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DEPARTMENT OF STATE DEVELOPMENT

Browse LNG Precinct

Master Plan Report

301012-01576 – 301012-01576-001-MP-REP-0001

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SYNOPSIS

The Department of State Development commissioned WorleyParsons to document the Basis of Design and key features of a Master Plan to support the development of the Browse LNG Precinct.

The purpose of this document is to define both spatially and in text, the key attributes of the Master Plan for the Browse LNG Precinct including all of its key onshore and offshore components. The value of this Master Plan is that it captures the most up to date planning for the precinct at its time of publication and provides a high-level vision for the precinct's development.

This version of the Master Plan (Revision 4) has been prepared following ongoing discussions between the State and a potential foundation proponent. It includes a number of modifications from a technical position adopted in previous revisions of the Master Plan, the result of additional information and data presented during these discussions.

Disclaimer

PROJECT 301012-01576 - BROWSE LNG PRECINCT

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
1	Issued as Final	D Foster	J Schepis	J Schepis	14-May-10	N/A	
2	Issued as final	D Foster	J Schepis	J Schepis	14-Jul-10		
3	Issued as update	M Wegg	J Schepis	J Schepis	13-Nov-13		
4	Issued as update	M Wegg	J Schepis	J Schepis	25-Mar-14		

EXECUTIVE SUMMARY

The Department of State Development (DSD) commissioned WorleyParsons to document the Basis of Design and key features of a Master Plan to support the development of the Browse LNG Precinct.

The focus is to provide flexibility within the land allotments:

- to accommodate varying LNG technology options;
- appreciate different approaches to design; and
- facilitate construction and development.

This version of the Master Plan has been prepared as an outcome of a number of investigations dating back to August 2008 when DSD engaged WorleyParsons to undertake an engineering review of four potential sites selected by the Northern Development Taskforce for an LNG precinct in the Kimberley region of Western Australia.

This study was broken into multiple phases (detailed in Appendix 1) including:

- Data collection, review and consolidation
- Site visit and technical review
- Development of Master Plan for the preferred site

This document represents a refinement to the Master Plan, which defines both spatially and textually the key attributes of the Browse LNG Precinct including all of its key onshore and offshore components. It sets out the location of the precinct including assumptions behind its layout, key components, staging and infrastructure requirements.

This Master Plan captures the most up to date planning for the precinct at its time of publication and provides a high-level vision for the precinct's development. The Master Plan identifies well-defined land and water areas with flexibility for proponents to develop their preferred plot plans (including the required onshore and marine facilities) to suit their needs without compromising the ability of future proponents to meet the Basis of Design requirements. The objective of this work was to ensure the precinct remains an effective option for the foundation proponent as well as for future developers of gas projects in the Kimberley.

In April 2009, Traditional Owners, the State Government and the proposed foundation proponent signed a Heads of Agreement for development of the Browse LNG Precinct. Since then, with the issuing of Notices of Intention to Take (NOITTs), the key areas of land were revised to include:

- A total precinct area of approximately 3,414.01ha, consisting of:
  - Port Land – 109.78ha
  - Industrial Precinct and Common User Area – 1980.00ha

  - Third Party Contractors' Site – 199.87ha
  - Accommodation Site – 199.86ha
  - Pipeline Corridors (North and South) – 437.05ha
  - Main Access Road, Third Party Contractors' Site Road, and Accommodation Road – 266.50ha
  - Service Corridors – 220.95ha
- In addition, under the Browse LNG Precinct Project Agreement a statutory buffer zone of approximately 3,000ha has been allocated.
- For future vesting of the port in the Broome Port Authority, an allocation of approximately 1,467ha offshore will be utilised.

A number of different port layout scenarios investigated during development of the Master Plan explored opportunities for shared jetties, channels, basins and other infrastructure in order to minimise the area required for the harbour footprint and the duplication of harbour infrastructure.

Subsequent to Revision 2 of the Master Plan, the proposed foundation proponent prepared two port layout options as part of its FEED process. These two options were based on the proposed foundation proponent's technical requirements and on outcomes of the further investigations undertaken at the site, including the collection of additional data such as improved bathymetry and nearshore geotechnical investigations. These findings supported a solution with more dredging and less breakwaters, leading to the siting of a harbour basin closer in-shore.

WorleyParsons undertook preliminary wave modelling work for both short and long period waves for a number of different layout scenarios. The modelling showed that the penetration of long period waves into the port will lead to some degree of amplification compared with the measured values in the existing location. The degree of amplification can be influenced by the selection of an appropriate layout, which ensures both proponents can achieve the minimum Basis of Design requirements for berth operability. The requirement of 98% for berth operability, typical for such marine terminals, is necessary to allow the supply chain to work efficiently and not be hindered by intermittent berth availability.

The modelling indicated that a suitable level of flexibility exists for a minimum of two proponents to develop workable solutions within the approved footprint, however this would need to be validated through a more detailed investigation upon understanding the desired configuration of the potential foundation proponent.

For the purposes of the Master Plan, the base case port layout only accommodates a single IMF including all MOF, tug pen and supply base activities; however in discussions with the potential foundation proponent, the option of separate IMFs was explored. Investigations revealed that the provision of more than one IMF would not function effectively. Following significant discussion and investigation, all parties agreed that the option of sharing a single IMF harbour basin was an efficient

use of the available space and capable of accommodating all of the needs of each proponent as per the Basis of Design.

GLOSSARY OF ACRONYMS

Acronym	Definition
AHD	Australian Height Datum
BIA	Broome International Airport
BrPA	Broome Port Authority
CD	Chart Datum
DAFF	Department of Agriculture Fisheries and Forestry – Biosecurity (Cth)
DSD	Department of State Development
DWT	Dead Weight Tonnes
EPA	Environmental Protection Authority
EPCM	Engineering Procurement and Construction Management
FEED	Front End Engineering Design
FPSO	Floating Production, Storage and Offloading
GPS	Geographic Positioning System
HAT	Highest Astronomical Tide
HLO	Heavy Load Out
IMF	Integrated Marine Facility
JPP	James Price Point
KLC	Kimberley Land Council
LADS	Laser Airborne Depth Survey
LAT	Lowest Astronomical Tide
LOLO	Lift On Lift Off
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MHWS	Mean High Water Spring
MOF	Materials Offload Facility
MPa	Mega Pascals
MSL	Mean Sea Level
Mtpa	Million Tonnes Per Annum
NDT	Northern Development Taskforce
NOITT	Notices of Intention To Take
PDD	Project Definition Document
Qa	Alluvium
Qs	Quartz sands

Qcd	Quartz calcareous sand (coastal deposits)
Qpb	Quartz sand (cemented beach conglomerate)
Kb	Sandstone bedrock
Tb	Ferruginous conglomerate
QRA	Quantitative Risk Analysis
RORO	Roll On Roll Off
SPM	Single Point Mooring
TCR	Technical Clarification Register
TO	Traditional Owners
UCS	Uniaxial Compressive Strength
UKC	Under Keel Clearance
WAPC	West Australian Planning Commission

CONTENTS

APPENDICES

1 INTRODUCTION

The Department of State Development (DSD) commissioned WorleyParsons to document the Basis of Design and key features of a Master Plan to support the development of the Browse LNG Precinct.

The expanded scope of the Master Plan incorporated a range of additional activities to support the native title, heritage and approvals phases of the precinct development. The Master Plan also supported discussions with potential users to determine the preferred site and land allocations.

The Master Plan provides flexibility to users in the development of their preferred plot plans, together with well-defined land and water areas to accommodate these plot plans (including the required onshore and marine facilities). The focus is to provide flexibility within the land allotments to:

- accommodate varying LNG technology options;
- appreciate different approaches to design; and
- facilitate construction and development.

It is a requirement of the master planning process to ensure that developments proposed by a foundation proponent do not preclude subsequent developments from achieving the Basis of Design criteria.

