.

Baseline water and sediment quality data collected during these surveys in combination with proposed marine infrastructure layouts and effluent discharge locations will be used to establish spatial allocation of ecological protection levels within the nearshore area of the Maret Islands. The overall objective will be to ensure ecosystem integrity. Guidance on establishing specific water quality objectives will be consistent with (Western Australian) State Water Quality Management Strategy (Government of Western Australia 2003 and 2004) which is the State's response to the National Water Quality Management Strategy. Whilst it is anticipated that during the operational phase of the Ichthys Project, moderate levels of ecological protection will be required around product offloading jetties, material offloading facilities and around effluent outfalls, it is expected that the majority of the State waters surrounding the Maret Islands will be able to accommodate high and perhaps even maximum ecological protection levels. The number of outfalls required will be minimised and their design will allow for maximum dilution and dispersion so as to minimise the required size of a mixing zone.

Detailed mapping of benthic communities around the proposed facilities and hydrodynamic modelling of the expected fate and trajectories of waste discharges will provide the information necessary to assess the risks to the receiving environment. Coastal process modelling and spill/discharge modelling is already underway to help elucidate the hydrodynamic characteristics of the receiving waters.

Objectives

Literature review and field surveys employing a range of methods such as water quality profiling using a high accuracy CTD, collecting and analysing water samples for baseline status of potential contaminants will be combined with the information on the distribution of benthic communities in areas potentially affected by the proposed development to:

- Identify sensitivities of the receiving environment
- Quantify the baseline status of the receiving waters and sediments in the development areas
- Characterise the physico-chemistry of the sediments
- Measure contaminant concentrations in potential bio-accumulating organisms
- Determine if there are any 'abnormal' existing levels in water quality that may already exceed the NWQMS guidelines
- Measure seasonal changes in water quality associated with natural events
- Provide physical water quality data for validating the hydrodynamic model
- Provide baseline information for the spatial establishment of ecological protection levels.

Timing

Intensive baseline water quality profiling and laboratory analysis commenced with surveys in September 2005 and continued from June 2006. Surveys required for input into the EIA will be completed by June 2007 as this will yield a baseline of the status of the receiving waters in both the wet and dry seasons.

Additional scope details are provided in Appendix C.

5.3.8 Marine Ecological Studies

Corals and Other Benthic Primary Producers and Associated Fauna

Direct removal, damage or disturbance to benthic primary producers (BPPs) could occur during dredging or other construction activities associated with the proposed development, or from reduced water quality or disruption to reproductive cycles.

Preliminary marine and intertidal surveys indicate that coral assemblages are the most important BPPs in the Maret Island and Browse Island areas. Coral assemblages are important primary producers, reef builders and support a high level of biodiversity. Macroalgal communities and mangroves are less predominant in the proposed development area. Thus, corals will be the focus of the marine benthic studies.

Detailed mapping of the coral and other BPP assemblages in subtidal and intertidal areas around Browse Island, the Maret Islands and surrounding islands will enable an assessment of the significance of the corals within the proposed development area. This will support a benthic primary producer habitat assessment in accordance with EPA Guidance Statement 29 (EPA 2004b). The surveys are also designed to provide the information needed to provide guidance on the management measures required to meet the EPA objective of maintaining the abundance, diversity, geographic distribution and productivity of benthic primary producers.

Objectives

A range of survey methods, including underwater video tows, aerial photography and intertidal surveys will be used to:

- Map the intertidal and subtidal marine habitats around the Maret Islands including those in potential development areas and at reference islands
- Describe the physical structure (geology and sedimentology) of intertidal and subtidal features that support the biotic assemblages
- Identify the conservation significance and environmental sensitivities of subtidal and intertidal assemblages in areas potentially affected by the proposed development (in the context of the West Kimberley bioregion and other reference sites)
- Determine the spawning period(s) for major coral taxa in the Maret Islands area
- Assess genetic connectivity between corals around Browse Island and in other parts of the offshore coral province
- Determine the species richness, assemblage composition and significance of deepwater (>200 m water depth) infauna communities in areas to be drilled
- Survey marine subtidal and intertidal fauna and flora, including sedentary and motile invertebrates and fish species
- Search for small EPBC-listed fish in intertidal habitats.

Timing

These studies commenced in July 2006 with intensive intertidal and subtidal field surveys commencing in September 2006. Regional field surveys will be completed

for West Montalivet, East Montalivet, Albert, Berthier, Bigge, Lamarck Islands and Rob Roy Reef. Surveys required for input into EIA will be completed in June 2007 as this will yield a baseline for wet and dry seasons of the same year.

Additional scope details are provided in Appendix C.

Marine Turtles

Light spill from marine and terrestrial facilities may affect the nesting behaviour of sea turtles and the sea-finding success of turtle hatchlings. Accidental collision with vessels and entrainment in dredging plant may cause injury or mortality of individual turtles. Disturbance by the vessel and shore-based workforce could disrupt turtle nesting and breeding activities. Turtles in the open water may be affected by accidental spills or leaks as well as from direct contact with vessels.

Preliminary data indicate that the Maret Islands support an active rookery for green (*Chelonia mydas*) and flatback (*Natador depressus*) turtles. Surveys in July 2006 indicated that turtles nest on many of the sandy beaches around the Maret Islands and on surrounding islands and the mainland coast. Other turtles such as hawksbill turtles (*Eretmochelys imbricata*) are also expected to occur in the area, but not necessarily to nest in areas potentially affected by the proposal.

Intensive baseline studies during the summer breeding season of 2006–2007 will provide the information required to assess the likely impacts of the proposed development for the EIA. Ongoing studies will examine inter-annual variation in measures of turtle nesting effort and will feed into refinement of the management strategies proposed to minimise or mitigate potential impacts.

Objectives

A range of survey methods including aerial surveys, tagging, nest counts, track counts, egg counts, genetic studies, literature review, and light attraction experiments will be used to:

- Determine the genetic affinities of the breeding population of green and flatback turtles on the Maret Islands
- Identify critical marine turtle habitats (aggregation and nesting areas) in the vicinity of the proposed development
- Determine the relative importance of habitats on the Maret Islands in comparison with surrounding areas of the West Kimberley region
- Quantify the usage of the Maret Islands by nesting marine turtles
- Assess the potential lighting impacts on turtles from the proposed development on the Maret Islands (see also Light Studies Section 5.3.2).

Timing

Preliminary studies commenced in July 2006 and intensive breeding season studies commenced in October 2006. Surveys required for input into the EIA will be completed by June 2007 as this will yield a baseline of a full turtle breeding season encompassing mating, nesting and hatching phases. Turtle studies will continue until construction commences in mid-2009 and the information on inter-annual fluctuations will feed into the design of management strategies for minimising impacts on the turtle populations.

Additional scope details are provided in Appendix C.

Cetacean Studies

Cetaceans and marine megafauna may be injured or killed in collisions with vessels. Noise and vibration associated with blasting, dredging and drilling may cause cetaceans to either avoid the area, or attract them into a potentially dangerous area. Vessel movements may affect important behaviours of marine megafauna such as feeding, mating, migration and calving. Accidental spills or leaks of hydrocarbons or other chemicals may affect the health of cetaceans depending on their exposure levels.

Humpback whales are known to migrate from Antarctic waters to the Kimberley coast to mate and calve each year. The recognised calving area lies to the south of the Maret Islands at Camden Sound. Humpback whales visit the Maret Islands in the early part of the calving period and the present view is that the Maret Islands area is not a significant calving or resting area. ,Current research and surveys being undertaken by Inpex will address the importance of the Maret Island region to cetacean populations.

Offshore areas may include feeding or migration areas for other cetaceans such as blue whales, minke whales and dolphins. Other marine megafauna that may occur in the area include dugong and migratory whale sharks. The distribution of these taxa in the development area is unknown.

Intensive cetacean and marine megafauna baseline studies commenced during the calving period for humpback whales in the spring of 2006. Further surveys during the dry and wet season for other fauna will provide the information required to assess the likely impacts of the proposed development for the EIA.

Objectives

A combination of survey methods including aerial surveys, vessel-based surveys and acoustic loggers will be used to:

- Determine the distribution and abundance of cetaceans and other marine megafauna in areas potentially affected by the proposed development
- Assess the importance of the development areas in regional terms to cetaceans and other marine megafauna
- Identify any critical habitats for protected marine fauna in areas potentially affected by the proposed development.

Timing

Cetacean surveys commenced in June 2006. Intensive surveys during the northward migration of breeding female humpbacks commenced in August 2006 and will continue through to the end of the breeding period in November 2006. Assessment of potential risks for the EIA will necessitate surveys over the full breeding season for the humpbacks and the migration period for the blue whales. Surveys of other marine megafauna will continue through a wet and dry season cycle to capture seasonal changes in abundance. Aerial and vessel-based surveys for the EIA will be completed in June 2007. Acoustic loggers were deployed in September 2006 to collect data throughout the humpback and blue whale migration periods and will continue in operation.

Additional scope details are provided in Appendix C.

5.3.9 Terrestrial Physical Environment Studies

Geographic and Hydrogeological Studies

The geology, soils, and hydrogeology of the Maret Islands could be impacted through cut-and-fill activities and the physical presence of onshore infrastructure.

The geomorphological processes that formed the offshore islands prior to their isolation from the Western Australian mainland have been described for the Kimberley region at a broad scale. Islands off the north Kimberley coast are geologically distinct from islands to the south; and further north and there is variation in the geological characteristics among islands in the development area.

Objectives

Existing datasets for the region will be reviewed and background information on the hydrogeology and geology of the area will be collated.

Field surveys to collect site specific geological and hydrogeological data for the study area and map landforms, drainage systems and soils will be collected during field surveys to:

- Identify and describe the soils, topography, geology and geomorphology of the land-based development areas
- Identify the extent and quality of existing surface and groundwater associated with the development areas
- Determine the likely effects of the proposed development on soils, geology, landform and surface and groundwater in the development areas and adjacent areas.

Timing

This study commenced in June 2006 and the field surveys required for input into EIA will be completed by June 2007.

Additional scope details are provided in Appendix C.

5.3.10 Terrestrial Ecological Studies

Terrestrial Fauna

Previous survey data indicate that the Maret Islands support diverse herpetofauna, but no mammals. It is not known whether short-range endemic (SRE) taxa are present on the islands (Burbidge et al. 1991). However, there is a paucity of ecological data available relevant to the Maret and surrounding islands, and therefore these studies will provide an opportunity to collate a meaningful baseline dataset for the region.

Terrestrial fauna habitat being cleared for infrastructure will lead to animals moving into other areas or dying. Displaced fauna are expected to suffer higher intra-specific and inter-specific competition for resources and may also die. Degradation

of fauna habitats through earthworks, accidental spills or leaks, noise and vibration, light pollution and workforce disturbance will lead to decreased abundances of some species and diversity may be affected.

Intensive baseline studies during the wet and dry season of 2006–2007 will provide the information required to assess the likely impacts of the proposed development for the EIA and will feed into development of the management strategies proposed to mitigate or manage potential impacts. The surveys will conform with EPA Guidance Statement Number 56, Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia

In conjunction with the field surveys, including those surveys scheduled during bird migration season, there will be opportunistic observations of migratory birds.

Objectives

A literature review and a range of survey methods, such as trapping, hand foraging, head-torching, sonic detection and aerial photographic interpretation may be used to:

- Determine the diversity and distribution of terrestrial fauna (including birds) on the Maret Islands
- Determine the presence of listed threatened fauna or potential SREs
- Assess the levels of endemism in potential SRE groups, such as land snails, arachnids and oligochaetes
- Investigate the presence of subterranean fauna on the Maret Islands
- Quantify the use of the Maret Islands and surrounding islands by migratory shorebirds and seabirds particularly those protected by JAMBA/CAMBA Agreements or protected under other Commonwealth or State Legislation
- Compare the faunal habitats and fauna of the Maret Islands with those on nearby islands of similar geology (laterite over basalt), and dissimilar geology (sandstone).

Timing

Preliminary surveys commenced in June 2006. Surveys required for input into EIA, will encompass the wet and dry seasons and be completed by June 2007.

Additional scope details are provided in Appendix C.

Terrestrial Vegetation

Clearing and earthworks for construction and disturbance of normal fire regimes may affect natural cycles of succession and regeneration in terrestrial vegetation communities. Emissions from the operating gas processing facility could have physiological effects on surrounding vegetation.

Preliminary data indicate that the Maret Islands support a typical West Kimberley flora and there are no ‘Declared Rare Flora’ (DRF) known from the islands (M. Henson, Western Australian Herbarium, pers. comm.)

Intensive mapping and floristic studies during the dry and wet seasons of 2006–2007 will provide the information required to assess the likely impacts of the

proposed development for the EIA, and will conform with EPA Guidance Statement Number 51, Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia.

Objectives

Aerial photography, literature review, relevés and quantitative plot surveys will be used to:

- Derive a taxonomic floral inventory for the Maret Islands
- Map the terrestrial vegetation communities on the Maret Islands
- Identify DRF, priority flora and flora, other significant flora and vegetation restricted to small areas on the Maret Islands
- Assess the conservation significance of flora and vegetation in areas proposed to be cleared in terms of listed status and representation in other areas of the Maret Islands and reference islands.
- Compare the terrestrial vegetation of the Maret Islands with those on nearby islands of similar geology (laterite over basalt), and dissimilar geology (sandstone).

Timing

Field surveys of terrestrial vegetation commenced in July 2006. Kimberley flora typically flowers and fruits after the wet season and the floristic analysis will be completed in April–May 2007. Surveys required for input into EIA will cover the wet and dry seasons and will be completed in June 2007.

Additional scope details are provided in Appendix C.

5.3.11 Sociological Studies

Cultural Heritage (Non-Indigenous) Studies

Seabed and terrestrial ground disturbance during construction may damage terrestrial historical and maritime sites and underwater shipwreck sites.

Currently there are seven shipwrecks reported in the Browse Island area on the National Shipwreck Register. There is also evidence from nearby islands that European and Macassans were visiting parts of this coastline and perhaps utilized Maret Island. Therefore, there is the potential for historical, Macassan and maritime sites in the area. Detailed desktop and field assessments will be undertaken to determine the potential for historical Maccassan and maritime sites in the area.

Desktop archival research and a gap analysis will identify recorded shipwreck sites and any written records of European and/or Macassan sites. In terms of the maritime component, preliminary desktop identification will be followed by remote sensing and fieldwork to confirm sites and identify any potential impacts. Physical location of potential maritime sites is dependent on access to and availability of baseline hydrographic and remote sensing data. For the historical component, following the desktop analysis initial research, comprehensive heritage surveys will be conducted within proposed development areas to identify further sites. Based on the gap analysis results and heritage research work in northern Australia, a

predictive model of archaeological site location will be developed. This model will be tested during systematic and purposive survey work on the Maret Islands.

A Heritage Management Plan will be prepared including management processes to address impacts to known heritage sites and the inadvertent discovery of sites. The nature and extent of the sites found will determine the kinds of mitigation strategies that are required.

Objectives

A range of methods, including desktop analysis, community meetings, assessment of existing sidescan, multibeam sonar and magnetometer, field assessments will be used to:

- Determine the distribution and morphology of maritime, Macassan and historical heritage sites in areas potentially affected by the development
- Assess the significance of the identified historical cultural material in terms of other areas in northern Australia
- Provide recommendations and a management plan to allow avoidance and/or mitigation of any identified sites.

Timing

The desktop studies commenced in June 2006. The first field survey for historical cultural heritage took place in October 2006. The full maritime and historic assessment will be completed by June 2007.

Additional scope details are provided in Appendix C.

Cultural Heritage (Indigenous) Studies

Ground disturbance within the project area has the potential to have negative impacts on sites of potential cultural sensitivity to Indigenous people, should such sites exist.

It is proposed to conduct investigations to determine the existence of such sites and to determine appropriate mitigation measures should sites of potential significance to indigenous people be identified that cannot be avoided. The studies will be performed in two parts.

Part A – Baseline studies

This will involve:

- Searching the DIA Indigenous Heritage Sites Register for registered sites and reports of previous heritage assessment on the Maret Islands and nearby islands
- Conducting heritage baseline field assessment work on the Maret Islands to determine if environments normally associated with culturally sensitive Indigenous heritage sites are present
- Determining the need for formal cultural heritage surveys

- Consulting with Indigenous parties to determine, under Indigenous tradition, who are the appropriate people to speak for the Maret Islands and the vicinity of the Maret Islands
- Identifying how such a survey should be conducted in consultation with appropriate Indigenous people.

Part B – Formal Study

It is proposed to conduct a comprehensive formal ethnographic heritage field survey with the participation of appropriate representatives of the local Native Title claimant group – the Uunguu Native Title Claimants. This will be followed by an archaeological survey of potential archaeological sites including any sites of potential archaeological or ethno-archaeological significance that are identified during the ethnographic survey.

Objectives

The objectives of the formal study, which will cover the entire area of the Maret Islands, are to:

- determine the location, dimensions, nature and significance of sites of potential archaeological and ethnographic significance to the Uunguu People if any occur on North and South Maret islands
- Determine if and how these sites can be avoided.

If they cannot be avoided:

- Determine appropriate mitigation measures that meet the requirements of state and federal indigenous heritage legislation and minimise any potential detrimental impacts on Indigenous cultural sensitivities.

Timing

Part A of the Indigenous studies began in October 2006 with Part B scheduled to commence in January 2007.

Additional scope details are provided in Appendix C.

Socio-Economic Studies

The proposed development has the potential to positively and negatively affect the economics and social viability of local communities. Direct and indirect effects at state and national levels are also anticipated.

Existing data will be used to provide a description of the existing state of the local, regional, state and national economies including but not limited to:

- A general description of the economy
- Major economic drivers
- Major industries (including recreation and commercial fishing)
- Employment by industry (other than the minerals and energy industry)
- Aboriginal socio-economics

- Employment and unemployment
- Existing infrastructure such as housing, medical and education
- Local businesses
- Future economic opportunities and social needs.

