



Browse LNG Precinct



Browse Liquefied Natural Gas Precinct

Strategic Assessment Report

(draft for public comment)

December 2010

PART 2

Strategic Assessment Process,
including Site Selection, Facilities
Description and Consultation Process

How to Make a Submission

The Western Australian Environmental Protection Authority (EPA) invites people to make a submission on this proposal. The environmental impact assessment process is designed to be transparent and accountable, and includes specific points for public involvement, including opportunities for public review of the Strategic Assessment documents. In releasing this document for public comment, the EPA advises that no decisions have been made to allow this proposal to be implemented.

The State of Western Australia, through the Minister for State Development (the Proponent), proposes to develop an onshore, common-user Liquefied Natural Gas (LNG) Precinct to process natural gas from Browse Basin gas fields off the west Kimberley coast. The Department of State Development (DSD) has been charged with advancing this proposal under the direction of the Proponent.

In accordance with the *Environmental Protection Act 1986* and the *Environment Protection and Biodiversity Conservation Act 1999*, a **Strategic Assessment Report (SAR)** has been prepared which describes this proposal and its likely effects on the environment. The **SAR** is available for a public review period of **12 weeks from 13 December 2010**, closing on **8 March 2011**.

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

Where to get copies of this document

The document/s may be accessed through the consultation portal at <http://public-consult.epa.wa.gov.au/portal> or the proponent's website at <http://www.dsd.wa.gov.au/>. This online public consultation portal will provide a user friendly platform to review the documentation and submit comments directly to the EPA.

Printed copies of the Executive Summary with a CD of the full document and Appendices may also be obtained from Sarah Woods, Department of State Development, Level 6, 1 Adelaide Terrace, East Perth, Western Australia 6004 (telephone: 9222 3191) free of charge. A limited number of the full set of documents have also been printed for distribution to key agencies, stakeholder groups and for placement in libraries.

Why write a submission?

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

All submissions received by the EPA will be acknowledged. Electronic submissions will be acknowledged electronically. The proponent will be required to provide adequate responses to points raised in submissions. In preparing its assessment report for the Minister for the Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information. Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992*, and may be quoted in full or in part in each report.

Why not join a group?

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

Developing a submission

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

When making comments on specific proposals in the **SAR**:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable; and
- suggest recommendations, safeguards or alternatives.

How to Make a Submission (continued)

Points to keep in mind.

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

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

Remember to include:

- your name,
- address,
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: **8 March 2011**

The EPA prefers submissions to be made via the consultation portal at:

<http://public-consult.epa.wa.gov.au/portal>

Alternatively, submissions can be

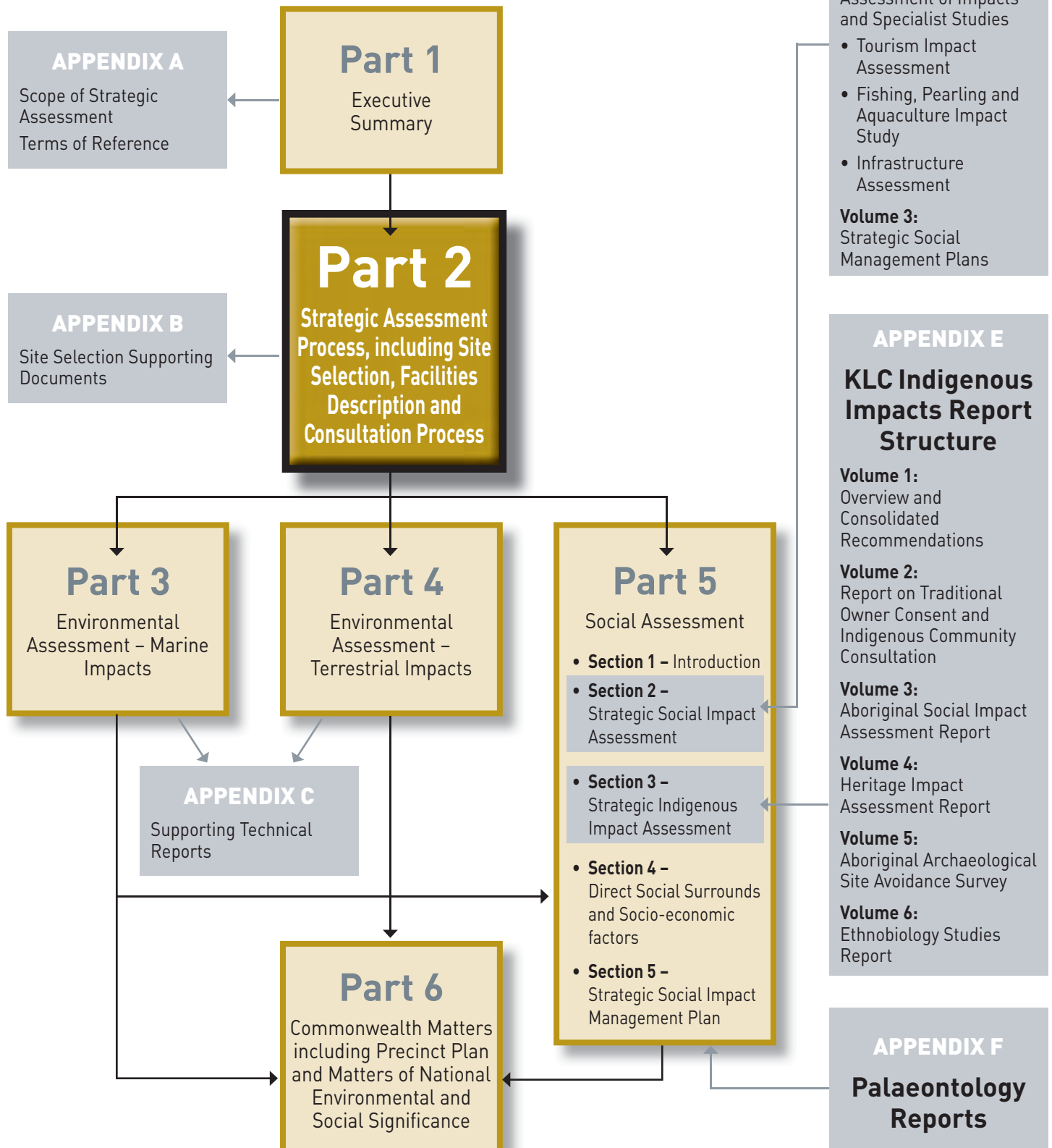
- made by email to submissions@epa.wa.gov.au.
- posted to: Chairman, Environmental Protection Authority, Locked Bag 33, CLOISTERS SQUARE WA 6850, Attention: Warren Tacey; or
- delivered to the Environmental Protection Authority, Level 4, The Atrium, 168 St Georges Terrace, Perth, Attention: Warren Tacey.

If you have any questions on how to make a submission, please ring the EPA assessment officer, Warren Tacey on 6467 5710 or Kathryn Schell on 6467 5426.

Browse LNG Precinct

Strategic Assessment Report – Structure Display

The State of Western Australia, through the Minister for State Development, has developed the Browse LNG Precinct Strategic Assessment Report (SAR) to enable consideration of a proposed common user liquefied natural gas (LNG) Precinct to process natural gas from the Browse Basin gas fields, at a location near James Price Point, approximately 60 kilometres north of Broome. This SAR is presented in six parts as shown in the following diagram. You are invited to make a submission by visiting the Environmental Protection Authority website at <http://public-consult.epa.wa.gov.au/portal>. Appendices are also available at <http://www.dsd.wa.gov.au/browseLNG>.



PREFACE

Browse LNG Precinct – Strategic Assessment Report

I am pleased to present for public examination and comment the Strategic Assessment Report for the proposed Browse Liquefied Natural Gas (LNG) Precinct.

This report is designed to meet the assessment requirements of both the Western Australian and Commonwealth environmental agencies.

It examines potential environmental, heritage and social impacts of constructing and operating LNG processing and export facilities, at a location near James Price Point, approximately 60 kilometres north of Broome, and outlines strategies for the management of those impacts.

Government agencies led by the Department of State Development, Woodside as a potential foundation precinct user, and external consultants have conducted extensive research and consultation and the report is informed by the results of more than 70 studies and numerous consultation activities.

The Western Australian Government's proposal is to establish a single, commercially viable gas processing site at a suitable location to attract and facilitate at least two projects processing the gas resources of the offshore Browse Basin.

The precinct will minimise environmental impacts, both through its design and rigorous ongoing management, and by avoiding ad hoc development along the Kimberley coast.

If the proposal is acceptable, this \$30 billion project will enable Western Australia and the Kimberley Region to gain maximum benefits in terms of investment, business and employment, from development of the massive Browse Basin.

For the Kimberley economy, construction of LNG processing facilities will create many new local employment and business opportunities, while their ongoing operations will provide additional resilience to the regional economy.

Development of the precinct will be accompanied by wider investment in public facilities and services, and workforce development to ensure these benefits are realised.

For Aboriginal people, through recognition of the interests of traditional owners of the precinct site, the development will bring major new funding for their communities, and for employment, training and business development.

I encourage you to read this report and invite you to make your contribution to decision-making about this proposal.



Colin Barnett MLA
PREMIER; MINISTER FOR STATE DEVELOPMENT

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How to Make a Submission

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1. Introduction

The State of Western Australia (**WA**), through the Minister for State Development (the **Proponent**), proposes to develop an onshore, common-user Liquefied Natural Gas (**LNG**) precinct to process natural gas from Browse Basin gas fields off the west Kimberley coast. The Department of State Development (**DSD**) has been charged with advancing this proposal under direction of the Proponent.

The Browse Liquefied Natural Gas Precinct (**BLNG Precinct** or **Precinct**) would consist of LNG processing facilities and associated infrastructure, and would be located in the vicinity of James Price Point, approximately 60 kilometres (**km**) north of Broome, on the west Kimberley coast of Western Australia, **Figure 1-1**. The BLNG Precinct would provide a location for processing gas and associated products from the Browse Basin with an LNG production capacity of up to 50 million tonnes per annum (**Mtpa**). If it were to occur, full development of the Precinct would most likely be phased in as demand for additional processing capacity arises. The Precinct would accommodate a minimum of two proponents at one location and enable sharing of common-user facilities such as the port, roads, infrastructure corridors and workers' accommodation. A **Precinct Plan** has been developed to meet the requirements of the State and Commonwealth Governments.

Woodside Energy Limited (**Woodside**), on behalf of the Browse LNG Development Joint Venture participants, was appointed as a potential Foundation Proponent for the Precinct under the Preliminary Development Agreement signed in October 2009. This Agreement established Woodside as a partner with the State Government in bringing the project to completion.

A detailed and comprehensive assessment has considered the environmental, social, economic, heritage and strategic implications of the Precinct should it reach its full capacity. The assessment process has involved desktop studies, field surveys, modelling, data analysis, impact assessment and stakeholder consultation, the results of which are documented in the BLNG Precinct Strategic Assessment Report (**SAR**).

The purpose of this Strategic Assessment Report is to meet the requirements of the State and Commonwealth governments in accordance with the Terms of Reference. The Strategic Assessment includes a high level impact assessment (including social factors), a description of the strategic proposal, identifying 'future proposals' (to be approved under the *Environmental Protection Act 1986* (the **EP Act**)) and the Precinct Plan (to be endorsed under the *Environment Protection and Biodiversity Conservation Act 1999* (the **EPBC Act**)), and includes the Proponent's proposed draft conditions that may be applied to future proposals. The document includes a summary of existing information, identifying main impact areas and sets out the proposed management arrangements, mitigation and safeguards to ensure impacts are managed.

The SAR is presented in six parts:

Part 1: Executive Summary

Part 2: Strategic Assessment Process including Site Selection, Facilities Description and Consultation Process

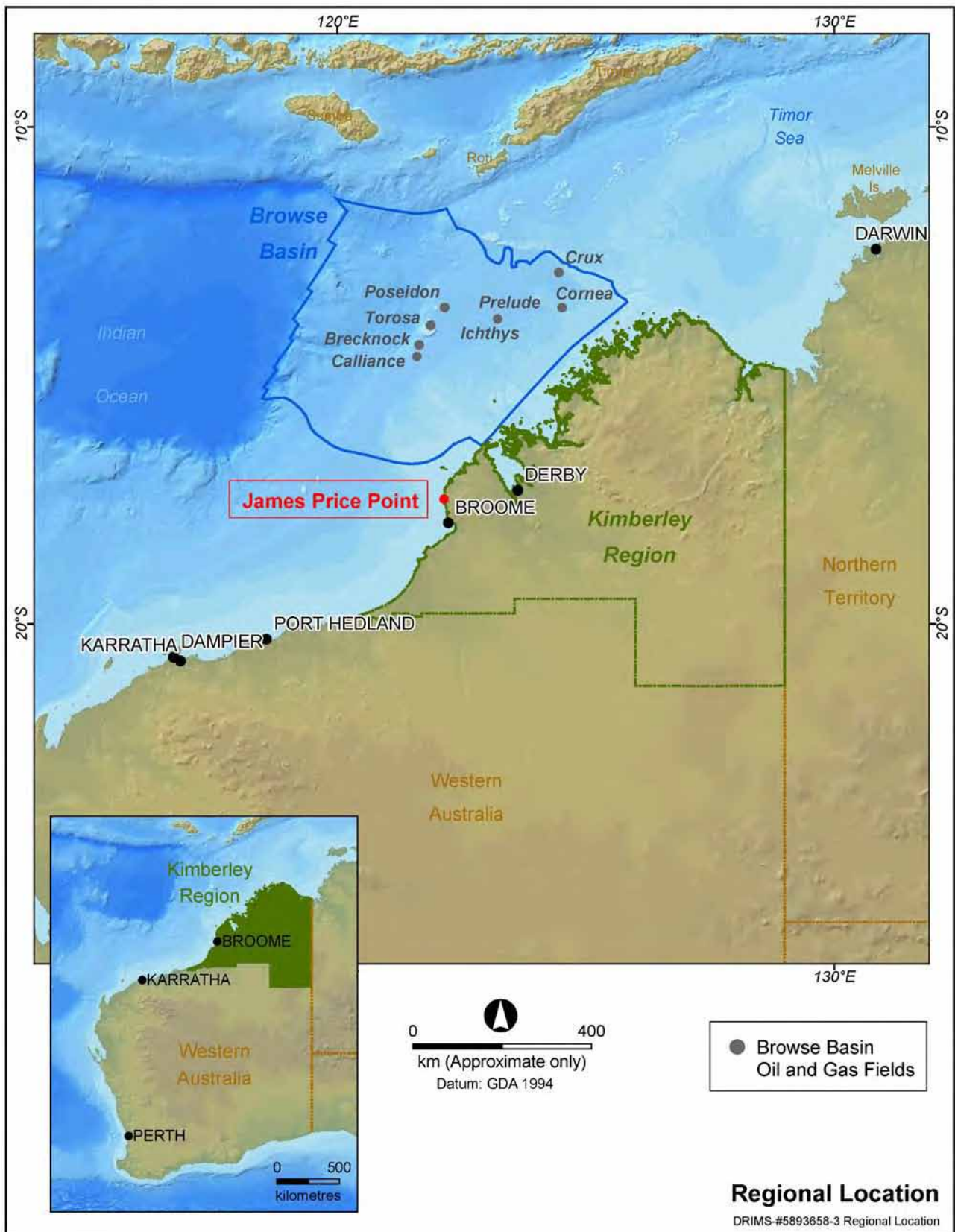
Part 3: Environmental Assessment – Marine Impacts

Part 4: Environmental Assessment – Terrestrial Impacts

Part 5: Social Assessment

Part 6: Commonwealth Matters including Precinct Plan, Management Arrangements and Matters of National Environmental and Social Significance

This document (**Part 2**) of the Strategic Assessment Report provides an overview of the Strategic Assessment process, including site selection, facilities description and consultation process.



■ Figure 1-1 Regional Location of James Price Point.

1.1. Objective and Benefits - A Balanced Approach

The State Government is seeking to develop the BLNG Precinct to:

- provide long term economic prosperity for the Kimberley region and Western Australia;
- minimise the environmental footprint associated with processing gas from the Browse Basin; and
- work with industry to ensure that the potential socio-economic benefits of such a major development are realised while the potential impacts, especially at the local and regional scale, are minimised and properly managed.

Achieving long-term regional economic development with the protection of social, cultural and environmental values of the west Kimberley region of Western Australia is a key aspiration of the State Government of Western Australia. As detailed later in this assessment (see **Part 2, Section 3.1**), the Browse Basin contains significant volumes of natural gas. Natural gas is a valuable resource which is increasingly in demand from customers that seek energy to provide for their growing domestic needs. Natural gas is also sought by many countries as a means to reduce greenhouse gas emissions by moving away from energy sources which present more significant environmental challenges.

A number of companies have already discovered significant quantities of gas in the Browse Basin, and continue to consider the various options to commercialise those reserves. The State recognises this as an opportunity to realise economic and social opportunities to benefit both the local region, and the State as a whole.

The Kimberley region has a population of around 42,000 across the six regional centres covering an area of 424,000 square kilometres (km^2) (almost twice the size of the state of Victoria and larger than Germany or Japan). Forty-two percent of the population is Indigenous. Unemployment is high and employment is narrowly based with the main industries being resources, tourism, construction, pearling and agriculture. There is no significant manufacturing base in the region.

The majority of gas in this region lies in Commonwealth waters and hence attracts Federal Petroleum Resource Rent Tax. Importantly, the State and the community potentially stand to benefit from a number of factors (depending upon where and how the gas is developed) including:

- benefits to Traditional Owners acknowledged to be the custodians of the land;
- provision of services to design, build and maintain projects within the Precinct;
- provision of support services including (but not limited to) catering, cleaning, port services, security, environmental management, machining and tooling, office support and transportation;
- provision of jobs through the employment of construction and operational workforces;
- jobs and contracts arising from the design, management and construction of related infrastructure such as roads and houses;
- expenditure arising from the jobs and contracts created leading to many indirect benefits;
- state taxes and duties applying to Precinct projects and other service companies (for example state payroll tax is estimated to be \$45 million during construction);
- various service fees to Government trading enterprises charged with managing the Precinct;
- local council rates and charges applying to those projects and companies;
- a share of royalties from those developed gas resources which fall into State waters; and
- a share of Goods and Services Tax (**GST**) revenues and other Commonwealth increases in revenue that would arise from this project - these are likely to be significant as the estimated positive impact on Australia's gross domestic product (**GDP**) from a similar 15Mtpa development by Chevron was \$64 billion (Chevron, 2009a).

The State also recognises the potential environmental and social impacts of an unplanned and uncoordinated approach to LNG development in the sensitive Kimberley region. The implementation of the Precinct Plan would prevent the proliferation of LNG processing plants at different locations in the west Kimberley region, thereby limiting the environmental, social and cultural impacts to a single location and allowing for coordinated, consistent and comprehensive environmental management of the region's LNG processing industry.

The Precinct Plan was developed after an exhaustive site selection process initially involving the assessment of 43 sites in the Kimberley region of Western Australia as well as examination of potential sites in the Pilbara and outside Western

Australia. Interstate locations were rejected as being remote from the Browse Basin thereby not offering the social and environmental co-location benefits, and not in the best economic interest of Western Australia. Notwithstanding this, individual proponents may have other options available to them but all existing major coastal industrial sites are significantly further from the Browse Basin and have site constraints that would prevent large scale gas processing of Browse Basin gas reserves by more than one proponent.

The west Kimberley coastline location was chosen as it is the closest to the Browse Basin, while the James Price Point vicinity was selected as it is remote from the iconic wilderness tourist destinations of the Kimberley and is relatively close to existing infrastructure.

The development of the Precinct Plan was accompanied by an extensive community consultation process that involved Traditional Owners, non-government organisations, the general community and relevant Government agencies.

The fundamental driver for onshore LNG processing in the west Kimberley is that this coastline is adjacent to the Browse Basin gas resources that require processing. Other gas processing options in the Pilbara and the Northern Territory (NT) would require the unprocessed gas to be transported over long distances. Onshore processing of gas in the west Kimberley would minimise the distance the unprocessed gas needs to travel which in turn would minimise the environmental and economic resources required to transport the gas. Although all sites have potential environmental and heritage constraints, the site selection process was designed to find the least constrained site where environmental issues could be managed and where Traditional Owners were confident that heritage values could also be managed. Full details on the site selection criteria are provided in **Part 2, Section 4**.

An important goal of the Precinct Plan is to minimise the environmental footprint of LNG gas processing by enabling more than one proponent to process gas in the same location. Major environmental and economic benefits would be realised through the use of a single shipping channel and Port Facility that would service a minimum of two proponents without needing to be significantly larger than that required for a single proponent. Other common user infrastructure would include roads, buffer zones, accommodation areas and a Light Industrial Area (LIA) to service the BLNG Precinct. Having all these facilities in one location would reduce fragmentation of habitats in the area and the risk of edge effects associated with clearing and development.

The consolidation of gas processing would also limit potential adverse impacts on amenity and access to a single location. This is especially important to minimise impacts on tourism, recreation and the region's "sense of place". While the Precinct would inevitably affect the amenity of the area in the vicinity of James Price Point for camping and fishing, and for safety reasons, there would be some restrictions within the buffers of the processing facilities and the port, this impact would be confined to one location in the Kimberley.

A "project ready" BLNG Precinct would provide proponents with an attractive option to develop gas processing facilities in Western Australia. The Browse Basin gas reserves are expected to provide gas for a considerable period and so this investment incentive is intended to provide long term economic prosperity at the regional, state and national level. While construction would inevitably generate major financial injections into the regional economy, the benefits of these economic impacts would be tempered by the relatively quick decline in demand as construction comes to an end. Other economic risks would include price inflation and competition for labour with existing or new industries.

The predicted population increases in Broome from the BLNG Precinct are expected to be only a small proportion of the growth in Broome, given the already rapidly expanding population. The potential impacts of a highly paid and potentially transient workforce on the social demographic in Broome may have an effect out of proportion with the numbers of people involved. Woodside, as the potential Foundation Proponent, and the State Government would make arrangements to accommodate the majority of the construction workforce at a managed, self contained facility outside of Broome to reduce this potential impact.

There are existing social infrastructure deficits and social issues in Broome that are well documented. Given the significant projected increase in population attributed to the region's natural growth, these will need to be addressed and managed into the future regardless of the establishment of the Precinct. The economic input provided by the implementation of the Precinct Plan offers an opportunity to provide additional resources to address existing issues and support future growth.

Further discussion regarding the rationale for the Precinct Plan is provided in **Part 2, Section 3**.

1.2. Background

1.2.1. Northern Development Taskforce

The Northern Development Taskforce (**NDT**) was established in 2007 to negotiate and coordinate a range of issues associated with the development of the Browse Basin gas fields, balanced against the tourism, fisheries, environmental and heritage values of the Kimberley. The main purpose of the NDT was to manage cross-government planning processes and stakeholder consultation with regard to the selection and development of a suitable location for the processing of Browse Basin gas reserves in the west Kimberley region. The NDT identified 43 sites as potentially suitable sites for a multi-user LNG precinct for future Browse Basin gas processing in the west Kimberley region and in June 2008, this was narrowed to 11 potential sites (see **Part 2, Section 4**). After the Final Site Evaluation Report (NDT, 2008d; **Appendix B-6**) was published, advising that the vicinity of James Price Point was found to be the most suitable west Kimberley site, the NDT's work was complete and its responsibilities for the BLNG Precinct were passed to the DSD.

1.2.2. Traditional Owner Taskforce and NDT Working Groups

A Traditional Owner Taskforce was established comprising west Kimberley Traditional Owner groups to assess the suitability of the shortlisted 11 sites from an Indigenous perspective. In September 2008, these were reduced to four sites.

The NDT established working groups that were comprised of representatives from industry, tourism, fishing and environmental non-government organisations to participate in an assessment process against a range of environmental, heritage and technical criteria. The subsequent report, released in December 2008, recommended the James Price Point coastal area as the preferred location for a LNG processing precinct (NDT, 2008d; **Appendix B-6**). These findings were supported by Section 16(e) advice issued by the Environmental Protection Authority (**EPA**) under the *Environmental Protection Act 1986* (EPA, 2008), which concluded that, based on the site assessment, environmental risks and impacts are likely to be manageable for the site in the vicinity of James Price Point.

1.2.3. Strategic Assessment Agreement

In recognition of the environmental and heritage values of the west Kimberley region, as well as the significant economic potential of the Browse Basin gas reserves, a Strategic Assessment Agreement was entered into in 2008 by the State and Commonwealth Ministers. This agreement provides for the assessment of impacts of proposed actions through a concurrent and collaborative process at a strategic level. The Terms of Reference for the assessment were publicly reviewed and agreed in 2008, and are provided in (DSD, 2010c) **Appendix A-3**.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the Western Australian *Environmental Protection Act 1986* require different information and follow different approval processes. The Strategic Assessment process accommodates both of these approval processes, as discussed in **Part 2, Section 2**.

1.2.4. Heads of Agreement

In April 2009, Traditional Owners, the State Government and Woodside signed a Heads of Agreement (**HoA**) for development of the BLNG Precinct which set out a way forward for each of the signatories for the establishment of a BLNG Precinct in the vicinity of James Price Point.

The HoA includes high level descriptions of key components of the BLNG Precinct, including the land areas provided for each.

Key land areas included within the agreement include:

- An exclusion zone (where access to land and water will be managed) comprising:
 - i. a fenced industrial precinct and port of 2,500 hectares (**ha**) on shore (now proposed to be reduced to 2,090ha after working with Traditional Owners to minimize the area required); and
 - ii. the waters of the port (approximately 1,040ha).
- An (unfenced) non-exclusion zone (also known as the ‘ancillary land’) as follows:
 - i. workers’ accommodation of approximately 200ha;
 - ii. Light Industrial Area for third party contractors to the Precinct of 200ha;
 - iii. access roads and corridors connecting the Precinct with other related infrastructure; and
 - iv. statutory buffer zone extending up to three kilometres from the industrial precinct.

The land asset tenure is described in **Part 2, Section 7**.

Following execution of the Heads of Agreement, the State, Woodside and the Kimberley Land Council (**KLC**) also entered into a Heritage Protection Agreement (**HPA**) on 13 November 2009 which is intended to protect areas of significance during site development.

Ongoing management of heritage will be undertaken through Cultural Heritage Management Plans (**CHMP**) to be established in discussion with Traditional Owners.

The State and the Traditional Owners have also agreed to enter into similar arrangements, in respect of those lands contained within the present boundary, for any future additional proponents.

1.3. Why a Strategic Assessment?

The establishment of a BLNG Precinct requires a strategic approach to approvals as it would involve more than one proponent over a long period of time. To ensure a consistent and transparent approvals process in recognition of the importance of the environmental and heritage values of the Kimberley, and to provide a level of certainty for future proponents, the State and Commonwealth Governments have agreed to undertake a Strategic Assessment of the Precinct Plan.

The Strategic Assessment enables the currently known environmental, social and economic issues to be considered now for future development permitted by the Precinct Plan. Commercial proponents of future projects, after the completion of the Strategic Assessment process, would then need to demonstrate the following in order to avoid further formal assessment:

- Their proposal is consistent with the proposal subject to this Strategic Assessment.
- No new environmental factors are raised by their project.
- There is no change in the relevant environmental factors or information available that would affect the outcome of the assessment.

The Strategic Assessment process offers the benefit of allowing the regulators, stakeholders and the community to assess upfront the total cumulative impact of the BLNG Precinct with a capacity of approximately 50Mtpa of LNG production, which is considered to be the maximum of potential development. The process provides increased certainty for future investors and would streamline consideration of their projects if they use the BLNG Precinct. A further benefit arises because project by project approvals generally provide no incentive for industry to develop common user facilities and new proponents often develop their own separate project (and footprint) rather than attempt to reach agreement with an existing operation.

The Precinct Plan enables significant LNG development and there is both a responsibility and an opportunity to ensure that the Precinct is developed in a coordinated and sustainable manner that takes into consideration social, economic

and environmental values. The impact assessment methodology and management approach is described in **Part 2, Section 8**.

The Strategic Assessment process will allow the EPA, State Government, Commonwealth Government, stakeholders and the general public to review the proposed BLNG Precinct, the predicted environmental, social and economic effects and the proposed management framework in a single process. This process has been agreed to by the relevant stakeholders as the most transparent and comprehensive way to assess a proposal of this nature and significance.

1.4. Precinct Plan Overview

The Precinct Plan provides for gas processing and liquefaction complexes, LNG and condensate storage tanks, common-user port facilities and supporting infrastructure facilities such as workers accommodation, Light Industrial Area, ancillary services, service corridors, roads and buffer zones.

The Precinct Plan does not address offshore rig facilities in the Browse Basin gas fields but rather focuses on activities that may occur on land and within the immediate offshore waters (within three nautical miles (Nm) of the Western Australian coastline).

The LNG processing facilities would be fed by a number of pipelines, bringing hydrocarbons from the offshore Browse Basin gas fields onshore for processing. To allow for the export of hydrocarbons and provide supporting infrastructure, a Port Facility (PF) is proposed, including product loading berths, a Marine Facility (MF) and small vessel harbour.

A detailed description of the activities and facilities that may be established under the Precinct Plan is provided in **Part 2, Section 5** and **Part 2, Section 6**. The Precinct Plan and management arrangements are provided in **Part 6**.

1.4.1. Development of the Precinct Plan

The Precinct Plan has been developed by DSD. In the process, consultation has occurred with Woodside, the KLC (on behalf of the Traditional Owners), the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) and the EPA. The key aspects of the Precinct Plan were initially developed by the NDT to determine criteria for the site selection process. The State Government, KLC and Woodside subsequently signed a Heads of Agreement in April 2009, which, *inter alia*, established the vicinity of James Price Point as the proposed site and determined the size of the BLNG Precinct.

The details of the Precinct Plan have been refined through an iterative planning process in response to industry requirements, environmental and heritage constraints and agency inputs. WorleyParsons Services Limited (WorleyParsons) was commissioned by DSD to document the design and key features in a Master Plan to support the development of the BLNG Precinct (WorleyParsons 2010, **Appendix B-8**). The Master Plan document defines the key attributes of the BLNG Precinct both spatially and descriptively and specifies the assumptions behind the layout, key components, staging and infrastructure requirements.

1.4.2. Activities Addressed Under the Precinct Plan

This Strategic Assessment addresses a number of activities that will take place through the implementation of the Precinct Plan to establish a BLNG Precinct. These activities may define “future proposals” and “actions” that require approval under the EP Act and EPBC Act and are also referred to in the Strategic Assessment as Category A activities.

The Strategic Assessment also addresses activities that may be indirectly related to the BLNG Precinct (Category B activities) and other significant related projects in the region (Category C activities) to allow consideration of cumulative impacts during assessment. Category B and C activities are not future proposals, actions or classes of actions under this strategic proposal or Precinct Plan and, if these activities eventuate, they may be subject to the assessment provisions of the EP Act and the EPBC Act.

The categories may be summarised in **Table 1-1**.

■ **Table 1-1 Categories of Facilities and Activities.**

Category	Description	Detail	Examples
A	BLNG Precinct	These are the core elements of the BLNG Precinct, including associated infrastructure, necessary to process and export hydrocarbons.	<ul style="list-style-type: none"> • LNG, condensate and other hydrocarbon processing facilities; • Port Facilities (PF); • Infrastructure within and immediately adjacent to the Precinct.
B	Indirect Activities	These are indirect activities and actions as a result of the BLNG Precinct that are considered in the impact assessment but do not form part of the approvals process.	<ul style="list-style-type: none"> • Broome Airport ; • Broome Port; • Regional roads; • Housing; • Waste Management; and • Material Sourcing.
C	Related Projects	Related projects that are outside the scope of the Strategic Assessment but form part of the cumulative impact assessment.	<ul style="list-style-type: none"> • Petroleum Exploration activities; • Browse field development; • Pipelines and infrastructure in Commonwealth waters; • Road to the Precinct; and • Pioneer Camp.

1.4.3. The Proponent

The Proponent for the Precinct Plan is the Minister for State Development.

Commercial proponents of future approved actions or derived proposals under this Precinct Plan will implement components of the Precinct Plan in accordance with conditions determined during this Strategic Assessment process. Future proponents of such derived proposals may include Government agencies, LNG companies (such as Woodside), Broome Port Authority (**BPA**) and private developers, depending on the action or proposal that is implemented under the Precinct Plan.

1.4.4. Consultation Undertaken in Development of the Precinct Plan

An extensive consultation process facilitated by DSD and involving potential commercial proponents and Traditional Owners was undertaken to develop a preferred location in the vicinity of James Price Point and layout for the BLNG Precinct. A range of options and scenarios were tabled for discussion (WorleyParsons 2008, **Appendix B-5**) for input into the final Master Plan. The Master Plan identified well defined land and water envelopes within which commercial proponents may develop facilities to suit their needs. The major objective of this work was to ensure the BLNG Precinct remains an effective option for future developers of gas projects within the Browse Basin, both in its capacity to accommodate a minimum of two operations and its proximity to gas reserves.

In developing the Precinct Plan for the establishment of an LNG Precinct near James Price Point, consideration was given to technical, environmental and heritage constraints. Initially, a location north of James Price Point was suggested by the Traditional Owners, however investigations concluded that this site would require more dredging and blasting than south of James Price Point and would also result in greater impacts on Benthic Primary Producer Habitat (**BPPH**). The Traditional Owners then agreed that south of James Price Point was acceptable in order to minimise marine impacts. The final Precinct layout has all processing activities set back from the coast, endeavouring to minimise the width of the shore crossing to less than 2km. The coastal set back was designed to minimise the impact on the monsoon vine thicket that exists along the coast, minimise impacts on the coastal dune system and avoid direct impacts on James Price Point itself, thereby minimising environmental, landscape, recreation and heritage values that may exist.

A summary of the consultation process to date is provided in **Part 2, Section 9**. The public review of this SAR provides additional opportunities for public and stakeholder input to the development of the Precinct Plan.

2. Strategic Assessment and Approvals Process

The State Government of Western Australia entered into an agreement with the Commonwealth Government to undertake a Strategic Assessment of the Precinct Plan.

The Strategic Assessment Agreement was established under Section 146(1) of the EPBC Act. It provides for the assessment of impacts of actions under the Precinct Plan for a common-user LNG precinct on all matters protected by Part 3 of the EPBC Act and is intended to meet the provisions of Section 38 of the EP Act, through a concurrent and collaborative process.

The strategic assessment process, under the EPBC Act, allows the Minister to endorse a Precinct Plan following a strategic assessment and also to approve "classes of actions" that are undertaken in accordance with the Precinct Plan. The Plan that is to be assessed for endorsement by the Minister is included in **Part 6, Section 3**.

The Strategic Assessment process under the State EP Act allows for the assessment of strategic proposals. A strategic proposal identifies future proposals and it also results in agreed implementation conditions to be applied to these future proposals. A future proposal identified in a strategic proposal can be declared a derived proposal by the EPA and subsequently the EPA is not required to assess the proposal. Once declared, the State Minister for the Environment may, by written notice, indicate which of the implementation conditions (if any) apply to the derived proposal. The strategic proposal and the identified 'future proposals' are outlined in **Part 2, Section 4**.

2.1. Commonwealth Government EPBC Approvals Process

The Precinct Plan for the BLNG Precinct (**Part 6, Section 3**) is subject to strategic environmental impact assessment under the provisions of the EPBC Act, based on the possibility that the implementation of actions under the Precinct Plan may adversely affect matters of National Environmental Significance (**NES**). A Strategic Assessment is appropriate under the EPBC Act as there are potentially more than one future commercial proponent of actions under the Precinct Plan.

The key steps of the EPBC Strategic Assessment process are as follows.

- 1) **Strategic Assessment Agreement:** The then Commonwealth Government Minister for the Environment, Heritage and the Arts (the Minister) triggers a Strategic Assessment under the EPBC Act by forming a Strategic Assessment Agreement with the authority responsible for the Precinct Plan (in this case the Western Australian State Government) to undertake an assessment pursuant to s146. The agreement can also detail the requirements for the assessment of impacts under other legislation; in this case the EP Act. The Strategic Assessment Agreement includes endorsement criteria that set out what the Minister must consider when endorsing the Precinct Plan.
- 2) **Terms of Reference:** Based on the Strategic Assessment Agreement, Terms of Reference were drafted to detail what information must be contained in the Strategic Assessment. The draft Terms of Reference were released for public review with the Strategic Assessment Agreement and finalised in July 2008 (DSD, 2010c; **Appendix A-3**).
- 3) **Preparation and finalisation of the SAR:** The draft SAR will be released for a minimum eight week public review period. The Strategic Assessment will then be amended and finalised, taking into account public comments and submitted to the Minister for consideration. Although the minimum comment period under the EPBC Act is 28 days, the State Government has agreed to at least an eight week public review period in recognition of the complexity and public interest in the proposal.
- 4) **Ministerial recommendations:** The Minister may recommend modifications to the Precinct Plan.
- 5) **Endorsement of the Precinct Plan:** If the Strategic Assessment meets the terms of reference and recommended modifications (or equivalent) have been made to the Precinct Plan, the Minister may endorse the Precinct Plan. At this stage, no actions are yet approved under the Precinct Plan.
- 6) **Approval of actions under the Precinct Plan:** Once the Precinct Plan has been endorsed, the Commonwealth Minister may, under s146B, approve actions or classes of actions that would normally trigger assessment under the EPBC Act. An approval under s146B may include conditions.

The approval of actions under a Precinct Plan can take place at any time following the endorsement of the Precinct Plan.

2.2. Western Australian EP Act Approvals Process

Under Section 38 (Division 1, Part IV) of the EP Act, the EPA may carry out an environmental assessment of strategic proposals. A strategic proposal is essentially a proposal that identifies future proposal(s) that are likely to have a significant effect on the environment. The assessment process culminates in the prescription of conditions that will apply to these future proposals. These conditions however, will not apply until a proposal, identified in the assessed strategic proposal, is referred to the EPA and declared to be derived under s39B of the EP Act. This is similar to the approval of actions phase under the EPBC process. However, the approval of actions by the Commonwealth Minister is a separate process and may occur at a different time to the determination of derived proposals by the EPA.

A three stage assessment process has been and will continue to apply to the Precinct Plan and future proposals addressed by the Precinct Plan as follows:

- 1) **Stage 1:** Early strategic advice was provided by the EPA under Section 16(e) of the EP Act on environmental sensitivities associated with short-listing of sites for the BLNG Precinct. The EPA concluded the following regarding development of the BLNG Precinct near James Price Point:
 - *“The environmental impacts and risks of locating a precinct in the James Price Point area are likely to be manageable. The risk of future expansion being significantly constrained is likely to be low.”*
 - *“Based on the available data, the EPA considers that the James Price Point area is the least environmentally constrained of the two short-listed sites on the Dampier Peninsula for a gas processing precinct.”*
- 2) **Stage 2:** Assessment of the Precinct Plan (strategic proposal) as described in this Strategic Assessment under Section 38 of the EP Act and the setting of implementation conditions that will apply to derived proposals identified in the strategic proposal.
- 3) **Stage 3:** Declaration of derived proposal(s) that were identified as “future proposals” in the assessed strategic proposal and the application of the relevant conditions to the proposal(s).

2.2.1. Assessment of the Strategic Proposal under Section 38 of the EP Act

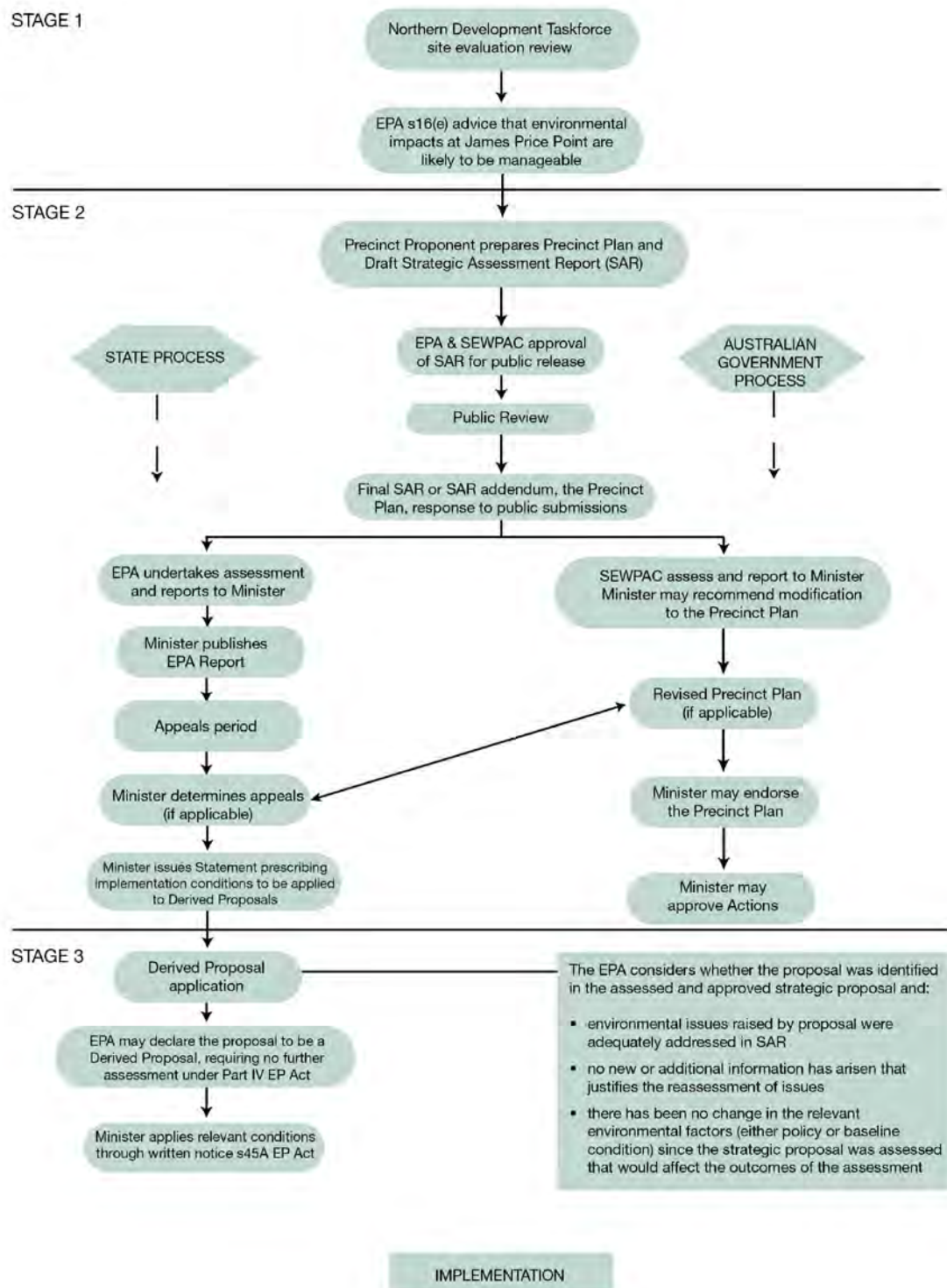
This SAR has been prepared as part of the Section 38 EP Act assessment process (Stage 2 in **Figure 2-1**). The BLNG Precinct strategic proposal was referred under s38 of the EP Act by the Minister for State Development (the Proponent) to the EPA on 1 April 2008. The EPA agreed to undertake an assessment of the strategic proposal and this decision was advertised on 14 April 2008. No formal EPA administrative procedures are currently published to outline the process to be followed under the EP Act for the assessment of strategic proposals.

The Terms of Reference established under the State and Commonwealth Governments Strategic Assessment Agreement provides the broad scope for the assessment of the Precinct Plan and associated future proposals, under both the EP Act and the EPBC Act (DSD, 2010c; **Appendix A-3**).

A detailed Scope of the Strategic Assessment (**SoSA**) and proposed studies to support the overall assessment process were described in the SoSA that was endorsed by the EPA on 1 December 2009 with reference to the Preface that was provided by DSD to clarify the purpose of the Strategic Assessment and the information expectations at each stage of the approvals process (refer to DSD, 2010a; **Appendix A-1** and DSD, 2010b; **Appendix A-2**).

The SAR was prepared in accordance with the SoSA and Terms of Reference and includes a strategic level impact assessment (including social factors), a description of the Precinct Plan (to be endorsed under the EPBC Act), identifying future proposals (to be approved under the EP Act), and the Proponent's view on draft conditions that may be applied to any future proposal that the EPA may declare to be derived.

Following approval by the EPA and SEWPAC for public release, this SAR is subject to a public review period as determined by the EPA. The Proponent then responds to public comments and modifies the SAR as necessary. The EPA will then prepare a report outlining its assessment and any recommended conditions.



■ **Figure 2-1 Strategic Assessment Process Outline.**

A person who disagrees with the content and/or recommendations in the EPA assessment report may lodge an appeal with the WA Minister for the Environment within 14 days of the release of the EPA report. The Minister will evaluate the merit of the appeals and consult with decision-making authorities on whether the proposal may be implemented and, if so, what conditions should be applied. If there is agreement that the proposal can be implemented, the Minister will issue a statement that the strategic proposal may be implemented and prescribe the implementation conditions to be applied. At this point in the process, there is no approval to implement any specific future proposals identified in the strategic proposal under the EP Act. Commercial proponents wishing to construct an LNG plant in the Precinct would need to refer a specific proposal to the EPA. Commercial proponents may request the EPA to declare the referred proposal to be a Derived Proposal. The EPA may declare that the referred proposal is a Derived Proposal if it was identified in the strategic proposal and it was decided that it could be implemented. The Authority may declare a proposal to be “derived” provided that:

- environmental issues were adequately assessed in the strategic proposal;
- there is no significant new or additional information justifying reassessment; and
- there has been no significant change in relevant environmental factors since the strategic proposal was assessed.

2.2.2. Declaration of a Derived Proposal under Section 39B of the EP Act

A commercial proponent (for example, Woodside) may develop a proposal and refer it to the EPA under s38, identified under the strategic proposal (the Precinct Plan), to undertake works associated with the establishment of the BLNG Precinct and may request that the proposal be declared a derived proposal (Stage 3 in **Figure 2-1**). The EPA may declare that the proposal is a derived proposal if the following criteria are met:

- The referred proposal was identified in the strategic proposal.
- Environmental issues raised by the derived proposal were adequately addressed in the Strategic Assessment.
- No significant new or additional information has arisen that justifies the reassessment of the issues raised by the proposal.
- There have been no significant changes in the relevant environmental factors since the strategic proposal was assessed.

The Proponent has also proposed in this Strategic Assessment that management plans be provided to the EPA during this phase. These management plans and other required information will be provided for evaluation in order for the EPA to determine as to whether the referred proposal could be a derived proposal under Section 39B. The EPA may, after receiving the management plans and other information, request further information until it is in a position to decide whether or not the proponent of the derived proposal has demonstrated that the proposal can achieve the environmental outcomes that have been determined as a result of this Strategic Assessment.

If the EPA declares the referred proposal to be a derived proposal, there will be no further assessment by the EPA. The EPA must publicly record the declaration and notify the Minister of its decision.

The Minister may then apply relevant implementation conditions (as published in the statement for the strategic proposal) to the derived proposal and issue a statement that this proposal may be implemented, subject to these conditions, under s45A of the EP Act. As a derived proposal may be for implementation of only part of the strategic proposal for the establishment of a BLNG Precinct, the Minister may apply only those conditions relevant to the derived proposal. For example, a proposal for the Light Industrial Area within the BLNG Precinct could be declared a derived proposal, but conditions addressing the marine environment may not be relevant and therefore, may not be applied to that derived proposal.

2.3. Compliance with the Strategic Assessment Terms of Reference

Table 2-1 outlines where each of the Terms of Reference have been addressed within the Strategic Assessment Report.

■ **Table 2-1 Outline of where each of the Terms of Reference have been Addressed within the Strategic Assessment Report.**

Item	Term of Reference	Section where Terms of Reference are addressed in the SAR
1	<p>Project Purpose</p> <p>The Report must include a general description of the purpose that a Common-user LNG Hub (the Precinct) will serve, including the resources the Precinct will need to function, the actions or classes of actions likely to be undertaken, the scope of related activities, the estimated life of the Precinct, and the regional context in which the Precinct will operate.</p>	<ul style="list-style-type: none"> A description of the purpose, objectives and benefits are described in the Introduction (Part 2, Section 1). The rationale for the Precinct Plan is described in Part 2, Section 3. The classes of action are described in Part 6, Section 3.
2	<p>Description of the Precinct Plan</p> <p>The Report must include a detailed description of the Precinct Plan to which the Agreement relates, including (but not limited to):</p> <ol style="list-style-type: none"> How the Precinct Plan has been developed and its legal standing; Identifying the person(s) or authority responsible for its adoption or implementation, and their jurisdiction; The legal structure under which owners, managers and users of the Precinct will participate in the Precinct; The basis of land/asset tenure; A description of the management arrangements required to ensure the Precinct Plan is implemented successfully; and Identifying the actions or classes of actions that are a subject of the Precinct Plan, including the short, medium and long term aspects of the actions or classes of actions at or associated with the Precinct. These could include relevant construction, operational and decommissioning aspects as well as a comprehensive description of each type of development or facility comprising the Precinct and its associated infrastructure. 	<ul style="list-style-type: none"> The Precinct Plan and management arrangements are provided in Part 6, Section 3. The description of activities and facilities comprising the Precinct and its associated infrastructure is provided in Part 2, Section 5. Land and asset tenure is described in Part 2, Section 7.
3	<p>Project Focus</p> <p>The Report must provide the rationale for the need to develop the Precinct. The Report must include an analysis of the impacts as they relate to the bio-physical, social and economic aspects of the development proposal associated with the development of the Precinct.</p>	<ul style="list-style-type: none"> The rationale for the Precinct Plan is provided in Part 2, Section 3. The analysis of impacts is provided in Part 3 (Marine), Part 4 (Terrestrial) and Part 5 (Social and Economic).
4	<p>Short-listing Process</p> <p>The Report must include a copy of the finalised Site Selection Criteria, and a comprehensive description of how the proposed site(s) for the Precinct were identified including (but not limited to) consideration of:</p> <ol style="list-style-type: none"> EPBC Act matters of National Environmental Significance (NES) (both current and identified as prospective, including likely National Heritage values); Land tenure; Stakeholder and public consultation; How the Site Selection Criteria were used in the shortlisting; The independent verification of feasibility and technical or engineering constraints as identified by the oil and gas industry; Regional environmental and social context and other relevant socio-economic matters inclusive of site security issues; An analysis of technically and economically viable gas processing options outside the Kimberley, focusing on locations that already have substantial industrial infrastructure, inclusive of floating LNG; and Cultural heritage and Indigenous knowledge, and Indigenous aspirations. 	<ul style="list-style-type: none"> Site Selection Criteria are included in (NDT, 2008a) Appendix B-2. Short-listing Process is described in Part 2, Section 4. Matters of NES are discussed in Part 6, Section 2. Land tenure is discussed in Part 2, Section 7. Stakeholder and Public Consultation is summarised in Part 2, Section 9. Description of how criteria were used in short-listing is provided in Part 2, Section 4. Independent verification is discussed in Part 2, Section 4.

Item	Term of Reference	Section where Terms of Reference are addressed in the SAR
		<ul style="list-style-type: none"> Regional, environmental and social context is provided for Marine (Part 3, Section 1), Terrestrial (Part 4, Section 1) and Social (Part 5, Section 2 and Section 3). Viable gas processing options evaluation is discussed in Part 2, Section 4. Cultural heritage and Indigenous knowledge (Part 5, Section 3).
5	<p>The Environment Likely to be Affected</p> <p>The Report must provide a detailed description of the environment likely to be affected by the Precinct Plan, the actions or classes of actions taken under the Precinct Plan including any associated infrastructure and construction and operational activities. This description must identify the environmental assets and characteristics, including biophysical processes associated with the site(s) selected in the Precinct Plan and the terrestrial and marine environments likely to be directly or indirectly impacted, for example:</p> <ol style="list-style-type: none"> Components of biodiversity including maintenance of important ecological processes recognising the potential importance of large intact areas in protecting and maintaining ecological processes; Listed threatened species, other protected and significant taxa (EPBC Act or WA listed), and new, unnamed species or taxa; A description of ecological communities, with reference to Threatened Ecological Communities (EPBC Act or WA listed) or other significant ecological communities; A description given about how uncertainties will be treated in relation to the environment that will be affected; Potential National Heritage values; Any physical environmental drivers influencing the environmental characteristics of the site or surrounds, or influencing the potential impacts on the site or surrounds, including tidal regime, cyclonic and other severe weather conditions and coastal processes; Any other environmental factors required to be described in the environmental impact assessment scoping document developed for the assessment under the EP Act; and Indigenous environmental values and Indigenous cultural heritage (environmental) values, including all values held by Traditional Owners in the area likely to be affected and including broader biological communities, habitats and environments in which species with Indigenous environmental/conservation values might live. 	<ul style="list-style-type: none"> The description of the environment potentially affected is provided in each of the impact assessment documents: Part 3 (Marine); Part 4 (Terrestrial); and Part 5 (Social and Indigenous).
6	<p>Environmental Impacts</p> <p>The Report must include an assessment of the potential impacts of the Precinct Plan, the actions or classes of actions taken under the Precinct Plan including any associated infrastructure, construction and operational activities on the environment including matters of NES and effects of the environment on the Precinct Plan. In particular, the assessment must include:</p> <ol style="list-style-type: none"> A description of the potential impacts of the Precinct Plan on the environment (including to the extent possible, information on the degree of confidence with which impacts can be predicted and quantified and any indirect impacts as defined by Section 527E of the EPBC Act); 	<ul style="list-style-type: none"> The assessment of impacts is provided in Part 3 (Marine), Part 4 (Terrestrial) and Part 5 (Social and Indigenous). The matters of NES are analysed in Part 6, Section 2.

Item	Term of Reference	Section where Terms of Reference are addressed in the SAR
	<p>b) An assessment of the nature and extent of the likely impacts on the environment, including whether the impacts will be short or long term, at the local and/or regional scale and cumulative impacts;</p> <p>c) An assessment of the extent to which impacts on the environment are likely to be unknown, unpredictable or irreversible;</p> <p>d) An analysis of the significance of potential impacts on known (or prospective) matters of NES – with reference to the EPBC Act Policy Statement 1.1 Significant Impact Guidelines and other relevant guidelines or policy advice; and</p> <p>e) Reference to the technical data (including traditional/Indigenous knowledge) and other information relied upon in assessing the environmental impacts of the Precinct Plan, including information collected and compiled to be consistent with the expectations of the Western Australian Environmental Protection Authority, including, but not limited to, that outlined in relevant position and guidance statements.</p>	
7	<p>Indigenous Impacts</p> <p>The Report must include a comprehensive analysis of the potential impacts of the Precinct Plan on Indigenous people and culture (including matters of NES and those prescribed under the <i>Aboriginal Heritage Act 1972 (WA)</i> (AH Act) and the WA EP Act) that are likely to be directly or indirectly affected by the Precinct Plan, in particular, the analysis must include:</p> <p>a) A description of the potential impacts, including socio-economic impacts, of the Precinct Plan on Indigenous people (including to the extent possible, information on the degree of confidence with which impacts and indirect impacts can be predicted and quantified)¹;</p> <p>b) An assessment of whether any impacts on Indigenous people (including Indigenous heritage) are likely to be unknown, unpredictable or irreversible;</p> <p>c) An analysis of the significance of potential impacts on known listed and unlisted Aboriginal heritage sites, objects or landscapes and values of cultural significance with reference to the <i>Aboriginal Heritage Act 1972</i>-section 5,6 and Indigenous Heritage values under the EPBC Act.</p> <p>d) Reference to the technical data and other information relied upon in assessing the Indigenous heritage impacts of the Precinct Plan; and</p> <p>e) Whether the Traditional Owners have given informed consent, in a culturally appropriate manner to the implementation of the Precinct Plan.</p>	<ul style="list-style-type: none"> Indigenous impact assessment summary is presented in Part 5, Section 3 and included in full in Appendix E. Informed Consent is discussed in Part 5, Section 3.9.
8	<p>Proposed Management Arrangements for the LNG Precinct and Associated activities</p> <p>The Report must include a description of legislation, policies, performance and mitigation measures that are relevant to the implementation of the Precinct Plan, the actions and classes of actions undertaken under the Precinct Plan, to avoid, minimise, manage and mitigate the associated environmental and Indigenous impacts.</p> <p>The Report must include information on any other requirements for approval that apply, or are likely to apply, in relation to the Precinct Plan including details of any Local or State Government planning scheme, or plan or policy under any Local or State Government planning system, or State or Commonwealth legislation, such as:</p> <p>a) What environmental assessment of the proposed project has been, or is being, carried out under the scheme, plan or policy;</p> <p>b) How the scheme, plan or policy provides for the prevention, minimisation and management of any relevant impacts;</p>	<ul style="list-style-type: none"> Management arrangements are included in Part 6, Section 3.8. The effectiveness of management arrangements is provided through the setting of performance targets in Part 6, Section 3.8, and through the provision of adaptive management mechanisms in Part 6, Section 3.9.

¹ Certain Indigenous information and knowledge provided as part of the assessment and consideration of approval for a Common-User LNG Precinct is confidential and will not necessarily be made available to the public.

Item	Term of Reference	Section where Terms of Reference are addressed in the SAR
	<p>c) Explicit clarification as to who is responsible for the proposed management arrangements;</p> <p>d) How the scheme will ensure that obligations contained in the <i>Aboriginal Heritage Act 1972 (WA)</i> are met; and</p> <p>e) How to provide effective protection for places that can be considered under the <i>Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i>.</p> <p>The Report must set out specific management arrangements, including the possible role of Traditional Owners in those arrangements. It must describe arrangements that will be in place under or associated with the Precinct Plan that are intended to ensure that development and operation of the Precinct and associated actions and classes of actions are undertaken in a manner designed to avoid impacts on significant environments, minimise environmental impacts generally and enable areas beyond the hub and port precinct to be maintained in an environmentally and an ecologically sustainable manner.</p> <p>The report must also provide a description of the likely effectiveness of these management arrangements and to what extent they will meet endorsement criteria at Attachment C (see Appendix A-3).</p>	
9	<p>Proposed Safeguards and Mitigation Measures</p> <p>The Report must identify and describe the specific measures intended to prevent, minimise and compensate for the potential environmental impacts of the Precinct Plan, and any measures to rehabilitate or offset damage to the environment. The Report must recognise and detail the role that Traditional Owners will play in these matters.</p> <p>The Report should include an analysis of the expected or predicted effectiveness of these measures. The assessment should identify the basis (e.g. statutory or policy) for implementation of each measure and the agency or authority responsible for ensuring implementation. The assessment must also identify how the relevant agency or authority will ensure compliance with these measures, and what steps will be taken in the event that environmental performance is other than anticipated.</p> <p>The Report must identify and describe the specific measures intended to avoid, minimise and mitigate for the potential environmental and Indigenous impacts of the Precinct Plan, and any measures to rehabilitate damage to the environment or impacts on Indigenous peoples live, values, or culture.</p> <p>The Report must also identify any program that is proposed to be put in place under the Precinct Plan to monitor and report on the proposed safeguards, mitigation and offset measures in the short and long term.</p>	<ul style="list-style-type: none"> Mitigation Measures and Safeguards are described in Part 6, Section 3 and after each impact assessment included in Part 3, Part 4 and Part 5. This includes an assessment of the residual significance of impact as an indication of effectiveness. Implementation basis and process are described in Part 6, Section 3.8.
10	<p>Sources of Information</p> <p>For information used in the assessment, the Report must state:</p> <p>a) The source of the information used in the assessment;</p> <p>b) How recent the information is;</p> <p>c) How the reliability of the information was tested; and</p> <p>d) What uncertainties (if any) are in the information.</p>	<ul style="list-style-type: none"> Throughout the document. The key source documents for the description of the existing environment and the impact assessment are included in technical appendices (Appendix B, Appendix C, Appendix D, Appendix E and Appendix F).