It has been necessary in the master planning process to identify all land areas including corridors, shore crossings and road alignments to provide an envelope of total land required as a basis for negotiations with Traditional Owners. The objective of this work is to ensure the precinct remains an effective option for future proponents and supports the justification of the areas of land required without limiting the design options for the onshore LNG plant and marine based facilities within the allocated areas.

A potential foundation proponent participated in the master planning process and engineering analysis conducted by WorleyParsons. A range of options and scenarios consistent with the data provided by the potential foundation proponent were considered in the development of the Master Plan. This process included a significant effort to benchmark other projects against the Master Plan.

Subsequent to issuing the initial draft of the Master Plan, and ongoing discussions between the State and this potential foundation proponent, testing of the basis for the master planning was undertaken through real data, investigations and engineering development. This provided significant insight on likely design solutions.

This process resulted in the further development of the Master Plan and the identification of key aspects of the form of agreement essential to secure viable development options for subsequent proponents.

1.1 Background

In August 2008, the Department of State Development (DSD) engaged WorleyParsons to undertake an engineering review of four potential sites (Anjo Peninsula, North Head, James Price Point and Gourdon Bay) for an LNG precinct in the Kimberley region of Western Australia. The Northern Development Taskforce (NDT) selected the four from a list of eleven potential sites which had previously been shortlisted. James Price Point was selected as the preferred site for development in December 2008 (see Appendix 7). The shortlisting and final selection of the site near James Price Point was not undertaken by WorleyParsons. The background and history of the master planning process, including the site screening and selection process, is documented in Appendix 1.

In April 2011, DSD engaged WorleyParsons to provide technical infrastructure development advice for the review of planning proposals for the Browse LNG Precinct. A proposed foundation proponent was preparing its detailed engineering design as part of a comprehensive Front End Engineering and Design (FEED) and commercial assessment exercise. DSD sought to verify the consistency between the proposed FEED specifications and the Master Plan. LandCorp and the Broome Port Authority (BrPA) were also involved in the process in their role as the future managers of the precinct and port respectively.

The Master Plan was refined following discussions with DSD and the proposed foundation proponent. These refinements were in response to the design process that the proposed foundation proponent had initiated and the additional site information that it presented. This opportunity allowed refinement and validation of many of the Master Plan attributes and tested the Master Plan solution against a real project.

In May 2011, DSD issued a number of queries to the proposed foundation proponent in the form of a Technical Clarification Register (TCR), including technical and planning clarification questions relating to deviations in the proposal when compared against the State's expectations as previously discussed and agreed with the proposed foundation proponent. The TCR's purpose was to illicit further information from the proposed foundation proponent to ensure that any proposed planning undertaken for the Browse LNG Precinct was in accordance with the Master Plan.

To elaborate on the Master Plan, DSD prepared a Precinct Definition Document (Appendix 3) in September 2011. The purpose of the Precinct Definition Document was twofold: firstly, to clarify and emphasise the intent of the agreement relating to State policy expectations; and secondly, to provide certainty and assurance to proponents regarding State requirements for planning and the design of projects within the precinct area.

With the issue of the Precinct Definition Document, further discussions conducted between the State and the proposed foundation proponent provided additional information and clarified the proposed foundation proponent's position on elements of its proposal. This resulted in further iterations of the TCR in October 2011, May 2012 and August 2012. During this time, access to the proponent's data room permitted WorleyParsons to undertake a review of reports prepared by the proponent's contractors. The review ensured that the investigations undertaken accorded with a methodology acceptable within the context of the Master Plan and agreements between the State and the

proponent. This process provided significant alignment of the Master Plan within a real development scenario.

2 PURPOSE

The purpose of this document is to define both spatially and textually the key attributes of the Master Plan for the Browse LNG Precinct including all of its key onshore and offshore components.

The Master Plan sets out the location of the precinct including assumptions behind its layout, key components, staging and infrastructure requirements. Revision 4 of the Master Plan defines the layout of the precinct, the rights of each proponent, and provides further definition around these issues and the challenges to the sharing of infrastructure.

As the Master Plan is strategic in nature, aspects of particular development proposals require further investigation in order to finalise layout and design aspects. Therefore, the layouts included in the Master Plan are indicative only.

The value of this Master Plan is that it captures the most up to date planning for the precinct at its time of publication and provides a high-level vision for the precinct's development. The Master Plan identifies well-defined land and water areas with flexibility for proponents to develop to suit their needs without compromising the ability of future proponents to meet the Basis of Design requirements. The objective of this work was to ensure the precinct remains an effective option for future developers of gas projects in the Kimberley.

3 MASTER PLAN METHODOLOGY

This Revision 4 of the Master Plan has evolved over multiple phases including:

- Data collection, review and consolidation;
- Site visit and technical review; and
- Development of Master Plan for the preferred site.

As noted above, a more detailed background of the master planning process is documented in Appendix 1.

In April 2009, the State Government and Traditional Owners signed a Heads of Agreement for the Browse LNG Precinct. The agreement sets out a number of key aspects of the precinct subsequently incorporated into the Basis of Design and which influenced the Master Plan arrangement included in this report.

The Heads of Agreement included high-level descriptions of the precinct's key components, including the land areas allowed for each. The details of this agreement are in Section 5.1.

Following execution of the Heads of Agreement, the parties entered into a Heritage Protection Agreement that sets out the areas within the precinct that require identification. Further details of the agreement are in Section 5.2.

In preparing a Basis of Design for the Master Plan, input was sought from all Browse Basin tenement holders in the preparation of a Project Definition Document (PDD) for their project. Further details of this process are in Section 5.3. Information provided by the proponents was combined with the State Government's requirements to confirm a Basis of Design for the Master Plan, covering both onshore (Section 5.4) and port components (Section 5.5).

Using the Basis of Design, WorleyParsons prepared a Master Plan for DSD in July 2010 (Revision 2 of this document).

Following preparation of Revision 2 of the Master Plan, the proposed foundation proponent sought to align their proposal with the Master Plan. In April 2011, DSD engaged WorleyParsons to provide technical infrastructure development advice in reviewing planning proposals presented by the proposed foundation proponent. Through the investigations undertaken by the proposed foundation proponent and the additional data presented, there were a number of departures from the Master Plan. Many of these departures, considered in previous revisions of the Master Plan and subsequently discounted, failed to optimise the overall cost of developing the precinct or to mitigate overall common or shared cost projections. It is however important that these key technical and economic drivers and company preferences, which drive these requirements, together with any economic impacts, are contained within any revisions of the Master Plan and reflected in the revision history.

To facilitate the process, a Technical Clarification Register (TCR) prepared by DSD documented a number of items where the proposed foundation proponent proposals deviated from the State's policy requirements or where further technical clarification was required as it related to the impacts of a proposal on future proponents of the precinct. A number of iterations of the TCR were prepared as a means of documenting the process between the State and the proposed foundation proponent. On 10 May 2011, DSD presented the first version of the TCR on behalf of the State.

In September 2011, the Precinct Definition Document was finalised and provided to the potential foundation proponent for consideration. Through later revisions of the TCRs and the issues that arose from this process, access to proponent data rooms allowed DSD and WorleyParsons to review the studies that had been prepared. The data room review was not to comment on the accuracy of the data, but to seek responses to the TCR process and confirm if alternative solutions put forward by the proposed foundation proponent could meet the intent of the Master Plan and the expectations and policies of the State.

This document represents a refinement to the Master Plan (Revision 3). In updating the Master Plan, this revision helps to clarify or re-state those aspects of the Basis of Design that may have been misinterpreted or overlooked in earlier iterations (as reiterated in the Precinct Definition Document). It also reflects the considerable additional input provided by the proposed foundation proponent because of the TCR and the access granted to the data room as part of that exchange.