The social baseline will be developed that identifies:

- kKey demographics
- Key stakeholders
- A description of social infrastructure
- Health infrastructure and issues
- Education facilities and levels of education
- Social well-being including access to services housing
- Social cohesion.

Objectives

A range of survey methods, including desktop reviews, database analyses, economic modelling and community surveys will be used to:

- Identify the economic impacts and benefits (at a regional ,state and national level), opportunities for local businesses and the project's alignment with Western Australia's sustainability strategy
- Identify the strategic benefits (e.g. the promotion of Western Australia as an investment destination, improving the skills of Western Australian workers)
- Identify the potential social benefits and impacts of the development through an analysis of workforce issues as well as employment and training needs at a regional and state level.

Timing

Literature review and community consultation commenced in August 2006. A full assessment of the socio-economic impacts for the EIA will be completed by June 2007.

Additional scope details are provided in Appendix C.

Human Health Risk Management Studies

Public health and safety impacts are likely to be few due to the remoteness of the island location for the Project.

To protect the health and safety of the workforce, potential hazards will be identified and assessed. Hazard Operability (HAZOP) studies will be conducted and hazard and risk workshops will be held in relation to the construction, commissioning and operational phases of the processing facilities.

The risk assessment process will be undertaken in line with the following guidance:

- NEPM Guideline on Health Risk Assessment Methodology B(4) NEPCSC (1999)

- Environmental Health Risk Assessment Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth 2002).

The risk assessment will comprise the following steps:

- Full data review and gap analysis to assess the validity and adequacy of the full data set.
- Construction of a detailed Conceptual Site Model (CSM) that identifies all the source-pathway-receptor relationships (pollutant linkages) that could be associated with significant risks.
- Tier 1 assessment – comparison against generic appropriate screening criteria. Failures of the Tier 1 assessment will proceed to the Tier 2 assessment phase.
- Identification of contaminant concentrations in media of concern (e.g. soil, water, air). Computer modelling will be used to simulate chemical concentrations where appropriate, e.g. indoor vapours.
- Estimation of exposure (uptake dose) to receptors that will include onsite employees, open space visitors and offsite land users. Pathways could include, but are not limited to, soil: ingestion, dust inhalation, dermal contact, and indoor and outdoor vapour inhalation; groundwater: indoor and outdoor vapour inhalation and ingestion. This exposure estimation will use computer-modelling techniques designed with reference to the industry standard known as ASTM RBCA.
- Integration of the exposure and toxicological data to produce numerical estimates of risk, which will be compared with acceptability criteria.
- If these criteria are exceeded then Site Specific Target Levels (SSTLs) will be produced for contaminants which give rise to potentially significant risks.
- A 'reality check' will be performed as part of the final risk characterisation stage of the risk assessment that involves scrutiny of the results to ensure that the SSTLs derived are correct, practically achievable and not greater than the solubility limit of the compound.

Objectives

The human risk management study is designed to:

- Identify and quantify potential risk associated with the onshore and offshore development scenario to determine whether potentially significant risks are posed to either human health under a commercial land use scenario or the environment including:
- Estimate and manage the frequency and size of hazardous material spills and leaks
- Identify risks to the public from the Project in terms of fatality risk contours around the planned facilities
- Identify credible scenarios for incidents likely to result in health and safety impacts for the workforce.

Timing

Preliminary studies on managing human health risks will commence in early 2007 and be completed by June 2007. Further studies will be commissioned as design details of the Project become available.

Additional scope details are provided in Appendix C.

Visual Amenity

The proposed development has the potential to alter the visual amenity of the site and surrounding areas. This change will take effect both night and day, and has the potential to be either positive or negative. Any change in the quality of visual amenity is defined by location specific receptors. In this case a qualitative survey of human activity in and surrounding the subject site is required to define the potential impacts, and determine human response to this change.

The site location, distance to shipping routes, topography and vegetation cover will be defined and measured against the proposed development.

Objectives

Use research, consultation and desktop and field studies to:

- Determine receptors and define human response to proposed development
- Determine existing landscape character and quality of subject site and surrounding areas
- Identify critical view sheds of proposed development, both off shore and on shore, as defined by identified receptors
- Identify visual impacts of the proposed development
- Identify mitigation measures to minimise the visual impacts of the onshore plant and offshore facilities.

Timing

Desktop studies are due to commence in early 2007, with field surveys scheduled in the first quarter of 2007. Visual Amenity studies required for the EIA will be completed in June 2007.

Additional scope details are provided in Appendix C.

5.4 Environmental Management Planning

INPEX's Environmental Management System (EMS) through which the project's environmental issues will be managed, will be consistent with the AS/NZS ISO 14000 series. A description of the EMS will be included in the EIS/ERMP.

Management plans will be developed for key environmental factors. The plans will include management actions, schedules, resources and responsibilities. Appropriate environmental objectives and targets will be developed, along with appropriate performance indicators, trigger levels, and the method by which the management plan will be reviewed and updated. The EIS/ERMP will describe the hierarchy of environmental documentation, including the role of INPEX's

management plans and those to be developed by the contractors involved in the project's actual construction, commissioning and operation.

It is envisaged there will be a series of separate management plans that together, will comprise the overarching environmental management program. The plans considered to be of highest priority (in no particular order) include but are not limited to:

- Flora and Fauna Management Plan
- Cultural Heritage Management Plan
- Waste Management Plan
- Quarantine Management Plan
- Greenhouse Gas Management Plan
- Oil Spill Contingency Plan
- Lighting Management Plan
- Dredging and Blasting Management Plan
- Fire Management Plan
- Decommission Plan
- Marine Construction Plan.

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6. GLOSSARY OF PROJECT ABBREVIATIONS

Abbreviation/Acronym	Definition
ALARP	As low as reasonably practicable
ALS	Analytical Laboratory Services
ANZECC	Australian and New Zealand Environment Conservation Council
ARL	Analytical Reference Laboratory
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
As	Arsenic
ASTM RBCA	ASTM International (originally known as the American Society for Testing and Materials) Risk-Based Corrective Action
BOM	Bureau of Meteorology
BPP	Benthic primary producer
BPPH	Benthic primary producer habitat
BTEX	Benzene Toluene Ethy-benzene Xylene
CALM	(Former) Western Australian Department of Conservation and Land Management (now DEC)
Cd	Cadmium
CEO	Chief Executive Officer
CMST	Centre for Marine Science and Technology, Curtin University
CO_2	Carbon dioxide
CPF	Central processing facility
Cr	Chromium
CSIRO	Commonwealth Scientific and Industrial Research Laboratories
CSM	Conceptual site model
CTD	Conductivity, temperature, depth
Cu	Copper
Cwlth	Commonwealth
CWR	Centre for Whale Research
DEC	Department of Environment and Conservation (WA)

Abbreviation/Acronym	Definition
DEWR	Department of the Environment and Water Resources (Cwlth)
DIA	Department of Indigenous Affairs (WA)
DITR	Department of Industry, Tourism and Resources (Cwlth)
DO	dissolved oxygen
DOCEP	Department of Consumer and Employment Protection (WA)
DoE	Department of Environment (WA)
DOH	Department of Health (WA)
DoIR	Department of Industry and Resources (WA)
DOTARS	Department of Transport and Regional Services (Cwlth)
DPI	Department of Planning and Infrastructure (WA)
DRF	Declared Rare Flora
E&P	Exploration and Production
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management System
ENM	Environmental Noise Modelling
EPA	Western Australian Environmental Protection Authority
EP Act	Western Australian *Environmental Protection Act 1986*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPP	Environmental Protection Policy (WA)
ERMP	Environmental Review and Management Programme
FEED	Front End Engineering and Design
FID	Financial Investment Decision
FRP	orthophosphate
GHG	Greenhouse gas
GL	Gigalitres
GPS	Global Positioning System
HAZID	Hazard identification

Abbreviation/Acronym	Definition
HAZOP	Hazard Operability
HDD	Horizontal Directional Drilling
Hg	Mercury
HSE	Health, Safety and Environment
KLC	Kimberley Land Council
km	Kilometre
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MAFRL	The Marine and Freshwater Research Laboratory
MLA	Member of the Legislative Assembly
MLC	Member of the Legislative Council
Mm^3	Million metres cubed
MMbbls	Million barrels
MOF	Materials offloading facility
MOU	Memorandum of Understanding
MP	Member of Parliament
mtDNA	mitochondrial DNA
Mtpa	Million Tonnes per Annum
NATA	National Association of Testing Authorities, Australia
NDT	Non Destructive Testing
NEPCSC	National Environment Protection Council Service Corporation
NEPM	National Environment Protection Measure
NIS	Non-indigenous species
Ni	Nickel
NNTT	National Native Title Tribunal
NOPSA	National Offshore Petroleum Safety Authority
NORMS	Naturally Occurring Radioactive Materials
NOx	nitrate and nitrite
NPI	National Pollution Inventory

Abbreviation/Acronym	Definition
NRDA	Natural Resource Damage Assessment
NWQMS	National Water Quality Management Strategy
ODAC	Office of Development Approvals Coordination (WA)
ONT	Office of Native Title (WA)
PAR	Photosynthetically Active Radiation
Pb	Lead
PLETs	Pipeline end terminal
PSA	Particle size
POJ	Product offloading jetty
PTTs	Platform terminal transmitters
Q	fiscal quarter
ROV	Remotely operated vehicle
SRE	Short-range endemic fauna
SSTLs	Site Specific Target Levels
TBA	To be advised
TBT	Tributyltin
Tcf	Trillion cubic feet
TLP	Tension leg platform
TN	Total nitrogen
TOC	Total organic carbon
TP	Total phosphorous
TPH	Total petroleum hydrocarbons
TSS	Total suspended solids
WA	Western Australia
WRS	Western Radiation Services
Zn	Zinc

APPENDIX A. APPLICABLE LEGISLATION

Commonwealth Legislation

The *Environment Protection and Biodiversity Conservation Act 1999* is the primary statute for the protection of environmental matters of national significance. This proposal has been referred to the Commonwealth Department for the Environment and Water Resources in accordance with requirements of the *EPBC Act 1999*.

Other Commonwealth legislation and regulations include, but are not limited to:

- Australian Ballast Water Management Requirements and Australian Quarantine Regulations
- Australian Heritage Commission Act (No 1) 2003
- Australian Heritage Commission Act 1975
- Australian Maritime Safety Authority Act 1990
- Environment Protection and Biodiversity Conservation Regulations 2000
- Environmental Protection (Sea Dumping) Act 1981
- Fuel Quality Standards Act 2000
- Hazardous Waste (Regulations of Export and Imports) Act 1989
- Historic Shipwrecks Act 1976
- Native Title Act 1993
- Navigation Act 1912
- Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
- Petroleum (Submerged Lands) (Management of Environment) Regulations 1999
- Petroleum (Submerged Lands) Act 1967
- Protection of the Sea (Prevention of Pollution from Ships) Act 1983
- Quarantine Act 1908.

Western Australian Legislation

The *Environmental Protection Act 1986* represents the primary statute for the protection of the environment in the State of Western Australia. This proposal will be referred to the Western Australian Environmental Protection Authority (EPA) in accordance with the requirements of the *EP Act 1986*.

Other Western Australian legislation and regulations that are likely to apply to this proposal include:

- Aboriginal Heritage Act 1972
- Agriculture and Related Resources Protection Act 1976
- Clean Air Regulations 1967
- Conservation and Land Management Act 1984
- Dangerous Goods (Transport) Act 1998
- Environmental Protection (Clearing of Native Vegetation) Regulations 2004

- Environmental Protection (Controlled Waste) Regulations 2004
- Environmental Protection (Liquid) Waste Regulations 1996
- Environmental Protection (NEPM–NPI) Regulations 1998
- Environmental Protection (Noise) Regulations 1997
- Explosives and Dangerous Goods Act 1961
- Jetties Act 1926
- Local Government Act 1995
- Marine and Harbours Act 1981
- Maritime Archaeology Act 1973
- Pearling Act 1990
- Petroleum (Submerged Lands) Act 1982
- Petroleum Act 1967
- Petroleum Pipelines Act 1969
- Pollution of Waters by Oil and Noxious Substances Act 1987
- Port Authorities Act 1999
- Shipping and Pilotage Act 1967
- Soil and Land Conservation Act 1941
- Western Australian Marine Act 1982
- Wildlife Conservation Act 1950.

Ancillary Approvals, Permits and Licences

In addition to Ministerial Approval and any conditions attached to such approval, a number of ancillary approvals, permits and licences will be required to enable construction and operation to proceed. Such permits and licences include, but are not limited to:

- Dredging Permit
- Sea Dumping Permit
- Dangerous Goods Transport Licences
- Vegetation Clearing Permit
- Works Approval Permit
- Licence to Operate/Emit
- Pipeline and infrastructure licences
- Sea Installations, Drilling and Works Approvals
- Consent to Construct
- Production Licence.

Numerous Environment Plans or Environmental Management Plans under Commonwealth or State legislation will also be required for drilling and well installation, pipe lay, operations and ultimately decommissioning of facilities. Inpex will develop a specific plan to decommission facilities with an objective to return the affected area to a state as close as practical to its natural state. Specific performance targets will be detailed in the environmental management plan to track progress against this objective. This plan will take into account

decommissioning guidelines which are currently under development by the Commonwealth Department of Industry and Resources.

Local Government Jurisdictions

- Onshore facilities: Maret Islands, Shire of Wyndham – East Kimberley
- Construction and supply base: Broome, Shire of Broome.

Appendix Table A-1 : WA EPA and Commonwealth Policy Documents and Guidelines

WA EPA Policy Documents	
Air	Towards an Environmental Protection Policy (EPP) for Ambient Air Quality in Western Australia Environmental Protection (Ozone Protection) Policy Approval Order 2000
Marine	Draft Environmental Protection (State Marine Waters) Policy 1998
WA EPA Position Statements	Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3 Towards Sustainability. Position Statement No. 6 Principles of Environmental Protection. Position Statement No. 7 Environmental Protection in Natural Resource Management. Position Statement No. 8 Environmental Offsets. Position Statement No. 9
WA EPA Guidance Statements	
Draft Guidance	33. Environmental Guidance for Planning and Development 47. Interim Guidance on Odour as a Relevant Environmental Factor 48. Groundwater Environmental Management Areas
Final Guidance	1. Guidance Statement of the Protection of Tropical Arid Zone Mangroves Along the Pilbara Coastline 2. Risk Assessment and Management: Offsite Individual Risk from Hazardous Industrial Plant 3. Separation Distances between Industrial and Sensitive Land Uses 4. Deep and Shallow Well Injection for Disposal of Industrial Waste 6. Rehabilitation of Terrestrial Ecosystems 12. Minimising Greenhouse Gases 15. Emissions of Oxides of Nitrogen from Gas Turbines 17. A Site Remediation Hierarchy for Contaminated Soil 18. Prevention of Air Quality Impacts from Land Development Sites 29. Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment 34. Linkage between EPA Assessment and Management Strategies, Policies, Scientific Criteria, Guidelines, Standards and Measures Adopted by National Councils 40. Management of Mosquitoes by Land Developers 41. Assessment of Aboriginal Heritage 51. Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia

	54. Sampling of Subterranean Fauna in Groundwater and Caves 55. Implementing Best Practice in Proposals Submitted to the Environment Impact Assessment Process 56. Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia
Guidance Notes	Air Quality Modelling Guidance Notes 2006
Community Consultation	Interim Industry Guide to Community Involvement (2003) Review
Commonwealth DEWR	
Policy Statements and Guidelines	EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance, May 2006. Guidelines on the application of the *Environment Protection and Biodiversity Conservation Act 1999* to interactions between offshore seismic operations and larger cetaceans. Humpback Whale Recovery Plan 2005–2010 Recovery Plan for Marine Turtles in Australia

