

# 03

## Development Alternatives



In the 10-year period before the Gorgon Joint Venturers decided to seek in-principle approval for restricted access to Barrow Island for a foundation development, a number of alternative locations, within a 200 km radius of the Gorgon gas field, were investigated. Pursuing these concepts required the completion of many engineering, commercialisation, marketing and environmental studies at a cost of almost \$1 billion.

A commercialisation attempt on the Burrup Peninsula was terminated when it became clear the proposed development would be internationally uncompetitive. Subsequently, a systematic and stepwise process was used to identify and assess alternative development locations. The alternative locations examined extend from the Burrup Peninsula in the north to Exmouth in the south together with island locations and potential floating concepts. Candidate locations were assessed against a suite of technical, commercial, social and environmental constraints and requirements. The results of the assessment led the Joint Venturers to the conclusion that Barrow Island, the closest landfall to the gas field, was the only commercially viable location to develop this important resource. This finding was verified by an independent review (and cost audit) commissioned by the Western Australian Department of Industry and Resources (DoIR).

The naturally high levels of carbon dioxide (CO<sub>2</sub>) in Gorgon gas must be removed in order to produce Liquefied Natural Gas (LNG) and meet domestic gas specifications. Barrow Island provides the unique opportunity to dispose of this reservoir CO<sub>2</sub> by injection into the Dupuy Formation that lies deep beneath the island. The proposed gas processing facility on Barrow Island would be sufficiently close to a suitable injection site to be an economically feasible undertaking and make the Gorgon Development one of the most greenhouse gas efficient LNG plants in the world.

An assessment of these regional alternative locations against the controlling provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) showed that all the locations have similar potential for impacts on Commonwealth Marine Areas and only the Exmouth south location has the potential to impact a Commonwealth Marine Protected Area. Similarly, all locations have potential for impacts to species listed as threatened or migratory under the EPBC Act.



An assessment of potential sites on Barrow Island led to the selection of Town Point as the preferred location for the gas processing facility. Compared to other feasible sites on Barrow Island, this site will have a low overall level of environmental impact and offers safe and reliable marine operating conditions due to the sheltered nature of the adjacent waters. Other considerations included a range of technical, operational and cost-related issues.

After investigating alternative shore crossing locations, and associated onshore feed gas pipeline route, North White's Beach was selected as the preferred location. Flacourt Bay is being carried as a fall-back option through the current design phase pending more detailed geological investigations. An onshore pipeline route from North White's Beach will run along existing roads and other disturbed land as much as possible.

A summary of the consequences of not proceeding with the Gorgon Development during the current window of market opportunity (the 'no development alternative') is also provided.

This chapter is a description of the process used to evaluate alternatives that led to the decision to develop a gas processing facility at Town Point on Barrow Island.

Alternative engineering or design options and environmental impact mitigation strategies are dealt with as they arise elsewhere in this document (particularly Chapters 6, 7 and 10–15).

### 3.1 Introduction

The various assessments that have been undertaken to select a location for the gas processing facility, and associated infrastructure for the proposed Gorgon Development are discussed in this chapter. It details the options considered and addresses the following questions:

- Why utilise Barrow Island for the gas processing facility rather than one of the other potential locations?
- Why was Town Point on Barrow Island selected as the site for the gas processing facility?
- Why is the shore crossing proposed at North White's beach?
- Why is it proposed to directionally drill the shore crossing?
- What happens if the proposed Development does not proceed?

The process used to identify Barrow Island as the only feasible location to inject reservoir CO<sub>2</sub> is discussed in Chapter 13.

### 3.2 Previous Development Attempts

The Gorgon gas field was discovered in 1980 and since that time the Gorgon Joint Venturers have invested nearly \$1 billion in exploration, development, and marketing in an effort to commercialise the resource. A wide range of development options and potential gas processing locations were evaluated; and during the 1990s the Joint Venturers began to actively seek a customer base sufficient to underwrite development of the Gorgon gas field.

Initial development concepts focused primarily on a large, conventional Liquefied Natural Gas (LNG) facility on the mainland. In 1998, the development case was based on a two-train, 8 million tonne per annum LNG development on the Burrup Peninsula. This concept involved an attempt to optimise economies of scale and synergies with adjacent infrastructure operated by the North West Shelf Joint Venture (NWSJV). However, due mainly to the high cost of the pipeline between the field and plant location, this concept proved to be uncompetitive in the LNG market. In addition, large volumes of carbon dioxide (CO<sub>2</sub>) would have had to be emitted to the atmosphere due to the lack of a suitable site for CO<sub>2</sub> injection at, or reasonably close to, the Burrup Peninsula. The lack of international

competitiveness, absence of a suitable site for injection of reservoir CO<sub>2</sub>, and changes in the LNG market in 1998, led to the termination of this commercialisation attempt.

Since that time, the Joint Venturers actively sought a domestic gas customer base sufficient to fund development of the Gorgon gas field. However, it was concluded that a domestic gas project would not be commercially viable in isolation and that a much larger project (such as LNG production) would be required to underwrite a domestic gas development.

### 3.3 Overview of the Development Concept

In recent years the LNG market has grown and LNG is being sought in both new and existing markets in Asia-Pacific countries. Other regions are also emerging as potential markets. The scale of these opportunities is significant as the proposed Gorgon Development must be large enough to capture economies of scale whilst being consistent with market capacity.

In parallel with marketing assessments, preliminary engineering studies were executed by the Joint Venturers on alternative concepts covering a vast area spanning from the Burrup Peninsula to Exmouth on the mainland to offshore and island-based concepts located on the Montebello Islands and Thevenard Island. Floating and gravity based offshore LNG processing facilities have also been considered.

Included in these studies was an assessment to determine whether Barrow Island could be an environmentally acceptable and commercially viable development alternative. Barrow Island is a Class A Nature Reserve and conservation of its flora and fauna presents significant challenges to the development of a gas processing facility. However, 40 years of oil production operations on Barrow Island demonstrates that a carefully managed development is compatible with maintaining its conservation values. After a review of the environmental issues that could be associated with a development on the island, the Joint Venturers concluded that a development could be undertaken in an environmentally acceptable manner. Therefore, Barrow Island was selected as a site for the gas processing facility. In parallel, development and execution concepts were further defined to capture a maturing market, which may not recur for a substantial period of time.

The Gorgon Development concept is based on a gas processing facility to produce LNG for the international market and domestic gas for the Western Australian market. LNG plants are typically built in ‘trains’ of processing capacity. Two trains of up to five million tonnes per annum (MTPA) notional capacity each are currently viewed as providing a good balance of technical efficiency, marketable capacity and economies of scale.

The Development concept, described in more detail in Chapter 6, is based on the initial installation of a subsea gas gathering system and pipeline (approximately 70 km) from the offshore reserves to Barrow Island. The gas would be processed at a facility located at Town Point on the east coast of the island. It is proposed to inject CO<sub>2</sub>, naturally contained in the gas, into the Dupuy Formation that lies deep below the island. The LNG will be transported by ship to international markets and natural gas delivered via a subsea pipeline to the Western Australian mainland for use by industrial and

domestic customers. Condensate associated with the gas stream would be separated and loaded onto ships for market directly from Barrow Island.

The following sections describe the process that led to this development proposal.

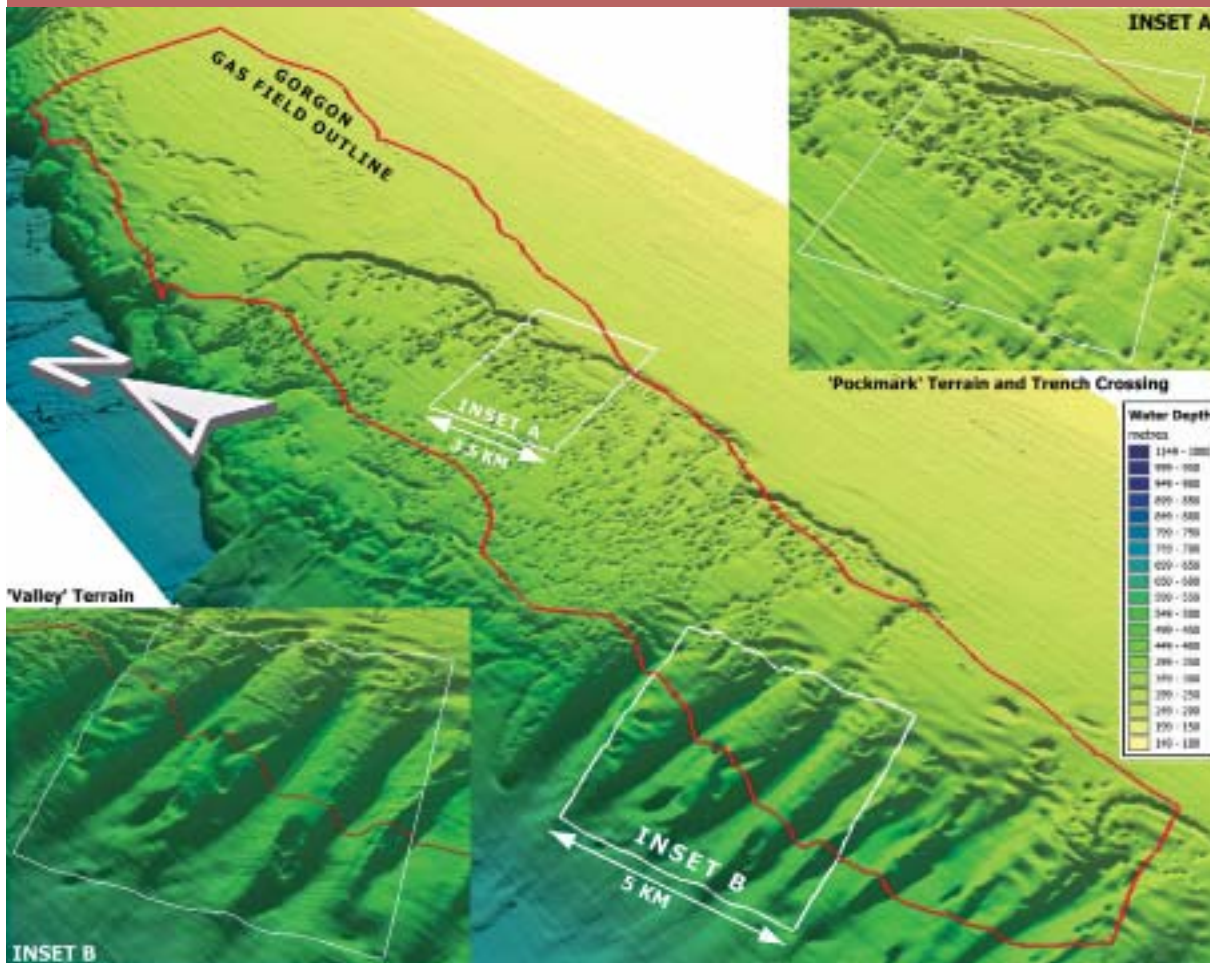
### 3.4 Technical and Commercial Constraints

Studies over the past 20 years demonstrate that, in addition to environmental challenges, there are significant technical and commercial constraints that affect development of the Gorgon gas field and the other fields of the Greater Gorgon area. The proposed Development must effectively address the following challenges:

- **Deep water** – as gas will be produced from at least 220 m of water, it will be one of the deepest production systems off the coast of Western Australia.