4 SITE ANALYSIS – OPPORTUNITIES AND CONSTRAINTS

4.1 General

This section provides a high-level overview of the opportunities and constraints of the selected site near James Price Point (JPP). For historical and supporting analysis of the site's characteristics, refer to the Phase 2 Site Analysis report.

The site suitability for an LNG precinct will be driven by key site attributes such as nearshore bathymetry and distance to deep water, site geology, the transition between onshore and nearshore site elevations and the availability and use of nearby construction materials along with other key constraints. It is not any one characteristic which drove the site precinct Master Plan, but the development of an optimum and integrated solution which works to maximise the opportunities and minimise the risks presented by all of these factors.

To allocate the land areas around JPP, it was necessary to develop solutions along the extent of the precinct in an effort to develop a feel for the solution drivers and lead to the recommended site. A desktop assessment of the advantages and disadvantages of each solution (based on a fully developed precinct plot plan); including LNG plant site, plot plan scenarios and marine facilities arrangement was carried out. As well as the engineering drivers as noted above, these sites are also analysed in the context of the environmental and heritage issues leading to a total solution.

The site analysis was constrained by the amount of available data, including metocean data, geotechnical data and other key information. It was therefore necessary to develop a basis of assessment for each site from public domain information, the limited data available to DSD and in some cases limited data provided by prospective proponents. The following sections provide a brief overview of this site data analysis, which was extensive and which included engagement on numerous occasions with the prospective proponents, the Traditional Owners and the Government.

The access to significant data sets compiled by the proposed foundation proponent provided greater insight into the conclusions drawn from this site analysis and validated the conclusions and assumptions drawn in other areas. Access to view and compare the data was also of significance to the master planning process.

4.2 Site Topography

The site topography trends from an elevation of approximately +10m (MSL) at the Pindan cliffs on the coast to approximately +40m (MSL) in land at the eastern end of the precinct. Low-lying vegetation covers dunes of Pindan sand with varying depths to the sandstone bedrock.

The extent of topographic relief is important in the following context:

- The depth of Pindan sands and potential for foundation challenges and cost (piling) will be reflected in the topography based on likely geology;

- The elevation in relation to storm surge levels and coastal flooding will be important and will need to meet a well-defined minimum level; and

- The degree of visual impact of the project on the horizon when viewed from offshore will be more pronounced for sites where the potential to shield this impact is limited.

As part of the assessment, considerable work focused on the impact of the above factors on key infrastructure foundations and how their arrangement could mitigate risk, including the preparation of 3D visualisation of the plot plan as an indication of the likely visual impact of the precinct.

Some preliminary assessment of storm surge was also undertaken. However, given that in close proximity to the coast the land elevation rises to a level where flooding from storm surge is no longer critical, the only consideration would be the impact of a tsunami.

Two major drainage channels bind the site to the north and south and form effective boundaries or areas of potential impact for an efficient precinct arrangement. Within these boundaries, no major drainage lines exist although two minor channels exist in areas of local depression. These channels only carry water during storm events in the wet season. Validation of the drainage assumptions occurred during the data room review and confirmed the general assumptions made in the master planning process. Key environmental constraints including the need to maintain floodwater dynamics in the vine thicket and manage drainage discharge drive the design solutions of the port area.

4.3 Nearshore Bathymetry

The nearshore bathymetry between Quondong and the Flat Rocks site show increasing distance to deep water (depth of -14m below CD) varying from approximately 5.2km at Quondong Point, to 6.4km at JPP and 14km at Flat Rocks. This trend towards deeper water closer to shore at Quondong Point was a key driver in the siting of the port in order to minimise dredging costs.

Laser Airborne Depth Survey (LADS) data, as provided by the proposed foundation proponent for visual inspection only during the preparation of the 2010 version of the Master Plan, showed a number of key features which identified more key items of interest and in general supported many of the previous observations made in the site selection process, including the following:

- Confirmation of the distance to deep water and the trends in nearshore bathymetry as noted in the existing public domain charting;

- Some minor variation in the depth trends between shoreline and offshore, which are to be expected from the much more intense density of elevations gathered by the LADS data sets when compared with the previous basis for charting which is likely to have been lead line soundings for this area;

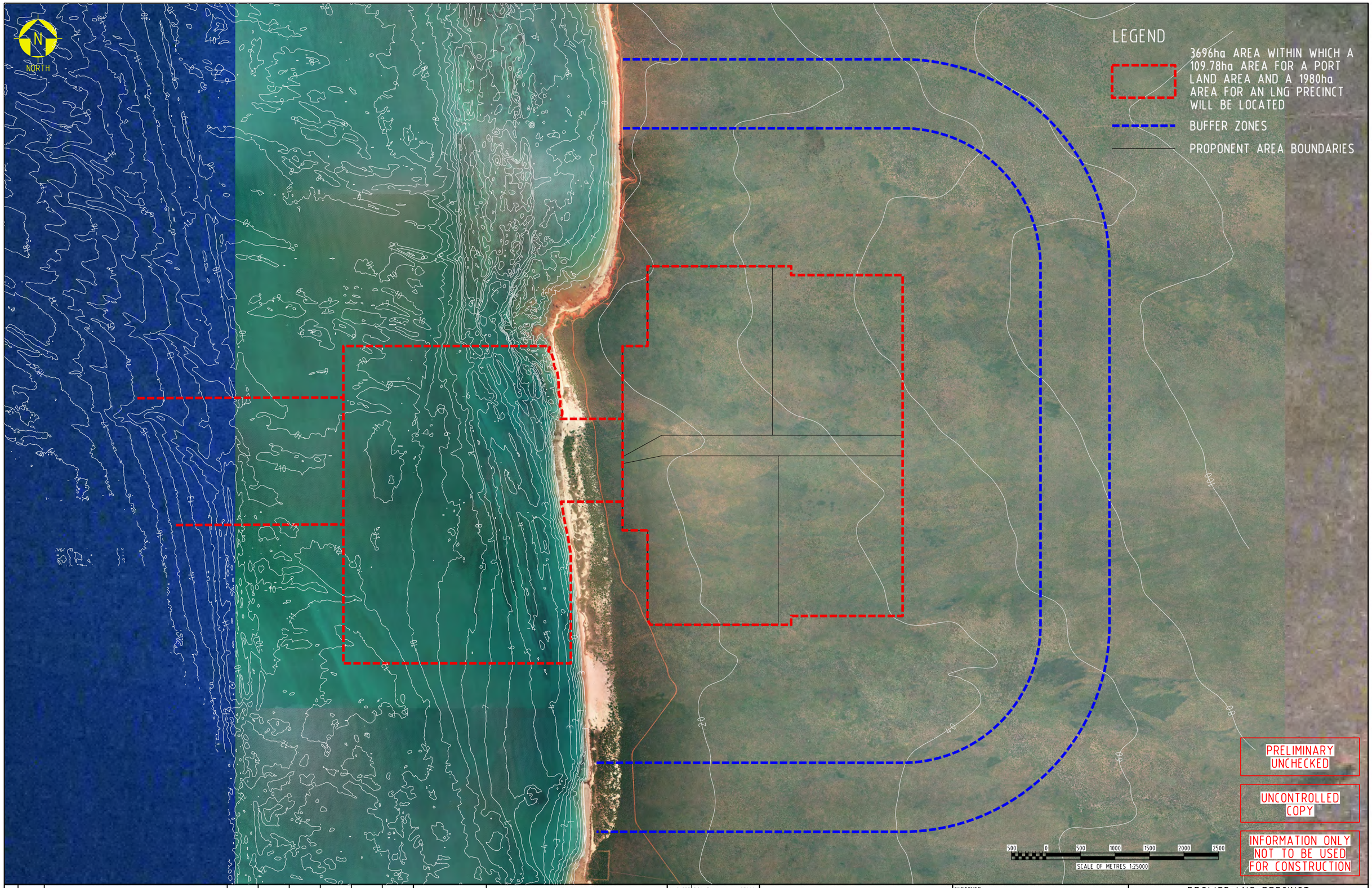
- The presence of what could be a paleochannel and region of uncemented seabed materials, reflected in the bathymetry and to a less obvious extent in the charting bathymetry;

- The presence of an outer calcarenite reef overlying the sandstone bedrock material typical of this region; and

- An incised channel in the outer reef system which could be a remnant of a paleochannel feature and which could lend itself to an enhanced dredging scenario.