APPENDIX B. SCOPE OF INVESTIGATIONS RELEVANT TO EPA ENVIRONMENTAL FACTORS AND PRINCIPLES

Relevant Environmental Factors

Appendix Table B-1 : Biophysical: Marine

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
Biophysical: Marine					
Seabed	Ichthys field, subsea gas export pipeline route, port, MOF, POJ, island interconnect	To maintain the integrity, ecological functions and environmental values of the seabed.	Sea bed disturbance from dredging, rock berm placement and physical presence of structures. Disturbance could impact on water and sediment quality, cetacean migration patterns, turtle nesting, benthic habitats and sediment transport.	Sediment quality studies including infauna and physico-chemistry. Water quality studies including hydrodynamic modelling and physico-chemistry. Cetacean and turtle studies. Benthic habitat mapping.	Minimise impacts by identifying unusual or limiting benthic habitats and avoiding disturbance of these in final infrastructure design. Design island interconnect and shoreline defence to minimise impacts on water circulation and sediment movement. Dredge plume modelling to facilitate management of dredge operations.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
Foreshore/Intertidal Zone	Shore crossing MOF Island interconnect	To maintain the integrity, ecological functions and environmental values of the seabed and coast.	Disturbance of intertidal and foreshore habitats during construction and physical presence or infrastructure. Habitat loss through pipe lay potentially involving trenching, drilling, blasting, and dredging. Disturbance could impact on water and sediment quality, turtle nesting by affecting beach stability. Potential spill of oil or other substances. Changed light horizons affecting turtle hatchling sea-finding success.	Mapping of intertidal and foreshore habitats. Sediment transport modelling. Turtle nesting surveys. Light surveys. Geotechnical / technical studies to determine suitability of micro-tunnelling and HDD for trunkline shore crossing	Minimise impacts by identifying unusual or limiting habitats and avoiding disturbance of these in final infrastructure design. Design island interconnect and shoreline defences to minimise impacts on water circulation and sediment movement.
Hydrodynamics	Shore crossing MOF Island interconnect	To maintain the integrity, ecological functions and environmental values of the nearshore marine environment.	Changes to hydrodynamics having consequential impacts on marine biota.	Hydrodynamic modelling.	Design island interconnect, shore crossing, MOF and other nearshore facilities to minimise impacts on water circulation and sediment movement.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
Water Quality	Offshore facilities, MOF, Island interconnect, onshore facility discharge areas	To maintain the integrity, ecological functions and environmental values of the marine environment.	Discharges to the marine environment during construction and routine operational phases affecting the quality of receiving waters. Construction activities such as dredging, and rock dumping temporarily reducing water quality. Accidental spills.	Water quality surveys. Detailed mapping of benthic communities around proposed facilities. Hydrodynamic modelling.	Design island interconnect and shoreline defences to minimise impacts on water circulation and sediment movement. Design facilities to minimise and manage waste outputs. Waste outfalls to be located away from sensitive areas. Spill emergency response planning. Dredge plume modelling to facilitate management of dredging operations.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
Flora and vegetation – benthic primary producers and benthic primary producer habitat (BPPH), seagrasses, macroalgae, corals, mangroves	Subsea pipeline corridor, nearshore infrastructure including port, MOF, island interconnect, dredged areas	To maintain the abundance, diversity, geographic distribution and productivity and of marine macrophytes at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. BPPH loss to meet cumulative loss threshold criteria (EPA Guidance 29). Mangrove loss to meet loss criteria for arid-zone mangroves (EPA Guidance).	Seabed disturbance through dredging, physical presence and reduced water quality may reduce the health or distribution of marine macrophytes and reduce coral spawning success in impact areas. Accidental spills during construction and/or operation reducing water quality, and impacting on biota.	Mapping of marine macrophyte communities and BPPH in region. Dredge plume modelling to estimate zone of effect from reduced water quality. Coral spawning date surveys. Hydrodynamic modelling.	Minimise impacts by identifying unusual or limiting BPPH and reducing direct disturbance of these in final infrastructure design. Design dredging, rock dumping and other construction operations to minimise turbid plumes. Spill emergency response planning.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
Fauna – listed threatened marine fauna, migratory marine birds, migratory marine mammals, marine reptiles, whale sharks, sea snakes and fish	Offshore field, subsea pipeline corridor, nearshore infrastructure including port, MOF, island interconnect, dredged areas, mooring areas, vessel transit routes.	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Seabed disturbance through dredging, physical presence and reduced water quality may reduce the habitat value of the area for marine fauna. Increased vessel traffic and dredging may interfere with migration or other behaviours of marine fauna. Physical interaction with listed threatened fauna such as turtles and cetaceans through entrainment in dredge or collisions with vessels.	Surveys to determine distribution of marine megafauna in project area. Habitat mapping to predict distribution of smaller marine fauna.	Minimise interference with critical processes for marine megafauna e.g. turtle nesting periods by avoiding critical habitats and times. Watch for cetacean and other megafauna from onboard all construction vessels. Pre-blasting warm up procedures and visual observations prior to blasting. Protection of representative areas of all marine fauna habitats to maintain local biodiversity.

Appendix Table B-2 : Biophysical: Terrestrial

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
Biophysical: Terrestrial					
Geology, soils and hydrogeology	Maret Islands	To maintain the integrity, ecological functions and environmental values of the soil and landform.	Loss of unusual landforms through earthworks. • General surface instability, erosion and/or sedimentation. Reduced stability of coastal dunes through disturbance for access tracks and infrastructure. Acid sulphate release from disturbed soils. Changes to distribution of topsoil resources through earthworks.	Mapping of landforms and soils through geological surveys on Maret and surrounding islands. Assessment of regional representation of soils and landforms. Undertake investigations into the most effective plant design, construction and operations management measures that minimize soil and landform disturbance. The presence of acid sulphate soils will be determined.	Strategies will be developed to either avoid loss through changes in project design or to facilitate other means of protection. These strategies will include: - minimising impacts from blasting and cut and fill, through avoiding unusual landforms in final site selection and facility design - maintaining drainage patterns to vine thickets - developing comprehensive monitoring and spill response procedures - establishing stormwater management and erosion control plans - managing topsoil during construction - implementing management measures for the control of acid generation should they be encountered - stabilising disturbed dune areas to avoid ongoing erosion.
Water (surface/ground)	Maret Islands	To maintain the quantity and quality of surface water and ground water to protect	Contamination of surface water or ground water from spills, leaks or discharges of chemicals.	Undertake site studies to determine the Islands hydrological characteristics and where necessary, obtain baseline data for	Strategies will be developed to either avoid impacts through changes in project design or ensure that appropriate control measures are developed.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
		existing and potential environmental values, including dependent flora and fauna. To minimise the potential for erosion due to stormwater flow.	Changes to existing patterns of soil erosion and sedimentation due to changes in characteristics of stormwater runoff. Modification of groundwater recharge patterns. Changes to nutrient cycling through changes to run-off and fire regime.	surface and groundwater quality and quantity. Drilling during pre-construction phase to confirm predictions of aquifer distribution. Water quality sampling of bores.	These strategies will include: - minimising changes to drainage and run off patterns through avoidance of natural drainage and ground water recharge areas - establishing environmental management plans for construction and operation - implementing surface and groundwater monitoring - establishing comprehensive monitoring and spill response procedures - adequately bunding under chemical stores and wet areas in facilities to ensure no leakage to ground water zones if spills occur.
Flora and vegetation communities	Maret Islands	To maintain the, diversity, geographic distribution and productivity of flora at species, community and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. To protect DRF and regionally	Loss of DRF or flora and communities restricted to the development areas through clearing and earthworks and changes to surface hydrology. Changed fire regime due to control around facility affecting community succession patterns.	Mapping of vegetation communities in impact areas and at reference sites. DRF searches using existing databases and by field surveys. Comparison with regional information.	Final facility layout designed to minimise impacts to rare or restricted flora and vegetation communities.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
		significant communities and taxa.			
Fauna (including habitats)	Maret Islands	To maintain the, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. To protect listed threatened species under the EPBC Act and the *Wildlife Conservation Act 1950.*	Loss of or reduced abundance of listed threatened fauna species due to habitat loss or degradation. Loss of genetic diversity through loss of short-range endemic (SRE) taxa populations. Long-term behavioural changes due to noise, discharges and light associated with the physical presence of facilities and workforce. Changed fire regime modifying community dominance patterns over long-term.	Mapping of faunal habitats. Assessment of critical habitats, processes and times for listed threatened and ecologically important fauna. Genetic studies on the levels of genetic endemism in potential SRE taxa.	Final facility layout designed to minimise impacts to habitats critical to listed threatened fauna. Relocation of SRE.
Subterranean fauna	Maret Islands	To maintain the abundance, diversity, geographic distribution and productivity of subterranean fauna at community and ecosystem levels	Loss of critical habitat through direct removal or infill by earthworks. Habitat degradation due to blasting, spills, changes to nutrient cycling and water recharge regimes.	Geological surveys to determine likelihood of subterranean fauna habitats occurring in development areas. Drilling during investigative phase to confirm predictions of subterranean habitat distribution.	Facility designed to minimise impacts to ground water recharge regime. Adequate bunding under chemical stores and wet areas in facilities to ensure no leakage to ground water zones if spills occur.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
		through the avoidance or management of adverse impacts and improvement in knowledge. To protect listed threatened species under the EPBC Act and the *Wildlife Conservation Act 1950.*		Subterranean fauna sampling of bores.	

Appendix Table B-3 : Pollution Management

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
Pollution Management					
Air quality	Offshore and onshore facilities areas: - onshore infrastructure - gas processing infrastructure - shipping channels	To ensure that atmospheric emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.	Dust emissions during the construction phase. Routine and non-routine emissions during the operation phase, including flaring, are expected to include: NO_x, SO_x, H_2S, VOC, CO_2 and particulates. Potential adverse impacts on: - human health - surrounding vegetation (from NOx deposition) - fauna - ambient air quality. Potential formation of acidic rain resulting from the interaction of NO_2 and SO_2 causing degradation of archaeological artefacts and artwork. Potential heat stress on vegetation caused from deposition of particulate matter.	Undertake air emission studies and dispersion modelling to estimate emissions, ground level concentrations and deposition rates and confirm that discharges are within agreed limits. Investigate best practicable technology measures to minimise emissions. Confirm ambient air quality modelling predictions using monitoring Ambient air quality monitoring undertaken on an ongoing basis (during the life of the operations) to verify ongoing compliance with ambient standards or requirements determined during the assessment.	Apply ALARP (As Low As Reasonably Practicable) to design and operate facilities to minimise atmospheric emissions. Maximise distance between the location of flare and site accommodation facilities. Include dust management strategies as part of a site Construction Environmental Management Plan. Implement best practical technology to reduce combustion GHG emissions as much as possible. GHG offsets.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
			Greenhouse Gas Emissions		
Noise and vibration	Offshore and onshore facilities areas	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards. To ensure that noise impacts emanating from the proposed plant comply with statutory requirements specified in the Environmental Protection (Noise) Regulations 1997.	Potential impacts associated with the development (construction and operations) include: - behavioural disturbance to marine and terrestrial fauna - physiological damage to fauna from blasting - reduced workforce and residential amenity - tourism amenity.	Undertake noise emission modelling. Establish baseline noise data for marine and terrestrial environments. Investigate spatial and temporal impacts to marine and terrestrial fauna. Undertake HAZID.	Apply ALARP to design and operate facilities to minimise noise emissions. Management strategies will include: - monitoring of noise in accordance with agreed criteria - scheduling of construction activities to avoid/ minimize impacts during ecologically sensitive periods (e.g. turtle breeding seasons) - implementing management measures to reduce risk of significant impacts to fauna during construction activities.
Light	Maret Islands onshore and near shore zones.	To maintain the abundance, diversity,	Potential disturbance to fauna due to introduction of artificial illumination.	Identify existing light levels and work with ecologists to identify	Reduce light pollution effects upon light sensitive fauna through lighting solutions, location, design and operating

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
		geographic distribution and productivity of light sensitive fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.		sensitive receptors. Benchmark project against similar facilities with comparable light sensitive receptors. Research light manipulation techniques to obviate the negative light pollution effects on nesting females and marine turtle hatchlings.	philosophies.
Liquid and solid waste disposal	Offshore and onshore facilities areas	To ensure that liquid and solid wastes do not adversely affect groundwater or surface water quality or lead to soil contamination.	Potential impacts associated with the development include: - contamination of soil, and surface, ground, and marine waters - contamination of marine sediments (associated with drilling operations) - the introduction of exotic organisms and pathogens associated with shipping– decline in water quality.	Undertake studies to estimate type and quantities of: - domestic wastes - process wastes (e.g. cooling water, process water and biocides) - construction wastes (e.g. hydrostatic test water). Determine appropriate disposal methods and specify limits and standards.	Waste management strategies will include: - developing a waste management plan which includes strict operating procedures - ensuring appropriate handling, treatment and disposal of wastes in design and operation - identifying opportunities to avoid, reduce, ameliorate and manage development wastes.
Hazards and spills	Offshore and onshore facilities areas	To ensure hydrocarbons and hazardous materials are	Potential impacts associated with the development include: - discharge of	The types and quantity of hydrocarbons and hazardous materials to be used or stored for	Potential management strategies will include: - implementing comprehensive training, inspection, monitoring,

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
		handled and stored in a manner that minimises the potential impact on the environment through leaks, spills and emergency situations.	hydrocarbons to the environment contaminating surface and ground waters, atmosphere, and/or soil - creation of acute and/or chronic toxic hazards - creation of flammable or explosive hazards.	development will be determined. Undertake HAZID. Undertake spill trajectory modelling for representative and credible spill scenarios.	auditing and reporting programs - ensuring correct storage and handling of hazardous materials comply with Australian Standards. - developing emergency response and contingency planning for a spill of all types of hydrocarbons or chemicals on-site - developing appropriate storage and handling protocols.

Appendix Table B-4 : Socio-Economic

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
Socio-Economic					
Local communities	Kimberley region	To maximise social enhancement opportunities dependent on the development while minimising and mitigating adverse impacts.	Potential impacts associated with the development include: - temporary population increases (construction phase) - permanent population increases in the operational phase - fly-in fly-out impacts on social infrastructure - pressures on local and regional health and welfare and emergency services, facilities, transport and other services - potential changes in population.	Identify any location that provides a base for the workforce, or infrastructure connected with the development. Establish baseline demographic data for local and regional areas. Predict potential population changes resulting from the development. Identify origins and locations of potential workforce. Quantify potential workforce movements resulting from the development. Detail the preferred workforce method and assess alternative means, if any, of sourcing labour (with reference to local	Potential management strategies include: - using labour available within the region (WA, and specifically, the Broome locality) - contributing to the social infrastructure used by both the development workforce and the local/regional community.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
				labour market).	
Government policy, strategic plans and legislation	Local, regional, national	To maximise social enhancement opportunities dependent on the development while minimising and mitigating adverse impacts.	Potential impacts associated with the development include: - economic and social development impacts at local, regional, state and national levels - extent to which the development meets current government policies and in particular furthers development policies.	Consult with government to identify areas where the development enhances or conflicts with policies, strategic plans and legislation. Discuss ongoing consultative links with local, regional, state and national governments. Legislative provisions will need to be identified. Regional strategic plans need to be identified and discussed with the agencies.	Potential management strategies include: - establishing consultative links between INPEX and government planing agencies - integrating government policies with INPEX planning and development processes . Development plan to enhance economic and social opportunities.
Livelihood and lifestyle	Kimberley region and Western Australia	To maximise social enhancement opportunities dependent on the development while minimising and mitigating adverse impacts.	Potential impacts associated with the development include: - changes to people's way of life, their sources of income, and opportunities for development - impacts on the economic and social	Identify community structures and lifestyles that may be affected by the development. Identify any significant issues for Indigenous communities in the development area and discuss any development impacts on these issues	Potential management strategies include: - examining assistance and cooperative ventures to assist local communities in taking up these opportunities - establishing measures that may be required to mitigate or remove inconsistencies or negative impacts - encouraging opportunities for employment locally and in the region.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
			development locally, regionally and nationally.	(for example, health, employment, education). Consider impacts to fisheries and tourism.	
Social infrastructure	Kimberley region	To maximise social enhancement opportunities dependent on the development while minimising and mitigating adverse impacts.	Potential impacts associated with the development include: - potential mismatches between planned construction of facilities - changes to demands for schools, hospitals, roads, health services, law and order and recreation - increase in employment in the Kimberley region - increase in employment in the region due to supply base activity.	Identify existing social infrastructure in the development region. Identify needs of the incoming population. Identify any potential shortfalls in service provision, or structural changes required to accommodate the workforce.	Potential management strategies include: - examining how the development may benefit the provision of social infrastructure.
Recreation	Onshore and offshore areas	To ensure that existing and planned recreational uses are not compromised. To minimize	The presence of the facilities and associated activities has the potential to affect the recreational uses of the project area and restrict access to areas around the Maret	Consultation with government and the community to identify potential conflicts and ensure impacts are reduced to as low as practicable.	All practicable measures will be implemented to design and operate facilities to minimise impact on recreation.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
		potential impacts on recreational uses of the area.	Islands.		
Workforce and Public Health and Safety	Onshore and offshore areas	To ensure that the risk to the workforce and public is as low as reasonably practicable.	Potential impacts associated with the development include: - potential health and safety risks to the workforce - health or safety risks to the local population - isolation issues - issues from constraints on the workforce due to quarantine requirements, development location or the environment.	Identify any potential health risks to the workforce due to location, climate and seasonal conditions. Identify any health or safety risks to the local population. Identify any health and safety issues arising from constraints on the workforce due to quarantine requirements, development location and environment.	Management strategies will be implemented to ensure workforce and public health and safety. The proponent's experience in the petroleum operations will provide a substantial contribution to identifying and addressing management of the issues potentially involved.
Visual amenity	Onshore and offshore areas	To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably	Potential impacts associated with the physical presence of the development include: - change from wilderness area - disturbance to tourism operations.	Evaluate plant and equipment designs in regards to visual amenity from surrounding Islands and the mainland. Conduct a visual amenity assessment to describe the prominent features of the existing landscape and determine the visual	All practicable measures will be implemented to design and operate facilities to minimise impact on visual amenity. Specific faculty design strategies will be implemented to avoid impacts to visual amenity including: - design and location of facilities to reduce visual impacts on surrounding

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
		practicable. To minimise impacts on the visual amenity of the areas surrounding the project.		impacts of the proposed plant during day and night-time operations. Recommend suitable changes (if required) to minimize the visual presence of the facilities on the Maret Islands.	Islands and the mainland - design and location of facilities to reduce lighting requirements and effects of light spill - development and implementation of operation controls and procedures to reduce risk of significant visual impacts (e.g. flaring, loading and operational procedures).
Cultural heritage (non-indigenous)	Offshore and onshore areas	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with the *Heritage of Western Australia Act 1990*, *Maritime Archaeology Act 1973* and the Commonwealth *Historic Shipwrecks Act 1976.*	Potential disturbance to registered or unrecorded cultural heritage sites.	Gap analysis to assess amount of historical activity that has occurred in the study area and any previously recorded terrestrial or maritime sites. Identification and discussion with stakeholders regarding potential impacts on cultural associations. Survey fieldwork of proposed development area including assessment of terrestrial historical and maritime sites and submerged maritime sites.	Where possible infrastructure will be sited to avoided any cultural heritage sites. Maritime strategies will include: - developing a cultural heritage management plan to avoid, mitigate and manage activities that may have the potential to impact cultural heritage sites. - implementing a monitoring program to ensure that any identified sites and/or unidentified subsurface finds are dealt with appropriately. - ensuring compliance with state and Commonwealth legislation.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Proposed Investigations	Potential Management
Cultural heritage (indigenous)	North and South Maret Islands including their shores.	Minimise the impact of the project on potential sites of Indigenous ethnographic and archaeological significance according to the *Aboriginal Heritage Act 1972* and *The Aboriginal and Torres Straight Islander Heritage Protection Act 1984* (Cwlth)	Potential disturbance to DIA registered sites and yet unidentified potential sites of cultural significance.	Preliminary baseline study to determine the likelihood of the presence of potential sites of cultural significance. Follow up comprehensive Indigenous heritage survey in conjunction with relevant stakeholders including appropriate Uunguu representatives to determine the location and importance of sites that are of cultural significance to the Uunguu People.	Where possible infrastructure will be sited to avoid any culturally sensitive sites. If sites cannot be avoided, culturally appropriate mitigation measures that comply with relevant heritage protection legislation will be determined and implemented in consultation with Uunguu people.