**Figure 3-1:**

Seabed Terrain of the Gorgon Gas Field



- **Carbon dioxide (CO<sub>2</sub>)** – gas from the Gorgon gas field contains approximately 14 vol% CO<sub>2</sub>, a feature that requires additional investment in materials and equipment; and specific greenhouse gas emission management strategies.
- **Liquid yield** – while the gas fields are high quality reservoirs and are very productive, the gas contains a very low proportion of liquid hydrocarbon (such as oil or condensate). Consequently, the proposed Development will not generate large revenue from the sale of liquids which are commonly associated with gas fields.
- **Geotechnical conditions** – the water depth combined with the seabed conditions on the scarp at the Gorgon field location are such that it is impractical to install a bottom-founded structure, such as a platform, directly over the producing reservoirs (Figure 3-1).
- **Development size** – the Development must be of sufficient size to underwrite the initial investment and capture the economies of scale, but not so large that the market cannot absorb the output, or that the deliverability of the reservoir is overstressed.

These challenges constrain the development alternatives open to consideration and underline the need to minimise costs, for example, by reducing the distance between the gas fields and the gas processing facility.

### 3.5 Assessment of Regional Locations

This section describes the process and reasons for selecting Barrow Island as the preferred location for the gas processing facility.

Barrow Island was selected as the preferred development location in 2003. As the regional assessment studies concluded other locations were not commercially viable, further engineering and environmental studies were restricted to a Barrow Island-based development. As a result, the development concept has been refined in response to this greater level of detail, resulting in the current concept as presented in Chapter 6. The following comparisons are based on the development concepts as tested through the ESE Review process.

A stepwise, systematic screening process was used to identify and assess possible development locations as shown schematically in Figure 3-2, and discussed in more detail throughout this Chapter.

The first step of the assessment was to identify location selection criteria. The most important of these selection criteria, their relevance and particular constraints are outlined in Table 3-1. These constraints are based on the knowledge and experience of the Joint Venturers' engineering staff and specialist consultants. Each of the Development requirements and constraints listed in this table were assigned a weighting that reflected their relative importance in a multi-criteria analysis.

Using the results of this multi-criteria analysis, and assuming that CO<sub>2</sub> injection would occur on Barrow Island (refer to Chapter 13 for an explanation), the second stage of the assessment identified a short-list of potential development locations.

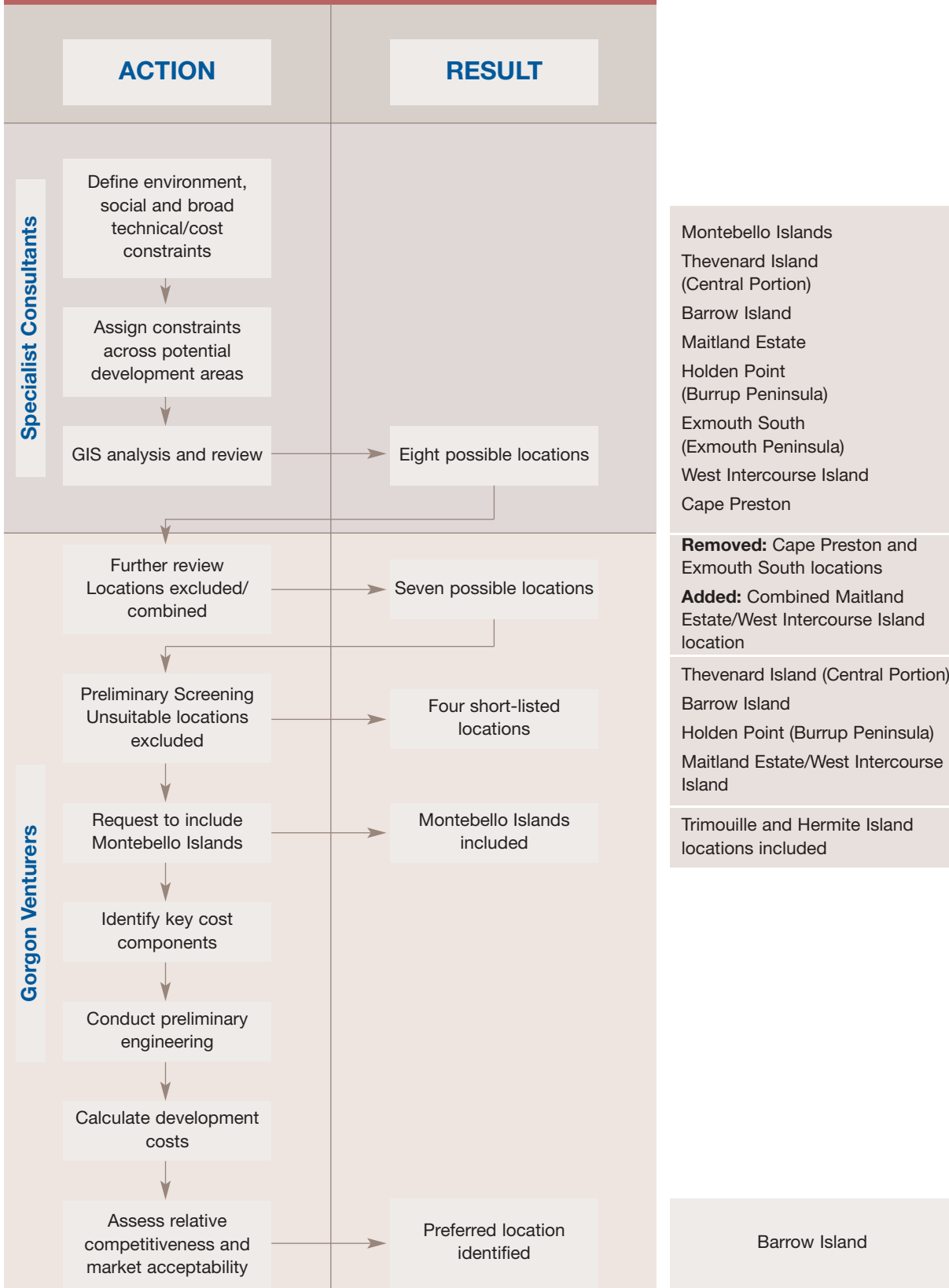
The area within an approximately 200 km radius of the Gorgon gas field, as shown in Figure 3-3, was divided into 500 x 500 m grid squares and assigned a score that reflected the level of constraint it had when requirements, constraints and associated weightings were considered (ChevronTexaco Australia 2003, Technical Appendix C). Areas that broadly met the Development requirements and constraints were then identified and a Geographic Information System (GIS)-based model was used to analyse the data. Detailed economic criteria were not included until the analysis of the short-list of potential locations was available. This reduced the risk of biasing the outcome and also allowed the next evaluation phase to concentrate on fewer locations.

The Maitland Estate was initially excluded due to its unacceptably long distance from the coast. However, because this location is a formally designated industrial zone, with few significant environmental or social constraints, it was considered in combination with West Intercourse Island. This island, which also offers a potentially suitable ship-loading point, was also retained as a possible stand-alone location.

Varanus Island was excluded because the majority of useable space on the island is already occupied by the existing facilities operated by Apache Energy.

Initially it was considered that a site at Onslow might also be feasible. However, more detailed assessment showed that the deep water contours did not extend as close to the coast as was initially indicated. This site would have therefore required a very extensive and prohibitively expensive dredging operation, and so was excluded from the short list and further assessment. (It is to be noted that, similar to other mainland sites, the distance from the gas field would increase development costs in the order of \$1 billion. Refer to Table 3-3).

**Figure 3-2:**  
Selection Process for Potential Development Locations



**Table 3-1:**

Key Requirements and Constraints for the Gorgon Gas Processing Facility (source: ChevronTexaco Australia 2003)

Requirement/Constraint	Parameter	Rationale
<b>Technical/Cost</b>		
Proximity to Gorgon gas field	Facility to be located within 200 km of Gorgon gas field.	Cost of large diameter gas supply pipelines become increasingly prohibitive with distance from the Gorgon gas field.
Sufficient available area	At least 300 ha of land available for development.	To safely accommodate plant, infrastructure and construction needs.
Proximity to coastline	Processing facility to be located within 10 km of coastline.	To allow the liquefied gas to be piped to export ships – i.e. jetty requirements and plant location are closely linked. Plant-to-ship pipeline length and costs will be reduced by minimising distance of the plant site from the shipping berth.
Proximity to deep water	Deep water within 5 km of adjacent coastline.	To keep dredging/jetty requirements within reasonable limits.
Sheltered water	Docking facilities will be located within sheltered, navigable waters.	To allow safe berthing of LNG carriers and loading of product.
Slope	Less than five per cent slope at plant location.	To keep earthworks disturbance during construction within reasonable limits.
Elevation	At least 5 m – Australian Height Datum (AHD).	To avoid storm surge flooding the site must be elevated.
Proximity to existing infrastructure	Preference for locations with existing infrastructure.	To minimise costs and associated impacts. This also includes proximity to tie-in to the existing domestic gas infrastructure.
Pipeline crossings	Avoid crossing existing subsea pipelines.	To minimise cost increases and risks.
<b>Environment</b>		
Mangroves	No development within 200 m of mangrove habitat.	To protect important habitat and key primary producers.
Declared rare flora	Exclusion zone of 1 km in areas where declared rare flora species are present.	To protect important species.
Fauna species and habitats	Avoid protected species and habitats. Small islands of less than 1000 ha to be avoided.	To protect important species and habitat. Small islands avoided as they have less resilience to habitat loss.
Conservation reserves	National and Marine Parks and other conservation reserves to be avoided where practicable.	To avoid disturbance to conservation reserves established for protection of flora, fauna and habitats.
Saline coastal flats	Avoid saline coastal flats.	To avoid disturbance to coastal flats considered to have habitat value.
Water courses	No development within 100 m proximity of water courses.	To avoid disruption on or near water courses including natural drainage patterns, as it may lead to erosion and loss of habitat.
Groundwater reserves	No development in areas where prescribed groundwater reserves exist.	To minimise risk of contamination of groundwater.

**Table 3-1: (continued)**

Key Requirements and Constraints for the Gorgon Gas Processing Facility (source: ChevronTexaco Australia 2003)

Requirement/Constraint	Parameter	Rationale
<b>Social</b>		
Settlements	No development within 3 km of settlements.	Development close to a settlement is considered unacceptable and counter to fundamental planning principles. Due consideration to amenity, visual impact, pollution potential, disturbance and health and safety risks.
Tourism and recreation reserves	No development within 3 km of tourism and recreation reserves or specific attractions or venues.	Due consideration to amenity and landscape values.
Aboriginal heritage sites	No development within 500 m of known Aboriginal heritage sites.	Protection required by legislation and buffer required to adequately protect sites.
Native Title claims	Avoid development in areas subject to Native Title claims where practicable.	Conflicting land use and potential to lead into protracted and complex negotiation and compensation.
Mineral deposits	Development to avoid known mineral deposits.	Preferable for a Development not to sterilise a mineral resource.
Mining tenements	Avoid development in areas subject to mining tenements.	To avoid conflicting land use and compensation requirements.
Pearling leases	No development within 2 km of areas covered by pearling leases.	To avoid potential disruption to pearling activities.

Large areas of the Pilbara coastline were not considered suitable for development due to the environmental values along the coastal fringe. This is reflected in extensive areas of saline coastal flats and mangroves, places on the Register of the National Estate, Conservation and Land Management (CALM) estate and proposed reserves. The mainland coastline from southern Exmouth Gulf to Cape Preston is also characterised by extensive areas of shallow water which further restrict development in this area. Cape Preston was ruled out primarily because it was already occupied by mining operations.