Item	Term of Reference	Section where Terms of Reference are addressed in the SAR
11	<p>Consultation</p> <p>The Report must include any details of consultation, in addition to the statutory consultation, about the Precinct Plan, including:</p> <ul style="list-style-type: none"> a) Details of the consultation process for site selection including the public process and directed engagement with stakeholders, and the outcome of these consultations; b) Any consultation that has already taken place, including with Indigenous communities; c) Proposed consultation about relevant impacts of the action, including with Indigenous communities; and d) If there has been consultation about the proposed development, and if so, whether there is any documented response resulting from the consultation (including how the assessment and Report have addressed issues raised by the consultation). 	<ul style="list-style-type: none"> • Consultation undertaken is described in Part 2, Section 9. • Further detail on consultation activities with Indigenous communities is provided in Part 5, Section 3. • Further detail on consultation activities as part of the social impact assessment is provided in Part 5, Section 2.

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3. Rationale for the Precinct Plan

The Precinct Plan would enable processing of the Browse Basin gas reserves at a single location and for commercial proponents to utilise fit for purpose infrastructure including common-user infrastructure. The implementation of the Precinct Plan also provides certainty to future commercial proponents that there is a “project ready” location where the establishment of LNG facilities would be streamlined. There are a number of other benefits that would flow from the implementation of the Precinct Plan including:

- development of the large Browse Basin gas reserves in the most effective manner;
- production of LNG which may be used as a substitute for other more greenhouse gas emissions intensive fuels (such as coal);
- concentration of LNG development in one place instead of at multiple locations on the west Kimberley coastline, thus reducing overall environmental impact;
- co-ordinated and consistent environmental management;
- development of common-user infrastructure; and
- enhanced economic and social benefits for the Kimberley Region and for Western Australia.

Future commercial proponents would be encouraged to locate in the BLNG Precinct as would it be “project ready” thereby allowing streamlined consideration of future LNG development proposals.

3.1. Browse Basin Gas Reserves

The Browse Basin sits directly off the Kimberley coast and is one of Australia's largest natural gas fields. The Browse Basin is a large basin of approximately 140,000 square kilometres divided into four sub-basins: Seringapatam; Caswell; Vulcan; and Barcoo (**Figure 3-1**). Hydrocarbon reserves for the Browse Basin are estimated at 34.6 trillion cubic feet (tcf) of gas and more than 600 million barrels of condensate (a light crude oil) (NDT, 2008a; **Appendix B-2**) with total reserve estimates expected to increase as exploration continues. Approximately 30 exploration permits are currently in place in the Browse Basin locality.

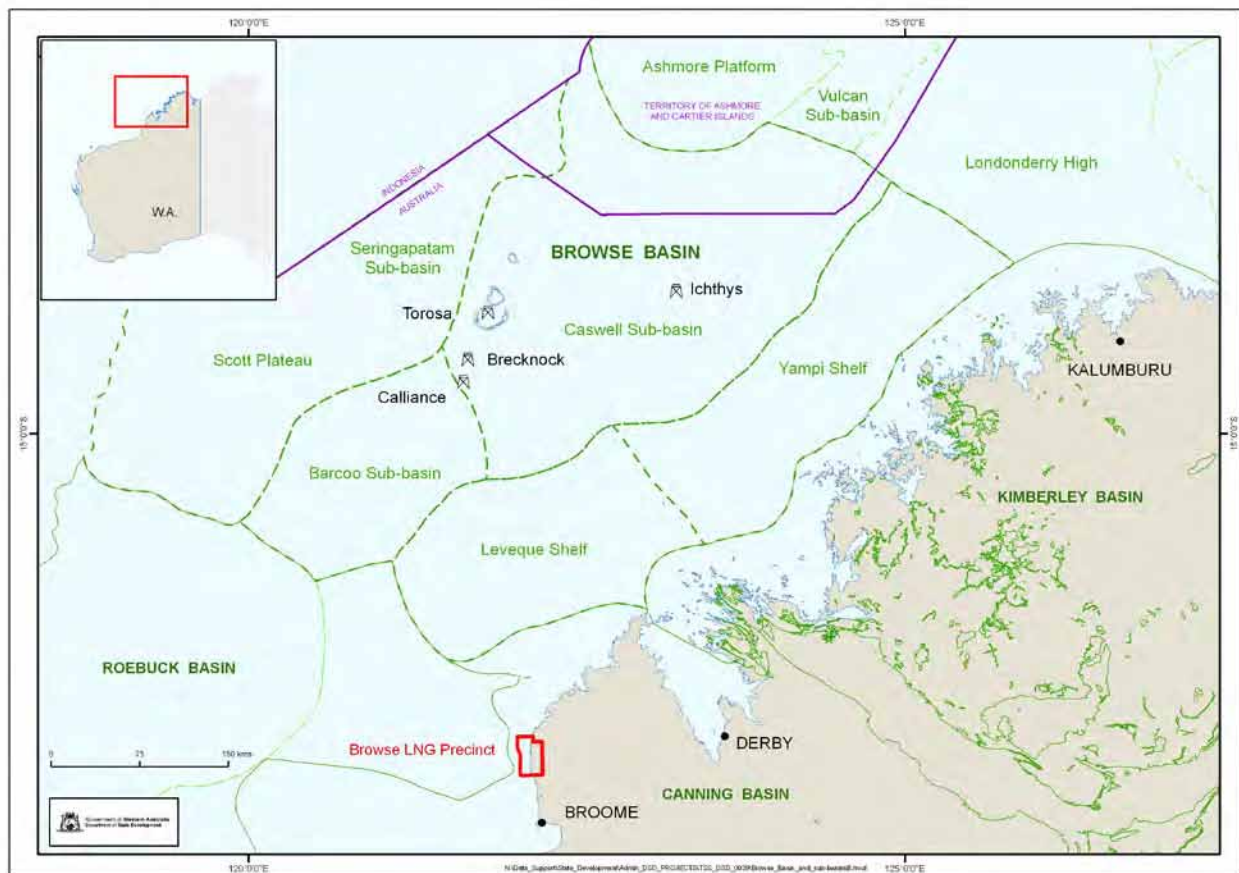
3.2. Demand for LNG Processing Facilities in the West Kimberley

Companies with exploration interest in the Browse Basin include: Woodside and its joint venture participants (Chevron, Shell, BP and BHP Billiton petroleum); Santos; Inpex; Nexus Energy; Shell; ConocoPhillips; and Karoon Gas. The main obstacle to the development of the Browse Basin has been its isolation, almost 300km from the mainland and in 300 to 500 metres (m) of water.

The location of the reserve and the exploration and development of gas fields within the Browse Basin creates increasing pressure for adjacent onshore LNG processing facilities to support development of this resource. The west Kimberley coast is the closest coastline to the Browse Basin and the Dampier Peninsula is the most accessible part of that coastline, being outside of the remote rocky wilderness areas of the Kimberley.

Currently, Woodside is developing three offshore gas-condensate fields in the Browse Basin namely: Torosa; Brecknock; and Calliance within the Caswell sub-basin, located around 425km north of Broome (see **Figure 3-1**). The estimated resource in the three fields is approximately half of the known Browse Basin reserves.

The establishment of the BLNG Precinct under the Precinct Plan would ensure that commercial proponents utilise common infrastructure (such as the port and shipping channel) would also provide certainty for future commercial proponents that there is an approved location with common infrastructure suitable for this purpose.



• **Figure 3-1 Selected Primary Commercial Gas Fields in the Browse Basin.**

3.3. Carbon Footprint of Natural Gas

Natural gas is mainly used in the industrial sector as a fuel for the generation of electricity, but it is also used directly in the domestic and commercial sectors as an alternative to electricity for water-heating, cooking and general heating. Natural gas emits less greenhouse gas per unit energy basis when burnt, than coal or diesel oil. **Table 3-1** shows that the combustion of coal emits in excess of 80% more greenhouse gasses (represented as Carbon Dioxide Equivalents (CO₂-e)) than LNG per unit of energy. The lower greenhouse gas emission rate of natural gas makes it a comparatively clean energy source, relative to other fossil fuels.

The other advantage of natural gas is that it can be used to meet peak electricity demands, unlike most renewable energy sources which cannot increase output on demand. For these reasons, natural gas is considered an integral part of a more carbon-efficient economy.

• **Table 3-1 CO₂-e Comparison between Fossil Fuels.**

Fuel combusted	CO ₂ -e Emission Factor (kgCO ₂ -e/ GJ)*	Difference emission to LNG [#] (percent)
Brown coal	93.11	+81.05
Black coal	88.43	+72.27
Diesel oil	69.32	+35.39
Liquefied Natural Gas	51.33	N/A

Note: * Taken from Table 1, 2 and 3 of National Greenhouse Accounts (NGA) Factors Workbook (Department of Climate Change and Energy Efficiency (DCCEE) 2010).

calculated using Table 1, 2 and 3 of National Greenhouse Accounts Factors Workbook (DCCEE, 2010).

3.4. Environmental Advantages

Under the Precinct Plan, the BLNG Precinct would be the largest facility (50Mtpa if fully developed) of its kind in Australia and would reduce the pressure for individual companies to propose separate smaller developments along the coast. In comparison, the North West Shelf LNG facility on the Burrup Peninsula, operated by Woodside, is currently the largest LNG facility in Western Australia and can process around 16Mtpa, or one third of the capacity enabled by the Precinct Plan.

The establishment of the BLNG Precinct would reduce the need for duplication of infrastructure such as ports, accommodation and roads, which would be required by individual companies if they were to build their own facilities. A single BLNG Precinct would offer commercial proponents the economic efficiencies of shared infrastructure, and would also reduce the environmental footprint of development compared to multiple, stand-alone LNG processing facilities. The establishment of a single BLNG Precinct would also limit the potential disturbance to cultural and heritage values.

Specific environmental benefits of a single BLNG Precinct for processing the Browse Basin gas reserves compared with multiple developments would include:

- a single dredged shipping channel, thus reducing the area of seabed potentially affected;
- a single port, therefore minimising changes to coastal processes;
- potential for shared infrastructure such as workers' accommodation, bore fields and road networks which would reduce the total terrestrial footprint and reduce fragmentation and edge effects by concentrating the development at a single location;
- reduction in the potential adverse effects on cultural and heritage values through consolidation on a single site; and
- limit the loss of visual amenity and recreational access to a single location, hence allowing for better conservation of these values in the region.

In addition, a single BLNG Precinct would enable a coordinated and consistent approach to environmental management and monitoring of cumulative environmental effects (for example, marine water quality or air quality), auditing and control. A single facility would allow the State Government (as the Precinct Plan Proponent), future operators within the BLNG Precinct and other regulatory agencies to efficiently audit activities being undertaken in the BLNG Precinct and ensure compliance with conditions of approval and other commitments. There would also be greater potential for integrated and effective carbon dioxide (CO₂) management.

The establishment of a single BLNG Precinct would enable coordinated risk management and emergency response facilities, resources and procedures. This consolidation would provide a more efficient and timely response to emergencies than could be achieved at multiple LNG facilities operating hundreds of kilometres apart. Emergency response personnel, equipment and training could be located at or very close to the BLNG Precinct, and not be dependent on other emergency response infrastructure in the region.

3.5. Economic and Social Benefits

The State Government is seeking to encourage the sustainable development of the Browse Basin gas field within Western Australia as there are substantial economic and social benefits potentially associated with this type of development. Gas processing is a very high revenue industry and by necessity gas processing plants are clean, highly controlled sites with strict industry standards in safety and environmental performance.

The BLNG Precinct would require a large initial capital outlay and significant expenditure on contractors for goods and services and payments to direct employees. The sale of the gas products would ensure that the Precinct has a positive net impact on Australia's gross domestic product. As an indication of the potential effect on GDP, one forecast predicted that Chevron's 15Mtpa Gorgon project has the potential to boost GDP by \$64 billion (net present value) (Chevron, 2009a).

The Precinct would significantly increase Western Australia's export income and the State Government would receive direct revenue through the payroll tax, estimated at up to \$45 million per year during construction. The majority of employment is expected to be fly in/fly out (FIFO), especially during construction, which would minimise demographic impacts on Broome whilst supporting economic growth in both Broome and in other areas of Western Australia.

Increases in regional and local GDP would derive from spending resulting from supply, procurement and, to some degree, associated new employees and their families. The development of the proposed BLNG Precinct would provide economic opportunities for service industries that may not be viable without major development to support them. Potential industries that would benefit include specialist service providers to the oil and gas industries, freight and transport companies, the establishment of industry-focused training, education and research institutes, and specialist risk management and emergency response resources in the west Kimberley region. It is predominantly during the construction phases that there would be the greatest procurement opportunities for local businesses and contractors. The State and commercial proponents would develop a local purchasing strategy based on the demands of the Precinct, related activities and an assessment of Broome and the region's current and future capacity to supply goods and services.

In recognition of the Precinct's proximity to, and potential effect on Broome, the State Government has committed to working with the commercial proponents, Local Government and the Commonwealth to provide infrastructure and services in Broome to address existing issues and to support growth in the region.

The development would also provide significant economic and other social benefits to Traditional Owners and west Kimberley Indigenous communities. The State Government has been negotiating with the KLC, who represents the registered native title claimant group, since January 2008 to secure the areas required for the BLNG Precinct. It is the State Government's preference to secure the land required via an Indigenous Land Use Agreement (**ILUA**) under the *Native Title Act 1993 (NTA)*, which would ultimately register the consent of the claimants to the establishment and operation of the BLNG Precinct. However, given continued questions about the authority of parties to negotiate such an Agreement and the timing issues that this presents, in September 2010, the State announced that it would commence a formal process under the *Native Title Act 1993*. This process involves negotiating in good faith with registered native title claimants for a six-month period. If agreement cannot be reached, the State will refer the matter to the National Native Title Tribunal for arbitration for up to a further six months, after which the Tribunal determines if the development may be done, and if so, under what conditions.

The State Government and Woodside (as a potential Foundation Proponent) have together committed to delivering about \$1.5 billion of social and economic benefits to local Aboriginal communities, under a Heads of Agreement signed by the KLC on behalf of the Goolarabooloo Jabirr Jabirr claimants in April 2009. The Heads of Agreement includes:

- recognition of the claimants as Traditional Owners of the affected land;
- providing an area of land, equivalent to that required for the precinct, to the Traditional Owners under freehold title;
- creating new economic opportunities, including in business development and trade training;
- strengthening environmental and heritage protection including creating new conservation reserves on the Dampier Peninsula;
- reforming of Indigenous land tenure to help establish appropriate titles for home ownership and economic development in Dampier Peninsula communities;
- creating Traditional Owner controlled funds for economic development, housing, education and cultural preservation;
- increasing funding to improve Government facilities and services for the wider community;
- when the land is no longer needed, returning it fully remediated to the Traditional Owners; and
- requiring an equivalent level of commitments from future commercial proponents as and when they undertake projects at the Precinct.

4. Site Selection Process Development Options

This section describes the decision-making process which resulted in the site near James Price Point being selected as the preferred location for the Browse LNG Precinct. Earlier sections described the opportunities which would be expected to arise from the development of the Browse Basin. Here the various options to develop the Browse Basin, as a means of creating economic development for the State, are examined and the reasons for focusing upon the west Kimberley region are expanded.

Significant known gas reserves within the Browse Basin are found at distances of more than 250km from the nearest landfall along the west Kimberley coastline of Western Australia (and more than 300km from James Price Point). Several companies have over time considered and are continuing to consider various options for processing these gas reserves.

While the Western Australian Government recognises this opportunity to create a significant economic opportunity for the State, it is also conscious of the very high environmental and Indigenous values of the iconic Kimberley wilderness.

By mid 2007, the State was concerned by the pattern being followed by industry in identifying and pursuing locations for gas processing along the west Kimberley coastline. The State's concern arose not just from an environmental and heritage perspective but also from the amount of a suitable land area available at these specific locations. Each location previously considered had only been capable of supporting one major developer. This would have potentially created a situation of having multiple locations dotted along the Kimberley coastline.

Under Western Australian law, future gas developers are legally afforded the right to apply to the State for land tenure and to seek subsequent environmental and heritage approvals for a gas processing facility. Thus, it is inevitable that unless one west Kimberley onshore location of suitable area to accommodate more than one developer is identified, ad hoc applications would continue to be made into the future.

In response, the Western Australian Government proposed to establish a single, commercially viable gas processing site at a suitable location to attract and facilitate at least two projects processing the gas resources of the offshore Browse Basin that would provide Western Australia and the Kimberley region the best opportunity to benefit in terms of investment, business and employment. Most particularly for Aboriginal people, the development would bring major new funding for their communities, and employment, training and business development opportunities.

A site selection process was designed which analysed a range of considerations including technical, economic, marine and terrestrial environment, natural and Indigenous heritage, and other Indigenous and socio-economic constraints. A range of development options were considered to determine the suitability of the State's proposal as well as to define the preferred location for the State's proposed development. Development options considered included:

- floating LNG (**FLNG**) processing facilities;
- development at one of 43 locations in the Kimberley region (including offshore at Scott Reef, the Maret Islands or at Wilson Point in the Camden Sound);
- sites in the Pilbara region to the south of the Kimberley (Onslow, Burrup Peninsula, Cape Lambert or Port Hedland); and
- locations to the north east of the Kimberley in the Northern Territory (Middle Arm, Glyde Point or Bynoe Harbour).

The site selection process used analyses and input by the Western Australian Government, the Commonwealth Government, Traditional Owners, and industry (primarily Woodside and Inpex) to identify the most suitable location for the BLNG Precinct. The process and rationale for the ultimate choice of a site in the vicinity of James Price Point as the location of the BLNG Precinct is described in the sections below. Some of the key considerations are also described in greater detail below.

Site Selection Technical Considerations

Technical constraints were the primary consideration in shortlisting a suitable site. Unless LNG development is feasible at a location, there is no value in undertaking further, more detailed analysis of a site.

From an economic and technical perspective, the most feasible options were found, by the individual companies, to be offshore processing at Scott Reef and onshore processing in the Kimberley region of WA at Wilson Point and Maret Islands, albeit that environmental and heritage constraints for these locations were identified as extremely significant. Some of the key economic and technical factors in respect to the onshore locations were the proximity to the gas reserves to the coast, the natural port features and the land elevation.

Analysis by Gaffney Cline and Associates (GCA) (2008) (Appendix B-1) advised that only companies with the advantage of being able to secure low-priced infrastructure facilities (such as pipelines and existing processing facilities) could consider locating outside the Kimberley region. Pipeline costs are likely to be in the order of \$4M per km, and for Darwin or Burrup alternatives, of offshore platforms with compressors would be required and condensate from the operations would more likely be separated, stored and loaded offshore. This would lead to increasing costs, technical complexity and the risk of environmental impacts.

In practical terms, this would mean that Browse Basin gas would likely be developed sequentially using existing facilities (that is new fields would only be developed once old fields are depleted), leading to less efficient development of the gas resources, less exploration incentives, only limited economic opportunities for the State or the nation, and less still for the immediate regions.

Floating LNG facilities in this region are also restricted, through climatic conditions and safety requirements. Industry generally considers floating facilities as more suitable for small, stranded or remote reserves. This is therefore not a suitable option for most gas developers as this would severely restrict the number of tonnes per annum that can be produced as compared to the size of the gas reserves available. For example, this option was selected by Shell for the development of its Prelude field with estimated gas reserves of 2.5 – 3.0tcf, noting that the proposal by Woodside as a potential Foundation Proponent is based on estimated reserves of around 15tcf. It could also lead to the ‘cherry picking’ of easier gas reserves, leaving otherwise economic resources in the ground and rendering them commercially unviable in their depleted state.

Environment Considerations

Environmental constraints were also critical in the site selection analysis.

From an environmental perspective, the Kimberley is clearly a vast wilderness with many important values which must be protected. In recognition of this, the State has recently announced the formation of Kimberley Wilderness Parks covering more than 3.5 million hectares (half the size of Tasmania) including four new marine parks, a new national park and a number of additional conservation reserves.

With respect to the environmental aspects of site selection, the objective of the State was to identify a site for which constraints could best be managed. A particular feature of the State process was to find a site which would be sufficient for at least two LNG projects; thus ensuring that, with the sharing of infrastructure such as a single port, the environmental footprint could be minimized and environmental impacts managed in a coordinated and consistent way.

With respect to sites outside of the Kimberley region, despite a popular emphasis on the Kimberley environmental values, much of the Pilbara and the Northern Territory present similar environments and values which must be managed.

Social and Economic Considerations

With respect to the social and local economic concerns, the State is also aware that the local population values the ‘sense of place’ which the region provides, and livelihoods are also dependent upon existing industries including fishing, pearling, aquaculture and tourism.

Notably, there is considerable opportunity to enhance the positive social and economic aspects of this project with the appropriate site selection.

It is noted that the Precinct development has the potential to create an increased demand in tourism related services, helping to balance out the otherwise highly seasonal nature of tourism, increase the occupancy of hotels and restaurants during the off-season, increase the level of airline services (with the potential to lower costs and thus helping increase the attractiveness for tourists).

The involvement of various agencies including the Department of Planning (**DoP**), Kimberley Development Commission (**KDC**), and Tourism WA in the Northern Development Taskforce, and the tourism, communities and fisheries working groups were reflective of the importance placed on the social and socio-economic considerations of site selection.

Indigenous Considerations

The site selection was also undertaken with the extensive consultation, towards ‘informed consent’, of Traditional Owners from across the Kimberley. This was managed by the KLC as the representative body for the many groups in the region. Issues that were taken into consideration included the cultural sensitivities of the many site locations, including Aboriginal heritage values, as well as the economic aspirations of the various Traditional Owner groups.

As noted above, there is a great opportunity to achieve positive outcomes arising from this project. Education, jobs and economic opportunities are particularly important to the region’s Traditional Owners, helping to break a cycle of high unemployment, which has been characteristic of this region for many years (particularly among young men and women) and which leads to other challenges for the local communities.

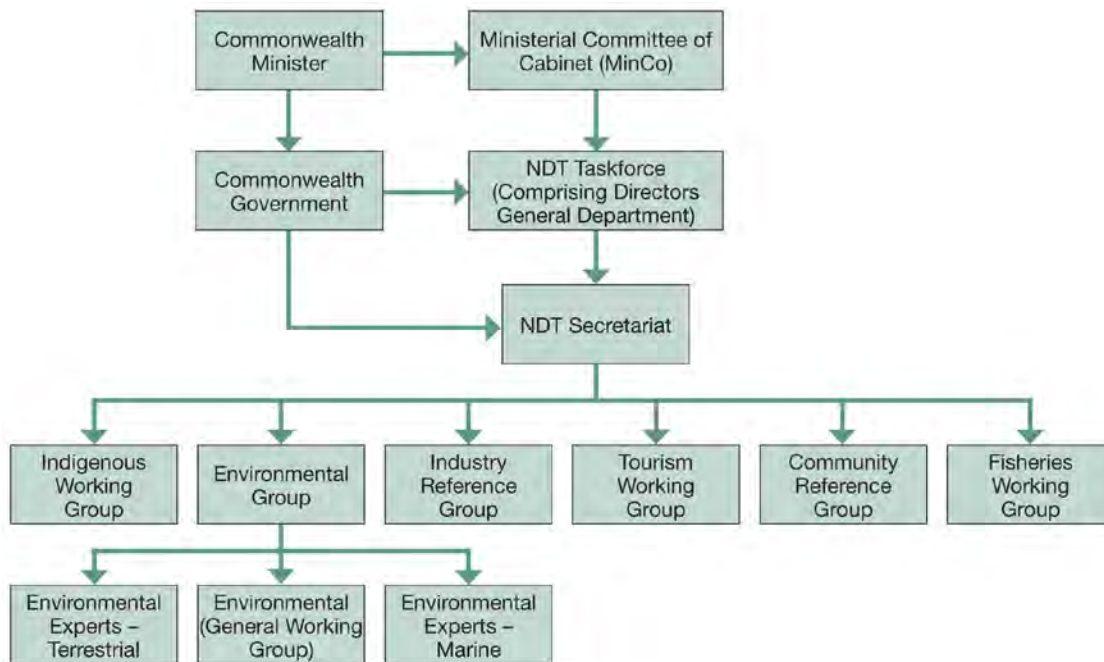
4.1. Overview of Western Australian Government Process for Site Selection

The site selection process was undertaken primarily by the NDT, which was established by the Western Australian Government in 2007. The NDT was to recommend, to a ministerial committee of cabinet, a location or locations for the processing of natural gas from the Browse Basin by one or more operators, giving full consideration to Indigenous, community, environmental, tourism and heritage issues.

The Taskforce membership consisted of the Directors General and/or Chief Executive Officers (**CEO**) of:

- Department of Industry and Resources (**DoIR**), now DSD (Chair);
- Department of Environment and Conservation (**DEC**);
- Department of Indigenous Affairs (**DIA**);
- Department for Planning and Infrastructure, now Department of Planning;
- Office of Native Title;
- Kimberley Development Commission; and
- Tourism Western Australia.

The NDT was supported by a secretariat made up of representatives from the above State government agencies. The structure of the NDT with its supporting working groups is shown in **Figure 4-1**.



■ **Figure 4-1 Northern Development Taskforce Structure.**

The NDT established a site selection methodology and identified draft site selection criteria derived from best practice models previously used by industry (NDT 2008a; **Appendix B-2**). To develop environmental criteria, the NDT convened expert environmental working groups which devised a detailed matrix of environmental indicators to assist in the evaluation of specific sites in Western Australia. The Strategic Assessment Agreement was executed in February 2008 and the need to analyse viable locations outside the Kimberley region was then included (**Part 2, Section 4.2**).

The NDT implemented the following three-step process for site selection, which led to the identification of a preferred site:

- 1) Initial filtering of potential sites: This step comprised the identification of potentially suitable coastal and offshore island locations based on finding areas with suitable geology and bathymetry (to accommodate large draft vessels). The 43 sites initially identified as potentially suitable were then assessed for technical feasibility, particularly focused on land suitability, maritime access considerations and regional constraints (**Part 2, Section 4.3**). This step involved the independent review of previous work by industry on site selection which included analysis of offshore options involving gravity based or floating LNG structures, and the use of existing infrastructure on the Burrup Peninsula (GCA, 2008; **Appendix B-1**). The NDT proposed 11 sites (including two suggested by the Traditional Owners) for more detailed investigation (NDT, 2008a; **Appendix B-2**).
- 2) Short-listing of technically feasible sites: The 11 sites identified as potentially feasible from an engineering point of view were then evaluated to determine the key technical, socio-economic, environmental, and heritage constraints. A multi-criteria matrix was constructed to rank each site from least sensitive to most sensitive. This step required significant key stakeholder consultation and involvement in risk analysis (**Part 2, Section 4.4**) and led to a short list of four sites. A two part site selection report was prepared by the NDT (NDT, 2008b; **Appendix B-3** and NDT, 2008c; **Appendix B-4**) and was subject to a public comment period. The NDT responded to the issues raised and provided all documentation to the EPA for advice under Section 16(e) of the EP Act.
- 3) The determination of a preferred site: A full assessment of the four shortlisted sites was conducted after undertaking geo-technical assessments, completing environmental studies, receiving EPA advice pursuant to s16(e) under the EP Act and engaging in further stakeholder consultations (**Part 2, Section 4.5**). The EPA provided independent advice on the site evaluation process and the four short listed sites to the Minister for the Environment (EPA, 2008). The EPA advised that two of the four sites (North Head and Anjo Peninsula) were unsuitable for large scale industrial development from an environmental perspective. The EPA also advised that the environmental impacts and risks of locating a precinct in the James Price Point coastal area were likely to be manageable. The EPA advice was considered by the NDT in issuing its final advice on the preferred location of the Precinct.

Following the release of the EPA advice, the NDT issued a report recommending James Price Point as the preferred location (NDT, 2008d; **Appendix B-6**). Subsequently the Premier announced that the preferred site for the BLNG Precinct would be located in the vicinity of James Price Point.

Further work was then undertaken to determine the most suitable location for the BLNG Precinct within the James Price Point coastal area (**Part 2, Section 4.5.3**).

Numerous studies by both industry and Government agencies have been conducted and were used as input to identify potential suitable sites for gas processing in the Kimberley region. A summary of these investigations is provided in **Table 4-1**.

■ **Table 4-1 Summary of Site Selection Analysis Conducted.**

Date	Author	Description	Outcome
May 2008	GCA	Gaffney, Cline and Associates (GCA, 2008) were commissioned by the NDT to independently review the existing site selection processes undertaken by Browse Basin title holders and comment on the technical suitability of the sites considered to date in the context of a gas processing precinct. This included analysis of the use of the Burrup Peninsula and offshore options that would require floating LNG or gravity based structures. Refer to Appendix B-1 .	Site selection technical factors suggested by the industry for screening LNG sites were considered appropriate and comprehensive. Report recommended seven sites that could accommodate a gas processing hub, each with over 950ha of technically suitable land and a manageable marine environment. It concluded that there was insufficient land available for a new single operator on the Burrup, and that offshore options (Scott Reef and Echuca Shoals) which would require FLNG or Gravity Based Structure (GBS) required too many technical "firsts" to recommend them.
July 2008	NDT	Interim report (NDT, 2008a) which detailed the process and criteria to be used in the selection of a preferred site and provided a preliminary technical assessment of 43 sites previously identified by industry and Government as having some potential for development. Refer to Appendix B-2 .	Report recommended 11 sites for further evaluation of their suitability, based on an analysis of the technical and environmental constraints identified at each site.
October 2008	NDT	A two-part Site Evaluation Report (NDT, 2008b and NDT, 2008c) prepared following comprehensive site evaluation and stakeholder consultation involving representatives with professional expertise in oil and gas, the environment, heritage, fishing, pearling, planning, tourism and Aboriginal culture. Refer to Appendix B-3 and Appendix B-4 .	Report recommended four sites, all of which were supported by the Traditional Owners for further evaluation, as having the potential to be used as a site for a multi-user gas processing facility. The Site Evaluation Report was subject to a public comment period with 243 written and 46 verbal submissions received.
November 2008	WorleyParsons	WorleyParsons (2008), Browse Onshore LNG Precinct Browse Siting Study. The WorleyParsons study involved data collection, review and consolidation including engagement with industry to consolidate both current and prospective development plans to define the scale and potential timing of development within the BLNG Precinct. Information provided by various proponents during this phase of study was consolidated so as to be non-attributable to a given entity. The study included a site visit and technical review. Refer to Appendix B-5 .	Outcome of study fed into final NDT report.

Date	Author	Description	Outcome
December 2008	EPA	<p>EPA s16(e) advice (EPA, 2008)</p> <p>EPA provided independent advice on the NDT site evaluation process and the four sites short-listed for a LNG processing precinct in the Kimberley including:</p> <ul style="list-style-type: none"> James Price Point; Gourdon Bay; North Head; and Anjo Peninsula. 	<p>Based on the available data, the EPA considered that the environmental issues at James Price Point and Gourdon Bay were likely to be manageable. Gourdon Bay was considered the least environmentally constrained of the four sites for a gas processing precinct, while North Head and Anjo Peninsula were considered not suitable.</p>
December 2008	NDT	<p>Final Site Selection Report (NDT, 2008d) was released which made recommendations on the nomination of a preferred location in the Kimberley for the establishment of a multi-user LNG processing precinct.</p> <p>Findings were drawn from studies commissioned from WorleyParsons on the geotechnical suitability of sites and analysis of various development options outside the Kimberley and from the continuing assessment activities of State and Commonwealth government agencies. The comparison of sites for this report included a preliminary assessment of economic viability. Refer to Appendix B-6.</p>	<p>Report recommended James Price Point as the preferred location of BLNG Precinct.</p>
January 2009	GHD	<p>Comparative analysis of the Feasibility of Alternative Locations for the Development of a Liquefied Natural Gas Precinct (GHD, 2009a) was commissioned by SEWPAC (then the Commonwealth Department for the Environment, Heritage, Water and the Arts (DEWHA)) to provide an assessment of location options for a BLNG Precinct outside of the Kimberley. Options included:</p> <ul style="list-style-type: none"> Pilbara; Northern Territory; and Offshore. <p>Refer to Appendix B-7.</p>	<p>Fifty-six options for a Precinct location were evaluated. Any greenfields site greater than 500km from the gas field was determined to be prohibitively expensive.</p>
July 2010	WorleyParsons	<p>The Browse LNG Precinct Master Plan report (WorleyParsons, 2010) documents the basis of design and key features of the Browse LNG Precinct. It provides flexibility to users to negotiate a preferred plot plan with Government to accommodate varying technology options, approaches to design, construction and development methodologies, while maintaining well defined land and water parameters.</p> <p>Refer to Appendix B-8.</p>	<p>WorleyParsons prepared a Master Plan addressing the following key aspects of the precinct:</p> <ul style="list-style-type: none"> Gas processing technology and footprint scenarios; Numbers of potential proponents and how they might be integrated; Onshore laydown and construction support areas; LNG marine facilities; Corridors connecting key components of infrastructure; and Construction marine support facilities. <p>Importantly the Master Plan led to the agreement in December 2009 of an agreed footprint for the Precinct to the South of James Price Point.</p> <p>The Finalised Master Plan was released in September 2010.</p>

4.2. Site Options outside the Kimberley Region

The Strategic Assessment Agreement Terms of Reference requires “an analysis of technically and economically viable gas processing options outside the Kimberley, focusing on locations that already have substantial industrial infrastructure, inclusive of floating LNG”. An analysis of these options is provided in relation to environmental and social aspects as well as technical and economic aspects. It is important to note that the economic aspects necessarily cover potential benefits to and/or impacts on the State of WA and regional and local economies as well as economic aspects that relate to the commercial viability of options.

As well as the site visit report prepared by WorleyParsons which considered both Darwin and the Burrup Peninsula as options (WorleyParsons, 2008; **Appendix B-5**), the then DEWHA (now SEWPAC) engaged independent consultants GHD to prepare a comparative analysis of the feasibility of location options for the development of a common-user BLNG Precinct outside of the Kimberley region (GHD, 2009a; **Appendix B-7**). Sites within the Pilbara and Northern Territory were considered as well as offshore options such as floating LNG and gravity based structures. Opportunities and constraints of these options are summarised in **Table 4-2** and described below.

■ **Table 4-2 Identification of Issues and Constraints for Other Site Options.**

Region	Technical	Environmental	Social	Economical	Outcome
Pilbara					
Onslow region		<ul style="list-style-type: none"> No conservation parks/reserves around mainland; and No critical habitats identified under EPBC Act. 	<ul style="list-style-type: none"> No Aboriginal heritage sites identified from databases except near town of Onslow; and Opportunity for employment from Aboriginal communities. 		Not feasible
	<ul style="list-style-type: none"> Dredging volumes required; Risk of flooding; Land constraints given development of Ashburton north and proposed Wheatstone and Macedon projects; Distance from Browse Basin (~1200km); and Distance from existing industrial infrastructure in Pilbara. 	<ul style="list-style-type: none"> Mangrove communities in vicinity of mainland sites; Two islands on the Register of National Estate (RNE); and EPBC listed species potentially present. 	<ul style="list-style-type: none"> Native title extends over half the potential sites; Limited available labour in Onslow; and Services/ infrastructure in Onslow would require significant upgrading. 	<ul style="list-style-type: none"> Distance from Browse Basin (~1200km); and Significant infrastructure required. 	
Dampier/ Karratha	<ul style="list-style-type: none"> LNG infrastructure already established on Burrup Peninsula; Sites near Dampier have good access to deep water; and Good regional infrastructure established. 	<ul style="list-style-type: none"> No conservation parks/reserves around mainland; and No critical habitats identified under EPBC Act. 	<ul style="list-style-type: none"> Sizable employment base in Karratha. 	<ul style="list-style-type: none"> Some infrastructure already established. 	Unlikely to be feasible
	<ul style="list-style-type: none"> A range of dredging requirements for the sites; Space restrictions within lease boundaries; Shipping channel restrictions; Limited berth availability and available space to align trunkline and shore crossings; and Limited land area available for development. 	<ul style="list-style-type: none"> Burrup airshed levels approaching constraints with existing developers; Islands off Cape Preston are nature reserves; Dampier Archipelago is listed on National Heritage List; Marine environment of Dampier Archipelago affected by recreation and commercial activities; EPBC listed species may be present; Mangrove communities along coast; Beaches may be used by turtles; Burrup has diverse and unique vegetation ; Diversity of coral and fish species; and Offshore islands all on RNE. 	<ul style="list-style-type: none"> Fishing, boating and tourism may be affected; Native title over area still to be negotiated; Large number of registered Aboriginal sites; and A National Heritage Area is established over a significant area to protect Indigenous heritage including rock art. 	<ul style="list-style-type: none"> Distance from Browse Basin (~1200km). 	

Region	Technical	Environmental	Social	Economical	Outcome
Cape Lambert	<ul style="list-style-type: none">Existing shipping channel.	<ul style="list-style-type: none">No critical habitats identified under EPBC Act; andNo conservation/ marine reserves.			Unlikely to be feasible
	<ul style="list-style-type: none">Only 135ha available without impact on mangroves;10m deep water located 2.5km offshore; andApproximately 960km from Browse Basin.	<ul style="list-style-type: none">EPBC listed species may be present;Mangrove communities along coast; andOne island on RNE.	<ul style="list-style-type: none">Mainly zoned Rural and Strategic Industry;European cultural sites identified at Cossack;Native title over all sites; andSome registered Aboriginal sites.	<ul style="list-style-type: none">Located at a considerable distance from existing industrial infrastructure; andDistance from Browse Basin (~960km).	
Port Hedland	<ul style="list-style-type: none">Multi-user deep water port established; andSuitable land areas available.	<ul style="list-style-type: none">No marine parks adjacent to mainland; andNo critical habitats identified under EPBC Act.	<ul style="list-style-type: none">No European heritage sites identified ; andTown has better capacity than other regions to manage influx of personnel.		Not feasible
	<ul style="list-style-type: none">10m deep water not readily accessible apart from at port;≥10m elevated land close to the coast not available; andIn excess of 800km from the Browse Basin.	<ul style="list-style-type: none">Offshore islands are nature reserves; andEPBC listed species potentially present.	<ul style="list-style-type: none">Native Title over whole area; andRegistered Aboriginal sites.	<ul style="list-style-type: none">Distance from Browse Basin (~800km).	
Darwin					
Middle Arm	<ul style="list-style-type: none">Infrastructure exists including all weather access, power and rail; andOnly minor dredging required.	<ul style="list-style-type: none">Only minor dredging required.	<ul style="list-style-type: none">Darwin and Palmerston have capacity to provide local labour and services.	<ul style="list-style-type: none">Existing infrastructure allows for some synergies in development.	Potentially feasible
	<ul style="list-style-type: none">Available land is limited in size: rezoning of land would be required; andWould require construction of a pipeline up to 930km in length.	<ul style="list-style-type: none">Monsoon vine thicket and mangrove communities zoned for conservation;Northern quoll recorded;Other EPBC listed species may be present;May result in loss of saltwater crocodile habitat; andPotential for Acid Sulphate Soils to occur.	<ul style="list-style-type: none">Number of archaeological sites.	<ul style="list-style-type: none">Distance from Browse Basin (~930km); andUpgrading of existing infrastructure required.	

Region	Technical	Environmental	Social	Economical	Outcome
Glyde Point		<ul style="list-style-type: none">Does not appear to be of major significance to whales or dolphins.		<ul style="list-style-type: none">Distance from Browse Basin.	Not feasible
	<ul style="list-style-type: none">Dredging volumes required;Possible presence of WWII unexploded ordnances;Would require construction of over 900km of pipeline; andNo existing infrastructure or services.	<ul style="list-style-type: none">Contains an environmentally sensitive area;EPBC listed species may be present;Howard Springs toadlet recorded;May result in loss of saltwater crocodile habitat ;Potential for acid sulphate soils (PASS) to occur; andProposed marine park in vicinity.	<ul style="list-style-type: none">Native title not resolved;Includes site on NT Heritage Register ;Glyde Point is zoned public open space and would require rezoning; andApproximately 90km from nearest community and services.	<ul style="list-style-type: none">Distance from Browse Basin (~900km); andGreenfield Site.	
Bynoe Harbour					Not feasible
	<ul style="list-style-type: none">Potential for conflict of industries;Would require construction of over 800km of pipeline;Considerable dredge length to navigable waters; andNo existing infrastructure or services.	<ul style="list-style-type: none">Contains subtidal reefs and largest known seagrass bed west of Darwin;Areas proposed to be a marine park by NT government; andEPBC listed species may be present.	<ul style="list-style-type: none">No registered Aboriginal sitesNo nearby communities to provide labour or services; andZoned rural and would require rezoning.	<ul style="list-style-type: none">Distance from Browse Basin (~800km); andGreenfield site.	
Offshore					
FLNG	<ul style="list-style-type: none">Increased gas use efficiency.	<ul style="list-style-type: none">Environmental footprint limited to moorings and subsea pipelines;Can be located to avoid conservation areas completely; andImpact on benthic primary producer habitat (BPPH) is anticipated to be short-term and recolonisation likely after completion of construction.	<ul style="list-style-type: none">Pressure on towns and communities mitigated through fly-in/fly-out; andRemote location could minimise impact on other land and marine businesses already in operation.	<ul style="list-style-type: none">Option is considered to reduce costs as long pipelines not required; andIncreased operational costs.	Not feasible

Region	Technical	Environmental	Social	Economical	Outcome
	<ul style="list-style-type: none"> Reliability more affected by weather and environmental conditions than a land-based facility; Capacity is smaller (1-5Mtpa) therefore not appropriate for a BLNG Precinct; Unproven technology; and Higher risk of loss of containment. 	<ul style="list-style-type: none"> Risk of loss of containment and resulting contamination of surrounding waters; Stormwater management is limited; and Potential for impact on EPBC listed species. 	<ul style="list-style-type: none"> Limited evacuation potential due to remote location. 	<ul style="list-style-type: none"> May require marine and airport upgrades in nearby towns; and Very little opportunity for synergy. 	
GBS	<ul style="list-style-type: none"> Provides additional protection against vessel collision by reducing vessel movement. 	<ul style="list-style-type: none"> Impact on BPPH is anticipated to be short-term and recolonisation likely after completion of construction; and Can incorporate CO₂ capture with sequestration. 	<ul style="list-style-type: none"> Remote location could minimise impact on other land and marine businesses already in operation. 	<ul style="list-style-type: none"> More than one LNG facility could be located on a GBS, making shared maintenance and utility services possible. 	Not feasible
	<ul style="list-style-type: none"> Shallower positioning may increase occurrence of wave action. 	<ul style="list-style-type: none"> Potential for impact on EPBC listed species; Environmental footprint greater than FLNG; Reduced vessel motion and therefore reduced risk of loss of containment; and Smothering of benthos may occur during construction and day to day operation. 	<ul style="list-style-type: none"> Limited evacuation potential due to remote location. 		

Source: Adapted from GHD, 2009a; **Appendix B-7**.

Key

	Positive
	Negative

4.2.1. Onshore Options

4.2.1.1. Pilbara

The Pilbara offers numerous sites that may be technically viable, however, many of these sites would be prohibitively expensive to develop as they are greenfield sites greater than 500km from the gas fields. Economic analysis has concluded that a site greater than 500km from the gas field may be viable but only if it is in an existing developed area with services (such as brownfield sites). Pipelines longer than 500km are likely to require compressor stations along the route, thereby adding to the cost of development. Longer pipeline distances involve more changes in sea floor elevations which can affect the physical properties of liquids in the gas. This can lead to significant operational difficulties. GCA (2008) (**Appendix B-1**) concluded that, for economic and energy efficiency reasons, the distance to the BLNG Precinct from the fields should be 400 to 500km, at a maximum. A secondary environmental cost of transporting the gas the additional distance would be generation of additional CO₂ emissions associated with the compressor stations.

Sites within the Pilbara that may be economically feasible as a location for the BLNG Precinct are limited to those sites with existing industrial infrastructure, as this will assist in offsetting the additional costs of the longer pipelines.

A number of Pilbara sites were evaluated by GHD (2009a) (**Appendix B-7**) including:

- Onslow region;
- Dampier/Karratha (Burrup Peninsula);
- Cape Lambert; and
- Port Hedland.

Port Hedland offers brownfield industrial development sites but does not have deep water nor does it have land more than 10m above sea level close to the coast. Cape Lambert and the Burrup Peninsula meet the basic marine and terrestrial criteria as a site for LNG processing, with the Burrup offering the advantage of existing LNG infrastructure and the availability of disturbed industrial land with developed port facilities and shipping channels. However, these brownfield sites are likely to be constrained by other technical aspects and environmental and heritage impacts (GHD, 2009a; **Appendix B-7**). Whilst it may be economically feasible for a developer such as Woodside to use a brownfield site in the Burrup, as it already has existing operations, this will not be the case for the many other potential developers in the Browse Basin as they do not hold an interest in any existing brownfield sites outside the Kimberley.

Recent consultation indicates that the local facilities and services of Karratha and Dampier are already under significant stress due to rapid population growth caused by the primary resources expansion. Development on the Burrup or at Cape Lambert could further exacerbate these problems (GHD, 2009a; **Appendix B-7**). From a State perspective the economic benefits that further growth in the LNG sector would bring are likely to be more beneficial to the Kimberley region than to the Pilbara region which already has a significant and diverse economy from the minerals and petroleum sectors.

Both WorleyParsons (2008) (**Appendix B-5**) and GHD (2009a) (**Appendix B-7**) concluded that, although the Pilbara Region generally, and the Burrup Peninsula in particular, remained an option, it is less attractive than development in the Kimberley region due to economic and development issues and the marginal reduction, if any, that could be achieved in net environmental and heritage impacts over the short-listed sites in the Kimberley. It is inevitable that proposed developers in the Browse Basin will require a Kimberley coastline location to process their gas at some point of time in the future and will apply to the State and Commonwealth regulatory agencies for such a proposal.

4.2.1.2. Northern Territory

Potential BLNG Precinct locations are limited in the Northern Territory and the following three sites were considered by GHD (2009a) (**Appendix B-7**):

- Middle Arm;
- Glyde Point; and
- Bynoe Harbour.

Both Glyde Point and Bynoe Harbour were greenfield sites with no existing infrastructure. Development of a greenfields site beyond 500km from the resource is considered cost prohibitive due to the length of the pipeline and additional infrastructure such as compressor stations required. These Northern Territory sites are over 800km from the Browse Basin and therefore the two greenfields sites were excluded from further consideration.

Middle Arm is the most viable site option in the Northern Territory due to the presence of existing infrastructure to support LNG production. However, a project of this size would affect port and harbour operability, which could require substantial upgrades or other changes. There are both environmental and operational constraints that reduce the suitability of the Middle Arm site. The site is in close proximity to mangroves and vine thickets and supports saltwater crocodile habitat.

From a State perspective it is also clearly less than desirable for the substantial economic and social benefits that would flow from the BLNG Precinct development to go to the Northern Territory rather than to Western Australia.

4.2.2. Offshore Options

GHD (2009a) (**Appendix B-7**) indicates that offshore LNG facilities such as floating LNG or GBS offer several advantages over land based LNG facilities including reduced environmental footprint, reduced pipeline costs and increased energy efficiency. However, both technologies also have significant limitations that make them unsuitable for the BLNG application, at the scale required.

FLNGs are a relatively new technology and no commercially operated facility is currently in use. Typical individual FLNG facilities are being designed to process from 1 to 2Mtpa with the largest proposed FLNG being designed to process up to 4Mtpa of LNG and condensate. While larger FLNG facilities have been discussed, none have been designed or constructed. FLNG systems are typically proposed for small or stranded gas fields that cannot be accessed otherwise. The use of FLNG for fields with larger reserves and with feasible, land-based production facilities, are not economical. For comparison, typical export scale units can produce between 2.5 and 8Mtpa, and can be combined to support a multi-user BLNG Precinct with an ultimate capacity of up to 50Mtpa.

GBS facilities have a greater capacity than FLNG facilities and more than one LNG facility could be located on a GBS. However, they are restricted to shallow water and are most suitable for relatively benign oceanic conditions. While multiple GBSs can be combined, it would not be economically viable to develop the capacity envisioned for the BLNG Precinct. Thus, for either offshore option, each producer would be likely to make individual investments in facilities, which would yield limited opportunity for synergy. At this stage, the developing technologies are not suitable for large gas resources such as the Browse Basin gas fields (GHD 2009a; **Appendix B-7**).

The use of GBS was one option considered by Woodside which proposed locating the facility at Scott Reef which lies within the Browse Basin. In its evaluation of this option, GCA (2008) (**Appendix B-1**) noted that the technology required had not been demonstrated and that any proposal to move directly to a precinct scale should be seriously questioned. GCA (2008) (**Appendix B-1**) also noted that INPEX had considered an offshore site at Echuca Shoals and had ruled it out on the basis of the significant technical challenges it presented.

Neither of these offshore options would provide the synergistic benefits of a combined gas processing facility that is one of the primary objectives of this strategic proposal. Offshore development would further limit the economic benefits to Western Australia from both operation and construction as it is most likely that FLNG or GBS would be built overseas and transported directly to site.

4.3. Initial Filtering of Kimberley Sites

The NDT commenced its process of site selection by commissioning GCA to undertake an independent review of the work previously undertaken by Inpex and Woodside to identify potentially suitable sites (GCA, 2008; **Appendix B-1**). The NDT requested that GCA review technical criteria used by Inpex and Woodside in its screening of some 43 Kimberley sites (shown in **Figure 4-2**) and to conduct their own evaluation of sites previously short-listed by industry. This evaluation was based on technical viability only, which was a combination of the engineering and economic criteria outlined in **Table 4-3**.

GCA concluded that the criteria used by industry in their single operator LNG plant site selection process were “appropriate and comprehensive”. On this basis, GCA adapted the technical criteria and utilised these criteria in their independent assessment of a range of sites within the Kimberley to determine their technical viability (**Table 4-3**). GCA also considered whether each site had sufficient land area for a stand-alone plant (300ha), a multi-operator plant site (600ha) and a gas processing hub site (950ha).

The analysis undertaken by GCA was consistent with previous conclusions by industry and confirmed that the vast majority of sites previously deemed technically unsuitable should not be investigated further. GCA identified seven locations that could accommodate a gas processing precinct, with over 950ha of technically suitable land with a manageable marine environment:

- Bigge Island;
- Wilson Point;
- Cape Leveque;
- North Head/Perpendicular Head;
- Packer Island;
- Quondong Point; and
- Fisherman’s Bend.

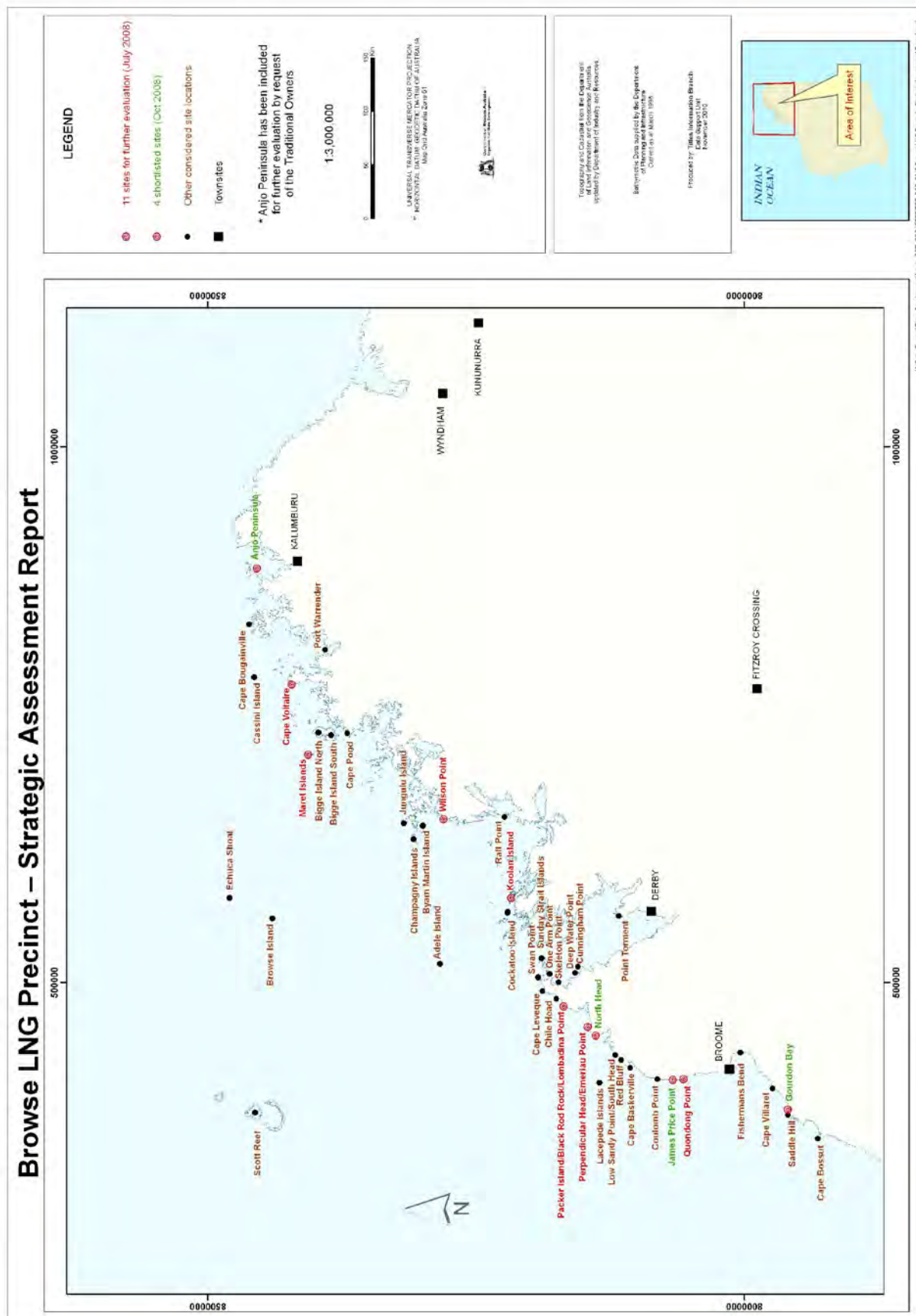
GCA only addressed technical viability in their analysis and some sites identified as viable had already been rejected by industry due to environmental or socio-economic constraints. These rejected sites included Bigge Island, Champagney Island, Fisherman’s Bend and Cape Leveque.

Using results from the GCA analysis and previous work by Inpex and Woodside, the NDT identified the following nine sites for further technical investigation and assessment related to Aboriginal heritage and cultural values and environmental constraints:

- Gourdon Bay;
- Quondong Point;
- James Price Point;
- North Head;
- Perpendicular Head;
- Packer Island;
- Koolan Island;
- Wilson Point; and
- Maret Islands.

The NDT included some sites that only offer sufficient land area for a single operator LNG plant and would not meet the land area criteria for a BLNG Precinct.

In addition to the above sites, the Traditional Owner Taskforce, established by the KLC, requested that the NDT reconsider Cape Voltaire and evaluate the Anjo Peninsula situated north of Cape Bougainville for a potential site.



■ Figure 4-2 Locations Considered for BLNG Precinct.

■ **Table 4-3 Technical Criteria Used in Initial Site Selection.**

Aspect	Criteria
Location	<ul style="list-style-type: none"> Close as feasible to gas field (pipeline distances greater than 250-300km were likely to require an off-shore platform to strip water and condensate from the gas and distances greater than 500km were likely to require an additional gas compression stage and infrastructure). Maximum distance from the LNG plant to the LNG storage tanks should be no more than 5km. Maximum distance from the storage tanks to the loading berth should be no more than 5km. An optimum distance would be 1km for each. Proximity to geological formations potentially suitable for the sequestration of CO₂ gas.
Land area requirements	<ul style="list-style-type: none"> A gas processing hub of up to 10 trains allowing for some downstream processing would require in excess of 950ha. Additional land would be required for a construction lay-down area and work camp.
Terrestrial site characteristics	<ul style="list-style-type: none"> Elevation above 10-20m Australian Height Datum (AHD) to protect hub from surge tides and extreme weather events. Elevated site close to coast (<4km to loading facilities –to limit length of the cryogenic gas line). Reasonably level site to minimise earth works and ground disturbance (approx 300+ha for a single operator site). Geotechnical stability and workability, sands/rock to reduce piling requirements. Land slope less than five degrees at plant location.
Marine site characteristics	<ul style="list-style-type: none"> Deep water (14m) access at port with limited need for dredging. Site should have capacity for: <ol style="list-style-type: none"> port/jetty capacity for multiple berths and jetty length <2km; 15m draft berth box to accommodate the anticipated mix of vessels associated with an LNG hub; and 700m swing basin and, should a channel need to be dredged, a minimum channel width of 300m. Reasonable shelter from long duration swell waves, minimal breakwater requirement. Substrate suitable for port infrastructure. Low ocean currents required for safe shipping ingress and exit. Wave heights and periods within acceptable range for berthing and port access. Suitable shoreline access for gas pipelines. Acceptable maximum currents for LNG carrier manoeuvring (Woodside study): <ol style="list-style-type: none"> cross current for channel transit: 1 knot (kn); cross current alongside jetty for berthing: 0.6kn; along berthing line when moored: 5.0kn; and cross current when moored: 0.8kn.
Domestic gas requirements	<ul style="list-style-type: none"> Ability to include domestic gas delivery options including domestic gas pipeline corridors.

Source: NDT, 2008a; **Appendix B-2.**

4.4. Short-listing of Technically Viable Sites

The nine sites previously identified as technically viable plus the two sites requested to be included by the KLC were then further evaluated in the context of their environmental, heritage, technical and socio-economic constraints.

4.4.1. Methodology

The objective of the evaluation was to determine the extent of any key environmental, heritage, technical and socio-economic constraints of each site in relation to the development of a BLNG Precinct. The studies undertaken to support the assessment were:

- DEC 2008, Preliminary Reconnaissance Survey of Benthic Habitats in the Anjo Peninsula, Kimberley Bioregion. Western Australia, Prepared by the Marine Ecosystems Branch for the NDT, October 2008.
- Fry *et al.* 2008 (**Appendix C-4**), Benthic habitat surveys of potential LNG hub locations in the Kimberley region, Prepared for the Western Australian Marine Science Institution on behalf of the NDT, October 2008.
- Western Australian Museum 2008, Intertidal Habitats of Selected Sites in the Canning Bioregion – Preliminary Field Results, Prepared for the NDT, June 2008.
- Holley and Prince 2008, Data Report – Report No. 2008-03 Historical datasets of dugong (*Dugong dugon*) Observations in the Kimberley Region of Western Australia, Edith Cowan University and DEC.
- Eliot & Eliot 2008, Coastal Geomorphology: Proposed LNG Hub Locations in the Kimberley Region Western Australia, Prepared for the NDT, Damara WA Pty Ltd, September 2008.
- ENV Australia 2008a (**Appendix C-14**), Perpendicular Head-North Head, Packer Island, Coulomb-Quondong, and Gourdon Bay Vegetation Assessment, Prepared for DoIR, October 2008.
- ENV Australia 2008b (**Appendix C-15**), Perpendicular Head-North Head, Packer Island, Coulomb-Quondong, and Gourdon Bay Flora Assessment, Prepared for DoIR, October 2008.
- ENV Australia 2008c (**Appendix C-16**), Perpendicular Head-North Head, Packer Island, Coulomb-Quondong, and Gourdon Bay Terrestrial Fauna Assessment, Prepared for DoIR, October 2008.
- ENV Australia 2008d, Anjo Peninsula Flora and Vegetation Assessment, Prepared for DoIR, October 2008.
- Hammond, R. 2008, Visual Landscape Study, Prepared for NDT.

4.4.1.1. Selection Criteria

The NDT developed a site-selection methodology and, jointly with DEWHA (now SEWPAC), identified site-selection criteria derived from best practice models used previously by industry and government. The site selection criteria were incorporated into a multi-criteria matrix to facilitate a qualitative comparison of the potential impacts of the BLNG Precinct at the 11 sites identified in the interim NDT report (NDT, 2008a; **Appendix B-2**).

The site-selection criteria were released for four weeks of public comment (together with the Commonwealth draft Terms of Reference) and subsequently modified.

The final site selection criteria were an annexure to the Strategic Assessment Agreement between the State and Commonwealth governments.