APPENDIX C. ENVIRONMENTAL IMPACT ASSESSMENT STUDIES TECHNICAL SCOPES OF WORK

1. DOCUMENT PURPOSE

The purpose of this document is to provide detailed descriptions of environmental study scopes to support the *Environmental Scoping/Guidelines Document for the Environmental Review and Management Programme and Environmental Impact Statement (EIS/ERMP) for the proposed Ichthys Gas Field Development*.

Descriptions are provided for specific physical and biotic environmental studies.

2. MARINE ECOLOGY

2.1 Aims

The marine ecology studies will provide detailed mapping of the coral and other benthic primary producer (BPP) assemblages in subtidal and intertidal areas around Browse Island, the Maret Islands and surrounding islands of the Bonaparte Archipelago. The regional data will provide a broader base against which to assess the significance of potential impacts to marine benthic habitats around the Maret Islands.

The studies will be sufficient to support a benthic primary producer habitat assessment in accordance with Environmental Protection Authority (EPA) Guidance Statement 29 (Environmental Protection Authority 2004a) and to provide guidance on the management measures required to meet the EPA objective of maintaining the abundance, diversity, geographic distribution and productivity of BPPs.

2.2 Objectives

The objectives of the marine ecological studies are to:

- Map the intertidal and subtidal marine habitats around the Maret Islands including those in potential development areas and at reference islands;
- Describe the physical structure (geology and sedimentology) of intertidal and subtidal features that support the biological assemblages;
- Identify the conservation significance and environmental sensitivities of subtidal and intertidal assemblages in areas potentially affected by the proposed development (in the context of the West Kimberley bioregion and other reference sites);
- Determine the spawning period(s) for major coral taxa in the Maret Islands area;
- Assess genetic connectivity between corals around Browse Island and in other parts of the offshore coral province;
- Determine the species richness, assemblage composition and significance of deepwater (>200 m water depth) infauna communities in areas to be drilled;
- Assess the likelihood of the occurrence of endemic marine subtidal and intertidal fauna; and
- Search for small Environment Protection and Biodiversity Conservation (EPBC)-listed fish in intertidal habitats.

2.3 Methods

Marine benthic habitats comprise and support a diverse array of organisms, some of which are protected under the EPBC Act 1999 and the Wildlife Conservation Act 1950. Potential impacts to benthic communities dominated by primary producers are assessed following EPA Guidance Statement 29 (Environmental Protection Authority 2004a).

RPS Bowman Bishaw Gorham (RPS BBG) will conduct all field studies and provide samples to specialist taxonomists for final identifications.

The studies will elucidate distribution patterns for listed species and derive an understanding of marine ecosystems of the Maret Islands. The distribution of benthic habitats and their representation in the region are therefore the major focus of the marine ecology studies.

The proposed Ichthys Gas Field Development spans marine habitats ranging from intertidal areas around the Maret Islands to greater than 200 m water depth at the field. The studies will focus on the components of the marine ecosystem that have higher ecological or conservation significance in each of these areas. These components comprise:

- Intertidal habitats around Browse Island and the Maret Islands;
- Subtidal coral reef and filter feeding communities around the Maret Islands; and
- Deeper water soft-bottom infauna communities.

The areas where these investigations will occur include:

- The Browse Basin Ichthys infield area;
- Browse Island;
- The proposed pipeline route from the offshore field to the Maret Islands;
- The marine and intertidal environments adjacent to the onshore development;
- Representative areas adjacent to other islands in the Bonaparte Archipelago.

This scope of work has been sub-divided by study location to reflect the different approaches required for each area.

Ichthys Field

The benthic environment in the Ichthys Field (permit area WA-285-P) is dominated by soft sediments. The proposed scope of studies to characterise the benthic communities at the Ichthys Field includes the following:

- A review of existing remotely operated vehicle (ROV) data and swathe bathymetry to obtain information on the existing physical nature of the field, with the aim of identifying areas of higher conservation significance or ecological value. This includes areas of hard substrate and variable bathymetry;
- Sediment sampling and tow camera surveys of up to nine sites spanning the field area. Video footage with a live global positioning system (GPS) overlay

will be recorded at each site. The location of the sites will be determined from the investigations of remotely-sourced data;

- Sediments will be analysed for metals, total petroleum hydrocarbons, naturally occurring radioactive materials (NORMs) and particle size.
- Three replicate grab samples (0.15 m^2) will be collected from each site for the infauna analysis. Infauna samples will be sieved on board the vessel, preserved in formalin and transported to Perth for sorting and identification by scientists from the University of Western Australia.

Browse Island

Browse Island is an isolated sandy cay surrounded by an intertidal reef platform and a shallow fringing reef. It is the nearest area of high conservation significance in the vicinity of the proposed infield development and pipeline route. The natural resources of the island and the surrounding shallow fringing reef and lagoon include important turtle nesting beaches, a fringing coral reef and shallow lagoon. The scope of environmental studies required at Browse Island to support the oil spill risk assessment for the EIS/ERMP includes:

- Mapping of intertidal and shallow marine habitats;
- Assessment of turtle populations nesting on the beaches and feeding/mating in the surrounding area (this data may be available through Woodside); and
- Collection of intertidal sediment samples for chemical and physical analyses.

Pipeline Corridor

The pipeline from the field development to the onshore facilities will affect approximately 200 km of seabed habitats. This will require a large laybarge and will involve either a horizontally directionally drilled (HDD), or pulled, shore crossing. The anchor spread for the lay-barge will be extensive, resulting in a broad corridor of possible impacts centred along the pipeline. The scope of studies required along the proposed pipeline corridor for the EIS/ERMP includes:

- Mapping of likely seabed habitats from ROV, bathymetry and reflectivity data;
- Assessment of the bathymetry and reflectivity to determine areas likely to support elevated diversity and abundance of habitats and taxa;
- Visual surveys (tow camera) of the identified areas of higher environmental value and representative areas of broadly distributed habitats; and
- Combining the remote data and the visual surveys to map the existing environment within the proposed pipeline corridor.

Onshore Facilities

The relatively clear waters and large tidal range in the outer parts of the Bonaparte Archipelago and other parts of the Kimberley region has facilitated the development of extensive and diverse intertidal habitats. Biological surveys will focus on mapping the distribution of habitats and identifying the main taxa present in these habitats, including potential short-range endemic taxa such as volutid marine snails.

Intertidal surveys will include detailed description of the beach profiles and delineation of zones with inventories of the taxa present in each habitat and zone. A surveyor's level will be used to measure beach heights and slopes and samples

of sediments will be analysed to determine particle sizes and composition. Other physical characteristics of the intertidal zones, such as rock types will be described as the basis for the biotic habitat mapping.

Surveys around the Maret Islands will focus on the areas likely to be impacted by construction of the shore crossing of the pipelines, the materials offloading facilities (MOFs), the export facility and dredging. The scope of the proposed studies includes:

- Using aerial photography, underwater video imagery and remotely sensed imagery in combination to map shallow environments around the Maret Islands and surrounding reference islands. The habitat map will form the basis for the assessment of potential changes in the distribution of benthic primary producer habitats within ecologically based Management Units, in accordance with the EPA Guidance Statement (Environmental Protection Authority 2004a);
- Tow camera surveys of adjacent islands to determine the regional significance of benthic marine communities around the Maret Islands;
- Investigating the species diversity of the major coral assemblages around the Maret Islands. Coral community composition and abundance will be assessed by collection of coral specimens from intertidal and subtidal sites combined with representative vertical still photography from at least 10 sites around the Maret Islands;
- Determining coral spawning periods for major taxa in the development areas by assessing the state of gonad development in representative samples. Samples of corals will be collected prior to the expected Autumn and Spring spawning periods to determine whether spawning events at that location are synchronous with other areas within the region;
- Collecting sediment and fauna samples in areas proposed to be dredged for chemical and taxonomic analysis, to satisfy the requirements of a Sea Dumping Permit application;
- Undertaking intertidal ground-truth surveys to map the benthic habitats and assessing marine faunal and floral diversity within major habitat types. Habitat boundaries will be ground-truthed by walking intertidal transects across the intertidal zone. Biotic assemblages will be described within each habitat by comprehensive survey and collecting during spring low tides;
- Collecting intertidal sediments for baseline chemical monitoring;
- Lodging voucher specimens with the Western Australian Museum during the study; and
- Collecting fish from intertidal rock pools using rotenone poison and netting during the spring low tide surveys. The distribution of EPBC-listed pipefish, some of which inhabit rock pools, is currently poorly known for the Kimberley region. These data will provide valuable insight into their distribution in the Maret Island area. A subset of the intertidal pools identified during the spring tide reconnaissance surveys in October 2006 will be surveyed.

Study Sites

Coral monitoring studies will be established at representative intertidal locations around the Maret Islands and at representative control sites. The locations of these sites will be determined with regard to the likely development infrastructure and the distribution of important habitats.

- Inter-tidal transects will be established in each of the major coral communities around the Maret Islands and in at least one location on each of two reference islands.
- A series of Acropora coral colonies will be marked for on-going vertical photographic monitoring. These will be located within the intertidal lagoons that have been identified on the east, west and south coasts of the Maret Islands.
- Rock pool fish will be sampled from at least one pool on each coast of the Maret Islands (where pools exist).

To obtain comparative data for the region, benthic communities will be mapped around the Montalivet Islands, Rob Roy Reef, Albert Island, Bigge, Lamarck and Berthier Islands.

Samples of corals will be collected from a selection of the coral monitoring sites across the study area to determine the timings of mass spawnings.

2.4 Survey Timing

Marine surveys commenced in July 2006 and will continue until the benthic habitats have been fully mapped and quantitative survey sites established and surveyed. Comprehensive surveys of marine and intertidal habitats have been conducted around Browse and the Maret Islands and are on-going. Initial investigations of a more regional nature have been undertaken at West Montalivet, East Montalivet, Albert and Berthier Islands, and Rob Roy Reef. Further surveys are planned for Bigge and Lamarck Islands in March 2007.

3. TERRESTRIAL FAUNA

3.1 Aims

The terrestrial fauna studies aim to describe the faunal assemblages and habitats on the Maret Islands and to determine the significance of potentially impacted sites by comparison with non-impact areas and reference islands.

3.2 Objectives

The objectives of the fauna studies are to:

- Determine the diversity and distribution of terrestrial fauna on the Maret Islands;
- Determine the presence of listed threatened fauna or potential Short Range Endemic (SRE) fauna;
- Assess the levels of endemism in representative SRE groups – land snails, arachnids and oligochaetes;
- Investigate the presence of subterranean fauna on the Maret Islands;
- Quantify the use of the Maret Islands and surrounding islands by migratory shorebirds and seabirds particularly those protected by JAMBA/CAMBA Agreements or protected under other Commonwealth or State Legislation; and
- Compare the faunal habitats and fauna of the Maret Islands with those on nearby islands of similar geomorphology.

Surveys will be conducted in accordance with the principles of EPA Guidance Statement No. 56 (Environmental Protection Authority 2004b).

3.3 Methods and Equipment

The Maret Islands and other islands of the Bonaparte Archipelago have been separated from the Kimberley mainland for thousands of years and the fauna of the islands is expected to comprise a subset of the mainland fauna. Island assemblages are expected to be less diverse than their mainland counter parts, but due to geographic isolation, to contain endemic genetic races of many taxa.

There is limited faunal information available for the offshore islands of the Bonaparte Archipelago (Burbidge and McKenzie 1978) and most of the faunal and ecological data is derived from on-shore surveys (e.g. Anon 1981, McKenzie et al. 1991a, Miles and Burbidge 1975). The bioregion (Kimberley – Mitchell Subregion) is biologically diverse with a relatively high degree of endemism (Graham 2002).

Preliminary investigations of selected islands of the Bonaparte Archipelago to date, including North and South Maret Island, indicate that the islands' terrestrial fauna is depauperate in comparison to the mainland biota. Bigge Island is the largest of the islands within the Bonaparte group and predictably supports a more diverse fauna than the smaller islands. The presence of fresh water and the greater range of vegetation communities on Bigge Island provide a greater degree of habitat diversity for fauna.

The most diverse faunal groups on the Maret Islands appear to be land birds and invertebrates. The groups with the greatest potential for short-range endemism are invertebrate groups such as earthworms, land snails and arachnids.

The environmental impact assessment (EIA) studies have been designed to assess the importance of the habitats on the Maret Islands to local fauna and to put the island fauna into context of the regional fauna.

Surveys will focus on the North and South Maret Islands to determine the importance of habitats within proposed development areas in relation to other areas on these islands. Berthier Island and East Montalivet Island have similar geomorphology and habitat characteristics and will be surveyed as reference sites for regional comparison. These islands are characterised by lateritic mesas overlying basalt base rock supporting grasslands on the mesa tops and dense tropical vine thickets in the valleys and deep depressions on the scree slopes with greater depth of soil. Sandy beaches are backed by low dune systems which extend to the vine thickets or woodlands at the base of scree slopes.

There is sufficient information on the mainland fauna to support regional comparisons for most faunal groups. Further, the Department of Environment and Conservation (DEC) currently plans to conduct fauna surveys in the region and these data will be used for regional comparisons when available.

The following scope of works was developed through consultation with Dr Andrew Burbidge, Dr Mike Bamford, Dr Shirley Slack-Smith, Professor Mike Johnson and Dr Ian Abbott on sections relevant to their expertise, a DEC scoping workshop and preliminary baseline data collected in July 2006. The methods proposed to conduct these studies are widely used and are consistent with the techniques recommended in the EPA Guidance Statement No. 56 for Terrestrial Fauna Surveys (Environmental Protection Authority 2004b).

Terrestrial Vertebrate Surveys

Terrestrial vertebrate surveys will be conducted by specialist zoologists from Bamford Consulting. The surveys will be run by Dr Mike Bamford and Dr Wes Bancroft.

The field programme is designed to provide quantitative data within the range of habitats represented in potential impact and non-impact areas on North and South Maret Islands and on reference islands.

Field surveys are planned for North Maret, South Maret, Berthier and East Montalivet Islands. On each of the four main study islands, terrestrial fauna will be surveyed using pitfall traps, funnel traps, drift fences, Elliott traps and cage traps. Elliott and cage traps are effective in catching mammals and some reptiles. Pit-fall and funnel traps are effective at catching invertebrates, small reptiles and mammals. The traps proposed for this survey are widely used in Western Australia for EIA fauna studies.

While pit-fall traps will be installed where possible, the rocky surface of the island will preclude installing pit-fall traps in many locations on top of the island. Safety considerations and sensitivity to the demands of the Traditional Land Owners will restrict pit-fall trapping to areas where blasting is not necessary. This will include the main faunal habitats in vine thickets and woodlands.

Traps will be deployed along a transect that traverse key habitat types and the transition between habitat types on each island. The key habitat types that will be targeted in the trapping are:

- Triodia open grassland;
- Sorghum closed grassland;
- Acacia/Grevillea shrubland;
- Corymbia woodland;
- Vine thickets; and
- Beach dunes.

There will be 50 sampling points along each transect with a drift-fence and funnel trap at each sampling point, and an Elliott trap and cage trap at alternative sampling points. Pit-fall traps will be installed at as many of these sites as possible. Surveys will continue over 4–5 consecutive nights on each transect. Heavy rainfall during the wet season may necessitate closing the traps for a night or two and extending the total trapping time.

Transects on North and South Maret Islands will lie inside and outside development areas and, where possible, transects will be retained for future monitoring. Trapped animals will be identified, measured (to investigate population structure and recruitment) and marked before release. Representative specimens will be collected for the voucher collection at the WA Museum in consultation with the WA Museum staff.

Nocturnal surveys (head-torching, spot-lighting) will be undertaken over at least two nights on each island depending on prevailing weather conditions. Bat recording equipment (ANABAT) will be used during night surveys on all islands. Comparative calls will be used for bat identification.

Terrestrial invertebrates will also be caught during the trapping and hand searching for fossorial and cryptic species. They will be counted, identified and released unless voucher specimens are requested by the WA Museum.

Land bird species and abundance will be recorded along transects during the fauna survey field trips and by trapping using mist nets in at least two sites on each island.

Shorebird Surveys

Shorebird surveys will be conducted by specialist ornithologists from Aquila Wildlife and Bamford Consulting. A comprehensive vessel-based survey of 36 islands, associated rocks and reefs including the Maret Islands, Berthier Islands, Lamarck, Montalivet, Don, Patricia and Walker Islands will provide information on the distribution of migratory and resident seabirds and shorebirds. Species and number of individuals will be recorded for migratory shorebirds, seabirds and other coastal species.

Terrestrial Mollusc Surveys

Dr Shirley Slack-Smith and Corey Whisson of the WA Museum sampled land snail populations at over 90 sites across the various habitats on the Maret Islands. Live snails have been collected by the WA Museum and RPS BBG for genetic analysis

by the genetics laboratory at the University of Western Australia Animal Biology Department.

Snail survey stations established on both the North and the South Maret Islands, focus on the plateau areas and on the slopes with vine thickets. Other survey stations will be established on some of the other islands of the Bonaparte Archipelago. These include the East and West Montalivet Islands, Don Island, Un-named Island (currently un-named), Patricia Island, Walker Island, Berthier Island and Lamarck Island.