Hermite Island in the Montebello Islands was ruled out because of the lack of useable space and its history associated with nuclear weapons testing.

A gravity based offshore structure in sheltered waters was also excluded because such a facility of this scale would present significant technical challenges and considerable costs.

After eliminating these sites from consideration, the remaining locations were subjected to the second stage of assessment, which included preliminary engineering studies and an assessment of commercial competitiveness.

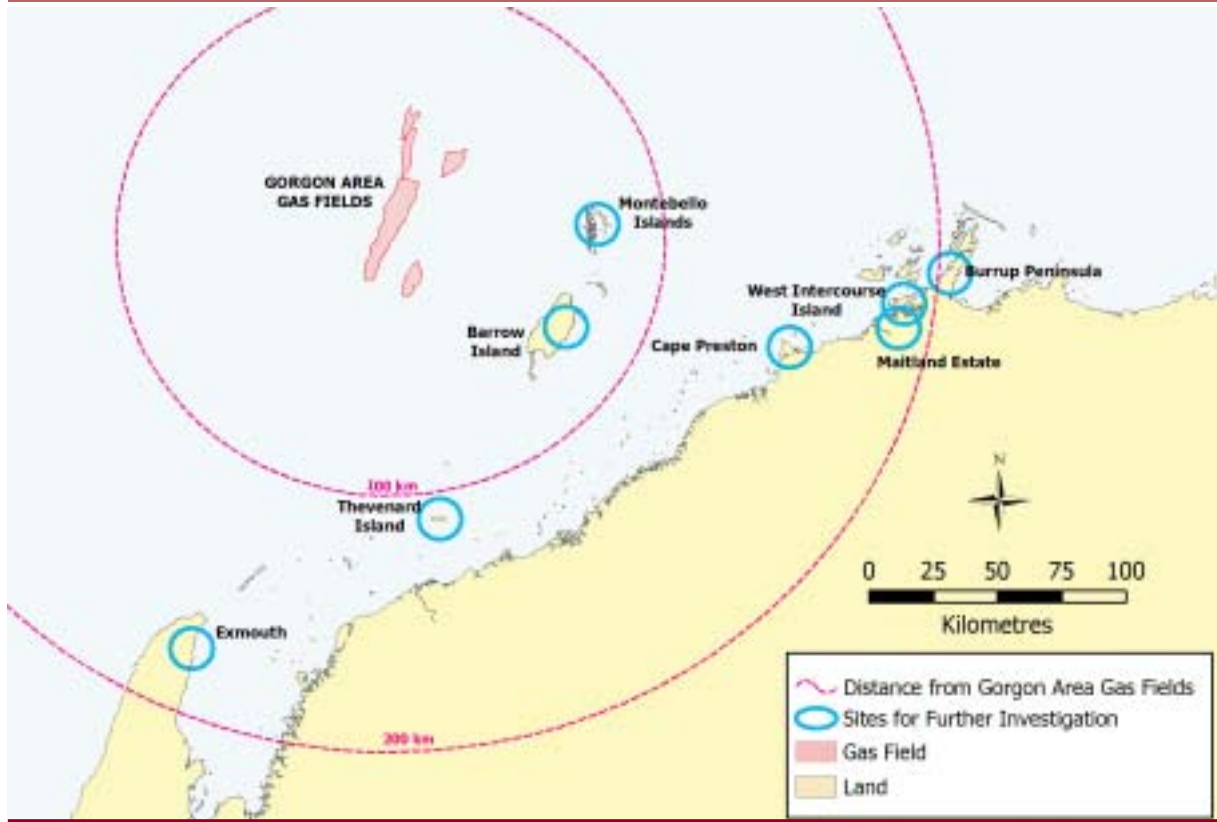
This process resulted in the following list of potential locations for further assessment:

- Montebello Islands
- Thevenard Island (central portion only)
- Barrow Island
- Maitland Estate/West Intercourse Island
- Burrup Peninsula (Holden Point )
- Exmouth South (Exmouth Peninsula)
- West Intercourse Island.

These locations are shown in Figure 3-3.

The key attributes of these locations were compared and are presented in Table 3-2, while Section 3.5.1 provides a detailed assessment of each site against the provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

**Figure 3-3:**  
Potential Locations for the Gorgon Gas Processing Facility



**Table 3-2:**  
Comparison of Key Attributes of Potential Locations

Constraints	Possible Locations						
	Montebello Islands (Trimouille Island)	Thevenard Island	Barrow Island	Maitland Estate (ME)/ West Intercourse Island (WII)	Burrup Peninsula (Holden Point)	Exmouth South (Exmouth Peninsula)	West Intercourse Island
<b>Technical/Cost</b>							
Pipeline distance to Gorgon gas field	Approx. 90 km	Approx. 120 km	Approx. 70 km	Approx. 250 km	Approx. 230 km	Approx. 200 km	Approx. 200 km
Sufficient available area	Area available for development is extremely restricted.	Area available for development is limited.	Sufficient area available for development requirements.	Sufficient area available for development requirements.	Sufficient area available for development requirements.	Sufficient area available for development requirements.	Sufficient area available for development requirements.
Proximity to coastline	Immediately adjacent to coast.	Immediately adjacent to coast.	Immediately adjacent to coast.	Maitland Estate 10 km inland, coastal access via West Intercourse Island.	Immediately adjacent to coast.	Coastal.	Immediately adjacent to coast.
Proximity to deep water	Good access to deep water.	Good access to deep water.	Moderate access to deep water.	Moderate access to deep water.	Moderate access to deep water.	Moderate access to deep water.	Moderate access to deep water.
Sheltered water	Limited sheltered waters.	Limited sheltered waters.	Sheltered waters.	Sheltered waters.	Sheltered waters.	Sheltered waters.	Sheltered waters.
Slope	Stable soils and minimal amount of earthworks required.	Soils would have to be stabilised.	Stable soils and minimal amount of earthworks required.	ME – stable soils with a minimal amount of earthworks required  WII – moderate geotechnical conditions.	Difficult geotechnical conditions at site.	Stable soils and minimum earthworks required.	Moderate geotechnical conditions.
Elevation	No elevation constraints.	No elevation constraints.	No elevation constraints.	ME – low lying site.  WII – no elevation constraints.	No elevation constraints.	No elevation constraints.	No elevation constraints.

**Table 3-2: (continued)**

Comparison of Key Attributes of Potential Locations

Constraints	Possible Locations						
	Montebello Islands (Trimouille Island)	Thevenard Island	Barrow Island	Maitland Estate (ME)/ West Intercourse Island (WII)	Burrup Peninsula (Holden Point)	Exmouth South (Exmouth Peninsula)	West Intercourse Island
<b>Technical/Cost (continued)</b>							
Proximity to existing infrastructure	No existing infrastructure.	Adjacent to existing oilfield infrastructure.	Adjacent to existing oilfield infrastructure.	No existing infrastructure at site. Good regional infrastructure.	Site is adjacent to the NWS LNG development. Good regional infrastructure.	No existing infrastructure. Good regional infrastructure.	No existing infrastructure. Good regional infrastructure.
Distance to potential CO <sub>2</sub> injection site at Barrow Island	40 km	115 km	14 km	165 km	~200 km	~200 km	~150 km
Pipeline crossings	No	No	Yes	Yes	Yes	No	Yes
<b>Environment</b>							
Mangroves	No mangroves.	No mangroves.	Relatively few areas of mangroves.	WII – surrounded by mangroves.	No mangroves.	No mangroves.	Surrounded by mangroves.
Declared rare flora	Locality has relatively few significant flora.	Locality has relatively few significant flora.	Locality has relatively few significant flora.	Locality has relatively few significant flora.	Locality has relatively few significant flora.	Locality has relatively few significant flora.	Locality has relatively few significant flora.
Fauna species and habitats	Locality has relatively few significant terrestrial fauna and habitats.  High marine environmental and habitat values.	Locality has relatively few significant terrestrial fauna and habitats.  High marine environmental and habitat values.	High ecological values.  Several fauna are endemic to Barrow Island.  High marine environmental and habitat values.	Locality has relatively few significant terrestrial fauna and habitats.  Presence of seasonal wading and water birds.	Locality has relatively few significant fauna and habitats.	Locality has relatively few significant fauna and habitats.  High marine environmental and habitat values.	Locality has relatively few significant fauna and habitats.
Conservation reserves	Class A Conservation Reserve.  Surrounding waters considered for a Marine Park.	Class C Nature Reserve.	Class A Nature Reserve.  Surrounding waters considered for a Marine Management Area.	None.	None.	Close proximity to Ningaloo Marine Park.	None.

**Table 3-2: (continued)**

Comparison of Key Attributes of Potential Locations

Constraints	Possible Locations						
	Montebello Islands (Trimouille Island)	Thevenard Island	Barrow Island	Maitland Estate (ME)/ West Intercourse Island (WII)	Burrup Peninsula (Holden Point)	Exmouth South (Exmouth Peninsula)	West Intercourse Island
<b>Environment (continued)</b>							
Saline coastal flats	No saline coastal flats.	No saline coastal flats.	No saline coastal flats.	WII surrounded by tidal mudflats.	No saline coastal flats.	No saline coastal flats.	Surrounded by tidal mudflats.
Water courses	No water courses.	No water courses.	Water courses exist (intermittent).	Water courses exist.	Water courses exist.	Water courses exist.	Limited numbers of water courses.
Prescribed groundwater reserves	None	None	None	None	None	Prescribed groundwater reserve exists.	None
<b>Social</b>							
Settlements	No settlements.	Small tourist resort accommodation.	No settlements.	Relatively close to Dampier.	Relatively close to Dampier.	Relatively close to existing settlements and major highway.	Relatively close to Dampier.
Tourism and recreation reserves, attractions or activities	Existing recreational boating and yachting activity. Islands support increasing tourism.	Existing recreational boat and yachting activity. Island also supports tourism.	No tourism or recreation.	No tourism or recreation.	Area used extensively for recreation and tourism.	High regional tourism activity and high tourism industry growth potential.	No island tourism or recreation. Nearby recreational fishing occurs.
Aboriginal heritage sites	Relatively few Aboriginal heritage sites exist.	One Aboriginal heritage site.	Few registered Aboriginal heritage sites.	Many Aboriginal heritage sites recorded.	High occurrence of Aboriginal heritage sites.	Aboriginal heritage sites in general area.	High occurrence of Aboriginal heritage sites.
Native title claims	No native title claims.	Native title claim exists.	No native title claims.	Native title claims settled.	Native title claims settled.	Native title claim exists.	Native title claims settled.

**Table 3-2: (continued)**  
Comparison of Key Attributes of Potential Locations

Constraints	Possible Locations						
	Montebello Islands (Trimouille Island)	Thevenard Island	Barrow Island	Maitland Estate (ME)/ West Intercourse Island (WII)	Burrup Peninsula (Holden Point)	Exmouth South (Exmouth Peninsula)	West Intercourse Island
<b>Social (continued)</b>							
Mineral deposits	No mineral deposits.	No mineral deposits.	No mineral deposits.	No mineral deposits.	No mineral deposits.	No mineral deposits.	No mineral deposits.
Mining tenements	No mining tenements.	No mining tenements.	No mining tenements.	No mining tenements.	No mining tenements.	Some mining tenements.	No mining tenements.
Pearling leases	Several existing pearling leases in adjacent waters.	Pearling leases.	Pearling lease in adjacent waters on east coast of island.	No pearling leases in adjacent waters.	No pearling leases in adjacent waters.	No pearling leases in adjacent waters.	No pearling leases in adjacent waters.