4.4.1.2. Independent Assessment against Agreed Site Selection Criteria

Two independent site evaluations were undertaken:

- 1) An assessment by an Independent Assessment Group; and
- 2) A site evaluation panel set up as an inter-agency panel to report directly to the NDT.

The Independent Assessment Group included nominated representatives from each of the working groups formed to review and provide feedback on particular issues. The working groups were set up in August 2007 and included:

- Three environmental working groups:
 - 1) marine experts;
 - 2) terrestrial experts; and
 - 3) general.
- Community reference group;
- Fisheries working group; and
- Industry reference group.

The membership of each group is outlined in NDT (2008a) (**Appendix B-2**). The Terms of Reference for all groups is listed in (NDT, 2008a; **Appendix B-2**) and included:

- review of draft site selection criteria and consideration of a short list of sites based on available information;
- identification of a preferred site; and
- consultation during strategic environmental assessment processes for review of a preferred Precinct site, and review of national heritage values.

The working groups provided input through the Independent Assessment Group. Their assessment of the 11 sites was published in an appendix of the Site Evaluation Report (NDT, 2008b; **Appendix B-3** and NDT, 2008c; **Appendix B-4**). The key issues identified through the process are also documented in the NDT Interim Report (NDT 2008a; **Appendix B-2**).

The Site Evaluation Panel reported directly to the NDT and was made up of senior officers with relevant expertise from a range of government departments and organisations including:

- Department of State Development;
- Department of Environment and Conservation;
- Department of Indigenous Affairs (**DIA**);
- Department of Planning;
- Office of Native Title (**ONT**);
- Department of Fisheries (**DoF**);
- Tourism Western Australia;
- LandCorp;
- The Heritage Council; and
- Kimberley Development Commission.

4.4.2. NDT Site Evaluation Report

Each of the 11 sites identified in the NDT Interim Report was assessed and the environmental constraints, technical attributes and socio-economic impacts of each site was rated on a qualitative scale, ranging from “advantage major” to “disadvantage significant.” The results of each assessment were shown in a matrix included in the Site Evaluation Reports (NDT, 2008b; **Appendix B-3** and NDT, 2008c; **Appendix B-4**).

The NDT Site Evaluation Reports (NDT, 2008b; **Appendix B-3** and NDT, 2008c; **Appendix B-4**) were released for a 28-day public comment period from 15 October to 11 November 2008.

All sites assessed had significant disadvantages for at least one criterion. Most sites were assessed as having a significant impact on either land-based or marine-based tourism except for Koolan Island and Anjo Peninsula. However, Koolan Island was disregarded as a potential site as it does not have enough land available for a LNG Precinct. Maret Islands were also ruled out primarily because there is insufficient land to meet the area requirements of a LNG Precinct.

Several sites were assessed as being unsuitable due to a combination of significant environmental, Aboriginal heritage, technical and tourism constraints. A summary of the findings is presented below.

- a) **Packer Island:** presence of sensitive ecological communities such as mangrove forests, tidal creeks, monsoonal vine thickets and mobile dunes. It is also an aggregation area for humpback whale cows and calves. The area also has Aboriginal cultural significance and development of the site was not supported by the Traditional Owners. The area would require significant site works as the coastal geomorphology is seen as unstable and low-lying lands near the coast would require infill.
- b) **Wilson Point:** lies within Camden Sound area, which is recognised as a central humpback whale calving ground. The area is within a region of outstanding natural, indigenous and historical values, which potentially include values that may meet criteria for national and possibly international heritage listing. The cost, difficulty and impact of creating 1000ha of level land were also considered to be prohibitive.
- c) **Cape Voltaire:** road access to such a remote location would introduce a range of environmental risks, including pests and weeds to a region of outstanding natural, indigenous and historical values. These have the potential to include values that may meet criteria for national and possibly international heritage listing. The tourism industry also believes that development of this site would have a major undermining impact on marine tourism in this area.
- d) **North Head and Perpendicular Head:** are close to each other and their assessments were very similar. Both were considered technically viable, however only North Head was selected to undergo further evaluation of site suitability as it was considered less constrained than Perpendicular Head. Perpendicular Head has a larger number of Aboriginal outstations near to the site and is likely to be important as dugong habitat. NDT recognised that North Head would need very innovative design and operational strategies to avoid significant impact on the whole of the north of the Dampier Peninsula, as it is situated within a whale migration aggregation area. Moreover, the development would be in conflict with the Aboriginal tourism sector.
- e) **James Price Point, Quondong Point and Gourdon Bay:** were assessed as being the only sites that did not have any significant disadvantages in regard to the environmental criteria, both by the Site Evaluation Panel and the Independent Assessment Panel. Quondong Point was ruled out from further evaluation, as James Price Point was deemed the more suitable location in the same coastal area.

Based on the site evaluation criteria, James Price Point, Gourdon Bay, North Head and Anjo Peninsula were selected for further evaluation of site suitability. The assessment of Anjo Peninsula could not be completed at this stage of the selection process as on-ground technical and environmental studies were not yet completed.

4.5. Determination of a Preferred Site

The NDT undertook further evaluation of the four selected sites by engaging WorleyParsons Services Pty Ltd to undertake geotechnical assessments of the sites, complete environmental studies and hold further consultations with industry, the KLC, Aboriginal communities and Local Government. The comparison of sites also included a preliminary assessment of the economic viability of the sites alongside those criteria used in the site evaluation process.

The NDT also considered the advice of the EPA on the four shortlisted sites. Their assessment and conclusions are presented in the final report (NDT, 2008d; **Appendix B-6**).

4.5.1. Methodology

The *Browse On-shore LNG Precinct Siting Study* (WorleyParsons, 2008; **Appendix B-5**) investigated key opportunities and constraints associated with each site based on geotechnical studies and project definition information from potential gas processing proponents. For the purpose of the study, WorleyParsons assumed that the BLNG Precinct would allow for the co-location of at least two LNG processing operators sharing non-processing critical infrastructure.

WorleyParsons developed guiding principles for the near-shore and on-shore aspects of the development:

- Nearshore
 - 1) The location of on shore infrastructure to be determined by closest access to deep water (required to minimise dredging and the length of shipping channels);
 - 2) The provision of breakwaters where required to ensure a target berth operability of 98 percent;
 - 3) The provision of a single common user turning basin, shipping channel, Marine Facility and tug boat pens; and
 - 4) The use of single user LNG loading facilities to ensure processing efficiency.
- Onshore
 - 1) The location of LNG storage tanks to be as close as practical to the jetty location and berth;
 - 2) The location of the LNG trains to be in-line with prevailing winds to assist with cooling of the plant;
 - 3) The location of the LNG trains to be in close proximity to the LNG storage tanks; and
 - 4) The accommodation and air support infrastructure to be shared between operators.

The environmental evaluation of the final four sites was based on advice provided by the EPA in accordance with Section 16(e) of the EP Act, advice from DEWHA (now SEWPAC), input from public comments received on the previous NDT site evaluation reports and further consultation with the KLC and Traditional Owners.

A preliminary review of the social impacts associated with each site was also undertaken during this process.

4.5.2. The Preferred Site

Table 4-4 outlines the key constraints of each site. It was used as the basis of the rationale for the selection of the preferred site. James Price Point was determined to be the preferred location for a LNG Precinct as it was the only site where all identified constraints were considered manageable and has several advantages over other sites on environmental, Indigenous, socio-economic, community, tourism and technical grounds. The rationale for the preference of James Price Point over the other three sites includes:

- 1) North Head was considered more economically viable than James Price Point as it is closer to the gas fields and access to deep water is close to the coast. However, it was ruled out as an option due to environmental and social constraints. North Head is close to whale calving and resting grounds and dugong habitat. The EPA considered that the environmental risks are unlikely to be readily or reliably manageable in this area. Development of North Head is also likely to have significant social impacts on Aboriginal communities and outstations in the vicinity of the site. Some of these outstations within 10km of the site may have to be closed down, to ensure that societal risk and ambient air quality standards could be met.
- 2) Anjo Peninsula has the advantage of being able to provide adequate port capacity and land area to support downstream processing and does not require the construction of a breakwater. However, it would require more than 500km of gas pipeline to service the Woodside gas fields in the Browse Basin, which makes the site less economically viable than James Price Point. The isolation of Anjo Peninsula would make providing community services difficult compared to other sites. The EPA concluded that Anjo Peninsula is not suitable for large scale industrial development because of both environmental and wilderness values. Anjo Peninsula was not selected as a preferred site on this basis.
- 3) The EPA considered that environmental risks and impacts are likely to be manageable for a 1000ha precinct at both James Price Point and Gourdon Bay. However, James Price Point was selected as the preferred site over Gourdon Bay for the following reasons:
 - a) Aboriginal outstations in the vicinity of Gourdon Bay may need to be relocated to ensure that societal risk and ambient air quality standards could be met, whereas the James Price Point site should have limited direct social impact on Aboriginal and other communities as there is no permanent population within 20km of the proposed site.

- b) Gourdon Bay would require at least 500km of pipeline from the Ichthys gas field and would be likely to require compressor stations along the route, making it a more expensive option than James Price Point.
- c) James Price Point is relatively close to social and community infrastructure (Broome is 60km away), therefore, duplication of infrastructure can be minimised. Gourdon Bay is 140 km south of Broome and would likely require duplication of infrastructure such as airports, service industries and waste management.
- d) James Price Point has the port capacity and land area to support downstream processing, while Gourdon Bay does not.
- e) James Price Point offers terrestrial flexibility of location to assist with optimisation of port access while also allowing for design solutions to limit impact on Aboriginal heritage sites.

4.5.3. Selection of Location near James Price Point

Three site options near James Price Point were considered for the LNG Precinct, the first based on a shore crossing north of James Price Point (northern option) and the second and third based on a shore crossing south of James Price Point (southern option). In December 2009, the Premier officially announced the agreed location of the LNG Precinct immediately south of James Price Point, with Traditional Owner approval.

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■ **Table 4-4 Final Site Evaluation – Constraints.**

Location	Technical		Economic	Environment		Heritage		Indigenous Impact	Socio-economic
	Marine	Terrestrial		Marine	Terrestrial	Natural	Indigenous		
Anjo Peninsula	<ul style="list-style-type: none"> Gas pipeline of >500km required to service Woodside Browse Project. 	<ul style="list-style-type: none"> No road access; Nearest existing social infrastructure is 310km away (Kununurra); and Lack of groundwater. 	<ul style="list-style-type: none"> Although no breakwater required, distance from Woodside gas field (>500km) and lack of social infrastructure makes this site less economically viable than other sites. 	<ul style="list-style-type: none"> Likely to support migratory species of NES. 	<ul style="list-style-type: none"> Considered part of Kimberley Wilderness Area; and Area of high biodiversity. 	<ul style="list-style-type: none"> Within a region of likely national heritage value. 	<ul style="list-style-type: none"> Sandstone outcrops contain numerous examples of Bradshaw and Wanjinna rock art. 	<ul style="list-style-type: none"> Site supported by Traditional Owners; Subject to the WanjinnaWunggurJunguu Native Title claim; and Land is reserved for the use and benefit of Aboriginal people. 	<ul style="list-style-type: none"> Remote (230km from Wyndham and 621km from Broome) with no site access – provision of community services to site would be difficult; Within wilderness tourism region; Limited positive impact on broader Kimberley economy due to isolation; and Fly-in-fly-out workforce operation.
North Head	<ul style="list-style-type: none"> Significant dredging required; and Single breakwater required. 	<ul style="list-style-type: none"> Access to the port site constrained due to landform of headland; Likely to be only suitable for two operators and only for processing LNG; Setback of 200m required due to presence of unstable limestone cliffs and reefs; Reefs will affect pipeline approaches to the area; and Site could be cut off from Broome in extreme wet season conditions. 	<ul style="list-style-type: none"> Closest site to gas fields (maximum 310km) makes this site more economically viable than other sites. 	<ul style="list-style-type: none"> Situated on southern end of whale calving/resting grounds; Dugong habitat; Relatively complex and diverse benthic habitats; and Lacepede Islands (A class nature reserve) 35km from site. 	<ul style="list-style-type: none"> Air quality risks to Indigenous settlements in proximity to site. 	<ul style="list-style-type: none"> Situated on southern end of the whale calving/resting grounds. 	<ul style="list-style-type: none"> Aboriginal cultural and heritage significance. 	<ul style="list-style-type: none"> Close proximity to Aboriginal outstations and communities; Aboriginal Reserve lands with existing long term leases; Native title over the area is pending (NyulNyul); Area is subject to a reservation that the land be used for the use and benefit of Aboriginal people; Area is the focus of Aboriginal customary practice and important source of healthy food for the communities. 	<ul style="list-style-type: none"> Close proximity to ecotourism, pearling and fishing activities; Limited community/social infrastructure; and Distance from Broome (150km) may lead to need to duplicate infrastructure.
James Price Point	<ul style="list-style-type: none"> Distance to deep water ranges from 5.2km to 9.5km therefore significant dredging required; and Requires a significant breakwater. 	<ul style="list-style-type: none"> Limited constraints. 	<ul style="list-style-type: none"> Economically manageable due to maximum distance of 390km to gas fields. 	<ul style="list-style-type: none"> Whales, dugongs and billfish present along whole coastline in vicinity of the site; and Fish aggregation areas. 	<ul style="list-style-type: none"> Interference with drainage lines, potentially altering surrounding vegetation; Presence of vine thickets; and Habitat for migratory birds. 	<ul style="list-style-type: none"> Whales, dugongs and billfish present along whole coastline in vicinity of the site. 	<ul style="list-style-type: none"> Aboriginal and cultural heritage significance (song line and sites). 	<ul style="list-style-type: none"> Subject to the Goolarabooloo/JabirrJabirr Native Title claim. 	<ul style="list-style-type: none"> Potential impact on housing and accommodation in Broome; and Potential impact on pearling and tourism.
Gourdon Bay	<ul style="list-style-type: none"> Would require ≥500km of pipeline to Ichthys and 450km of pipeline to Woodside, therefore would require gas compression ; Variable bathymetry will affect the scale of dredging required; and Requires a significant breakwater. 	<ul style="list-style-type: none"> Constricted land area will limit site to a maximum of two LNG operators; Parts of land below the 10m elevation deemed necessary to ensure protection from extreme tide surge events; and Area more prone to cyclone risks than other sites. 	<ul style="list-style-type: none"> Length of pipeline (≥500km) and likely need for compressor stations, along with the need for a breakwater makes this site the least economically viable. 	<ul style="list-style-type: none"> Limited constraints. 	<ul style="list-style-type: none"> Located between two Ramsar wetlands (very important for migratory shorebirds); and Potential interference with drainage lines and freshwater soak. 	<ul style="list-style-type: none"> Limited constraints. 	<ul style="list-style-type: none"> Aboriginal cultural and mythological significance. 	<ul style="list-style-type: none"> Close proximity to Aboriginal communities and outstations; and Subject to exclusive possession Native Title rights. 	<ul style="list-style-type: none"> Distance from Broome (140km) may lead to duplication of infrastructure.

Source: Adapted from NDT, 2008d; **Appendix B-6.**

Key

	Significant constraints
	Constrained but manageable
	Limited constraints

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A shore crossing south of James Price Point was agreed by Traditional Owners for development of the BLNG Precinct and has the following relative advantages:

- 1) **Reduced construction cost:** Deeper water near the coast would substantially reduce the amount and costs of dredging required by comparison to the northern option. Preliminary estimates indicate the dredging volume for the southern option would be less than half the volume for the northern option.
- 2) **Less biological impact:** Impacts on Benthic Primary Producers (**BPP**) and other marine habitats would be less.
- 3) **Less blasting:** Significantly less rock would need to be blasted in the southern option during construction of the shipping channel due to the decreased width of the wave cut platform in this location (approximately 1km compared to 2.5km in the northern option). The estimated blast volume for the northern option would be about 12 times that required for the southern option.
- 4) **Minimised heritage impact:** Due to the size of the BLNG Precinct, impacts on registered Aboriginal heritage sites could be managed.
- 5) **Shorter access road:** The southern option allows a shorter distance for road access to the BLNG Precinct from the Broome Road, thus minimising the vegetation clearing required.
- 6) **Lower land requirement for construction:** The northern option is likely to have pindan down to a greater depth, which makes construction of the foundations more difficult and is likely to result in a larger land area requirement for construction.
- 7) **Less potential requirement for shoreline stabilisation:** The northern option is more exposed and is likely to have a less stable shoreline.

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5. Description of Activities and Facilities under the Precinct Plan (Category A)

This section provides a description of BLNG Precinct activities and facilities, including descriptions of the development scenarios, major BLNG Precinct components, and activities relating to the construction, commissioning, operation and decommissioning of facilities that may occur under the Precinct Plan. Indirect activities and projects related to the development of the BLNG Precinct are described in **Section 6**.

The key facilities under the Precinct Plan are shown in **Table 5-1**.

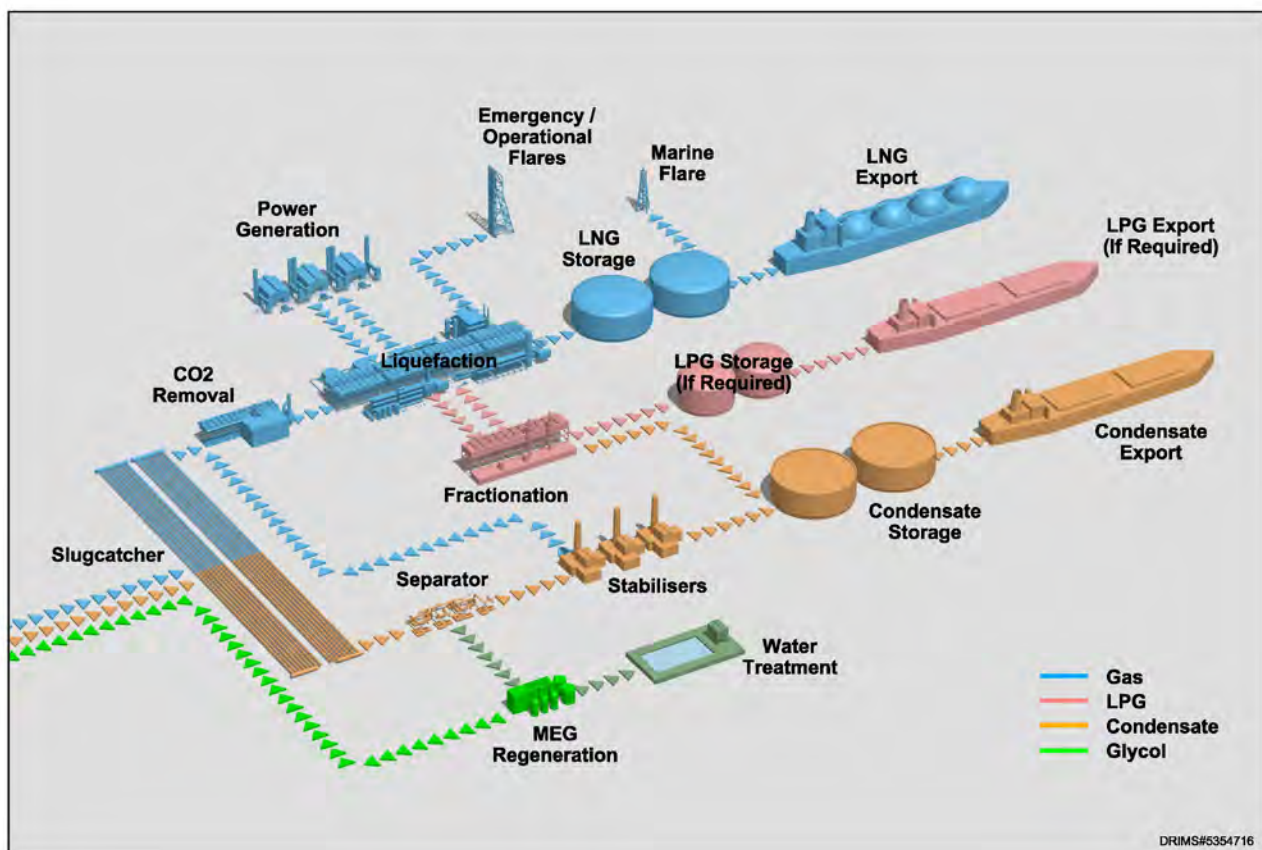
■ **Table 5-1 Key Characteristics Table of Facilities under the Precinct Plan (Category A).**

Activity Zone (see Figure 5-2)	Activity	Description of Activity
1	LNG-related hydrocarbon processing	<p>Production facilities, including:</p> <ul style="list-style-type: none"> Facilities for the receipt, transportation, and processing of hydrocarbons, including pre-treatment, conditioning, compressing and liquefaction of gas to produce Liquefied Natural Gas (LNG) and other hydrocarbon products such as condensate and potentially LPG; Power generation; Carbon dioxide (CO₂) removal and potentially CO₂ compression facilities (for potential sequestration); Storage facilities for hydrocarbons including LNG, condensate and other hydrocarbon products. Flaring and fuel systems; Feed and utility pipelines from the approximately 3 nautical miles (Nm) State Waters limit to and within the Precinct; Wastewater treatment facilities. Utilities (e.g. nitrogen supply, diesel supply and fire water, etc); and Any other activities necessary or ancillary to such Activities to a plant capacity limit equivalent to 50 million tonnes of LNG per annum. <p>These would give rise to air, greenhouse gas (GHG), and effluent emissions.</p>
2	Product Storage	Storage, handling and delivery of products derived from the processing of hydrocarbons including liquefaction of gas into LNG and other hydrocarbon products and any other requirements necessary or ancillary to such Activities.
3	Product Export	Port facilities through which the loading of LNG and other hydrocarbon products into tankers for product export would occur.
4	Workers' Accommodation	Accommodating workers associated with the Activities described in this table (excluding Broome Pioneer Camp).
5	Light Industrial Area	Light Industrial Area (LIA) facilities for third party contractors ancillary to the Activities described in this table.
6	Port Facilities	<p>Port Facility through which the loading of LNG and other hydrocarbon products into tankers, delivery of raw materials, construction materials and plant components from marine vessels would occur, including:</p> <ul style="list-style-type: none"> Shipping channel, turning basin, navigation aids and offshore anchorage area; Export jetty facilities with loading berths; Breakwaters; Seawalls (small scale breakwater); Marine Facility; Small vessel all weather harbouring facilities; Access (causeway); and Rock load out wharf.

7	Supporting Infrastructure	<p>Supporting infrastructure associated with the Activities described in this table including:</p> <ul style="list-style-type: none"> • Water supplies for Precinct activities (including groundwater bores); • Borefields; • Access and haul roads within the Precinct (excluding main Precinct Access Road); • Fire management; • Administration and other plant buildings (including central control rooms, and telecommunications); and • Concrete batching plants and rock screening and crushing facilities. <p>Also includes service corridors and connecting infrastructure between the Precinct, LIA and workers accommodation, including:</p> <ul style="list-style-type: none"> • power lines; • water transmission; • effluent pipelines; and • telecommunications.
8	Buffer Zones	Industrial and sensitive land use buffers and Manari Road diversion.
9	Fire Management	Management of fire within buffer zones and the wider Dampier Peninsula.

The activities associated with the construction, commissioning, operation and decommissioning of the above facilities, including maintenance and fire management are termed Category A activities and are the subject of this assessment and subsequent approval under the Part IV of the EP Act and Division 4 of the EPBC Act.

The key processes and facilities involved in the production of LNG and other hydrocarbon products are illustrated in **Figure 5-1** and addressed in the following sections.



■ **Figure 5-1 Indicative Process Flow Diagram.**

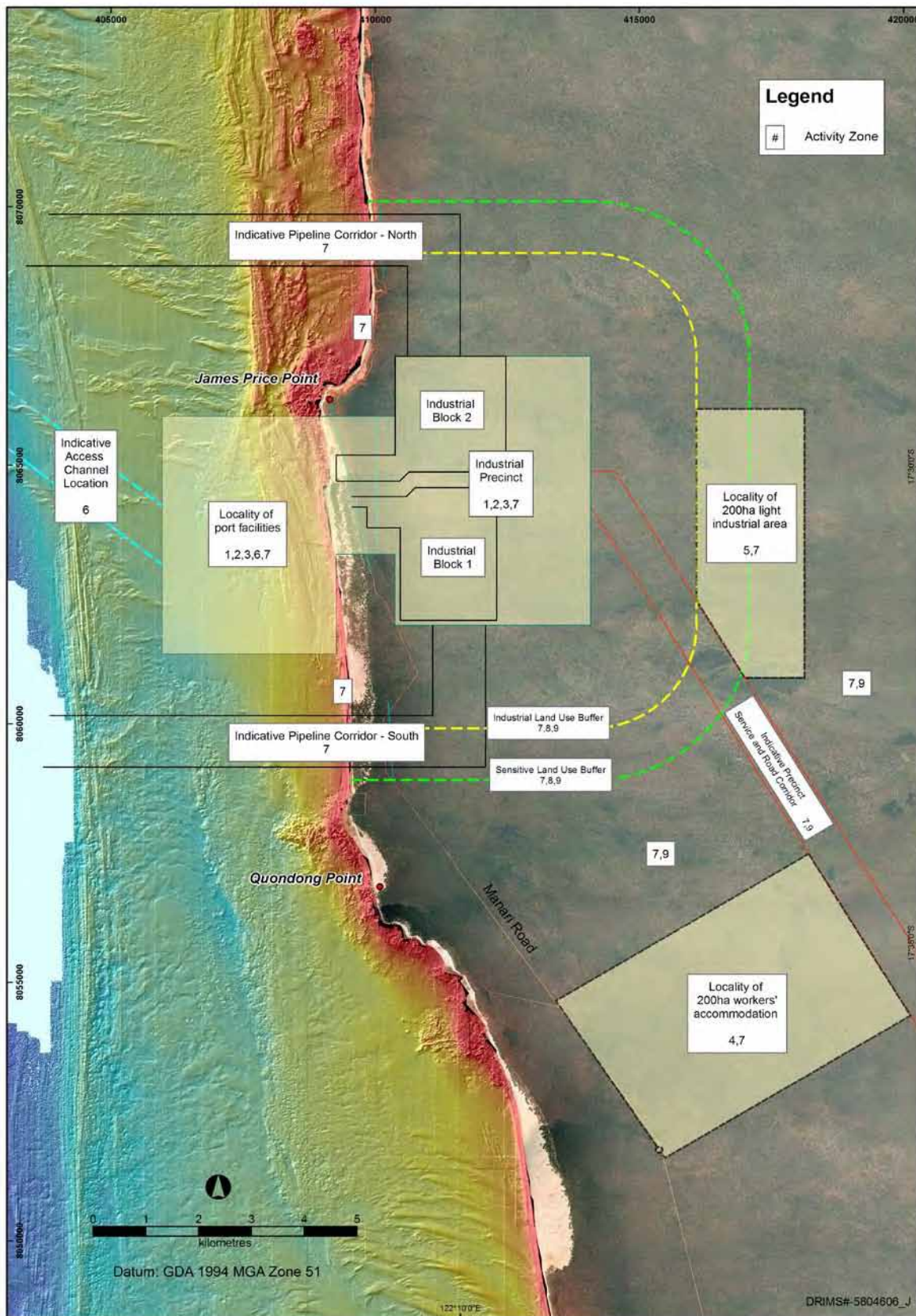
5.1. Generic Layout of BLNG Precinct

The location of the BLNG Precinct near the coast is to ensure that the LNG facilities have access to marine onshore feed gas pipelines and product export and also operate safely, efficiently and effectively. Industrial blocks are set back from the coastline, but in the vicinity of a Marine Facility, to ensure safe and efficient processing and delivery of LNG, condensate or potentially LPG product for offloading to ships for export. The original BLNG Precinct layout was based on the Master Plan produced by WorleyParsons (WorleyParsons, 2010; **Appendix B-8**). Minor iteration to the Master Plan occurred following consultation with the potential Foundation Proponent.

The BLNG Precinct is divided into the following areas in which selected Category A activities associated with the implementation of the Precinct Plan would occur (**Figure 5-2**):

- 1) **Two industrial blocks:** These areas set inside an industrial precinct would be for hydrocarbon processing and storage and related infrastructure. The cryogenic properties of LNG (-161° centigrade (°C)) requires LNG storage tanks to be in proximity to both LNG facilities and LNG ship loading berths to minimise heat gain. The LNG facilities within these industrial blocks would be set back 1 to 2 km from the coast with a central corridor connecting to the Marine Facility to help protect environmental and cultural values along the coast. The LNG facilities within the industrial blocks would also be orientated in line with prevailing wind direction to ensure correct air circulation along the processing facilities. The processing facilities should be placed orthogonal to prevailing wind direction to minimise heat recirculation and maximise energy efficiency (i.e. stacked in a north-south direction) if prevailing wind is westerly.
- 2) **Common user area:** This area would be located between the designated industrial blocks, within the industrial precinct and would include ancillary facilities and supporting infrastructure to be available for use by more than one proponent, as well as internal buffers to ensure that simultaneous operations may be undertaken to maximise use of available land and minimise land area footprint while meeting safety requirements.
- 3) **Port Facility:** These Facilities would be established in a central location with a shipping channel, turning basin and associated navigation aids. This arrangement would minimise the footprint area for development of facilities without compromising marine vessel movements. The area of disturbance is expected to be about 500ha.
- 4) **Service, pipeline and road corridors:** Infrastructure such as the power and water supply lines, waste (sewerage) pipelines and access roads (linking workers' accommodation, processing facilities, port facilities, and borefield sites) would be required and maintained in designated services corridors within the BLNG Precinct. Offshore pipeline corridors would be located outside of the port area at appropriate safety distances to prevent damage to pipelines from vessel movements.
- 5) **Light industrial area:** The LIA for third party contractors to the BLNG Precinct would be about 200ha in area and located outside the industrial land use buffer.
- 6) **Workers' accommodation area.** This is an area of about 200ha located external to the buffer to sensitive land users and provides for a pioneer camp, construction camp, and permanent accommodation during operations. The exact location of the area is yet to be determined, but it is likely to be within three to five kilometres south east of the LNG facilities.
- 7) **Onshore buffer zones:** These areas were designed in accordance with State Planning Policy (Industrial Buffer Policy) and EPA requirements in Guidance Statement No. 3 Separation Distances between Industrial and Sensitive Land Uses. These zones would ensure that appropriate separation distances are maintained between land uses. The two proposed buffer zones surrounding the industrial blocks are as follows:
 - Industrial Land Use Buffer: A 2,000m buffer around the industrial block areas within which all uses not directly associated with the processing of hydrocarbons would be excluded. For example, the LIA would be at least 2000m from LNG processing facilities.
 - Sensitive Land Uses Buffer: A 3,000m buffer around the industrial block areas (1,000m from the Industrial Land Use Buffer) within which all permanent structures and sensitive land users would be excluded, including workers' accommodation, residential developments, caravan parks, tourist accommodation, child care facilities, shopping centres, general commercial use and other land uses related to prolonged public presence greater than 24hrs.

A generic layout of the BLNG Precinct is provided in **Figure 5-2** and indicative land requirements for the above areas are provided in **Table 5-2**.



Source: Based on WorleyParsons, 2010; **Appendix B-8**.

■ **Figure 5-2 Generic Layout of BLNG Precinct.**

■ **Table 5-2 Indicative Land Requirements for Land Use Activity Areas.**

Area Description	Terrestrial Areas to be cleared (ha) ^{1,2,3}	Notes
Browse LNG Precinct		
Industrial Precinct - Industrial Blocks and Common User Area	1,980	Precinct consists of: <i>Exclusion Zone</i> <ul style="list-style-type: none"> Industrial Block 1 (500ha); Industrial Block 2 (500ha); Common User Area (500 - 1000ha); and Port (1000ha land and waters). <i>Non-Exclusion Zone</i> <ul style="list-style-type: none"> Workers Accommodation (200ha); and Light Industrial Area (200ha).
Port Facility	110	
Workers' Accommodation Site	200	
Light Industrial Area	200	
Sub-Total: BLNG Precinct Area	2490	
Additional land requirements for ancillary infrastructure		
Pipeline Corridors – North and South	250	
Minor Access Roads and Service Corridors	160	Clearing for minor access roads and services corridors would be required to link the Light Industrial Area and Workers Accommodation to the Main Access Road and Services Corridor. This would include: <ul style="list-style-type: none"> Road from Main Access Road to Workers Accommodation (100m corridor) and associated Services Corridor (60m); and Road from Main Access Road to Light Industrial Area (100m corridor) and associated Services Corridor (60m).
Other infrastructure as required	137	Clearing required for other infrastructure such as the Manari Road diversion and bore field is subject to final design and layout. This total includes a nominal alignment for the Manari Road diversion and up to 22 groundwater bores, supported by an approximate 70m x 70m compound.
Sub-Total: Ancillary infrastructure	547	
Total Land Area for Assessment	3037	This is the Area under consideration in this Strategic Assessment Report
The Main Access Road to the Browse LNG Precinct forms part of a separate environmental assessment. Approval is not sought under this Strategic Assessment.		
Main Access Road from Broome - Cape Leveque Road to BLNG Precinct (100m corridor)	191	Clearing and related impacts associated with the Main Access Road from Broome - Cape Leveque Road to the BLNG Precinct would be formally assessed as a separate referral. Cumulative impacts associated with this road are considered in the SAR as Category C impacts, with indicative areas quantified.
Services Corridor (90m) Accompanying the Main Access Road.	172	

Note: ¹ In each case, larger areas were advertised in *Notices of Intention to Take* published in the *Koori Mail* and the *West Australian* on Wednesday 8 September 2010 to enable avoidance of direct environment and aboriginal cultural heritage impacts and geotechnical considerations (~7458ha).

² All areas are measured from above the mean low water mark.

³ Note that fuel reduction activities and clearing for fire access would be as described in the Fire Management Strategy, utilising the above infrastructure where practicable.

5.2. Development Scenarios for the BLNG Precinct

The BLNG Precinct would accommodate a minimum of two proponents and enable sharing of common-user facilities such as the Port Facility, roads, infrastructure corridors, and workers' accommodation. The BLNG Precinct concept has been developed to eliminate demand for *ad-hoc* development of LNG facilities on the west Kimberley coast and islands by providing an approved site option for future proponents.

The ultimate capacity and phasing of the Precinct would be highly dependent on future natural gas discoveries in the Browse basin and how various offshore proponents choose to develop these fields. A capacity of 50Mtpa of LNG has been chosen as the maximum foreseeable required capacity of the BLNG Precinct based on prospectively of the Basin and the historical development of the State's North West Shelf.

The indicative development scenarios for the BLNG Precinct provided below may not exactly match the actual staging and capacity of the BLNG Precinct but it does represent a range of potential outcomes and provide a basis for the impact assessment and planning of the BLNG Precinct management and mitigation during the implementation of the Precinct Plan.

Representative development scenarios for the BLNG Precinct were modelled based on the following capacities and timescales as follows:

- Scenario 1 (no development of Precinct);
- Scenario 2 (15Mtpa of LNG capacity within 15 years based on a five year construction timeframe to develop a 12Mtpa capacity followed by expansion to the 15Mtpa capacity over the remaining period);
- Scenario 3A (25Mtpa of LNG capacity within 25 years based on an additional LNG facilities producing up to 10Mtpa of LNG capacity being constructed within 10 years after the initial development of the 15Mtpa LNG Facility);
- Scenario 3B (35Mtpa of LNG capacity within 25 years based on an additional LNG facilities producing up to 20Mtpa of LNG capacity being constructed within 10 years after the initial development of the 15Mtpa LNG Facility); and
- Scenario 4 (50Mtpa of LNG capacity within 30 years).

The development of the BLNG Precinct would require a commensurate increase in utilities and associated infrastructure, in line with the above LNG production scenarios.

5.3. Operational Activities (LNG Facilities)

Reservoir fluids from the Browse basin would be transported from the offshore gas fields to onshore processing facilities at the BLNG Precinct. The offshore facilities, limited to the component in Commonwealth waters from the 3Nm boundary, would be managed by offshore proponents and are not within the scope of this Strategic Assessment.

The reservoir fluids are gathered through a network of subsea and surface facilities and are transported via either single multi-phase pipelines (conveying both gas and liquids together), or separate liquid and gas pipelines. The reservoir fluids would consist of a mixture of hydrocarbons and associated water, predominantly:

- 1) natural gas - a mixture of gaseous hydrocarbons (primarily methane) with small amounts of ethane, propane, butane, pentane etc;
- 2) hydrocarbon liquids (condensate) – a light oil at normal temperature and pressure that has condensed after extraction from subsurface reservoirs; and
- 3) associated water – found as a vapour mixed with the gas, and as free water from the reservoir.

The gas processing and liquefaction complex would be located within the two industrial blocks in order to ensure proper integration of the processing facility. Within each industrial block, a number of parallel LNG processing trains would operate and the processing capacity would vary depending on what is optimal for each proponent. This optimisation would be influenced by factors such as the size of the hydrocarbon resource supporting the development, technology selection and project economics.

Onshore, the reservoir fluids would undergo treatment to separate or remove condensate, water, CO₂ and other impurities, followed by fractionation to separate remaining condensate and to produce LPG for use in the liquefaction process and potential export, and finally liquefaction of gas to produce LNG. Processing facilities would be controlled using comprehensive computerised control systems and a maintenance database of all equipment. These systems would be housed in a plant control building or centre. The key activities are described in **Section 5.3.1** to **Section 5.3.14**.

Once operational, the LNG facilities would operate continuously with the exception of planned shutdown for maintenance (see **Section 5.10**) or emergency events.

5.3.1. Separation of Gas and Liquids

Separation of liquids from the feed gas stream can occur offshore or onshore via separation vessel or slug catcher. Where the separation occurs offshore, some minor separation onshore is also required. In any case, gas, condensate and potentially water separation facilities form part of the inlet facilities, and would be established by each proponent.

From the separator, liberated gas would flow to a removal unit for CO₂, sulphur compounds and other impurities in the raw gas (see **Section 5.3.3**) while condensate would be separated from the water phases and diverted to stabilisation units (see **Section 5.3.5**).

5.3.2. Mercury Removal

To prevent degradation of the aluminium used in the process equipment, mercury present in the feed gas (in trace amounts), is removed by passing the feed gas through a removal medium typically consisting of a metal oxide absorbent. Periodically, the metal oxide medium requires removal and return to the supplier potentially for recycling or other appropriate management of disposal.

5.3.3. CO₂ Removal

Gas flow from the inlet facilities (feed gas) would be rich in CO₂ with residual traces of hydrogen sulphide (H₂S). Typical reservoir CO₂ levels from the Browse basin hydrocarbon reserves range from 6 to 12mol%. CO₂ is removed to ensure that it does not freeze in the liquefaction process and block the main cryogenic heat exchanger or other equipment.

The standard process used in LNG facilities involves running a solvent through the feed gas stream which absorbs the CO₂. Typically the absorption process uses an amine based solvent such as activated methyl-di-ethanol amine (**aMDEA**) or similar medium. The solvent is then heated to drive the CO₂ off so that the solvent can be circulated back through the feed gas stream. A small amount of co-absorption of other hydrocarbons including benzene, toluene, ethylbenzene and xylene (**BTEX**) would occur. Other technologies such as membranes can be used, and selection technologies would be based on decision-making by individual proponents.

CO₂ is typically disposed of to atmosphere by venting, however, the final disposal method is yet to be determined and may include the use of a thermal oxidizer or thermal combustion unit (for removal of BTEX).

5.3.4. Gas Dehydration

Water is removed from the gas stream using a dehydration unit. The water component is returned to the CO₂ solvent. The gas stream continues downstream for further processing.

5.3.5. Stabilisation of Liquids

Condensate separated from the feed gas stream is stabilised by heating the condensate to drive off gaseous vapours which are then returned to the gas stream. The stabilised condensate is routed to the condensate storage and export facilities, while the water stream is routed to a regeneration unit where the condensed and produced water is removed and directed to water treatment facilities. As with the initial separation of liquids from gas to recover condensate, these facilities would be established by each proponent.

5.3.6. Hydrate Inhibitor (e.g. MEG) Regeneration

Hydrate inhibitors such as glycol (e.g. mono-ethylene glycol (**MEG**)) are used in pipelines to prevent hydrate formation and corrosion. A hydrate is a compound that contains water molecules and hydrocarbons which crystallise or freeze within pipelines or gas processing facilities. Glycol or MEG may be recovered at the onshore processing facility and regenerated using heat to remove the water. The water stream is condensed and sent to water treatment facilities, and the glycol piped back offshore for re-use. These regeneration facilities would form part of the inlet facilities to be established by each proponent.

5.3.7. Fractionation

Hydrocarbons containing compounds such as propane and butane (known as LPG) are separated from the main gas stream in a distillation (scrub) column and directed to a fractionation unit. Multiple fractionation units would be installed by proponents at the BLNG Precinct. Fractionation units use heat to separate the light and heavy components from the liquid (condensate) stream. The remaining liquid stream is diverted to the condensate storage tanks.

LPG can be extracted for use as a refrigerant gas in the LNG liquefaction process. If desired, the LPGs can also be recovered for export, if the product is economically feasible for market.

5.3.8. Liquefaction

Liquefaction of a natural gas to form LNG is the key component of the LNG processing plant and this would be carried out in liquefaction unit(s), implemented per proponent. In the liquefaction process, the gas is cooled to enable the LNG to be stored and transported by ship for export. Common with all LNG technologies, is the concept that natural gas would pass through either a single or multiple heat exchangers to chill the natural gas to temperatures approaching minus 161°C to form LNG. At this temperature, the gas is 1/600 of its volume at standard atmospheric conditions. The heat exchangers would be chilled by a refrigerant circuit involving refrigerant (gas) compressors not dissimilar to those found in a domestic refrigerator or a refrigerated air conditioning system.

Refrigerant gases used can include methane, ethane, propane, ethylene and/or nitrogen which can be used either individually or combined. These refrigerants are stored on site and are typically obtained from the fractionation process (see **Section 5.3.7**) or alternatives may be imported.

Refrigerant compressors are the largest energy consumers in LNG facilities and typically represent approximately 80 to 90% of the energy required in an LNG plant. This energy can be provided in many ways including gas turbines, electrical motors, steam turbines or a combination of these.

Depending on the design of the LNG trains, the final processing step may include an end flash system. An end flash system works by dropping the pressure of the chilled natural gas down to atmospheric pressure which chills it to the last few degrees to form LNG. As a result of this process, some of the gas vaporises off. This so-called 'flash-gas' is recovered back to the process or for use as fuel. If the natural gas includes significant nitrogen, it is also removed in the process and then vented to the atmosphere (after purification to minimise hydrocarbon gas losses).

5.3.9. Recovery of Gas for Fuel (Fuel Systems)

Fuel requirements for power of the LNG facilities are mostly met by recovery of gas from various points in the process, as undertaken by each proponent. Typically 6 to 8% of feed gas would be utilised as fuel gas.

Diesel would be used as back up fuel for the power generation system, for emergency power, and other utilities systems such as firewater pumps. Typically, diesel would account for less than 1% of the fuel required to operate an LNG facility.

5.3.10. Inert Gas Removal

Inert gases such as nitrogen would be removed from the gas stream by each proponent to meet final product specification.

5.3.11. Product Storage and Loading

LNG and LPG product would be pumped via pipeline to designated storage tanks. Stabilised condensate is piped to the condensate storage tanks. Whilst in storage, the products are stabilised at atmospheric pressure. Storage facilities at the Precinct would include:

- up to seven LNG storage tanks with an approximate capacity of 200,000 cubic metres (m³) per tank;
- potentially up to three LPG storage tanks with approximate capacity of 60,000m³ per tank; and
- up to seven condensate tanks with approximate capacity of 120,000m³ per tank.

LNG storage tanks would have a full containment system and leak detection systems potentially consisting of thermal sensors. In addition, other protective systems would include pressure relief valves, vacuum relief valves, overfill protection systems, and fire and heat detection systems with water sprays and/or foam dispensers.

For the LNG tanks, pumps in the LNG storage tanks would transfer product via (insulated) pipelines to the loading arms and onto LNG carriers. Vapour is returned from the ship and re-liquefied or used as fuel. Condensate is stored in tanks and is also transported via pipeline to the export jetties (situated in the Port area) for loading onto condensate tankers. Future LPG loading would be at the discretion of future development proponents, however typical loading systems are similar to LNG loading facilities.

During vessel loading, vapours would be produced during the cool down of the LNG vessel loading line and displaced from the vessel as it filled. A proportion of these vapours are used to displace the LNG removed from the tank during loading, whilst remaining vapours are transferred via a vapour return line to be compressed and diverted back to the processing facility for recovery and re-liquefaction. Additionally, loading of LNG vessels would result in the production of methane gas within the LNG storage tanks caused by a combination of heat differential and displacement of liquids. This gas would be recovered by the boil-off compressors and returned to the liquefaction system.

5.3.12. Flare Systems

Flare systems are required for the safe and effective operation of an LNG facility. Each proponent would be required to implement flaring systems. The main flaring systems and their purpose are:

- Marine flare(s) – the marine flare is a low pressure flare which is used primarily as an emergency control measure during upset conditions during export, or to safely dispose of off specification gas which cannot be returned to the process. This latter process is typically required when LNG is loaded to a ship returning from the dry dock which is considered to be warm. The marine flare is relatively low in height.
- Low flow flare system – this flare is used to manage smaller quantities of gas typically related to start-up activities, operational aspects and smaller maintenance related events.
- Emergency high pressure flare system – this flare is typically mounted on a stack (approx. 100 to 180m height) or potentially ground type. The flare is irregularly used, primarily for major upsets, train start-up and/or emergency situations when large volumes of gas require release for short periods of time.

5.3.13. Wastewater Treatment

Wastewater streams from processes such as liquid stabilisation and from the MEG regeneration facilities would be treated and managed onsite. The systems are discussed further in **Section 5.7**.

5.3.14. Plant Utilities and Associated Infrastructure

The LNG facilities would be self-sufficient in terms of some utilities which would comprise, but not be limited to, nitrogen supply, demineralised water, instrumentation, safety control and communication equipment, firewater systems and drainage systems.

Supporting utilities and associated infrastructure would be established per proponent as required for full development of the BLNG Precinct. The utilities and infrastructure required to support the Precinct include power, heating medium, fuel systems, fuel and chemical storage, water supply, wastewater treatment and stormwater management, solid waste management, telecommunications, buildings, access roads and accommodation camps and are discussed further in **Section 5.7**.

5.4. Offshore Feed and Onshore Pipelines

Pipelines would transport raw hydrocarbons (reservoir fluids) from the offshore Browse Basin gas fields facilities to the onshore LNG processing facilities with export pipelines conveying other products such as MEG in the same corridor. The boundary between the offshore component and the onshore component (this strategic proposal) is the boundary of State waters at 3Nm. Pipelines beyond 3Nm from shore are not part of this assessment but are subject to appropriate approvals processes.

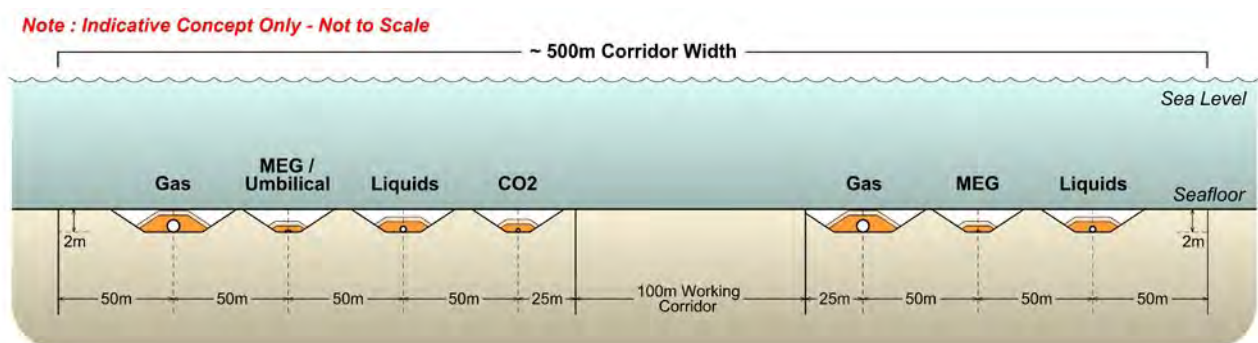
The component of the hydrocarbon pipelines associated with the onshore development concerns the pipelines in State waters from the 3Nm boundary limit, as well as up to two shore crossings within the James Price Point coastal area and a short section of onshore pipelines to transport feed gas to the LNG production facilities.

Provision for hydrocarbon pipelines and the related pipeline corridors are proposed for:

- Up to eight hydrocarbon feed gas pipelines conveying hydrocarbons from offshore gas fields to B LNG Precinct consisting of:
 - up to four gas or multi-phase pipelines (in the order of 1,200 millimetres (mm) diameter); and
 - up to four liquid pipelines (in the order of 500mm diameter).
- An option for four export pipelines (up to 450mm diameter) conveying MEG or alternative hydrate inhibitor and production chemicals to offshore facilities if required.
- An option for two export pipelines (up to 600mm diameter) to convey CO₂ from onshore to an offshore location.

Potentially other services or rigging of offshore (for example fibre optic cable) may be incorporated into the pipeline corridors and shore crossings.

A conceptual diagram of a pipeline corridor (with a nominal 500m width), including potential stabilisation method and safety separation distances between pipelines is illustrated in **Figure 5-3**. Discussion of the construction methods is provided in **Section 5.8.12**.



■ **Figure 5-3 Pipeline Corridor with Safety Separation Distances (Subject to Pipeline Construction Methodology Adopted).**

5.5. Port Facility

The Port Facility is a multi-purpose facility to support marine operations for the BLNG Precinct. The Port Facility would support vessel operations, allow for supplies of goods and materials to the BLNG Precinct and import of construction materials including large modules that could only be transported relatively short distances on land. The Port Facility would be located primarily within the Port (Figure 5-2). Conceptual layouts for the Port Facility are currently under development, however, it is envisaged that facility requirements would disturb about 500ha of this zone.

5.5.1. Key Components of the Port Facility

The establishment of the Port Facility would include:

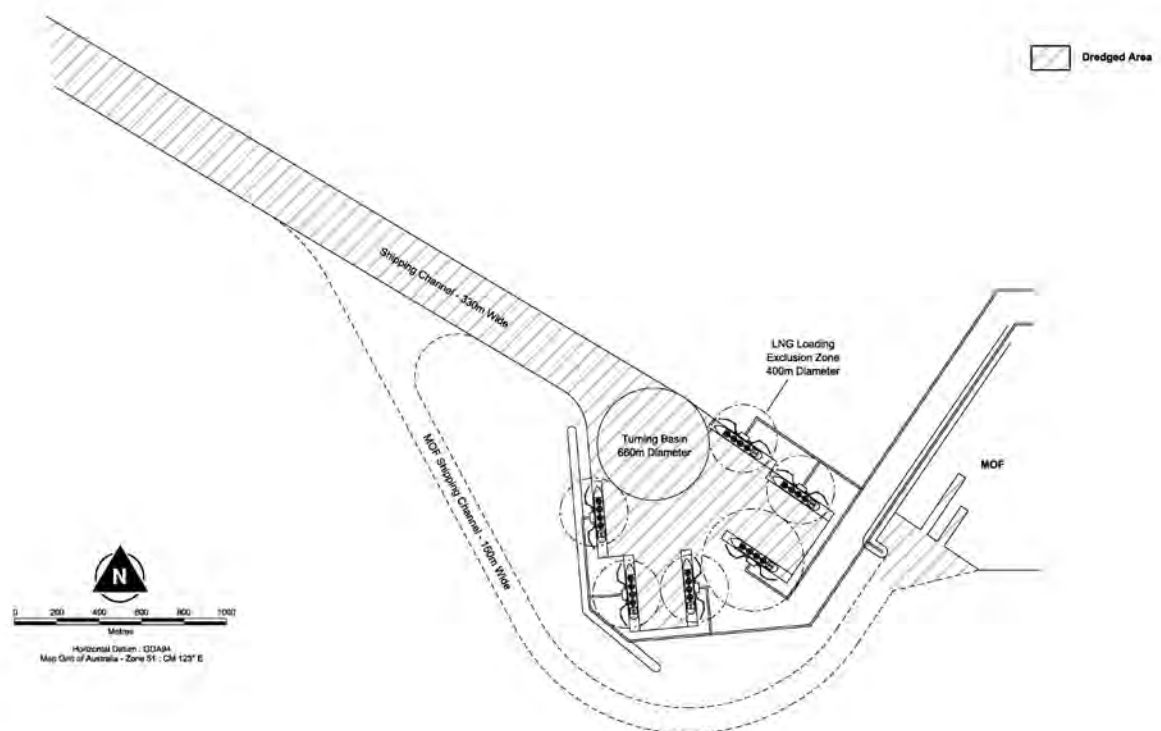
- **Shipping channel, turning basin, navigation aids and offshore anchorage area:** These facilities would be shared by all proponents. The channel may have a nominal width of 300 metres to accommodate the shipping vessel movements but the exact width is subject to finalisation of the port layout. The turning basin is used for stopping and turning ships and would have a diameter equivalent to at least twice the overall length of the largest ship.
- **Export jetty facilities with loading berths:** There is expected to be two to three jetties supporting up to six berths, with the Foundation Proponent establishing and having exclusive use of the first jetty. Each berth would include loading platforms, breasting and mooring dolphins, LNG vapour recovery equipment, emergency shutdown systems and other infrastructure. Up to two of the berths would be multi-product berths (that is they can handle LNG, potential LPG and condensate). Up to four would be dedicated LNG berths. Further detail is provided in Table 5-3.
- **Breakwaters:** These facilities would be shared by all commercial proponents. Breakwaters may be required to shelter the Port Facility including product loading berths at the export jetty, and other facilities due to ambient wave conditions or cyclonic conditions.
- **Seawalls (small scale breakwater):** The construction of seawalls would be required to enable the initial construction facilities such as loading berths and the offloading facility within the port area.
- **Marine Facility.** This facility will have the capability for handling and transfer of materials, fuel, chemicals, water and other provisions for the construction and operation of LNG facilities. The Marine Facility includes a Material Offloading Facility (MOF), which will be used for offloading heavy equipment and modularised units. Initial construction of the MOF will occur during site preparation works to enable delivery of equipment and machinery to site by ocean going vessels. A Roll on Roll off (RORO) will also be developed in the Marine Facility as well as a wetlock type arrangement to cope with the high tidal range.
- **Small vessel all weather harbouring facilities:** This is a facility for tugs and support/supply vessels including vessel berths (tug pens) and bunkering and refuelling stations for small boats (tugs) and support vessels. The facility would provide a cyclone refuge for protection for vessels under ambient and extreme wave conditions associated with both cyclonic events and Tsunamis.
- **Access (causeway):** Access to the Port Facility would be provided via a purpose built causeway to allow access to and from the LNG facilities.
- **Rock load out wharf:** This facility would be provided to supply vessels installing rock protection to the offshore trunkline.

5.5.2. Reclamation

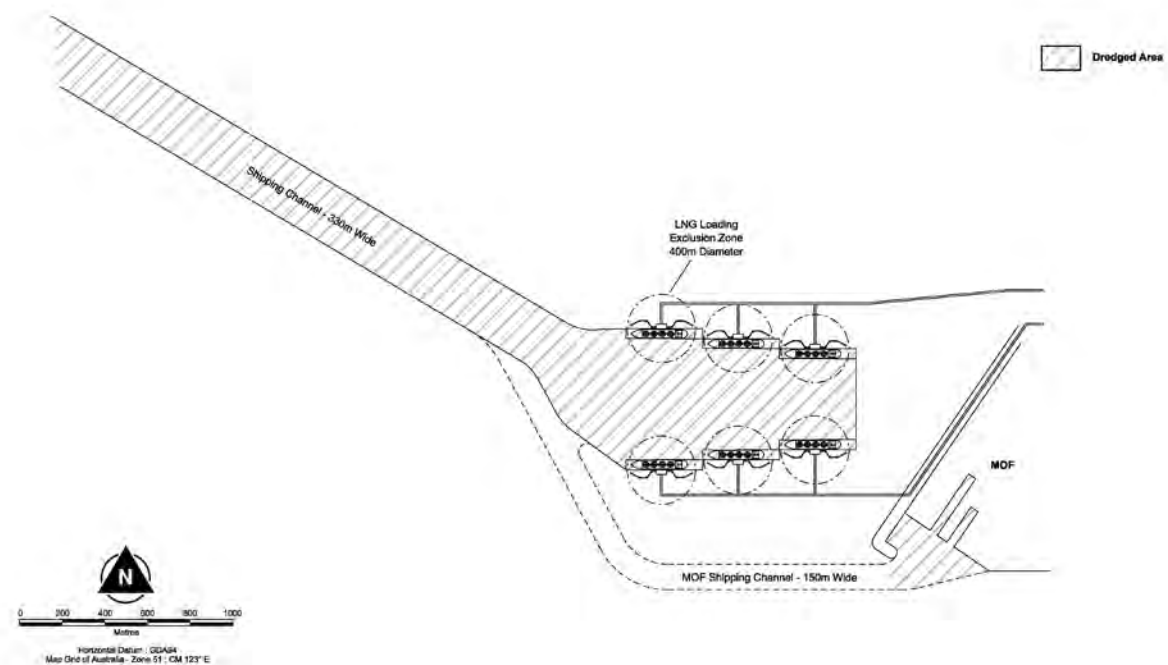
Reclamation of some of the shoreline and adjoining seabed would be necessary to connect LNG processing facilities to the Marine Facility. This would allow shipping vessels to moor in the vicinity of the shore and unload materials, building supplies and equipment. Road vehicles such as trucks would access the Port Facility (by haul road) close to the vessels to allow for unloading of materials for road transportation.

5.5.3. Conceptual Layout Options for the Port Facility

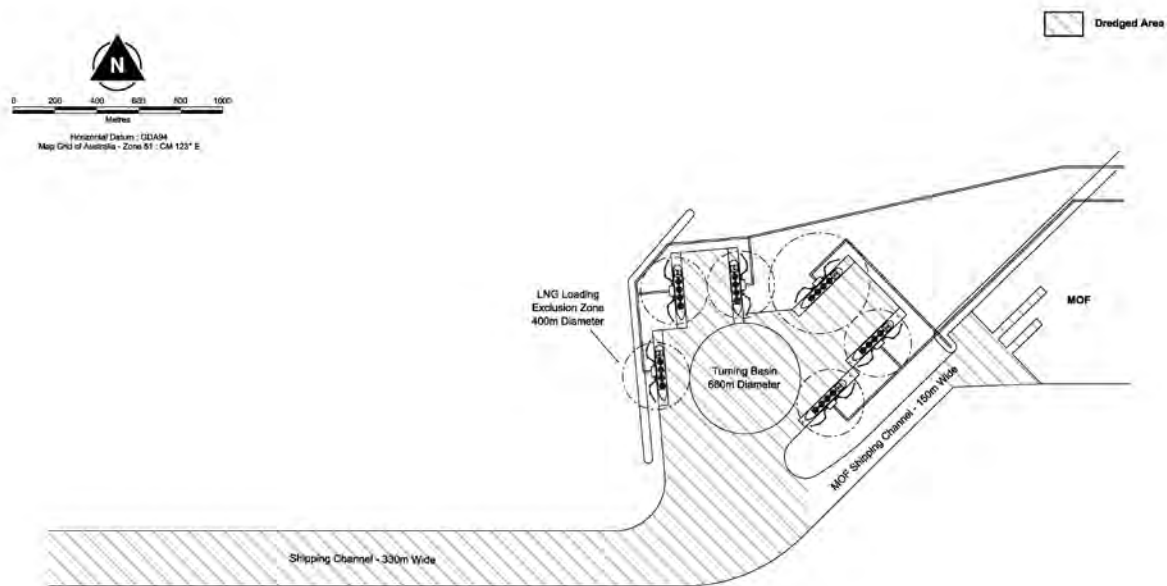
Figure 5-4, Figure 5-5, Figure 5-6 and Figure 5-7 represent four possible conceptual layouts of the Port Facility. Finalisation of the layout would be dependent on functional and shipping handling safety requirements, and consider geotechnical and metocean conditions.