The significance in this trending is reflective of the amount of dredging and the jetty length required for the arrival, berthing, loading and departures of ships. Clearly the greater this distance the greater the expected cost outcomes for the project.

The proposed foundation proponent subsequently collected additional nearshore bathymetry data, which was tabled in discussions with DSD and provided to WorleyParsons (refer Figure 1). This data is not significantly different to the LADS data and therefore has not been included in this version of the Master Plan. The additional bathymetry data indicates that deeper water is available sooner than indicated in previous data sets. This, coupled with the finding that less cementing occurs in the nearshore strata, could result in a lower cost solution for the development of the port.



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1	25.02.14	ISSUED FOR CLIENT INFORMATION	AMW							
0	19.06.13	ISSUED FOR CLIENT INFORMATION	ARB							

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CUSTOMER: DEPARTMENT OF STATE DEVELOPMENT

BROWSE LNG PRECINCT BATHYMETRY

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4.4 Shoreline Relief and Geometry

The shoreline crossing is characterised by significant relief in the area north of JPP where an eroded escarpment cutting into the Pindan materials is evident. To the south of JPP, there are limestone cliffs with cast features and areas with risk of collapse, which may need treatment to support the jetty abutment and the Materials Offload Facility (MOF), haul road and facilities. A narrow sandy beach separates the cliffs from the water line along the alignment of the shoreline to the north and south of JPP.

Generally, the height of the Pindan cliffs increases to the north of JPP as does the depth of Pindan over the sandstone bedrock.

Intersecting the shoreline with any structures will require careful consideration of this geometric constraint and more importantly, the longer-term stability of the coastline from erosion of the Pindan escarpment and the stability of the limestone cliffs and beach platform. These engineering issues are not insurmountable.

4.5 Site Metocean Conditions

The site is subject to a range of ambient and extreme metocean conditions both of which will dictate the most suitable solution for the landside and marine components of the precinct. The Kimberley region experiences two distinct seasons annually, the dry season between April and October and the wet season between November and March, both with distinctive Monsoonal wind systems.

During the wet season, the region is susceptible to cyclonic activity and extreme storm events, having the potential to impact on the construction and operational activities of the precinct as there will be periods when construction activities may be limited or ships unable to use the port. The cyclonic conditions lead to substantial wind, wave and current conditions, which drive the final marine, coastal and minimum design platform levels onshore. This section provides a brief overview of the key site characteristics as they have influenced the precinct arrangements.

The Kimberley region is also characterised by significant tides and associated strong currents. A close assessment of the tides in this region formed part of the site selection process and are a key driver to the safe navigation of vessels in the approaches to any port site. Tides influence the degree of dredging and configuration of the port. As shown in Table 2 below, a Mean High Water Spring (MHWS) water level of 8.0m is substantial and presents many port design challenges from a geometric perspective (vessel and berth interface) as well as having significant impacts on the cost and utilisation of marine structures.

The ambient wave climates are also a substantial consideration in the port suitability and the need for breakwaters to provide suitable levels of operability. Waves are generally from a westerly direction with winds from the west/southwest and east/southeast in line with the Indian Ocean swell patterns and the monsoonal wind systems that are prevalent over this site.

The ambient wave fields will dictate the need for breakwaters and the type of mooring and berthing structures. Table 1 summarises the ambient wave climate statistics at JPP based on a preliminary hindcast completed for the short listed sites to allow comparison for relative degree of exposure. The screening of wave heights, periods and directions (from the hindcast) against typical limiting criteria shows the site near JPP to include a number of potential limiting conditions and the likelihood that a breakwater will be required. Section 4.6 provides further information.

Since extracting this data from Public Domain and Government measurement programmes for the master planning process, the proposed foundation proponent made a significant effort to gather a data set suitable for design. Data room review of the proposed foundation proponent hindcast and measurement data sets has provided confirmation about the general observations that can be drawn from the preliminary master planning data and the conclusions which have been arrived at as they relate to master planning.

A comprehensive data set is advisable to achieve the level of accuracy required for design purposes to support the final design.

Table 1 Percentage Exceedance of Significant Wave Height by Season at James Price Point

Significant Wave Height (m)	Dec – Feb	Mar – May	Jun – Aug	Sep – Nov	Annual
>0.00	100.00	100.00	100.00	100.00	100.00
>0.25	95.85	99.89	54.14	69.34	79.38
>0.50	78.15	31.66	19.17	33.68	39.64
>0.75	33.15	10.69	0.56	7.51	12.43
>1.00	11.03	3.46		0.69	3.60
>1.25	5.17	1.03			1.45
>1.50	2.71	0.36			0.72
>1.75	1.39	0.21			0.37
>2.00	0.97	0.15			0.26
>2.25	0.66	0.03			0.16
>2.50	0.49				0.11
>2.75	0.41				0.09
>3.00	0.22				0.05

Significant Wave Height (m)	Dec – Feb	Mar – May	Jun – Aug	Sep – Nov	Annual
>3.25	0.17				0.04
>3.50	0.08				0.02
>3.75	0.07				0.02
>4.00	0.05				0.01

A review of the proposed foundation proponent's measurement data indicates that Long Period Waves do affect the site during periods of significant swell wave conditions. The response of the harbour design can lead to resonance of these conditions where no assessment is made of basin geometry and depths. DSD and the proposed foundation proponent have undertaken some significant work to validate the various Master Plan solutions. Further validation is required prior to acceptance of any proponent's final design solution. It will be incumbent on the foundation proponent to confirm that any resonance of Long Period Waves at the future proponents' berths will not affect the berth efficiency.

Preliminary wave modelling work was undertaken by WorleyParsons for both short and long period waves for a number of different layout scenarios. The modelling showed that the penetration of long period waves into the port will lead to some degree of amplification compared with the measured values in the existing location. This is indicated in Figure 2 which shows one of the scenarios modelled and assessed. The degree of amplification can be influenced by the selection of an appropriate layout which ensures both proponents can achieve the minimum Basis of Design requirements for berth operability. Furthermore, it is critical that the foundation proponent acknowledges the impact that their port layout may have on a future proponent and demonstrates that the layout and staging can accommodate future proponents with no adverse impacts on berth operability.

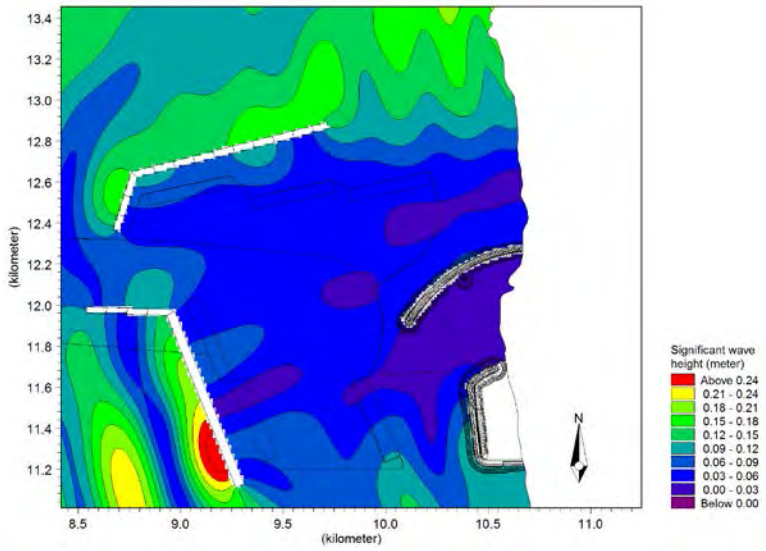


Figure 2 Long Period Wave Modelling Scenario

The modelling also indicated that a suitable level of flexibility exists for both foundation and future proponents to develop a workable solution within the approved footprint; however, this would need to be validated through a more detailed investigation upon understanding the desired configuration of the potential foundation proponent. The occurrence of extreme cyclones will dictate the plant levels and it is important in the site precinct arrangements that minimum platform levels are achievable by balanced cut to fill in view of the limited availability of construction materials. To this end, Table 2 presents a preliminary assessment of extreme coastal water levels considering the high tide levels and contributions from cyclonic surge and wind and wave influences. This table indicates the site development platform should have levels no lower than +13.0m above LAT, plus some margin for accuracy of these preliminary estimates. As indicated in section 4.1, besides the near coastal margin, this level is achieved at close proximity to the shoreline.