Prior to detailed commercial assessments three potential locations were excluded from further assessment:

- **Exmouth South** was excluded because it has high environmental, social and technical/cost constraints. It was considered highly unlikely to be viewed more favourably following detailed analysis.
- **West Intercourse Island** was excluded as a separate location because it was incorporated into the **Maitland Estate/West Intercourse Island** concept with the island being used for storage and jetty facilities due to its proximity to deep water. Also it did not offer any significant advantages as a stand alone option over the nearby Burrup Peninsula or Maitland Estate/West Intercourse Island concepts.
- **The Montebello Islands** were ruled out because of the background with testing of nuclear weapons.

Four locations, Barrow Island, Thevenard Island, Maitland Estate and the Burrup Peninsula, were included in the short-list for further analysis of commercial competitiveness.

Cape Preston and two of the islands in the Montebello group, which were initially excluded, were re-included in the assessment in response to stakeholder requests during the ESE Review process.

The commercial competitiveness assessment was a multi-factor analysis that considered economics, market acceptance, technical and environmental considerations and social and strategic considerations. The components of the proposed Development concept that have the greatest impact on the cost of construction and operation of selected sites are listed in Table 3-3.

For each location, a number of development concepts were considered (e.g. corrosion resistant alloy (CRA) pipeline vs. a platform and carbon steel pipeline to shore; and site options within the general area). Well fluids from the Gorgon gas field reservoir contain water and approximately 14 vol% CO<sub>2</sub>, which significantly increase the risk of corrosion. This makes it essential to use a comprehensive corrosion management system from the wellhead to the point of first gas treatment to ensure pipeline integrity. The use of CRA is one strategy that will ensure the pipeline integrity, while another is the use of carbon steel with continuous injection of corrosion inhibitor chemicals. As CRA material is expensive, beyond a distance of 100 km it becomes more economic to install an unmanned offshore platform with water removal facilities. This would allow a carbon steel pipeline (with the aid of continuous corrosion inhibitor injection) to be used to transport the well fluids to shore (refer to Chapter 6 for

**Table 3-3:**  
Comparison of Key Cost Driver Components

Key Cost Attributes	Short-listed Locations				Other Potential Locations		
	Thevenard Island	Barrow Island	Maitland Estate/West Intercourse Island	Burrup Peninsula	Cape Preston	Montebello Islands Trimouille	Montebello Islands Hermite
Gas Pipeline Length	120 km	72 km	250 km	230 km	175 km	93 km	115 km
Offshore Platform	Required	Not Required*	Required	Required	Required	Not Required*	Not Required*
Jetty Length	1.1 km	3.9 km	1.1 km	0.5 km	1.9 km	0.5 km	2.9 km
Distance from Coast	0.1 km	0.7 km	12.1 km	0.1 km	3.4 km	0.2 km	0.1 km
Volume of Dredging	0.86 Mm <sup>3</sup> soft soils/sand	6.9 Mm <sup>3</sup> soft soils/sand	6.7 Mm <sup>3</sup> hard soils/rock	7.8 Mm <sup>3</sup> hard soils/rock	3.25 Mm <sup>3</sup> soft soils/sand	0.75 Mm <sup>3</sup> soft soils/sand	2.94 Mm <sup>3</sup> soft soils/sand
Extent of earthworks	1.4 Mm <sup>3</sup> soft soils/sand	1.4 Mm <sup>3</sup> soft soils/sand	1.4 Mm <sup>3</sup> soft soils/sand	1.7 Mm <sup>3</sup> hard soils/rock	3.0 Mm <sup>3</sup> soft soils/sand	1.4 Mm <sup>3</sup> soft soils/sand	1.7 Mm <sup>3</sup> soft soils/sand
CO <sub>2</sub> Pipeline Length	115 km	14 km	165 km	200 km	95 km	40 km	30 km
Relative Cost, Millions	+ \$500	Reference Point	+ \$1100	+ \$1000	+\$720	+ \$70	+ \$300
Useable Land (300 ha available)	Yes	Yes	Yes	Yes	Yes (but covered by an existing mining tenement)	No	No

\* Not required for initial development.

additional information). However, for the purpose of cost comparison, the most economic concept for each regional location was used.

Disposal of reservoir CO<sub>2</sub> is considered to be a critical issue for a number of stakeholders, and was included in all development concepts. Extensive work, beginning in 1997, identified that the only feasible site for disposal of reservoir CO<sub>2</sub> for Gorgon gas was the Dupuy Formation

beneath Barrow Island (Chapter 13). Therefore the cost to deliver CO<sub>2</sub> from each potential location to Barrow Island is included in the comparison.

The following section provides a detailed commentary on each site against the provisions of the EPBC Act. It has been intentionally kept separate from the main discussion but the information was integrated into the decision making assessment.

### 3.5.1 Comparison against EPBC Act Provisions

The seven potential locations for the gas processing facility, as listed in Table 3-2, were also assessed in detail against the provisions of the EPBC Act.

Only three of the seven matters of National Environmental Significance (NES), protected under the EPBC Act, are considered relevant to the proposed Gorgon Development: Listed Threatened Species ('Endangered' and 'Vulnerable'); Listed Migratory Species; and Commonwealth Marine Areas, including one Marine Protected Area. None of the other four matters (i.e. World Heritage Properties; National Heritage Places; Ramsar Wetlands of International Significance; and Nuclear Activities) are considered to relate to any of the alternative locations.

The following sections discuss the three controlling provisions of the EPBC Act as they relate to each of the seven alternative locations (listed above) for the proposed Gorgon Development.

#### Regional Commonwealth Marine Areas

The Commonwealth Marine Area extends from the offshore boundary of Western Australian state waters at 5.6 km (3 nautical miles) out to 370 km (200 nautical miles) from the coast. The Gorgon gas field lies within this area. Thus the proposed gas pipelines for the Gorgon Development run through the Commonwealth Marine Area before crossing into Western Australian state waters. Although shore crossings for the proposed Development are within Western Australian state waters, there is potential for impacts on marine species that are protected under the EPBC Act. Therefore, activities in state waters have also been assessed against the controlling provisions of the EPBC Act.

Marine species listed as 'Threatened' or 'Migratory' are generally widespread throughout the region and are likely to occur at all of the alternative locations. Therefore, each site is considered to have equal potential for impacts on Commonwealth Marine Areas. Marine protected species that are likely to be widespread within the Commonwealth Marine Area, or in the adjacent Western Australian state waters, are discussed below, while further information is included in Technical Appendix C6.

Listed Threatened Species known to occur, or likely to occur, in the Commonwealth Marine Areas of the region comprise:

- two 'Endangered' turtle species (loggerhead turtle – *Caretta caretta*, olive ridley sea turtle – *Lepidochelys olivacea*)
- one Endangered seabird species (southern giant petrel – *Macronectes giganteus*)
- one Endangered whale species (blue whale – *Balaenoptera musculus*)
- one 'Vulnerable' seabird species (soft-plumaged petrel – *Pterodroma mollis*)
- four Vulnerable turtle species (green turtle – *Chelonia mydas*, flatback turtle – *Natator depressus*, leatherback turtle – *Dermochelys coriacea*, hawksbill turtle – *Eretmochelys imbricata*)
- three Vulnerable shark species (whaleshark – *Rhincodon typus*, grey nurse shark – *Carcharias taurus*, great white shark – *Carcharodon carcharius*)
- one Vulnerable whale species (humpback whale – *Megaptera novaeangliae*).

Some of these species have a predominantly southern distribution and rarely venture into the tropical waters of the proposed Development area. For example, grey nurse and great white sharks are only likely to visit the region at rare frequency (Last and Stevens 1994). The great white shark is more likely to be found in the southern-most alternative location, Exmouth south. The Endangered southern right whale (*Eubalaena australis*) and the southern giant petrel (*M. giganteus*) were identified in searches of the Department of the Environment Heritage (DEH) website ([www.deh.gov.au/epbc/assessmentapprovals/index.html](http://www.deh.gov.au/epbc/assessmentapprovals/index.html)); however these species are very unlikely to venture further north than North West Cape.

The migratory species protected under the EPBC Act that are likely to occur within the marine areas of the region comprise:

- three seabird species (wedge-tailed shearwaters – *Puffinus pacificus*, bridled tern – *Sterna anaethetus*, Caspian tern – *Sterna caspia*)
- six wetland bird species (ruddy turnstone – *Arenia interpres*, oriental plover – *Charadrius veredus*, oriental pratincole – *Glareola maldivarum*, little whimbrel – *Numenius minutus*, whimbrel – *N. phaeopus*, greenshank – *Tringa nebularia*)
- seven cetacean species (blue whale – *B. musculus*, Antarctic minke whale – *B. bonaerensis*, Bryde's whale – *B. edeni*, humpback whale – *M. novaeangliae*, killer whale – *Orcinus orca*, sperm whale – *Physeter macrocephalus*, spotted bottlenose dolphin – *Tursiops aduncus*)
- dugong – *Dugong dugon*
- six turtle species (loggerhead turtle – *Caretta caretta*, green turtle – *Chelonia mydas*, flatback turtle – *Natator depressus*, leatherback turtle – *Dermochelys coriacea*, hawksbill turtle – *Eretmochelys imbricata*, olive ridley turtle – *Lepidochelys olivacea*)
- two shark species (whaleshark – *R. typus*, great white shark – *C. carcharias*).

Other listed migratory cetacean species such as sei (*B. borealis*), fin (*Balaenoptera physalus*) and sperm (*Physeter macrocephalus*) whales occur in deep waters off the Western Australian coast and may occasionally visit the shelf waters between the Gorgon gas field and the mainland.

While leatherback and olive ridley sea turtles rarely breed in Australian waters, green, flatback and hawksbill turtles nest throughout the region.

The white-bellied sea-eagle (*Haliaeetus leucogaster*) and the barn swallow (*Hirundo rustica*) are protected as migratory terrestrial birds. While sea-eagles are likely to occur throughout the region, they are generally considered to be non-migratory. The barn swallow is unlikely to occur at any of the alternative locations.

#### Commonwealth Marine Protected Areas

The only Commonwealth Marine Protected Area in the region of the proposed Development is the Ningaloo Marine Park, which runs along North West Cape and

extends 16.7 km (9 nautical miles) from the 5.6 km (3 nautical miles) limit of Western Australian coastal waters. A pipeline from the Gorgon gas field to the Exmouth south alternative location would run past the northern end of the Ningaloo Marine Park.

#### Threatened Species

Unlike most of the Threatened and Migratory marine species described above, some marine and terrestrial fauna species are more restricted in distribution with closer associations to one or a few of the alternative locations.

The 'Vulnerable' djoongari (*Pseudomys fieldi*) is listed for the region, but is only known to occur naturally on Bernier Island in Shark Bay.

Two Vulnerable reptiles, the Hermite Island worm-lizard (*Aprasia rostrata*) and the Airlie Island ctenotus (*Ctenotus angusticeps*) are known from a few offshore locations, but may occur in similar habitats on other offshore islands such as Barrow Island, Trimouille Island and Thevenard Island. These species have not been recorded at the other alternative locations.

The 'Threatened' species with restricted distribution known to occur, or likely to occur, at each alternative location are discussed below and a summary is provided in Table 3-4.

The following sections examine each of the seven potential locations as listed in Table 3-3 in light of the above information.