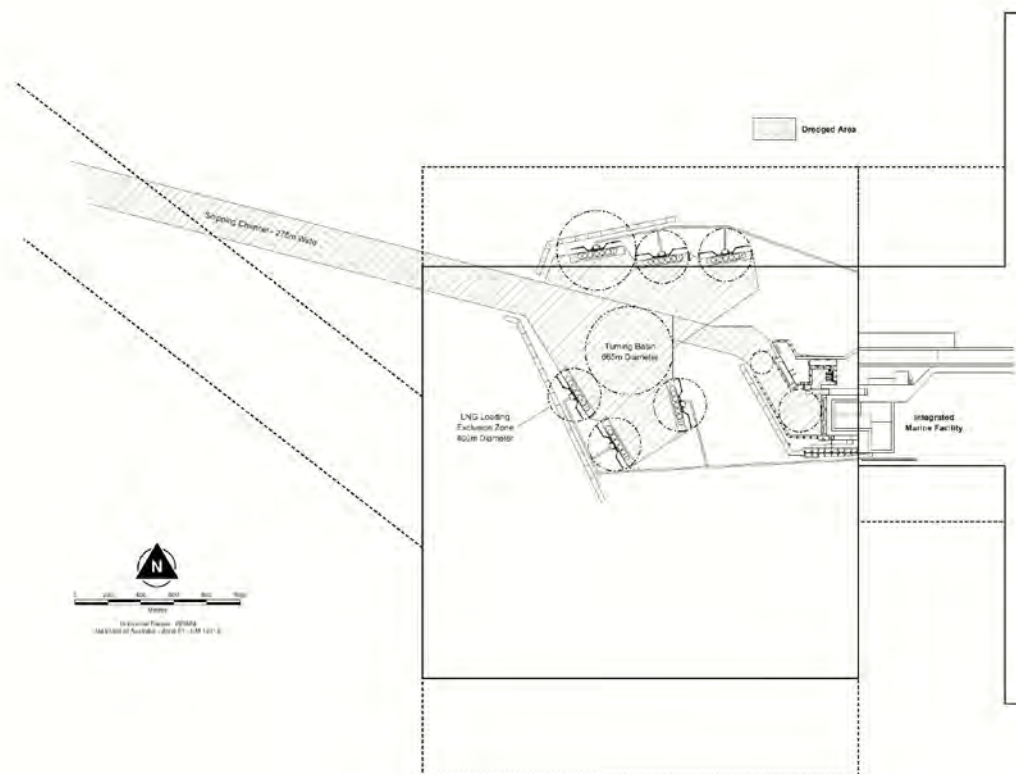
■ Figure 5-4 Potential Conceptual Port Facility Layout (a).



■ Figure 5-5 Potential Conceptual Port Facility Layout (b).



■ Figure 5-6 Potential Conceptual Port Facility Layout (c).



■ Figure 5-7 Potential Conceptual Port Facility Layout (d).

5.5.3.1. Development of the Port Facility

The phased development of the Marine Facility to handle the development scenarios of the Precinct is described in **Table 5-3**.

■ **Table 5-3 Phased Development of the Port Facility.**

Scenario	BLNG Precinct Capacity	Loading Berths	Jetties	Turning Basin	Channels
1	0	0	0	0	0
2	15Mtpa	2	1	1	1
3A	25Mtpa	4	1-2	1	1
3B	35Mtpa	4 to 5	2 to 3	1	1
4	50Mtpa	5 to 6	2 to 3	1	1

5.6. Shipping Movements

5.6.1. Product Shipping Vessels

Vessels for loading would enter and depart the Port Facility via the shipping channel with the aid of navigational and berth aid systems to allow safe and efficient passage to the product offloading facilities.

Shipping vessels required for product export include specifically designed LNG (and potentially LPG) carriers and condensate tankers. An LNG carrier is an ocean going vessel specially designed to transport LNG. These vessels contain double hulls with primary and secondary containment systems. LNG product is stored in vessel containment and maintained at approximately -160°C at atmospheric pressure. Storage capacity of LNG vessels may vary between 115,000 to 250,000m³.

LPG carriers are used for transfer of liquefied petroleum with similar containment systems as per LNG carriers. Storage capacities of LPG vessels are typically 80,000m³.

Condensate tankers are used to transport crude or light oil with typical storage capacities between 80,000 to 120,000 tonnes.

The number of shipping movements per annum would be dependent on vessel size and installed facilities. Preliminary estimates of shipping frequency per annum for each of the development scenarios are provided below (**Table 5-4**).

■ **Table 5-4 Preliminary Estimates of Annual Shipping Movement for Development Scenarios.**

Shipping vessel	Scenario 1 No development	Scenario 2 15Mtpa	Scenario 3A 25Mtpa	Scenario 3B 35Mtpa	Scenario 4 50Mtpa
LNG	0	150-260	250-430	350-600	500-860
Condensate	0	45-70	70-100	110-155	155-220
LPG	0	50-70	80-100	120-170	170-240
Total (approx.)	0	245 - 400	400-630	580 - 925	825 - 1,320

Note: Data are based on historical shipping frequencies with a margin of 10 to 30 percent.

LNG (and potentially LPG) carriers and condensate tankers that enter the Port Facility would generate sewage and wastewater during operations. All discharges would be in accordance with requirements of the *Pollution of Waters by Oil and Noxious Substances Act 1987* (WA), the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cwth) and MARPOL 1973/78 regulations.

5.6.2. Support Vessels

Tugs would be required to aid in berthing of shipping vessels into and out of the Port Facility. A minimum of three tugs are required for berthing of a single LNG vessel. Potentially up to six to ten tugs may be moored at the Port Facility for the Precinct at 50Mtpa of LNG production.

Supply boats would be used to offload and on-load materials and chemicals, required for operations and maintenance at the Port Facility. In addition, supply boats would be loaded with any wastes and other materials to and from the Precinct to be transport to a suitable location for further treatment or disposal. The frequency of supply boats to the Port Facility may be a nominal two to ten vessels per week. Whilst not in transit, supply boats are likely to be moored at the Port Facility.

Various activities such as bunkering, refuelling operations and vessel maintenance for tugs and supply boats would be undertaken within the Marine Facility.

5.7. Plant Utilities and Associated Infrastructure

The BLNG Precinct would require a diversity of infrastructure including supporting buildings, power, telecommunications and water, wastewater and solid waste treatment facilities.

Some of these infrastructure components would be unique to each proponent and some would be shared. This would be determined once the layout of the BLNG Precinct is progressed and by agreements between future proponents.

5.7.1. Power Supply

Power supply would be provided by each commercial proponent in each phase of the development of the BLNG Precinct.

Power would be generated by either:

- Gas turbine driven generators with heat recovered to meet process heating demands if required;
- A combined cycle power station based on gas turbines. Typically considered where a large power demand is required (e.g. when utilising electrically driven liquefaction compressors); or
- A fully integrated combined heat and power system. The ability to implement this type of concept efficiently and effectively is highly dependent on the power and heat balance of the facility which is driven by factors such as inlet gas composition, LNG technology and size of the LNG trains.

In all cases, the primary energy source for the LNG facilities would be a combination of gas and steam generators. A dedicated plant for the production of electrical power would be established, and may supply power to users outside the industrial blocks, such as the LIA, workers' accommodation area, or others.

The exact configuration would depend upon inlet gas composition, size of the selected LNG trains, LNG technology selected, current project economics, Health, Safety and Environmental (HSE) aspects, and decisions made by proponents on complexity and operability of future expansion of the Precinct.

During initial works and construction, power to the pioneer camp and construction camp is anticipated to be via diesel fuelled generators.

Emergency power supply would be provided by diesel backup generators/boilers and/or turbines which are used during initial start-up of operations, including emergency situations (e.g. firewater pumps) or sourced from an external provider.

5.7.2. Heating Medium

A number of processes in an LNG facility require heat. The major uses of this process heat are to regenerate the solvent used for CO₂ removal and the regeneration of MEG (to drive the water off the glycol). This heat is typically recovered from the exhaust of the gas turbines used in the process, but in some cases, may require the use of boilers.

The heating medium used can include hot oil, water or steam. Selection of the heating medium and installation of these would be based on decision-making by each commercial proponent at the BLNG Precinct.

5.7.3. Fuel and Chemical Storage

Fuel and chemicals would be stored onsite in tanks within designated storage areas with impervious berms or appropriate bunds for spill management. Transportation of chemicals to the Precinct may be undertaken by marine transportation (supply vessel to Marine Facility) or by road vehicle as required.

Designated storage areas would be located outside of the process areas with containment for flammable, combustible or toxic materials, as required by the relevant Australian Standards and regulations. Design of containment would take into account accumulation of stormwater during high rainfall events.

Bulk chemicals (e.g. MEG) and fuels (e.g. diesel) would be stored in tanks and/or transportable containers with some containment in the event of leaks or tank rupture. Refrigerants would be imported to site during commissioning activities.

Types of chemicals and fuel that may be stored include:

- hydrate inhibitors (e.g. MEG);
- corrosion inhibitors;
- oxygen scavenger;
- solvents for CO₂ removal;
- liquid refrigerants (e.g. propane, ethane, ethylene and mixed refrigerants);
- diesel fuel;
- hydraulic oils and fluids, coolants and other workshop solvents;
- liquid nitrogen;
- laboratory chemicals;
- water demineralisation and contamination treatment chemicals (e.g. sulphuric acid); and
- seawater and freshwater system treatment chemicals (e.g. biocides).

5.7.4. Water Supply

A good quality water supply would be required for both potable and process requirements during construction and operations. There are several potential sources anticipated to meet demand including surface aquifers, desalination of the confined Wallal/Grant aquifer (brackish) and desalination of seawater (saline). Infrastructure for the provision of water may potentially include a groundwater abstraction system (i.e. borefield(s)), desalination system (such as reverse osmosis units for brackish water, or biofouling agents, filtration and distillation as with seawater) and/or seawater intakes.

Preliminary water demand estimates based on potential water supply options for each development scenario of the BLNG Precinct are provided in **Table 5-5**.

■ **Table 5-5 Preliminary Estimates of Freshwater and Saline Aquifer Supply per Development Scenario.**

Development Scenario	Freshwater (GL/yr)	Saline aquifer (GL/yr)	Seawater (GL/yr)
Scenario 1	0	0	0
Scenario 2	2	5	8
Scenario 3A	4	8	14
Scenario 3B	6	12	19
Scenario 4	8	16	27

Note: Data based on a nominal 20% contingency. Estimate volumes exclude cooling water since it may not be required if the LNG processing facilities are air cooled.

During initial works, and subject to discussions with licence holders (i.e. Water Corporation) and regulators (i.e. Department of Water) with respect to availability, it is anticipated that a supply of fresh water from a suitable local source could be trucked to site for use during pioneering works and at the pioneer camp. For construction purposes water from the Broome aquifer is likely to be used.

Infrastructure to support the establishment of a potential borefield would primarily consist of designated compounds (approximately 50m by 50m) per bore and a services corridor (to contain an access road, pipelines, power and communication lines). It is anticipated the bores would require a spacing of approximately 2km between each bore, with the number of bores determined by actual demand and productivity of each bore. Final locations of the borefield are dependent upon results of hydrogeological assessments. However, it is possible that the borefield may be present within the land use buffer zones.

Seawater desalination involves treating seawater with a biofouling agent, filtering, vacuum distillation or reverse osmosis (RO) to produce fresh water with discharge of salty brine back to the ocean,

Abstraction of water from the Wallal/Grant aquifer also requires desalination where potable water quality is required, however, due to the lower salt content of the formation water, lower energy requirements and reduced brine for discharge (in volume and salinity) to the ocean are anticipated when compared to the desalination of seawater.

Water supply may be provided by individual proponents or alternatively shared within the BLNG Precinct. This would require agreement in the future between multiple proponents.

5.7.5. Wastewater Management

Wastewater treatment facilities would be developed to treat and manage wastewater generated from the LNG facilities and supporting utilities and associated infrastructure. Potential wastewater streams that would require treatment prior to discharge to an approved location include:

- produced water and associated liquid effluent from LNG processing;
- condensed wastewater from associated infrastructure;
- contaminated water from process areas;
- surface runoff (for example stormwater) from process areas;
- sanitary wastewater (sewage and grey water); and
- other wastewater associated with provision and supply of water (such as brine water) for the LNG facilities at the Precinct.

Further detail on effluent discharges is provided in **Section 5.15**.

Treatment methodologies have yet to be selected and are highly dependent upon the characteristics of the wastewater stream. Generally, treatment may include a segregation phase prior to biological treatment (to reduce the biological and chemical oxygen demand levels) then transport via pipeline to marine outfall(s) once the liquid effluent has met the requirements for discharge. Biological treatment systems could include aeration, settlement ponds, microbiological reactors or similar systems.

Once treated, wastewater would be disposed of according to water quality criteria to meet environmental protection guidelines. It is likely to be discharged via marine outfalls located offshore, however, exact locations are not yet defined. Further details are provided in **Part 3, Section 2.3** (Marine Water Quality).

Where practical to do so, grey water would be collected for re-use in an appropriate manner that may include its use for dust suppression.

During initial works and construction activities, wastewater treatment facilities may comprise modular treatment plants, septic tank systems or storage and transport to an external treatment / disposal facility.

5.7.6. Stormwater Management

Stormwater would be managed during operations by collecting and diverting clean and contaminated water away from the onshore LNG processing facilities to prevent any flooding and associated impacts. Handling and disposal of stormwater would depend on intensity and frequency of rainfall events and considering surface areas within the BLNG Precinct that are subject to inundation.

Natural stormwater flows may require diversion in and around the industrial blocks of the BLNG Precinct. This may require diversion channels, culverts or other drainage infrastructure to manage flows in and around the Precinct to natural watercourses.

Surface runoff collected from hardstands and pavements in non-process areas (e.g. roads, firewater tank storage) would be directed to silt/oil/rubbish traps followed by discharge to an appropriate location either via an ocean outfall or terrestrial stormwater discharge structure.

Potentially contaminated stormwater from process areas and surrounding access roads would be sent to water treatment facilities for removal of contaminants to ensure it meets acceptable water quality criteria prior to discharge.

5.7.7. Solid Waste Management

The LNG facilities would generate the following solid wastes:

- domestic waste (from construction and operations); and
- operational wastes (e.g. scrap materials, sand and scale, MEG solids).

Wastes generated during construction and operations would be collated, divided into hazardous and non-hazardous and temporarily stored on site. These wastes would be handled by licensed waste contractors and would be recycled, treated or disposed of as appropriate. No landfill facility would be constructed within the Precinct.

5.7.8. Crushing and Screening Plant

Rock and aggregate obtained from on-site and off-site sources would be crushed or processed in a crushing and screening plant to obtain rock of suitable size for various applications during construction. The plant would be either built in-situ (stick built) or mobile (modularised).

A stationary plant would involve set up of concrete foundations whilst a mobile plant would consist of rock breaking machinery installed on a wheeled trailer.

Typically, the plant is fed by a wheeled loader mechanism and the raw material is extracted from a hopper by means of a vibrating conveyor prior to being crushed. Crushed material from the plant is delivered to a stockpile area via discharge chute and conveyor belt. Varying crushing and screening machinery may be used to produce coarse, medium and/or fine aggregate from raw materials.

Type and volumes of aggregate generated by the plant would depend on the selected earthworks strategy and construction methodology for development of the port infrastructure associated with the BLNG Precinct.

The sources of raw rock for this plant have yet to be determined.

5.7.9. Concrete Batch Plant

A concrete batch plant would be built during pioneering works at a location to be determined within the BLNG Precinct. The batching plant would utilise potable water, aggregates, sand and cement to produce high strength, low permeability concrete in the order of several thousand cubic metres for establishment of site footings, plant foundations, and hydrocarbon storage tanks, including administration and plant buildings.

5.7.10. Laydown Areas

Laydown areas for temporary storage of various machinery, equipment and materials would be located in each of the industrial blocks and in the Common User Area of the BLNG Precinct.

5.7.11. Access Roads

Access roads and haul roads would be constructed within the BLNG Precinct for the purposes of accessibility in and around the BLNG Precinct site and for movement of personnel, equipment and materials. Roads would be provided between the workers' accommodation and the main precinct access road and to link potential borefield and monitoring sites. Roads would also be required to connect the port facilities to the BLNG Precinct site. The road from the port facilities to the plant site, known as the haul road, would be used to transport imported heavy equipment and materials during construction.

Subject to local government planning provisions, a diversion of Manari Road would be constructed to maintain efficient public access from south of the BLNG Precinct to James Price Point. It is anticipated that this road diversion would incorporate fire management infrastructure where practicable, resulting in an access track of approximately 20m wide around the BLNG Precinct. Construction of the precinct access road (outside of the BLNG Precinct boundary), although required for access to the BLNG Precinct site, does not form part of the scope of this document.

Road construction would include a combination of bitumen surfaces for main access roads and crushed rock for minor roads using road base material from locally source aggregate and/or sourced from a commercial supplier and imported to site. Dust may be generated during construction that would require water suppression as the primary management measure for control.

The width of access roads within the BLNG Precinct would be subject to final design requirements. The haul road is anticipated to have a nominal 20m width with a clearance area in the order of 40m to be able to accommodate loads applied from transportation of large modules.

Future and final road network corridors constructed within the Precinct would be undertaken by future commercial proponents according to the nominated footprint designated for future works. Future road construction would primarily include a duplication and/or extension of the existing road network. It is anticipated that the future road construction would not impact the operation of the LNG facilities.

5.7.12. Telecommunications and Built Support Infrastructure

Telecommunication facilities would be provided within the BLNG Precinct. This would include optical fibre link, microwave or other telecommunications links to provide fixed line, internet and mobile services.

The following buildings would be required to support the gas processing activities:

- Warehouse(s) would be established by each commercial proponent at the Precinct site for storage of equipment and materials.
- Laydown areas would be constructed at the BLNG Precinct within the Common User Area to the east of the industrial blocks (see **Figure 5-2**).
- Laboratories would be developed and maintained by each commercial proponent to provide analytical testing for product and by-products, and would contain testing equipment and a chemical storage area for conducting testing schedules.
- Plant buildings would be established by commercial proponents to house central controls, plant and auxiliary buildings while some equipment may be enclosed in purpose built structures to meet noise control requirements, and workshops would be provided for maintenance of equipment for the LNG facilities.
- Administration buildings (i.e. including offices for personnel, training and induction, etc) would be built by each commercial proponent.
- Security building(s) and infrastructure (fence lines, security gates, car parking, etc) would be established and may be coordinated between multiple proponents.

5.7.13. Workers' Accommodation

Accommodation would be required during the development of the BLNG Precinct consisting of a pioneer camp, construction camp, and permanent accommodation village during operations and during major shutdown events for the LNG facilities.

The pioneer camp is included as Category C and is discussed further in **Section 6.2**.

The permanent accommodation village would support the operational workforce and is anticipated to accommodate between 200 and 1000 personnel with the ability to support a peak workforce in the order of an additional 1000 personnel during planned major maintenance activities. It is anticipated that the workforce would be a combination of fly in/fly out using existing air services through Broome with bus transport to the accommodation site, and a small proportion of workers who would live in Broome. Construction and operational workforce projections for different development scenarios are discussed in **Section 5.13**.

Workers' accommodation would consist of:

- accommodation units;
- amenities, including mess, dining and kitchen facilities; and
- utilities including water and power supply, ablution blocks (showers and toilets), wastewater and waste management, laundry facilities, medical facilities (such as first aid) and recreational facilities (such as gyms, playing fields, barbeque facilities, pools and recreational rooms).

The accommodation facilities would be self-contained single and double rooms, with provision of amenities and utilities as above. Water and power supply, sewage, wastewater and solid waste management may be supplied either from the LNG processing facilities or as standalone systems, however, this would be subject to technology selection, project economics and decision-making by each commercial proponent.

A road connecting the workers' accommodation to the Precinct would be provided for daily transportation of workers to and from site operations.

5.7.14. Light Industrial Area

During construction and operations, various third party companies and contractors would require separate facilities to conduct their services and activities, so as not to interfere with the LNG facilities. The types of companies that may use this facility include scaffolding yards, crane and equipment hire, warehouses, welding yards, fabrication yards, sand blasting facilities, transport companies or other that are typically associated with a light industrial area. Infrastructure (such as power, water and waste management) for operations at the LIA may be either standalone facilities or form part of those provided for the BLNG Precinct.

Buildings would be constructed for LIA facilities using either pre-cast concrete panels, steel structures and other building materials imported to site via marine barge or heavy road vehicles. Large buildings such as sheds and warehouses would be of nominal tens of metres in height. Surfaces surrounding the buildings would most likely consist of cleared open, paved areas incorporating a drainage collection system to contain surface runoff. All facilities and activities associated with the LIA would be incorporated into a 200ha area (**Figure 5-2**).

Facilities for services and goods would be established independently of the LNG proponents and is anticipated to be based on commercial decisions from potential services providers and standard planning conditions.

5.8. Construction Activities Associated with Precinct Development

Typical construction activities associated with establishment of an LNG facility would commence with initial construction of roads, development of the pioneering camp, site clearing and earth works, followed by establishment of the construction camp. Construction of LNG processing trains and plant utilities, storage and distribution systems, Port Facility development, including construction of administration and plant buildings, and permanent accommodation for operational workers are required.

Rock and aggregate obtained from onsite and offsite would need to be converted into rock of suitable size for various applications during construction. This would require a crushing and screening plant to produce high quality aggregates.

Construction of the foundation development of the precinct would likely occur over a period of up to four to five years, with additional construction periods of three to five years, associated with each expansion or new facilities in subsequent development phases.

Table 5-6 outlines key construction activities associated with development of the BLNG Precinct, with additional detail provided in **Section 5.8.1** to **Section 5.8.15**.

■ **Table 5-6 Key Construction Activities for the BLNG Precinct.**

Construction of LNG Production and Export Facilities
Terrestrial Activities
Construction of roads and service corridors
Site clearing and preparation works
Construction of workers' accommodation and associated services and facilities
Earthworks and foundations construction
Stormwater management
Hydrocarbon storage tanks construction
Construction of onshore processing facilities
Construction of administration and plant buildings
Construction of onshore pipelines
Sourcing, transport and import of fill and construction materials
Marine Activities
Dredging works associated with construction of port facilities (i.e. shipping channel, turning basin, pocket berths)
Construction of Port Facility (including export jetties, offloading platforms, loading berths, breakwaters and other supporting infrastructure)
Construction of Marine Facility.
Pipeline construction (in State waters) and shore crossing approach
Construction of Supporting Infrastructure and Services
Construction of LIA
Lay down areas
Construction and operation of crushing and screening and concrete batching plants
Construction of fuel and chemical storage
Construction and operation of supporting utilities and services

5.8.1. Initial Works and Site Clearing

The establishment of pioneer facilities would enable commencement of site preparation work for the workers' accommodation inclusive of facilities such as site offices, and warehousing facilities. As a minimum, pioneering works would include establishment of associated facilities including:

- construction of pioneer camp and construction camp;
- provision of utilities (power, water supply, wastewater treatment, IT infrastructure and communications);
- construction of site access tracks;
- construction of laydown areas and stockpile areas;
- site clearing of LNG footprint areas for early site preparation activities;
- site fencing for separation from heavy equipment, and security of the site including plant, equipment and supplies housed on site; and
- temporary material offloading facilities for sea access and associated dredging (if required).

Site clearing would be conducted in stages as required and during future construction works. Dependent on the actual staging of the Precinct development, future clearing and levelling would be undertaken by future commercial proponents according to the nominated footprint designated for future works.

5.8.2. Port Facility (including Marine Facility)

Initial construction of the facility would occur during site preparation works to enable delivery of equipment, machinery to site by ocean going vessels.

The schedule for construction works is based on activities conducted during both dry and wet seasons, however some activities such as dredging may need to be undertaken during dry season only due to the potential impact of cyclones. The main construction activities associated with establishment of the Port Facility are:

- dredging activities; and
- installation of facilities.

The schedule of construction is likely to be conducted in the following sequence:

- dredging and preparation and establishment of breakwaters and offloading facility;
- construction of wharf (wet lock or tidal quay concept, materials offloading facility, rock load-out);
- installation of facilities to accommodate materials and module offloading, mooring facilities, and infrastructure to support materials handling and transfer during operations; followed by
- installation of tug pens.

These activities are discussed in detail in the following sections.

During development of the Port Facility, which includes dredging activities, there would be a concentration of vessel movements in the port area. There may be in the order of 40-60 construction effort and support vessels for dredging, piling, pipelay, survey, monitoring, etc operating around the clock and within the port area, with additional delivery vessels moving in and out of the port area daily carrying cargo, fuel, and rock, etc. These vessel movements are expected to peak in the initial year of construction and would be managed to minimise impacts on the marine environment.

5.8.3. Dredging

Dredging works for the establishment of the Port Facility (based on currently available conceptual layouts) would take approximately 18 months for the first phase development. This includes mobilisation of dredging equipment and machinery (including preparation of dredged material holding and stockpiling area) and dredging for the Port Facility. Dredging for port facilities is expected to be conducted over one or two seasons for each development phase.

Dredging would be required for the shipping channel, turning basin, berth pockets, and Marine Facility during foundation development of the BLNG Precinct. Dredging would also be required for establishment of breakwaters, and along designated sections of pipeline routes. Further dredging would occur for expansion development of the facilities (i.e. berthing pockets) as required according to the proposed development scenario.

Dredging volumes generated would be dependent on the location and layout of the export facilities. Generally, the metocean conditions, seabed soil conditions and dredge vessel availability are governing factors for the duration and nature of dredging operations.

Preliminary estimates based on the indicative site layout options with the majority occurring for Foundation Development of the BLNG Precinct (channel, turning basin and one to two of the six berth pockets) indicate that the upper limit of the dredging volumes are:

- | | |
|--|---------------------------|
| • Foundation Development (phase one) | 15.5 million cubic metres |
| • Potential future development for 50Mtpa (Scenario 4) | 5.5 million cubic metres |

Dredging works would be carried out using specialised dredging equipment on floating barges or vessels to excavate material in marine environments. Typical dredge vessels may include:

- Cutter suction dredger;
- Trailer suction hopper dredger;
- Backhoe/grab dredger; and
- Jack-up drill and blast barge vessel.

A cutter suction dredger (**CSD**) contains a cutter head (toothed blades) that is lowered onto the seabed to cut away marine sediment and rock. The dredged material is removed by suction and pumping onto a barge moored adjacent to the vessel, or deposited to the same location from which it was cut and reclaimed from the seabed at a later date using a trailer suction hopper dredger (**TSHD**). This vessel can also be used for removing moderately hard material.

Similar to a CSD, TSHD is a hydraulic dredge containing its own equipment including suction and pumping for removal of soft and fine (clay, silt and loam) from the seabed. Dredged material is pumped into the hopper of the vessel for loading and transport away for disposal. TSHD may be utilised in combination with other dredging techniques to remove softer material and fine sediments generated from rock breaking using a CSD.

A backhoe or grab dredger operates similarly to a land-based backhoe excavator but the dredging machine is usually mounted on a floating pontoon. The backhoe dredger contains a large bucket and extended hydraulic arm to dig and extract sediment underwater prior to loading the dredged material on to a barge moored alongside the pontoon. The backhoe dredger may be used in combination with CSD and TSHD dredgers, depending on the type of material for excavation (typically used for softer material) however it may be limited to water depths of up to 20m.

Some blasting and drilling works may be necessary using a drill rig on a jack-up barge if any isolated pockets of hard rock (e.g. cap rock) are encountered in the dredge area. Less than 20% of the dredge spoil is anticipated to be hard composite material requiring potential removal by drilling and blasting techniques, however the extent of hard rock is yet to be determined.

Final selection of dredging techniques and associated equipment is dependent upon the type and nature of the material to be excavated, and technical and environmental constraints associated with the location of the Port Facility.

Dredged spoil material would be either deposited in a designated offshore spoil disposal ground (most likely beyond the 3Nm limit) by placing the dredged material back on the seabed in a location that would have minimal effect on the environment. If deemed suitable for use, dredged spoil may be stockpiled and used as quality fill material during construction.

Future dredging work and associated spoil volumes for development of the BLNG Precinct is to be determined based on final configuration and layout of the Port Facility to facilitate expansion of the LNG production facilities. Maintenance dredging may be required to maintain integrity of appropriate water depths for the shipping channel and turning basin (see **Section 5.10.2**).

5.8.4. Breakwater and Offloading Facility

During the early construction phases, an offloading facility is required to import the material for the early stages of construction until the Port Facility is completed.

Construction of the Port Facility would commence with the placement of a breakwater fabricated from natural rock and/or manmade armour consisting of a mixture of sand, gravel and cement. The construction of the breakwater would most likely involve dredging works. The breakwater would be designed to accommodate cyclonic weather conditions, with a high tide regime up to 9m and in water depths of around 7 to 10m below chart datum, as well as prevailing metocean conditions. If required, the breakwater would be built for the shipping berths in approximately 12 to 15m depth of water below chart datum. The length and orientation would be governed by the site location and Port Facility layout. A range of options would be considered for establishment of the breakwater including:

- caisson type breakwater;
- rubble mound breakwater; or
- (segmental) concrete armour breakwater.

Prefabricated caissons from a fabrication yard can be floated to site on flat top barges, launched in relatively deep water offshore from the site and then towed to position and ballasted into prepared beds (consisting of important graded quarry) during high tide.

Once the breakwater is in place, the Marine Facility may be constructed as either a tidal quay or wet lock design. The wet lock provides a wet pen or lock for vessels to float at controlled water levels eliminating tidal constraints on vessels during offloading operations. In addition, the need for ballast water pumping in the vessel is reduced.

5.8.5. Jetties

Export jetties would be built to provide access to mooring facilities to receive LNG (and potentially LPG) carriers and condensate tankers. Construction of export jetties and other port facilities would involve either drill and grouted piles or driven piles into the rock/soil below the seabed. The spacing and number of the piles would depend on the final configuration of the jetty as part of the Port Facility and the finds of geotechnical investigation.

Once the piles are in place, the jetty itself is likely to be built as an open piled or trestle structure installed on the top of the piles. The jetties would provide an access road (for maintenance purposes), a series of product pipelines for product loading, and return lines for gases and vapour recovery. The design would need to account for any cyclone or other extreme event based on at least a 1-in-100 year return period cyclone conditions.

5.8.6. Earth Works

Clearing of access tracks and LNG plant footprint areas would be undertaken before the commencement of bulk earthworks and would commence immediately following mobilisation and establishment of site preparation contractors. Preparation of the LNG processing plant site would require significant bulk earthworks to prepare appropriate ground conditions for construction. This would involve the removal of pindan soil to a nominal depth between 5 and 10m under the main components of the plant.

Earthworks would be conducted using typical earthmoving equipment such as excavators, scrapers and bulldozers to strip and grade the topsoil. Some controlled blasting (although considered unlikely) for excavation of sandstone bedrock (underlying the surface sands) may be used with appropriate safety and environmental protection. Any surplus rock may be stockpiled and processed through a screening plant as road base or backfill material, or potentially for construction of the Marine Facility.

Alternative fill material may be required for site preparation but the source and volume is not currently defined. However fill material may include material imported from other locations or use of dredge spoil.

Earthwork activities would involve installation of site drainage, sediment and erosion control measures. Stabilisation works may be required including diversion structures such as geotextiles, rock armour, localised drainage and other site specific measures, as appropriate.

5.8.7. Foundations for LNG Production Facilities

The type of foundation would be determined, following soil analysis and geotechnical assessment of the ground conditions, in accordance with the type of processing infrastructure or plant building to be supported.

Options for construction of foundations may include the following in combination with ground stabilisation:

- spread foundation or pad footings;
- raft foundations; or
- piled foundations.

Spread or pad footings are established at a nominal depth below the final paving level and are suitable for heavy structures where ground conditions are sound and not subject to settlement. Pad footings are typically used for heavy load capacities where the ground bearing capacity is high.

Raft foundations can be constructed for critical equipment where ground conditions have less capacity or may be subject to settlement over time.

Piled foundations would be used if soil conditions are not suitable for establishment of the foundation types described above and consist of groups of drilled concrete piles or steel piles that support pile beam foundations on which structures are built. This is likely to require many hundreds of piles.

Lighter foundations consisting of flat concrete slab may be suitable for establishment of plant buildings (i.e. central control rooms and administration offices, including security, warehouses, and laboratories).

Ground improvement techniques such as compaction or stabilisation methods would be investigated so as to determine the most appropriate ground preparation technique.

Confirmation of the foundation construction methodology including elevated areas for processing plant infrastructure is subject to the outcome of detailed geotechnical investigations of areas associated with the LNG facilities.

On completion of foundations, all underground services would be placed and the area backfilled to the paving level.

Dredge spoil removed from the marine environment may be used for backfill requirements for construction of the onshore foundations. The composition and suitability of dredge spoil for material use is subject to confirmation of geotechnical assessment.

5.8.8. Onshore Processing Facilities

There are several methods of construction for onshore LNG processing facilities, either by stick built (in-situ), module components (pre-assembled units or racks) or a combination of both. The LNG facilities are likely to be mostly prefabricated offsite as module components for installation onsite according to the onshore layout of the Precinct.

For stick built methods for construction, activities may include welding, grit blasting and bolting down. With modules, the components are all assembled offsite at fabrication yards, once complete the modules are placed over Self Propelled Module Trailers (SPMT) or Roll-on Roll-off wheeled trailers and safety secured for sea transport.

Modules would be designed for loading in and out of the Marine Facility using SPMT or wheeled trailers and towed to the plant site via the designated haul road.

Future plant construction would be conducted as a staged development according to requirements for future processing capacity, gas composition, technology selection, project economics and decision-making by commercial proponents.

5.8.9. Storage Tanks

Hydrocarbon storage tanks would be constructed in-situ utilising concrete and metal construction techniques, as per relevant design code and standards (e.g. EN14620) for LNG facilities. Various containment levels for storage tanks located within the BLNG Precinct may comprise the following:

- Double containment – These tanks comprise a primary tank surrounded by a pre-stressed concrete outer tank wall and roof.
- Full containment – These tanks consists of an inner tank enclosed by a pre-stressed concrete outer tank wall, with insulation on the inside of the outer tank wall. The roof of the pre-stressed roof is constructed of reinforced concrete. Loss of gas and liquid from the inner tank is fully containable in the inner tank. No bund walls are required around the tank area for spill containment.
- Membrane vertical cylindrical - These tanks contain a primary tank with a single inner wall. Bunding outside of the tank is required for potential loss of containment.

LNG tanks may be constructed using multiple concrete panels joined together to develop the tank shell (outer wall). The roof is constructed within the inside of the tank (at the base). Once complete the roof is lifted into position.

The condensate tank(s) may be constructed using multiple large-sized steel plates transported to site on road by semi-trailer or marine barge followed by transport to the site. Steel plates are offloaded by cranes into position and welded/ bolted into place.

Preliminary estimates of the total number of hydrocarbon storage tanks required to support future expansion of the Precinct are provided in **Table 5-7**.

■ **Table 5-7 Preliminary Estimates of Hydrocarbon Storage Tanks per Development Scenario.**

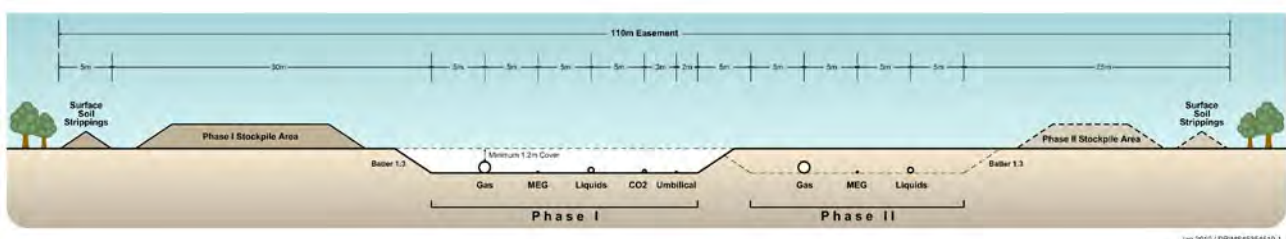
Development Scenario	LNG Storage Tanks	Condensate Tanks	LPG (if required) Storage Tanks
Scenario 1	0	0	0
Scenario 2	3	3	1
Scenario 3A	5	5	2
Scenario 3B	6	6	2
Scenario 4	7	7	3

5.8.10. Administration and Plant Buildings

Construction of the administration and plant buildings would likely be carried out either using modular building techniques involving the transportation of pre-assembled units and/or prefabricated concrete panels to site for assembly or in-situ construction methods (stick built) using imported materials (e.g. steel, bricks) and concrete supplied on site via the purpose built concrete batch plant (see **Section 5.7.9**).

5.8.11. Onshore Pipelines

Onshore pipelines would be installed to transport raw hydrocarbons and MEG (to and from offshore gas fields) along designated pipeline corridors from the shore crossing point to the LNG processing facilities (**Figure 5-8**). The onshore hydrocarbon pipelines would be designed and constructed in accordance with appropriate standards such as AS2885.1.



■ **Figure 5-8 Notional Cross Section of Onshore Pipeline Corridor.**

A minimum right of way (**RoW**) of 110m width (permanent easement) allows access of heavy machinery and a work surface for pipe make-up (stringing and welding), including spoil stockpiles and storage areas.

The buried pipeline would be designed to take the shortest practicable route from the shore crossing point to the site of the proposed gas plant, consistent with environmental and heritage objectives and technical considerations. The proposed alignment of the onshore pipeline corridor(s) is yet to be finalised.

Construction of other pipe work would be required to transport LNG, condensate, potentially LPG, and wastewater across the facility. In addition, onshore pipeline corridors may include return lines that pump chemicals recovered from the liquid stream back offshore.

Pipe work is expected to be prefabricated at a designated fabrication yard and brought to site either via marine transport in sections (most likely), or fabricated onsite. Material type for pipe work is yet to be determined, however for onshore interconnecting pipes for transfer of LNG product, it is likely to be prefabricated carbon steel with insulation.

Pipeline corridors may also accommodate other services, in particular fibre optic cable.

5.8.12. Offshore Pipeline Construction and Shore Crossing

Pipelines would be installed to transport hydrocarbon along a designated pipeline corridor to near shore, where they would cross the shore and continue onshore to the processing facilities. This assessment addresses those pipelines within State waters (from the 3Nm limit to the LNG facilities).

Installation of pipelines in State waters would involve placement via a pipeline vessel into a designated pipeline corridor constructed using proven methods of pipeline installation. Pipeline stabilisation is likely to require a combination of dredging, trenching, rock dumping, and potentially using pre-cast concrete gravity anchors. Rock stabilisation or other alternative material protects the feed gas pipelines from scour and vessel anchors.

There are a range of construction methods for installation of pipelines in near shore environments and for the shore crossing currently being investigated, these include:

- conventional excavation (trenching) and installation (including offshore pipeline pull);
- horizontal directional drilling (**HDD**); and
- tunnelling.

These are discussed in **Section 5.8.13** to **Section 5.8.15**.

5.8.13. Conventional Excavation and Installation

This method involves the use of excavation equipment, such as CSDs, rock trenching machines or backhoe dredges, to create a pipeline trench. The pipes would then be pulled into the trench from a shore based winch, followed by potential burial using rock placed over the pipeline for protection.

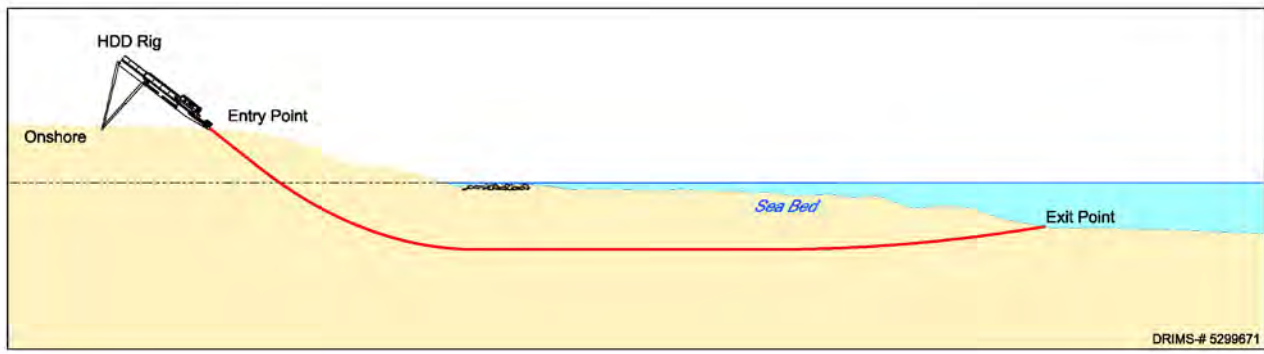
The nearshore pipeline installation (and shore crossing) methodology may comprise similar activities as described for onshore pipeline construction. A summary of the activities associated with pipeline trenching would be as follows:

- Preparation and excavation of up to two pipeline corridors nominally 500m wide each to house feedstock hydrocarbon pipelines and other pipeline infrastructure from the beach to a suitable offshore location. A coffer dam or open cut may be required to allow access for machinery for excavation works.
- Installation of pulling winch spread located onshore and pulling wires within the pipeline trench up to the lay barge position.
- Establishment of a winch pad which would be setup on the beach (within the shore pull area) for push/pull installation of pipelines.
- Pipeline pull to the shore from the pipelay vessel located offshore. Pipelay barge would be positioned as close as possible to the nearshore to prevent pipeline friction along the seabed during installation.
- Backfill of the trench or rock armour protection. The nearshore pipelines would be laid on the seabed.

5.8.14. Horizontal Directional Drilling

This method may be selected over conventional shore crossing method for areas where open cut methodologies are not feasible due to geological and environmental constraints. This installation method involves drilling a hole at a shallow angle beneath the surface then pulling the welded pipe string back through the drill hole (**Figure 5-9**).

Drilling is conducted by a special purpose rig. Soil excavations are typically required to prepare a pad setup area for the rig, a settlement pit for drill cuttings, and containment pits for drilling mud at the drill entry and exit points. The land footprint required is dependent upon the size of the pipe, subsurface geology and length of the drill.



■ **Figure 5-9 Generic Profile of Horizontal Directional Drilling.**

The application of this method is limited by site conditions such as soil stability, gradient and characteristics of subsurface geology. Horizontal directional drilling is unlikely to be technically feasible due to the large diameter size of the proposed pipelines for the Precinct and the shallow water of the near shore area; however this is subject to further investigation.

5.8.15. Tunnelling

Tunnelling involves a special purpose tunnel boring machine used to excavate material to create a large borehole (i.e. tunnel) which is prevented from collapsing by installation of a casing. At completion of bore-hole operations the pipelines can be passed into the hole (if not direct pipe method). Pipelines are installed into the tunnel similar to the horizontal directional drilling method; however the tunnelling machine is recovered at the offshore end of the pipeline once installation has taken place, or could be abandoned below ground at the end of the tunnel.

The excavated material may be stockpiled temporarily before disposal to an approved site or reused if deemed suitable as fill material for other construction purposes.

Tunnelling is best suited for installation of pipelines of larger diameters; however detailed site investigation would be required to determine the feasibility of tunnelling based on geotechnical analysis, and project economics.

5.9. Commissioning

Commissioning of the LNG processing facilities and plant utilities would comprise functional testing and verification of equipment and systems prior to start-up of production. The key commissioning activities would include commissioning of:

- pipelines;
- gas processing facilities and associated supporting infrastructure;
- flare systems;
- plant utilities;
- refrigerant storage facilities; and
- hydrocarbon storage tanks and export facilities.

Gas would be directed to the plant flare in line with normal practice during the commissioning of cryogenic equipment as the system would initially be too warm to produce LNG.

Gas would be flared over prolonged periods at high rates whilst equipment is being tested during initial start-up and commissioning of the processing facilities. LNG would be produced and flaring would cease as the commissioning process continues, and systems cool down toward their normal operating conditions.

Typical commissioning of pipelines would include flooding, hydrotesting, dewatering and purging, with the management of effluent discussed in **Section 5.15.3**.

5.10. Maintenance

5.10.1. Maintenance of LNG Facility and Plant

Maintenance and regular inspections would ensure the integrity and efficiency of the LNG processing facilities and plant utilities associated with the BLNG Precinct. Planned shutdown of the processing facilities would be scheduled and coordinated with routine maintenance on plant equipment and shipping vessels. It is estimated that an additional workforce of approximately 1000 personnel would be required to support major shutdowns that could occur at least once every eight years.

5.10.2. Maintenance Dredging

Maintenance dredging in the port area would also be required to maintain required water depths. This may require maintenance dredging to remove sands and silts that have accumulated due to tidal movements and displacement of sediment over time. Maintenance dredging would use similar methods for removal of soft sediment as described in the construction sections, and the frequency and volume of dredging would depend on coastal sediment processes, and in particular would be influenced by the frequency and severity of cyclones in the region. Dredged spoil may be disposed of either to the same location as the spoil removed during previous dredging programs, or at an alternative location to be agreed.

5.11. Fire Management

5.11.1. Process Fire Management

A Process Fire Management strategy would be in place for operations of the BLNG Precinct that would consist of a combination of measures and management protocols to prevent escalation of consequences from fire events. Primarily, management is achieved through passive and active means of fire protection including:

- safety distances (i.e. unit separation, equipment separation);
- isolation and blow down (i.e. limiting inventory release);
- passive fire protection (i.e. fire proofing structures); and
- active fire protection (i.e. fire and gas detection systems, fire water systems, fire fighting equipment).

LNG facilities would utilise small amounts of freshwater or potable water (stored in tanks on site) for routine testing of fire fighting system according to safety standards. Either freshwater or seawater (or a combination of both) may be used as main sources of firewater. Firewater may be treated with chemicals for prevention of biological growth during storage. Once used, the firewater would need to be treated and disposed of in water treatment facilities.

5.11.2. Bushfire Management

A Fire Management Plan would be in place for construction and operations of the BLNG Precinct. The Plan would consist of a combination of measures and management protocols to reduce the risk of bushfires to the facilities and associated infrastructure. The strategy is likely to involve a combination of fuel load management through clearing and prescribed/mosaic burning. The strategy would also require the construction of fire breaks on the perimeter of facilities and access tracks to facilitate fire management activities such as fire fighting and prescribed burning.

The strategy would be developed with appropriate expertise and would likely comprise the following typical elements:

- haul/access road(s) around LNG equipment providing a firebreak;
- nominal 500m of thinned or cleared vegetation (i.e. spear grass mowed/removed, pindan trees thinned);
- security / access road either side of fence as firebreak (nominal 60m);
- nominal 200m of thinned vegetation; and
- mosaic burning.

5.12. Decommissioning

Decommissioning of the BLNG Precinct would be undertaken to adhere with the relevant regulatory requirements and industry practice at the time of decommissioning. The BLNG Precinct facilities requiring decommissioning are:

- onshore gas processing facilities;
- plant utilities;
- port and marine facilities;
- supporting infrastructure; and
- pipelines (consisting of hydrocarbon feedstock pipelines, onshore pipelines and other pipe work).

Prior to the removal of equipment, the facilities would be depressurised, purged and flushed of any hydrocarbons to avoid any environmental impacts during removal. Where possible, materials would be salvaged from site and reused or recycled elsewhere.

Once the site has been cleared, the ground contours would be reinstated close to the pre-existing conditions, and native flora species would be replanted, to rehabilitate the site.

5.13. Workforce

During early pioneering (site) works, the camp would house up to 800 workers. Workforce numbers would increase to between 5,500 and 8,000 during the peak construction periods, associated with the phased development of the Precinct.

Routine operations would be carried out by a permanent contingent of approximately 1,000 personnel for a BLNG Precinct with a capacity of 50Mtpa. An additional 900-1,000 workforce may be required for major shutdown maintenance of LNG facilities (**Section 5.10.1**). The workforce would be a combination of fly-in/fly-out workers and those residing in Broome. At the start and end of the workers' operation cycle they would be transported by bus to and from Broome airport.

Air passenger movements during construction are anticipated to be in the order of 15,000 per month during peak construction for approximately 12Mtpa LNG facility. During operations, air passenger movements are anticipated to be in the order of 1,000 to 2,000 per month for a 12Mtpa LNG facility.

5.14. Transport

Transportation of goods and raw materials would be provided during construction and operations of the LNG processing facilities, accommodation facilities and LIA.

Provision and supplies of raw materials (i.e. food, rock, construction materials) and maintenance items (i.e. process chemicals, spare parts for equipment) would be transported to the Precinct using road and marine transport. Bulk support of fuel (i.e. diesel) and chemical inventory (i.e. glycol) directly associated with operations of the processing facilities and Port Facility are likely to be transported to site by marine vessels and/or road transport to the Marine Facility, or alternatively via Broome Port for delivery to the Precinct.

Used materials and wastes would be transported offsite by road vehicles to licensed recycling and waste facilities.

5.15. Emissions, Discharges and Wastes

The key emissions, discharges and waste streams in this section are described in broad terms based on the current BLNG Precinct development scenarios. However, discharge rates and total volumes of each stream would be subject to refinement based on individual commercial proponent decisions on the design and construction and operation of their respective facilities.

Emissions, discharges and wastes associated with construction, commissioning, operation and decommissioning of the BLNG Precinct have been estimated for the purpose of the SAR. A summary of the emissions, discharges and wastes associated with the construction and operation of the BLNG Precinct are provided in **Table 5-8**. The following sections provide more detail on the key waste streams generated by the Precinct.

■ **Table 5-8 Key Emissions, Discharges and Wastes.**

Atmospheric Emissions and Discharges
Combustion products: nitrogen oxides NO and NO ₂ (NO_x), oxides of sulphur (SO_x) and carbon monoxide (CO)
Greenhouse gases (predominantly CO ₂)
Dust (as particulates)
Dark smoke
Odour
Light (terrestrial and marine)
Noise and vibration (terrestrial and marine)
Marine Discharges and Waste
Cooling water
Hydrotest water
Dredge spoil
Deck drainage
Anti-fouling
Ballast water
Food scraps from vessels
Wastewater (including produced water, sewage and grey water etc.)
Terrestrial Discharges and Waste
Domestic waste from terrestrial activities
Domestic waste from marine activities
Green waste
Hazardous waste from terrestrial activities
Hazardous waste from marine activities

5.15.1. Atmospheric Emissions (including Greenhouse Gas Emissions)

Atmospheric emissions would primarily arise from:

- power generation;
- CO₂ removal unit at the onshore LNG processing facilities;
- flaring;
- fugitive emissions (from connections and valves); and
- shipping movements (LNG, condensate and potentially LPG vessels).

During construction, emissions to air would predominantly consist of dust emissions generated from initial site clearing and earthworks, vehicle movements on unssealed roads, and wind action over exposed areas. Dust emissions (particulate matter) is largely confined to construction related activities, and is likely to vary substantially from day-to-day, depending on the nature of the disturbance, vehicle movements, ground moisture and meteorological conditions.

Emissions from fuel combustion due to vehicle, vessel and machine use during construction would be temporary and are not considered to be significant compared to emission levels generated during routine operations. The estimated emissions into the air during routine operations for different development scenarios of the Precinct are outlined in **Table 5-9** to **Table 5-12**.

■ **Table 5-9 Estimated Emissions into the Air for Scenario 2 (15Mtpa LNG Facility).**

Emissions Area/Source	CO tonnes per annum (tpa)	NO _x (tpa)	SO ₂ (tpa)	VOC (tpa)	BTEX (tpa)	PM (tpa)	CO ₂ (tpa)	NO ₂ (tpa)	CH ₄ (tpa)	GHG (CO ₂ -e) (tpa)
Energy generation	1,700	4,400	130	170	3	560	4,200,000	4,400	1,100	5,600,000
CO ₂ removal unit	30	830	1,300	20	470	50	2,950,000-5,900,000	830	1,700	6,200,000
Flares	160	65	1	530	2	0	0	65	0	20,000
Fugitive emissions	0	0	0	480	4	0	0	0	85	1,800
Total emissions (tpa)	1,900	5,300	1,400	1,200	480	610	7,000,000-10,000,000	5,300	2,900	12,000,000

■ **Table 5-10 Estimated Emissions into the Air for Scenario 3A (25Mtpa LNG Facility).**

Emissions Area/Source	CO (tpa)	NO _x (tpa)	SO ₂ (tpa)	VOC (tpa)	BTEX (tpa)	PM (tpa)	CO ₂ (tpa)	NO ₂ (tpa)	CH ₄ (tpa)	GHG (CO ₂ -e) (tpa)
Energy generation	2,900	7,300	220	280	6	930	7,000,000	7,400	1,800	9,300,000
CO ₂ removal unit	50	1,400	2,100	30	780	80	4,900,000-9,800,000	1,400	2,900	10,300,000
Flares	270	110	2	880	3	0	0	110	0	33,000
Fugitive emissions	0	0	0	800	6	0	0	0	140	2,900
Total emissions (tpa)	3,200	8,900	2,300	2,000	800	1,010	12,000,000-17,000,000	8,900	4,800	20,000,000

■ **Table 5-11 Estimated Emissions into the Air for Scenario 3B (35Mtpa LNG Facility).**

Emissions Area/Source	CO (tpa)	NO _x (tpa)	SO ₂ (tpa)	VOC (tpa)	BTEX (tpa)	PM (tpa)	CO ₂ (tpa)	NO ₂ (tpa)	CH ₄ (tpa)	GHG (CO ₂ -e) (tpa)
Energy generation	4,100	10,000	300	390	10	1,300	9,800,000	10,000	2,500	13,000,000
CO ₂ removal unit	70	1,900	2,900	40	1,100	120	7,000,000-14,000,000	1,900	4,000	14,000,000
Flares	380	150	3	1,200	4	0	0	150	0	46,000
Fugitive emissions	0	0	0	1,100	10	0	0	0	200	4,000
Total emissions (tpa)	4,600	12,000	3,200	2,800	1,100	1,400	17,00,000-24,00,000	12,000	6,700	27,000,000

■ **Table 5-12 Estimated Emissions into the Air for Scenario 4 (50Mtpa LNG Facility).**

Emissions Area/Source	CO (tpa)	NO _x (tpa)	SO ₂ (tpa)	VOC (tpa)	BTEX (tpa)	PM (tpa)	CO ₂ (tpa)	NO ₂ (tpa)	CH ₄ (tpa)	GHG (CO ₂ -e) (tpa)
Energy generation	5,800	14,700	430	550	12	1,900	14,000,000	15,000	3,600	19,000,000
CO ₂ removal unit	100	2,800	4200	60	1,600	160	10,000,000-20,000,000	2,800	5,700	20,000,000
Flares	540	200	4	1,800	5	0	0	200	0	66,000
Fugitive emissions	0	0	0	1,600	12	0	0	0	280	6,000
Total emissions (tpa)	6,400	18,000	4,600	4,000	1,600	2,060	24,000,000-34,000,000	18,000	9,600	39,000,000

- Notes:
1. Emissions estimates have been calculated based on 24 hours, over approximately 350 days of operation (to account for planned maintenance and major shutdowns of the processing facilities).
 2. Minor emissions such as those related to support vessels (for example tug boats) are excluded from the tables above; however it is anticipated that vessel emissions would be less than one percent of the total emissions per annum.
 3. Emissions from shipping vessel movements have not been included.
 4. CO₂ emissions from the CO₂ removal unit are based on 6-12mol% of CO₂ in the reservoir gas stream.
 5. Total estimated emissions measured in tonnes per annum (tpa) are rounded to 2 significant figures.
 6. CO, NO_x, Sulphur Dioxide (SO₂), volatile organic compounds (VOC), BTEX, particulate matter (PM) (less than 10 microns in size), CO₂, nitrogen dioxide (NO₂), methane (CH₄), GHG.

Non-routine operations include start-up, shutdown and emergency or upset events, and these may last for several hours or days. During these periods it is anticipated there would be increased flaring and some individual turbines would emit high concentrations of NO_x.

Other atmospheric emissions are outlined as follows:

- **Dark Smoke:** Dark smoke is caused by the release of soot particular during flaring. Under normal operating conditions, when the flare is operating efficiently, dark smoke is not produced. Design of the flare system including use of smokeless flare tips to meet regulatory requirements is currently under consideration.
- **Odour:** Potential sources of odour associated with the BLNG Precinct are likely to be limited given that gas including LNG does not naturally have an odour, and due to the relatively low sulphur levels in the reservoir gas, odour emissions of sulphurous compounds at the LNG processing facilities are not expected to be significant.
- **Light:** The generation of artificial light from construction and operation of the BLNG Precinct has the potential to result in light emissions (or light spill), particularly during night-time operations. The amount of light spill generated would be determined by the wavelength and intensity of the light source, the location and/or placement of light fittings and the method of light switching. Likely sources include elevated and marine structures lit for safety.

5.15.2. Noise and Vibration

Noise would be generated during the construction and operational phases of the BLNG Precinct for various activities. The principle noise sources are shown in **Table 5-13**.

■ **Table 5-13 Key Noise Sources from Construction and Operation.**

Emissions Source	Construction	Operations
Terrestrial		
Vehicle movements	✓	
Site clearing and earthworks	✓	
Piling and blasting (if required)	✓	
Power generation	✓	✓
LNG processing facilities		✓
Flare system		✓
Marine		
Dredging vessels ¹ and dredging works	✓	✓
Construction of port facilities	✓	
Pipelay (in state waters and shorecrossing)	✓	
Supply vessels (for import of materials and modularised units)	✓	✓
Shipping vessels and support vessels		✓
Pile driving (hammering)	✓	
Helicopter operations (crew mobilisation and demobilisation from vessels)	✓	
Drill rig on a jack up-barge	✓	

Note: ¹ Dredging vessels during operations may be used for maintenance dredging (activities as described in **Section 5.10.2**).

Noise levels would depend on the equipment being operated, such that size, engine specification, thruster use, speed of movement, and type of activity would influence noise levels. Some sources would be continuous in nature, reflecting 24-hour activities, whilst others are anticipated to occur on a short-term and intermittent basis only. A predicted noise and vibration level from construction related activities is dependent on the outcomes of noise modelling assessments.

Key sources of ground vibration concern the use of heavy construction equipment, particularly piling for establishing foundations of facilities. The layout and configuration of facilities within the Precinct would influence ground vibration levels.

5.15.3. Effluent Discharges

The main liquid effluent streams would include:

- produced water and associated liquid effluent from processing;
- condensed and other wastewater from ancillary equipment;
- surface runoff (for example stormwater) including oily contaminated water from process areas;
- brine water from desalination of saline water; and
- sanitary wastewater (sewage and grey water).

Preliminary estimates of wastewater that would likely be generated at the BLNG Precinct are provided for each development scenario in **Table 5-14** to **Table 5-17**.

■ **Table 5-14 Estimated Wastewater Volume Discharge Rate for Scenario 2 (15Mtpa LNG Facility).**

Emissions Source/ Area	Wastewater (by type)	Volume discharge (kL/hr)	Volume discharge (GL/yr)
Liquid effluent from processing	Produced water and associated liquid effluent	80	1
Ancillary equipment	Condensed water, including water from boilers and tank bottoms	20	0.2
Process areas	Surface runoff for example stormwater and oily contaminated water	-	2
Desalination plant (if required)	Brine (reject) water from reverse osmosis of seawater	700	0 - 6
Sanitary wastewater	Sewage and grey water	9 - 14	0.07 - 0.1
Total wastewater volume (GL/yr)		-	9

■ **Table 5-15 Estimated Wastewater Volume Discharge Rate for Scenario 3A (25Mtpa LNG Facility).**

Emissions Source/ Area	Wastewater (by type)	Volume discharge (kL /hr)	Volume (GL/yr)
Liquid effluent from processing	Produced water and associated liquid effluent	130	1
Ancillary equipment	Condensed water, including water from boilers and tank bottoms	40	0.3
Process areas	Surface runoff for example stormwater, and oily contaminated water	-	4
Desalination plant (if required)	Brine (reject) water from reverse osmosis of seawater	1,000	10
Sanitary wastewater	Sewage and grey water	15-20	0.1 - 0.2
Total wastewater volume (GL/yr)		-	15

■ **Table 5-16 Estimated Wastewater Volume Discharge Rate for Scenario 3B (35Mtpa LNG Facility).**

Emissions Source/ Area	Wastewater (by type)	Volume discharge (kL /hr)	Volume discharge (GL/yr)
Liquid effluent from processing	Produced water and associated liquid effluent	190	2
Ancillary equipment	Condensed water, including water from boilers and tank bottoms	50	0.4
Process areas	Surface runoff for example stormwater, and oily contaminated water	-	5
Desalination plant (if required)	Brine (reject) water from reverse osmosis of seawater	2,000	13
Sanitary wastewater	Sewage and grey water	20 - 30	0.2 – 0.3
Total wastewater volume (GL/yr)		-	20

■ **Table 5-17 Estimated Wastewater Volume Discharge Rate for Scenario 4 (50Mtpa LNG Facility).**

Emissions Source/ Area	Wastewater (by type)	Volume discharge (kL /hr)	Volume discharge (GL/yr)
Liquid effluent from processing	Produced water and associated liquid effluent	100 ¹	2
Ancillary equipment	Condensed water, including water from boilers and tank bottoms	300	0.6
Process areas	Surface runoff for example stormwater including oily contaminated water	-	8
Desalination plants (if required)	Brine (reject) water from reverse osmosis of seawater	2,000	20
Sanitary wastewater	Sewage and grey water	30 - 45	0.3 - 0.4
Total wastewater volume (GL/yr) ²		-	30

Notes: ¹ Stormwater discharge from process areas is estimated based on average annual rainfall (recorded at Broome Airport, Bureau of Meteorology).