Table 2 100 year extreme plant level (relative to LAT)

Water Level	James Price Point
MHWS	8.0
Storm Surge	2.7
Wave set-up	1.0
Wave run-up	1.5
Climate change	0.4
Free Board	1.0
Plant Level (above LAT)	13.0
Plant Level (above AHD)	8.5

This assessment of extreme water levels is even more critical when considering the likely challenges of handling and managing the local Pindan materials over the site.

DSD has not assessed tsunami events but notes the extensive work undertaken by the proposed foundation proponent in this area. However, there is a need to complete a probabilistic estimate of tsunami events to validate the extent of inundation on the nearshore facilities in finalising a design solution. Whilst tsunami events in this location will have minimal impact, they will influence the nearshore facilities design.

4.6 Berth Operability and Port Design Implications

The preliminary wave hindcast study undertaken as part of this desktop assessment was not sufficiently detailed to provide definitive estimates of berth operability and was completed to provide indicative information only. The high requirement of 98% for berth operability, typical for such marine terminals, is necessary to allow the supply chain to work efficiently and not be hindered by intermittent berth availability and as such this is an important consideration. Notwithstanding this, this hindcast which was undertaken as part of the site assessment, has provided a preliminary indication of the conditions and likely berth operability when compared against typical berth operating criteria. Some of the observations made from the desk top assessment are summarised below:

- The total wave dominant directions are from west with the west / south west direction being a secondary dominated wave direction, reflecting the presence of the dominant monsoonal wind condition and the presence of the Indian Ocean swells.
- The maximum significant wave height reaches approximately 1.5m for total waves which is composed predominantly of sea wave energy.
- Swell waves at the site are significantly lower in general and maximum significant wave heights for swell are generally lower than 0.8m. The wave period range for the swells is observed to range up to 18s in the hindcast model which is important in the berth mooring behaviours.
- The tidal current conditions at the proposed development site are expected to be dominated by the tide, with a maximum and mean current of 0.8 and 0.4m/s respectively, as indicated by measurements provided by the proposed foundation proponent's measurement programmes, trending to lower values to the south of the site driven by local circulation patterns.

Some observations made from the assessment of the available hindcast, which will influence the port's ability to achieve 98% operability without a breakwater, are as follows:

- The presence of the underlying swell, at the site with wave heights beyond typical threshold values for this wave condition, indicates the likelihood of some significant periods of limited mooring conditions.
- The complex and multidirectional local seas make it difficult to develop a single berth orientation, which can minimise the influence of waves on mooring response, again limiting the potential to achieve the Basis of Design requirements for berth operability.

- The target operability of a reliable port (where the project supply chain does not have its bottleneck in port availability and operability) is 98% or greater. Subject to detailed analysis and an understanding of the likely limiting conditions, the site would be unable to achieve this outcome without a breakwater structure of sufficient extent to achieve this key design requirement.
- The target operability of 98% or higher ensures the efficiency of supply chains and is considered a base case for the Master Plan. The proposed foundation proponent further validated this position in the work undertaken and the conclusion reached that a breakwater is necessary to support the port development, although the extent of breakwater is variable depending on what constitutes an acceptable berth operability window.
- Some new and unproven technologies have been proposed, such as vacuum based mooring systems to replace mooring lines and flexible loading arms (which can lead to significant variance in the mooring type) and relieve the criteria for mooring limitations and the need for a breakwater. These systems are yet unproven in this application, and without sufficient technical support or evidence of their suitability for this site, cannot be considered as a base case option in the Master Plan. They can, however, be carried as an option subject to suitable levels of verification and applications where their viability at this site can be proven.
- If alternative technologies were applied within the area of the port that eliminate the requirement for a breakwater it is likely that the overall environmental impacts of the port would be significantly reduced.
- The application of the breakwater at this site will need to meet the design requirements for significant metocean design criteria associated with the high tide levels and cyclonic events at the site. This is an onerous requirement and as such, the need to work and refine these estimates is an important consideration in determining the precinct solution.
- Tug pens will also require sheltering within the main breakwaters or with separate breakwaters of their own, depending on their location.

4.7 Geotechnical Site Analysis

The geotechnical conditions are a key driver to the site analysis and will form the basis of key engineering design and cost outcomes for the selected site. This will include key aspects of the design and construction, including earthworks, foundation conditions and availability of construction materials, dredging, piling and other key aspects of the project.

WorleyParsons undertook a geological overview of four potential areas of interest in the Kimberley region, nominated by the NDT for inspection during a site reconnaissance (Figure 31). The main objectives of these investigations were to:

- Characterize ground conditions at each of the respective sites (onshore/nearshore) based on visual observations;

- Identify potential geohazards that could affect plot layouts for the plant and marine facilities; and
- Provide geological advice to the WorleyParsons Civil and Marine Teams in relation to anticipated earthworks, foundation conditions, dredging requirements and construction materials to assist in the development of an industrial Master Plan.

The following sections discuss the findings of this review by WorleyParsons for the site near JPP.

4.7.1 Desktop Study

The conduct of an initial desktop study occurred prior to a site reconnaissance. This phase of work included the review and collation of available information in the public domain, and preparation of base plans by superimposing aerial photography, topography, bathymetry and geological information (available at the time) at the site to allow the conduct of productive ground and aerial surveillance.

4.7.2 Fieldwork

The reconnaissance site inspection was carried out from 5 to 11 September 2008 attended by representatives from WorleyParsons Civil/Planning, Marine and Geotechnical Teams and accompanied at various times by members from DSD, Kimberley Land Council (KLC) and Traditional Owners, the proposed foundation proponent and another potential proponent.

DSD chartered a fixed wing aircraft to conduct the aerial reconnaissance, typically flying at low altitude between 500 to 800 feet during surveillance. Where access permitted, a visual inspection by four-wheel drive occurred.

Evaluation of the site during the geological component of the fieldwork was on the following basic criteria:

- Available land area, elevation and relief;
- Proximity to and nature of coastline;
- Distance to relatively deep water and nature of seabed;
- Onshore and nearshore geology, and potential geohazards as they may affect the key project components such as dredging and earthworks; and
- Constructability issues.