GPS coordinates (WGS84; Zone 51), samples of soil/litter and notes on the time, locality, habitat and floral assemblage is recorded at each site. Each soil/litter sample (of approximately 1 litre in volume) is sieved in the field to remove large objects such as stones, leaves, twigs, etc. as well as the finest dust. The sieved material and specimens collected by hand within the station area are bagged, labelled and prepared for transport. The soil/litter samples are sieved again in the laboratory and sub-samples of each grade of litter and sand examined under a dissecting microscope. From these sub-samples snails, both living and dead, are selected, sorted and labelled. Dead-taken shells as well as the preserved live-taken material will be registered in the Museum's database and stored in the Museum's research collections.

Where sufficient (5–10) live specimens of a single species are collected from all study islands, these specimens will be kept alive or preserved until genetic analysis. Some specimens will be preserved in 100% ethanol and some will be stored in an Ultrafreezer to allow for subsequent DNA or similar analysis. Others will be fixed in neutralised formalin and then preserved in methylated ethanol for subsequent anatomical work. The genetic study will examine the level of relatedness among land snail populations from various sites across the Maret Islands. This will provide an indication of inter-breeding amongst the different areas and consequently the levels of short-range endemism that can be expected among populations of seasonally site restricted fauna.

Oligochaete Surveys

Oligochaetes were identified as a potential SRE organism due to their reliance on moist soil in an environment where this a patchy habitat.

Oligochaete (earthworm) expertise will be provided by Dr Ian Abbott of the DEC and his research team at the DEC Kensington research facility. The study will apply sampling strategies that have proved successful in agricultural and forest regions of south-west Western Australia (Abbott and Parker 1980; Abbott 1982, 1985a,b; Wills and Abbott 2002, 2003).

The survey will focus on North and South Maret Island to determine the significance of earthworms within the proposed development areas in relation to other areas on these islands. Berthier Island and East Montalivet Island have similar geomorphology and habitat characteristics and will be surveyed as reference sites for regional comparison. Terrestrial flora and vegetation data collected by RPS BBG during preliminary vegetation surveys on the Maret Islands was used to determine the major habitat types on the islands. Earthworms will be sampled from a range of potential impact and reference sites ensuring that all of the major habitats were covered.

The study of earthworms will be conducted in two parts as follows:

- The presence or absence of earthworms over each island; and
- For vegetation types where earthworms were most abundant, the density, frequency of occurrence and biomass of earthworms will be surveyed.

Presence/Absence

Samples consist of a block of soil 19 cm by 19 cm by 15 cm deep (or to the depth present if <15 cm). The geographical location of each sample will be determined by GPS. The block of soil is placed on a white surface and sorted in situ. All earthworms recovered are retained and later preserved (washed in 40% ethanol for five to ten minutes, fixed in 4% formalin for one to two hours and then stored in vials containing 70% ethanol).

Density and Biomass

Vegetation types in which earthworms are most abundant will be sampled in more detail. For each vegetation type to be sampled, a single 100 m transect will be marked and 50 blocks of soil (of the dimensions cited above) will be randomly located, removed, and sorted in situ. All earthworms recovered are retained and later preserved (in the same manner described above). Earthworms will be identified by DEC specialists from the Kensington laboratories. The distribution of earthworm species, or morphotypes, will be correlated with vegetation habitat type and soil characteristics to provide a predictive tool for assessing the likely distribution of earthworms across the islands. Soils will be mapped independently (see Section 7.0) but the sampling will cover the sites where the earthworms were abundant.

Short Range Endemic Invertebrate Surveys

Short range endemic (SRE) invertebrates will be surveyed by specialist staff from Dr Mark Harvey's group at the WA Museum – Dr Volker Framenau, Ms Julianne Waldock and Ms Karen Edward.

The SRE invertebrate fauna of the Bonaparte Archipelago is currently poorly known and has never been extensively surveyed. As with many other Kimberley islands or the adjacent coastal areas of the mainland, very little information is currently available on the SRE fauna of the Maret Islands, with only a few specimens of scorpions and pseudoscorpions recorded from the Kimberley islands.

Field Survey

The SRE fauna of the various habitat types will be surveyed by hand collecting representative specimens of all short-range endemic taxa at survey stations within habitats such vine thickets and woodlands. Within each habitat type, microhabitats such as vegetated and un-vegetated areas, hard and soft substrates (including all soil types with and without evident plant litter) and on and under living and dead plants (under bark, on foliage, etc.) will be searched.

Representative specimens of all short-range endemic taxa will be preserved, labeled and stored for transport to the laboratory. Specimens will be identified (to the species level if possible) with the aid of relevant literature and by comparison with specimens in the WA Museum's collections. All specimens will be deposited in the Museum's collections as voucher specimens after being labeled and registered on the Museum's database.

3.4 Survey Timing

Intensive baseline studies during the wet and dry season of 2006–2007 will provide the information required to assess the likely impacts of the proposed development for the EIA and will feed into development of the management strategies to mitigate or manage potential impacts.

Terrestrial Vertebrate Fauna

Preliminary surveys commenced in June 2006. Intensive trapping and foraging surveys commenced in July 2006. Surveys required for input into EIA, will encompass the wet and dry seasons and be completed in June 2007. Surveys are planned for February 2007 (Maret Islands), March 2007 (Maret Islands, Montalivet Island) and April 2007 (Berthier Islands).

Shorebirds

The vessel survey was conducted in October–November 2006 during the southern migration of waders through the region. Further shorebird surveys will be conducted in conjunction with the vertebrate surveys outlined above.

Land Snails

A survey of the land snails of the Maret Islands was carried out between October 29 and November 11, 2006. Further snails were collected during additional surveys by RPS BBG between September and November 2006.

Earthworms

Earthworm surveys will be undertaken on North and South Maret Islands in February 2007 during the wet season when the worms are more abundant and more active.

Short Range Endemic Invertebrates

Preliminary field studies were conducted during July/August, 2006 on North and South Maret, Berthier, Albert, Walker, East Montalivet and Bigge (west coast only) Islands. Further field surveys will take place in March 2007 during the late wet season.

4. TERRESTRIAL FLORA & VEGETATION

4.1 Aims

The aims of the flora studies are to determine the distribution of rare or restricted flora and vegetation communities across the Maret Islands and to assess the significance of the communities in the context of the regional flora and vegetation.

4.2 Objectives

The objectives of the flora studies are to:

- Derive a taxonomic floral inventory for the Maret Islands;
- Map the terrestrial vegetation communities on the Maret Islands;
- Identify Declared Rare Flora (DRF), priority flora and flora and vegetation restricted to small areas on the Maret Islands; and
- Assess the conservation significance of flora and vegetation in areas proposed to be cleared in terms of listed status and representation in other areas of the Maret Islands and reference islands.

4.3 Methods and Equipment

The Maret Islands and other islands of the Bonaparte Archipelago have been separated from the Kimberley mainland for thousands of years and the flora of the islands is expected to comprise a subset of the mainland flora. Vegetation assemblages on the islands are expected to be less diverse than their mainland counter parts, but due to geographic isolation, to contain endemic genetic races of many taxa.

There is limited information available for the vegetation and flora of the offshore islands of the Bonaparte Archipelago and consequently most of the regional data is derived from on-shore surveys. The bioregion (Kimberley – Mitchell Subregion) is biologically diverse with a relatively high degree of endemism (Graham 2002).

Preliminary data indicate that the Maret Islands support a typical west Kimberley flora and no DRF are known from the islands. Surveys of the North and South Maret Islands in September 2006 indicate that the islands support a range of vegetation communities ranging from Triodia grasslands to closed vine thickets and woodlands.

The proposed scope of works is based on methods that are widely used and are consistent with the techniques recommended in the EPA guidelines for Terrestrial Flora Surveys as described below. The DEC plans to survey 24 islands off the Kimberley coast, starting in 2007, and the methodology of this survey is sufficiently in alignment with the DEC's methodology to allow comparison of datasets.

EPA Guidance No. 51 (Environmental Protection Authority 2004c), indicates that a Level 2 Survey is required to support the EIA.

Aerial photography of the site has been reviewed to provide information on vegetation distribution across North and South Maret Islands. Literature on pre-existing work completed on the islands has been collated. The DEC databases for

DRF and Priority Flora has been searched within a 100 kilometre radius of the Maret Islands.

Surveys will focus on the proposed development areas on North and South Maret Islands and surrounding areas of similar vegetation to determine the importance of assemblages within proposed development areas in relation to other areas on these islands. Berthier Island and East Montalivet Island have similar geomorphology and habitat characteristics and will be surveyed as reference sites for regional comparison. These islands are characterised by lateritic mesas overlying basalt base rock supporting grasslands on the mesa tops and dense tropical vine thickets in the valleys and deep depressions on the scree slopes with greater depth of soil. Sandy beaches are backed by low dune systems which extend to the vine thickets or woodlands at the base of scree slopes. Other islands in the region would be surveyed if restricted vegetation communities are discovered on the Maret Islands that are not represented on the listed reference islands.

Vegetation will be mapped from high resolution aerial photography and ground-truthed survey data. Assemblage classifications will be derived from plot and relevé studies. Permanent plots will be established in all vegetation units large enough for a plot. Where possible at least 2 plots will be established in each vegetation type. Plots will be 50 m x 50 m and marked with a permanent marker in the north western corner for at least 15 sites. Many vine thickets are too dense to permit recording of plot data and will be surveyed by relevé. Relevé data will include a description of the site and edaphic factors such as soil characteristics and rock cover as well as heights and cover values for flora present. GPS positions (WGS84; Zone 51) and photographs of each site will be included in the EIA.

Specimens of all flora will be collected under permit, and pressed (usually on site) for confirmation of field identifications and will subsequently be lodged with the Western Australian Herbarium. Fertile specimens will be collected for as many taxa as possible. All plant specimens will be dried soon after collection by the use of a fan heater and drying box in order to minimise mould attack. Specimens will be identified using various keys, Floras and comparison with specimens held in the Western Australian Herbarium collection.

4.4 Survey Timing

Intensive mapping and floristic studies are being conducted for the dry and wet seasons of 2006–2007 and will provide the information required to assess the likely impacts of the proposed development for the EIA. Reconnaissance surveys were conducted in July 2006. Further surveys are planned for February, March and April 2007. The Kimberley flora typically flowers and fruits after the wet season and the floristic analysis will be completed in April–May 2007.

5. CETACEAN STUDIES

5.1 Aims

The aims of the cetacean studies are to assess the importance of the sheltered waters surrounding the Maret Islands and the deeper offshore waters to regional cetacean populations.

5.2 Objectives

The objectives of the cetacean studies are to:

- Determine the distribution and abundance of cetaceans and other marine megafauna in areas potentially affected by the proposed development;
- Assess the importance of the development areas in regional terms to cetaceans and other marine megafauna; and
- Identify any critical habitats for protected marine fauna in areas potentially affected by the proposed development.

5.3 Methods and Equipment

All cetaceans are protected under the EPBC Act 1999 and the Wildlife Conservation Act 1950 as well as international treaties on whale conservation and trade in endangered species. The acceptability of the development proposal and consequently development approval will be contingent on INPEX demonstrating that impacts on non-endangered cetaceans can be managed to avoid population level effects. The impacts on endangered cetaceans will need to be managed to avoid impacts to individuals. The focus in both cases is on critical habitats such as feeding aggregation areas, migratory pathways and calving and resting areas. Existing data on the distribution of cetaceans indicates that the development areas may be used by several listed threatened cetacean species.

Another important element of the study will be the incorporation of reference sites for regional comparison. While cetaceans are known to use the development areas already, the importance of these sites to the cetacean populations will be further assessed by comparison with other areas in the region.

The methods proposed to achieve the objectives of the study comprise five elements:

- Desktop literature review;
- Aerial surveys;
- Vessel surveys;
- Acoustic monitoring; and
- Interpretation, analysis and reporting.

The general methodology for each of these elements is outlined below.

Desktop Review

Available published and grey literature and other datasets will be reviewed, collated and interpreted in terms of what is currently known of cetacean distribution, temporal patterns in abundance, critical habitats and the sensitivities of cetaceans and other marine mega-fauna to potential impacts from the proposed development.

Aerial Surveys

Curt Jenner of the Centre for Whale Research (CWR) will coordinate and run the aerial surveys. Curt is a leading authority on cetaceans migration along the Western Australian coast.

Aerial surveys will focus on nearshore aggregations of humpback whales during their calving period in August–September, when they frequent nearshore waters along the Kimberley coast. During the calving period, humpback whales spend a large proportion of their time at the sea surface. They are therefore good subjects for aerial survey. Reasonable estimates of breeding female populations can be gained from a few surveys through the critical calving areas. Aerial survey techniques are similarly suitable for assessing dugong distribution.

Aerial surveys will target the coastal areas where humpbacks have been documented previously (Pender Bay, Buccaneer Archipelago and Camden Sound) and include other similar bays between these areas and the Maret Islands. The surveys will cover the Maret Islands and adjacent areas of the coast to determine the northward limit of the calving area in 2006.

A small aircraft with two experienced cetacean observers will be deployed from Derby to cover as much of the area between Broome and Kalumburu as is possible within the safety limitations of the aircraft.

Four aerial surveys of the coastal areas were planned to cover the August–September calving period in 2006. This will provide adequate data to describe the distribution of cetaceans in coastal waters and to identify the importance of the development areas in relation to other parts of the Kimberley coast.

The timing of the aerial surveys and the anticipated survey area are shown in Table 5.4-1, Figure 5.4-1 and Figure 5.4-2 respectively.

Vessel Surveys

Curt Jenner of the CWR will coordinate and run the vessel based surveys.

Vessel surveys will facilitate detailed observations of cetacean behaviour. The observations will provide information on whether the whales are feeding or resting in a given area, or simply passing through. Rarer cetaceans such as the pygmy blue whale, sei whales and sperm whales and smaller marine mega-fauna such as turtles, dolphins and dugong can also be effectively surveyed from a vessel.

Four coastal vessel surveys will cover the waters adjacent to the Kimberley coast to gain distributional and behavioural data on the humpback whales and other coastal marine mega-fauna. Coastal vessel surveys will be run during the August to November period during which humpback whales are either migrating or calving in the region.

Four offshore surveys will cover the waters likely to be frequented by oceanic cetaceans such as the pygmy blue whales, sei whales and sperm whales. Offshore surveys will be run in the August to November period when pygmy blue whales are expected the passing through the region and may be feeding in the region. A fifth offshore survey will be conducted to cover the pygmy blue whales' northward migration.

The timing of the vessel surveys and the anticipated transect survey paths are shown Table 5.4-1 and Figure 5.4-2 respectively.

Acoustic Monitoring

Professor Rob McCauley of the Centre for Marine Science and Technology at Curtin University will provide acoustic logging equipment and expert services in interpretation of acoustic data. Professor McCauley is highly respected for his acoustic monitoring research on blue whales and other cetaceans. Analysis of the acoustic data will reveal the abundance and identity of cetaceans present in the development areas.

While there is some indication of the peak times of year when cetaceans can reasonably be expected to be present in the Kimberley region, the temporal limits of their northward and southward migrations is poorly known. Acoustic loggers will be deployed at the seabed to monitor the presence of cetaceans in the development areas throughout the year. These data are important assessing the importance of the area to cetaceans and for developing management strategies for minimising disturbance of the cetaceans.

Two acoustic loggers will be deployed; one in the offshore infield area and one near the Maret Islands. These loggers will be downloaded after the humpback migration period to feed data into the EIA and after the beginning of the expected northward migration of blue whales through the area. These data will be processed at a high level to identify the species and abundances of cetaceans present in the development areas at various times of year in time to meet the EIS/ERMP schedule. It is anticipated that the loggers will be re-deployed in April to continue logging and collect data during the pre-construction period.

5.4 Survey Timing

Cetacean surveys commenced in June 2006. Intensive surveys during the northward migration of breeding female humpbacks commenced in August 2006 and continued through to the end of the breeding period in November 2006. Assessment of potential risks for the EIA will necessitate surveys over the full breeding season for the humpbacks and the migration period for the blue whales. Surveys of other marine megafauna will continue through a wet and dry season cycle to capture seasonal changes in abundance. Aerial and vessel-based surveys for the EIA will be completed in June 2007.

Acoustic loggers were deployed in September 2006 to collect data throughout the humpback and blue whale migration periods and will continue to be operated up to 2009.

Table 5.4-1: Cetacean Field Survey Schedule

Task	Actual/Planned Survey Dates
Aerial survey 1	4/08/2006
Aerial survey 2	12/08/2006
Aerial survey 3	5/09/2006
Aerial survey 4	30/09/2006
Vessel survey 1 (coastal & offshore)	15/08/2006 – 3/9/06
Vessel survey 2 (coastal & offshore)	9/9/2006 – 28/9/06
Vessel survey 3 (coastal & offshore)	4/10/2006 – 23/10/06
Vessel survey 4 (offshore)	29/10/2006 – 4/11/06
Vessel survey 5 (offshore -optional)	15/4/2007 – 24/4/07
Acoustic logging - deploy	28/08/2006
download	10/02/2007
download	15/05/2007

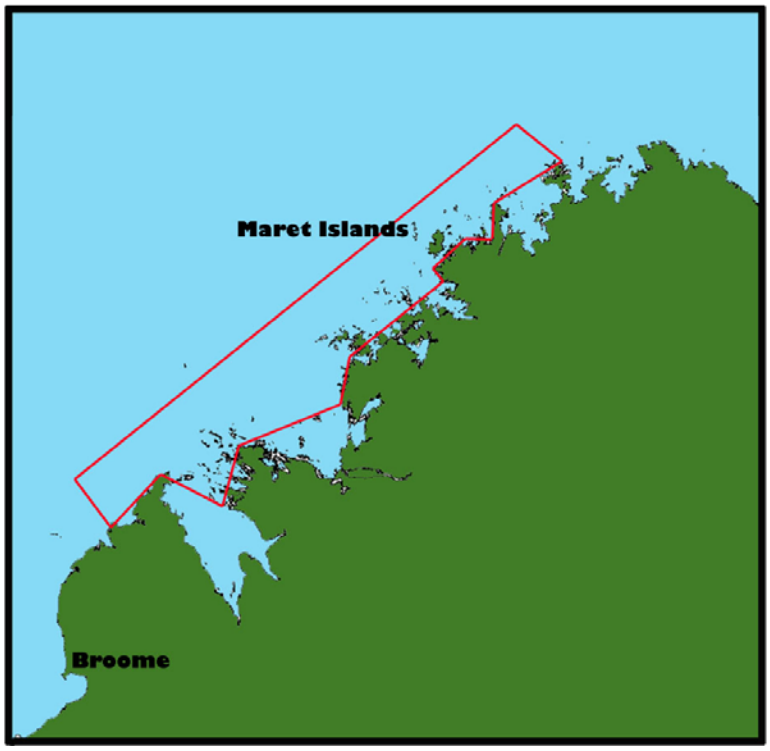

Figure 5.4-1: Cetacean Aerial Survey Area (indicated by the red box)

Note: Actual survey route will vary according to weather and aircraft capabilities.