² Total estimated wastewater discharge (measured in GL/yr) is rounded to 1 significant figure.

All wastewater volumes provided in the above tables are anticipated to be routine (planned) discharges; albeit surface runoff (consisting predominantly of stormwater, potentially containing oily water) would be intermittent depending on rainfall in the localised area. Total wastewater volumes would vary over time based on average annual rainfall.

5.15.4. Terrestrial Discharges and Hazardous Wastes

Key solid discharges from terrestrial and marine activities associated with the construction, commission, operations and decommissioning of the BLNG Precinct are discussed in this section. The volume of waste predicted during construction would vary depending on the activity. Due to the nature of construction activities, wastes generated are anticipated to be greater than those generated during routine operations.

Domestic waste such as food scraps, paper, plastic, and packaging waste would be generated and either re-used, recycled or managed by licensed contractors.

During construction, likely wastes may comprise glass, scrap metal, concrete and construction rubble, pallets, cardboard, plastic, aluminium cans, empty drums, personal protective equipment and office materials. Large volumes of inert material (e.g. spoil materials such as soil or rock, and green waste from site clearing) would be generated during early site preparation works, however, it is anticipated that a proportion of the spoil material may be re-used onsite as fill material during earthworks.

Green waste would primarily consist of vegetation and timber that has been removed during site clearing activities. It is unlikely during routine operations that the BLNG Precinct would generate green waste, however low volumes may be generated during maintenance for firebreaks.

Hazardous wastes generated may consist of, but would not be limited to, hydrocarbons (waste oils and grease, particularly during construction), glycol regeneration wastes (salts during operations), laboratory chemicals, medical wastes, oily wastewater, paints, treated timber, filters (including mercury), batteries, solvents and lubricants, and fluorescent tubes. Marine activities would also generate hazardous wastes that may include the above types of waste, in addition to spill clean-up materials, empty chemical containers and unused solvents.

The volumes generated during construction activities are anticipated to be greater than those generated for routine operations. Hazardous wastes would be managed by waste contractors for disposal, recycling or treatment in accordance with State and local regulatory requirements.

5.15.5. Marine Discharges

Discharges and wastes that are likely to be disposed of to the offshore or nearshore marine environment during construction and operation of the BLNG Precinct are described in this section. Key marine discharges and wastes derived from the BLNG Precinct may consist of:

- sewage and grey water;
- brine from desalination;
- produced water and process water;
- stormwater;
- hydrotest fluids (an estimated total of up to 800,000m³ of hydrotest water would be required for commissioning of the hydrocarbon storage tanks, based on the assumption that hydrotest water may be partially re-used from one tank to another;
- dredge spoil (preliminary estimates of volumes are discussed in **Part 2, Section 5.8.3** and **Part 3, Section 2.3**);
- ballast water and deck drainage; and
- cooling water (potential discharge as it is likely that proponent will adopt more efficient air cooling technologies).

Vessels associated with the construction, commissioning and operation of the BLNG Precinct are anticipated to conform to maritime legislation and in accordance with applicable guidance and legislation pertaining to ballasting operations, anti-fouling paints, and management of deck drainage.

All water effluents will be managed to ensure disposal occurs at approved locations, at controlled rates, and according to National Water Quality Guidelines (or other appropriate standard) to minimise environmental impact.

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6. Indirect Activities and Related Projects

A variety of activities would occur as a result of the implementation of the BLNG Precinct, and the impacts of those activities must be considered even though they would not be subject to permits and approvals under the BLNG Precinct. In addition, there are a series of projects that would occur in time and space, the impacts of which would be cumulative to those of the BLNG Precinct. These two categories of projects are identified and described in the following sub-sections.

6.1. Category B Activities

Category B activities are described as indirect activities or actions that would occur as a result of the BLNG Precinct. The Category B activities included in the cumulative impact assessments in **Part 3**, **Part 4** and **Part 5** are outlined below.

6.1.1. Housing and Associated Infrastructure

Housing and associated infrastructure would be required to accommodate a proportion of non fly-in/fly-out BLNG Precinct workers and their families. This off site housing would be separate from the workers' accommodation associated with the BLNG Precinct. The housing could be provided within Broome's planned future residential development (such as Broome North or elsewhere). For this reason, the BLNG Precinct may increase the rate of development, and thus it has been included in the cumulative impact assessment.

6.1.2. Industrial Services

The BLNG Precinct would likely increase demand for industrial services in the area. To cater for this demand new industrial estates may be required. These estates could be provided for within land zoned for industry within Broome or elsewhere. Because the size and location of such additional industrial services are not known, this development is only generally included in the cumulative impact assessment. A new LIA is planned for Broome North in addition to the LIA associated with the BLNG Precinct.

6.1.3. Solid Waste

The solid waste facility in Broome has nearly reached capacity and has an anticipated lifespan of five more years. The BLNG Precinct may reduce this lifespan, since it would dispose of its general waste at this location. Currently, a new landfill is being planned but the location of the new facility is unknown at the time of writing. Thus the impacts of the specific sites cannot be evaluated in the cumulative impact assessment. Rather the availability of suitable areas for this site within or around Broome would need to be evaluated in a separate evaluation not associated with the BLNG Precinct SA.

6.1.4. Power

An expanded power supply network would be required to cater for the increased Broome population, even without the BLNG Precinct. However, the population increase in Broome due to the BLNG Precinct would bring forward the requirement for a new power station. A portion of atmospheric emissions from the new station has been included in the cumulative impact assessment.

6.1.5. Transport

Both Broome airport and Broome port would experience increased vehicle movement and passenger throughput due to the BLNG Precinct. Their ability to cater for this increase and the impact on noise and air pollution has been included in the cumulative impact assessment. The BLNG Precinct is not expected to require Broome airport to be relocated outside of the confines of the town any sooner than without the BLNG Precinct.

The transport infrastructure of Broome would generally not require upgrading beyond that already planned to cater for the Category B activities. However, due to increased traffic some intersections, cycle and pedestrian facilities would require upgrading. Transport improvements would be catered for within the road reserve, so these upgrades have not been included in the cumulative impact assessment. However, the social impact of increased traffic within Broome has been evaluated.

6.1.6. Material Sourcing

Aggregate and fill materials would be sourced from a variety of locations from identified quarries or borrow pits (if available). Where practicable, onsite materials would be maximised for use, for example: sand fill and sandstone rock, fill from bulk excavations during construction, and/or marine (dredged) spoil from dredging operations. Depending on the source and location of the aggregate and materials, these materials would be imported to site either by haul trucks or marine vessels.

Additional aggregates such as cement, rock, clean sand and other fill materials during construction works would be sourced remotely. Because the source and amount of material is unknown, this activity is included only generally in the cumulative impact assessment.

6.1.7. Leisure Activities

The BLNG Precinct would include upgrading access to the Dampier Peninsula through improvements to the Broome - Cape Leveque Road, and the construction of the access road to the BLNG Precinct and a diversion of the Manari Road to the coast immediately north of James Price Point. This may increase the recreational and leisure use of the Dampier Peninsula, which would have an impact on the marine and terrestrial environment. Thus this increased use has been included in the cumulative impact assessment.

6.1.8. Additional Development

Through the Heads of Agreement, the State Government has committed to providing an area of land equivalent to that required for the BLNG Precinct, under freehold title, to the Traditional Owners. This land could be developed for any use, subject to environmental and other relevant approvals, including those of the Traditional Owners.

As the location and nature of this potential development is not known, the potential impact of this Category B activity has not been considered in the cumulative impact assessment.

6.2. Category C Activities

Category C activities are described as related projects, which are independent of the BLNG Precinct in environmental approvals terms, but could have similar impacts in times and/or space. Such impacts have been considered when addressing cumulative impacts from implementation of the Plan.

6.2.1. Upstream Development

The upstream development refers to the infrastructure required to remove the gas from the gas fields and transport it to the BLNG Precinct. The gas fields are located north of Broome. The pipeline connecting the field to the BLNG Precinct is included as Category C activities up to 3Nm from the Western Australian coast (within 3Nm it is Category A). The types of activities included in Category C for upstream developments may include:

- Subsea wells, manifolds and flow lines to collect the hydrocarbons from the gas fields;
- Infield floating facilities, one for each of the gas condensate reservoirs;
- Central processing facilities;
- Pipelines connecting the gas fields to the BLNG Precinct; and
- Supply base development to service and supply the upstream developments.

6.2.2. Upstream Exploration and Appraisal Activities

The upstream oil and gas exploration and appraisal activities included in Category C are:

- Those within the Browse Basin, plus activities required to support this operation; and
- Those within the Canning Basin.

6.2.2.1. Main Access Road

The Department of Main Roads is currently undertaking the planning and project management for the construction of an access road connecting the Browse LNG Precinct with the existing Broome-Cape Leveque road. Main Roads will submit separate applications for environmental and other approvals for the road as required. Cumulative impacts associated with clearing for the main access road are considered in the SAR.

6.2.2.2. Pioneer Camp

Woodside is considering a 600 person pioneer accommodation facility ahead of the development of the permanent construction and operational workforce facilities which are part of the BLNG Precinct. Woodside will seek separate approvals for this facility as required.

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7. Land and Asset Tenure

The land required for the BLNG Precinct is comprised entirely of unallocated Crown land, which includes the seabed out to the three nautical mile State territorial limit. It is located on part of the land and adjacent waters subject to a registered claim under the Commonwealth *Native Title Act 1993* by the Goolarabooloo Jabirr Jabirr registered native title claimant. Development of the BLNG Precinct cannot proceed in the absence of the appropriate land tenure being granted, with the granting of such tenure being subject to the acquisition of native title rights and interests over the area of land required.

The State Government has been negotiating with the Kimberley Land Council, who represents the registered native title claimant, since January 2008 to secure the areas required for the BLNG Precinct. It is the State Government's preference to secure the land required via an Indigenous Land Use Agreement or similar agreement, which would ultimately register the consent of the claimant to the establishment and operation of the BLNG Precinct. However, given continued questions about the authority of parties to negotiate such an Agreement and the timing issues that this presents, on 2 September 2010 the State announced that it would commence a formal process under the *Native Title Act 1993*. This process involves negotiating in good faith with registered Native Title claimants over a six-month period. If agreement cannot be reached, the State will refer the matter to the National Native Title Tribunal for arbitration for a further six months, after which the Tribunal determines if the development may be done, and if so, under what conditions.

Land tenure would ultimately be granted by the State of Western Australia to individual project proponents in the form of leases, easements or licences granted through the State land management body LandCorp and the Broome Port Authority which will be responsible for management of the Port. Freehold land will not be granted to individual project proponents.

The State Government and Woodside (as a potential foundation proponent) have together committed to delivering about \$1.5 billion of social and economic benefits to local Aboriginal communities, under a Heads of Agreement signed by the Kimberley Land Council on behalf of the Goolarabooloo Jabirr Jabirr claimants in April 2009. The Heads of Agreement includes:

- recognition of the claimants as Traditional Owners of the affected land;
- providing an area of land, equivalent to that required for the precinct, to the Traditional Owners under freehold title;
- creating new economic opportunities, including in business development and trade training;
- stronger environmental and heritage protection including creating new conservation reserves on the Dampier Peninsula;
- reform of indigenous land tenure reform to help establish appropriate titles for home ownership and economic development in Dampier Peninsula communities;
- creating Traditional Owner controlled funds for economic development, housing, education and cultural preservation funds;
- increased funding to improve Government facilities and services for the wider community; and
- when the land is no longer needed, returning it fully remediated to the Traditional Owners

An equivalent level of commitments would be required from future commercial proponents as to those from the Foundation LNG Proponent, as and when they undertake a project at the Precinct.

Subject to the State securing the rights and interests over the land required for the BLNG Precinct, land tenure would ultimately be granted by the State of Western Australia to individual commercial proponents in the form of leases, easements or licences, in accordance with the *Land Administration Act 1997*, the *Western Australian Land Authority Act 1992* and/or the *Port Authorities Act 1999*.

LandCorp would manage the onshore tenure arrangements granted under *the Western Australian Land Authority Act 1992* while the Broome Port Authority would manage tenure arrangements granted under the *Port Authorities Act 1999*. It is anticipated that some provision for subleases would also be provided to satisfy individual commercial arrangements. Importantly, all leases, subleases, easements and licenses and their respective conditions must be consistent with conditions imposed in relation to native title, any ILUA or equivalent consent agreement with Traditional Owners, and any commercial development agreement reached with commercial proponents.

8. Impact Assessment Methodology

8.1. Assessment Approach

This section outlines the methodology used to assess the potential environmental impacts resulting from the BLNG Precinct. The methodology presented in this section should be read in conjunction with the description of impacts and the preventative and management measures described in **Part 3** (for marine environmental factors), **Part 4** (for terrestrial environmental factors) and **Part 5** (for social and Indigenous factors).

The environmental assessment was undertaken as a two stage process to ensure that all relevant issues were addressed (refer to **Table 1-1** for a description of Category A, B and C Activities):

1. **Category A factor impact assessment.** The factor impact assessment is based on an assessment of the impacts from each Category A activity affecting that factor, and includes mitigation and environmental or social outcomes assessed against relevant policy and legislation. Matters of NES pursuant to the EPBC Act have been assessed using the same methodology and are addressed under each factor as appropriate, but are also consolidated in a separate impact assessment section.
2. **Cumulative impact assessment of Category A, B and C activities.** Category B and C activities are not part of the Strategic Proposal or actions to be implemented under the Plan, but are addressed to ensure that direct and indirect impacts of the Plan are considered. An assessment is made as to whether the environmental impacts arising from Category A activities are altered by Category B and C activities both locally and regionally and over short and long timeframes.

A suite of tools was applied during the impact assessment process for the BLNG Precinct. These tools included:

- a high-level screening process to identify potential impacts and prioritise actions to minimise them;
- the identification of key and other relevant factors based on qualitative significance definitions;
- application of the hierarchy of controls to ensure that residual impacts are as low as reasonably practicable; and
- application of policies and guidelines to determine the significance of the residual impact.

The first step of the environmental impact assessment was the assessment of impacts arising from each aspect of the proposal identified in the Scope of the Strategic Assessment (**SoSA**) on relevant environmental factors. This was achieved through a semi-quantitative risk-based assessment. The results of the assessment should not be interpreted in isolation from the broader environmental assessment process which includes consideration of the significance of potential impacts based on regulatory guidelines. The screening assessment evaluates the likelihood and consequences of an adverse effect occurring as a result of exposure to one or more aspects or hazards. The methodology used for BLNG Precinct assessment is consistent with standard management processes and practice as outlined in the Australian risk management standards (AS/NZS 4360). The main elements of the environmental screening assessment process comprised:

- establishing the context;
- identifying the potential environmental hazards and pathways for exposure;
- assessing the potential environmental impact of the aspect, the resulting environmental consequences and the likelihood that the aspect would occur;
- identifying preventative and management measures; and
- recovery.

The Scoping Phase of the assessment had focussed on the application of a systematic approach to identify potential impacts. A high-level screening assessment was used to identify the range of potential impacts based on potential interactions between: a) the receiving environment ("environmental factors", including social factors); and b) environmental stressors ("environmental aspects", including social factors). These factors were presented to the OEPA for their consideration in the *Browse LNG Precinct Scope of the Strategic Assessment* (DSD, 2010b; **Appendix A-2**). The Proponent's decisions took into consideration the standard controls that would be in place to prevent an aspect from occurring, as well as the nature of the materials or substances that contribute to the aspect. Those factors that required

in-depth investigation during the impact assessment phase, were identified in accordance with the following qualitative definitions:

Key Factors:

- Potential impacts may raise significant concern from stakeholders; and/or
- Require high/moderate level of mitigation and/or management for potential impact to comply with guidelines and standards; and/or
- Direct/permanent loss of environmental attributes or conservation significance and/or social attributes of significance; and/or
- Represent a severe or high rating from the screening assessments.

Other Relevant Factors:

- Potential impacts are unlikely to be of significant concern from stakeholders; and/or
- Potential impacts will be minor requiring minimal management measures to comply with guidelines and standards; and/or
- Potential impacts will be localised and short-term, with minimal loss to environmental attributes of conservation significance and/or social attributes of significance; and/or
- Represent a medium, low or less than low rating from the screening assessments.

The environmental factors and resultant significance rating identified through the impact assessment phase are presented in **Table 8-1**. As the assessment progressed, it became clear that several of the community and social surrounds factors should also be addressed.

These factors were further evaluated through existing information, findings of investigation studies, consultation with relevant stakeholders and experience gained from a similar project undertaken on the North West Shelf.

■ **Table 8-1 Environmental Factors and Significance Rating.**

Key Factors	Other Relevant Factors
Marine Environment (reported in Part 3 of the SAR)	
<ul style="list-style-type: none"> • Marine water quality; • Benthos including benthic primary producers; • Marine mammals; and • Marine reptiles. 	<ul style="list-style-type: none"> • Tidal regimes, currents and hydrodynamics; • Marine sediment quality; • Fish; and • Marine ecosystem integrity.
Terrestrial (reported in Part 4 of the SAR)	
<ul style="list-style-type: none"> • Terrestrial flora and vegetation; • Greenhouse gas emissions; and • Terrestrial fauna. 	<ul style="list-style-type: none"> • Soils and geomorphology; • Surface water; • Groundwater; • Terrestrial ecosystem integrity; • Air quality; and • Species of ethno-biological significance.
Community and Social Surrounds (reported in Part 5, Section 4 of the SAR unless otherwise specified)	
<ul style="list-style-type: none"> • Palaeontology; • Aboriginal heritage; • Visual amenity; • Light and landscape character; • Commercial fishing; • Aquaculture and pearling; • Tourism; • Sports, recreation and land use (including recreational fishing); and • Community services (reported in Part 5, Section 2). 	<ul style="list-style-type: none"> • Environmental heritage and conservation areas; • Colonial heritage; • Mining (reported in Part 5, Section 2); • Agriculture (reported in Part 5, Section 2); and • Human health.

The factor impact assessments have been prepared to meet the requirements of Item 6 of the Terms of Reference (DSD, 2010c; **Appendix A-3**). The potential impacts on key and relevant factors from the assessment of aspects were collated and the combined or cumulative potential impacts on each factor were determined and assessed against the relevant government guidance, policies and standards relevant to the factor. For each factor, a systematic process was followed to identify the values, key aspects, impacts, mitigation and outcomes associated with Category A activities. Then these outcomes are viewed in the context of potential cumulative impacts from Category B and C activities. Particular attention was given to the management and mitigation measures (as appropriate at this strategic proposal stage) required to reduce impacts to acceptable levels and the safeguards and management arrangements to limit, avoid or offset environmental impacts from these aspects in order to protect identified environmental values. This was achieved by systematically applying the hierarchy of controls, based on measures to:

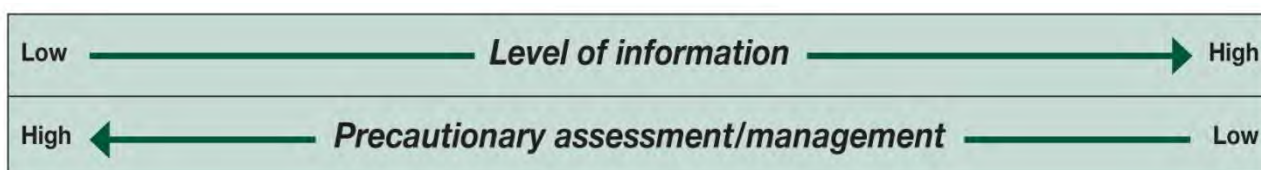
- prevent or reduce the likelihood of an aspect from occurring;
- facilitate detection of an aspect prior to a resultant impact occurring;
- control the extent/escalation of an aspect;
- mitigate the impacts resulting from an aspect; and/or
- initiate safeguards to mitigate potential impacts should control measures fail.

Finally, an assessment of the significance of the residual impact on each factor resulting from the construction and operation of the BLNG Precinct was undertaken using key statutory requirements, environmental policies and guidance statements.

Although exact details of future proponent proposals within the BLNG Precinct are not known, this document provides sufficient information to allow an assessment of whether the issues raised by the establishment of the BLNG Precinct are manageable and to establish the safeguards and management arrangements that would be in place to ensure impacts are acceptable.

8.2. Managing Uncertainties of Precinct Development

As a number of actions or future proposals under the Plan may not be implemented for a considerable period of time, the level of design and environmental information that is normally provided in an impact assessment of specific actions or significant proposals is not necessarily available for this strategic assessment. In some cases, detailed information is available on both the environment and scope of future actions or proposals, and there is a high level of scientific certainty regarding the data inputs to the impact assessment. In these instances, the impact assessment is similar to the usual project impact assessment, with less need for precautionary assessment and management arrangements to be applied (**Figure 8-1**).



■ **Figure 8-1 Sliding Scale for Environmental Management Approach.**

An example of this situation is the assessment of impacts on vegetation and flora, where there is a high level of certainty regarding environmental values as detailed surveys have been undertaken and the maximum extent of the terrestrial footprint is fixed (**Part 4, Section 2.4**). On the other hand, where little baseline environmental information is available or the project scope is not so well defined (for example the extent and location of groundwater resources and abstraction), a precautionary approach to assessment and management has been taken to reach the required level of certainty regarding environmental outcomes, without the level of detail usually included in project impact assessment (**Part 4, Section 2.3**). In these cases, a range of mechanisms have been employed and outlined in each factor impact assessment section:

- 1) *Other regulatory processes.* For some impacts there are other existing regulatory processes that address aspects of the proposal or action to ensure the desired environmental outcome. As the environmental outcome is already ensured through other processes, broad management strategies and alternatives are sufficient to be included in the

Strategic Assessment in order to demonstrate that these outcomes are achievable. In these cases, the Strategic Assessment broadly outlines the potential impacts and their significance, details the regulatory processes that apply and the environmental outcome that is to be achieved by these processes. Examples include groundwater abstraction licences under the *Rights in Water and Irrigation Act 1914*, sea dumping permits under the *Environment Protection (Sea Dumping) Act 1981* and works approvals to control discharges under Part V of the EP Act. In some cases, where very little information is available on the aspect or the affected factor, another option for which sufficient information is available may be proposed. This would be implemented if the original option was subsequently found to be unable to achieve the desired environmental outcome (for example, desalination instead of groundwater supply).

- 2) *Outcome-based conditions.* Where key environmental values have been identified but there are less detailed baseline data available on which an assessment can be made (for example, long term datasets for detailed hydrodynamic modelling are not available), outcome based conditions that will set environmental limits can be developed to provide certainty of the environmental outcome. Future proponents would have to demonstrate that their proposal can meet these conditions in order to be implemented. Outcome-based conditions may also include adaptive management triggers to address uncertainty in predictions of impact. Even with full information, there are always uncertainties in environmental modelling. The Strategic Assessment proposes outcome-based conditions that may be applied by the regulators.
- 3) *Sensitivity analysis.* Where the predicted impact is uncertain, a sensitivity analysis has been undertaken to determine whether a range of scenarios changes the environmental outcome. For example, there is no detailed information available regarding the predicted air emissions of future developments. However, the types of emissions from LNG processing are well understood and a range of emissions and meteorological scenarios can be assessed to see whether the appropriate standards are likely to be exceeded at a given sensitive receptor.
- 4) *Assessment of conservative scenarios.* This is similar to a sensitivity analysis but is most applicable when the project scope is uncertain. For example, the exact configuration of the port is not known so the assessment has been based on a footprint that is larger than that expected to be required, to ensure that the footprint of any configuration within that envelope is likely to be acceptable.
- 5) *Risk assessment.* Risk assessment is a tool that was used in the SoSA to prioritise impact assessment and management, even in situations where detailed information may not be available. As outlined in the previous section, a review of relevant risks was undertaken at the SAR assessment stage, taking into account additional information and knowledge gained through a range of baseline and technical studies.
- 6) *Management plans.* In a Strategic Assessment, it is appropriate to require the preparation of a management plan to ensure that the methods used by future proposals are appropriate to achieve the required environmental outcome. The requirement for management plans is outlined in the Strategic Assessment as part of the information that would be required for a proposal to be declared derived, or may become one of the implementation conditions. It is proposed to provide additional information through management plans on a range of issues including fire management, monsoon vine tick and drainage basins, dredge and dredge spoil management.

For some factors, a range of approaches have been employed to achieve the required level of certainty. For example, a range of air emissions scenarios have been assessed to determine whether a sensitive receptor would be unacceptably affected, but an outcome-based condition has also been proposed that sets air quality limits at the boundaries of the Precinct.

While detailed project scope certainty may not be available, the Proponent considers that sufficient information has been included in the SAR to provide certainty regarding the environmental outcome through one or more of the above approaches.

8.3. Cumulative Environmental Impact Assessment Methodology (for Category A, B and C Activities)

The Scope of the Strategic Assessment provides guidance with respect to the Category B and C activities to be included in the cumulative impact assessment. The majority of Category B activities are related to increased population and use of or provision of services in Broome, while Category C impacts are largely oil and gas exploration and development projects offshore, as defined in the Scope of the Strategic Assessment.

Aspects of Category B and C activities, which affect the same matters of NES as a Category A activity, have been identified and the impacts on them have been assessed both individually and cumulatively with Category A impacts. Only those factors that are affected by Category A activities will be subject to cumulative assessment. For instance, it may be identified that Category B or C activities will not affect vine thickets and therefore, the cumulative assessment of impacts on vine thickets is limited to Category A impacts. Similarly, the impact of Category B and C activities on factors not affected by Category A activities have not been addressed.

The significance of cumulative impacts has been assessed at the local and regional scale and against the relevant environmental policy and legislation. Due to the lower level of detail being available on the environmental aspects of Category B and C activities and the environments they affect, a range of impact assessment methods and information sources were utilised to assess cumulative effects including:

- best professional judgement regarding sensitivity of the factor/species to the cumulative impacts identified;
- spatial habitat assessment, such as proportion of habitats affected, location of pressures in relation to migratory routes, key habitats or proportion of habitats protected;
- identification of potential protection measures to mitigate environmental impact resulting from these activities that are not already addressed by management arrangements for Category A activities; and
- other environmental assessments being undertaken for Category B and C activities (for example LandCorp Broome North project and upstream development activities proposed for the offshore Browse basin).

The cumulative impact assessment culminates in an assessment of likely environmental outcome of the cumulative impacts of Category A, B and C activities. Where relevant, the SAR considers the identification of regional knowledge gaps and environmental constraints that may be addressed by the Government in west Kimberley planning and priorities for future conservation management, monitoring and research in the west Kimberley, linked with the proposed management arrangements and State Government measures outlined in The Precinct Plan.

8.4. Presentation of Findings

The findings of the impact assessment are presented in **Part 3, Section 2** and **Part 4, Section 2** for marine and terrestrial factors respectively and in **Part 5, Section 2, Section 3** and **Section 4** for the social and Indigenous factors. These impact assessment sections present the following information:

1. **Current knowledge:** This section summarises the extent of existing knowledge and information, including current and relevant baseline studies relevant to each factor, and key Commonwealth and State policy documents.
2. **Identification of key aspects:** An outline of the key aspects determined to be of primary relevance to the factor, and an overview of the sources of potential impact from Category A activities. Where relevant, a summary of the sensitivity and resilience of the relevant components of the factor in the context of impact assessment, to the extent that these are known from available literature and supporting studies. This is intended to focus on the main issues that will be addressed in the impact assessment.
3. **Predicted impacts:** An assessment of impacts, taking into account the outcomes of the risk assessment. This considers the extent to which the factor is likely to be affected including magnitude, extent and duration of impact. The significance of the impact both locally and regionally is assessed based on existing policies and guidelines. This section includes a summary of the proposed management measures and controls, taken into account in the assessment of relative risks that will be used to manage impacts to acceptable levels.
4. **Management measures:** Management measures that have been identified to avoid, minimise, manage and mitigate the potential impacts to each factor are outlined. These reflect the tiered approach to management presented in **Part 6, Section 3; Part 3, Section 2; and Part 4, Section 2**.

- *Tier 1 - State Government Measure*

State government measures have been developed to address environmental aspects associated with the BLNG Precinct with the highest potential environmental impact significance or uncertainty. State government measures provide a means by which regional scale mitigations or protection measures are realised and also ensure state government involvement in relevant precinct matters. Various state government agencies are responsible for supporting the implementation of these state government measures.

- *Tier 2 - Proposed Condition for the Strategic Proposal*

Conditions of approval for the strategic proposal have been proposed to address impacts from activities considered to be of moderate or high potential significance or uncertainty. The proposed conditions can be issued under Section 45 of the *Environmental Protection Act 1986* and shall be met by derived proposal proponents, where a proposal relates, or is relevant to such conditions. These conditions will require sign-off by the State Minister for Environment or delegated authority.

- *Tier 3 - Requirements for Derived Proposals*

Additional requirements for derived proposal proponents have been proposed to address medium or low environmental impact significance from activities associated with the BLNG Precinct. These requirements will be implemented by derived proposal proponents at various stages of the development as applicable to the activity being undertaken. Some proposed requirements will require sign-off by the Minister for Environment or delegated authority.

- *Application of Best Practice Management Measures*

Certain management measures presented in Parts 3, 4, 5 and 6 of the Strategic Assessment Report make reference to the demonstration of the application of 'best practice'. For the purposes of the Strategic Assessment Report, the term 'best practice' is defined as the following:

'the application of the best available mitigation measures that are practicable in the particular circumstances of a proposal to avoid or minimise environmental impact'. The process of achieving best practice would include developing design and management measures against international benchmarks whilst having regard to local conditions and circumstances (including costs) and to the current state of technical knowledge'.

The philosophy of application of best practice, as outlined above, is the underlying approach for developing environmental management plans and design of proposals consistent with the management framework identified in the Strategic Assessment.

5. **Environmental outcome:** This section concludes with outcomes from the implementation of Category A activities in the context of relevant environmental guidelines and the management measures to reduce risks to acceptable levels. A brief summary of the potential consideration of the cumulative impacts of the Strategic Proposal or actions under the Plan and indirect impacts from other actions or proposals not included in the Plan or Strategic Proposal (i.e. Category B or C activities) is provided.
6. **Summary tables:** A summary of predicted impacts arising from Category A activities, associated management measures and significance of the resultant residual impacts is presented.

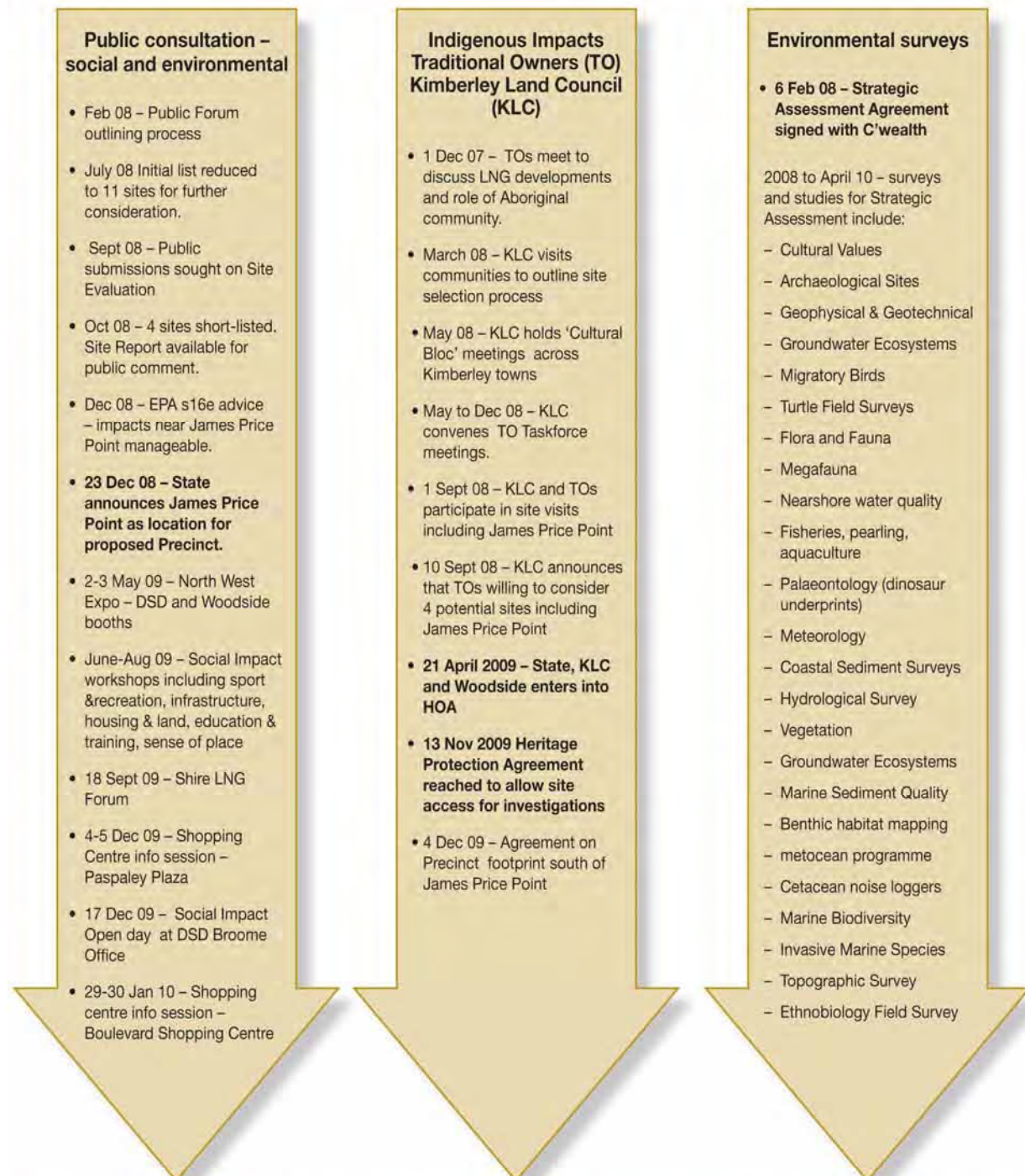
9. Consultation Undertaken

Public participation in decision-making in relation to the BLNG Precinct can be traced back to the NDT process which effectively comprised a screening phase of an environmental and social impact assessment (**SIA**) to inform selection of an appropriate BLNG Precinct development site. The Final Site Evaluation Report (NDT, 2008d; **Appendix B-6**) summarises the consultation process.

Consistent with the Terms of Reference for the Strategic Assessment, consultation during the assessment has comprised two main sub-processes: (i) high level briefings and communication on the Precinct assessment project; and (ii) specific consultations in support of the SIA (DSD, 2010c; **Appendix A-3**).

The relationship between the high level briefings/communication and progress of studies of heritage, environment and SIA that comprise the Strategic Assessment are represented in **Figure 9-1**.

**June 2007 – State endorsed strategy to develop Browse gas;
43 sites evaluated against environmental, social, technical & economic criteria;**



**Over the past 12 months, consultation has continued in parallel with:
Environmental and heritage surveys;
Native Title Negotiations; and
Preparation of the Strategic Assessment Report**

■ **Figure 9-1 Relationship of High Level Briefings and Strategic Assessment Component Studies.**

9.1. Consultation Undertaken Towards the Social Impact Assessment

9.1.1. Social Impact Assessment Phases

The SIA program methodology included a baseline assessment (or profiling stage), drawn primarily on information from secondary data review, technical exchanges with agencies and several stakeholder theme workshops. More discussion about SIA methodology is provided in **Part 5**.

Table 9-1 lists the tasks and mechanisms undertaken in relation to each of the SIA phases. Community involvement is an integral part of any SIA process and the table details the range of different mechanisms that have been used to involve the community/stakeholder and collect relevant information to inform the assessment process.

The SIA Stakeholder Engagement Plan was conducted in two phases following the announcement of a site in the vicinity of James Price Point as the preferred Precinct location. The overall SAR process has a statutory requirement for a written public comment opportunity and for the Precinct proponent to respond to these comments.

The KLC is the recognised Native Title Representative Body for the Kimberley region. It represents Traditional Owners in this region for the purposes of the *Native Title Act 1993* (Commonwealth). The KLC established a Traditional Owner Taskforce and facilitated consultations with all coastal native title holders, claimants and Aboriginal communities from Cape Bougainville in the north to the Kimberley/Pilbara representative area in the south, which provided input into the State site selection process. An Aboriginal Social Impact Assessment (**ASIA**) was undertaken by the KLC alongside a series of Indigenous impact reports. A summary of the consultation process undertaken towards the assessment of impacts on Indigenous people is provided in **Part 5, Section 3**.

9.1.2. Scoping and Profiling

In the current assessment, stakeholders were identified through previous NDT work and through a stakeholder networking approach. Information was collected using a range of methods and techniques.

A desktop social impact risk assessment was undertaken based upon:

- NDT reported outcomes;
- review of previous international and Australian LNG SIA studies;
- professional experience of DSD and Woodside's regional and Perth-based staff; and
- a review of previous impact assessment studies and SIA professional literature.

This assessment was used to inform scoping of the issues together with data collected during consultation fieldwork. Data collected from key stakeholder interviews and workshops was collated and analysed for impact themes, causation, potential management strategies and existing contextual issues.

■ **Table 9-1 SIA Phases, Tasks and Description of Consultation.**

Phase	Task/Mechanism	Summary of Disclosure and Consultation
Scoping	Review of NDT outcomes. Personal interviews (key stakeholders). Development of a preliminary activity-factor-impact matrix and associated consultation target database.	Consultation with key stakeholders including: <ul style="list-style-type: none"> Local Government; State Development Agencies; Indigenous Groups; Service Providers; and Commerce and Industry Associations. Development of study scopes SAR Scoping Report. Publication of scope in SIA Volume 1: Profile and Scoping Report (DSD, 2009a; Appendix D-1).
Profiling	Secondary data review. Social indicators analysis.	Publication of a baseline profile of the socio-economic and health context in SIA Volume 1: Profile and Scoping Report (DSD, 2009a; Appendix D-1).
Compare Options	Documentation of potential Precinct development scenarios.	Incorporation into publication SIA Volume 2: Impact Assessment (DSD, 2009b; Appendix D-2).
Project and Estimate Effects	Issue assessment and evaluation including population modelling and specialist receptor studies: (e.g. fisheries, tourism, indigenous community, community infrastructure, colonial heritage) (see Appendix D).	Key stakeholder theme workshops on: <ul style="list-style-type: none"> Sport and recreation; Health; Infrastructure; and Sense of Place. Publication of SIA Volume 2: Impact Assessment (DSD, 2009b; Appendix D-2). Publication of SIA Volume 3: Management and Monitoring (DSD, 2009c; Appendix D-3). ASIA: <ul style="list-style-type: none"> In-community consultation by KLC; and Publication of ASIA Report (Appendix E).
Monitor and Mitigate	Development of Precinct Plan and SAR. Feedback from Public Review.	Phase 3 communication plan (in development) includes statutory public comment period/responses to regulator. Publication of SAR for public review and comment.
Evaluation	Public comments. Final report.	Approval of SAR by State and Commonwealth.

9.1.3. Project and Estimate Effects

The need for sixteen specialist social studies was identified in the Scope of the Strategic Assessment. In practice, the inter-related nature of the impacts reduced the number of studies required to address the scope. The most significant studies included: population modelling, tourism impact assessment; community infrastructure; and fisheries assessment (**Appendix D**). A series of Indigenous impact reports were produced by the KLC (**Appendix E**).

9.1.3.1. Population Modelling

Based on workforce projections and assumptions about the normal place of residence of construction and operational workers, various population change scenarios were developed to evaluate the significance of these changes. This assessment involved the collection of data by telephone or in person that related to the existing levels of service provision and current service provision challenges and pressures being faced in Broome. This data (published in DSD SIA Volume 1; DSD, 2009a; **Appendix D-1**) has allowed for conclusions to be made on the ability of specific services in specific places to respond to different modelled levels of population change.

9.1.3.2. Tourism Impact Assessment

The Tourism Impact Assessment (KPP Business Development, 2009; **Appendix D-5**), was commissioned by Tourism WA in partnership with DSD. The scope of this included consultation with mainstream and eco-tourism operations both on and around the Dampier Peninsula and operations in the town of Broome. In addition to profiling the industry, the study reported on stakeholders' perceptions of impacts and developed impact management alternatives.

9.1.3.3. Infrastructure Assessment Study

BLNG Precinct Infrastructure Assessment Study (AECOM, 2010d; **Appendix D-6**) was prepared for the DoP and DSD. It made an assessment of the capacity of community services and infrastructure to respond to the likely levels of population growth using objective service standards, where available, and noting priority action areas to address identified deficits.

9.1.3.4. Fisheries Industry Impact Study

The scope of the Fishing Industry Impact Study (EconSearch, 2009; **Appendix B-4**), prepared for the Department of Fisheries (**DoF**), included consultation with commercial fisheries, aquaculture, recreational fishing and customary (Indigenous people) in relation to their fishing practices. In addition to profiling current activities, the assessment canvassed opinion on the range and nature of potential impacts.

9.1.4. Consultation and Communication Methods

Consultation methods employed as part of the SIA have included:

- key stakeholder interviews;
- key stakeholder theme workshops;
- community events.
- community information including production of factsheets and audio-visual presentations distributed on DVD/Department website;
- overview/progress presentations with questions and answers by DSD; and
- stakeholder reference group.

The scope of these methods is summarised in **Section 9.1.4.1** to **Section 9.1.4.4** and **Section 9.2.1.3**.

9.1.4.1. Key Stakeholder Interviews

A number of limited key stakeholder interviews were undertaken to capture stakeholder values, issues and impacts in relation to the Precinct. The process also involved the identification by stakeholders of impact management proposals. Prior to undertaking these interviews, a series of factsheets and a DVD were distributed to assist stakeholders to consider potential issues.

9.1.4.2. Key Stakeholder Theme Workshops

A number of workshops were held, mainly with service providers, to inform them of the proposed development of the Precinct and the potential development scenarios, and to provide an opportunity for input into the identification of issues. The workshops all followed a similar format with an introduction from the facilitator, followed by presentations on the overall development of the Precinct from the DSD, an overview of Woodside's proposed development (as a potential Foundation Proponent), and an overview of the SIA process.

Some of the workshops contained additional presentations. For example, a presentation by LandCorp on the new Broome North development was included at the Land and Housing Workshop; and a presentation on the planning aspects of 'Sense of Place' from the Planning consultants working on the Broome North development, was also undertaken during the 'Sense of Place' Workshop.

The workshops focused on the potential social impacts from both the primary impact area (James Price Point coastal area extending to Broome) and the secondary impact area (Dampier Peninsula, Derby and Bidjadanga). All the workshops were attended by DSD and Woodside representatives.

Table 9-2 summarises the workshop themes and attendees.

■ **Table 9-2 Key Stakeholder Theme Workshops.**

Factor	Date	Attendees
Sport and recreation	22 June 2009	Department of Sport and Recreation, Department of Education, Department of Fisheries, Department of Planning, Department of Environment and Conservation, the Police, the Kimberley Development Commission, the Shire of Broome, Tourism WA, Garnduwa, the Broome Fishing Club, the Broome airport and representatives from a number of sporting groups.
Infrastructure	6 August 2009	Department of Planning, Department of Transport, Kimberley Development Commission, Shire of Broome, Main Roads, Broome Port Authority, Norwescom, Broome International Airport, Broome Chamber of Commerce, Water Corporation, Toxfree, Horizon Power, Toll Mermaid.
Land and housing	11 August 2009	Department of Planning, Department of Regional Development and Lands, Department of Housing, Landcorp, Indigenous Affairs, Shire of Broome, Kimberley Development Commission, Foundation Housing, Broome Air, Red Cross.
Health	12 August 2009	Department of Health, Indigenous Coordination Centre, Shire of Broome, Red Cross, Tartal Kura Maya-Bidyadanga Health Clinic, Broome Doctors Practice, Anglicare, Broome Medical Clinic, Kimberley Aboriginal Medical Service Council, Men's Outreach Service and the Kimberley Division of General Practice.
Education and training	8 September 2009	State Departments of State Development, Planning, Indigenous Affairs, Education and Training and the Commonwealth Department of Education, Employment and Workplace Relations, Woodside Energy Limited, the KLC, Djaringo Training, Kimberley Group Training, Kimberley TAFE, Broome Chamber of Commerce, Notre Dame University.
Sense of place	10 September 2009	State Departments of Planning, Transport and Indigenous Affairs, Shire of Broome, Tourism WA, Broome Chamber of Commerce, the KLC, the former Commonwealth Department of Environment, Water, Heritage and the Arts, Magabala Books, Arts and Culture, Kimberley Aboriginal Medical Services Council, the Broome Historical Society and a number of long-term residents and business owners in Broome.

Source: DSD, 2009b; **Appendix D-2.**

9.1.4.3. Community Events

A number of community sessions were held where the broader community were provided an opportunity to make an input into the SIA. These included:

- the North West Expo (2009 and 2010);
- DSD SIA Open Day;
- Shire LNG Forum; and
- shopping centre information sessions – conducted at both shopping centres in Broome (2009 and 2010).

9.1.4.3.1. North West Expo

The North West Expo was held over the weekend of 2 and 3 May 2009 and 1 and 2 May 2010. DSD manned a booth at the Expo, as did Woodside. Although this forum was mainly an information-provision opportunity, community members were asked to indicate their broad issues of concern, with 32 community members completing a brief questionnaire. The results of this questionnaire are shown in **Table 9-3**.

■ **Table 9-3 Overview of North West Expo.**

Issues of most concern	Number of Responses	Percentage
Housing, health, education, roads etc	14	44%
Environmental	17	53%
General business and employment impacts	19	59%
Aboriginal issues	12	38%
Recreational fishing, boating	16	50%
Lifestyle	14	44%
Commercial fishing, pearling aquaculture	5	16%
Tourism	9	28%
Others <ul style="list-style-type: none"> • Heritage, indigenous and tourism; • Indigenous tourism; and • Jobs for aboriginals. 	8	25%

9.1.4.3.2. DSD SIA Open Day

An Open Day was held on 17 December 2009 at the DSD offices in Broome to provide an opportunity for members of the community to ask questions about all aspects of the SIA. A video of key stakeholder workshop presentations was available for viewing. Various subcomponents of the studies being undertaken as part of the SIA and broader assessment being undertaken by DSD and Woodside were also presented. These included:

- DSD - SIA Program;
- DoF – Fishing Industry Impact Study;
- Former Department of Planning and Infrastructure - Dampier Peninsula Land Use Plan;
- Tourism WA – TIA; and
- Woodside – environmental assessment studies.

Members of the community were provided with the opportunity to discuss issues relating to the specific studies.

The open day was advertised in the Broome Advertiser and in a leaflet drop in all post office boxes. People attending the open day were asked to complete a questionnaire. The same questionnaire was used at the Shire of Broome LNG Forum (**Section 9.1.4.3.3**) on the subsequent two days and the results of the questionnaires have been aggregated into **Table 9-4**.

9.1.4.3.3. Shire of Broome LNG Forum

On Friday and Saturday 18 and 19 September 2009, the Shire of Broome facilitated an LNG Forum. A number of organisations set up booths and the broader community was invited to attend to find out about the proposed LNG development. Representatives of DSD, KLC, the Port and Airport, Woodside, Sate the Kimberley and Environs Kimberley were represented at the forum. Presentations were made on Saturday by all those with a presence at the forum, as well as selected other organisations such as Tourism WA. Questions were not taken during the presentations but people were directed to the organisational representatives following the presentations.

Community members were invited to complete the same questionnaire as at the SIA Open Day and the results of the aggregated questionnaire are shown in **Table 9-4**. A total of 71 people completed the questionnaire at both the SIA Open Day and the Shire of Broome LNG Forum.

■ **Table 9-4 Overview of Shire of Broome LNG Forum.**

Issues of most concern	Number of Responses	
Access to recreational areas near the precinct	55	77%
Indigenous issues	55	77%
Potential changes to Broome's unique character or 'sense of place'	61	86%
Potential impacts on commercial fishing and pearling	45	63%
Potential impacts on recreational fishing	44	62%
Potential impacts on tourism	49	69%
The capacity of education services	45	63%
The availability of housing, including affordable housing	58	82%
The capacity of existing town utilities	50	70%
The capacity of health services	55	77%
The capacity of the police and the justice system	41	58%
Others (please specify)	50	70%
<ul style="list-style-type: none"> • Unhappy with public consultation for the BLNG Precinct; • Concern for Sense of Place/Community; • Environment; • Fishing, Tourism and Recreational; and • Heritage and Indigenous. 		

9.1.4.3.4. Shopping Centre Information Sessions

Shopping Centre Information Sessions were held at both of the shopping centres in Broome.

- The Paspaley Plaza on 4 and 5 December 2009; and
- The Boulevard Shopping Centre on 29 and 30 January 2010.

Forty-one people were surveyed at the Paspaley Plaza and the results are shown in **Table 9-5**.

■ **Table 9-5 Overview of Shopping Centre Information Sessions.**

Issues of most concern to you	Number of Responses	
Access to recreational areas near the Precinct	18	44%
Indigenous issues	18	44%
Potential changes to Broome's unique character or 'sense of place'	22	54%
Potential impacts on commercial fishing and pearling	15	37%
Potential impacts on recreational fishing	18	44%
Potential impacts on tourism	19	46%
The capacity of education services	14	34%
The availability of housing, including affordable housing	18	44%
The capacity of existing town utilities	18	44%
The capacity of health services	23	56%
The capacity of the police and the justice system	14	34%
Others <ul style="list-style-type: none"> Indigenous/heritage issues; Community infrastructure; Education and training; and Concern for sense of place/community. 	26	63%

9.1.4.4. Community Information

The SIA community engagement has taken place within the context of a broader stakeholder engagement process. To date, this has largely consisted of fact sheets and community updates (two-weekly) in the Broome Advertiser. The fact sheets have been made available at the Shire offices, the library and at all community events. All fact sheets are posted on the DSD website, http://www.dsd.wa.gov.au/documents/NEW_Browse_LNG_Precinct. Topics covered in the fact sheets are:

- The Government's Role and Precinct Details;
- Site Selection, Approvals Required and Decision Timeline;
- Native Title and Indigenous Heritage;
- Benefits to the Kimberley;
- Social Impact Assessment;
- Final Site Selection and Public Information Booklet; and
- Strategic Assessment Agreement

9.1.4.5. Consultation with Aboriginal Stakeholders

It was recognised that an ASIA would be of benefit to understanding Indigenous social issues and integrating it into the planning of the Precinct and the SAR. This work has been undertaken by the KLC alongside a series of Indigenous impact reports and is summarised in **Part 5, Section 3.9** and **Part 5, Annexure B**.

9.1.5. Integration with Strategic Assessment Consultation

Integration between SIA-related stakeholder engagement and the broader SA process has occurred through:

- high level project meetings;
- the establishment of a Stakeholder Reference Group (**Section 9.2.1.3**); and
- the Strategic Assessment stakeholder engagement strategy.

The scope of high level project meetings undertaken throughout the site selection and Strategic Assessment process included both environmental and social elements of the assessment. More recently, a Stakeholder Reference Group was established comprising mainly participants in the former NDT process, to retain and build upon their background knowledge of the project.

In addition, all SIA events provided broad enabled provision of Strategic Assessment and environmental information on request.

9.1.6. Stakeholders Consulted

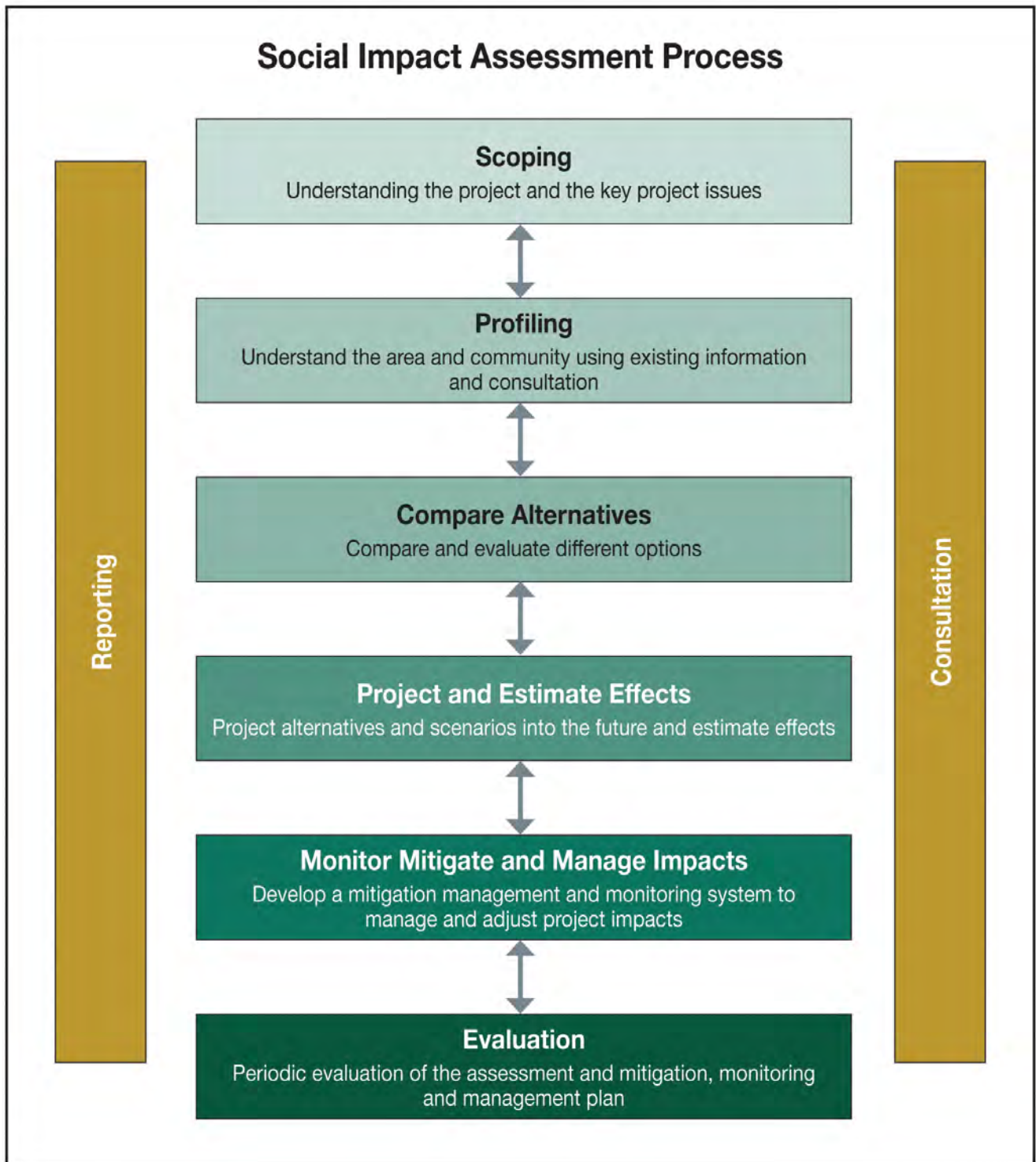
The following stakeholders (**Table 9-6**) were informed about the potential development of the Precinct and consulted regarding their issues. The consultation either occurred with the organisation or as part of the key stakeholder theme workshops.

■ **Table 9-6 List of Stakeholders Consulted in DSD SIA Process.**

Local Government	Commonwealth Government
<ul style="list-style-type: none"> Shire of Broome council and officers; and Shire of Derby West Kimberley councillors and officers. 	<ul style="list-style-type: none"> Department of Resources, Energy and Tourism (DRET); Former DEWHA, now SEWPAC; Commonwealth-appointed facilitator, Bill Gray; Australian Sports Commission (Broome representative).
State Government	Service Providers
<ul style="list-style-type: none"> Regional Impacts Working Group. <ul style="list-style-type: none"> Department of State Development; Department of Planning; LandCorp; Department of Fisheries; Department of Regional Development and Lands; Department of Indigenous Affairs; Tourism WA; Kimberley Development Commission; Department of Health; Department of Education and Training; and Department of Water. Broome-based representatives of State Government Departments and Agencies including Planning, Health, Education and Training, Agriculture, Fisheries, Sport and Recreation, Environment and Conservation, Police, Housing, Tourism, Indigenous Affairs, Disability Services, Kimberley Development Commission, Landcorp, Broome Port Authority. Perth-based representatives of State Government Departments and Agencies including Planning, Transport, Health, Education and Training, Housing, Fisheries, Tourism, Treasury and Finance, Indigenous Affairs. Regionally based representatives of the Department of Water, Main Roads. Environmental Protection Authority. 	<ul style="list-style-type: none"> Both Perth and Broome-based service providers were consulted, (e.g. at workshops) including: <ul style="list-style-type: none"> Water Corporation; Telstra; Norwescom; Horizon Power; Toxfree (Waste); Tartal Kura Maya-Bidyadanga Health Clinic; Anglicare; Broome Medical Centre; Kimberley Division of General Practice; Djaringo Training; Catholic Education Office Broome; Kimberley Technical and Further Education (TAFE); Notre Dame University; Kimberley Group Training; Circle Broome Housing Group; Kimberley Aboriginal Medical Services Council (KAMSC); Foundation Housing; and Red Cross.
Social services review	Business and Industry
<ul style="list-style-type: none"> Australian Red Cross Blood Service; Burderkin Youth In Action Inc; Broome Dental Clinic; Broome Hospital; Broome Medical Clinic; 	<ul style="list-style-type: none"> Woodside; Broome Chamber of Commerce; Toll Mermaid; Clipper Pearls; Broome International Airport;

<ul style="list-style-type: none"> • Broome Doctors Practice; • Broome Regional Aboriginal Medical Services; • Child Health Clinic; • CRS Australia; • Disability Services Commission; • Dr Neil Jensen; • Homelessness Action Group; • Kimberley Aboriginal Medical Services Council; • Kimberley Community Drug Service Team; • Kimberley Division of General Practice Ltd; • Kinway Counselling Service / Anglicare; • Kullarri Patrol; • Marnja Jarndu Women's Refuge; • Men's Outreach Service; • Milliya Rumurra Alcohol and Drug Rehabilitation Centre; • St Johns Ambulance; • Tartal Kura Maya – Bidyadanga Health Clinic; • WA Cancer Support Group; and • WA Country Health Service (includes: Kimberley Aged and Community Services, Kimberley Mental Health and Drug Service, Kimberley Population Health Unit, Broome Hospital, Regional Medical). 	<ul style="list-style-type: none"> • Magabala Books, Arts and Culture; • Linneys Pearls; • Kimberley Clothing; • Roberts Day; and • Goolarri Media.
Community	Indigenous Organisations
<ul style="list-style-type: none"> • North West Expo (2-3 May 2009); • DSD SIA Open Day (17 September 2009); • Shire of Broome LNG Forum (18-19 September 2009); and • Broome Historical Society. 	<ul style="list-style-type: none"> • KLC; • Lingari Foundation; and • Yawuru Prescribed Body Corporate (PBC).