#### Trimouille Island (Montebello Islands)

The Montebello Islands have regionally important rookeries of migratory wedge-tailed shearwaters and roseate terns.

There are no data available on stygofauna from Trimouille Island but it is possible that two protected species (blind cave eel – *Ophisternon candidum* and blind gudgeon – *Milyeringa veritas*) occur in the subterranean limestone structures of the island (Humphreys, B. pers. comm.).

Although not confirmed, it is possible that one and/or both of the Vulnerable reptiles, the Hermite Island worm-lizard (*Aprasia rostrata*) and the Airlie Island ctenotus (*Ctenotus angusticeps*) occur on Trimouille Island.

### Thevenard Island

Limited sampling for stygofauna has been carried out on Thevenard Island however none have been collected to date (Humphreys, B. pers. comm.).

Two Vulnerable reptiles, the Hermite Island worm-lizard (*Aprasia rostrata*) and the Airlie Island ctenotus (*Ctenotus angusticeps*) could possibly occur on the island.

Flatback turtles (*Eretmochelys imbricata*) and green turtles (*Chelonia mydas*) nest on Thevenard Island.

### Barrow Island

Barrow Island is home to six Vulnerable species of terrestrial mammal, one Vulnerable land bird species, three Vulnerable sea turtle species and two Vulnerable subterranean fish species. The terrestrial fauna are listed as Vulnerable due to their localised island population and restricted distribution.

The listed Vulnerable terrestrial mammal species comprise: the burrowing bettong (*Bettongia lesueur*), the black-flanked rock wallaby (*Petrogale lateralis lateralis*), the spectacled hare-wallaby (*Largorchestes conspicillatus conspicillatus*), the Barrow Island golden bandicoot (*Isoodon auratus barrowensis*), the Barrow Island euro (*Macropus robustus isabellinus*) and the Barrow Island chestnut mouse (*Pseudomys nanus ferculinus*).

The Vulnerable white-winged fairy wren (*Malurus leucopterus edouardi*) is endemic to Barrow Island where it is abundant.

Of the Vulnerable subterranean fish species, the blind gudgeon (*M. veritas*) occurs on Barrow Island and the blind cave eel (*O. candidum*) is likely to occur on the island.

The Vulnerable reptiles, the Hermite Island worm-lizard (*Aprasia rostrata*) and the Airlie Island ctenotus (*Ctenotus angusticeps*) may also occur on the island, but have not been found to date.

Green and flatback turtles commonly nest on beaches around Barrow Island. Hawksbill turtles nest on nearby Varanus Island and infrequently on Barrow Island.

### Maitland Estate

One Vulnerable bat species (Pilbara leaf-nosed bat – *Rhinonictus aurantius*) is likely to occur on or near Maitland Estate. The Vulnerable terrestrial mammal, the mulgara (*Dasyercus cristicauda*), and the Pilbara subspecies of the Olive python (*Liasis olivaceus barroni*) may also occur in this area.

There is no information available regarding stygofauna at Maitland Estate.

Loggerhead, hawksbill, flatback and green turtles nest on beaches within the Dampier Archipelago. These turtles are likely to visit the waters off the Maitland Estate during breeding time.

### West Intercourse Island

Listed Threatened Species known to occur, or likely to occur, on or near West Intercourse Island comprise one Vulnerable mammal, the Pilbara leaf-nosed bat (*R. aurantius*) and one vulnerable reptile, the Pilbara subspecies of the Olive python (*Liasis olivaceus barroni*).

There is no information available regarding stygofauna at West Intercourse Island.

Loggerhead, hawksbill, flatback and green turtles nest on beaches within the Dampier Archipelago.

### Holden Point (Burrup Peninsula)

Listed Threatened Species known to occur, or likely to occur, in the area surrounding Holden Point comprise two Vulnerable mammal species (Pilbara leaf-nosed bat – *R. aurantius*; and the mulgara – *Dasyercus cristicauda*) and one Vulnerable reptile, the Pilbara subspecies of the Olive python – *Liasis olivaceus barroni*).

There is no information available regarding stygofauna at Holden Point.

Loggerhead, hawksbill, flatback and green turtles nest on beaches within the Dampier Archipelago.

### Exmouth South

Listed Threatened Species known to occur, or likely to occur, in the area surrounding the Exmouth south site comprise two Vulnerable subterranean fishes (blind cave eel – *O. candidum* and blind gudgeon – *M. veritas*), one Vulnerable subterranean remipede (*Lasionectes exleyi*), two Vulnerable mammals, (the mulgara – *Dasyercus cristicauda*; and the black-flanked rock wallaby – *Petrogale lateralis lateralis*).

In 1993, the Vulnerable Shark Bay Mouse (*Pseudomys fieldi*) was translocated to Doole Island in Exmouth Gulf in order to enhance the conservation of this extremely restricted native rodent.

Loggerhead turtles nest on the Muiron Islands to the north of Exmouth, while other turtle species nest on the beaches in the Exmouth region.

### 3.5.2 Most Suitable Development Location

All of the locations evaluated are considered to have similar potential for impacts on Commonwealth Marine Areas. Ningaloo Marine Park is the only Commonwealth Marine Protected Area in the Development area and would be potentially impacted by the proposed pipeline from the Gorgon gas field to the Exmouth South alternative location. Numerous marine protected species occur in the region including turtles, seabirds, whales and sharks. These are likely to be widespread within the Commonwealth Marine Area, or in the adjacent Western Australian state waters. Overall, in regard to listed threatened species, none of the locations contain critically endangered species and all locations contain four endangered species and 27 migratory species. Vulnerable species are found at all

locations with Thevenard Island, Holden Point and West Intercourse Island likely to contain the least number (11) and Barrow Island the greatest number (20).

Findings from the various studies indicate that Barrow Island is the only location where the Gorgon Development can be commercially viable (refer also to Section 3.5.4 for a discussion on independent verification of this finding). Barrow Island is close enough to the gas field to use a CRA-lined pipeline all the way to landfall without the need for a platform.

Utilisation of Barrow Island would therefore minimise costs of the initial development, which is critical to making the Gorgon Development competitive in international markets. Infrastructure developed by the existing oil operations on Barrow Island may be re-used and the island is relatively close to existing infrastructure for transport of domestic gas.

Barrow Island also provides safe access to relatively sheltered water, especially on the east coast. Access to deep water for LNG carriers can be provided economically with a cost effective combination of dredging and a jetty (Chapter 6). A relatively flat, adequately elevated site of 300 ha can be accommodated on this island without significant adverse impacts to sensitive vegetation or fauna habitats (Chapter 10). A gas processing facility on Barrow Island would avoid impacts on: residential areas and industrial or commercial land users, tourism and recreational areas, mineral deposits and mining tenements, and Aboriginal heritage sites and existing native title claims. Due to existing oilfield operations, Barrow Island already supports logistical infrastructure,

**Table 3-4:**

Fauna Protected under the EPBC Act Likely to Occur at Alternative Sites

Fauna Type and Status	Trimouille Island	Thevenard Island	Barrow Island	Maitland Estate	Holden Point	Exmouth South	West Intercourse Island
Critically Endangered	0	0	0	0	0	0	0
Endangered	4	4	4	4	4	4	4
Vulnerable	13	11	20	12	11	15	11
Migratory	27	27	27	27	27	27	27
Threatened Ecological Communities	0	0	0	0	0	0	0

including an airfield, accommodation and communications and marine services. The management of the island oilfield is widely recognised as an industry benchmark for the coexistence of petroleum development and biodiversity protection.

This island also provides a unique opportunity to dispose of the CO<sub>2</sub>, contained naturally in the reservoir fluid, by injection into reservoirs deep beneath the island. Carbon dioxide disposal is explained in more detail in Chapter 13, but Barrow Island offers the only viable site to inject and dispose of this CO<sub>2</sub>.

The assessment of the shortlist of alternative development locations is summarised in Figure 3-4.

### 3.5.3 Less Suitable Development Locations

Some of the key attributes of each of the other sites are briefly explained in the following, but the focus is on why each of the sites on the short-list is less suitable overall than Barrow Island.

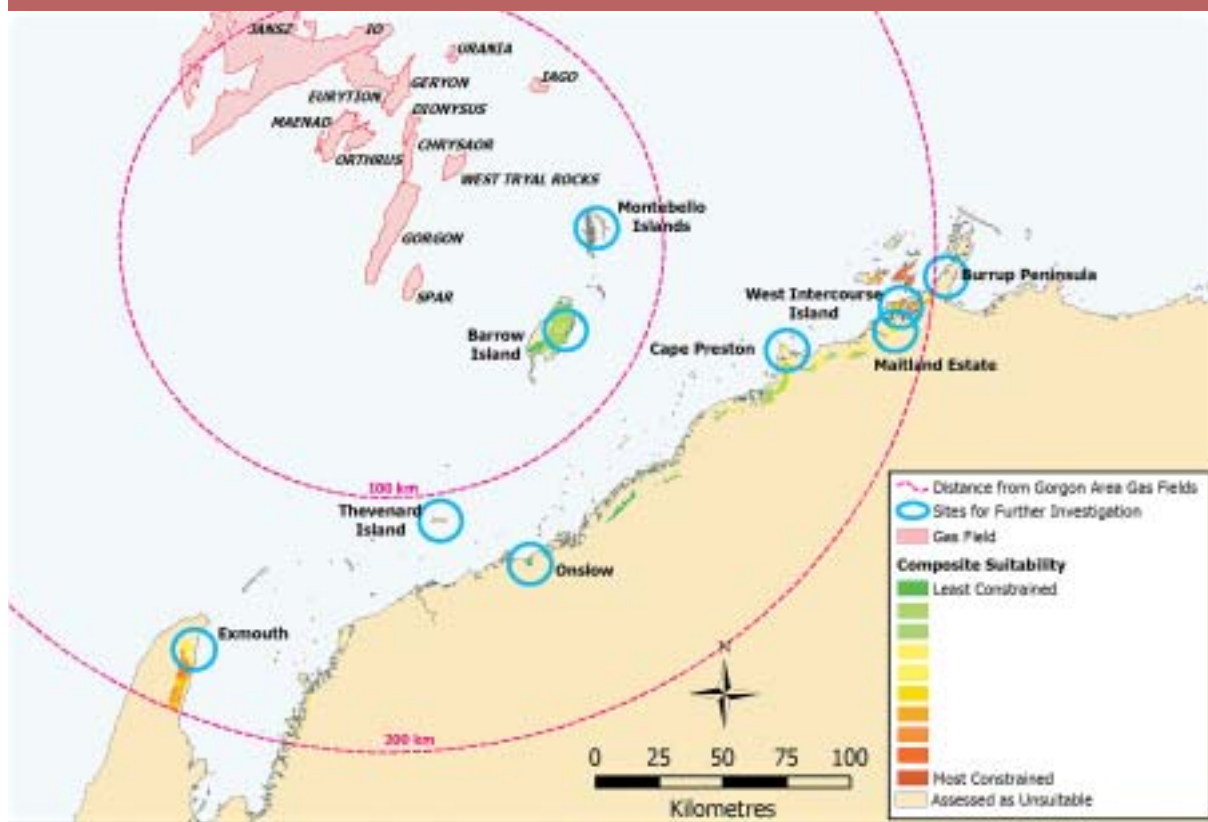
### Montebello Islands

The Montebello Islands were initially excluded from consideration due to the lack of usable land and history as a nuclear weapons test site.