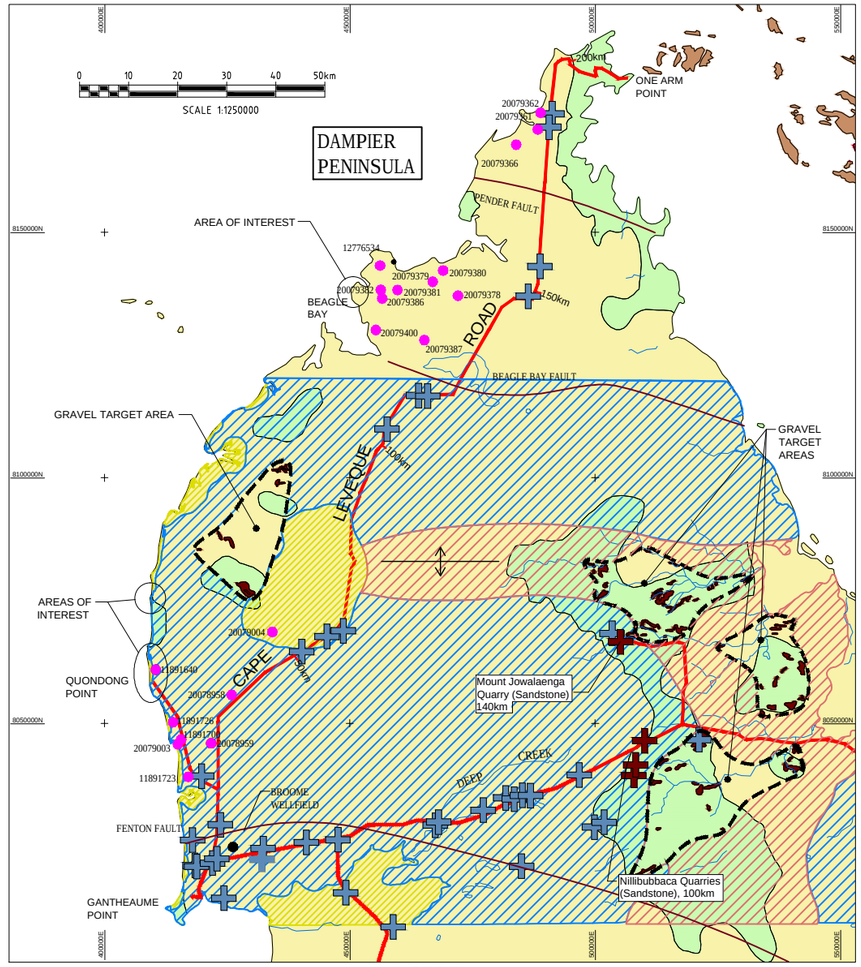
4.7.3 Geological Site Conditions

Figure 3 presents a regional geology and resource map for the Kimberley and is further discussed in Appendix 4 (insert provides detail for the Dampier Peninsula). The following provides an overview of the local geological conditions observed during the site reconnaissance. Explanatory notes describing the engineering geology terms used in this report are at Appendix 5.

4.7.3.1 QUONDONG, JAMES PRICE POINT & FLAT ROCKS

Quondong, JPP and Flat Rocks are on the same stretch of coastline located north of Broome on the Dampier Peninsula, representing a gently domed plain that rises some 220m above sea level. Rough sandstone exposures occur at the north end of the peninsula (part of Lombadina Plateau), as rocky headlands along the west coast and as flat topped ridges inland capped with laterite (Figure 3).

These sites represent a single area of interest, accessible from Manari Road.



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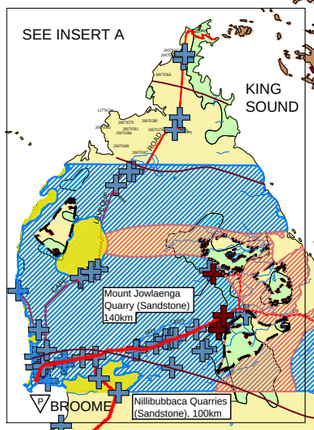


POTENTIAL CONSTRUCTION MATERIALS:

- BORROW (FILL)
- LATERITE GRAVEL (BASECOURSE/SUBBASE)
- SANDSTONE (SECONDARY ARMOUR/CORE/CRUSHED ROCK BASE)
- LIMESTONE (PRIMARY ARMOUR)
- GRANITE-GREENSTONE IGNEOUS ROCK (PRIMARY ARMOUR)

POTENTIAL CONSTRUCTION WATER RESOURCES:

- SURFICIAL SEDIMENTS (ALLUVIAL AND EOLIAN SANDS), MINOR GROUNDWATER RESOURCES WITH BORE / WELL YIELDS UP TO 50 TO 100m³/DAY, GENERALLY LOW SALINITY EXCEPT IN COASTAL DISCHARGE AREAS
- SEDIMENTARY AQUIFERS (BROOME SANDSTONE), MAJOR GROUNDWATER RESOURCES, HIGH YIELDS OF UP TO 2000m ³/DAY, USUALLY FRESH EXCEPT NEAR COAST WHERE SALINE INTRUSION OCCURS
- SEDIMENTARY AQUICLUDES (JARLEMAI SILTSTONE), MINOR OR NO GROUNDWATER RESOURCES

LEGEND:

- EXISTING HIGHWAY/ROAD
- WATERCOURSE
- FAULT
- BASKERVILLE ANTICLINE
- MAJOR PORT HANDLING FACILITY
- CONSTRUCTION MATERIAL
- QUARRY SITE/POTENTIAL RESOURCE
- 11891640 EXISTING WATER BORE/DEPARTMENT OF ENVIRONMENT REFERENCE (NEAR PROJECT SITES)

GEOLOGY:

	WATER
PHANEROZOIC	ALLUVIAL, SHORELINE, AND EOLIAN DEPOSITS
PHANEROZOIC	MARINE AND CONTINENTAL SEDIMENTARY ROCKS
PHANEROZOIC	MARINE AND CONTINENTAL SEDIMENTARY ROCKS
PHANEROZOIC	MARINE AND CONTINENTAL SEDIMENTARY AND VOLCANIC ROCKS
PROTEROZOIC	SANDSTONE
PROTEROZOIC	SANDSTONE
PROTEROZOIC	SANDSTONE AND SHALE
PROTEROZOIC	BASALT
PROTEROZOIC	METASEDIMENTARY ROCKS
PROTEROZOIC	METAMORPHOSED VOLCANIC AND BASIC INTRUSIVE ROCKS
PROTEROZOIC	GRANITE AND GNEISS
ARCHAEAN	BASALT, DACITE, AND SANDSTONE
ARCHAEAN	METAMORPHOSED SEDIMENTARY AND ACID VOLCANIC ROCKS
ARCHAEAN	METAMORPHOSED BASIC AND ULTRABASIC VOLCANIC AND INTRUSIVE ROCKS
ARCHAEAN	GRANITE AND GNEISS

GENERAL NOTES:

1. Geology based on 1:2500000 scale generalised state geology prepared by the Geological Survey of Western Australia, GSWA (Cooper and Flint, 2005)
2. Construction material locations generally sourced from Minedex Database (Department of Industries and Resources, March 2005)
3. Groundwater information extracted from 1:250000 scale Hydrogeological Sheets SE 51-6 and SE 51-7 (Broome & Derby) prepared by the GSWA (Laws 1991 & Smith 1992)

DATUMS:

Horizontal: Geocentric Datum of Australia 1994 (GDA94)
Coordinate System: Map Grid Australia (MGA) Zones 50, 51 & 52

CLIENT:

DEPARTMENT OF STATE DEVELOPMENT

WorleyParsons

BROWSE BASIN ONSHORE LNG PRECINCT REGIONAL GEOLOGY AND RESOURCE MAP

DRAWN	M. GUERIN	SEP '08	SHT	JOB No:	FIG No:	REV:
APPROVED	M. WEGG		A3	301012-01576	FIGURE 3	0
SCALE	As Shown	19/06/13				

4.7.3.2 ONSHORE

These sites contain the following similar geological units as illustrated in Figure 4:

- Pindan sand, predominantly silty to clayey quartz sands (Qs), red with low plasticity fines. The fines often act as a binder to the extent that this unit stands as moderate cliff/scarp faces along the edge of the coastal plain between JPP and Flat Rocks (Photograph 1 through to Photograph 4). The depth of Pindan sand appears to be greatest between JPP and Flat Rocks. This unit extends a considerable distance inland as a sand plain, with elevations ranging from about 15m AHD at the coast to between 30 to 60m AHD at a distance of 5km respectively. Such soil has a mixed windblown and alluvial origin and supports the characteristic Pindan vegetation comprising grassland with sparsely wooded trees and dense understorey.