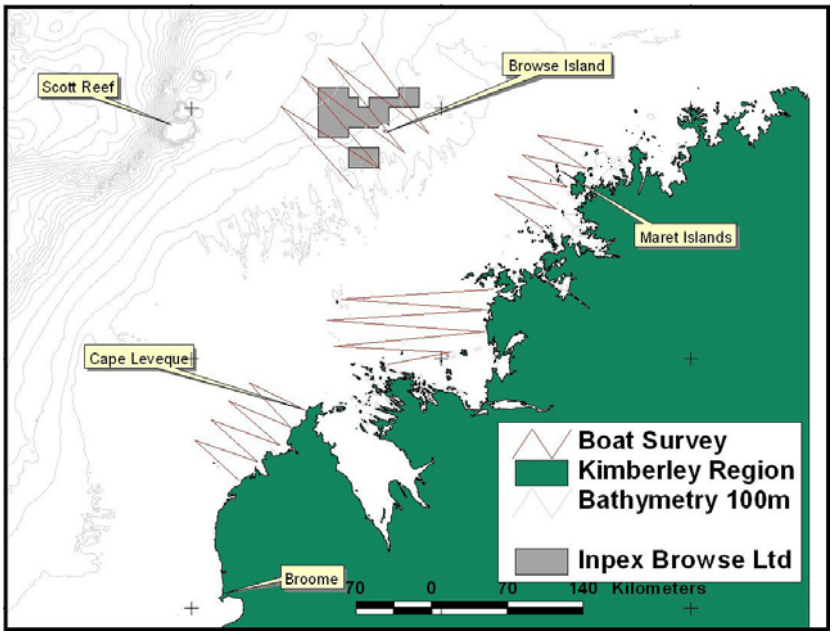

Figure 5.4-2: Cetacean Vessel Survey Transects (indicated by the red lines)

Note: Actual survey route will vary according to time of year and tides.

6. MARINE TURTLE STUDIES

6.1 Aims

The aims of the marine turtle baseline studies are to describe the behaviour and distribution of marine turtles and their favoured nesting beaches around the Maret Islands and in the broader West Kimberley region.

6.2 Objectives

The objectives of the turtle population studies are to:

- Determine the genetic affinities of the breeding population of green and flatback turtles on the Maret Islands;
- Identify critical marine turtle habitats (aggregation and nesting areas) in the vicinity of the proposed development;
- Determine the relative importance of habitats on the Maret Islands in comparison with surrounding areas of the West Kimberley region;
- Quantify the usage of the Maret Islands by nesting marine turtles; and
- Assess the potential lighting impacts on turtles from the proposed development on the Maret Islands.

6.3 Methods and Equipment

Green Turtle Genetic Study

Green turtles in the Browse Island area may be part of the Ashmore-Cartier population, a small breeding stock restricted to offshore islands. It is not known whether the green turtles on the Maret Islands are part of the same stock or part of a larger northern Western Australian stock. Genetic studies will be conducted to help elucidate the genetic connections among the green turtle populations. These data will aid in assessing the significance of potential impacts to sub-populations.

Mitochondrial DNA analysis will be run on tissue samples of 0.1–0.2 gram collected from the rear flipper of green (50 samples) and flatback (30 samples) turtles as they return to the ocean. Further samples will be collected opportunistically from freshly dead hatchlings (Fitzsimmons et al., 1999). Mitochondrial DNA and nuclear DNA will be extracted from 15–30 tissue samples from the Maret Islands population to determine the degree genetic connection with other breeding stocks within the region. Samples will be preserved in 20% dimethylsulfoxide in saturated sodium chloride solution (Dutton 1996; Fitzsimmons et al. 1999).

Marine Turtle Habitat Studies – Mating Aggregations

Marine turtles nesting on the Maret Islands are expected to aggregate in the nearshore waters around islands of the Bonaparte Archipelago for mating prior to nesting. Aggregation areas are not necessarily adjacent to nesting beaches and these represent separate critical habitats for the turtles.

The size and location of mating aggregations will be determined from aerial surveys. The aerial surveys will cover all nearshore areas (waters <100 m from shoreline) between East Montalivet and Lamarck Island. The distance from the

shore was based on observations of mating aggregations from aerial surveys around Barrow Island (Pendoley 2005).

Marine Turtle Habitat Studies – Nesting

The distribution of nesting effort on various beaches around the Maret Islands and surrounding islands (East Montalivet Island and Lamarck Island), and on islands in the broader West Kimberley region, will be quantified to help determine the significance of the Maret Islands to breeding marine turtles.

Aerial Surveys

Aerial survey data will provide a regional snapshot of the nesting distribution of green and flatback turtles and provide the basis for comparing track densities at the Maret Islands and the surrounding areas.

The aerial survey will cover a sub-sample of potentially suitable sandy beaches identified between Broome and Eclipse Islands near Truscott, covering a total distance of approximately 860 km. Early morning surveys will be undertaken on three consecutive days (31 January, 1 and 2 February 2007) following high tides the previous evenings. This is optimal for the visibility of new tracks from the air.

Tracks left in the sand from the previous night will be counted from the air to gain an index of the relative nesting effort on each beach. The density and species of turtles will be recorded on video and later analysed using digital video software. High, medium and low density nesting areas will be identified and comparisons between rookeries will be calculated.

Ground Surveys

Ground surveys will be conducted during the peak turtle nesting season as described in Section 6.4. Four survey teams will be able to survey four separate beaches each day during the survey period.

Each species nesting in the area will be identified based on methods described by Schroeder and Murphy (1999) and Waayers (2001). All personnel will survey the same beach during the first few days of the survey and compare counts and observations to ensure consistency among teams. Nests will be counted at daily survey beaches to determine the annual number of turtles present. Ground surveys will also be conducted every three days at the Montalivet Islands or Lamarck Island to understand the nesting activity in the areas around the Maret Islands.

Aspects of the methodology may change in response to unexpected nesting activity and/or other environmental conditions such as weather or the presence of crocodiles.

Population Dynamics Studies

Inter-nesting and post-nesting variables

Important factors to be considered when assessing marine turtle populations are their re-nesting intervals (time between nesting events), number of clutches per season, clutch success, and movement between beaches during the nesting period. These variables will be determined by deploying satellite tracking devices and by applying numbered titanium tags to assess recapture rate and re-nesting intervals.

FASTLOC platform terminal transmitters (PTTs) will be attached to eight marine turtles in order to record their inter-nesting behaviour including re-nesting interval, clutches per season, inter-nesting movements and post nesting migration. Six PTTs will be attached to green turtles and two PTTs will be attached to flatback turtles. All PTTs will be deployed from South Beach where both green and flatback turtles have been found.

The FASTLOC PTTs are packaged with two lithium D cell batteries and a 40-second repetition rate. The units have a duty cycle of 90 days continuous, then 12 hours every 72 hours to give an approximate life span of 200 days. The units also have a conductivity meter to indicate when the turtle is on land. Signals are only received by satellites when the turtle is out of the water (i.e. on land or at the waters surface) and within local satellite range.

In conjunction with the PTTs, a sub-sample of nesting population will also be tagged to provide additional information regarding re-nesting intervals and clutches per season. Titanium tags provided by DEC will be applied to both front flippers as described by Prince (pers. comm.) and Balazs (1999).

Clutch Success

Clutch success will be determined by counting the number of hatched eggs and undeveloped embryos and dead hatchlings left in the nest after hatching as described in Miller (1999). Nests will be excavated to look for moribund eggs four days after an observed emergence. As nests generally emerge over three days or less, this will reduce the probability of premature exposure of hatchlings remaining in the nest.

Light studies

A range of light studies are being undertaken on Maret Islands. These include arena experiments to determine the attraction of turtle hatchlings to a range of filtered light sources with the intent of determining whether attraction stimuli can be prevented with appropriate filters. Preliminary trials have suggested that there may be an opportunity to develop “turtle proof” lights, suitable for orientation of workforce to the work site. The objectives of these studies are to:

- Determine the existing light levels of the onshore and nearshore study area and indicate nearby land uses and sensitive receptors;
- Identify the light sensitive receptors in the proposed site area;
- Benchmark project against similar facilities with comparable light-sensitive receptors;
- Identify measures to minimize the potential impacts of estimated light emissions from the onshore plant, and nearshore marine facilities;
- Assess the likely impact on sensitive receptors, including assessment against background levels, regulatory requirements, and identified performance indicators;
- Assess light manipulation techniques should significant levels of light pollution remain following mitigation using all commercially acceptable means; and
- Model light levels that could reach turtles on nesting beaches.

Additionally, experiments are planned which involve turtle hatchling releases and observation of their attraction to a marine based light source positioned at

increasing distances offshore from South Beach on South Maret Island. This will involve releases of 100 hatchlings at a time. Hatchlings will be marked to allow identification. The numbers of both marked and unmarked hatchlings attracted to the light source will be recorded. Hatchlings will also be released from the water and numbers attracted to a shore based light will also be recorded. Dr. Bob Prince from DEC has been involved in the design of these experiments.

Trials will be replicated and hatchlings will not be used more than three times for arena and marine based trial.

6.4 Survey Timing

The survey schedule has been based on the expected timing of the green and flatback turtle reproductive events (Table 6.4-1), based on limited information from other areas, as follows:

- Mating aggregations (Oct – Nov)
- Peak nesting (Nov – Feb)
- Peak hatching (Jan – April).

The proposed timing of surveys and the spatial spread of sampling sites is:

December	South Maret Island (South Beach)
January	South Maret Island (South Beach, SE Beach, East Beach)
	North Maret Island (NE Beach, Brunei Bay)
	Albert Island (North Beach)
	Turbin Island (North Beach)
	Lamarck Island (East Beach)
	West Montelivet Island (East Beach)
	East Montelivet Island (East Beach)
February	South Maret Island (South Beach, SE Beach, East Beach)
	North Maret Island (NE Beach, Brunei Bay)
	Albert Island (North Beach)
	Turbin Island (North Beach)
	Lamarck Island (East Beach)
	West Montelivet Island (East Beach)
	East Montelivet Island (East Beach)

- Tissue samples were collected for genetic analysis in the first two weeks of December 2006 and January 2007. Further samples will be collected on an opportunistic basis during other surveys.
- Aerial surveys to determine the location of potential major mating aggregation areas were conducted in early November 2006 and covered the islands listed above and as much of the Bonaparte Archipelago as possible during the flights. These flights are scheduled for one or two months prior to the peak nesting season (Limpus and Miller 1993).
- Aerial surveys to determine the distribution of nesting activity in the region were conducted in late January 2007 for three consecutive days.
- Ground surveys recorded nesting densities during December 2006, January and February 2007 over 14 consecutive days.
- Satellite transmitters were attached to turtles from South Beach.
- Light experiments will be conducted during February and March 2007 on South Maret Island.

Table 6.4-1: Biologically Important Dates for Turtles and Proposed Survey Schedule

Activity	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07
Courtship period									
Nesting period									
Internesting period									
Hatching period									
Aerial Surveys – Mating Aggregations									
Deployment of PTTs									
Collect DNA samples									
Track Counts									
Aerial Surveys – Nesting Activity									
Light Experiments									

7. GEOGRAPHIC AND HYDROGEOLOGICAL STUDIES

7.1 Aims

The aims of the geography and hydrogeology studies are to characterise the hydrogeology and geology of the Maret Islands obtained during field surveys and compare with existing regional data.

7.2 Objectives

The objectives of the geography and hydrogeology studies are to conduct field surveys to collect site specific geological and hydrogeological data for the study area, specifically:

- Identify and describe the soils, topography, geology and geomorphology of the land-based development areas;
- Identify the extent and quality of existing surface and groundwater associated with the development areas; and
- Determine the likely effects of the proposed development on soils, geology, landform and surface and groundwater in the development areas and adjacent areas.

7.3 Methods and Equipment

Topography, Geology and Geomorphology

The field programme is designed to provide data on topography, geology and geomorphology, which will be confirmed by aerial photography. Rocks and soils on North and South Maret Islands will be assessed, mapped and sampled and their baseline chemical and physical parameters analysed. Landforms and drainage systems will be observed and mapped and in combination with geological field data and aerial photographs used to establish an understanding of the geomorphologic character of the Maret Islands.

The fieldwork components of the programme consist of one and two person teams to assess and map the morphology and local geology. This will be done by interpreting and sampling local outcrops and samples obtained from the monitoring bore drilling program, as well as landform observation and mapping of springs and drainage features. Samples from the bore drilling will be assessed and characterised on site by a qualified geologist.

Hydrology

The field programme is designed to identify the extent and quality of existing surface and groundwater on the islands, by assessing and mapping soaks and springs, and a monitoring and sampling program of groundwater obtained from the monitoring wells due to be installed on the islands. An intrinsically safe electronic water dipper attached to a graduated measuring tape will be used to measure groundwater levels in monitor bores. The dipper emits an acoustic signal indicating when water is intercepted. The dipper is raised and lowered until the signal is emitted at the same depth on three consecutive occasions. Groundwater samples

will be collected from monitor bores in accordance with the relevant guidelines using the following methods:

- Samples are recovered using a dedicated bailer.
- Water is purged from each bore with the bailer. A multi-parameter probe is used to measure pH, temperature, electrical conductivity, redox potential and dissolved oxygen. Care is taken to avoid oxygenation through mixing and exposure to air.
- Monitor bores are purged until a minimum of 4 well casing volumes and stable groundwater conditions are achieved (based on less than 10% variation in physiochemical parameters between measurements), or four well casing volumes are removed, prior to sampling of groundwater.
- All groundwater samples are immediately stored on ice/ice packs within an esky in the field.
- Back on board the ship samples are refrigerated and delivered to a NATA registered laboratory within one week of collection.

7.4 Survey Timing

This study commenced in June 2006 and the field survey results required for input into EIA will be completed in May 2007.

8. MARINE WATER AND SEDIMENT QUALITY

8.1 Aims

The aim of the marine and sediment quality studies is to characterise the baseline condition (natural status) of the sediments and waters at the Ichthys Field, along the proposed pipeline route and at the Maret Islands.

8.2 Objectives

The objectives of the marine and sediment quality studies are to

- Identify sensitivities of the receiving environment;
- Quantify the baseline status of the receiving waters and sediments in the development areas;
- Characterise the physico-chemistry of the sediments;
- Measure contaminant concentrations in potential bio-accumulating organisms;
- Determine if there are any 'abnormal' existing levels in water quality that may already exceed the National Water Quality Management Strategy guidelines;
- Measure seasonal changes in water quality associated with natural events;
- Provide physical water quality data for validating the hydrodynamic model; and
- Provide baseline information for the spatial establishment of ecological protection levels.

8.3 Methods and Equipment

The methods proposed to achieve the objectives of the study comprise five elements:

- Desktop literature review;
- Water quality monitoring;
- Sediment quality monitoring;
- Bioaccumulation studies; and
- Interpretation, analysis and reporting.

Reference sites, to allow spatial comparison of the monitoring results once construction and operation of the facilities is underway, will be characterised. The baseline studies will provide a one-off 'snapshot' of the natural condition of selected marine sediment and water quality parameters, such as NORMs, as well as providing spatial and temporal data on other parameters, such as Total Suspended Solids (TSS), to take into account possible seasonal changes.

The general methodology for each of these study elements is outlined below.

Desktop Review

Available published and grey literature and other datasets will be reviewed, collated and interpreted in terms of what is currently known of marine sediment and water

quality in the region. This will include RPS BBG reports from previous studies in the area. The desktop review will focus on the potential impacts from the proposed development on local and regional sediment and water quality.

Water Quality Monitoring

Baseline water quality will be measured from in situ instrumentation and laboratory analyses of water samples.

A high precision water quality instrument will be used for profiles of physico-chemical parameters through the water column. The Seabird SBE19 will be configured to sample every 0.5 sec during profiles and measures:

- Depth
- Conductivity
- Temperature
- Pressure
- pH
- Dissolved oxygen (DO)
- Turbidity
- Photosynthetically Active Radiation (PAR).

Salinity, density and sound velocity are derived from the above parameters.

Near surface and near bottom water samples will be collected using a niskin bottle, with samples preserved and stored for subsequent laboratory analysis. All samples will be analysed in accordance with relevant Australian Standards (AS/NZS 5667.1:1998) and will be conducted by NATA accredited laboratories.

Samples designed to characterise the physico-chemical nature of the waters will be collected at the Ichthys Field, along the proposed pipeline route, at the Maret Islands and at reference sites. Water samples will be collected from near the surface and near the seabed for subsequent analysis of:

- Nutrients
  - Ammonium
  - Total Nitrogen (TN)
  - Total Phosphorus (TP)
  - Orthophosphate (FRP)
  - Nitrate and Nitrite (NOx)
- Chlorophyll and Phaeophytins
- Total Suspended Solids (TSS)
- Total Petroleum hydrocarbons (TPH)
- Benzene Toluene Ethyl-benzene Xylene (BTEX)
- Naturally Occurring Radioactive Material (NORMs)
- Metals (Ultra Trace Level)
  - Cadmium (Cd)

- Chromium (Cr)
- Copper (Cu)
- Mercury (Hg)
- Lead (Pb)
- Zinc (Zn)
- Nickel (Ni)
- Arsenic (As).