This island group was the location of nuclear weapon testing in 1952 and 1956 and elevated radiation levels are still found in some parts of the islands. Radiation Hazard Area covers two-thirds of Trimouille Island and no works involving digging and/or excessive dust movement should be carried out in the contaminated areas (Western Radiation Services 2002). The inhalation hazard from alpha-emitting radionuclides in these areas will not change appreciably over several hundreds of years (Western Radiation Services 2002).

In response to requests during the ESE Review process the only two islands (Trimouille and Hermite) that could possibly support significant infrastructure were included in a short list for assessment of their commercial competitiveness in response to stakeholder comments.

**Figure 3-4:**  
Results Summary of the Location Assessment



Trimouille Island is considered inappropriate as a location for the Gorgon Development due to the potential for long-term exposure to radiation. The Gorgon Joint Venturers are not prepared to expose workers to such risks. Stakeholder engagement has also confirmed that this would be a serious industrial relations issue.

No trace of radioactivity above normal background levels have been found in soil samples from Hermite Island (Western Radiation Services 2002). However, data on re-suspension and deposition is not available and a thorough survey would be required before the site could be considered (Western Australian Department of Health, pers. comm.).

The connection of the Montebello Islands to nuclear weapons testing would also expose the Development to negative public and customer perceptions, adversely impacting the ability of the Gorgon Joint Venturers to attract and retain customers.

In addition to occupational health concerns, neither Trimouille nor Hermite Island has sufficient land available to safely accommodate the Gorgon Development. Trimouille Island is approximately 450 ha and contains less than 100 ha of useable land. Hermite Island is approximately 950 ha, but is such a convoluted shape that it does not provide sufficient contiguous consolidated area for practical planning and establishment of a gas processing facility.

Further, as indicated in Table 3-3, cost penalties are greater than those for Barrow Island (i.e. \$300 million for Hermite Island; and \$70 million for Trimouille Island).

This option would still require considerable construction activity, operating facilities and a substantial footprint on Barrow Island, mainly associated with injection of CO<sub>2</sub>.

### Thevenard Island

Thevenard Island is a moderate distance from the Gorgon gas field and provides good access to the coast and deep water. The island is relatively unconstrained from an environmental perspective, although it is surrounded by a rich marine environment and is designated as a Class C Nature Reserve. However, this option is \$500 million more expensive than Barrow Island. The main factors contributing to the higher costs include the need for:

- site-specific ground improvements to prevent movement of the soil and equipment during a seismic event
- additional feed gas pipeline length
- levees to protect against storm surge associated with cyclones
- an additional pipeline to connect to the CO<sub>2</sub> injection site
- personnel to be transferred from Barrow Island or Onslow via boat and/or helicopter
- relocation of the existing airstrip as, for safety reasons, fixed wing aircraft movements are incompatible with a gas processing facility in such a limited area.

Other disadvantages of Thevenard Island include:

- limited area available for development
- lack of sufficiently sheltered waters for LNG carrier berthing and loading, which would reduce the reliability of the marine export system and adversely affect the ability to satisfy market delivery requirements
- compromised operational safety if cyclones trigger the evacuation of personnel by helicopter
- limited utility for future expansion due to being well south of the Greater Gorgon area reserves
- potential impacts to recreational fishers, boat users and tourists, all of whom visit the island and its waters
- lack of a jetty location – unless the only feasible location, on the south-east end of the island, is acquired from Mackerel Islands Resort.

This concept would require twin construction sites – one on Thevenard Island and the other on Barrow Island. Compression facilities for injection of CO<sub>2</sub>, with associated utilities and infrastructure would be required on both Thevenard and Barrow Islands, and as such this option would still require considerable construction activity, operating facilities, additional quarantine controls on all activities and a substantial footprint on Barrow Island.

#### Maitland Estate/West Intercourse Island

The combined Maitland Estate/West Intercourse Island option is over \$1 billion more costly than the Barrow Island development option. In terms of gas supply, these costs arise from the need for a remote hub platform and an additional 180 km of carbon steel gas pipeline. In terms of gas processing, the location is more distant from the coast (12 km) and would impact on a sensitive shore crossing. In terms of CO<sub>2</sub> injection and disposal, this option would also require an additional 150+ km of CO<sub>2</sub> pipeline, CO<sub>2</sub> compression and booster compression at Barrow Island.

The use of West Intercourse Island for LNG storage and load-out is seen as a distinct disadvantage as this option would require a 12 km long interconnecting causeway and a pipeline easement for LNG pipe-work between the gas processing facility and load-out facility. It would also require construction of LNG storage tanks on a rocky environment at West Intercourse Island, disturbance to a significant number of aboriginal sites, mangroves, and significant dredging would be required to reach the Hamersley Channel. It may also be necessary to dredge a new channel to avoid congestion or to avoid conflicts with other shipping traffic.

This option would still require considerable construction activity, operating facilities and a substantial footprint on Barrow Island.

#### Holden Point, Burrup Peninsula

The Burrup Peninsula option was significantly more costly (+\$1 billion) than the Barrow Island development option. This extra cost is due to the distance from the gas field, which necessitates a remote hub platform, and an additional 160 km length of carbon steel gas pipeline. For CO<sub>2</sub> injection and disposal, an additional 200 km length of CO<sub>2</sub> pipeline would be required along with CO<sub>2</sub> compression and booster compression at Barrow Island.

This option would still require considerable construction activity, operating facilities and a substantial footprint on Barrow Island. This location also failed to meet many of the social and technical cost requirements. Failure to secure a customer for a Burrup Peninsula-based development in 1998 supports this conclusion.

#### Cape Preston

Cape Preston was originally eliminated from consideration due to potential conflict with an existing mining tenement and a proposal to load treated iron ore. This was primarily because multiple use results in competition for the limited space available, and LNG loading activities require intrinsically safe operations to avoid ignition sources, and so cannot coexist directly alongside iron ore operations.

During the ESE Review process, and in response to stakeholder comments, a civil engineering study was conducted specifically for Cape Preston using the same criteria applied to other short-listed locations based on the assumption that the Joint Venturers would have exclusive use of Cape Preston. The study confirmed preliminary conclusions that the site offered no significant cost advantage over a Burrup Peninsula location as development at Cape Preston would cost \$720 million more than Barrow Island.

This option would still require considerable construction activity, operating facilities and a substantial footprint on Barrow Island, primarily to inject reservoir CO<sub>2</sub>.

#### 3.5.4 Independent Technical Audit of Relative Costs

As noted in Chapter 2, the Allen Consulting Group was commissioned by DoIR to undertake a detailed and confidential review of the Joint Venturers' assessment of development alternatives. This detailed review included examining the justification of the Joint Venturers' selection of Barrow Island as the preferred location for the proposed Development; and provided an opinion on the likelihood of an alternative, feasible location being available in a similar cost range. The Allen Consulting Group undertook a technical audit of the relative costs in various locations as proposed by the Joint Venturers (The Allen Consulting Group 2003).

This analysis relied substantially on information provided by the Joint Venturers under a confidentiality agreement. During that review process, commercially sensitive information, such as detailed relative costs of gas supply and break-even gas price analysis results, were shared with The Allen Consulting Group but not made public to avoid exposing this information to potential customers and competitors.

The analysis presented by The Allen Consulting Group stated that:

Barrow Island clearly represents the most competitive location for a large-scale facility to process Gorgon gas. The Montebellos do not meet the GJV's commercial criteria because of unsuitable terrain (Hermitte) or perceived risks from nuclear contamination (Trimouille). While Thevernard Island may well be competitive if the sequestration of CO<sub>2</sub> were not undertaken, the GJV is unwilling to accept the commercial risk of not sequestering this greenhouse gas. On that basis, and in the absence of very substantial support, Thevernard Island would not offer a competitive location...

...From an economic and commercial perspective the Barrow Island site has three clear advantages, all relating to distance. ...None of the other locations, other than perhaps Trimouille Island which is ruled out for other reasons, can match these advantages.

...we conclude that Barrow Island represents the only commercial option for monetising the substantial national asset represented by the Gorgon resource.

### 3.5.5 In-Principle Approval

As outlined in Chapter 2, the site selection process was documented in the ESE Review, public comments were sought and responded to by the proponent, an independent review and cost audit was conducted and bulletins were issued by the Western Australian Environmental Protection Authority (EPA) and

Conservation Commission of Western Australia. Consideration of the ESE Review was coordinated by the Standing Interagency Committee of Chief Executive Officers (SIAC). This was supported by an extensive proponent-led stakeholder consultation program where the selection of the regional location was a key issue.

As a result of this process and after considering all arguments presented, State Cabinet granted in-principle approval for restricted access to Barrow Island as a foundation development for the Gorgon Development. The *Barrow Island Act 2003* resulted from this comprehensive evaluation process which simultaneously assessed technical, commercial, social, economic, and environmental aspects of the proposed development.

### 3.6 Assessment of Barrow Island Sites

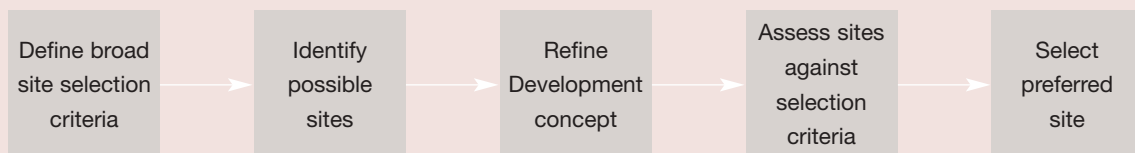
This section is a description of the process and reasons for selecting Town Point as the preferred site for the gas processing facility.

Selection of a preferred site on Barrow Island is based on an LNG development reference case of two 5 MTPA notional capacity trains, and an associated domestic gas plant. This includes an allowance for a controlled area within which construction materials can be stored and construction accommodation can be established. It also accounts for potential for future growth in the LNG market and the capability to meet projected Western Australian domestic gas demand.

Protection of the conservation values of Barrow Island, which are not evenly distributed over the island, was a major consideration in determining the site for the gas processing facility. Other considerations include a range of technical, operational and cost-related issues such that the site will be safe, practical and allow the development to remain economically viable.

A process was designed to systematically identify and assess potential sites for the gas processing facility and is shown in Figure 3-5.

**Figure 3-5:**  
Basic Steps in the Site Selection Process



### 3.6.1 Selection Criteria

A gas processing facility and associated infrastructure on Barrow Island will require an area of approximately 300 ha to accommodate plant, equipment and pipeline easements.

Sites were assessed giving consideration to the following main criteria:

- safety
- degree of environmental impact
- marine operability for approaching and berthing LNG carriers (such as impacts of currents)
- constructability for a gas processing facility – including potential for expansion and ease of construction as well as environmental conditions such as cyclones and geology)
- relative costs.

These aspects are discussed in more detail later in the chapter for a shortlist of sites.

### 3.6.2 Possible Sites for the Gas Processing Facility

Figure 3-6 provides an indication of water depths around Barrow Island and classifies the island into two broad categories, namely, preferred for development or unfavourable for development. Areas of greater environmental sensitivity are placed within the latter group and are based upon the known distribution of environmental factors such as threatened fauna habitat, EPBC listed species distributions and restricted vegetation communities.

Figure 3-6 shows the six areas on Barrow Island which were considered as potential locations for the gas processing facility. It includes the potential footprint associated with the gas processing facility together with the offloading facility and the associated approach channel.

The potential locations identified for the gas processing facility were:

- Latitude Point on the east coast
- Town Point on the east coast
- Surf Point at the north-east corner
- Flacourt Bay on the west coast
- The Chair on the west coast
- Bandicoot Bay at the south end of Barrow Island.