The proposed SIA process was outlined in SIA Volume 1 Scope and Profile (DSD, 2009a; **Appendix D-1**). **Figure 9-2** illustrates the key role of reporting and consultation (to obtain data and verify conclusions) during each phase of the SIA.



■ **Figure 9-2 SIA Process.**

9.2. Consultation Undertaken Towards the Environmental Impact Assessment

Consultation undertaken that was focused on the Environmental Impact Assessment (EIA) followed similar steps as discussed above.

Each of the SA components study programs included varying degrees of stakeholder involvement. A summary of the scope of consultation is provided in **Table 9-7**.

■ **Table 9-7 Strategic Assessment Component Study Programs and Scope of Consultation.**

Study Program	Scope of Consultation
Heritage studies	Technical exchanges with Traditional Owners to develop and implement the Heritage Protection Agreement (HPA) and new nature and heritage reserves on the Peninsula. Provision of advice to feed into the Indigenous impact reports summarised in Part 5, Section 3 .
Environmental studies	Consultation undertaken with key stakeholders in relation to specific studies e.g. scoping of megafauna surveys was done in consultation with various marine mammal observers, tourism operators and SEWPAC's Australian Marine Mammal Centre. Limited field consultation undertaken in relation to the identification of specific issues of interest to specific interest groups such as involvement of Traditional Owners in identification of palaeontology or bush-tucker sites.
SIA – ASIA	Limited consultation with Traditional Owner groups by KLC to verify social impact characterisation.
SIA – Fisheries, Pearling and Aquaculture	Consultation with commercial operators and industry stakeholders including relevant State Government departments.
SIA – Tourism	Consultation with tourism operators and industry stakeholders.
SIA – Community Infrastructure	Collation of technical data from relevant State agencies.
SIA – Integration report	Focus groups with stakeholder and theme interest groups; limited public participation (see further breakdown below).
SAR High Level Briefings	Series of briefings in the Kimberley region and Perth to outline the scope, key tasks and participation opportunities of the SAR process.

Methodology

Consultation methods employed as part of the EIA included:

- high level briefings with key stakeholders;
- meetings with Traditional Owners;
- meetings with a Stakeholder Reference Group;
- communications with the general public as per the SIA activities list in **Section 9.1** (for example open days, shopping centre displays);
- Fact sheets issued and one-on-one meetings were held with stakeholders prior to the commencement of each environmental study activity; and
- Regulator and other Government agency engagement (e.g. SEWPAC, EPA and DEC).

Actions Undertaken

In addition to the consultation undertaken towards site selection, particularly with respect to the NDT, a series of other activities have been undertaken throughout the Strategic Assessment and continue to be undertaken. They are outlined in the following sections.

9.2.1.1. High Level Project Meetings

As part of the stakeholder engagement process, DSD's current and previous Director Generals undertook high level project meetings with counterparts and senior officials from key stakeholder groups. These included meetings with officials from:

- Port of Broome;
- Shire of Broome;
- Commonwealth Department of Education, Employment and Workplace Relations (**DEEWR**);
- Indigenous Coordination Centres (**ICC**);
- Environs Kimberley;
- Broome Chamber of Commerce;
- Department for Planning and Infrastructure (**DPI**);
- Goombaragin Eco Tours;
- Jabirr Jabirr Aboriginal Corporation;
- KLC;
- Yawuru Jarndu Woman's Group;
- Shire of Derby and Water Corporation;
- Department of Prime Minister and Cabinet;
- DRET;
- DEWHA; and
- Western Australian Planning Commission (**WAPC**).

9.2.1.2. Meetings with Traditional Owners

While the Indigenous impact reports (including the ASIA undertaken by the KLC) occurred as a discrete study (**Appendix E**), a point of integration exists where Traditional Owners were engaged to participate in the EIA. Through the site selection process, senior DSD personnel and environmental consultants have met regularly with the KLC to discuss environmental impacts, and the KLC is represented on the Stakeholder Reference Group. Further details of Indigenous engagement are provided in **Part 5, Section 3.9** and **Part 5, Annexure B**.

9.2.1.3. Stakeholder Reference Group

In order to support the development and review of the SA, a Stakeholder Reference Group was established by DSD to gain key stakeholder perspectives in relation to the impact assessment and proposed management plans for the proposed BLNG Precinct.

The Stakeholder Reference Group drew from the various working groups which were established to support the NDT's activities and pulled them into one integrated group. The aim was to build on the knowledge and experience already gained by the members.

The Stakeholder Reference Group sought to engage mainly non-government individuals who could provide a broad perspective to the group on their area of interest/expertise. State and Commonwealth Departments, Ministers, other Government agencies and local government were consulted directly via a separate process, principally comprising high level briefings.

Stakeholders directly affected by the proposed BLNG Precinct continue to be consulted directly at a one-to-one level. This includes Traditional Owners and Pearl lease holders via specific meetings to discuss potential issues.

The Stakeholder Reference Group has not been asked to make a decision about whether the BLNG Precinct should go ahead, but rather to participate in the review of the impact assessment - ensuring it is robust, helping to identify any gaps or issues in relation to the findings, ensure that the appropriate management arrangements are being considered, and if not, highlight these as part of the review process.

Members of the reference group are not expected to represent their communities or organisations views (either for or against) about the BLNG Precinct, but rather provide a perspective or input from that stakeholder sector to enrich the review and evaluation of the impact assessment work.

Invitations have been extended to appropriate officers of the EPA and SEWPAC to participate/observe the meetings.

Generally, the format of the meetings have involved:

- the presence of Woodside (as potential Foundation Proponent) and any specialist technical advisors in addition to DSD to provide presentations and to respond to specific questions from members;
- a DSD engaged consultant to facilitate and record proceedings;
- provision of documents, where required, for review prior to meetings;
- presentations on a range of matters generally related to the environmental and social impacts of the BLNG Precinct;
- a question and answer session on these impacts; and
- discussion on proposed management arrangements to minimise these impacts.

9.2.1.3.1. Composition of Stakeholder Reference Group

Table 9-8 shows the original composition of the Stakeholder Reference Group. Some variation from this composition has occurred depending on the availability of members, however, the groups aim has been to ensure that all sectoral and interest groups listed are appropriately represented at each meeting.

■ **Table 9-8 Original Composition of the Stakeholder Reference Group.**

Stakeholder Perspective	Organisation
Fisheries - recreation	Broome Fishing Club
Fisheries - professional	WA Fishing Industry Council and Pearl Producers Assoc.
Conservation - Perth based	WWF-Australia
Conservation - Broome based	Environs Kimberley
Conservation – Broome based	Self nominated
Tourism - land based	ARDI Indigenous Tourism Operators Incorporated
Tourism - land based	APT Touring
Tourism - marine based	Kimberley Marine Tourism Assoc
Business	Broome Chamber of Commerce
Community	Shire of Broome
Community - general	As endorsed by Shire
Community – general	As nominated by Shire
Indigenous	Kimberley Land Council
Environmental Science - marine	Australian Institute of Marine Science
Environmental Science - terrestrial	Local consultant

9.2.1.3.2. Theme and Coverage of Meetings

The first three meetings of the Stakeholder Reference Group were held in the first quarter of 2010. They were held to examine the terrestrial, marine and social components of the SA. The following is an outline of the meeting themes and structures:

Meeting 1 – 12th February

- Introduction and setting ground rules.
- Overview of process and proposal.
- Terrestrial environment and impacts.
- Management strategies for impacts.

Meeting 2 – 5th March

- Review of matters from previous meeting.
- Marine environment and impacts.
- Management strategies for impacts.

Meeting 3 – 26th March

- Review of matters from previous meeting.
- Social context and impacts.
- Management of social impacts.

9.3. Summary

This part of the Strategic Assessment Report (**Part 2**) provides an overview of the Strategic Assessment process, including site selection, facilities description and consultation process.

Part 3 (Environmental Assessment – Marine Impacts), **Part 4** (Environmental Assessment – Terrestrial Impacts) and **Part 5** (Social Assessment) of this SAR include summaries of existing information, identifying main impact areas and set out the proposed management arrangements, mitigation and safeguards to ensure impacts that arise from the activities described in this Part are managed appropriately. **Part 6** addresses Commonwealth Matters including Precinct Plan, Management Arrangements and Matters of National Environmental and Social Significance.

The public is encouraged to review the information contained in the complete SAR via the consultation portal website at <http://public-consult.epa.wa.gov.au/portal>.

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10. References

AECOM. 2010a. Supplementary Terrestrial Flora and Vegetation Assessment James Price Point WA. Prepared for Department of State Development, Perth, Western Australia. [Appendix C-19].

AECOM. 2010b. Supplementary Terrestrial Fauna and Habitat Assessment James Price Point WA. Prepared for Department of State Development, Perth, Western Australia. [Appendix C-20].

AECOM. 2010c. Preliminary Report upon the Palaeontology (including Dinosaur Footprints) of the Broome Sandstone in the James Price Point Area. Prepared by M. Siversson. Western Australia. [Appendix F-1].

AECOM. 2010d. Infrastructure Assessment Study. Internal report prepared for the Department for State Development, Perth, Western Australia. [Appendix D-6].

Air Assessments. 2010. Browse LNG Development – Air Quality Assessment. Prepared for Woodside Energy Ltd by Air Assessments. Rev. 2, October 2010. [Appendix C-25].

Australian Standard AS/NZS 4360 Risk Management and Handbook HB 436 Risk Management Guidelines - Companion to AS/NZS 4360.

BG&E. 2010a. Browse LNG Development: Browse Hydrology 2009 Study – Local Catchment Flood Study. Prepared for Woodside Energy Ltd. [Appendix C-23].

BG&E. 2010b. Browse LNG Development: Browse Hydrology 2009 Study – Regional and Local Hydrology in the vicinity of the proposed LNG Precinct. Prepared for Woodside Energy Ltd. [Appendix C-24].

Biota Environmental Sciences (Biota). 2009b. James Price Point Terrestrial Fauna Survey: Wet Season 2009. Prepared for Department of State Development, Perth, Western Australia. [Appendix C-17].

Biota Environmental Sciences (Biota). 2009c. A Vegetation and Flora Survey of James Price Point: Wet Season 2009. Prepared for the Department of State Development, Perth, Western Australia. [Appendix C-18].

Cappo M., Syms C., Stowar M., Johansson C., and Cooper T. 2010b. Survey of fish habitat associations in the region offshore from James Price Point using Baited Remote Underwater Video Systems (BRUVS). Australian Institute of Marine Science. Prepared for Woodside Energy Ltd. [Appendix C-6].

Chevron Australia, 2009a. Gorgon Gas Development Response to Submissions. Gorgon Gas Development Revised and Expanded Proposal, Public Environmental Review. Chevron Australia, Perth as cited in EPA Bulletin Report 1323.

Commonwealth Scientific and Industrial Research Organisation (CSIRO). 2010. Classification of Vine Thicket on Dampier Peninsula using TM Imagery. CSIRO Mathematics Informatics and Statistics. Prepared for Woodside Energy Ltd. [Appendix C-21].

Department of Climate Change and Energy Efficiency (DCCEE). 2010. National Greenhouse Accounts (NGA) Factors. Commonwealth of Australia, Canberra, ACT, July 2010.

Department of Environment and Conservation (DEC) 2008. Preliminary Reconnaissance Survey of Benthic Habitats in the Anjo Peninsula, Kimberley Bioregion. Western Australia, Prepared by the Marine Ecosystems Branch for the NDT, October 2008.

Department of State Development (DSD). 2009a. Volume 1: Social Impact Assessment Scope and Profile [Online]. www.dsd.wa.gov.au. Department of State Development, Perth, Western Australia. [Appendix D-1].

Department of State Development (DSD). 2009b. Volume 2: Impact Assessment [Online]. www.dsd.wa.gov.au. Department of State Development, Perth, Western Australia. [Appendix D-2].

Department of State Development (DSD). 2009c. Volume 3: Impact Management [Online]. www.dsd.wa.gov.au. Department of State Development, Perth, Western Australia. [Appendix D-3].

Department of State Development (DSD) 2010a. Preface to the Scope of the Strategic Assessment. Department of State Development, Perth, WA, 2010. [Appendix A-1].

Department of State Development (DSD) 2010b. Scope of the Strategic Assessment. Department of State Development, Perth, WA, 2010. [Appendix A-2].

Department of State Development (DSD) 2010c. Appendices to the Scope of the Strategic Assessment, Including the Terms of Reference. State-Commonwealth Terms of Reference for the Strategic Assessment. Department of State Development, Perth, WA, 2010. [Appendix A-3].

Department of State Development (DSD) 2010d. BLNG Precinct Dredging and Spoil Disposal Assessment. Department of State Development, Perth, WA, 2010. [Appendix C-13].

Econsearch. 2009. Economic Analysis: Fishing Industry Impact Study – Kimberley LNG Project. Department of Fisheries Occasional Publication 77, 2010. 68 pp. [Appendix D-4].

Eliot, I. and Eliot, M. 2008. Coastal Geomorphology: Proposed LNG Hub Locations in the Kimberley Region Western Australia. Report for Northern Development Taskforce Environment Experts Working Group.

ENV Australia. 2008a. Perpendicular Head-North Head, Packer Island, Coulomb- Quondong and Gourdon Bay Vegetation Assessment. Prepared for Department of Industry and Resources. October 2008. [Appendix C-14].

ENV Australia. 2008b. Perpendicular Head – North Head, Packer Island, Coulomb-Quondong and Gourdon Bay Flora Assessment. Prepared for Department of Industry and Resources. October 2008. [Appendix C-15].

ENV Australia. 2008c. Perpendicular Head-North Head, Packer Island, Coulomb- Quondong and Gourdon Bay Vertebrate Fauna Assessment. Prepared for Department of Industry and Resources. October 2008. [Appendix C-16].

ENV Australia. 2008d. Anjo Peninsula Flora and Vegetation Assessment. Prepared for Department of Industry and Resources, October 2008.

Environmental Protection Authority (EPA). 2008. Kimberley LNG Precinct - Review of Potential Sites for a Proposed Multi-User Liquefied Natural Gas Processing Precinct in the Kimberley Region Perth. Report 1306. Western Australian Environmental Protection Authority, Perth, Western Australia.

Eureka Archaeological Research and Consulting. 2010. Indigenous Impacts Report Volume5: Aboriginal Archaeological Site Avoidance Survey, James Price Point: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome and University of Western Australia, Perth, August 2010. (ASIA Volume 5: Archaeological Report). [Appendix E-5].

Fry, G., Heyward, A., Wassenberg, T., Taranto, T., Stieglitz, T, and Colquhoun, J. 2008. Benthic habitat surveys of potential LNG hub locations in the Kimberley region, Prepared for the Western Australian Marine Science Institution on behalf of the NDT, October 2008. [Appendix C-4].

Gaffney, Cline and Associates (GCA). 2008. Browse Basin Gas Technical Report Development Options Study – Reports 1-3. Report to the Northern Development Taskforce (May 2008). [Appendix B-1].

Galaxia Marine Environmental Consulting (Galaxia). 2010. Browse LNG Development Migratory Bird Study, James Price Point. Prepared for Woodside Energy Ltd. Browse Business Unit, Rev 1. May 2010. [Appendix C-1].

GHD 2009a. Comparative Analysis of the Feasibility of Alternative Locations for the Development of a Liquefied Natural Gas Precinct, January 2009. [Appendix B-7].

Hammond, R. 2008, *Visual Landscape Study*, Prepared for NDT.

Holley D.K. and Prince R.I.T. 2008. Historical Datasets of Dugong (*Dugong dugon*) Observations in the Kimberley Region of Western Australia. pp. 25. Edith Cowan University and DEC.

Jenner C. and Jenner M. 2009. Draft Humpback Whale Distribution and Abundance in the Nearshore SW Kimberley During Winter 2008 Using Aerial Surveys. Unpublished report for Woodside Energy Ltd. **[Appendix C-11]**.

Kadar Pearson and Partners (KPP) Business Development. 2009. Tourism Impact Assessment – Kimberley Liquefied Natural Gas (LNG) Project. Report commissioned by Tourism Western Australia, in partnership with the Western Australian Department of State Development. **[Appendix D-5]**.

Kahn, K. and O'Faircheallaigh, C. 2010. Indigenous Impacts Report Volume3: Aboriginal Social Impact Assessment: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome and Griffiths University, QLD, 3 September 2010. (ASIA Volume 3: Impacts). **[Appendix E-3]**.

Kimberley Land Council, (KLC). 2010a. Indigenous Impacts Report Volume1: Overview and Consolidated Recommendations, Indigenous Impacts Report: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome, 3 September 2010. (ASIA Volume 1: Overview). **[Appendix E-1]**.

Kimberley Land Council. (KLC). 2010b. Indigenous Impacts Report Volume 4: Report on Heritage Impact Assessment: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome, 7 September 2010. (ASIA Volume 4: Heritage Impacts Report). **[Appendix E-4]**.

Margetts, V. & Grabasch, G. (UDLA). 2010a. Indigenous Impacts Report Volume 6: Ethnobiological Report, James Price Point: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome, 2010. (ASIA Volume 6.1: Ethnobiological Report – Final). **[Appendix E-6]**.

Margetts, V. & Grabasch, G. (UDLA). 2010b. Legal Requirements, Marine Species Invasion Table & Mitigation Management Measures: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome, 3 September 2010. (ASIA Volume 6.2: Ethnobiological Report Appendix A – Draft). **[Appendix E-7]**.

Morgan D.L., Whitty J.M., Phillips N.M. 2009. Endangered Sawfishes and River Sharks in Western Australia. Centre for Fish and Fisheries Research, Murdoch University. Report to Woodside Energy Limited. **[Appendix C-7]**.

Northern Development Taskforce (NDT). 2008a. Site Selection Methodology and Draft Site Selection Criteria. Northern Development Taskforce, Perth, Western Australia. **[Appendix B-2]**.

Northern Development Taskforce (NDT), 2008b. Site Selection Evaluation Report Part A. Northern Development Taskforce, Perth, Western Australia. **[Appendix B-3]**.

Northern Development Taskforce (NDT). 2008c. Site Evaluation Report Part B, Department of Industry and Resources, Perth, September 2008. **[Appendix B-4]**.

Northern Development Taskforce (NDT). 2008d. Final Site Evaluation Report December 2008, Department of Industry and Resources, Perth, WA. **[Appendix B-6]**.

O'Faircheallaigh, Ciaran, Professor of Politics and Public Policy, Griffith University and Twomey, Justine Legal Practitioner: Kimberley LNG Precinct Strategic Assessment, Indigenous Impacts Report Volume 2, Traditional Owner Consent and Indigenous Community Consultation: Final Report Kimberley Land Council, 3 September 2010: © 2010 Kimberley Land Council and Griffith University. (ASIA Volume 2: Consultation and Traditional Owner Consent). **[Appendix E-2]**.

Rockwater Proprietary Limited. 2009. Assessment of Hydrogeology for LNG Precinct at James Price Point, West Kimberley, Western Australia. Prepared for Woodside Energy Limited. December 2009. **[Appendix C-22]**.

RPS. 2010a. Humpback Whale Survey Report, Browse MMFS 2009. Prepared for Woodside Energy Ltd. **[Appendix C-8]**.

RPS. 2010b. Woodside Browse Turtle Technical Report, Ecology of Marine Turtles of the Dampier Peninsula and the Lacepede Island Group 2009 – 2010. Prepared for Woodside Energy Ltd. [**Appendix C-2**].

RPS. 2010c. Nearshore Regional Survey Dugong Report, Browse MMFS 2009. Prepared for Woodside Energy Ltd. [**Appendix C-9**].

RPS. 2010d. Marine Megafauna Report Browse MMFS 2009. Prepared for Woodside Energy Ltd. [**Appendix C-10**].

SKM 2010a. Nearshore benthic habitat modelling and mapping, James Price Point. Report for Woodside Energy Ltd. [**Appendix C-5**].

SKM 2010b. James Price Point Intertidal Survey, Browse LNG Development. Report prepared for Woodside Energy Ltd. [**Appendix C-3**].

SVT 2010. Downstream Browse Underwater Noise Assessment. Prepared by SVT Engineering Consultants for Woodside Energy, October 2010. [**Appendix C-12**].

Western Australian Museum. 2008. Intertidal Habitats of Selected Sites in the Canning Bioregion – Preliminary Field Results, Prepared for the NDT, June 2008.

Western Australian Museum 2010. Report on macro-fossils in intertidal outcrops of the Broome Sandstone, 1.2-2.7 km south of James Price Point (proposed marine infrastructure shore crossing) and 6.2-7.5 km south of James Price Point (proposed southern pipeline shore crossing). Western Australian Museum, Department of Earth and Planetary Sciences Record 2010/1, Unpublished report prepared for the Department of State Development. Prepared by M. Siverrson. [**Appendix F-2**].

WorleyParsons 2008. Browse On-shore LNG Precinct Siting Study, Prepared for the Northern Development Taskforce (NDT), 2008. [**Appendix B-5**].

WorleyParsons 2010. Browse LNG Precinct Master Plan Report. Prepared for the Department of State Development, Perth, WA, July 2010. [**Appendix B-8**].

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Social Impact Assessment: SIA (Part 5)

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Appendix B

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- Appendix B-2 Northern Development Taskforce (NDT). 2008a. Site Selection Methodology and Draft Site Selection Criteria. Northern Development Taskforce, Perth, Western Australia.
- Appendix B-3 Northern Development Taskforce (NDT), 2008b. Site Selection Evaluation Report Part A. Northern Development Taskforce, Perth, Western Australia.
- Appendix B-4 Northern Development Taskforce (NDT). 2008c. Site Evaluation Report Part B, Department of Industry and Resources, Perth, September 2008.
- Appendix B-5 WorleyParsons 2008. Browse On-shore LNG Precinct Siting Study, Prepared for the Northern Development Taskforce (NDT), 2008.
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- Appendix B-7 GHD 2009a. Comparative Analysis of the Feasibility of Alternative Locations for the Development of a Liquefied Natural Gas Precinct, January 2009.
- Appendix B-8 WorleyParsons 2010. Browse LNG Precinct Master Plan Report. Prepared for the Department of State Development, Perth, WA, July 2010.

Appendix C

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- Appendix C-2 RPS. 2010b. Woodside Browse Turtle Technical Report, Ecology of Marine Turtles of the Dampier Peninsula and the Lacepede Island Group 2009 – 2010. Prepared for Woodside Energy Ltd.
- Appendix C-3 SKM 2010b. James Price Point Intertidal Survey, Browse LNG Development. Report prepared for Woodside Energy Ltd.
- Appendix C-4 Fry, G., Heyward, A., Wassenberg, T., Taranto, T., Stieglitz, T, and Colquhoun, J. 2008. Benthic habitat surveys of potential LNG hub locations in the Kimberley region, Prepared for the Western Australian Marine Science Institution on behalf of the NDT, October 2008.
- Appendix C-5 SKM 2010a. Nearshore benthic habitat modelling and mapping, James Price Point. Report for Woodside Energy Ltd.

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Appendix D

- Appendix D-1 Department of State Development (DSD). 2009a. Volume 1: Social Impact Assessment Scope and Profile [Online]. www.dsd.wa.gov.au. Department of State Development, Perth, Western Australia.
- Appendix D-2 Department of State Development (DSD). 2009b. Volume 2: Impact Assessment [Online]. www.dsd.wa.gov.au. Department of State Development, Perth, Western Australia.
- Appendix D-3 Department of State Development (DSD). 2009c. Volume 3: Impact Management [Online]. www.dsd.wa.gov.au. Department of State Development, Perth, Western Australia.
- Appendix D-4 EconSearch. 2009. Economic Analysis: Fishing Industry Impact Study – Kimberley LNG Project. DOF Occasional Publication 77, 2010. 68 pp.
- Appendix D-5 Kadar Pearson and Partners (KPP) Business Development. 2009. Tourism Impact Assessment – Kimberley Liquefied Natural Gas (LNG) Project. Report commissioned by Tourism Western Australia, in partnership with the Western Australian Department of State Development.
- Appendix D-6 AECOM. 2010d. Infrastructure Assessment Study. Internal report prepared for the Department for State Development, Perth, Western Australia.

Appendix E

- Appendix E-1 Kimberley Land Council, (KLC) 2010a, Indigenous Impacts Report Volume1: Overview and Consolidated Recommendations, Indigenous Impacts Report: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome, 3 September 2010. (ASIA Volume 1: Overview).
- Appendix E-2 O'Faircheallaigh, Ciaran, Professor of Politics and Public Policy, Griffith University and Twomey, Justine Legal Practitioner: Kimberley LNG Precinct Strategic Assessment, Indigenous Impacts Report Volume 2, Traditional Owner Consent and Indigenous Community Consultation: Final Report Kimberley Land Council, 3 September 2010: © 2010 Kimberley Land Council and Griffith University. (ASIA Volume 2: Consultation and Traditional Owner Consent).
- Appendix E-3 Kahn, K. and O'Faircheallaigh, C. 2010. Indigenous Impacts Report Volume3: Aboriginal Social Impact Assessment: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome and Griffiths University, QLD, 3 September 2010. (ASIA Volume 3: Impacts).
- Appendix E-4 Kimberley Land Council. (KLC) 2010b. Indigenous Impacts Report Volume 4: Report on Heritage Impact Assessment: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome, 7 September 2010. (ASIA Volume 4: Heritage Impacts Report).
- Appendix E-5 Eureka Archaeological Research and Consulting. 2010. Indigenous Impacts Report Volume5: Aboriginal Archaeological Site Avoidance Survey, James Price Point: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome and University of Western Australia, Perth, August 2010. (ASIA Volume 5: Archaeological Report).
- Appendix E-6 V. Margetts & G. Grabasch (UDLA). 2010a. Indigenous Impacts Report Volume 6: Ethnobiological Report, James Price Point: Draft Report to the Kimberley Land Council. Kimberley Land Council, Broome, July 2010. (ASIA Volume 6.1: Ethnobiological Report – Draft).
- Appendix E-7 V. Margetts & G. Grabasch (UDLA). 2010b. Legal Requirements, Marine Species Invasion Table & Mitigation Management Measures: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome, 3 September 2010. (ASIA Volume 6.2: Ethnobiological Report Appendix A – Draft).

Appendix F

- Appendix F-1 AECOM. 2010c. Preliminary Report upon the Palaeontology (including Dinosaur Footprints) of the Broome Sandstone in the James Price Point Area. Prepared by M. Siverrson. Western Australia.
- Appendix F-2 Western Australian Museum 2010. Report on macro-fossils in intertidal outcrops of the Broome Sandstone, 1·2-2·7 km south of James Price Point (proposed marine infrastructure shore crossing) and 6·2-7·5 km south of James Price Point (proposed southern pipeline shore crossing). Western Australian Museum, Department of Earth and Planetary Sciences Record 2010/1, Unpublished report prepared for the Department of State Development. Prepared by M. Siverrson.

Annexure B Complete Nomenclature, Acronyms, Measurements and Units List

Acronym	Definition
ABS	Australian Bureau of Statistics
ACMC	Aboriginal Cultural Materials Committee
AGRU	Acid Gas Removal Unit
AGT	Aero Derivative Gas Turbines
AH Act	<i>Aboriginal Heritage Act 1972(WA)</i>
AHC	Aboriginal Heritage Commission
AHD	Australian Height Datum
AIHW	Australian Institute of Health and Welfare
AIMS	Australian Institute of Marine Science
aMDEA	activated methyl-di-ethanol amine
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment Conservation Council
AQIS	Australian Quarantine Inspection Service
ARI	Average Recurrence Interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ARR	Australian Rainfall and Runoff
ARRP Act	<i>Agriculture and Related Resources Protection Act 1976</i>
ASIA	Aboriginal Social Impact Assessment
ASS	Acid Sulphate Soils
ATSIHP Act	<i>Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i>
AWAC	Acoustic Doppler Wave and Current Profiler
Best Practice	The application of the best available mitigation measures that are practicable in the particular circumstances of a proposal to avoid or minimise environmental impact.
BLNG	Browse Liquefied Natural Gas
BLNG Precinct	Browse Liquefied Natural Gas Precinct
BoM	Bureau of Meteorology
BPA	Broome Port Authority
BPEMP	BLNG Precinct Environmental Management Plan
BPMF	Broome Prawn Managed Fishery
BPP	Benthic Primary Producer
BPPH	Benthic Primary Producer Habitat
Bq kg ⁻¹	Becquerels per kilogram
BRAC	Broome Recreation and Aquatic Centre
BRAMS	Broome Regional Aboriginal Medical Service
BRUVS	Baited Remote Underwater Video Surveys
BTEX	benzene, toluene, ethylbenzene and xylene
°C	degrees celsius, degrees centigrade
CaCO ₃	Calcium Carbonate
CAEPR	Centre for Aboriginal Economic Policy Research
CALM	Department of Conservation and Land Management , now DEC
CAMBA	China-Australia Migratory Bird Agreement

Acronym	Definition
Category A	These are the core elements of the BLNG Precinct, including associated infrastructure, necessary to process and export hydrocarbons.
Category B	These are indirect activities and actions as a result of the BLNG Precinct that are considered in the impact assessment but do not form part of the approvals process.
Category C	Related projects that are outside the scope of the Strategic Assessment but form part of the cumulative impact assessment.
CCIMP	Committee for Introduced Marine Pest Emergencies
CEMP	Construction Environment Management Plan
CDEP	Community Development Employment Projects
CEO	Chief Executive Officer
CH ₄	Methane
CHMP	Cultural Heritage Management Plan
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
CO ₂ -e	Carbon Dioxide Equivalents
CPI	Consumer Price Index
CPRS	Carbon Pollution Reduction Scheme
CSD	Cutter Suction Dredger
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTM	Chemical Transport Model
CWR	Centre for Whale Research
Cwth	Commonwealth
DAFF	Department of Agriculture, Fisheries and Forestry
DAFWA	Department of Agriculture and Food Western Australia
dB	decibels
dB(A)	A-weighted decibels
DCCEE	Department of Climate Change and Energy Efficiency
DDSDMP	Dredging and Dredge Spoil Disposal Management Plan
DEC	Department of Environment and Conservation
DEEWR	Commonwealth Department of Education, Employment and Workplace Relations
DEWHA	Commonwealth Department for the Environment, Water, Heritage and the Arts, now SEWPAC
DIA	Department of Indigenous Affairs
DLGRD	Department of Local Government and Regional Development
DLNG	Darwin Liquefied Natural Gas
DMAG	Dredging Management Advisory Group
DMP	Department of Mines and Petroleum
DoF	Department of Fisheries
DoIR	Department of Industry and Resources
DoLA	Depart of Land Administration
DoP	Department of Planning
DoT	Department of Transport
DoW	Department of Water
DPI	Department for Planning and Infrastructure
DRDL	Department of Regional Development and Lands

Acronym	Definition
DRET	Commonwealth Department of Resources, Energy and Tourism
DRF	Declared Rare Flora
DSD	Department of State Development
DSDG	Dredge Spoil Disposal Ground
DSDMP	Dredging and Dredge Spoil Disposal Management Plan
EAG3	Environmental Assessment Guideline 3
ECHT	Environment and Cultural Heritage Team
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
EP Act	<i>Environmental Protection Act 1986</i>
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
eq.	Acid Equivalents
EVT	Evergreen Vine Thickets
FEED	Front End Engineering Design
FESA	Fire and Emergency Services Authority of Western Australia
FID	Final Investment Decision
FIFO	Fly in/Fly out
FIS	Fishing Industry Impact Study
FLNG	Floating LNG
FM Act	<i>Fish Resources Management Act 1994</i>
Foundation Proponent	Woodside is a potential Foundation Proponent
FRMR	Fisheries Resource Management Regulations 1995
FRP	Filterable reactive phosphorus
GBRMPA	Great Barrier Reef Marine Park Authority
GBS	Gravity Based Structure
GCA	Gaffney Cline and Associates
GDEs	Groundwater Dependant Ecosystems
GDP	Gross Domestic Product
GHG	Greenhouse Gas
G	grams
GJ	gigajoule
GL	gigalitre
GL/yr	gigalitres per year
GGAP	Greenhouse Gas Abatement Plan
GROH	Government Regional Officer Housing
GRP	Gross Regional Product
GSP	Gross State Product
GST	Goods and Services Tax
GWP	Global Warming Potential
H ₂ S	hydrogen sulphide
ha	hectare
HAT	Highest astronomical tide
HCWA	Heritage Council of Western Australia

Acronym	Definition
HDD	Horizontal Directional Drilling
HFCs	Hydrofluorocarbons
HIA	Heritage Impact Assessment
HNO ₃	Nitric Acid
HoA	Heads of Agreement
HONO	Nitrous Acid
HPA	Heritage Protection Agreement
hr	hour
HSE	Health, Safety and Environment
HYPE	Helping Young People Engage
IBRA	Interim Biogeographic Regionalisation of Australia
ICC	Indigenous Coordination Centres
IFPIC	Indigenous Free Prior Informed Consent
IGCC	Integrated Gasification Combined Cycle
ILUA	Indigenous Land Use Agreement
IMO	International Maritime Organisation
IMS	Invasive Marine Species
IMSMP	Invasive Marine Species Management Plan
IP	Important Population
IPCC	Intergovernmental Panel on Climate Change
IS	Integrated System
ISQG	Interim Sediment Quality Guidelines
ITF	Indonesian Throughflow
IUCN	International Union for Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
JPP	James Price Point
KAMSC	Kimberley Aboriginal Medical Services Council
KAC	Kimberley Aquaculture Corporation
KACS	Kimberley Aged and Community Services
KDC	Kimberley Development Commission
KES	Kullari Employment Services
kg	kilogram
kgCO ₂ -e	kilogram of Carbon Dioxide Equivalents
kmh ⁻¹ , km/h	kilometres per hour
kHz	kilohertz
KLC	Kimberley Land Council
km	kilometre
km ²	square kilometre
kn	knot
KPP	Kadar Pearson and Partners
kt	kilotonne
LAU	Local Assessment Unit
LCUs	Landscape Character Units
LGA	Local Government Area
LIA	Light Industrial Area

Acronym	Definition
LiDAR	Light Detection and Ranging
LIGT	Large Industrial Gas Turbines
LNG	Liquefied Natural Gas
LNG Hub	Alternative wording for BLNG Precinct
LoR	Limit of Reporting
LPG	Liquefied Petroleum Gas
LPS	Local Planning Strategy
LSR	Light Sensitive Receptors
LVIA	Landscape and Visual Impact Assessment
$\mu\text{g}/\text{m}^3$	microgram per cubic metre
$\mu\text{g g}^{-1}$, $\mu\text{g}/\text{g}$	microgram per gram
$\mu\text{g L}^{-1}$, $\mu\text{g}/\text{L}$	microgram per litre
μm	micrometre
$\mu\text{g m}^{-3}$, $\mu\text{g}/\text{m}^3$	microgram per metre cubed
μMol	micromole
m	metre
m^2	square metre
m^3	cubic metre
m^3/hr	cubic metre per hour
m/s	metres per second
Ma	Mega annum (million years)
mAHD	Metres Australian Height Datum
MDS	Multi Dimensional Scaling
MEG	Mono-ethylene glycol
MF	Marine Facility
mg L^{-1} , mg/L	milligram per litre
MIGT	Medium Industrial Gas Turbines
ML	megalitre
mm	millimetre
MMbtu	Millions of British Thermal Units
MNES	Matters of National Environmental Significance
MODIS	Moderate Resolution Imaging Spectroradiometer
MOF	Materials Offloading Facility
mol%	Mole percentage
MPA	Marine Protected Areas
MPB	Microphytobenthos
ms^{-1} , m/s	metre per second
MSL	Metres below sea level
Mt	megatonne (million tonne)
Mtpa	million tonnes per annum
MVT	Monsoon Vine Thicket
MWDMP	Marine Wasterwater Discharge Management Plan
MWh	megawatt hour
NAGD	National Assessment Guidelines for Dredging
NDT	Northern Development Taskforce

Acronym	Definition
NE	North-east
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NES	National Environmental Significance (i.e. matters of NES)
NGA	National Greenhouse Accounts
NGCC	Natural Gas Combined Cycle
NGER Act	<i>National Greenhouse and Energy Reporting Act 2007</i>
NH ₃	Ammonia
NH ₄	Ammonium
NILF	not in labour force
Nm	nautical mile
NNTT	National Native Title Tribunal
NNW	north-north-west
NO ₂	nitrogen dioxide
NO _x	oxides of Nitrogen (NO and NO ₂)
NPI	National Pollutant Inventory
NRIF	<i>National Recreational and Indigenous Fishing Survey</i>
NRM	Natural Resource Management
NSW	New South Wales
NT	Northern Territory
NTA	<i>Native Title Act 1993</i>
NTU	Nephelometric Turbidity Units
NWMR	Northwest Marine Region
NWQMS	National Water Quality Management Strategy
O ₃	Ozone
OSCP	Oil Spill Contingency Plan
PAH	Polycyclic Aromatic Hydrocarbons
PAR	Photosynthetically Available Radiation
PASS	Potential Acid Sulphate Soils
PBC	Prescribed Body Corporate
PCG	Precinct Control Group
PECs	Priority Ecological Communities
Plan	The formal Plan for the BLNG Precinct under Commonwealth legislation (see also Precinct Plan)
PM	particulate matter
PF	Port Facility
PFCEMP	Port Facilities Construction Environmental Management Plan
PFCs	Perfluorocarbons
ppb	Parts per billion
Ppt	parts per thousand
Precinct Plan	The formal Plan for the BLNG Precinct under Commonwealth legislation (see also Plan)
proponent	Commercial proponents will undertake projects within the Precinct.
Proponent	The Proponent for the Precinct is the Minister for State Development
PRRT	Petroleum Rent Resource Tax
PSD	Particle size distribution

Acronym	Definition
PTS	Permanent Threshold Shift
QA/QC	Quality Assurance/ Quality Control
QMP	Quarantine Management Plan
QLD	Queensland
RBA	Reserve Bank of Australia
RBWG	Roebuck Bay Working Group
RIWI Act	<i>Rights in Water and Irrigation Act 1914</i>
RMS	Root Mean Square
RNE	Register of National Estate
RO	Reverse Osmosis
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
RORO	Roll on Roll off
RoW	Right of Way
RTO	Registered Training Organisation
SA	Strategic Assessment
SAA	Strategic Assessment Agreement
SAP	Sediment Sampling and Analysis Plan
SAR	Strategic Assessment Report
SE	south-east
SEL	Sound Pressure Level
SEP	State Environmental Policy
SEWPAC	Commonwealth Department of Sustainability, Environment, Water, Population and Community
SF ₆	Sulphur Hexafluoride
SIA	Social Impact Assessment
SO _x	oxides of sulphur
SO ₂	sulphur dioxide
SOPEP	Shipboard Oil Pollution Emergency Plan
SoSA	Scope of the Strategic Assessment
SPL	Sound Pressure Level
SPMT	Self Propelled Module Trailers
SPRAT	Species Profile and Threats Database
SRE	Short Range Endemic
SRG	Stakeholder Reference Group
SSIMP	Strategic Social Impact Management Plan
STI	Sexually Transmitted Infection
SWIS	South West Interconnected System
TAFE	Technical and Further Education
TAPM	The Air Pollution Model
TBT	Tributyltin
tcf	trillion cubic feet
TCU	Thermal Combustion Units
TDS	Total Dissolved Solids
TEC	Threatened Ecological Community
TIA	Tourism Impact Assessment
TJ	terajoules

Acronym	Definition
TM	Thematic Mapper
TN	Total Nitrogen
TOC	Total Organic Carbon
TONC	Traditional Owner Negotiating Committee
ToR	Terms of Reference
TOTF	Traditional Owner Taskforce
TP	Total Phosphorous
tpa	tonne per annum
TPH	Total Petroleum Hydrocarbons
TSHD	Trailer Suction Hopper Dredger
TSS	Total Suspended Solids
TTS	Temporary Threshold Shift
UNDRIP	United Nations Declaration of Rights of Indigenous People
UNFCCC	United Nations Framework Convention on Climate Change
UV	Ultraviolet
VET	Vocational Education and Training
VMP	Vessel Management Plan
VOC	Volatile Organic Compounds
VSR	Visually Sensitive Receptors
WA	Western Australia
WACHS	Western Australian Country Health Service
WALFA	West Arnhem Land Fire Abatement
WAM	Western Australian Museum
WAPC	Western Australian Planning Commission
WC Act	<i>Wildlife Conservation Act 1950</i>
WEED	Weed Education Eradication Delivery
WHO	World Health Organisation
WNW	west-north-west
WONS	Weed of National Significance
Woodside	Woodside Energy Limited
WRC	Water and Rivers Commission, now Department of Water (DoW)
WSW	west-south-west
WWF	World Wildlife Fund
WWTP	Waste Water Treatment Plant

Annexure C Complete References and Bibliography for SAR (all six parts)

ACARA. 2010. *My School*, viewed 8 February 2010 <http://www.myschool.edu.au/SchoolSearch.aspx>.

AECOM. 2010a. Supplementary Terrestrial Flora and Vegetation Assessment James Price Point WA. Prepared for Department of State Development, Perth, Western Australia. [Appendix C-19].

AECOM. 2010b. Supplementary Terrestrial Fauna and Habitat Assessment James Price Point WA. Prepared for Department of State Development, Perth, Western Australia. [Appendix C-20].

AECOM. 2010c. Preliminary Report upon the Palaeontology (including Dinosaur Footprints) of the Broome Sandstone in the James Price Point Area. Prepared by M. Siversson. Western Australia. [Appendix F-1].

AECOM. 2010d. Infrastructure Assessment Study. Internal report prepared for the Department for State Development, Perth, Western Australia. [Appendix D-6].

AECOM. 2010e. Colonial and Environmental Heritage. Internal report prepared for the Department for State Development, Perth, Western Australia.

Air Assessments. 2010. Browse LNG Development – Air Quality Assessment. Prepared for Woodside Energy Ltd by Air Assessments. Rev. 2, October 2010. [Appendix C-25].

Allen G.R. 1992. Fishes. In: Morgan G.J. (ed). Survey of the Aquatic Fauna of the Kimberley Islands and Reefs, Western Australia. pp 62-74. Unpublished report for Western Australian Museum, Perth, Western Australia.

Allen G.R. 1997. Marine Fishes of Tropical Australia and South-East Asia - A Field Guide for Anglers and Divers. Third Revised Edition. Western Australian Museum, Perth, Western Australia.

Allen G.R. and Steene R. 1994. Indo-Pacific Coral Reef Field Guide. Tropical Reef Research, Singapore.

Amoser S. and Ladich F. 2005. Are Hearing Sensitivities of Freshwater Fish Adapted to the Ambient Noise in their Habitats *Journal of Experimental Biology* 208, 3533-3542.

Anderson and Barclay. 1995. Acoustic Signals of Solitary Dugongs: Physical Characteristics and Behavioural Correlates. *Journal of Mammalogy* 76(4), 1226-1237.

Anderson P K and Birtles A 1978. Behaviour and ecology of dugong, Dugong dugon (Sirenia): Observations in Shoalwater and Cleveland Bays. *Australian Wildlife Research* 5, 1-23.

Anderson P.K. 1982. Studies of Dugongs in Shark Bay, Western Australia, II. Surface and Subsurface observations. *Australian Wildlife Research* 9. pp. 85-99.

Anderson P.K. 1997. Shark Bay Dugongs in Summer. I. Lek mating. *Behaviour* 134, 433–462.

Anon. 1972. North, North-West, and West Coasts of Australia from the West Entrance of Endeavour Strait to Cape Leeuwin. Australia Pilot. Vol. V. 6th Edn. Hydrographer of the Navy: Taunton. England.

Anthony J. 2007. Housing Issues in Broome; A Shelter WA Discussion Paper 2007, Shelter WA.

Anthony K.R.N. and Fabricius K.E. 2000. Shifting Roles of Heterotrophy and Autotrophy in Coral Energetic Under Varying Turbidity. *J Exp Mar Biol Ecol.* Vol. 252. pp 221-253.

Atkinson D, Bridge C, Gray D 1999, Kimberley Aboriginal Health Plan, Kimberley Aboriginal Medical Services Council, ATSIC, WA Aboriginal Affairs Department and the University of Western Australia.

Atteris. 2010a. Browse LNG Development Pipeline Shore Crossing Study. Prepared for Woodside Energy Ltd.

Atteris. 2010b. Browse LNG Development Shore Crossing Geological Engineering Model. Prepared for Woodside Energy Ltd.

Au, WWL, Pack, AA, Lammers, MO, Herman, LM, Deakos, MH and Andrews, K, 2006, Acoustic properties of humpback whale songs, JASA, vol. 120, iss. 2.

Aurecon. 2010. Browse Nearshore Preliminary Geotechnical Investigation. Prepared for Woodside Energy Ltd.

Australian and New Zealand Environment and Conservation Council (ANZECC) and Australian Department of the Environment, Sport and Territories (now SEWPAC). 1996. National Strategy for the Conservation of Australia's Biological Diversity. 1996.

Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ). 2000. National Water Quality Management Strategy: Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

Australian Broadcasting Authority (ABC News). 2009. Domestic violence, criminal assault 'not treated equally' [Online]. <http://www.abc.net.au/news/stories/2009/06/05/2590606.htm> [27/11/2009].

Australian Broadcasting Commission. 2007. Kimberley Endures Mental Health Worker Shortage, ABC Online, available at <<http://www.abc.net.au/news/stories/2007/08/17/2007801.htm>> [23/11/2009].

Australian Bureau of Statistics (ABS). 1996. Technical Paper: 1996 Women's Safety Survey.

Australian Bureau of Statistics (ABS). 2006. Census: Basic Community Profile: Broome: Table 31: Catalogue No. 2001.0.

Australian Bureau of Statistics (ABS). 2007. Population Distribution, Aboriginal and Torres Strait Islander Australians, Catalogue No. 4705.0. Released December 2002.

Australian Bureau of Statistics (ABS). 2008a. Information Paper – Population Concepts Australia, Catalogue No. 3107.0.55.006. Released 12 March 2008.

Australian Bureau of Statistics (ABS). 2008b. 1367.5 - Western Australian Statistical Indicators, Jun 2008. Commonwealth of Australia.

Australian Bureau of Statistics (ABS). 2009. Regional Population Growth, Australia 1996-2006, Catalogue No. 3218.0. Released 23 April 2009.

Australian Ecologically Sustainable Development Steering Committee. 1992. National Strategy for Ecologically Sustainable Development. Prepared by the Ecologically Sustainable Development Steering Committee, endorsed by the Council of Australian Governments, December 1992.

Australian Government, 2010. *Caring for our Country Business Plan 2010-11. Priorities for investment: Coastal environments and critical aquatic habitats - Protecting Ramsar wetlands*. Australian Government Land and Coasts, Canberra, ACT. Available at: <http://www.nrm.gov.au/business-plan/10-11/priorities/coastal/ramsar/index.html>

Australian Institute of Health and Welfare (AIHW). 2006. Counting the Homeless, available from: <http://www.aihw.gov.au/publications/hou/hou-209-10760/hou-209-10760-x00.pdf> [17 November 2009].

Australian Maritime Safety Authority (AMSA). 1997. Australian Ship Reporting Records for 2007.

Australian Maritime Safety Australia (AMSA). 2010. The Effects of Maritime Oil Spill on Wildlife including Non-Avian Marine Life. [online]
http://www.amsa.gov.au/Marine_Environment_Protection/National_plan/General_Information/Oiled_Wildlife/Oil_Spill_Effects_on_Wildlife_and_Non-Avian_Marine_Life.asp [16 August 2010].

Australian Standard AS/NZS 4360 *Risk Management and Handbook HB 436 Risk Management Guidelines - Companion to AS/NZS 4360*.

Australian Wildlife Conservancy (AWC). 2010. Wildlife Matters – Newsletter of the Australian Wildlife Conservancy, winter 2010 edition, June 2010.

Bain, D.E. and Williams, R. 2006. Long-range Effects of Airgun Noise on Marine Mammals: Responses as a Function of Received Sound Level and Distance. IWC-SC/58E35.

Baker C S and Herman L M 1989. Behavioural responses of summering humpback whales to vessel traffic: Experimental and opportunistic observations. In Final Report to the National Park Service.

Baker C. Potter A. Tran M. Heap A.D. 2008. Sedimentology and Geomorphology of the North West Marine Region of Australia. Geoscience Australia. Canberra, ACT.

Baldrige, H. D. Jr. 1970. Sinking Factors and Average Densities of Florida Sharks as Functions of Liver Buoyancy. *Copeia* 4, 744–754.

Bannister, J.L. Kemper C.M. and Warneke R.M. 1996. The Action Plan for Australian Cetaceans. Canberra: Australian Nature Conservation Agency. [Online]. <http://www.environment.gov.au/coasts/publications/cetaceans-action-plan/pubs/whaleplan.pdf>.

Bartol S.M. Musick J.A. and Lenhardt M.L. 1999. Auditory Evoked Potentials of the Loggerhead Sea Turtle (*Caretta caretta*). *Copeia* 3, 836-840.

Bayne, B.L., Iglesias, J.I.P., Hawkins, A.J.S., Navarro, E., Heral, M. and Deslous-Paoli, J.M. 1993. Feeding Behaviour of the Mussel, *Mytilus edulis*; Responses to Variations in Both Quantity and Organic Content of Seston, *Journal of the Marine Biological Association of the United Kingdom* 73, 813-829.

Beard J.S. 1979. Vegetation Survey of Western Australia - Kimberley. 1:1000000 Vegetation Series. Explanatory Notes to Sheet 5. University of Western Australia Press, Perth, Western Australia.

Bechdel, S.E., Mazzoil, M.S., Murdoch, M.E., Howells, E.M., Reif, J.S., McCulloch, S.D., Schaefer, A.M. and Bossart, G.D. 2009. Prevalence and Impacts of Motorized Vessels on Bottlenose Dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida. *Aquatic Mammals* 35(3), 367-377.

Belan TA 2004. Marine environmental quality assessment using polychaete taxocene characteristics in Vancouver Harbour. *Marine Environmental Research* 57, 89-101.

Bellwood, D.R. and Stobutzki, I.C. 1997. Sustained Swimming Abilities of the Late Pelagic Stages of Coral Reef Fishes. *Marine Ecology Progress Series* 149, 35-41.

Berg, L. and Northcote, T. G. 1985. Changes in territorial, gill-flaring, and feeding-behaviour in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. *Canadian Journal of Fisheries and Aquatic Sciences* 42(8): 1410-1417.

Bergert B.A. and Wainwright P.C. 1997. Morphology and Kinematics of Prey Capture in the Syngnathid Fishes *Hippocampus erectus* and *Syngnathus floridae*. *Marine Biology* 127, 563–570.

Berry P.F. 1993. Marine Faunal Surveys of Ashmore Reef and Cartier Island, North-Western Australia. Records of the Western Australian Museum Supplement No. 44. pp. 1-11.

BG&E. 2010a. Browse LNG Development: Browse Hydrology 2009 Study – Local Catchment Flood Study. Prepared for Woodside Energy Ltd. [Appendix C-23].

BG&E. 2010b. Browse LNG Development: Browse Hydrology 2009 Study – Regional and Local Hydrology in the vicinity of the proposed LNG Precinct. Prepared for Woodside Energy Ltd. [Appendix C-24].

Big Island Research. 2009. Fishing Industry Impact Study, James Price Point Proposed Liquefied Natural Gas Precinct. Prepared for the Department of Fishers, Western Australia. Fisheries Occasional Publication No. 78, 2010.

Big Island Research. 2010. Impact of the Proposed Kimberley LNG Precinct on Customary Fishing in the Vicinity of James Price Point, Prepared for the Department of Fisheries, WA Perth.

Biota Environmental Services (Biota). 2009a. Cape Lambert Port B Development Marine Turtle Management Plan. Prepared for Rio Tinto Iron Ore.

Biota Environmental Sciences (Biota). 2009b. James Price Point Terrestrial Fauna Survey: Wet Season 2009. Prepared for Department of State Development, Perth, Western Australia. [Appendix C-17].

Biota Environmental Sciences (Biota). 2009c. A Vegetation and Flora Survey of James Price Point: Wet Season 2009. Prepared for the Department of State Development, Perth, Western Australia. [Appendix C-18].

Bite J S. Campbell S J. McKenzie L J. and Coles R G. 2007. Chlorophyll fluorescence measures of seagrass *Halophila ovalis* and *Zostera capricorni* reveal differences in response to experimental shading. Marine Biology 152, 405-414.

Bjorndal, K. A. 1997. Foraging Ecology and Nutrition of Sea Turtles. Pp. 199-232 In PL Lutz and JA Musick, editors.

Blaber, S.J.M., Brewer D.T. and Salini J.P. 1995. Fish Communities and the Nursery Role of the Shallow Inshore Waters of a Tropical Bay in the Gulf of Carpentaria, Australia. *Estuarine, Coastal and Shelf Science* 40 (2), 177-193.

Black, A. W. and Hughes, P. 2001. The Identification and Analysis of Indicators of Community Strength and Outcomes, Occasional Paper No. 3. Report for the Department of Family and Community Services.

Black, S. 2001. Vine Thickets on Dampier Peninsula. Department of Conservation and Land Management, Perth, Western Australia.

Blakeway, D. and Radford B. 2005. Scleractinian Corals of the Dampier Port and Inner Mermaid Sound: Species List, Community Composition and Distributional Data. In: Stoddart J.A. and Stoddart S.E. (eds) Corals of the Dampier Harbour: Their Survival and Reproduction During the Dredging Programs of 2004. MScience Pty Ltd. Perth, Western Australia.

Boden, T. A., Marland, G., and Andres, R. J. 2009. Global, regional, and national CO₂ emissions, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, 2009.

BP 2010. Statistical Review of World Energy 2010. June 2010. <http://www.bp.com/statisticalreview>.

Brewer, D., Lyne, V., Skewes T. and Rothlisberg P. 2007. Trophic Systems of the North West Marine Region. CSIRO, Perth, Western Australia.

Brockman Resources. 2010. Marillana Iron Ore Project Noise to Fortescue Marsh Report, Prepared by Lloyd George Acoustics for Brockman Resources. [Online].
<http://www.brockman.com.au/pdf/per/appendices/U%20Noise%20Report%20-%20Fortescue%20Marsh.pdf> . [08/06/10].

Broome Advertiser. 2006. Leading Industries of the Kimberley: Fish Farms a New Frontier, p. 19.

Broome Visitor Centre. 2008. Introducing Broome, Broome Visitor Centre, available from:
<<http://www.broomevisitorcentre.com.au/pages/introducing-broome/>> [4 March 2009].

Browne, R.K., Baker, J.L. and R.M. Connolly. 2008. Syngnathids: Seadragons, Seahorses, and Pipefishes of Gulf St Vincent. University of Adelaide, Adelaide, South Australia.

Bryce C. (ed.) 2006. Marine Biodiversity Survey of Mermaid Reef (Rowley Shoals), Scott and Seringapatam Reef. Records of the Western Australian Museum Supplement No. 77, Perth, Western Australia.

Bryce C.W. 1997. Molluscs. In: Walker D.I. (ed) Marine Biological Survey of the Central Kimberley Coast, Western Australia. pp 46-57. University of Western Australia, Perth, Western Australia.

Burbidge A., McKenzie N. and K. Kenneally. 1991. Nature Conservation Reserves in Kimberley Western Australia. Department of Conservation and Land Management, Perth, Western Australia.

Bureau of Meteorology (BoM). 2010a. Climate Statistics for Australian Locations [Online].
http://www.bom.gov.au/climate/averages/tables/cw_003003.shtml [15/01/2010].

Bureau of Meteorology (BoM). 2010b. Tropical Cyclones affecting Broome [Online].
<http://www.bom.gov.au/weather/wa/cyclone/about/broome/index.shtml> [15/01/2010].

Bureau of Rural Sciences. 2006. A Field Manual for Surveying and Mapping Nationally Significant Weeds. Bureau of Rural Sciences, Canberra, ACT.

Cabaco, S., Santos R. and Duarte C. M. 2008. The impact of sediment burial and erosion on seagrasses: A review. *Estuarine, Coastal and Shelf Science* 79, 54-366.

Campbell, I.C. and Doeg T.J. 1989. Impact of Timber Harvesting and Production on Streams: A Review. *Australian Journal of Marine and Freshwater Research* 40(s), 519-539.

Campbell, R. and Holley D. 2010. Progress Report: Movement behaviours and habitat usage of West Kimberley dugongs: A community based approach. Unpublished progress report for Woodside.

Campbell-Malone R. 2007. Biomechanics of North Atlantic Right Whale Bone: Mandibular Fracture as a Fatal Endpoint for Blunt Vessel-Whale Collision Modelling. Doctoral, Massachusetts Institute of Technology/Woods Hole Oceanographic Institution, Cambridge, Massachusetts.

Cappo M., MacNeil A., Stowar M., and Doherty P., 2010a. The Influence of Zoning (Closure to Fishing) on Fish Communities of the Deep Shoals and Reef Bases of the Southern Great Barrier Reef Marine Park- Part 1. Australian Institute of Marine Science.

Cappo M., Syms C., Stowar M., Johansson C., and Cooper T. 2010b. Survey of fish habitat associations in the region offshore from James Price Point using Baited Remote Underwater Video Systems (BRUVS). Australian Institute of Marine Science. Prepared for Woodside Energy Ltd. **[Appendix C-6]**.

Centre for Marine Science and Technology Curtin University (CMST). 2010. Woodside Kimberley Sea Noise Logger Program, Sep- 2006 to May- 2010: Whales, Fish and Man Made Noise. Prepared By R. D. McCauley for Woodside Energy Ltd, October 2010.

Chamber of Minerals and Energy 2005, *Fly In/Fly Out: A Sustainability Perspective*, available from:
<<http://www.cmewa.com.au/UserFiles/File/Publications%20-%20Human%20Resources/FIFO%20Report.pdf>>

Cheshire A.C., Collings G., Edyvane K. and Westphalen G. 2000. Overview of the Conservation Status of Australian Marine Macroalgae. Report for Environment Australia. Department of Environmental Biology. University of Adelaide, Adelaide, South Australia.

Chevron Australia, 2008. Gorgon LNG Project Revised PER, Chevron Australia, 2008.

Chevron Australia, 2009a. Gorgon Gas Development Response to Submissions. Gorgon Gas Development Revised and Expanded Proposal, Public Environmental Review. Chevron Australia, Perth as cited in EPA Bulletin Report 1323.

Chevron. 2009b. Gorgon Gas Development and Janz Feed Gas Pipeline – Long Term Marine Turtle Management Plan.

Chevron. 2010a. Website accessed 18/11/10 (www.chevronaustralia.com/ourbusiness/gorgon/economicbenefits.aspx).

Chevron. 2010b. Draft Environmental Impact Statement/Environmental Review and Management Programme for the Proposed Wheatstone Project. Chevron Australia, Perth.

Chittleborough, R.G. 1953. Aerial observations on the humpback whale. *Megaptera nodosa* (Bonnaterre), with notes on other species. *Australian Journal of Marine and Freshwater Research* 4, 219-226.

Clarke, R.B. 2005. Marine Pollution, 5th Edition. Oxford University Press, Oxford.

Cockburn Sound Management Council (CSMC), 2010. State of Cockburn Sound - 2009 Report. Report endorsed by the Cockburn Sound Management Council, 24 May 2010.

Collins J., Hutley L.B., Williams R.J., Boggs G., Bell D., and Bartolo R. 2009. Estimating landscape-scale vegetation carbon stocks using airborne multi-frequency polarimetric synthetic aperture radar (SAR) in the savannas of north Australia. *International Journal of Remote Sensing* 30: 1141–1159.

Colman J.G. 1997. A Review of the Biology and Ecology of the Whale Shark. *Journal of Fish Biology* 51, 1219-1234.

Colson D. J. 1998. Sound Production During Feeding in Hippocampus seahorses (Syngnathidae). *Environmental Biology of Fishes* 51, 221-229.

Commonwealth of Australia. 2006. A Guide to the Integrated Marine and Coastal Regionalisation of Australia Version 4.0.

Commonwealth of Australia 2008a. Carbon Pollution Reduction Scheme Green Paper. Published by the Department of Climate Change, July 2008.

Commonwealth of Australia 2008b. Carbon Pollution Reduction Scheme – Australia's Low Pollution Future. White Paper. Published by the Department of Climate Change, December 2008.