Other contaminants such as corrosion inhibitors, biocides and faecal coliform bacteria are very unlikely to be present naturally at measurable concentrations and specific information regarding the discharge of substances, such as hydrotest water and corrosion inhibitors, from the development is not yet available. These contaminants will be added to the analytical suite immediately prior to commissioning and will be maintained during any further monitoring of discharges from the facilities.

In addition to water column profiling and laboratory sample analysis, self cleaning water quality loggers will be deployed on the seabed in at least three representative areas of high coral cover to determine fine scale changes in turbidity, light and sediment accumulation (Figure 8.3-1 and Figure 8.3-2).

Data from the sensors will be logged internally every one to two hours, depending on battery life. Because of the remote location of the planned development, telemetry of the data will not be possible. Therefore, data will be manually downloaded by qualified personnel every four to six weeks. At this time the loggers will be removed from the seabed, the data downloaded and checked and the meters cleaned, serviced, batteries replaced and anti-fouled as necessary. The loggers will then be redeployed in the same location. The data from the automated loggers will be validated against field water samples and SBE19 data to ensure the veracity of the data.

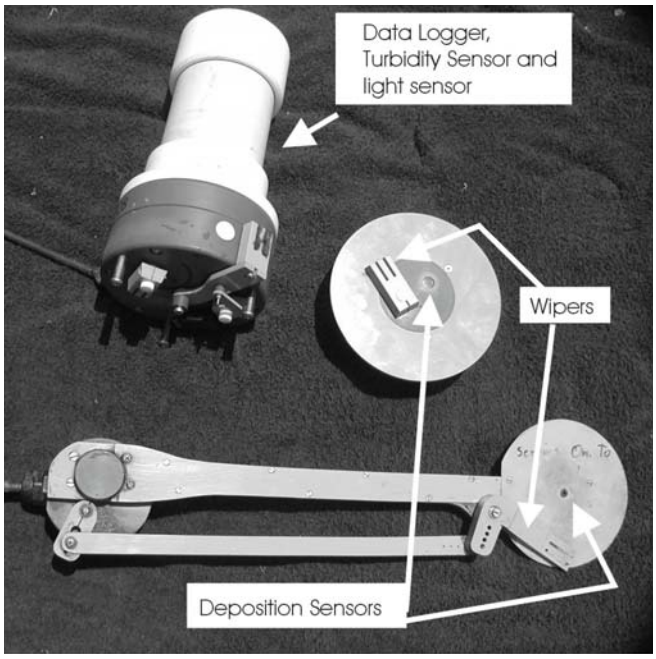

Figure 8.3-1: Data logger (incorporating light and turbidity sensors) and deposition sensor with automated wiper

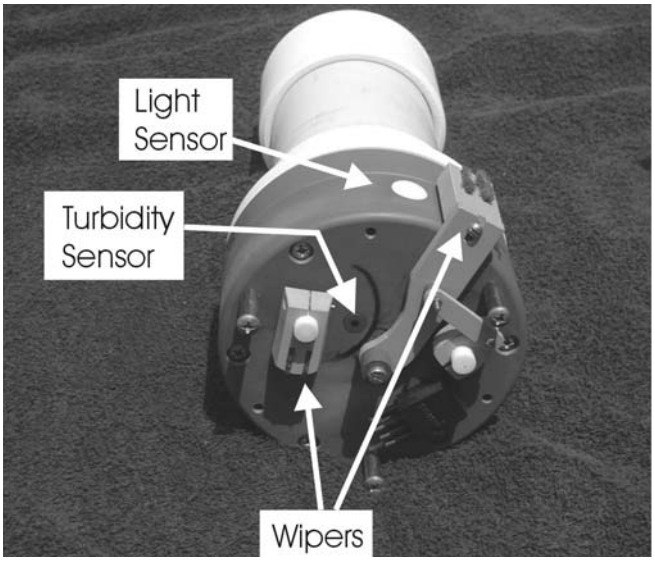

Figure 8.3-2: Turbidity and light sensors with automated wipers to prevent biofouling of the sensors

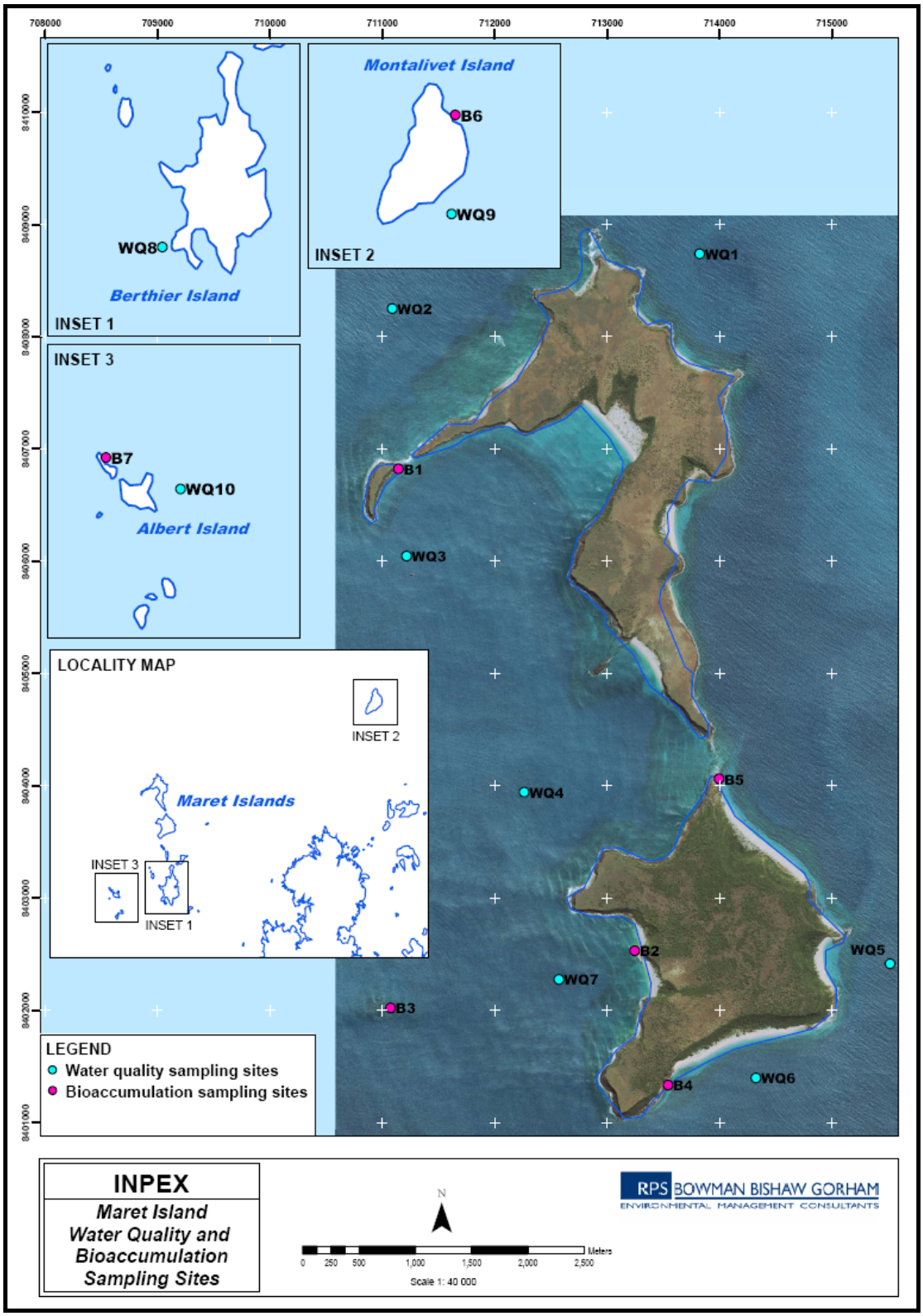

Figure 8.3-3: Water quality and bioaccumulation sampling sites

Sediment Quality Monitoring

Samples designed to characterise the physico/chemical nature of the sediments will be collected at the Ichthys field, along the proposed pipeline route, at the Maret Islands and at reference sites.

Sediments will be collected directly from intertidal deposits or in deeper waters using a stainless steel Van Veen grab. Strict sample hygiene protocols and QA/QC standards will be followed for all sediment sampling. Samples will be kept cold or frozen in accordance with accepted protocols prior to laboratory analysis. All samples will be analysed in accordance with relevant Australian Standards (AS/NZS 5667.1:1998) and will be conducted by NATA accredited laboratories. Samples will be analysed for:

- Metals
  - Cd
  - Cr
  - Cu
  - Hg
  - Pb
  - Zn
  - Ni
  - As
- TPH
- Organotins (TBT)
- NORMs
- Nutrients
  - TN
  - TP
- Total Organic Carbon (TOC)
- Particle Size (PSA)
- Infauna community composition (sieved prior to preservation).

Other analytes will be added as appropriate, following HAZID workshops to identify potential risks to the environment and following the identification of specific waste streams from the Ichthys Gas Field Development. The particle size distribution will be assessed in sediment samples from geotechnical cores along the proposed pipeline routes. If appropriate, these will be used to augment the regional understanding of the physical characteristics of sediments and to facilitate sediment facies mapping.

Bioaccumulation Studies

Filter-feeding bivalves that are abundant near the development areas represent potential bioaccumulators. Rock oysters (Saccostrea sp.) have been found to be plentiful in areas around the Maret Islands and at Albert, Berthier and West Montalivet islands during reconnaissance surveys. Pearl oysters (Pinctada sp.) are also present in the area and would also be a suitable candidate for bioaccumulation monitoring, however rock oysters can be collected more reliably and have thus been chosen as the target bioaccumulation species.

For baseline bioaccumulation monitoring, rock oyster tissue will be collected from a variety of sites at the Maret Islands and at reference locations. For ongoing, post-construction monitoring, both of these bivalve species may need to be sampled to allow flexibility in design for subsequent stages of the monitoring programme. The water depth at the field precludes deploying bioaccumulation organisms at that location until there is infrastructure in place to attach the cages.

The flesh of similar sized rock oysters will be collected and the samples preserved and stored for subsequent laboratory analysis. All samples will be analysed in accordance with relevant Australian Standards (AS/NZS 5667.1:1998) and will be conducted by NATA accredited laboratories. Samples will be analysed for:

- Metals
  - Cd
  - Cr
  - Cu
  - Hg
  - Pb
  - Zn
  - Ni
  - As
- TPH

8.4 Survey Timing

Field sampling for the marine sediment, water quality and bioaccumulation studies are being undertaken on three separate occasions, October and December 2006 and February 2007 to provide a temporal comparison between the dry and the wet seasons. Self cleaning, water quality loggers will be deployed early in 2007, with a requirement for regular maintenance and data downloading. Indicative sample locations, parameters to be measured and number of samples to be collected is described below for each sampling occasion.

The final locations of the sites will be modified on the basis of continuing hydrodynamic studies, ongoing Development design, better information on the locations of discharges (for example possible ocean outfalls for facility wastes) and further information on the magnitude of the proposed dredging and spoil disposal programme.

The sampling programmes to be conducted during survey period are outlined in the following.

October 2006

Between the 16–18th of October 2006, a total of ten water quality sites were sampled, incorporating seven sites around the Maret Islands and three additional reference sites, one at each of Albert, Berthier and West Montalivet islands (Figure 8.3-3).

At each site, a physico-chemical profile of the water column and near surface and near bottom water samples were collected. The water samples were stored on board the vessel and subsequently returned to the laboratory for the analysis of;

- Nutrients
  - Ammonium
  - TN
  - TP
  - FRP
  - NOx
- Chlorophyll and Phaeophytins
- TSS
- NORMs

A further seven bioaccumulation samples were collected during the same voyage, five around the Maret Islands with additional reference samples at Albert Island and West Montalivet Island (Figure 8.3-3). Two replicate samples of rock oyster flesh were collected from each site, frozen onboard the vessel and subsequently submitted to the laboratory for the analysis of:

- Metals
  - Cd
  - Cr
  - Cu
  - Hg
  - Pb
  - Zn
  - Ni
  - As
- TPH

Analysis of the water quality and bioaccumulation samples from the October 2006 survey is currently underway.

December 2006

The same ten water quality sites sampled in October 2006 were sampled between the 11th and 20th of December 2006 (Figure 8.3-3).

At each site, a physico-chemical profile of the water column and near surface and near bottom water samples will be collected. The water samples will be stored on board the vessel and then returned to the laboratory for the analysis of:

- TPH
- BTEX

Samples will be collected opportunistically at:

- Rob Roy Reef; and
- East Montalivet Island.

February 2007

In conjunction with other surveys, currently planned for February 2007, a total of 18 water and sediment quality sites will be sampled. Sampling sites will include:

- The seven Maret Island sites sampled previously;
- Three sites along the pipeline route;
- Five sites at the Ichthys Field (locations of sampling sites will be refined once final field layout diagrams are provided by INPEX); and
- Three reference locations; Albert Island, Berthier Island and either East or West Montalivet islands. The decision between East and West Montalivet islands will be made in early 2007 when the benthic habitat mapping is progressed and appropriate coral reference sites are located at either of the two islands.

At each site, a physico-chemical profile of the water column and near surface and near bottom water samples will be collected. These data will provide a temporal comparison with that collected during the dry season. The water samples will stored on board the vessel and subsequently returned to the laboratory for the analysis of:

- Nutrients
  - Ammonium
  - TN
  - TP
  - FRP
  - NOx
- Chlorophyll and Phaeophytins
- TSS
- TPH
- BTEX
- Norms (8 sites only)
- Ultra Trace Level Metals (CSIRO)
  - Cd
  - Cr
  - Cu
  - Hg
  - Pb
  - Zn

- Ni
- As

Bioaccumulation samples will also be collected during the same voyage for a temporal comparison with dry season samples. The same seven sites will be sampled in February as previously sampled in October 2006; five around the Maret Islands with additional reference samples at Albert Island and West Montalivet Island (Figure 8.3-3).

Samples will be analysed for:

- Metals
  - Cd
  - Cr
  - Cu
  - Hg
  - Pb
  - Zn
  - Ni
  - As
- TPH

Three replicate sediment samples will be collected at the same 18 sites sampled for water quality. Samples will be collected directly from intertidal deposits or in deeper waters using a stainless steel Van Veen grab. It is proposed that a video camera is mounted above the grab sampler to increase grab efficiency rates. Upon recovery, the sediment samples will be reduced to a standard surface area of 0.15 m^2 using measured dividers. From each of the three grab samples per site, this standardised portion (0.15 m^2) will be sieved and taken as an infauna sample.

From a randomly selected grab sample per site, physico-chemical samples will be taken from that portion of the sample not used for infauna analysis, giving a total of three infaunal samples and one physico-chemical sample per site. Physio-chemical samples will be collected from the top 2 cm of the grab sample and will be subsequently analysed for:

Metals

- Cd
- Cr
- Cu
- Hg
- Pb
- Zn
- Ni
- As
- TPH
- BTEX

- TBT
- NORMs (8 sites only - Pipeline and Ichthys Field)
- Nutrients
  - TN
  - TP
- TOC
- PSA.

8.5 Statistics and Data Analyses

Sediment and water quality data will be analysed by the relevant experts to provide a quantitative assessment of the sediment and water quality within the development areas and at suitable reference locations.

Water and sediment samples will be analysed at specialist water quality laboratories. These laboratories comprise:

- The Marine and Freshwater Research Laboratory
- Analytical Reference Laboratory
- Analytical Laboratory Services
- Western Radiation Services
- Commonwealth Scientific and Industrial Research Laboratories.

This ensures NATA accredited analysis for water and sediment quality parameters.

9. NOISE AND VIBRATION

9.1 Aims

The aims of the noise and vibration studies are to characterise existing noise and vibration levels on the Maret Islands and to develop predicted noise contours to assist in identifying potential impacts on local fauna.

9.2 Objectives

The objectives of the Noise and Vibration Study are to:

- Characterise the existing noise levels in the proposed development area;
- Estimate noise emission levels associated with the development; and
- Assess the potential impact of noise and vibration emissions on sensitive receptors from the project during construction and operations of both onshore and offshore infrastructure.

9.3 Methods and Equipment

RPS BBG will be utilising the services of their expert sub consultants SVT. SVT specialises in supporting the oil and gas and power generation industries in the fields of noise and vibration and has over 20 years of experience in undertaking noise and vibration assessments for new and existing oil and gas, and power generation facilities. SVT has recently undertaken the noise impact assessment for the Gorgon EIS/ERMP (Chevron Australia 2005).

The methods proposed to achieve the objectives of the study comprise the following elements:

1. Review of all plant layout drawings, proposed mechanical equipment, and operating scenarios.

All plant layout drawings, proposed mechanical equipment and operating scenarios will be reviewed to determine potential sources of noise and vibration.

2. Undertake baseline noise measurements.

To assess the ambient baseline noise levels at noise sensitive areas at the proposed site and at the closest noise sensitive premises. Typically at least two logging positions should be assessed. The noise logging will be undertaken in accordance with EPA Guidance Statement No 8. RPS BBG and its sub consultants propose to undertake two weeks of noise logging at the nominated positions around the islands.

3. Develop a noise model for the project activities.

A noise model will be developed for the study area for the operations of the liquefied natural gas (LNG) trains. The noise model will incorporate all local topography and major buildings. A noise model will be developed for construction activities, normal operation of the facility and for abnormal operations (i.e. flaring). An acoustic noise model will be developed using the environmental noise modelling program “ENM”, version 3.6, developed by RTA Technology. The ENM program

calculates sound pressure levels at nominated receiver locations or produces noise contours over a defined area of interest around the noise sources. The ENM noise modelling program was originally developed by RTA Technology for the Australian Noise Advisory Council. The model will be used to generate noise contours for the area surrounding the LNG plant and also to predict noise levels at the accommodation sites and the surrounding environment.