### 3.6.3 Redefine Development Concept

It should be noted that the locations shown in Figure 3-6 are as assessed over the period 2001 to 2002 and were presented in the ESE Review (ChevronTexaco Australia 2003). Further environmental and engineering studies since that time have resulted in the refinement of the development footprint and concept as outlined in Chapter 6. Changes have been made to the preliminary site location to further reduce overall environmental impacts.

### 3.6.4 Assessment of Sites Against Selection Criteria

The suitability of Camp Point (in the vicinity of the Chevron camp) as a potential site has been raised by stakeholders. However, this location has been excluded from the short list because, although the site offered some environmental benefits over other sites, such as proximity to airport and existing accommodation and thus reduced requirement for clearing of transport corridors, these benefits were outweighed by other factors, which include:

- The gas processing facility site would be situated approximately 500 m upwind from the existing oilfield operations camp under the prevailing south westerly winds. The existing camp would need to be moved to avoid potential human health and safety impacts from the plant, and so result in additional land use.
- It is located approximately 2.5 km north-east of the airport runway and in the direct approach path of aircraft. To avoid the flare stack, minimise thermal impacts and to meet regulatory requirements, the runway would need to be significantly re-aligned. This re-alignment would require an additional footprint of approximately 30 ha. It would also require additional manpower, and significant volumes of aggregate to be brought onto the island under quarantine restrictions (refer to Chapter 12 for details on quarantine). The re-alignment would also have an impact on the current oil field operations.
- The Material Offloading Facility (MOF) would require a dredged channel 1.5 to 2 km longer than that required at Town Point. This would result in an additional 16 ha of seabed directly impacted by the dredging operation and up to 30 ha of additional seabed disturbed by the disposal of dredge spoil. The dredge operation would also be closer to the coral communities off the south-east coast of Barrow Island and pose a greater risk of dredge related impacts to these communities.

**Figure 3-6:**  
Potential Sites for a Gas Processing Facility on Barrow Island



- It would require an additional 3 km of pipeline easement for the feed gas pipeline, and the CO<sub>2</sub> line resulting in 10 ha of additional footprint.
- The south-east and south of the island have been shown to have the highest abundances of migratory shorebirds on Barrow Island.

From the short list of six sites, Bandicoot Bay and The Chair were rejected during the initial screening process.

Bandicoot Bay was excluded primarily because it was intended as a Marine Conservation Area for benthic fauna and seabird protection (CALM 2004) and it provides very restricted access to deep water. The construction of a gas processing facility at this site would require a 3 km jetty connecting the loading platform to the site and a 9 km dredged approach channel. This exceptionally large amount of dredging would incur unacceptable construction and maintenance costs and pose safety hazards for shipping and produce unacceptable environmental impacts on areas important for marine benthic fauna and migratory birds.

The Chair was excluded because of its exposure to severe ocean conditions that would limit the safe operation of the port for approaching and berthing LNG carriers.

The remaining four locations were the subject of more detailed engineering studies to confirm whether the facility and associated equipment could be built in a manner that would avoid significant environmental impacts and meet technical requirements. A summary of the findings of these studies are presented in Table 3-5.

### 3.6.5 Most Suitable Development Site

After comparing site characteristics, Town Point was selected as the preferred site for the gas processing facility, despite being the most expensive of the short listed locations.

The selection of Town Point was based on both technical and environmental merit.

From a technical perspective, this site offers:

- The safest and most reliable marine operating conditions, due to the more sheltered nature of the adjacent waters.
- A west coast shore crossing for the feed gas pipeline, rather than using a circuitous route around the island through strong-current areas (refer to Section 3.7).
- A 3.1 km long jetty (with 800 m causeway) and a relatively short dredged approach channel for the LNG carriers could be used, which is less than many of the alternative sites.
- Geological stability.
- Relatively flat terrain that would minimise earth works at the site.
- A rocky headland that would provide excellent coastal access, with minimum disturbance.
- Good proximity to existing operations, or is close to areas that have been previously utilised by oil operations.
- One of the shortest routes to connect to the domestic gas network.

**Table 3-5:**

Summary of Comparison among Potential Development Sites on Barrow Island

Site Characteristic	Site/Concept			
	Town Point	Latitude Point	Flacourt Bay	Surf Point
	Reference Point	Relative Cost: -\$60 million	Relative Cost: -\$130 million	Relative Cost: -\$180 million
<b>Environmental</b>				
Development would be in close proximity to existing oil operations	Yes	Yes	Yes	No
Development area contains a high percentage cover of restricted vegetation associations	No	No	No	Yes (located in the relatively pristine northern portion of the island)
Development infrastructure would avoid rock wallaby habitat	Yes	Yes	No (pipeline and plant transport corridor through habitat)	Yes (if feed gas pipeline located at the northern end of island)
Development infrastructure would avoid habitats of 'mobile' EPBC listed macrofauna (bettong, spectacled hare-wallaby, golden bandicoot, euro, chestnut mouse)	No (some translocation maybe required, e.g. bettongs)	No (some translocation maybe required, e.g. bettongs)	No (some translocation maybe required, e.g. bettongs)	No (some translocation maybe required, e.g. bettongs)
Development infrastructure would avoid habitats of subterranean EPBC listed fauna (blind gudgeon, possibly blind cave eel)	Unlikely (given the karstic nature of the island)	Unlikely (given the karstic nature of the island)	Unlikely (given the karstic nature of the island)	Unlikely (given the karstic nature of the island)
Development infrastructure would avoid nesting beaches of EPBC listed turtles (green turtle, leatherback turtle, hawksbill turtle, flatback turtle)	No (important flatback nesting beaches in close proximity)	No (important flatback nesting beaches in close proximity)	No (important green and hawksbill nesting beaches in close proximity)	No (important green and hawksbill nesting beaches in close proximity)
Development infrastructure would avoid habitats of EPBC listed marine birds (white-bellied sea eagle, southern giant petrel, soft-plumaged petrel, migratory waders etc)	No (although marine birds tend to be concentrated in the south and south-east of the island)	No (although marine birds tend to be concentrated in the south and south-east of the island)	No (although marine birds tend to be concentrated in the south and south-east of the island)	No (although marine birds tend to be concentrated in the south and south-east of the island)
Development infrastructure would avoid habitats of EPBC listed terrestrial bird (white-winged fairy wren)	No (although this species is widely distributed over the island)	No (although this species is widely distributed over the island)	No (although this species is widely distributed over the island)	No (although this species is widely distributed over the island)
Development infrastructure would avoid habitats of EPBC listed marine mammals (whales, dolphins, dugongs)	No (although significant impacts are unlikely)	No (although significant impacts are unlikely)	No (except dugongs)	No (except dugongs)

**Table 3-5: (continued)**

Summary of Comparison among Potential Development Sites on Barrow Island

Site Characteristic	Site/Concept			
	Town Point	Latitude Point	Flacourt Bay	Surf Point
	Reference Point	Relative Cost: -\$60 million	Relative Cost: -\$130 million	Relative Cost: -\$180 million
<b>Environmental (continued)</b>				
Coastal stability would be maintained	Yes (rocky headland)	Yes (rocky headland)	No (sandy beach)	No (sandy beach/dune systems)
Marine dredging would be distant from coral communities	No	No	No (very close to proposed marine protected area)	Yes (although plume modelling would be required to confirm area of impact)
<b>Technical</b>				
Stable soils and minimal amount of earthworks required at site	Yes	Yes	Yes	No
Good coastal access for jetty and MOF via rocky outcrop	Yes	Yes	No	Moderate
Close to existing oilfield infrastructure	Yes	Yes	Yes	No
Access to deep water via jetty and dredged channel	Moderate (via jetty=3.9 km; dredged channel=2.3 km)	Moderate (via jetty=2.0 km; dredged channel=4.3 km)	Good (via 1.4 km jetty)	Good (via jetty=2.0 km; dredged channel=1.9 km) but the East Spar and Wonnich pipelines would need to be relocated to allow construction of the dredged channel.
Low-to-moderate impacts from nearshore currents on marine operations	Yes	No	No	No
Close proximity to domestic gas connection	Yes (closest)	Yes	No	Yes
* Note: 'Relative Cost' relates to those components of the Development concept that vary between sites. That is, these are not total construction costs.				

Furthermore, Town Point is considered to have a reasonably low overall level of environmental impact compared to other locations since:

- Vegetation communities within the Development area extend outside that area.
- Vegetation communities are larger outside the proposed Development areas than those within these respective areas.
- No part of the proposed Development on Barrow Island is within 200 m of mangroves, or within 100 m of water courses that lead to mangrove communities at their seaward end.
- The Development area does not appear to have any intrinsic value to mammal or herpetofauna above that of adjacent and surrounding habitats.
- The gas processing facility is distant from Vulnerable black-flanked rock wallaby communities.
- The coastline in the vicinity of the proposed Development is of relatively low importance for coastal water birds compared with other points of Barrow Island.
- Town Point is not an important waterbird foraging or roosting site, as evidenced from low abundances, in relation to other parts of the Barrow Island shoreline.
- The proposed Development area is not locally or regionally significant for land birds and has no unique features that might constitute critical habitat.
- There are no known features in the Development area or its surrounds to suggest that significant concentrations of protected marine invertebrates, fish or cetaceans would be expected to occur.
- Although the proposed Development area is within an important feeding and breeding ground for marine turtles, primarily flatback turtles on the east coast and green turtles on the west coast, the Gorgon Joint Venturers consider that risks to turtles (e.g. lighting) can be appropriately managed through the rigorous implementation of safeguards (Chapter 11).

### 3.6.6 Less Suitable Development Sites

#### Latitude Point

Latitude Point is similar to Town Point as it is in close proximity. Latitude Point also offers:

- more sheltered waters than west coast locations
- geological stability
- relatively flat terrain
- proximity to existing operations, or is close to areas that have been previously utilised by oil operations
- a west coast shore crossing for the feed gas pipeline (Section 3.7)
- a 2 km jetty connecting a loading platform and a 4.3 km dredged approach channel for the LNG carriers, which requires less infrastructure than many options.

Access to deep water is a critical issue. A site at Latitude Point would require a 2 km jetty connecting a loading platform and a 4.3 km-long dredged approach channel. Thus, an additional 2 km of dredging would be required to construct the approach channel for LNG carriers at this site compared to Town Point. The Gorgon Joint Venturers consider that the potential impacts to significant coral communities located nearby from a larger dredging program, without any other obvious technical or environmental benefit over the Town Point site, is unacceptable. Thus, Latitude Point was considered to be a less favourable option than Town Point.

#### Surf Point

Situated at the north-east corner of Barrow Island, Surf Point offers deep water relatively close to shore, but is exposed to strong tidal currents which may adversely affect the safe operation of LNG carriers in the area. Potential development sites at this location are heavily restricted due to the presence of sensitive vegetation associations and sandy, unstable soils. The north of the island is also relatively undisturbed and is the furthest point on the island from the existing oil operations infrastructure. Stakeholder consultation has identified a strong preference for avoiding direct impacts to the less disturbed northern portion of the island.

The Surf Point site does offer some environmental benefits over other sites. For example, the onshore section of the feed gas pipeline between the shore crossing and the facility would be relatively short, resulting in fewer disturbances to vegetation communities (and their associated fauna) than at other sites. However, much of the disturbance would be to restricted vegetation communities. A Surf Point site would also require less dredging, resulting in fewer impacts to surrounding marine habitats. However, the strong currents in the area make it unlikely that LNG carriers would be able to operate safely.