- Coastal deposits; range from uncemented and mobile calcareous sand (Qcd) along beaches and low dunes, to well cemented beach conglomerate (Bossut Formation, Qpb) found directly overlying bedrock, observed to be 1 to 2m thick near JPP (Coastal deposits; range from uncemented and mobile calcareous sand (Qcd) along beaches and low dunes, to well cemented beach conglomerate (Bossut Formation, Qpb) found directly overlying bedrock, observed to be 1 to 2m thick near JPP (Photograph 3).

- Sandstone bedrock; Broome Sandstone (Kb) typically consisting of sandstone with subangular quartz grains (up to 10mm). At Quondong Point (south), the sandstone has high rock strength and joint spacings in the 200mm to 2m range with characteristic flat bedding planes resulting in tabular block shape (Photograph 5). A thin layer of ferruginous conglomerate (Tb) is also present at this location directly overlying the sandstone bedrock (Photograph 6). This rock is about 1 to 2m thick and is indicative of an older boulder deposit derived prior to the onset of the Bossut Formation. At Flat Rocks, the sandstone has a conglomeratic texture and is rich in heavy minerals (Photograph 7) with interbedded, ferruginous siltstone (Photograph 8 and Photograph 9) of lower strength. *In situ* weathering of these bedrock lithologies at this location has led to the formation of thin laterite deposits (Photograph 4).

Geology:

QUATERNARY		Qa — Sand, silt, clay; minor gravel: alluvial and lacustrine
		Qs — Sand, silt; minor gravel; mixed alluvial and neritic
		Qcd — Calcareous sand, partly oolitic; coastal aeolian dunes (includes reworked Qpl)
EARLY CRETACEOUS	Broome Sandstone	Kb — Sandstone, fine to very coarse; mudstone in part; minor conglomerate; ripple-marked, cross-bedded, partly bioturbated; plant fossils; shelf/ar marine

Legend:

- Bouguer anomaly contour (micrometres sec^{-2}), computer-plotter produced
- Geological boundary
- Where location of boundaries is approximate, line is broken
- P15 — Photo point and direction
- 20 — Surface contours (mAHD)
- • 15 — Elevation in metres
- Vehicle track
- Water course

Scale 1:100000 — 0 1 2 3 4 5km

Geology Source:

Broome (Sheet SE 51-6) 1:250000 Geological Series
map prepared by Geological Survey of Western Australia (1982)

Datums:

Horizontal: Geocentric Datum of Australia 1994 (GDA94)
Coordinate System: Map Grid of Australia (MGA94) Zone 51

DEPARTMENT OF STATE DEVELOPMENT

WorleyParsons

BROWSE
LNG PRECINCT
JAMES PRICE POINT
GEOLOGICAL PLAN

			SHT	JOB No:	FIG No:	REV
DRAWN	M. GUERIN	Aug '08	A3	301012-01576	FIGURE 4	0
APPROVED	M. WEGG					
SCALE	1:100000	19/06/13				

Photograph 1 James Price Point, Pindan scarps and wave cut platform

Photograph 2 James Price Point, Moderate cliffs developed in Pindan sand

Photograph 3 James Price Point, subvertical cliff face in Pindan sand, thin layer of beach conglomerate overlaying sandstone bedrock

Photograph 4 View at Flat Rocks of erosion rills and thin cover of laterite deposits

Photograph 5 Quondong Point, sandstone overlain by Pindan sand

Photograph 6 Quondong Point, thin layer of ferruginous conglomerate (circled) overlying Broome sandstone

Photograph 7 Flat Rocks, very abrasive bedrock belonging to Broome sandstone

Photograph 8 Flat Rocks, headland and point exposing ferruginous siltstone overlain by weathered horizon in turn capped by laterite deposits

Photograph 9 Flat Rocks, raised terrace at point exposing sandstone overlain with siltstone; undercutting extends approximately 5m inland

At each of these sites, the headlands are separated by beaches with calcareous sand backed by low coastal dunes (Photograph 10). Several westward draining watercourses traverse this part of the peninsula, containing thin deposits of alluvium (Qa). Seasonal flow during tropical cyclones is likely to be accompanied by erosion, particularly in the Pindan sand soils where gullies extend to 5m depth around JPP (Photograph 11). Elsewhere on the peninsula, the radial drainage system tends to be choked with sand.

Photograph 10 James Price Point, calcareous sand on beaches pass inland to Pindan sand, rock cut platforms developed in Broome sandstone

Photograph 11 James Price Point, erosion gully (5m deep) developed in Pindan sand

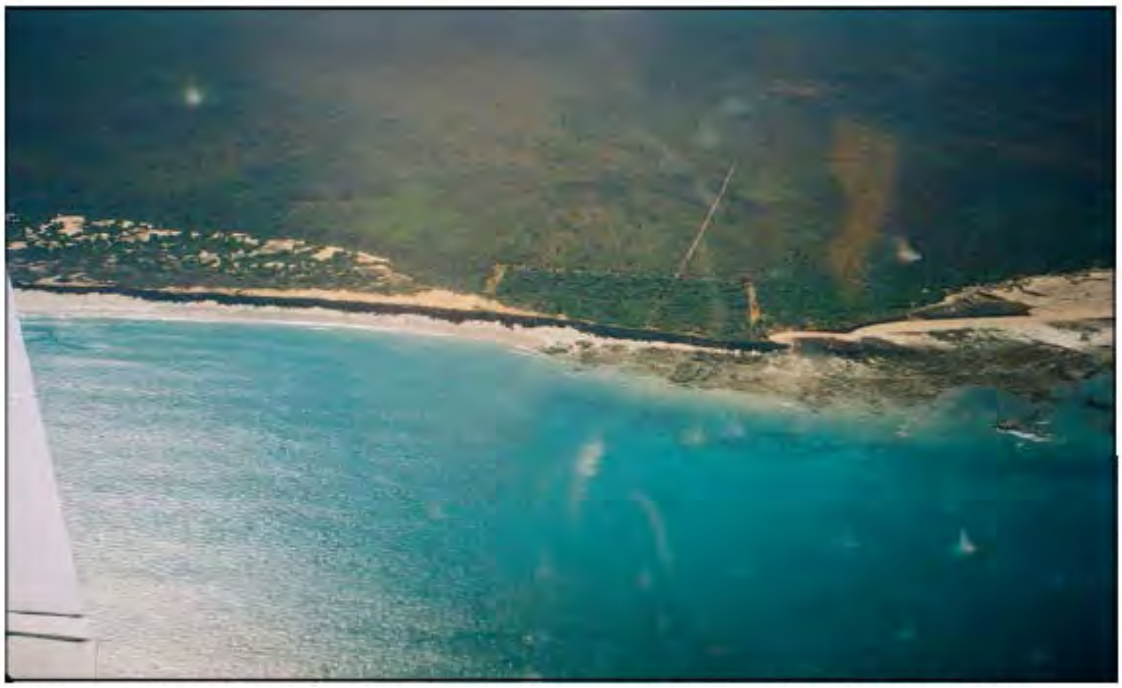
The sandstone present at Quondong Point (south) is the most competent bedrock of the three sites, primarily due to partial silicification (in turn making it more resistant to weathering). Bedrock is likely to continue inland at a similar level to that exposed at each respective headland.

4.7.3.3 NEARSHORE

A characteristic feature attributed to all these sites is the occurrence of a wave cut platform in Broome Sandstone extending some 500m offshore (Photograph 1, Photograph 12 through to Photograph 15). In addition, the present day wave cut platform also appears to step down to a submerged sandstone terrace containing several rocky shoals (possibly limestone). These shoals were clearly protruding above sea level during the aerial reconnaissance. The terrace appears to extend at least 1km from the coast at Quondong Point and around JPP, to some 2km at Flat Rocks.