Noise modelling will comprise the following activities.

- Develop sound power levels for equipment used for construction, normal and emergency operations. Sound power levels will be developed assuming that the sound pressure level at 1 m from individual equipment items will not exceed 85 dB (A). This criterion is consistent with occupational noise emission requirements. The spectral contents of equipment noise will be obtained either from other similar project, or using empirical methods described in standard acoustic texts.
- Develop noise contours and point noise level calculations for normal plant operating conditions. The study team will develop noise contours for the study area for various wind speeds and directions, including neutral and worst case. The contours will be run with and without a thermal gradient as per EPA Guidance Statement No 8. Topographical information for the acoustic model will be extracted from 1 m ground contours supplied for the area surrounding the gas processing facilities. The acoustic model also includes shielding effects of large buildings and structures at the facilities location such as electrical substations and storage tanks. The acoustic model will be used to predict noise contours for a range of meteorological conditions. Night time atmospheric conditions will be used as per the default values provided in EPA Guidance Statement No. 8.
- Review noise emission from the plant during abnormal or emergency operations. An assessment of the likely noise emission that will result when the plant is operating under abnormal or emergency conditions will be undertaken. Noise contours will be developed for continuous flaring, venting of gas, and for an emergency condition when the plant is blowing down to a high pressure flare and operating diesel firewater pumps, etc.
- Review noise emission from the construction operations. An assessment of the likely noise emission that will result when the plant is under construction will be undertaken.
- For noise sensitive locations around the plant RPS BBG and its sub consultants will also undertake point noise calculations at these locations for the above operating and meteorological conditions.

9.4 Survey Timing

A literature review and field studies on potential noise and vibration impacts commenced in August 2006. A full assessment, under both wet and dry season conditions, will be completed by June 2007.

Baseline noise recordings were obtained on both North Maret Island and South Maret Island between 24 October 2006 and 11 November 2006. The monitoring stations were located at the following co-ordinates:

- North Maret Island: 14º 23’ 45.25754” S, 124º 58’ 46.43244” E

- South Maret Island: 14º 26’ 56.61263” S, 124º 58’ 58.00005” E

The noise monitoring equipment was prepared for use by SVT Engineering Consultants and deployed / collected by RPS BBG personnel.

9.5 Statistics and Data Analyses

Baseline

At each site the noise monitoring equipment was set to continuously record LA1, LA10 and LA90 noise levels at 15 minute intervals, where:

- LA1 is the noise level exceeded for 1 % of the time;
- LA10 is the noise level exceeded for 10 % of the time; and
- LA90 is the noise level exceeded for 90 % of the time.

The logged results are reported in accordance with the requirements of EPA Guidance Statement No.8 for assessing noise impacts from new proposals. The data presented has also been analysed to determine the “L90” of the LA90 noise levels for the day, evening and night-time periods. This data provides a good indication of the lowest ambient noise levels.

Noise modelling

The ENM acoustic noise model will be used to calculate sound pressure levels at nominated receiver locations and produce noise contours over a defined area of interest around the noise sources. The ENM noise modelling program was originally developed by RTA Technology for the Australian Noise Advisory Council.

10. OCEANOGRAPHIC DISCHARGE MODELLING

10.1 Aims

The oceanographic discharge modelling study will provide a quantification of the likely trajectories, fates and consequences of the following production discharges and potential accidental spills that have been identified to date:

- Produced formation water;
- Heated (cooling water);
- Grey water and sewage;
- Hydrotest water from dewatering of the export pipeline;
- Wastewater from a desalination plant;
- Sediment suspended by dredging/trenching for the subsea pipeline, including potential discharge from directional drilling from land;
- Disposal of the dredge-spoil;
- Sediments suspended by propeller-wash from export tankers; and
- Accidental releases of liquid hydrocarbons into the sea.

These studies must examine realistic scenarios based on the planned activities and must account for trends and variations in ambient conditions. Modelling studies will require the development of fit-for-purpose hydrodynamic models to suit the various studies. Some studies will require modelling that covers a relatively large area and incorporates hourly to decadal time-scales. Others will require modelling at finer spatial and temporal scales. In addition, the physical processes that must be addressed will vary among the model applications.

10.2 Objectives

The objectives of the Oceanographic Discharge Modelling Study are to:

- Predict the hydrodynamic circulation over the wider study area and local Islands using a validated three-dimensional hydrodynamic model;
- Predict the exposure risk from accidental hydrocarbon releases (trajectory, dispersion and weathering of hydrocarbons spills) using a validated 3-dimensional oil spill fates and effects model;
- Predict potential deposition and erosion of sediment in sensitive areas such as beaches and benthic primary producer habitats through coastal transport modelling;
- Predict the fate of sediments released from dredging, dredge spoil disposal and propeller-wash using a validated 3-dimensional spill fates and effects model; and
- Provide model output data to support the assessment of potential impacts arising from accidental hydrocarbon spills associated with the Inpex project. These include the provision of:
  - Time-series plots showing the predicted weathering of the specified oil types under local conditions;

- Contour plots showing probability of exposure to shorelines and open water locations;
- Contour plots showing the minimum elapsed time before exposure by slicks at locations;
- Contour plots showing the average and maximum concentration of surface oil at locations;
- Probability of exposure to entrained oil at sub-surface locations;
- Potential concentrations of entrained oil at sub-surface locations (maximum and average);
- Probability of exposure to dissolved aromatic (BTEX and PAH) hydrocarbons;
- Potential concentrations of dissolved aromatic hydrocarbons in the water column (maximum and average); and
- Maximum cumulative doses (concentration x time of exposure) of dissolved and entrained components at sub-surface locations.

10.3 Methods

Modelling studies will involve the development of fit-for-purpose hydrodynamic models to suit the various studies. Some studies will require modelling that covers a relatively large area and incorporates hourly to decadal time-scales. Others will require modelling at finer spatial and temporal scales. In addition, the physical processes that must be addressed will vary among the model applications.

For the discharge modelling studies, a rigorous, three-dimensional circulation model will be established over the study area and wider surrounds. The domain size will cover the potential range of oil-spill drift over scales of at least one week. A large domain size will also incorporate important regional inputs. This circulation model will be configured to provide higher resolution of circulation patterns over areas of special interest, such as the facility locations, Browse Island and the inshore islands. The model will include forcing due to wind, tide and large-scale drift currents.

Spill modelling will sample randomly from the output from this wide-area model to account for trends and variability in patterns of circulation in the area. To provide suitable rigour, the model data must cover multiple years to account for inter-annual variability and a wider sample of unusual events. Sampling will be seasonally-stratified to identify effects of seasonal weather patterns on exposure risks for surrounding habitats.

The performance of the circulation model(s) will be demonstrated to the satisfaction of the various regulators. To achieve this, the study must also provide suitable comparisons of model outputs with various sources of field data.

The following provides a summary of the models that have been selected for this study:

Hydrodynamic modelling

Modelling of hydrodynamic circulation over the wider study area will be carried out using the HYDROMAP model, a validated three-dimensional hydrodynamic model

that has been widely applied to similar investigations on the North West Shelf, Timor Sea and many other locations around the world.

HYDROMAP is used by the Australian Maritime Safety Authority (AMSA) for the Australian national oil spill response system and by the Western Australian Marine Rescue Co-ordination Centre for marine search and rescue operations over the area. APASA have previously established, validated and operated HYDROMAP over the Browse Basin and Timor Sea for other studies.

HYDROMAP provides the advantage of calculating 3D current fields that have patches of higher spatial-resolution over user-defined areas. We propose to establish finer resolution areas around the offshore facility, Browse Island, the Maret Islands and other neighbouring inshore islands.

As suitable input to the model, we currently hold:

- Gridded tidal constituents (Topex Poseidon tidal data set. Source: NOAA) suitable for any period forward or backward;
- Archives of wind data from Browse Island, collected by the Bureau of Meteorology (BOM). These data are intermittent but cover multiple years;
- Gridded (25 km resolution) wind data from the BOM Local Area Prediction System. These are hourly-gridded data covering 1 year (August 2005 to current);
- Gridded wind data from the NCEP/NCAR atmospheric re-analysis programme (Source: NOAA) covering 5 decades at 6-hourly steps;
- Gridded (0.5 resolution) wind data from the NOGAPS data archive (Source: USGODAE from USNAVY) covering 4 years (2003-current) at 6 hourly steps;
- Drift current data from altimetric measurement (Various sources: Global Ocean Observation System, CSIRO BLUELINK database); and
- Gridded, modelled current data from the US Navy Layered Ocean model, which incorporates AVHRR and altimetric satellite measurements.

To form the data required for robust risk assessments, the hydrodynamic model must be applied to generate current data spanning multiple years. These data will be produced by hind-casting the currents for a period of historic wind and tidal conditions (using sources listed above). Current data will be produced on an hourly time-step.

In addition, the deeper offshore portion of the study area will be affected by large-scale drift currents. Interpretations of these currents are available from various sources, including the satellite and modelled sources listed above. Data from these sources will be assimilated to represent these currents.

Model output will be validated by comparison with local measurements of:

- Tidal elevations; and
- Current measurements at multiple locations (with concurrent wind measurements); and
- Drogue tracks (from satellite tracking buoys).

Drogue studies will use Omnitrak satellite tracking units fitted to current drogues. The Omnitrak units use GPS positioning and provide regular position reports via

satellite telemetry through the Fugro Omnistar service. Multiple drogue tracks from different locations will be produced to provide confidence that the hydrodynamic model is accurate over a wide area and under a wide range of conditions.

Hydrocarbon spills

Exposure risk from accidental hydrocarbon releases will be calculated using stochastic modelling, which involves repeated simulation of a defined spill scenario using randomly selected samples of metocean conditions for the location. The methods have been developed to meet the expectations of state and federal regulators over the past several years and applied in a large number of previous assessments.

To identify seasonal trends, stochastic modelling of each spill scenario will be separately carried out using metocean data from each of three major seasons: summer, winter and the transitional periods (spring and autumn transitions combined).

Potential leak sources for the Ichthys development will include submerged facilities and many of the sensitive habitats surrounding the development are submerged. We therefore propose to apply a specialised, fully 3-dimensional oil spill fates and effects model, the Spill Impact Mapping and Assessment Program (SIMAP), to simulate the trajectory, dispersion and weathering of hydrocarbons spills.

SIMAP simulates the weathering of hydrocarbons through spreading, evaporation, entrainment, emulsification, sedimentation and dissolution (of soluble hydrocarbons – including mono and polycyclic aromatic hydrocarbons). The model separately predicts the trajectory of surface slicks and plumes of entrained and dissolved hydrocarbons.

SIMAP is a development of the Natural Resource Damage Assessment (NRDA) model developed by ASA for the US Department of Interior (French et al., 1996), and is used throughout the world for the assessment of environmental damage caused by real spill events, and for forward-risk assessment purposes. The model predicts:

- Probability of exposure;
- Minimum time until exposure;
- Potential concentrations (for surface oil, entrained oil and dissolved aromatic components); and
- Potential dosages (concentration x time of exposure).

SIMAP uses the following information:

- Physical and chemical characteristics of specific oil types;
- Specifications for the spill scenario; and
- Samples of time and space-varying environmental conditions (wind, current, sea temperature and salinity).

The preliminary set of spill scenarios is summarised in Table 10.3-1 below.

Table 10.3-1: Preliminary hydrocarbon spill scenarios to be modelled

Location	Dev Phase	Site	Hydrocarbon	Spill Type
Field	Operations	Seabed flowline	condensate	rupture
Field	Operations	Seabed flowline	condensate	leak
Pipeline route	Operations	Browse Island	condensate	rupture
Maret Islands	Operations	Nearshore pipeline	condensate	rupture
Maret Islands	Operations	Nearshore pipeline	condensate	leak
Maret Islands	Operations	Tanker	condensate	vessel collision
Maret Islands	Operations	Tanker	bunker fuel	vessel collision
Maret Islands	Construction	North MOF	diesel	vessel collision
Maret Islands	Construction	South MOF	diesel	vessel collision
Maret Islands	Operations	POJ – flowline	condensate	rupture
Maret Islands	Operations	POJ – coupling	condensate	rupture
Maret Islands	Operations	Storage tanks	condensate	leak/rupture

Model outputs will include:

- Time-series plots showing the predicted weathering of the specified oil types under local conditions;
- Contour plots showing probability of exposure to shorelines and open water locations;
- Contour plots showing the minimum elapsed time before exposure by slicks;
- Contour plots showing the average and maximum concentration of surface oil at locations;
- Probability of exposure to entrained oil at sub-surface locations;
- Potential concentrations of entrained oil at sub-surface locations (maximum and average);
- Probability of exposure to dissolved aromatic (BTEX and PAH) hydrocarbons;
- Potential concentrations of dissolved aromatic hydrocarbons in the water column (maximum and average); and
- Maximum cumulative doses (concentration x time of exposure) of dissolved and entrained components at sub-surface locations.

Trajectory predictions of SIMAP will be validated by comparison with the tracks of modified drogues. These will use the same Omnitrak units and floats but will not be fitted with the perforated tube that is designed to lock the drogue into the subsurface current. The flexible skirt of the float is designed to ride the surface layer in a similar way to oil.

Fate of sediments released from drilling, dredging, dredge spoil disposal and propeller-wash

For assessment and management of sediment discharges, we propose to operate the MUDMAP and DREDGEMAP modelling systems. Both systems simulate the fate of mixed sediment releases to yield solutions for the distribution of suspended solids and sedimentation patterns.

MUDMAP simulates the turbulent mixing, dispersion, transport, sinking and sedimentation processes affecting sediments discharged from point or line sources, and has been widely applied in many previous studies to model discharges of cuttings and drilling-muds from offshore platforms. Inputs include specification of the grain-size distribution of the discharged sediment mixture, density and rate of the discharge, depth and orientation. The model reports concentrations of suspended sediments over time at specific depths and locations as well as the expected deposition pattern on the seabed. Contaminant concentrations can be estimated based on dilution into ambient sediment layers. The cumulative footprint from multiple disposal operations/locations can also be calculated.

DREDGEMAP was jointly developed by ASA and the US Army Corps of Engineers and is designed to represent more complicated discharge scenarios associated with dredging and disposal operations. This system can represent the various discharge sources associated with different dredging systems (e.g. clam-shell, cutter-suction, hopper barge), pipe discharges and jet-ploughing, as well as multiple dumping operations from barging.

The model represents moving sources of sediment suspension, as well as multiple simultaneous sources (each may be unique), and can represent the turbidity and sedimentation associated with advancing dredgers as well as propeller-wash from moving ships.

MUDMAP and DREDGEMAP both use the time and space varying (3D) current field produced by HYDROMAP to define the ambient circulation patterns. Simulations will use long-run current samples from appropriate seasons. Sensitivity tests using circulation patterns under different conditions will be run to understand implications for the fate of the discharge under non-seasonal conditions.

Model outputs include:

- Time-series concentrations of suspended sediments;
- Contours of suspended solid concentrations and thickness; and
- Contours for sediment exposure (suspended or sedimented) beyond defined concentration/duration limits.

Sediment modelling will report additional loads of suspended and sedimented material resulting from the proposed operations, and these loads will be reported in the context of existing levels including natural variation. Field sampling to quantify changes in ambient turbidity, suspended sediment loads and sedimentation at selected sites in the vicinity of the developments is included in Section 8.0.

The DEC require investigation of resuspension processes affecting the longer-term fate of disposed material, particularly if surface sediments are modified (e.g. if very fine silt is deposited over existing coarse sands, or if depths are significantly modified). Resuspension will be affected by the wave climate, and wave data will be incorporated into the modelling.

Sediment Transport Modelling

Marine based structures such as MOFs, inter-island connecting jetties and product offloading jetties have the potential to affect sediment transport in the nearshore environment. Potential affects could include erosion and accretion of turtle nesting beaches and sediment accumulations over areas of benthic primary producer habitats. INPEX is engaging HR Wallingford, an internationally recognised company with expertise in coastal modelling to undertake this work.

The modelling tool proposed to be used is the PISCES. Pisces is a state of the art fully interactive coastal area modelling framework, capable of stimulating the various processes of wave propagation, current distribution, and the resulting sediment transport in complex coastal areas.

For this study, PISCES will comprise the wave propagation model, TOMOWAC in combination with the finite element flow model TELEMAC and the SANDFLOW sand transport model. All models work on the same TELEMAC unstructured mesh.

Output from the TELEMAC (in the form of (wave generated) currents) and TOMOWAC (in the form of wave orbital velocities) are input to SANDFLOW to simulate sediment transport in both the offshore and nearshore (wave breaker) zones. By this means, sediment transport due to waves and wave induced currents are simulated.

Typical application of PISCES comprises setting up a bathymetric database, selection of specific input wave conditions for simulation, calculating the corresponding currents and sand transport pathways and analysis of the results. A consequence of detailed model resolution and sophistication of the models means that it is not usually possible to model all wave conditions in a particular climate. Accordingly, PISCES is used to model representative patterns of drift for selected representative wave conditions and the results are integrated to yield the gross and net longshore drift. Through research and application of PISCES to a number of case studies, HR Wallingford has developed reliable techniques to determine representative input wave conditions.

10.4 Timing of Surveys and Modelling Data

Field validation data were collected in October 2006 using surface drogues. Multiple drogues were released simultaneously to derive measures of dispersion. These track data will be used for comparison with model predictions for the concurrent time.

All archives of measured wind speed and direction have been obtained from five BOM meteorological stations in the region. These span different periods but at least five years to date are concurrent records. These have been processed for quality and missing data and converted into a model-ready format. Archives of wind data (20+ years) from the NCEP/NCAR reanalysis archive (compiled by NOAA) have been retrieved for a regular grid of locations covering the study area.

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