#### Flacourt Bay and The Chair

Flacourt Bay and The Chair are situated on the west-side of Barrow Island with access to deep water close to the shoreline. A gas processing facility at either of these sites would also be closer to the landfall of the feed gas pipeline, but further from the domestic gas pipeline on the mainland. However, marine terminal operations would be subjected to more severe swells that would adversely affect port availability for unprotected jetty sites. This makes a jetty with no protection impractical, and breakwater alternatives extremely expensive. The terrain is relatively flat and stable in structure. However, both sites are adjacent to sensitive rock wallaby habitat.

A facility at Flacourt Bay would require no dredging, but would require a 700 m breakwater and a 1 km jetty connecting a loading platform to shore, so it was assessed as a much less favourable site than Town Point.

A facility at The Chair would require a jetty of approximately 1 km, but the site would not require dredging. However, The Chair site was rejected during the initial screening as it is exposed to severe ocean conditions due to a steeply shelving sea floor and significant wave loading and thus would require a prohibitively expensive breakwater shelter for protection. Such a breakwater would also potentially have significant environmental impacts during construction and subsequent operations, such as sourcing materials, smothering, silt movement, and impact on water flows.

#### Bandicoot Bay

The potential site at Bandicoot Bay is situated within the existing oil operations in an area of relatively flat topography away from significant vegetation associations and terrestrial fauna habitats. However, the south of Barrow Island offers no access to deepwater close to shoreline, so would require a 3 km jetty connecting the loading platform to the site and a 9 km dredged approach channel. As this exceptionally large amount of dredging would incur unacceptable construction and maintenance costs, pose safety hazards for shipping and impact on areas important for marine benthic fauna and migratory birds, it was rejected during the initial screening process and excluded from preliminary engineering studies.

### 3.7 Assessment of Feed Gas Pipeline Alternatives

This section describes the process and reasons for selecting North White's Beach as the preferred site for the shore crossing of the feed gas pipeline and horizontal directional drilling as the preferred shore crossing technique.

It examines potential shore crossing locations and routes for the feed gas pipelines on Barrow Island. While these locations and routes are closely related to the location of the gas processing facility, the discussion is presented separately here so that more detailed information can be provided. This assessment also includes details on the construction technique and onshore feed gas pipeline route as these decisions are all linked.

#### 3.7.1 Selection Criteria

To enable a rational selection of the preferred site, a series of criteria were established against which the various sites could be evaluated. These are shown in Table 3-6.

### 3.7.2 Potential Sites for the Shore Crossing

During the selection process five potential shore crossing locations were considered as sufficiently feasible to warrant further evaluation. These were:

- Flacourt Bay
- North White's Beach
- Obe's Beach
- Cape Dupuy
- Town Point (via a marine route).

Refer to Figure 3-7.

### 3.7.3 Assessment of Potential Sites for the Shore Crossing

Cape Dupuy and Town Point (marine route) were screened-out relatively early. A marine route to Town Point would have required a large dredging campaign (in addition to that required for the materials offloading facility and LNG load-out), and involved high cost and complexity associated with a longer offshore pipeline installation in shallow water. Cape Dupuy was ruled-out because of the greater footprint and technical challenges of operating installation vessels in the strong currents around the cape. The remaining sites Flacourt Bay, North White's Beach and Obe's Beach were assessed in more detail.

The base case for each of the three west coast locations initially included the requirement to dredge a trench at shore crossing. Detailed assessment has since shown that dredging is not technically feasible due to the prevailing rough sea conditions on the west coast of Barrow Island, and the presence of very high strength rock. Other construction techniques, such as, 'post trenching' and 'rock ploughing' were not considered technically feasible due to the high rock strength.

Feasibility studies for horizontal directional drilling (HDD) and tunnelling were undertaken. It was concluded that HDD would be feasible at North White's Beach, and to a lesser extent at Flacourt Bay and Obe's Beach. Tunnelling requires considerable dredging to construct a receival pit. Due to the ocean conditions on the west coast and the proximity of (and potential impacts to) the Barrow Island Marine Park, this technique was not considered feasible. As such, HDD was determined to be the only feasible below-ground construction technique.

Three above-ground alternatives were considered and included: laying the feed gas pipelines on the seabed and beach; running the pipelines over a jetty; and establishing a groyne upon (or in) which the feed gas pipelines would run. These were less preferred for various technical and environmental reasons which included:

- the complication of accessing the shallow water area to be able to stabilise the pipe. In most cases this requires a temporary jetty/groyne to be constructed from the shore out to approximately the 5 m water depth point. This is both costly and intrusive to the near shore environment
- the potential to alter existing beaches through an artificial change to the mobility of suspended/deposited sediment
- seabed disturbance during construction.

The key differences between the construction techniques are: the quantity of seabed disturbance; the amount of imported material required; construction duration; vegetation clearing; blasting and excavation; plume generation; light and noise; and weather dependency.

Table 3-6 shows the results of the assessment for each of the feasible shore crossing options against the key criteria.

### 3.7.4 Preferred Shore Crossing Location

From the assessment of shore crossing options, the preferred shore crossing location is North White's Beach, constructed using HDD. The key benefits of this option over the other feasible alternatives are that it:

- presents lower risks to rock wallabies, turtle habitat and the Marine Park
- requires less earthworks and footprint
- involves a shorter construction period due to the bathymetric conditions
- offers the lowest construction risk due to the preferred geology for HDD and open beach that provides route flexibility to avoid geohazards
- provides cost-saving opportunities associated with being able to install the pipe from onshore through a drilled hole (which removes dependency on sea state and lay barge standby rates)
- allows for relatively simple stabilisation techniques.

**Figure 3-7:**  
Potential Shore Crossing Locations



**Table 3-6:**

Comparison of Shore Crossing Sites with Short-Listed Construction Technique (HDD)

Characteristic	Flacourt Bay (HDD)	North White's Beach (HDD)	Obe's Beach (Jetty)
Complies with land use limit of 50 ha for feed gas pipelines as specified by the Barrow Island Act.	Yes Construction easement = 31 ha. Permanent additional footprint after construction = 9 ha.	Yes Construction easement = 40 ha. Permanent additional footprint after construction = 13.1 ha.	Yes Construction easement = 42 ha. Permanent additional footprint after construction = 12.7 ha.
Key Environmental Factors <ul style="list-style-type: none"> <li>rock wallabies</li> <li>marine park</li> <li>turtles</li> </ul>	<ul style="list-style-type: none"> <li>High risk</li> <li>High risk</li> <li>Medium/High risk</li> </ul>	<ul style="list-style-type: none"> <li>Low risk</li> <li>Low risk</li> <li>Low risk</li> </ul>	<ul style="list-style-type: none"> <li>High risk</li> <li>Low risk</li> <li>Medium/High risk</li> </ul>
Avoid existing oilfield infrastructure/activities	Yes	Yes	Yes
Wave climate	Acceptable	Acceptable	Expected downtime during construction due to rough weather.
Bathymetry	Requires drilling length of 1200 m.	Requires drilling length of 600 m.	Jetty construction approximately 800 m long.
Site layout	Narrow site does not accommodate flexibility for re-routing.	Open site with good flexibility to avoid geo-hazards.	Narrow site not flexible to re-routing.
Earthwork requirements	Significant earthworks required for construction site. Hard rock will require blasting.	Very little earthworks required, Predominantly sandy material.	Significant excavation work required on the beach in establishing the foundations for the jetty and to accommodate vehicle traffic across the beach.
Site access	Existing roads along 83% of route. Beach approach is narrow and steep.	Existing roads along 70% of route. Wide open beach.	Existing roads along 80% of route. Narrow and inclined track to beach.
Floodways/Drainage channels	Pipeline route does not interfere with any significant drainage channels.	Pipeline route does not interfere with any significant drainage channels.	Pipeline route does not interfere with any significant drainage channels.
Pipeline stabilisation requirements	Standard stabilisation (rock dumping in shallow water approach).	Standard stabilisation (rock dumping in shallow water approach).	Standard stabilisation (rock dumping in shallow water approach).
Pipeline damage risk	Acceptable	Acceptable	Acceptable
Geological hazards	Paleo channels may exist but should be avoided by HDD. No other geotechnical impediments identified to date.	Surface geology and data collected indicate that the ground is suitable for HDD, most competent rock is at depth between 6-9 m.	Paleo channels are expected to exist but are not expected prevent construction of piles.

### 3.7.5 Less Preferred Shore Crossing Locations

Flacourt Bay is the preferred fall-back option as it provides a pipeline route which is adjacent to existing oil field operations and infrastructure and provides the shortest pipeline route across the island.

The geology at Obe's Beach does not support the HDD technique due to the suspected presence of channelling, and therefore requires more environmentally intrusive and costly construction techniques which makes it of lower preference to the other two sites.

If there is an unexpected geohazard for HDD at North White's Beach, then other construction concepts would be considered at North White's Beach before opting to change the site to the fall-back site of Flacourt Bay. The possible construction techniques include drilling offshore piles and stabilising the pipeline above the seabed.

### 3.8 Defer or Not Develop Alternative

This section addresses the question of what would happen if the proposed Gorgon Development does not proceed.

The Joint Venturers have identified a market window of opportunity for deliveries of gas from the Gorgon gas field as mentioned in Chapter 1. A delay in meeting this delivery schedule may result in losing LNG market opportunities to an international competitor and/or losing industrial gas customers to alternative investments. International competitors may not be as energy efficient as the Gorgon Development and alternative investments may mean coal or oil which have significantly greater greenhouse gas emissions. Refer to Chapter 13 for additional details of both of these aspects.

Economic models run for the proposed Development predict that the investment phase would result in flow-on benefits in the Australian community of a peak increase of 15 500 jobs driven by the \$6 billion initial investment by the Joint Venturers (ChevronTexaco Australia 2003).

During the operations phase, gross domestic product (GDP) may increase by an average of \$3.6 billion per year as a direct result of the proposed Development. If the development opportunity is realised, it is predicted to sustain an average of over 6000 jobs through the decades of the Development's operation.

If this opportunity is missed, it will risk not realising national, state and regional economic benefits that would increase general economic growth, sustain regional development, and increase competition in domestic gas markets. Missing the current development opportunity would also risk the loss of a substantial increase in government revenues, both through the direct payment of taxes by the Joint Venturers and the workers and businesses associated with the Development (Chapter 15). This would deny Australians and Western Australians the associated social benefits such as an increase in community services and highly skilled employment opportunities.

At a regional level, the Pilbara region of Western Australia in particular, would be at risk of losing the benefits of growth in employment and business opportunities (Chapter 15), but the area on Barrow Island would remain undisturbed. Other opportunities at risk include technology transfer and capacity building from the design, construction and maintenance of the Development to Western Australian businesses that may enable them to service other resource and industrial projects in the state.

### 3.9 Conclusion

The gas fields in the Greater Gorgon area are a substantial national asset. The initial development of the Gorgon gas field to a new gas processing facility is needed to initiate the development of these resources. Extensive studies have shown that Barrow Island is the only commercially viable location to develop those resources. This finding has been verified by an independent review undertaken for the State Government of Western Australia (The Allen Consulting Group 2003).

Following a detailed investigation the preferred location for the gas processing facility on Barrow Island is Town Point. Of the possible shore crossings (and resultant onshore pipeline routes on Barrow Island), North White's Beach is considered the base case for the development with Flacourt Bay being carried as a fall-back option.