Commonwealth Scientific and Industrial Research Organisation (CSIRO). 1997. The Kwinana Coastal Fumigation Study [Online]. http://www.cmar.csiro.au/e-print/open/sawford_1997a.html [15/01/2010].

Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BoM). 2007. Climate Change in Australia: Technical Report. 2007.

Commonwealth Scientific and Industrial Research Organisation (CSIRO). 2010. Classification of Vine Thicket on Dampier Peninsula using TM Imagery. CSIRO Mathematics Informatics and Statistics. Prepared for Woodside Energy Ltd. [**Appendix C-21**].

Connell J.H., Hughes T.P. and Wallace C.C. 1997. A 30-year Study of Coral Abundance, Recruitment and Disturbance at Several Sites in Space and Time. *Ecological Monographs* 67, 461-488.

Connolly R M. Melville A J and Preston K. 2002. Patterns of movement and habitat use by leafy seadragons tracked ultrasonically. *Journal of Fish Biology* 61, 684-695.

Cooper, T.F., Gilmour, J.P. and Fabricius K.E. 2009. Bioindicators of Changes in Water Quality on Coral Reefs: Review and Recommendation for Monitoring Programmes. *Coral Reefs* 28, 589-606.

Cooper, T.F., Ridd P.V., Ulstrup K.E., Humphrey C., Slivkoff M. and Fabricius K.E. 2008. Temporal Dynamics in Coral Bioindicators for Wave Quality on Coastal Coral Reefs of the Great Barrier Reef. *Marine and Freshwater Research* 59, 703-716.

Cooper, T.F., Uthicke S., Humphrey C. and Fabricius K.E. 2007. Gradients in Water Column Nutrients, Sediment Parameters, Irradiance and Coral Reef Development in the Whitsunday Region, Central Great Barrier Reef. *Estuarine, Coastal and Shelf Science* 74, 458-470.

Cox, N. 2002. (unpublished) Preliminary status report for the Dugong (*Dugong dugon*) in Con Dao National Park - Observations of the Dugong (*Dugong dugon*) in Con Dao National Park, Vietnam, and recommendations for further research Vietnam.

Crabbe M. and Smith. D. 2005. Sediment Impacts on Growth Rates of Acropora and Porites Corals from Fringing Reefs of Sulawesi, Indonesia. *Coral Reefs* 24, 437–441.

- CRC Weed Management. 2010. Weed Management Guide: Buffel Grass (*Cenchrus ciliaris*). CRC Weed Management, Australia. [Online].
http://www.aabr.org.au/images/stories/resources/ManagementGuides/WeedGuides/wmg_buffelGrass.pdf [15/07/2010].
- Cresswell, G.R. and Badcock K.A. 2000. Tidal Mixing Near the Kimberley Coast of NW Australia. *Marine and Freshwater Research* 51, 641-646.
- Crossland, C.J., Barnes D.J. and Borowitzka M.A. 1980. Diurnal Lipid and Mucus Production in the Staghorn Coral *Acropora acuminata*. *Marine Biology* 60, 81-90.
- Centre for Whale Research (Western Australia). 2001. K.C.S. Jenner, M-N.M. Jenner and K.A. McCabe. Geographical and Temporal Movements of Humpback Whales in Western Australian Waters.
- DAFWA 2009 Department of Agriculture and Food - Declared Plants in Western Australia. Available at
<http://www.agric.wa.gov.au>.
- Davenport, J. and Davenport, J.L. 2006. The Impact of Tourism and Personal Leisure Transport on Coastal Environments: A Review. *Estuarine, Coastal and Shelf Science*. 67, 280-292.
- Davie, P.J.F. and Short J.W. 1995. Crustaceans. In: Wells F.E. Hanley R. and Walker D.I. (eds). Marine Biological Survey of the Southern Kimberley, Western Australia. Western Australian Museum, Perth, Western Australia.
- Davie P.J.F. and Short J.W. 1996. Crustaceans. In: Walker D.I. Wells F.E. and Hanley R. 1996. Survey of the Marine Biota of the Eastern Kimberley, Western Australia. University of Western Australia, Western Australian Museum and the Museum and Art Gallery of the Northern Territory.
- De longh, H. H. Bierhuizen, B and Van Orden, B. 1997. Observations on the behaviour of the Dugong (*Dugong dugon* Müller, 1776) from waters of the Lease Islands, eastern Indonesia. *Contributions to Zoology* 67, 71-77.
- Dennison, W. C. Orth, R J., Moore, K A., Stevenson J C. Carter V., Kollar S., Bergstrom P.W. and Batiuk R.A. 1993. Assessing water quality with submersed aquatic vegetation. *Bioscience* 43, 86-94.
- Dennison, W.C. and Abal E.G. 1999. Moreton Bay Study: A Scientific Basis for the Healthy Waterways Campaign. Healthy Waterways, Brisbane, Queensland.
- Department of Agriculture and Food Western Australia (DAFWA). 2009. Common Regional Pests of Western Australia. Bulletin 4771 [Online]. http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/commregpestbulletinnew.pdf.
- Department of Agriculture, Fisheries and Forestry. 2006. Australian Marine Pest Monitoring Manual. Commonwealth of Australia, Canberra, ACT. [Online]. http://www.daff.gov.au/__data/assets/pdf_file/0016/1503151/Monitoring_Manual-lowres.pdf [07/06/2010].
- Department of Child Protection. 2009, *Annual Report 2008-2009*, Government of Western Australia, Perth, Western Australia.
- Department of Climate Change (DCC). 2009a. National Greenhouse Accounts (NGA) Factors. Commonwealth of Australia, Canberra, ACT.
- Department of Climate Change (DCC). 2009b. Australian National Greenhouse Accounts - State and Territory Greenhouse Gas Inventories 2007. Commonwealth of Australia, Canberra, ACT.
- Department of Climate Change (DCC). 2009c. Climate Change Risks to Australia's Coasts: A First Pass National Assessment. Commonwealth of Australia, Canberra, ACT.
- Department of Climate Change (DCC) WA. 2007. Making Decisions for the Future: Climate Change. Western Australian Department of Climate Change, May 2007.
- Department of Climate Change and Energy Efficiency (DCCEE). 2010. National Greenhouse Accounts (NGA) Factors. Commonwealth of Australia, Canberra, ACT, July 2010.

Department of Conservation and Land Management (CALM). 1994. Reading the Remote – Landscape Characters of Western Australia. Department of Conservation and Land Management, Perth, Western Australia.

Department of Conservation and Land Management (CALM). 1999. Environmental Weed Strategy for Western Australia. Department of Conservation and Land Management, Perth, Western Australia.

Department of Conservation and Land Management (CALM) 2003. A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002. Government of Western Australia, September 2003.

Department of Education Western Australia. 2010. Schools Online, viewed 11 February 2010, <http://www2.eddept.wa.edu.au/schoolprofile/main_page.do>.

Department of Environment (DoE). 2004. The State Water Quality Management Strategy No. 6. Department of Environment, Canberra, ACT.

Department of Environment (DoE). 2005. Landfill Waste Classification and Waste Definitions 1996 (as amended 2005).

Department of Environment (DoE). 2006. Air Quality Modelling Guidance Notes. Department of Environment, Western Australia, Perth, Western Australia, March 2006.

Department of Environment and Conservation (DEC). 2001. Dugong Research in Shark Bay [Online]. <http://www.dec.wa.gov.au/news/archives-calm/dugong-research-in-shark-bay.html> [5/11/2009].

Department of Environment and Conservation (DEC). 2002. Biodiversity Audit for WA: A Contribution to the Development of WA's Biodiversity Conservation Strategy. Editors: McKenzie N. L., May J. E. and McKenna S.

Department of Environment and Conservation (DEC). 2006. Pilbara Coastal Water Quality Consultation Outcomes. Environmental Values and Environmental Quality Objectives, Marine Report 1. Report from the Department of Environment to the Environmental Protection Authority and the Rangelands NRM Coordinating Group. Department of Environment, Perth.

Department of Environment and Conservation (DEC) 2008. Preliminary Reconnaissance Survey of Benthic Habitats in the Anjo Peninsula, Kimberley Bioregion. Western Australia, Prepared by the Marine Ecosystems Branch for the NDT, October 2008.

Department of Environment and Conservation (DEC). 2009a. A Synthesis of Scientific Knowledge to Support Conservation Management in the Kimberley Region of Western Australia. Department of Environment and Conservation, Perth, Western Australia.

Department of Environment and Conservation (DEC). 2009b. Turtle Impacts from Dredging Workshop. Industry workshop held on 21/10/2009 at the Sheraton Hotel, Perth, Western Australia.

Department of Environment and Conservation (DEC). 2009c. Definitions, Categories and Criteria for Threatened and Priority Ecological Communities. Publicly available list prepared by the Department of Environment and Conservation, Perth, Western Australia.

Department of Environment and Conservation (DEC). 2009d. Draft Marine Turtle Recovery Plan for Western Australia 2009 – 2016. Wildlife Management Program No. 45. Department of Environment and Conservation, Perth, Western Australia.

Department of Environment and Conservation (DEC). 2009e. Protecting the Kimberley: A Synthesis of Scientific Knowledge to Support Conservation Management in the Kimberley Region of Western Australia. Department of Environment and Conservation, Perth, Western Australia.

Department of Environment and Conservation (DEC). 2009f. Monitoring of the Extent of Dampier Peninsula Vine Thickets Threatened Ecological Community. Department of Environment and Conservation, Perth, Western Australia.

Department of Environment and Conservation (DEC). 2010. NatureMap: Mapping Western Australia's Biodiversity. Department of Environment and Conservation and Western Australian Museum, Perth, Western Australia.

Department of the Environment and Heritage (DEH). 2000. National Environmental Alert List for Environmental Weeds. [Online]. <http://www.weeds.gov.au/weeds/lists/alert.html> [14/07/2010]. Department of the Environment and Heritage, Canberra, ACT.

Department of the Environment and Heritage (DEH). 2005a. Blue, Fin and Sei Whale Recovery Plan 2005 – 2010 [Online]. <http://www.environment.gov.au/biodiversity/threatened/publications/recovery/balaenoptera-sp/index.html>. [30/07/2009]. Department of the Environment and Heritage, Canberra, ACT.

Department of the Environment and Heritage (DEH). 2005b. Humpback Whale Recovery Plan 2005-2010 [Online]. <http://www.environment.gov.au/biodiversity/threatened/publications/recovery/m-novaeangliae/index.html> [07/06/2010]. Department of the Environment and Heritage, Canberra, ACT.

Department of the Environment and Heritage (DEH). 2005c. Humpback Whale Distribution, Migration and Recognised Aggregation Areas Map. [Online]. <http://www.environment.gov.au/soe/2001/publications/theme-reports/biodiversity/biodiversity04-3b.html#figure52> [07/06/2010]. Department of the Environment and Heritage, Canberra, ACT.

Department of the Environment and Heritage (DEH). 2006. Management of *Phytophthora cinnamomi* for Biodiversity Conservation in Australia. Department of the Environment and Heritage, Canberra, ACT. June 2006.

Department of Families, Housing, Community Services and Indigenous Affairs (ICC). 2008. Submission to the Senate Inquiry into Petrol Sniffing and Substance Abuse in Central Australia. Australian Government, Canberra, ACT.

Department of Families, Housing, Community Services and Indigenous Affairs. 2009. Closing the Gap on Indigenous Disadvantage: The Challenge for Australia. Australian Government, Canberra, ACT.

Department of Fisheries and Kimberley Development Commission. 1996. Kimberley Aquaculture Development Plan.

Department of Fisheries (DoF). 2006. Fletcher, W.J. and Santoro, K. (eds). State of the Fisheries Report 2006/07. Department of Fisheries, Western Australia.

Department of Fisheries (DoF). 2008a. Farming Trochus [Online]. <http://www.fish.wa.gov.au/docs/aqwa/Trochus/index.php> [04/03/2008]. Department of Fisheries, Canberra, ACT.

Department of Fisheries (DoF). 2008b. State of the Fisheries Report 2007/08 [Online]. <http://www.fish.wa.gov.au/docs/sof/2007/sof2007-2008-full.pdf> [05/11/2009]. Department of Fisheries, Canberra, ACT.

Department of Fisheries (DoF), State of the Fisheries Report, 2008/09 [Online]. <http://www.fish.wa.gov.au/docs/sof/2008/sof2008-2009-full.pdf> [05/11/2009]. Department of Fisheries, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2000. National Environmental Alert List. Available at <http://www.weeds.gov.au/weeds/lists>.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2003. Sleeper Weeds List. Available at <http://www.weeds.gov.au/weeds/lists>.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2004. Interim Biogeographic Regionalisation for Australia Version 6.1 [Online]. <http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html#ibra>. [07/07/2010]. Department of Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2007. Fragmentation of Remnant Vegetation. [Online]. <http://www.environment.gov.au/> [07/07/2010]. Department of Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2008a. North-West Marine Bioregional Plan: Bioregional Profile: A Description of the Ecosystems, Conservation Values and Uses of the North-West Marine Region. Department of Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2008b. Threat Abatement Plan for Predation by Feral Cats [Online]. <http://www.environment.gov.au/biodiversity/threatened/publications/tap/cats08.html> [8/12/2009]. Department of Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2008c. Background Document for the Threat Abatement Plan for Predation by the European Red Fox [Online]. <http://www.environment.gov.au/biodiversity/threatened/publications/tap/foxes08.html> [08/12/2009]. Department of Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2008d. EPBC Act Policy Statement 2.1. Interaction Between Seismic Exploration and Whales. Department of the Environment, Water, Heritage and the Arts, September 2008.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2009a. Marine Bioregional Planning in the North-West [Online]. <http://www.environment.gov.au/coasts/mbp/north-west/index.html>. [20/08/2009]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2009b. Sulfur Dioxide Air Quality Fact Sheet [Online]. www.environment.gov.au/atmosphere/airquality/publications/sulfurdioxide.html [21/12/2009]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2009c. *Megaptera novaeangliae* in Species Profile and Threats Database [Online]. <http://www.environment.gov.au/sprat>. [19/06/2009]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2009d. Biodiversity Hotspots [Online]. <http://www.environment.gov.au/biodiversity/hotspots/index.html> [17/11/2009]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2009e. National Assessment Guidelines for Dredging [Online]. <http://www.environment.gov.au/coasts/pollution/dumping/index.html> DEWHA 2009. [5/02/2010]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2010a. *Balaenoptera musculus* in Species Profile and Threats Database [Online]. <http://www.environment.gov.au/sprat>. [20/01/2010]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2010b. *Balaenoptera bonaerensis* in Species Profile and Threats Database [Online]. <http://www.environment.gov.au/sprat>. [20/01/2010]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2010c. *Balaenoptera edeni* in Species Profile and Threats Database [Online]. <http://www.environment.gov.au/sprat>. [20/01/2010]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2010d. *Physeter macrocephalus* in Species Profile and Threats Database [Online]. <http://www.environment.gov.au/sprat>. [20/01/2010]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of Environment, Water, Heritage and the Arts (DEWHA). 2010e. Species Profile and Threats Database [Online]. <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl> [20/1/2010]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2010f. *Macrotis lagotis* — Greater Bilby in Species Profile and Threats Database [Online]. <http://www.environment.gov.au/sprat>. [04/06/2010], Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2010g. *Isoodon auratus auratus* — Golden Bandicoot (mainland) in Species Profile and Threats Database [Online]. <http://www.environment.gov.au/sprat>. [04/06/2010], Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2010h. *Numenius madagascariensis*. – Eastern Curlew in Species Profile and Threats Database [Online]. <http://www.environment.gov.au/sprat>. [08/06/2010], Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2010i. Weeds of National Significance. [Online]. <http://www.weeds.gov.au/weeds/lists/wons.html> [15/07/2010]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2010j. The Biological Effects, Including Lethal Toxic Ingestion, Caused by Cane Toads (*Bufo marinus*) – 12 April 2005. [Online]. <http://www.environment.gov.au/> [07/07/2010]. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2010k, National recovery plan for the Golden Bandicoot *Isoodon auratus* and Golden-backed Tree-rat *Mesembriomys macrurus* 2004 – 2009 [online], Commonwealth of Australia, <http://www.environment.gov.au/biodiversity/threatened/publications/recovery/i-auratus-m-macrurus/habitat.html> [19 July 2010].

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2010l, *Draft EPBC Act Policy Statement 3.21 – Significant Impact Guidelines for 36 Migratory Shorebird Species*, Commonwealth of Australia.

Department of the Environment and Water Resources (DEWR). 2007. Reports of Interactions with Listed Species [Online]. www.environment.gov.au/epbc/permits/notifications.html#report-species. Department of the Environment and Water Resources, Canberra, ACT.

Department of Health (DOH). 2009. *The Epidemiology of Notifiable Sexually Transmitted Infections and Blood-Borne Viruses in Western Australia 2007*, Department of Health, Western Australia.

Department of Health (DOH). 2010a. Public Health Fact Sheets, Mosquito-borne diseases, Government of Western Australia. http://www.public.health.wa.gov.au/3/1187/2/mosquitoborne_diseases.pm. [22 November 2010].

Department of Health (DOH). 2010b. Working together — WA Health Strategic Intent 2010-2015. Department of Health, Western Australia.

Department of Local Government and Regional Development (DLGRD). 2007. Regional Price Index Project [Online]. www.kdc.wa.gov.au [06/12/2009]. Department of Local Government and Regional Development, Perth, Western Australia.

Department of Local Government and Regional Development (DLGRD). 2008. Statistical Snapshot – Healthcare, State of Western Australia, Perth, available from: http://www.dlgrd.wa.gov.au/Publications/Docs/StatSnapshot_health.asp. Department of Local Government and Regional Development, Perth, Western Australia.

Department of Local Government and Regional Development (DLGRD). 2009. Statistical Snapshot – Regional Economy, State of Western Australia, Perth. [Online]. http://www.dlgrd.wa.gov.au/Publications/Docs/StatSnapshot_regionEconomy.asp [20/03/2009]. Department of Local Government and Regional Development, Perth, Western Australia.

Department of Local Government and Regional Development and Kimberley Development Commission (DLGRD and KDC). 2006. Kimberley Economic Perspective [online]. DLGRD and KDC. Western Australia. http://www.dlgrd.wa.gov.au/Publications/Docs/EconomicPerspectives_kmbrly.pdf [6/5/2009]. Department of Local Government and Regional Development and Kimberley Development Commission, Perth, Western Australia.

Department of Land Administration (DOLA). 2000. Waterbank Structure Plan. Department of Land Administration. Perth, Western Australia.

Department of Mines and Petroleum (DMP). 2009. Western Australian Minerals and Petroleum Statistics Digest 2008/09. Government of Western Australia. Perth, Western Australia.

Department of Natural Resources, Environment, The Arts and Sport (NRETA). 2007. Brush-tailed Rabbit-Rat - Fact Sheet. Northern Territory Parks and Wildlife Commission, Northern Territory.

Department of Planning and Infrastructure (DPI). 2007. Visual Landscape Planning in Western Australia: A Manual for Evaluation, Assessment, Siting and Design. Department of Planning and Infrastructure, Perth, Western Australia.

Department of Planning and Infrastructure (DPI). 2008. Dampier Peninsula Plan: Background Information and Key Issues – Working Draft. Department of Planning and Infrastructure, Perth, Western Australia.

Department of Planning and Infrastructure (DPI). 2009. Dampier Peninsula Land Use and Infrastructure Plan - Working Draft 1. November 2009. Department of Planning and Infrastructure, Perth, Western Australia.

Department of State Development (DSD). 2009a. Volume 1: Social Impact Assessment Scope and Profile [Online]. www.dsd.wa.gov.au. Department of State Development, Perth, Western Australia. [**Appendix D-1**].

Department of State Development (DSD). 2009b. Volume 2: Impact Assessment [Online]. www.dsd.wa.gov.au. Department of State Development, Perth, Western Australia. [**Appendix D-2**].

Department of State Development (DSD). 2009c. Volume 3: Impact Management [Online]. www.dsd.wa.gov.au. Department of State Development, Perth, Western Australia. [**Appendix D-3**].

Department of State Development (DSD). 2009d. Browse Liquefied Natural Gas Precinct Public Information Booklet, October 2009.

Department of State Development (DSD) 2010a. Preface to the Scope of the Strategic Assessment. Department of State Development, Perth, WA, 2010. [**Appendix A-1**].

Department of State Development (DSD) 2010b. Scope of the Strategic Assessment. Department of State Development, Perth, WA, 2010. [**Appendix A-2**].

Department of State Development (DSD) 2010c. Appendices to the Scope of the Strategic Assessment, Including the Terms of Reference. State-Commonwealth Terms of Reference for the Strategic Assessment. Department of State Development, Perth, WA, 2010. [**Appendix A-3**].

Department of State Development (DSD) 2010d. BLNG Precinct Dredging and Spoil Disposal Assessment. Department of State Development, Perth, WA, 2010. [**Appendix C-13**].

Department of Water (DoW). 2004. Stormwater Management Manual for Western Australia. Department of Water, Perth, Western Australia.

Department of Water (DoW). 2009a. Fitzroy Catchment Subregion Overview and Future Directions. Kimberley Regional Water Plan, Working Discussion Paper. Department of Water, October 2009.

Department of Water (DoW). 2009b. Dampier Peninsula Subregion Overview and Future Directions, Kimberley Regional Water Plan Working Discussion Paper. Department of Water, Perth, Western Australia.

Department of Water (DoW). 2010. Drainage Divisions of the Kimberley Region. [Online]. www.water.wa.gov.au [06/06/2010]. Department of Water, Perth, Western Australia.

DeRuiter, S.L., Tyack P., Lin, Y.-T., Newhall A.E., Lynch J. and Miller P.J.O. 2006. Modeling Acoustic Propagation of Airgun Array Pulses Recorded on Tagged Sperm Whales. Woods Hole Oceanographic Scientific Community.

Dethmers, K.E.M., Broderick D., Moritz C., FitzSimmons N.N., Limpus C.J., Lavery S., Whiting S., Guinea M., Prince R.I.T. and Kennett R. 2006. The Genetic Structure of Australasian Green Turtles (*Chelonia mydas*): Exploring the Geographical Scale of Genetic Exchange. *Molecular Ecology* 15(13), 3931-3946.

- de Villèle, X., and Verlaque, M. 1995. Changes and degradation in a *Posidonia oceanica* bed invaded by the introduced tropical alga *Caulerpa taxifolia* in the north western Mediterranean. *Botanic Marina*. Vol 38. pp79-87
- DHI. 2010a. Browse LNG Development: BLNG Precinct Dredging and Spoil Disposal Modelling Report. Report prepared for Woodside Energy Ltd.
- DHI. 2010b. Browse LNG Development: Browse Environmental Modelling – Phase 2B. Coastal Processes in the James Price Point Region. Report prepared for Woodside Energy Ltd.
- DHI. 2010c. Browse LNG Development: Hydrodynamic Model Validation of the James Price Point Region. Report prepared for Woodside Energy Ltd.
- Diaz, R.J. and Rosenberg R. 1995. Marine Benthic Hypoxia: A Review of its Ecological Effects and the Behavioural Responses of Benthic Macrofauna. *Oceanographic Marine Biology Annual Review* 33, 245–303.
- Dickerson, D.D., Richardson J. I., Ferris J. S., Bass A. L. and Wolff M. 1991. Entrainment of Sea Turtles by Hopper Dredges in Cape Canaveral and Kings Bay Ship Channels. Environmental Effects of Dredging. Vol. D-91-3. U.S. Army Engineer Waterways Experiment Station. Vicksburg. MS.
- Doherty, J. L. and Gabriele C. M. 2001. Population characteristics of humpback whales in Glacier Bay and adjacent waters. In Report to the National Park Service, pp. 24.
- Double, M.C. Gales, N. Jenner, K.C.S. and Jenner, M.N. 2010. Satellite Tagging of South-Bound Female Humpback Whales in the Kimberley Region of Western Australia: Field Report. <http://www.wamsi.org.au/research-kimberley/satellite-tracking-humpback-whales-kimberley-region-western-australia>.
- Driscoll, F.G. 1986. Groundwater and Wells, 2nd ed. Johnson Filtration Systems, Minnesota, USA.
- Duarte, C. M. 1991. Seagrass depth limits. *Aquatic Botany* 40, 363–377.
- Duarte, C.M., Uri, J., Agawin, N.S.R., Fortes, M.D., Vermaat, J.E. and Marbà, N., 1997. Flowering frequency of Philippine Seagrasses. *Botanica Marina* 40, 497-500.
- Duarte, C.M. 2007. Consequences of Mediterranean Warming Events in Seagrass (*Posidonia oceanica*) Flowering Records. *Global Change Biology*, 13: 224–235.
- Duffy J.E. 1996. Eusociality in a Coral-Reef Shrimp. *Nature* 381, 512-514.
- Dutton, P.H. Broderick, D. and Fitzsimmons, N. 2002. Defining Management Units: Molecular Genetics. In: Kinan I. (ed.) Proceedings of the Western Pacific Sea Turtle Co-operative Research and Management Workshop. Western Pacific Regional Fishery Management Council. Honolulu USA. pp. 93–101.
- Ecologia Environment. 2004. Beagle Bay Big Tree Country timber Plantation Flora Assessment Survey. Unpublished report for Tropical Timber Plantations Pty, Ltd.
- Ecologia Environment. 2005. Browse Onshore Gas Plant Environmental Constraints Map. Unpublished report for Woodside Petroleum.
- Econsearch. 2009. Economic Analysis: Fishing Industry Impact Study – Kimberley LNG Project. Department of Fisheries Occasional Publication 77, 2010. 68 pp. [Appendix D-4].
- Edgar, G.J. 1997. Australian Marine Life: The Plants and Animals of Temperate Waters. Reed Books, Melbourne, Victoria.
- Edmonds, J.S., Shibata, Y., Prince, R.I.T., Preen, A.R. and Morita, M. 1997. Elemental Composition of a Tusk of a Dugong, *Dugong dugon*, from Exmouth, Western Australia. *Marine Biology* 129, 203–214.
- Eliot, I. and Eliot, M. 2008. Coastal Geomorphology: Proposed LNG Hub Locations in the Kimberley Region Western Australia. Report for Northern Development Taskforce Environment Experts Working Group.

Ellison, C. 2009. Foundations for a Kimberley Strategy. Report on the Consultation Process for the Kimberley Science and Conservation Strategy.

Ellison, J.C. and Simmonds, S. 2003. Structure and Productivity of inland mangrove stands at Lake MacLeod, Western Australia. *Journal of the Royal Society of Western Australia*, 86 . pp. 21-26. ISSN 1329-7759

Elshorbaghy, W. 2005. Overview of Marine Pollution in the Arabian Gulf with Emphasis on Pollutant Transport Modelling. Keynote Address Arabian Coast 2005.

ENV Australia. 2008a. Perpendicular Head-North Head, Packer Island, Coulomb- Quondong and Gourdon Bay Vegetation Assessment. Prepared for Department of Industry and Resources. October 2008. **[Appendix C-14]**.

ENV Australia. 2008b. Perpendicular Head – North Head, Packer Island, Coulomb-Quondong and Gourdon Bay Flora Assessment. Prepared for Department of Industry and Resources. October 2008. **[Appendix C-15]**.

ENV Australia. 2008c. Perpendicular Head-North Head, Packer Island, Coulomb- Quondong and Gourdon Bay Vertebrate Fauna Assessment. Prepared for Department of Industry and Resources. October 2008. **[Appendix C-16]**.

ENV Australia. 2008d. Anjo Peninsula Flora and Vegetation Assessment. Prepared for Department of Industry and Resources, October 2008.

Environment and Behaviour Consultants. 2009. Kimberly LNG Social Impact Assessment: Sensitivity Analysis of Workforce Population Impacts Model, Report Prepared for Department of State Development, Government of Western Australia, Perth.

Environment and Behaviour Consultants. 2010. Workforce Modelling for the Browse LNG Precinct. Prepared for Department of State Development, Government of Western Australia, Perth.

Environment Australia. 1998. Noise, Vibration and Airblast Control. Best Practice Environmental Management in Mining. Commonwealth of Australia.

Environment Australia. 2000. Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and Development of Version 5.1. Summary Report. Environment Australia, Canberra, ACT.

Environment Australia. 2003. Recovery Plan for Marine Turtles in Australia - July 2003. Environment Australia. Canberra, ACT.

Environmental Protection Authority (EPA). 2000a. EPA Position Statement No. 2 – Environmental Protection of Native Vegetation in Western Australia. Western Australian Environmental Protection Authority. Perth, Western Australia.

Environmental Protection Authority (EPA). 2000b. State Water Quality Management Strategy Document No.6 –Perth's Coastal Waters, Environmental Values and Objectives. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2000c. EPA Guidance Statement No. 15 – Emissions of Oxides of Nitrogen from Gas Turbines. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA) 2000d. EPA Guidance Statement No. 18 – Prevention of Air Quality Impacts from Land Development Sites. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA) 2001. Relocation of Broome International Airport. Bulletin 1017. Report and Recommendations of the Western Australian Environmental Protection Authority. Perth. June 2001.

Environmental Protection Authority (EPA). 2002a. EPA Position Statement No. 3 – Terrestrial Biological Surveys as an Element of Biodiversity Protection. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2002b. EPA Guidance Statement No. 12 – Minimising Greenhouse Gases. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2003a. Guidance Statement No. 55 – Implementing Best Practice in Proposals submitted to the Environmental Impact Assessment Process. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2003b. EPA Guidance Statement No. 54A – Sampling Methods and Survey Considerations for Subterranean Fauna Western Australia. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2004a. EPA Guidance Statement No. 29 – Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2004b. EPA Guidance Statement No. 51 – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2004c. Guidance Statement No. 56 – Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2004d. Principles of Environmental Protection. Position Statement No. 7 – Government of Western Australia. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2005. Guidance Statement No. 3 – Separation Distances between Industrial and Sensitive Land Uses. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2006a. Fire Management in the Kimberley and other Rangeland Regions of Western Australia, Advice of the Environmental Protection Authority to the Minister for the Environment under Section 16(e) of the Environmental Protection Act 1986. Bulletin 1243, December 2006. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2006b. EPA Position Statement No. 9 – Environmental Offsets. Western Australian Environmental Protection Authority. Perth, Western Australia.

Environmental Protection Authority (2007). Pluto LNG Development, Burrup Peninsula. EPA Bulletin 1259. Western Australian Environmental Protection Authority. Perth, Western Australia.

Environmental Protection Authority (EPA). 2008. Kimberley LNG Precinct - Review of Potential Sites for a Proposed Multi-User Liquefied Natural Gas Processing Precinct in the Kimberley Region Perth. Report 1306. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2009a. Environmental Assessment Guideline No. 3 – Protection of Benthic Primary Producer Habitats in Western Australia's Marine Environment. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2009b. EPA Guidance Statement No. 20 – Sampling of Shorrange Endemic Invertebrate Fauna for Environmental Impact Assessment. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2009c. EPA Bulletin 1323 Gorgon Gas Development Revised and Expanded Proposal: Barrow Island Nature Reserve. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2009d. State Environment (Ambient Air) Policy 2009, Draft Ambient Air SEP and Explanatory Document. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA) 2009e. Draft guideline *Application of Risk-based Assessment in EIA* Western Australian Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority (EPA). 2009f. Guide to EIA Environmental Principles, Factors and Objectives. Environmental Protection Authority, Perth, Western Australia. June 2009.

Environment Protection Authority (EPA) 2010. Environmental Assessment Guideline No. 5 - Draft Protecting Marine Turtles from Light Impacts. Draft, March 2010. Western Australian Environmental Protection Authority, Perth, Western Australia.

Environs Kimberley. 2002. Save the Nature of the Kimberley: environs Kimberley Inc. Bulletin No. 24. [Online]. www.environskimberley.org.au/weeds.htm [07/07/2010].

Environs Kimberley. 2010. Weeds and Biodiversity in the Kimberley. [Online]. www.environskimberley.org.au/weeds.htm [07/07/2010].

ESOMAR Market Research Glossary: <http://www.esomar.org/index.php/glossary-i.html>.

Eureka Archaeological Research and Consulting. 2010. Indigenous Impacts Report Volume5: Aboriginal Archaeological Site Avoidance Survey, James Price Point: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome and University of Western Australia, Perth, August 2010. (ASIA Volume 5: Archaeological Report). [**Appendix E-5**].

Fabricius, K.E. 2000. Effects of terrestrial runoff on the ecology of corals and coral reefs: review and synthesis. Australian Institute of Marine Science and CRC Reef, PMB No. 3, Townsville MC, Qld 4810, Australia.

Fabricius, K.E. 2005. Effects of Terrestrial Runoff on the Ecology of Corals and Coral Reefs: Review and Synthesis. Marine Pollution Bulletin 50, 125-146.

Felger, R.S., Clifton, K., and Regal P.J. 1976. Winter Dormancy in Sea Turtles: Independent Discovery and Exploitation in the Gulf of California by Two Local Cultures. *Science* 191, 283–285.

FitzSimmons, N.N. and Jenson M.P. 2008. Western Australian Green Turtles (*Chelonia mydas*): Genetic Analysis to Define Breeding Populations and Characterise Foraging Populations. Report to Woodside Energy Ltd.

Flanders, T, 2009. Rate your skyglow. *Sky and Telescope*. February 2009 Issue.

Fletcher, W.J. and Head, F. (eds). 2006. State of the Fisheries Report 2005/06. Department of Fisheries, Perth, Western Australia.

Fletcher, W.J. and Santoro, K. (eds.). 2007. State of the Fisheries Report 2006/2007. Department of Fisheries, Perth, Western Australia.

Fraschetti S., Terlizzi A. and Boero F. 2008. How Many Habitats are There in the Sea (and Where)? *Journal of Experimental Marine Biology and Ecology* 366, 109–115.

Frojan R.S.B., Kendall M.A., Paterson G.L.J., Hawkins L.E., Nimsantijaroen S. and Aryuthaka C. 2009. The Importance of Bare Marine Sedimentary Habitats for Maintaining High Polychaete Diversity and the Implications for the Design of Marine Protected Areas. *Aquatic Conservation: Marine and Freshwater Ecosystems* 19, 748-757.

Fromont J. Vanderklift M.A. and Kendrick G.A. 2006. Marine Sponges of the Dampier Archipelago, Western Australia: Patterns of Species Distributions, Abundance and Diversity. *Biodiversity and Conservation* 15(11), 3731-3750.

Fry, G., Heyward, A., Wassenberg, T., Taranto, T., Stieglitz, T, and Colquhoun, J. 2008. Benthic habitat surveys of potential LNG hub locations in the Kimberley region, Prepared for the Western Australian Marine Science Institution on behalf of the NDT, October 2008. [**Appendix C-4**].

Fugro LADS. 2009. Browse Nearshore ALB Survey. Browse LNG Development, James Price Point Western Australia. Unpublished. Prepared for Woodside Energy Ltd.

Fugro LADS. 2010. Geotechnical Report - Investigation Data. Browse LNG Development, James Price Point, Western Australia. Unpublished Prepared for Woodside Energy Ltd.

Gaffney, Cline and Associates (GCA). 2008. Browse Basin Gas Technical Report Development Options Study – Reports 1-3. Report to the Northern Development Taskforce (May 2008). [**Appendix B-1**].

Gage J D and Tyler P A 1992. Deep Sea Biology: A Natural History of Organisms at the Deep Sea Floor. Cambridge University Press. Cambridge.

Galaxia Marine Environmental Consulting (Galaxia). 2010. Browse LNG Development Migratory Bird Study, James Price Point. Prepared for Woodside Energy Ltd. Browse Business Unit, Rev 1. May 2010. [**Appendix C-1**].

Gales N., McCauley R., Lanyon J. and Holley D. 2004. Change in the Abundance of Dugongs in Shark Bay, Ningaloo and Exmouth Gulf, Western Australia: Evidence for Large-scale Migration. *Wildlife Research* 31, 283-290.

Galli L., Hurlbutt B., Jewett W., Morton W, Schuster S. and Van Hilsen Z. 2003. Boat Source-Level Noise in Haro Strait: Relevance to Orca Whales. Orca Vocalization and Localization (OVAL) [Online]. <http://www.coloradocollege.edu/dept/ev/Research/Faculty/OVALItems/FinalRptWeb/finalAll.html>.

Gao, Q.F., Cheung, K.L., Cheung, S.G., Shin, P.K.S., 2005. Effects of nutrient enrichment derived from fish farming activities on macroinvertebrate assemblages in a subtropical region of Hong Kong. *Marine Pollution Bulletin* 51, 994–1002.

Garakouei, M. Y., Pajand, Z., Tatina, M. and Khara, H. 2009. Medial lethal concentration (LC50) for suspended sediments in two sturgeon species *Acipenser persicus* and *Acipenser stellatus* fingerlings. *Journal of Fisheries and Aquatic Science*, 4(6), 285-295.

Gardline Marine Sciences. 2009. Woodside Energy Ltd, Browse LNG Development, Environment Survey, June to July 2009, Environmental Baseline Report. Report to Woodside Energy Ltd.

Gardner, S.L. Fitzgerald, B. Acosta-Vargas and L. Mendez-Rodriguez. Heavy Metal Accumulation in Four Species of Sea Turtles from the Baja California Peninsular, Mexico, *Biomaterials* 19 (2006), pp.91-99.

Gee, J.M., Warwick, R.M., Schaanning, M., Berge, J.A., Ambrose, W.G., 1985. Effects of organic enrichment on meiofaunal abundance and community structure in sublittoral soft sediments. *Journal of Experimental Marine Biology and Ecology*, 91, 247–262.

Geoscience Australia. 2010. Natural Hazards Mapping [Online]. <http://webmap.ga.gov.au/hazards/earthquake/> [25/02/2010].

GHD 2008. Comparative Analysis of the Feasibility of Alternative Locations for the Development of a Liquefied Natural Gas Precinct, Draft Report to the Commonwealth Department of Environment, Water, Heritage and Arts (December).

GHD 2009a. Comparative Analysis of the Feasibility of Alternative Locations for the Development of a Liquefied Natural Gas Precinct, January 2009. [**Appendix B-7**].

GHD. 2009b. Report for Broome North Development Area Targeted Fauna Survey.

Gibson D.L. and Walton D.G. 1982. Broome, Western Australia, 1:250 000 geological series map. Sheet SE/51-06, 1st edition. Bureau of Mineral Resources. Australia and Geological Survey of Western Australia.

Gifford S.P., Macfarlane G.R., O'Connor W.A. and Dunstan R.H. 2006. Effect of the Pollutants Lead, Zinc, Hexadecane and Octococane on Total Growth and Shell Growth in the Akoya Pearl Oyster, *Pinctada imbricate*. *Journal of Shellfish Research* 25(1), 159-165.

Gilmour J.P., Smith L.D., Brinkman R.M. (2009) Biannual Spawning, Rapid Larval Development and Evidence of Self-Seeding for Scleractinian Corals at an Isolated System of Reefs. *Mar. Biol.* 156:1297–1309

Glockner-Ferrari R.A.I. and Ferrari M.J. 1985. Individual Identification, Behavior, Reproduction and Distribution of Humpback Whales, *Megaptera novaeangliae*, in Hawaii. Report to the Marine Mammal Commission. U.S. Department of Commerce. NTIS PB85-200772. 36 pp.

- Goold, J.C. and Coates, R.F.W. 2006. Near Source, High Frequency Air-Gun Signatures. IWCS.
- Gordon, A.N., Gordon, A.R. Pople and J. Ng, 1998. Trace Metal Concentrations in Livers and Kidneys of Sea Turtles from South-Eastern Queensland. *Australian Marine Freshwater Research*. 49 (1998) pp. 409-414.
- Gordon J., Gillespie D., Potter J., Frantzis A., Simmonds M.P., Swift R. and Thomson D. 2004. A Review of the Effects of Seismic Surveys on Marine Mammals. *Marine Technology Society Journal* 37, 16-34.
- Gordon S., Hallahan K., Henry D. 2002. The Gordon Report: Putting the Picture Together, Inquiry into Response by Government Agencies to Complaints of Family Violence and Child Abuse in Aboriginal Communities, Department of Premier and Cabinet, Perth, Western Australia.
- Government of Western Australia 2003, Hope for the future – The Western Australian State Sustainability Strategy – A Vision for Quality of Life in Western Australia, Perth, Western Australia, September 2003.
- Government of Western Australia. 2004. State Water Quality Management Strategy No. 6: Implementation framework for Western Australia for the Australian and New Zealand Guidelines for Fresh and Marine Water Quality Monitoring and Reporting (Guidelines Nos. 4 & 7: National Water Quality Management Strategy). Government of Western Australia 2004.
- Government of Western Australia 2008a, Premier Colin Barnett: Interview Transcript: Report of the Northern Development Taskforce, 15 October 2008. Department of the Premier and Cabinet, Government Media Office.
- Graham G. 2001. Dampierland 2 (DL2- Pindanland Subregion). In: A biodiversity Audit of Western Australia's 53 Biogeographical Subregions. Department of Conservation and Land Management, Perth, Western Australia.
- Graham G. 2002. Dampierland 2 (DL2 – Fitzroy Trough subregion) – Mount Eliza subregion. In: A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions. Department of Conservation and Land Management, Perth, Western Australia.
- Great Barrier Reef Marine Park Authority (GBRMPA). 2010. Boat Strikes [online]. http://www.gbrmpa.gov.au/corp_site/key_issues/conservation/natural_values/threats_and_management/boat_strikes. [25/02/2010].
- Greene C R 1987. Characteristics of oil industry dredge and drilling sounds in the Beaufort Sea. *Journal of the Acoustical Society of America* 82, 1315-1324.
- Greenland J., Limpus C.J. and Currie K. 2002. Marine Wildlife Stranding and Mortality Database Annual Report 2001-2002 III. Marine Turtles Queensland EPA report.
- Gregory and Northcote 1993 - Gregory, R. S., and T. G. Northcote. 1993. Surface, planktonic, and benthic foraging by juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in turbid laboratory conditions. *Canadian Journal of Fisheries and Aquatic Sciences* 50:233–240.
- Griffith J.K. 2004. Scleractinian Corals Collected During 1998 from the Dampier Archipelago, Western Australia. In: Marine Biodiversity of the Dampier Archipelago Western Australia 1998-2002. Jones DS (Eds). Western Australian Museum, Perth, Western Australia.
- Guinea M.L. and Whiting S.D. 2005. Insights into the Distribution and Abundance of Sea Snakes at Ashmore Reef. The Beagle. Records of the Museums and Art Galleries of the Northern Territory. Supplement 1. pp 199-205.
- Guiry M.D. and Guiry G.M. 2009. AlgaeBase. National University of Ireland, Galway. [Online]. <http://www.algaebase.org>.
- Hallegraeff G.M. 1998. Transport of Toxic Dinoflagellates via Ships' Ballast Water: Bioeconomic Risk Assessment and Efficacy of Possible Ballast Water Management Strategies. *Marine Ecology Progress Series* 168, 297-309.
- Hallegraeff G.M. and Jeffrey S.W. 1984. Tropical Phytoplankton Species and Pigments of Continental Shelf Waters of North and North-West Australia. *Marine Ecology* 20, 59-74.

Hammond, R. 2008, *Visual Landscape Study*, Prepared for NDT.

Hanley J.R. 1992. Current Status and Future Prospects of Mangrove Ecosystems in North Australia. In: Moffat I. and Webb A. (eds). *Conservation and development issues in north Australia*. pp 45–54. Australian National University Press, Canberra, ACT.

Hanley J.R. 1995. Polychaeta. In: Wells F.E. Hanley J.R. and Walker D.I. (eds). *Marine Biological Survey of the Southern Kimberley*, Perth, Western Australia.

Harding C., McGilvray A., and Beames L. 2009. Monitoring the Effectiveness of Weed Control in Dampier Peninsula Vine Thickets Threatened Ecological Community. Version 1.0 (October 2009). Prepared for Department of Environment and Conservation - Significant Native Species and Ecological Communities – Resource Condition Monitoring Project. [Online]. [http://www.dec.wa.gov.au/component/option,com_docman/task,doc_details/Itemid,/gid,3920/\[11/12/2009\]](http://www.dec.wa.gov.au/component/option,com_docman/task,doc_details/Itemid,/gid,3920/[11/12/2009]).

Harris L.D. 1984. *The Fragmented Forest*. University of Chicago Press. Chicago. IL.

Harino, J., Ohji I., Wattayakorn, G., Adulyanukosol, K., Ara, T., Miyazaki, N. 2007. Concentrations of Organotin Compounds in Tissues and Organs of Dugongs from Thai Coastal Waters. *Archives of Environmental Contamination and Toxicology* 53: (3) p. 495-502.

Hass C.G. and Jones D.S. 1999. Marine Introductions to Western Australia, with a focus on Crustaceans. pp. 37-44. In: Kesby J.A. Stanley J.M. McLean R.F. and Olive L.J. (eds). *Geodiversity: Readings in Australian Geography at the Close of the 20th Century*. Special publication Series. no. 6. Canberra, ACT. School of Geography and Oceanography. University College. Australian Defence Force Academy. 630 pp.

Hassan L.Y. 2004. Mineral Occurrences and Exploration Potential of the West Kimberley, Geological Survey of Western Australia. Report 88.

Haswell-Elkins M., McGrath V., Moore M.R., Satarug S., Walmsby M. And Hg. J. C. (2007) Exploring potential of dietary contributions including traditional seafood and other determinants of urinary cadmium levels among indigenous women of a Torres Strait Island (Australia). *Journal of Exposure Science and Environmental Epidemiology*, 17: (3) p. 298-306.

Hawker D.W. and Connell D.W. 1992. Standards and Criteria for Pollution Control in Coral Reef Areas. In: *Pollution in Tropical Aquatic Systems*. Connell D.W. and Hawker D.W. (eds). CRC Press.

Hayes D., Lyne V., Condie S., Griffiths B., Pigot S. and Hallegraeff G.M. 2005. Collation and Analysis of Oceanographic Datasets for National Marine Bioregionalisation. Report to the Australian Government National Oceans Office.

Haynes D., Carter S., Gaus S., Muller J., and Dennison W. 2005. Organochlorine and Heavy Metal Concentrations in Blubber and Tissue Collected from Queensland (Australia) dugong (*Dugong dugon*). *Marine Pollution Bulletin* 51: (1-4) p. 361-369.

Hazel J., Lawler I.R., Marsh H. and Robson S. 2007. Vessel Speed Increases Collision Risk for the Green Turtle *Chelonia mydas*. *Endangered Species Research* 3, 105–113.

Hedley S.L., Bannister J.L. and Dunlop R. 2009. Group IV Humpback Whales: Abundance Estimates from Aerial and Land-based Surveys off Shark Bay, Western Australia, 2008. Paper SC/61/SH23 presented to the Scientific Committee of the International Whaling Commission, June 2009. (unpublished) 17 pp.

Heede, R. 2006. LNG Supply Chain Greenhouse Gas Emissions for the Cabrillo Deepwater Port: Natural Gas from Australia to California. May 2006.

Henry and Lyle. 2003. *The National Recreational and Indigenous Fishing Survey*.

Heritage Council of Western Australia, 1999. *Heritage Trail – Lurujarri – Retracing the Song Cycle from Minarriny to Yinara*. Brochure published February, 1999.

Hewitt, C.L. 2000. *Baseline port sampling for introduced marine species*. Paper presented at Sea Australia Conf. Sydney, Aust. 1-3 February 2000.

- Hewitt, M.A. 1997. Crustaceans: Non-caridean Decapods. In: Walker D.I. (ed). Marine Biological Survey of the Central Kimberley Coast, Western Australia. University of Western Australia, Perth, Western Australia.
- Hibbard E. 1975. Eyes and Other Sense Organs of Seasnakes. In the *Biology of Seasnakes*. 355-384. University of Park Press, Baltimore, London and Tokyo.
- Hightower M M. Gritz L A. Luke-Hanlin A. Covan J. Tieszen S. Wellman, G. Irwin M. Kaneshige M. Melof B. Morrow C. and Ragland D. 2004. Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water. Sandia National Laboratories, Albuquerque, New Mexico.
- Hodgson A. J. 2004. Dugong Behaviour and Responses to Human Influences. PhD thesis. School of Tropical Environment Studies and Geography. James Cook University, Townsville, Queensland.
- Hodgson A.J. 2007. The Distribution, Abundance and Conservation of Dugongs and Other Marine Megafauna in Shark Bay Marine Park, Ningaloo Marine Park and Exmouth Gulf. Report to Department of Environment and Conservation, Perth, Western Australia.
- Hodgson G. 1990. Tetracycline Reduces Sedimentation Damage to Coral. *Marine Biology* 104, 493-496.
- Holley D.K. and Prince R.I.T. 2008. Historical Datasets of Dugong (*Dugong dugon*) Observations in the Kimberley Region of Western Australia. pp. 25. Edith Cowan University and DEC.
- Hondo. H. 2005. Lifecycle GHG emission analysis of power generation systems: Japanese case. *Energy* 30 (2005): 2042-2056.
- Honkoop P.J.C., Pearson G.B., Lavaleye M.S.S. and Piersma T. 2006. Spatial Variation of the Intertidal Sediments and Macrozoobenthic Assemblages Along Eighty-mile Beach, North-western Australia. *Journal of Sea Research* 55(4), 278-291.
- Hooper and Ekins 2004 - Hooper, J. and Ekins, M. 2004. Collation and validation of museum collection databases related to the distribution of marine sponges in Northern Australia (Contract National Oceans Office C2004/020). Unpublished Report to the National Oceans Office, Queensland Museum, Brisbane. 206pp.
- Hooper J.N.A. 1988. Character Stability, Systematics and Affinities Between Microcionidae (Poecilosclerida) and Axinellida (Porifera: Demospongiae). A revision of the Australasian Microcionidae. PhD Thesis. University of Queensland, Brisbane, Queensland. 1208 pp. 43 pls.
- Horizon Power 2006, available from: <http://www.horizonpower.com.au/> [17 March 2009].
- Hughes G.R. and Oxley-Oxland R. 1971. A Survey of Dugong (*Dugong dugon*) in and around Antonio Enes, Northern Mozambique. *Biological Conservation* 3, 299-301.
- Huisman J.M., Phillips J.C., Freshwater D.W. 2009. Rediscovery of *Gelidiella ramellosa* from near the Type Locality in Western Australia. *Cryptogamie Algologie* 30, 1–14.
- Hutchings P.A., Hilliard R.W. and Coles S.L. 2002. Species Introductions and Potential for Marine Pest Invasions into Tropical Marine Communities, with Special Reference to the Indo-Pacific. *Pacific Science* 56(2), 223–233.
- Hutchins J.B. 1995. Fishes. In: Wells F.E. Hanley J.R. and Walker D.I. (eds). Marine Biological Survey of the Southern Kimberley, Western Australia. pp 137-149 Unpublished report, Western Australian Museum, Perth, Western Australia.
- Hutchins J.B. 2003. Checklist of Marine Fishes of the Dampier Archipelago, Western Australia. In: Wells F.E. Walker D.I. and Jones D.S. (eds) The Marine Flora and Fauna of Dampier, Western Australia. Vol. 2. pp. 453–478. Western Australian Museum, Perth, Western Australia.
- Iglesias J.I.P, Navarro E., Alvarez P. and Armentia I. 1992. Feeding, Particle Selection and Absorption in Cockles *Cerastoderma edule* Exposed to Variable Conditions of Food Concentration and Quality. *Journal of Experimental Marine Biology and Ecology* 162(2), 421-454.

IMCRA Technical Group. 2006. Interim Marine and Coastal Regionalisation for Australia. An Ecosystem Based Classification for Marine and Coastal Environments, V 4.0. Commonwealth of Australia 2006.
<http://www.environment.gov.au/coasts/mbp/publications/imcra/imcra-4.html>.

Immel R.A. 1995. Shhh...Those Peculiar People Are Listening. *Smithsonian Magazine* 26(1), 151-160.

Inoue S., Oshima Y., Nagai K., Yamamoto T., Go J., Kai N. and Tsuneo H. 2004. Effect of Maternal Exposure to Tributyltin on Reproduction of the Pearl Oyster (*Pinctada fucata martensii*) *Environmental Toxicology Chemistry* 23, 1276–1281.

In-Situ Marine Optics (IMO). 2010. James Price Point Background Light Attenuation Study and MODIS Algorithm Development. Unpublished Report prepared for Woodside Energy Ltd.

INPEX. 2008. Presentation at the Northern Development Taskforce Site Evaluation Workshop. Broome, WA. 24 July 2008.

Intergovernmental Panel on Climate Change (IPCC). 2007. IPCC Fourth Assessment Report: Climate Change 2007 (AR4). Available at http://www.ipcc.ch/publications_and_data/publications_and_data_reports.htm#1.

International Association for Impact Assessment (IAIA). 2003. Social impact assessment: International principles. IAIA Special Publication Series No. 2, May 2003.

International Risk Consultants Pty Ltd. 2007. Petroleum and Minerals Industries in the Northwest Marine Region: A Report to the Department of the Environment, Water, Heritage and the Arts. October 2007. Accessed via <http://www.environment.gov.au/coasts/mbp/publications/north-west/nw-petroleum-minerals.html> on (13) November 2009.

IUCN 2009. IUCN Red List of Threatened Species Version 2009. [Online]. www.iucnredlist.org [16/12/2009].

International Whaling Commission (IWC). 2008. Country Report on Ship Strikes - Australia (IWC/62/CC4) Submitted by the Government of Australia to the IWC Conservation Committee.

Irvine T. and Keesing J. 2009. Identification of Epi-benthic Sled Samples from the Dampier Peninsula and Gourdon Bay, Kimberley Region, Western Australia. CSIRO. Prepared for Woodside Energy Ltd.

Isono RS, Kita J, Setoguma T (1998) Acute Effects of Kaolinite Suspension on Eggs and Larvae of Some Marine Teleosts. *Comp Biochem Phys C* 130:449–455.

Jackson J. A. 1983. Possible Effects of Excessive Noise on Red-cockaded Woodpeckers. Paper presented at the Red-cockaded Woodpecker Symposium II Proceedings, Panama City, Florida.

Jackson J. 2005. Is There a Relationship Between Herbaceous Species Richness and Buffel Grass (*Cenchrus ciliaris*) *Austral Ecology* 30, 505-517.

James N.P., Bone Y., Kyser T.K., Dix G.R. and Collins L.B. 2004. The Importance of Changing Oceanography in Controlling Late Quaternary Carbonate Sedimentation on a High-energy, Tropical, Oceanic Ramp, Northwestern Australia. *Sedimentology* 51(6), 1179–1205.

Jenner K.C.S., Jenner M-N.M. and McCabe K.A. 2001. Geographical and Temporal Movements of Humpback Whales in Western Australian Waters. *Appea Journal*. 2001, 749-765. <http://www.cwr.org.au/publications/appea2001>.

Jenner C. and Jenner M. 2009. Draft Humpback Whale Distribution and Abundance in the Nearshore SW Kimberley During Winter 2008 Using Aerial Surveys. Unpublished report for Woodside Energy Ltd. [**Appendix C-11**].

Jensen A S and Silber G K 2003. Large whale ship strike database. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. Technical Memorandum NMFS-OPR-. 37 pp.

Jones D.S. 1992. Barnacles (Cirrepedia) In: Morgan G.J. (ed). Survey of the Aquatic Fauna of the Kimberley Islands and Reefs, Western Australia. Western Australian Museum, Perth, Western Australia.

Jones D.S. and Hewitt M.A. 1997. Barnacles (Cirrepedia). In: Walker D.I. (ed). Marine Biological Survey of the Central Kimberley Coast, Western Australia. University of Western Australia, Perth, Western Australia.

Jones J. B. 2006. Why Won't They Grow? – Inhibitory Substances and Mollusc Hatcheries. *Aquaculture International* 14: 395-403.

Jutson J.T. 1950. The Physiography (Geomorphology) of Western Australia. Geological Survey of Western Australia. Bulletin: 95.

Kadar Pearson and Partners (KPP) Business Development. 2009. Tourism Impact Assessment – Kimberley Liquefied Natural Gas (LNG) Project. Report commissioned by Tourism Western Australia, in partnership with the Western Australian Department of State Development. **[Appendix D-5]**.

Kahn, K. and O'Faircheallaigh, C. 2010. Indigenous Impacts Report Volume3: Aboriginal Social Impact Assessment: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome and Griffiths University, QLD, 3 September 2010. (ASIA Volume 3: Impacts). **[Appendix E-3]**.

Karakassis I. Tsapakis M. Hatziyanni E. Papadopoulou KN. and Plaiti W 2000. Impact of cage farming of fish on the seabed in three Mediterranean coastal areas. *Journal of Marine Science* 57, 1462-1471.

Kasamatsu F., Joyce G.G., Ensor P. and Mermoz J. 1996. Current Occurrence of Baleen Whales in Antarctic Waters. Reports of the International Whaling Commission. 46:293-304.

Kay J J and Regier H A 2000. Uncertainty, complexity, and ecological integrity: Insights from an ecosystem approach. In Crabbe, P. (ed.). Implementing Ecological Integrity. Kluwer Academic.

Keighery B.J. 1994. Bushland Plant Survey. A Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc.), Perth, Western Australia.

Kenneally K.F. and Western Australian Department of Conservation and Land Management (Kenneally and CALM). 2006. Common Plants of the Kimberley. Department of Conservation and Land Management, Perth, Western Australia.

Kenneally K.F., Edinger D.C. and Willing T. 1996. Broome and Beyond. Plants and People of the Dampier Peninsula, Kimberley, Western Australia. Department of Conservation and Land Management, Perth, Western Australia.

Kimberley Development Commission (KDC). 2006. Kimberley Economic Perspective. Government of Western Australia, Perth, Western Australia.

Kimberley Development Commission (KDC). 2008. The Kimberley – An Economic Profile, August 2008 [Online]. http://www.kdc.wa.gov.au/documents/kdc/KDC_Economic_Profile_August08.pdf. [06/03/2010].

Kimberley Development Commission (KDC). 2009. Kimberley Development Commission, available from: <http://www.kdc.wa.gov.au/> [2 February 2009].

Kimberley Land Council, (KLC). 2008. Hydrocarbon Processing in the Kimberley Region: Laying the Foundations for an Aboriginal Social Impact Assessment: Confidential Report. KLC, Broome.

Kimberley Land Council, (KLC). 2010a. Indigenous Impacts Report Volume1: Overview and Consolidated Recommendations, Indigenous Impacts Report: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome, 3 September 2010. (ASIA Volume 1: Overview). **[Appendix E-1]**.

Kimberley Land Council. (KLC). 2010b. Indigenous Impacts Report Volume 4: Report on Heritage Impact Assessment: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome, 7 September 2010. (ASIA Volume 4: Heritage Impacts Report). **[Appendix E-4]**.

Kimberly TAFE. 2008. Annual Report 2008, Kimberley TAFE, Broome.

Kirk, J.T.O. 1994. Light and photosynthesis in aquatic ecosystems. 2nd ed. Cambridge: Cambridge University Press.

- Kline D.I., Kuntz N.M., Breithart M., Knowlton N. and Rohwer F. 2006. Role of Elevated Organic Carbon Levels and Microbial Activity in Coral Mortality. *Marine Ecology Progress Series* 314:119-125.
- Knowlton A.R. and Kraus S.D. 2001. Mortality and Serious Injury of Northern Right Whales (*Eubalaena glacialis*) in the Western North Atlantic Ocean. *Journal of Cetacean Research and Management Special Issue 2*, 193-208.
- Kojis BL and Quinn NJ, 1984. Seasonal and depth variation in fecundity of *Acropora palifera* at two reefs in Papua New Guinea. *Coral Reefs* 3, 165 – 172.
- Kuo J and den Hartog C 2006. Seagrass Morphology, Anatomy, and Ultrastructure. In: Larkum A W D. Orth R J. and Duarte CM. (Eds.) *Seagrass: Biology, Ecology and Conservation*. Springer, pp. 51–87.
- Kwan D. 2002. Towards a Sustainable Indigenous Fishery for Dugongs in Torres Strait: A Contribution of Empirical Data and Process. Unpublished PhD thesis. James Cook University, Townsville, Queensland.
- Laist D. W., Knowlton A. R., Mead J. G., Collet A. S. and M. Podesta. 2001. Collisions Between Ships and Whales. *Marine Mammal Science* 17, 35-75.
- Lancellotti D A and Stotz W B. 2004. Effects of shoreline discharge of iron mine tailings on a marine soft-bottom community in northern Chile. *Marine Pollution Bulletin* 48,303-312.
- Landgate. 2010. Firewatch. Western Australian Land Authority, Western Australia, Perth. [Online]. <http://firewatch.landgate.wa.gov.au/> [07/07/2010].
- Larcombe P., Ridd P.V., Prytz A. and Wilson B. 1995. Factors Controlling Suspended Sediment on Inner-shelf Coral Reefs, Townsville, Australia. *Coral Reefs* 14(3), 163-171.
- Larkin R.P. 1994. Effects of Military Noise on Wildlife: A Literature Review. Centre for Wildlife Ecology, Illinois Natural History Survey.
- Lawler I. Marsh H B. McDonald and Strokes T. 2002. Current state of knowledge: dugongs in the Great Barrier Reef. CRC Reef Research Centre. Townsville.
- Laws A. 1991. Broome, Western Australia, 1:250,000 Hydrogeological Series Explanatory Notes.
- Legge, S, Murphy S, Heathcote J, Flaxman E, Augusteyn J and Crossman M. 2008. The short-term effects of an extensive and high-intensity fire on vertebrates in the tropical savannas of the central Kimberley, northern Australia. *Wildlife Research*, 35: 33-43 (also published by CSIRO).
- Lenhardt M.L. 1982. Bone Conduction Hearing in Turtles. *Journal of Auditory Research* 22, 153-160.
- Lenhardt M.L. and Harkins S.W. 1983. Turtle Shell as an Auditory Receptor. *Journal of Auditory Research* 23, 251-260.
- Lenhardt M.L., Bellmund S., Byles R.A., Harkins S.W. and Musick J.A. 1983. Marine Turtle Reception of Bone Conducted Sound. *Journal of Auditory Research* 23, 119-125.
- Limpus C.J., Parmenter C.J., Baker V. and Fleay A. 1983. The Flatback Turtle, *Chelonia depressa*, in Queensland: Post-Nesting Migration and Feeding Ground Distribution. *Australian Wildlife Research* 10, 557-561.
- Limpus C.J., Miller J.D., Parmenter C.J., Reimer D., McLachlan N. and Webb R. 1992. Migration of Green (*Chelonia mydas*) and Loggerhead (*Caretta caretta*) Turtles to and from Eastern Australian Rookeries. *Wildlife Research* 19, 347-358.
- Limpus C.J. 2002. Western Australian Marine Turtle Review. Queensland Environmental Protection Agency, Brisbane, Queensland.
- Limpus C.J. 2004. A Biological Review of Australian Marine Turtles. Department of Environment and Heritage and the Queensland Environmental Protection Agency, Brisbane, Queensland.

- Limpus C.J. 2007. A Biological Review of Australian Marine Turtle Species. 5. Flatback Turtle, *Natator depressus* (Garman). Queensland Environmental Protection Agency, Brisbane, Queensland.
- Limpus, C.J. 2008a. A Biological Review of Australian Marine Turtle Species. 1. Loggerhead Turtle, *Caretta caretta* (Linnaeus). Environmental Protection Agency, Brisbane, Queensland.
- Limpus, C.J. 2008b. A Biological Review of Australian Marine Turtle Species. 2. Green Turtle, *Chelonia mydas* (Linnaeus). Environmental Protection Agency, Brisbane, Queensland.
- Limpus, C.J. 2009a. A biological review of Australian marine turtle species. 3. Hawksbill turtle, *Eretmochelys imbricata* (Linnaeus). Environmental Protection Agency, Brisbane, Queensland.
- Limpus, C.J. 2009b. A biological review of Australian marine turtle species. 6. Leatherback turtle, *Dermochelys coriacea* (Linnaeus). Environmental Protection Agency, Brisbane, Queensland.
- Lindenmayer D. and Burgman M. 2005. Practical Conservation Biology. CSIRO Publishing, Australia.
- Lloyd D.S. 1987. Turbidity as a Water Quality Standard for Salmonid Habitats in Alaska. *North American Journal of Fisheries Management* 7, 34-35.
- Longstaff B J and Loneragan N R O 1999. The effects of light deprivation on the survival and recovery of the seagrass *Halophila ovalis*. *Journal of Experimental Marine Biology and Ecology* 234, 1–27.
- López-Mendilaharsu M., Sales G., Giffoni B., Miller P., Niemeyer Fiedler F. and Domingo A. 2007. Distribución y composición de tallas de las tortugas marinas (*Caretta caretta* y *Dermochelys coriacea*) que interactúan con el palangre pelágico en el Atlántico Sur. *Collect. Vol. Sci. Pap. ICCAT*. 60, 2094-2109.
- Lourie S.A., Vincent A.C.J. and Hall H.J. 1999. Seahorses: An Identification Guide to the World's Species and their Conservation. Project Seahorse, London, United Kingdom.
- Lukoschek V., Waycott M. and Marsh H. 2007. Phylogeography of the Olive Sea Snake, *Aipysurus laevis* (Hydrophiinae) Indicates Pleistocene Range Expansion Around Northern Australia but Low Contemporary Gene Flow. *Molecular Ecology* 16(16), 3406-3422.
- Luning And Dring 1979 - Lüning, K. and M. J. Dring 1979. Continuous underwater light measurements near Helgoland (North Sea) and its significance for characteristic light limits in the sublittoral region. *Helgoländer wissenschaftliche Meeresuntersuchungen* 32:403- 424.
- Lutcavage M.E., Plotkin P.T., Witherington B. and Lutz P.L. 1996. Human Impacts on Sea Turtle Survival. In Lutz, P.L. and Musick J.A. (eds). *The Biology of Sea Turtles*. pp. 387-409. CRC Press, Boca Raton, Florida.
- Machin and Kolkovski. 2004. Identification and Evaluation of Sites for the Development of Large Scale, Land Based Marine Aquaculture in Western Australia. *DOF Occasional Publication* 13. 68pp.
- Madsen P.T., Johnson M., Miller P.J.O., Aguilar Soto N., Lynch, J. and Tyack P. 2006. Quantitative Measures of Airgun Pulses Recorded on Sperm Whales (*Physeter macrocephalus*) Using Acoustic Tags During Controlled Exposure Experiments. *Journal of Acoustical Society of America* 120(4), 2366–2379.
- Magvelashvili N., Andrewartha J., Condie S., Herzfeld M., Parslow J., Sakov P. and Waring J. 2006. North West Shelf Joint Environmental Study: Modeling Suspended Sediment Transport on Australia's North West Shelf. *CSIRO Technical Report No. 7*.
- Main Roads WA. 2009. Design Standards and Guidelines [Online]. <http://www.standards.mainroads.wa.gov.au>. [11/03/2010].
- Maio, A. D., Ricci, G., & Tesauro, M. (2001). On CFAR detection of oil slicks on the ocean surface by multifrequency and/or multipolarization SAR. In *Radar conference, 2001. Proceedings of the 2001 IEEE* (pp. 351– 356).

Marchesan M., Spoto M., Ferrero E.A. 2009. Impact of Artificial Light on Behavioural Patterns of Coastal Fishes of Conservation Interest. *Varstvo Narave* 22, 117-136.

Margetts, V. & Grabasch, G. (UDLA). 2010a. Indigenous Impacts Report Volume 6: Ethnobiological Report, James Price Point: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome, 2010. (ASIA Volume 6.1: Ethnobiological Report – Final). [**Appendix E-6**].

Margetts, V. & Grabasch, G. (UDLA). 2010b. Legal Requirements, Marine Species Invasion Table & Mitigation Management Measures: Final Report to the Kimberley Land Council. Kimberley Land Council, Broome, 3 September 2010. (ASIA Volume 6.2: Ethnobiological Report Appendix A – Draft). [**Appendix E-7**].

Margvelashvili N. Herzfeld M. and Webster I. 2006. Modelling of fine sediment transport in Fitzroy Estuary and Keppel Bay. Technical Report No. 39, CRC for Coastal Zone, Estuary and Waterway Management, Brisbane.

Markager and Sand-Jensen 1992 - Markager S, Sand-Jensen K (1992) Light requirements and depth zonation of marine macroalgae. *Marine Ecological Progress Series*. Vol 88: 83–92.

Marsh H. 1991. The Use of Carrier Species for Identifying and Selecting Protected Areas in the Marine Environment. Australian Mammal Society Annual Meeting, Brisbane, Queensland.

Marsh H. 1992. Biological Basis for the Management of Dugongs and Other Large Vertebrates in the Great Barrier Reef Marine Park. Great Barrier Reef Marine Park Authority Technical Report.

Marsh H., Prince R.I.T., Saalfel, W.K. and Shepherd R. 1994. The Distribution and Abundance of the Dugong in Shark Bay. *Wildlife Research* 21, 149-161.

Marsh H. 1999. Reproduction in Sirenians. pp. 243–256. In: Reynolds J.E. and Rommel S.A. (eds). *Biology of Marine Mammals*. Smithsonian Institution Press, Washington D.C.

Marsh, H. and Lawler, I. 2001. Dugong distribution and abundance in the southern Great Barrier Reef Marine Park and Hervey Bay: Results of an aerial survey in October-December 1999. Report to Great Barrier Reef Marine Park Authority, Townsville, Australia.

Marsh H., Penrose H., Eros C. and Hugues, J. 2002. Dugong: Status Reports and Action Plans for Countries and Territories. Early Warning and Assessment Report Series [Online].
<http://www.tesag.jcu.edu.au/dugong/doc/dugongactplan.pdf>.

Marsh H. Penrose H. and Eros C. 2003. A Future for the Dugong. pp. 383-399. In: Gales N. Hindell M. and Kirkwood R. (eds) *Marine Mammals: Fisheries, Tourism & Management Issues*. CSIRO Publishing. Victoria.

Marsh H., Arnold P., Freeman M., Haynes D., Laist D., Read A., Reynolds J. and Kasuya T. 2003. Strategies for Conserving Marine Mammals. pp. 1-19. In: Gales N. Hindell M. and Kirkwood R. (eds). *Marine Mammals: Fisheries, Tourism and Management Issues*. CSIRO Publishing, Melbourne, Victoria.

Marsh H., Lawler I., Kwan D., Delean J., Pollock K. and Alldredge M. 2004. Dugong Distribution and Abundance in Torres Strait. Australian Fisheries Management Authority Torres Strait Research Program Final Report. AFMA, Canberra, ACT.

Martin R.A. 2005. Conservation of Freshwater and Euryhaline Elasmobranchs: A Review. *Journal of the Marine Biological Association of the United Kingdom* 85, 1049-1073.

Masini R., Sim C., Simpson C., McKenzie M., Start T., Burbidge A., Kenneally K. and Burrows N. 2009. A Synthesis of Scientific Knowledge to Support Conservation Management in the Kimberley Region of Western Australia. Draft Report. Department of Environment and Conservation, Perth, Western Australia.

May J.E. and McKenzie N.L. (eds). 2003. A Biodiversity Audit of Western Australia's Biogeographical Subregions in 2002. Department of Environment and Conservation, Perth, Western Australia.

- McCauley R.D. 2008. Scott Reef Sea Noise Logger Recovery September 2008 and Analysis of Drilling Noise. Report for SKM/Woodside Energy by Centre for Marine Science and Technology (CMST). Project CMST 639-2, 688 and 790. Report No. R2008-46. Unpublished.
- McCauley R.D. and Salgado-Kent C. 2008. Sea Noise Logger Deployment 2006-2008 Scott Reef – Whales, Fish and Seismic Surveys. Report for URS/Woodside Energy by Centre for Marine Science and Technology (CMST). Project CMST 639-2 and 688. Report No. R2008-36. Unpublished.
- McCauley R.D., Fewtrell J., Duncan A.J., Jenner C., Jenner M.N., Penrose J.D., Prince R.I.T., Adhitya A., Murdoch J. and McCabe K. 2000. Marine Seismic Surveys - a Study of Environmental Implications. *APPEA Journal* pp. 692-708.
- McCauley, R. D., Jenner, M-N., Jenner, C., McCabe, K. A., & Murdoch, J. (1998). The response of humpback whales (*Megaptera novaeangliae*) to offshore seismic survey noise: Preliminary results of observations about a working seismic vessel and experimental exposures. *Australian Petroleum Production and Exploration Association Journal*, 38, 692-707.
- McCauley, R. D., Fewtrell, J., Duncan, A. J., Jenner, C., Jenner, M-N., Penrose, J. D., et al. (2000). Marine seismic surveys: A study of environmental implications. *Australian Petroleum Production and Exploration Association Journal*, 40, 692-708.
- McGilvray A. 2008. Conserving Dampier Peninsula's Vulnerable Vine Thickets. 2008 WA NRM Conference Bridgetown: Submission to Tech Talk Lounge [Online]. Available at http://www.environskimberley.org.au/weeds/NRM_Conference08_Dampier_Peninsula_paper_Feb08_final.pdf.
- McKenzie D.J., Pedersen P.B. and Jokumsen A. 2007. Aspects of Respiratory Physiology and Energetics in Rainbow Trout (*Oncorhynchus mykiss*) Families with Different Size-at-age and Condition Factor. *Aquaculture* 263(1-4), 280-294.
- McKenzie N.L., May J.E. and McKenna S (eds). 2003. Bioregional Summary of the 2002 Biodiversity Audit for Western Australia. Department of Conservation and Land Management, Perth, Western Australia.
- Meager, J.J.; Domenici, P.; Shingles, A. and Utne-Palm, A.C. (2006). Escape responses in juvenile Atlantic cod (*Gadus morhua*): the effect of turbidity and predator velocity. *Journal of Experimental Biology*. 209: 4174-4184.
- Menge B. 2000. Top-down and Bottom-up Community Regulation in Marine Rocky Intertidal Habitats. *Journal of Experimental Marine Biology and Ecology* 250, 257-289.
- Menkhorst P. and Knight F. A. 2004. Field Guide to the Mammals of Australia (2nd ed). Oxford University Press, South Melbourne, Victoria.
- Meuleners M., Ivey G.N., Fringer O. and Van Gastel P. 2009. Tidally Generated Internal Waves on the Australian North West Shelf. *J. Cont. Shelf Res.* Submitted.
- Miller, G. W., Moulton, V. D., Davis, R. A., Holst, M., Millman, P., MacGillivray, A., 2005. Monitoring seismic effects on marine mammals – southeastern Beaufort Sea, 2001-2002. In S. L. Armsworthy, P. J. Cranford, & K. Lee (Eds.), *Offshore oil and gas environmental effects monitoring: Approaches and technologies* (pp. 511-542). Columbus, OH: Battelle Press.
- Miller J., Maragos J., Brainard R., Asher J., Vargas-Angel B., Kenyon J., Schroeder R., Richards B., Nadon M., Vroom P., Hall A, Keenan E., Timmers M., Gove J., Smith E., Weiss J., Lundblad E., Ferguson S., Lichowski F., and Rooney J. (2008). The State of Coral Reef Ecosystems of the Pacific Remote Island Areas. pp. 353-386.
- Miner, G. J. and Stein, R. A. (1993). Interactive influence of turbidity and light on larval bluegill (*Lepomis macrochirus*) foraging. *Canadian Journal of Fisheries and Aquatic Sciences* 50: 781-788.
- Miner J.G, Stein R.A 1996 Detection of predators and habitat choice by small bluegills: effects of turbidity and alternative prey. *Trans. Am. Fish. Soc.* 125, 97–103.
- MMS. 2007. Seismic Surveys in the Beaufort and Chukchi Seas, Alaska. Draft Programmatic Environmental Impact Statement. OCS EIS/EIA MMS 2007-001.

Morgan, G.J. (1992). Decapod Crustaceans. In Morgan, G.J. (ed.), Survey of the Aquatic Fauna of the Kimberley Islands and Reefs, Western Australia. Report of the Western Australian Museum Kimberley Island and Reefs Expedition, August 1991: 44–49. Western Australian Museum, Perth.

Morgan D.L., Whitty J.M., Phillips N.M. 2009. Endangered Sawfishes and River Sharks in Western Australia. Centre for Fish and Fisheries Research, Murdoch University. Report to Woodside Energy Limited. **[Appendix C-7]**.

Moritz C., Broderick D., Dethmers K., Fitzsimmons N. and Limpus C. 2002. Population Genetics of Southeast Asian and Western Pacific Green Turtles, *Chelonia mydas*. Report for Convention on the Conservation of Migratory Species of Wild Animals: Bonn 20th June.

Mscience. 2007. Cape Lambert Upgrade Dredging Program 2007 - Evaluation of Coral Health Monitoring. MScience Pty Ltd, Perth, Western Australia.

MScience. 2008. Water quality during dredging for the Pluto LNG Project in the predicted high impact zone (Zone A). Report Prepared by Edith Cowan University. Report No. 2008-04.

MScience. 2010. Pluto LNG Development – An evaluation of dredging impacts on coral -November to February 2010. Unpublished report MSA145R1 by MScience Pty Ltd to Woodside Burrup Pty Ltd, MSA101R6, Perth, WA

Muscatine, L. 1990. The Role of Symbiotic Algae in Carbon and Energy Flux in Reef Corals. In: Z. Dubinsky (ed) Coral Reefs, Ecosystems of the World. Elsevier. Amsterdam. pp. 75-84.

Musick (Eds.) The Biology of Sea Turtles. CRC Press, Boca Raton, Florida, USA.

Mustoe, S. and Edmunds, M. 2008. Coastal and Marine Natural Values of the Kimberley. WWF Australia, Sydney, NSW.

Myrberg, A.A. Jr. 1978. Underwater Sound: Its Effects on the Behaviour of Sharks pp. 392 – 417. In E.S. Hodgson and R.F. Mathewson (eds.). Sensory Biology of Sharks, Skates and Rays. Office of Naval Research, Arlington.

National Environment Protection Council (NEPC). 2003. National Environment Protection (Ambient Air Quality) Measure 2003.

National Environment Protection Council (NEPC). 2004. National Environment Protection (Air Toxics) Measure 2004.

Natural Gas Supply Association (NGSA). 2010. Overview of Natural Gas – Background. [25 November 2010]
<http://www.naturalgas.org/overview/background.asp>.

National Tidal Centre. 2009. The Australian Baseline Sea Level Monitoring Project. Annual Sea Level Data Summary Report. National Tidal Centre of the Australian Bureau of Meteorology. Kent Town, South Australia.

Nedwell, J.R., Edwards B., Turnpenny A.W.H. and Gordon J. 2004. Fish and Marine Mammal Audiograms: A Summary of Available Information. Subacoustech report ref. 534R0214. Submitted to Chevron Texaco Ltd. 278 pp.

Newman S.J., Young G.C. and Potter I.C. 2003. Characterisation of the Inshore Fish Assemblages of the Pilbara and Kimberley Coasts. FRDC final report project 2000/132.

Nightingale B. and Simenstad C.A. 2001. Dredging Activities: Marine Issues. White Paper, Research Project T1803, Task 35, Overwater Whitepaper. University of Washington. Seattle. Washington. 98195.

Northcote, K. H. with Beckmann, G. G., Bettenay, E., Churchward, H. M., Van Dijk, D. C., Dimmock, G. M., Hubble, G. D., Isbell, R. F., McArthur, W. M., Murtha, G. G., Nicolls, K. D., Paton, T. R., Thompson, C. H., Webb, A. A. and Wright, M. J. (1960-1968). Atlas of Australian Soils, Sheets 1 to 10. With explanatory data (CSIRO Aust. and Melbourne University Press: Melbourne).

Northern Development Taskforce (NDT). 2008a. Site Selection Methodology and Draft Site Selection Criteria. Northern Development Taskforce, Perth, Western Australia. **[Appendix B-2]**.

Northern Development Taskforce (NDT), 2008b. Site Selection Evaluation Report Part A. Northern Development Taskforce, Perth, Western Australia. [Appendix B-3].

Northern Development Taskforce (NDT). 2008c. Site Evaluation Report Part B, Department of Industry and Resources, Perth, September 2008. [Appendix B-4].

Northern Development Taskforce (NDT). 2008d. Final Site Evaluation Report December 2008, Department of Industry and Resources, Perth, WA. [Appendix B-6].

Northern Territory Department of Natural Resources, Environment and the Arts (NRETA). 2007. Threatened Species of the Northern Territory. Brush-tailed Rabbit Rat *Conilurus penicillatus*.

Northern Territory Seafood Council (NTSC). 2010. Protected Species Awareness Information for Commercial Fishing Operations- Dugongs [online] http://www.ntsc.com.au/pdfs/interactions_with_dugong.pdf Accessed 17th August 2010.

Noss R F 1991. Landscape connectivity: different functions and different scales. Pages 27-39 in W E Hudson (ed). Landscape linkages and biodiversity. Island Press, Washington, D.C. USA.

Nowacek D.P., Thorne L.H., Johnston D.W. and Tyack P.L. 2007. Responses of Cetaceans to Anthropogenic Noise. *Mammalian Review* 37(2), 81-115.

NSW Environmental Protection Authority (2005). Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. Department of Environment and Conservation, Sydney, NSW.

Nyström, M., Folke, C. and Moberg, F. 2000. Coral reef disturbance and resilience in a human-dominated environment. *Trends in Ecology and Evolution* 15: 413-417.

O'Faircheallaigh, Ciaran, Professor of Politics and Public Policy, Griffith University and Twomey, Justine Legal Practitioner: Kimberley LNG Precinct Strategic Assessment, Indigenous Impacts Report Volume 2, Traditional Owner Consent and Indigenous Community Consultation: Final Report Kimberley Land Council, 3 September 2010: © 2010 Kimberley Land Council and Griffith University. (ASIA Volume 2: Consultation and Traditional Owner Consent). [Appendix E-2].

Ocean Studies Board (OSB). 2003: Ocean Noise and Marine Mammals: Committee on Potential Impacts of Ambient Noise in the Ocean on Marine Mammals. National Academies Press, Washington, DC.

Oxford Dictionaries Online: http://oxforddictionaries.com/view/entry/m_en_gb0173250#m_en_gb0173250.007.

PACE, 2009. Life Cycle Assessment of GHG Emissions from LMG and Coal Fired Generation Scenarios: Assumptions and Results. Report prepared by PACE Global Energy Services for the Centre for Liquefied Natural Gas, February 2009.

Palumbi, S. R. 2003. Population genetics, demographic connectivity, and the design of marine reserves. *Ecological Applications* 13:S146-S158.

Pedretti Y.M. and Paling E.I. 2001. WA Mangrove Assessment Project 1999-2000. Murdoch University, Perth, Western Australia.

Pendoley Environmental. 2005. Gorgon Development on Barrow Island: Sea Turtles Technical Report.

Pendoley K. 1997. Sea turtles and management of seismic programs in Western Australia, Pendoley Environmental. SA Journal. 25, 8-16.

Pendoley K. 2004. Sea Turtles and Industrial Activity on the North West Shelf, Western Australia. PhD Thesis. School of Biology and Biotechnology, Murdoch University, Perth, Western Australia.

Pendoley K. 2005. Sea Turtles and the Environmental Management of Industrial Activities in North-west Western Australia. PhD thesis, Murdoch University, Perth, Western Australia.

Perry C.T., Smithers S.G., Palmer S.E., Larcombe P., Johnson K.G. 2008. 1200 year Paleoecological Record of Coral Community Development from the Terrigenous Inner Shelf of the Great Barrier Reef. *Geology* 36, 691-694.

Philipp E. and Fabricius K. 2003. Photophysiological Stress in Scleractinian Corals in Response to Short-term Sedimentation. *Journal of Experimental Marine Biology Ecology* 287, 57-78.

Piersma T., Aelst R., van Kurk K., Berkhoudt H. and Maas L.R.M. 1998. A New Pressure Sensory Mechanism for Prey Detection in Birds: The Use of Principles of Seabed Mechanics? *The Royal Society* 265, 1377-1383.

Planning Western Australia. 1999. Shire of Broome Town Planning Scheme No. 4.
<http://www.planning.wa.gov.au/The+planning+system/Region+schemes/Local+planning+schemes/435.aspx>

Planning Western Australia. 2009. Pilbara Regional Profile, Department of Planning and Infrastructure, West Australian Government, Perth, Western Australia.

Playford, P. E., Cope, R. N., Cockbain, A. E., Low, G. H., and Lowry, D. C. 1975. Phanerozoic. *Memoires of the Geological Survey of Western Australia* 2:221-433.

Plumpton D.L. and Lutz R.S. 1993. Influence of Vehicular Traffic on Time Budgets of Nesting Burrowing Owls. *Journal of Wildlife Management* 57, 612-616.

Pogonoski J.J. and Pollard D. 2003. *Glyphis garricki*. In: IUCN 2009. IUCN Red List of Threatened Species Version 2009. [Online]. www.iucnredlist.org [16/12/2009].

Pogonoski J.J., Pollard D.A. and Paxton J.R. 2002. Conservation Overview and Action Plan for Australian Threatened and Potentially Threatened Marine and Estuarine Fishes 2002. Environment Australia, Australia.

Popper A.N. and Hastings M.C. 2009. The Effects on Fish of Human-generated (anthropogenic) Sound. *Integrative Zoology* 4, 43-52.

Popper A.N., Carlson T.J., Hawkins A.D., Southall B.L. and Gentry R.L. 2006. Interim Criteria for Injury of Fish Exposed to Pile Driving Operations: A White Paper.

Portlock C., Graham G., Done C., Gilmour J. and Williamson J. 2001. Kimberley Region Draft Regional. Management Plan. Unpublished.

Preen A. 1992. Interactions Between Dugongs and Seagrasses in a Subtropical Environment. PhD thesis. James Cook University of North Queensland, Townsville, Queensland.

Preen A. and Marsh H. 1995. Response of Dugongs to Large-scale Loss of Seagrass from Hervey Bay. Townsville, Queensland. *Wildlife Research* 22, 507-519.

Preen A.R., W.J. Long., R.G. Coles. 1995. Flood and Cyclone Related Loss and Partial Recovery of More than 1000 km² of Seagrass in Hervey Bay, Queensland, Australia. *Aquatic Botany* 52:3-17.

Preen A.R. 2001. Dugongs, Boats, Dolphins and Turtles in the Townsville-Cardwell Region and Recommendations for a Boat-traffic Management Plan for the Hinchinbrook Dugong Protection Area. Research Publication No. 67. Great Barrier Reef Marine Park Authority, Townsville, Queensland.

Prince R.I.T. 1984. Dugongs in Northern Waters of Western Australia. Unpublished report to the Australian National Parks and Wildlife Service.

Prince R.I.T. 1986. Dugong in Northern Waters of Western Australia 1984. Western Australian Department of Conservation and Land Management, Technical Report No. 7, Perth, Western Australia.

Prince R.I.T. 1994. Status of the Western Australian Marine Turtle Populations: The Western Australian Marine Turtle Project 1986–1990. pp. 1–14. In: Proceedings of the Australian Marine Turtle Conservation Workshop. Gold Coast. 14–17 November 1990.

Pruitt, E. and Krull R.C. 2002. The Effects of *Noise* on Birds of Prey: A Study of *Peregrine. Falcons* in Alaska, U.S. Air Force Research Laboratory, Report No. AFRL-HE-WP-TR-. 2002-0190.

Public Health Information Development Unit (PHIDU). 2005. Population health profile of the Kimberley Division of General Practice. Population Profile Series: No. 108. Public Health Information Development Unit (PHIDU), Adelaide, South Australia.

Ralph N., Hamaguchi, K. and Murray R. 2003. True Words - Real Life: A Study of the Social and Emotional Wellbeing of Young People in the Kimberley. Plain language report on the preliminary findings. Kimberley Aboriginal Medical Services Council, Broome, Western Australia.

Reid K, Watkins J, Croxall JP, Murphy EJ. 1999. Krill population dynamics at South Georgia 1991–1997 based on data from predators and nets. *Mar Ecol Prog Ser* 117:103–114.

Richardson W. J. 1995. Introduction. In *Marine mammals and noise*. Edited by WJ Richardson.

Richardson, W. J., Miller, G. W., & Greene, C. R., Jr. 1999. Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. *Journal of the Acoustical Society of America*, 106, 2281.

Ridgway S.H., Scronce B.L. and Kanwisher J. 1969. Respiration and Deep Diving in the Bottlenose Porpoise. *Science* 166,1651 -1654.

Ripley J.L. 2006. Effects of Environmental Factors on the Paternal Brood Pouch and Sound Production in Two Sympatric Pipefish Species from the Chincoteague Bay, Virginia. Dissertation submitted to the Eberly College of Arts and Sciences at West Virginia University. Department of Biology, Morgantown, West Virginia.

Robins C.M., Goodspeed A.M., Poiner I. and Harch B.D. 2002. Monitoring the Catch of Turtles in the Northern Prawn Fishery. Fisheries Research and Development Corporation. Department of Agriculture, Fisheries and Forestry, Canberra, ACT.

Rockwater Proprietary Limited. 2009. Assessment of Hydrogeology for LNG Precinct at James Price Point, West Kimberley, Western Australia. Prepared for Woodside Energy Limited. December 2009. **[Appendix C-22]**.

Roebuck Bay Working Group (RBWG). 2009. Roebuck Bay Interim Management Guidelines, Kimberley Land Council.

Rogers C. S. 1979. The Effects of Shading on Coral Reef Structure and Function. *Journal of Experimental Marine Biology and Ecology* 41, 269-288.

Rogers C.S. 1983. Sub-lethal and Lethal Effects of Sediments Applied to Common Caribbean Reef Corals in the Field. *Marine Pollution Bulletin* 14, 378-382.

Rogers D., Hassell C., Clemens R., Boyle A. and Rogers K. 2009. Monitoring Yellow Sea Migrants in Australia (MYSMA): North-western Australian shorebird surveys and workshops. December 2008.

RPS. 2010a. Humpback Whale Survey Report, Browse MMFS 2009. Prepared for Woodside Energy Ltd. **[Appendix C-8]**.

RPS. 2010b. Woodside Browse Turtle Technical Report, Ecology of Marine Turtles of the Dampier Peninsula and the Lacepede Island Group 2009 – 2010. Prepared for Woodside Energy Ltd. **[Appendix C-2]**.

RPS. 2010c. Nearshore Regional Survey Dugong Report, Browse MMFS 2009. Prepared for Woodside Energy Ltd. **[Appendix C-9]**.

RPS. 2010d. Marine Megafauna Report Browse MMFS 2009. Prepared for Woodside Energy Ltd. **[Appendix C-10]**.

Ruddock I. and Hassan L.Y. 2004. Mineral Deposits and Exploration Activity in the Kimberley. Geological Survey of Western Australia. Extended abstracts.

- Sakai, A. K., Allendorf, F.W., Holt, J.S., Lodge, D.M., Molofsky, J. With, K.A., Baughman, S., Cabin, R.J., Cohen, J.E., Ellstrand, N.C., McCauley, D.E., O'Neil, P.O., Parker, I.M., Thompson, J.N. and Weller, S.G. 2001. The Population Biology of Invasive Species. *Annual Review of Ecology and Systematics* 32: 305-332.
- Salmon M. 2005. Protecting Sea turtles from Artificial Night Lighting at Florida's Oceanic Beaches. In: Rich C. Longcore T. (eds). *Ecological Consequences of Artificial Night Lighting*. pp 141-168. Washington D.C. Island Press.
- Salmon M., Reiners R., Lavin C and Wyneken J. 1995. Behaviour of Loggerhead Sea Turtles on an Urban Beach. I. Correlates of Nest Placement. *Journal of Herpetology* 29, 560-567.
- Samuel Y., Morreale S.J., Clark C.W., Greene C.H. and Richmond M.E. 2005. Underwater, Low-frequency Noise in a Coastal Sea Turtle Habitat. *Journal of Acoustical Society of America* 117, 1465-1472.
- Sanchez-Camara J. and Booth D. 2004. Movement, home range and site fidelity of the weedy seadragon *Phyllopteryx taeniolatus* (Teleostei: Synnathidae). *Environmental Biology of Fishes* 70, 31-41.
- Sand-Jensen K. 1988. Photosynthetic responses of *Ulva lactuca* at very low light. *Marine Ecological Progressive Series* 50, 187-193.
- Save the Kimberley. 2010. *Save the Kimberley*, viewed 2 February 2010, <<http://www.savethekimberley.com/>>.
- Scherrer, P., Smith, A.J. & Dowling R. 2008. *Tourism and the Kimberley Coastal Waterways: a review of environmental and cultural aspects of expedition cruising along the Kimberley coast, Western Australia*. STCRC Press, Gold Coast, Australia.
- Scheidat, M., C. Castro, J. Gonzalez, & R. Williams. 2004. Behavioural responses of humpback whales (*Megaptera novaeangliae*) to whalewatching boats near Isla de la Plata, Machalilla National Park, Ecuador. *J. Cetacean Res. Manage.* 6:63-8.
- Seafarer Tides. 2008. Tide Predictions for Red Bluff. Produced by the Australian Hydrographic Service.
- Seaturtle Org. Barrow Island Flatback Tracking 2009-2010. [Online] http://www.seaturtle.org/tracking/?project_id=457
- Semeniuk V. 1980. Mangrove Zonation Along an Eroding Coastline in King Sound, North-Western Australia. *Journal of Ecology* 68(3), 789-812.
- Semeniuk V., Chalmer P.N. and Le Provost I. 1982. The Marine Environment of the Dampier Archipelago. *J R SOC WA* Vol 65 97-114.
- Seminoff J A. Resendiz A. and Nichols W J. 2002. Home range of the Green Turtle (*Chelonia mydas*) at a coastal foraging ground in the Gulf of California, México. *Marine Ecology Progress Series* 242, 253-265.
- Senko L., Koch V., Megill W., Carthy R., Templeton R. And Nichols W. 2010. Finescale Movements and Habitat Use of East Pacific Green Turtles at a Shallow Coastal Lagoon in Baja California Sur, Mexico. *Journal of Experimental Marine Biology and Ecology Series* 391:92-100.
- Shire of Broome, Engineering Services Department 2009. Guidelines for Design and Construction of Stormwater Drainage Systems, September 2009.
- Short A.D. 2006. Beaches of the Northern Australian Coast the Kimberley, Northern Territory and Cape York: A Guide to their Nature, Characteristics, Surf and Safety. University Press, Sydney, NSW.
- Shpigel M. and Fishelson L. 1989. Habitat Partitioning Between Species of the Genus *Cephalopholis* (Pisces, Serranidae) Across the Fringing Reef of the Gulf of Aqaba (Red Sea). *Marine Ecology Progress Series* 58, 17-22.
- Simmonds M.P., Dolman S.J. and Weilgart L. (eds). 2004. Oceans of Noise [Online]. http://www.wdcs.org/submissions_bin/OceansofNoise.pdf. A WDCC Science Report Published by the Whale and Dolphin Conservation Society.

- SKM. 2006. Pluto LNG Development. Draft Public Environment Report/Public Environmental Review. Report prepared for Woodside.
- SKM. 2008. Cape Lambert Port B Development: Dredging and Spoil Disposal Management Plan. Public Environmental Review.
- SKM. 2009a. Cape Lambert Port B: Public Environmental Review and Public Environmental Report. Report prepared for Rio Tinto.
- SKM. 2009b. Cape Lambert Port B Development Marine Water Quality Baseline Monitoring Report, pp. 60: Sinclair Knight Merz.
- SKM. 2009c. Draft Aerial Survey of Inshore Marine Megafauna along the Dampier Peninsula: Late Wet Season. Unpublished report for Woodside Energy Ltd.
- SKM. 2009d. Gigas 2D Pilot OBC MSS. Environmental Monitoring Program. Report for Woodside Energy Ltd.
- SKM 2010a. Nearshore benthic habitat modelling and mapping, James Price Point. Report for Woodside Energy Ltd. [Appendix C-5].
- SKM 2010b. James Price Point Intertidal Survey, Browse LNG Development. Report prepared for Woodside Energy Ltd. [Appendix C-3].
- SKM 2010c. Nearshore Marine Water Quality, Browse LNG Development. Report prepared for Woodside Energy Ltd.
- Smith N.M. 2002. Weeds of the Wet/Dry Tropics of Australia: A Field Guide. Environment Centre NT, Darwin, Northern Territory.
- Sodal A. 1999: Measured Underwater Acoustic Wave Propagation From a Seismic Source. In: Proceedings of the Airgun Environmental Workshop, London, July 6 1999.
- Soule M.E. (ed). 1987. Viable Populations for Conservation. Cambridge University Press, Cambridge, UK.
- Southall B.L., Bowles A.E., Ellison W.T., Finneran J.J., Gentry R.L., Greene Jr. C.R., Kastak D., Ketten D.R., Miller J.H., Nachtigall P.E., Richardson W.J., Thomas J.A. and Tyack P.L. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. *Aquatic Mammals*. 33, 411-521.
- Southgate P.C. and Lucas J.S. 2008. The Pearl Oyster. Elsevier Press.
- Spence J. 2007. A Summary of Existing and Future Potential Treatments for Reducing Underwater Sounds from Oil and Gas Industry.
- State Training Board 2009, *Western Australian State Training Profile 2009-2011*, Department of Education and Training, State of Western Australia, Perth.
- Stead D.G. 1963. Sharks and Rays of Australian Seas. Angus and Robertson, Sydney, NSW.
- Steffe A.S. Westoby M. and Bell J.D. 1989. Habitat Selection and Diet in Two Species of Pipefish from Seagrass: Sex Differences. *Marine Ecology Progress Series* 55, 23-30.
- Stevens J.D. Pillans R.D. and Salini J. 2005. Conservation Assessment of *Glyphis* sp. A (speartooth shark), *Glyphis* sp. C (northern river shark), *Pristis microdon* (freshwater sawfish) and *Pristis zijsron* (green sawfish). Final Report to the Department of Environment and Heritage. June 2005. CSIRO.
- Stevick P.T. 1999. Age-length Relationships in Humpback Whales: A Comparison of Strandings in the Western North Atlantic with Commercial Catches. *Marine Mammal Science* 15, 725-737.
- Stobutzki, I. C. and Bellwood, D. R. 1997. Sustained swimming abilities of the late pelagic stages of coral reef fishes. *Mar. Ecol. Prog. Ser.* 149, 35-41.

Stoddart J.A. and Anstee S. 2004. Water Quality, Plume Modelling and Tracking Before and During Dredging in Mermaid Sound, Dampier, Western Australia. In: Stoddart J.A. and Stoddart S.E. (eds). Corals of the Dampier Harbour: Their Survival and Reproduction During the Dredging Programs of 2004. MScience Pty Ltd., Perth, Western Australia pp 9-30.

Stowar M. 1997. Effects of Suspended Solids on Benthic Macroinvertebrate Fauna Downstream of a Road Crossing, Jim Jim Creek, Kakadu National Park. Internal report 244. Supervising Scientist. Canberra. Unpublished paper.

Stowar M., Cooper T. and Cappo M. 2009. Surveys of Fish-habitat Associations in the Region Offshore James Price Point. Part 2. Field operations report using Baited Remote Underwater Video Stations (BRUVS). Australia Institute of Marine Science.

Strain, R 2008, *Broome Residents Homelessness and Overcrowding Survey 2007*, Broome Circle, Broome.

Strickland J D H. 1958. Solar Radiation Penetrating the Ocean. A review of requirements, data and methods of measurement, with particular reference to photosynthetic productivity. *Journal of the Fisheries Research Board of Canada* 15, 453-493.

Susanto R.D., Gordon A.L. and Zheng Q. 2001. Upwelling Along the Coasts of Java and Sumatra and It's Relation to ENSO. *Geophysical Research Letters* 28, 1599-1602.

SVT 2009. Cape Lambert Port B Development Underwater Noise Assessment report. Prepared by SVT Engineering Consultants for Rio Tinto. August 2009.

SVT 2010. Downstream Browse Underwater Noise Assessment. Prepared by SVT Engineering Consultants for Woodside Energy, October 2010. **[Appendix C-12]**.

Szabo A.R. and Duffus D. 2007. Mother-offspring Association in the Humpback Whale (*Megaptera novaeangliae*): Following behaviour in an aquatic mammal. *Animal Behaviour* 75, 1085-1092.

Tanaka K. and Aoki M. 1998. Crustacean Infauna of the Demosponge *Halichondria okadai* (Kadota) with reference to the life cycle of *Gnathia* sp. (Isopoda: Gnathiidae). In: Watanabe Y. and Fusetani N. (eds). *Sponge Science: multidisciplinary perspectives*. Springer-Verlag. Tokyo. pp. 259–267.

Taylor, J. 2006. *Indigenous People in the West Kimberley Labour Market*, Centre for Aboriginal Economic Policy Research: Australian National University, Canberra.

Taylor, J. 2008. *Indigenous Labour Supply Constraints in the West Kimberley*, Centre for Aboriginal Economic Policy Research: Australian National University, Canberra.

Taylor J.J., Southgate P.C. and Rose R. A. 1997. Fouling Animals and their Effect on the Growth of Silver-lip Pearl Oysters, *Pinctada maxima* (Jameson) in Suspended Culture. *Aquaculture* 153, 31-40.

Telesnicki G.J. and Goldberg W.M. 1995. Effects of Turbidity on the Photosynthesis and Respiration of Two South Florida Reef Coral Species. *Bulletin of Marine Science* 57:527-539.

Terrados J. Borum J. Duarte C M. Fortes M D. Kamp-Nielsen L. Agawin N S R. and Kenworthy W J. 1999. Nutrient and mass allocation of South-east Asian seagrass. *Aquatic Botany* 63, 203–217.

Thiel M. 2000. Population and Reproductive Biology of Two Sibling Amphipod Species from Ascidians and Sponges. *Marine Biology* 137, 661- 674.

Thorburn D.C. and Morgan D.L. 2004. The Northern River Shark *Glyphis* sp. C (Carcharhinidae) Discovered in Western Australia. *Zootaxa* 685, 1-8.

Threatened Species Scientific Committee (TSSC) (2009). Commonwealth Conservation Advice on *Keraudrenia exastia* (Fringed Keraudrenia). [Online]. Department of the Environment, Water, Heritage and the Arts. Canberra, ACT: Department of the Environment, Water, Heritage and the Arts. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/66301-conservation-advice.pdf>.

Thulborn, R. A., Hamley, T. and Foulkes, P. 1994. Preliminary report on sauropod dinosaur tracks in the Broome Sandstone (Lower Cretaceous) of Western Australia. *Gaia* 10:85-94.

Titlyanov E.A. and Latypov Y.Y. 1991. Light-dependence in Scleractinian Distribution in the Sublittoral Zone of South China Sea Islands. *Coral Reefs* 10, 133-138.

Tomczak M. and Godfrey J. S. 1994. Regional Oceanography: An Introduction. Pergamon, Oxford.

Tourism WA. 2008. Development Commission Area Fact Sheet: Kimberley 2007 (published May 1998) [Online]. [http://www.tourism.wa.gov.au/Research_and_Statistics/Regional_Research_And_Statistics/Documents/Kimberley%20\(RDC\)%202007.pdf](http://www.tourism.wa.gov.au/Research_and_Statistics/Regional_Research_And_Statistics/Documents/Kimberley%20(RDC)%202007.pdf).

Travers M.J., Newman S.J. and Potter I.C. 2006. Influence of Latitude, Water Depth, Day v. Night and Wet v. Dry Periods on the Species Composition of Reef Fish Communities in Tropical Western Australia. *Journal of Fish Biology* 69, 987-1017.

Travers, M.J., Potter, I.C., Clarke, K.R., Newman, S.J., Hutchins, J.B. 2010. The Inshore Fish Faunas Over Soft Substrates and Reefs on the Tropical West Coast of Australia Differ and Change with Latitude and Bioregion. *Journal of Biogeography*. 37:148-169.

Trudgen, M.E. 1988. A Report on the Flora and Vegetation of the Port Kennedy Area. Unpublished report prepared for Bowman Bishaw and Associates, West Perth.

Tyack P. 2008. Large Scale Changes in the Marine Acoustical Environment and its Implications for Marine Mammals. *Journal of Mammalogy* 89, 549-558.

U.S. Environmental Protection Agency (USEPA). 1999. Draft Guidance for Water Quality based Decisions: The TMDL Process (Second Edition). EPA 841-D-99-001. Office of Water, Washington, D.C. August.

Underwood, J.N., Smith, L.D., Van Oppen, M.J.H. and Gilmour, J.P. 2009. Ecologically relevant dispersal of corals on isolated reefs: implications for managing resilience. *Ecological Applications*. Vol 19:18–29.

Underwood J.N., Smith L.D., van Oppen J.H. and Gilmour J.P. 2007. Multiple Scales of Genetic Connectivity in a Brooding Coral on Isolated Reefs Following Catastrophic Bleaching. *Molecular Ecology* 16, 771-784.

UrbanPlan. 2009. James Price Point Community Values: Landscape and Recreation.

URS 2005. Review of DEH Guidelines on the Application of the EPBC Act to Interactions between Offshore Seismic Operations and Larger Cetaceans - Appendix A: Review of literature on sound in the ocean and effects of sound on marine mammals and turtles.

URS. 2007. Scott Reef Environmental Survey 4: ROV Inspection of Deep Habitats in Scott Reef Lagoons. Report to Woodside Energy Ltd. DRIMS # 350512.

Vandenbyllaardt, L., Ward, F.J., Braekevelt, C.R and McIntyre, D.B. 1991. Relationships Between Turbidity, Piscivory, and Development of the Retina in Juvenile Walleyes. *Transactions of the American Fisheries Society*. 120:382-390.

Vanderlaan A.S.M. and Taggart C.T. 2007. Vessel Collisions with Whales: The Probability of Lethal Injury Based on Vessel Speed. *Marine Mammal Science* 23, 144-156.

Vermaat, J.E., Agawin, N.S.R., Fortes, M.D., Uri, J.S., Duarte, C.M., Marba, N., Enriquez, S. and VanVierssen, W. 1997. The Capacity of Seagrasses to Survive Increased Turbidity and Siltation: The Significance of Growth Form and Light Use. *Ambio*. 26:499-507.

Veron J.E.N. 1993. Part 2. Hermatypic Corals of Ashmore Reef and Cartier Island. In: Berry P.F. (ed) Marine Faunal Surveys of Ashmore Reef and Cartier Island, north-western Australia. Records of the Western Australian Museum Supplement No. 44, 13-20.

Viada S.T., Hammer R.M., Racca R., Hannay D., Thompson M.J., Balcom B.J. and Phillips. N.W. 2008. Review of Potential Impacts to Sea Turtles from Underwater Explosive Removal of Offshore Structures. *Environmental Impact Assessment Review* 28:267-285.

Victoria Government Gazette. 2001. State Environment Protection Policy (Air Quality Management). No. S 240 Friday 21 December 2001. [Online]. <http://www.epa.vic.gov.au/Air/EPA/default.asp>.

Vogel, J. L. and Beauchamp, D. A. 1999. Effects of light, prey size, and turbidity on reaction distances of lake trout (*Salvelinus namaycush*) to salmonid prey. *Canadian Journal of Fisheries and Aquatic Sciences* 56: 1293-1297.

Walker D.I. 1992. Seagrasses. In: Morgan G.J. (ed). Survey of the aquatic fauna of the Kimberley islands and reefs, Western Australia. Western Australian Museum, Perth, Western Australia.

Walker D.I. 1995. Seagrasses and Macroalgae. In: Wells F.E. Hanley R. and Walker D.I. (eds) Marine Biological survey of the southern Kimberley, Western Australia. Western Australian Museum, Perth, Western Australia.

Walker D.I. 1996. Seagrasses and Macroalgae. In: Walker D.I. Wells F.E. and Hanley R. (eds). Survey of the marine biota of the eastern Kimberley, Western Australia. University of Western Australia. Western Australian Museum and the Museum and Art Gallery of the Northern Territory.

Walker D.I. 1997. Macroalgae and Seagrasses. In: Walker D.I. (ed). Marine Biological survey of the central Kimberley coast, Western Australia. University of Western Australia, Perth, Western Australia.

Walker D.I. and Prince R.I.T. 1987. Distribution and Biogeography of Seagrass Species on the Northwest Coast of Australia. *Aquatic Botany* 29, 19-32.

Walker M.K., Cook P.M., Butterworth B.C., Zabel E.W. and Peterson R.E. 1996. Potency of a Complex Mixture of Polychlorinated Dibenzo-p-dioxin, Dibenzofuran, and Biphenyl Congeners Compared to 2,3,7,8-tetrachlorodibenzo-p-dioxin in Causing Fish Early Life Stage Mortality. *Fundamental and Applied Toxicology* 30(2), 178-186.

Walker S., Rogers G.M., Lee W.G., Rance B., Ward D., Rufaut Conn, A., Simpson N., Hall G. and Larivière. 2006. Consequences to Threatened Plants and Insects of Fragmentation of Southland Floodplain Forests. *Science for Conservation* 365, 5-86.

WAPET. 1995. Spectral Measurement of Illumination Sources at Thevenard Island. Prepared by Remote Sensing of Mine Environment for Western Australian Petroleum Pty Ltd.

Wartzok D. and Ketten D.R. 1999. Marine Mammal Sensory Systems. In: Reynolds J.E. and Rommel S.A. (eds). Biology of Marine Mammals. pp. 117-175. Washington D.C. Smithsonian Institution Press.

Washington, H.G. 1984. Diversity, biotic and similarity indices. A Review with Special Relevance to Aquatic Ecosystems 18(6) : 653 694.

Water Authority of Western Australia. 1994. Broome Groundwater Management Plan. Produced by Groundwater and Environment Branch, Water Authority of Western Australia.

Water and Rivers Commission (WRC). 1997. The State of the Northern Rivers, Water Resource Allocation and Planning Series, WRAP 10, May 1999. Water and Rivers Commission, Perth, Western Australia.

Water and Rivers Commission (WRC). 2001. Broome Water Reserve Water Source Protection Plan, Broome Town Water Supply. Water Resource Protection Series No WRP 41. July 2001. Water and Rivers Commission, Perth, Western Australia.

Watkins D. 1993. Roebuck Bay: Background Information for the Conservation of a Wetland of International Importance. Department of Conservation and Land Management, Perth, Western Australia.

Watson AJ, Boyd PW, Turner SM, Jickells TD, Liss PS. 2008. Designing the next generation of ocean iron fertilization experiments. *Mar Ecol Prog Ser* 364:303–309.

Waycott M., McMahon K., Mellors J., Calladine A. and Kleine D. 2004. A Guide to Tropical Seagrasses of the Indo-West Pacific. James Cook University, Townsville, Queensland.

Weber M. Lott C. Fabricius K.E. 2006. Sedimentation Stress in a Scleractinia Coral exposed to Terrestrial and Marine Sediments with Contrasting Physical Organic and Geochemical Properties. *Journal of Experimental Marine Biology and Ecology* 336,18-32.

Weilgart L.S. 2007. A Brief Review of Known Effects of Noise on Marine Mammals. *International Journal of Comparative Psychology* 20(2-3), 159-168.

Weller 2001. The population biology of invasive species. *Annual Review of Ecology and Systematics* 32, 27.

Wells, F. E., McDonald, J. I. and J. M. Huisman. 2009. Introduced Marine Species in Western Australia. Department of Fisheries. Perth, Western Australia. Fisheries Occasional Publications No. 57, March 2009.

Wells F.E. 1989. Survey of the Invertebrate Fauna of the Kimberley Islands, Western Australia. Western Australian Museum, Perth, Western Australia.

Wells F.E. 1992. Molluscs. In: Morgan G.J. (ed). Survey of the Aquatic Fauna of the Kimberley Islands and Reefs, Western Australia. Western Australian Museum, Perth, Western Australia.

Wells F.E. and Bryce C.W. 1995. Molluscs. In: Wells F.E. Hanley J.R. and Walker D.I. (eds). Marine Biological Survey of the Southern Kimberley, Western Australia. pp 101-117. Western Australian Museum Perth, Western Australia.

Wells F.E. and Bryce C.W. 1996. Molluscs. In: Walker D.I. Wells F.E. and Hanley J.R. (eds). Marine Biological Survey of the Eastern Kimberley, Western Australia. University of Western Australia, Western Australian Museum and the Museum and Art Gallery of the Northern Territory.

Wells F.E. and Jernakoff P. 2006. An Assessment of the Environmental Impact of Wild Harvest Pearl aquaculture (*Pinctada maxima*) in Western Australia. *Journal of Shellfish Research* 25(1):141-150. 2006.

Wells F.E., Hanley J.R. and Walker D.I. (eds) 1995. Marine Biological Survey of the Southern Kimberley, Western Australia.

Wenziker K., McAlpine, K. Apte S. and Masini R. 2008. Technical Report No.18: Background Quality for Coastal Marine Waters of the North West Shelf, Western Australia. CSIRO.

West's Encyclopedia of American Law, edition 2 at Free Dictionary: <http://legal-dictionary.thefreedictionary.com/informed+consent>.

Western Australian Country Health Service (WACHS). 2008. Kimberley Clinical Services Plan, Aurora Projects, August 2008.

Western Australian Greenhouse Taskforce. 2004. Western Australian Greenhouse Strategy. Government of Western Australia, September 2004.

Western Australian Herbarium (WAH). 2010. FloraBase: the Western Australian Flora. Western Australian Herbarium, Perth, Western Australia.

Western Australian Museum. 2008. Intertidal Habitats of Selected Sites in the Canning Bioregion – Preliminary Field Results, Prepared for the NDT, June 2008.

Western Australian Museum 2010. Report on macro-fossils in intertidal outcrops of the Broome Sandstone, 1.2-2.7 km south of James Price Point (proposed marine infrastructure shore crossing) and 6.2-7.5 km south of James Price Point (proposed southern pipeline shore crossing). Western Australian Museum, Department of Earth and Planetary Sciences Record 2010/1, Unpublished report prepared for the Department of State Development. Prepared by M. Siverrson. **[Appendix F-2]**.

Western Australian Planning Commission (WAPC). 2003. Statement of Planning Policy 2.6: State Coastal Planning Policy. <http://www.planning.wa.gov.au/Plans+and+policies/Publications/139.aspx>

Western Australian Planning Commission (WAPC). 2004a. Broome 2004 - Country Land Development Programme, February 2004. West Australian Government, Perth, Western Australia.

Western Australian Planning Commission (WAPC). 2004b. State Planning Policy 4.1 State Industrial Buffer. <http://www.planning.wa.gov.au/Publications/152.aspx>

Western Australian Police. 2009. *Monthly Reported Crime Statistics: 2008/09*, available from: <http://www.police.wa.gov.au/LinkClick.aspx?fileticket=usTOUOkktjo%3d&tabid=1219> > [18 November 2009].

Whiting S D and Miller J D. 1998. Short term foraging ranges of adult Green Turtles (*Chelonia mydas*). *Journal of Herpetology* 32, 330-337.

Wildlife Australia 1996. Action Plan for Australian Marsupials and Monotremes. Department of Environment, Water, Heritage and the Arts. [Online]. <http://www.environment.gov.au/biodiversity/threatened/publications/action/marsupials/19.html> [01/06/2010].

Williamson P.C., Sumner N.R. and Malseed B.E. 2006. A 12-month Survey of Recreational Fishing in the Pilbara Region of Western Australia During 1999-2000. Department of Fisheries, Fisheries Research Division. Western Australian Fisheries and Marine Research Laboratories, Perth, Western Australia.

Wilson S.G., Polovina J.J., Stewart B.S. and Meekan M.G. 2006. Movements of Whale Sharks (*Rhincodon typus*) Tagged at Ningaloo Reef, Western Australia. *Marine Biology*. 148, 1157-1166.

Witherington B.E. 1997. The Problem of Photopollution for Sea Turtles and Other Nocturnal Animals. In: Clemmons J.R. and Buchholz R. (eds). Behavioral approaches to conservation in the wild. Cambridge University Press, Cambridge, UK.

Witherington B.E. 2000. Understanding, Assessing, and Resolving Light-pollution Problems on Sea Turtle Nesting Beaches. St. Petersburg. FL. Florida Marine Research Institute Technical Report TR-2. 73 pp.

Witherington B.E. and Martin R. 1996. Understanding, Assessing, and Resolving Light-pollution Problems on Sea Turtle Nesting Beaches. Florida Marine Research Institute Technical Report RT-2.

Witherington, B.E., and Martin, R.E. 2000. Understanding, Assessing, and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches. 2nd edition, Revised. Florida Marine Research Institute Technical Report TR-2. 73 p.

Wood M. and Mills D. 2008. A Turning of the Tide: Science for Decisions in the Kimberley-Browse Marine Region. Western Australian Marine Science Institution, Perth, Western Australia.

Woodside Energy Limited (WEL). 2006. Pluto LNG Development – Draft Public Environment Report/Public Environmental Review.

Woolley P.A. 2005. The Species of *Dasycercus* Peters, 1875 (Marsupialia: Dasyuridae). *Memoirs of Museum Victoria* 62, 213–221.

Woolley P.A. 2006. Studies on the Crest-tailed Mulgara *Dasycercus cristicauda* and the Brush-tailed Mulgara *D. blythi* (Marsupialia: Dasyuridae). *Australian Mammalogy* 28, 117-120.

World Health Organisation (WHO). 2000. Air Quality Guidelines. World Health Organisation.

WorleyParsons 2008. Browse On-shore LNG Precinct Siting Study, Prepared for the Northern Development Taskforce (NDT), 2008. [Appendix B-5].

WorleyParsons 2010. Browse LNG Precinct Master Plan Report. Prepared for the Department of State Development, Perth, WA, July 2010. [Appendix B-8].

WWF. 2008. Coastal and Marine Natural Values of the Kimberley. WWF Australia, South Australia, Victoria.

WWF-Australia 2005, *Protecting Roebuck Bay* [online], WWF-Australia, <http://www.wwf.org.au/news/protecting-roebuck-bay/> [23 July 2010].

Wyatt R. 2008. Joint Industry Programme on Sound and Marine Life Review of Existing Data on Underwater Sounds Produced by the Oil and Gas Industry Issue 1.

Yang, T. F., P. C. Chuang, S. Lin, J. C. Chen, Y. Wang, and S. H. Chung, 2006. Methane venting in gas hydrate potential area offshore of SW Taiwan: evidence of gas analysis of water column samples. *Terr. Atmos. Ocean. Sci.*, 17, 933-950.

Yelverton J.T., Richmond D.R., Hicks W., Saunders K. and Fletcher E.R. 1975. The Relationship Between Fish Size and their Response to Underwater Blast. Report DNA 3677T. Defence Nuclear Agency, Washington, DC.

Yukihira H., Klumpp D.W. and Lucas, J.S. 1998, Effects of Suspension Feeding and Energy Budgets of the Pearl Oysters *Pinctada margaritifera* and *P. maxima*. *Marine Ecology Progress Series* 170, 119-130.

Yukihira H., Klumpp D.W. and Lucas J.S. 1999. Feeding Adaptations of the Pearl Oysters *Pinctada margaritifera* and *P. maxima* to Variations in Natural Particulates. *Marine Ecology Progress Series* 182, 161-173.

Zubrick SR, Lawrence DM, Silburn SR, Blair E, Milroy H, Wilkes T, Eades S, D'Antoine H, Read A, Ishiguchi P, Doyle S. 2004. *The Western Australian Aboriginal Child Health Survey: The Health of Aboriginal Children and Young People*. Perth: Telethon Institute for Child Health Research.

Zubrick SR, Silburn SR, Lawrence DM, Mitrou FG, Dalby RB, Blair EM, Griffin J, Milroy H, De Maio JA, Cox A, Li J. 2005. *The Western Australian Aboriginal Child Health Survey: The Social and Emotional Wellbeing of Aboriginal Children and Young People*. Perth: Curtin University of Technology and Telethon Institute for Child Health Research.

Zubrick SR, Silburn SR, De Maio JA, Shepherd C, Griffin JA, Dalby RB, Mitrou FG, Lawrence DM, Hayward C, Pearson G, Milroy H, Milroy J, Cox A. 2006. *The Western Australian Aboriginal Child Health Survey: Improving the Educational Experiences of Aboriginal Children and Young People*. Perth: Curtin University of Technology and Telethon Institute for Child Health Research.