Drowned shorelines are also a distinctive feature along this part of the coastline (refer Figure 5). The distance to -10m CD contour varies from about 2km (Quondong Point) to 4.5km (JPP) and 8km (Flat Rocks). There are numerous rocky shoals scattered inside the main -10m CD contour around JPP and particularly at Flat Rocks. Deep water (-15m CD) is located a further 2 to 3km offshore for all the sites.

Photograph 12 Quondong Point, wave cut platform



Photograph 13 James Price Point, wave cut platform

Photograph 14 Quondong Point, outcropping Broome sandstone extending as shallow reef offshore

Photograph 15 James Price Point, shoreline rock platform in play

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LOCATION MAP

BROOME

Jetty Zone

Flat Rocks Plant Zone
1000 Ha

Green
34
Red Cli

Shipping Zone

6.4km

Jetty Zone

James Price Plant Zone
1000 Ha

James Pric

(Red sand

James Price
Patches

5.2km

Jetty Zone

Quondong Plant Zone
1000 Ha

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LEGEND

BATHYMETRY (M) - DEC

DIA SITES

8_3 CHART DEPTHS ARE IN FATHOMS (UNDER ELEVEN IN FATHOMS AND FEET) REDUCED APPROXIMATELY TO INDIAN SPRING LOW WATER.

1 0.5 0 1 2

Datum: GDA94, Projection: MGA94, Zone 51S (Kilometres)

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REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING	REFERENCE DRAWING TITLE
0	19-06-2013	REISSUED FOR CLIENT REVIEW	PIR							
B	19-06-2013	RENUMBERED FROM FIGURE 9 AND RE-ISSUED FOR CLIENT INFORMATION	PIR							
A	11-12-2009	ISSUED FOR INTERNAL REVIEW	MS							

A3 SHEET SCALE 1:60,000

OneWay to zero harm

WORLEYPARSONS PROJECT No. 301012-01576

WorleyParsons resources & energy

EcoNomics

CUSTOMER

DEPARTMENT OF STATE DEVELOPMENT

BROWSE LNG PRECINCT
JAMES PRICE POINT
MARINE CHART

DRG No **FIGURE 5**

REV **0**

Produced by: Paul Rolfe - Geomatics W.A.

G:\PROJECTS\301012-00633_Browse Onshore LNG Precinct\03Project\Workspace\Rev 0\301012-00633-00-GI-DLP-0005_FIGURE10.mxd

4.7.4 Inferred Site Geology and Preliminary Engineering Design Conclusions

Based on the findings of the geological site assessment, some key conclusions can be drawn which will drive the basis for the Master Plan. Documented below, these findings represent the present state of knowledge of these sites.

4.7.4.1 Groundwater

As shown on Figure 3, the Broome Sandstone is a major groundwater resource on the peninsula capable of producing high yields. Water quality is usually fresh away from the coast. For these three sites, a relatively flat hydraulic gradient is present approaching mean sea level at the coast where saline intrusions are expected. There is also an expectation of local springs emanating from the base of the dunes north of Flat Rocks.

4.7.4.2 Pindan Sands, Collapsible Soils, Earthworks and Foundations

Pindan sand is present extensively at all the sites inspected on the Dampier Peninsula and Gourdon Bay, but is absent from Anjo Peninsula. The amount of fines in this unit is highly variable. When the soil becomes saturated, the particle framework has the potential to collapse under load.

The depth, profile and “real” collapse potential at the sites inspected is unknown and requires further investigation. Based on analysis of existing water bore information (see Table 3) and heights of existing cliff faces observed within this unit, the thickness of Pindan sand is likely to vary from about 5m near the coast to 15m inland. The thicker piles of Pindan sand appear to coincide with where siltstone is present in the underlying rock. Siltstone is more susceptible to weathering than resistant sandstone, in turn allowing a thicker pile of red soil to accumulate on top.

Table 3 Summary of Existing Water Bores

WINSite No.	Owner	Easting	Northing	General Location	Lithology	Bore Depth (m)	Static Water Level (m)	Supply (m^3/day)	pH	Total Dissolved Salts (mg/L)
12776534	Beagle Bay Community	456196	8143228	Emeriau Point	conglomerate	6.1	3.4		8.2	760
20079381	Beagle Bay Mission	459720	8138247	Tappers Inlet (east)	9.14m red sand over sandstone/conglomerate	45.7				
20079382	WAPET	456330	8138279	Tappers Inlet	16.8m red silty clay over sandstone/ conglomerate	68.86	21.6	327		
20079386		456604	8136527	Tappers Inlet (south)		54.8	20.7	550	3.5	
20079380	Beagle Bay Community	469025	8142216	Weedong Well			2.1		6.9	240
20079379	Beagle Bay Community	466913	8139930	Weedong Well (southwest)		46	15.4		7.3	370
20079378	Beagle Bay Mission	472065	8137076	Weedong Well (southeast)	12.2m red sand over sandstone	29				
20079400	Beagle Bay Mission	455331	8130102	Lumad Well			2.2	33	8.4	1020
20079387	Beagle Bay Mission	465192	8128053	Lumad Well (east)	13.7m sand over sandstone	38.1				

Note: Data extracted from DoE database (2005).

The impact of this geohazard for onshore development will largely depend on the thickness and nature of the soil encountered, particularly at critical structures with heavy or vibratory loads. Although piling may be required if this unit is deep, other alternative remediation solutions are available where it is shallower, or situated beneath non-critical areas less sensitive to settlement.

The susceptibility of Pindan sand to erosion is evident at all these sites, necessitating proper surface water drainage control and scour protection.

In all cases, the removal and conditioning of the soils to develop robust engineering properties in the absence of piling may be necessary. This will require access to significant laydown areas to allow the soils stripped from the site to be stored, conditioned with moisture or other additives in well-defined and usually thin layers. The soils, once conditioned, could be suitable for use at the site under controlled conditions. All earthworks options will require some form of treatment of the Pindan soils.

The heavy foundations under critical equipment, tanks and vessels will require piling, the assumption being that piling will be founded on the sandstone bedrock levels. In this study, this has been interpreted to reflect a foundation level at the wave cut platform levels as noted on the shoreline in line with the geological models developed in this desktop study.

4.7.4.3 Shoreline Interface at Unstable Cliffs

The coastal limestone exposed along the headland at North Head presents a significant geohazard. Until further investigations and a full understanding of the extent of cavernous ground beneath the

headland is known, it is recommended that a 200m wide buffer zone or setback be adopted from the coast for all major structures.

North of JPP, the escarpment is characterised by a Pindan erosion escarpment and south of JPP there are limestone cliffs with perched beaches at the water level. A comparative assessment undertaken at desktop level of the stabilisation requirements of the two areas contributed to the master planning. This assessment recognises that the shoreline interface and the unstable cliffs will require some supplementary engineering to stabilise the cliffs against coastal erosion or in the areas of unstable limestone cliffs their potential removed and replaced in a stable configuration as a structural fill (stabilised with armour facing against cyclone design wave conditions). This will provide a stable foundation for the pipeline corridor to the berth and the jetty abutment to be established. Piling is another option considered for this location. The outcome of this assessment shows that stabilisation in the limestone cliffs provides a more robust solution to this key infrastructure area.

At this interface, the critical MOF facility haul road connection to the onshore site from the Heavy Load Out (HLO) wharf will need to be established. Again, this alignment will need to traverse this significant relief and area of identified geohazard. The cliffs will need rework to meet the stringent geometric design (vertical and horizontal profile) and to accommodate the heavy loads.

4.7.4.4 Seabed Geology and Dredging

All the sites inspected contain shoreline rock platforms grading to submerged terraces in deeper water draped with a variable cover of marine sediments. Sandstone is considered to be the dominant bedrock lithology with an estimated uniaxial compressive strength (UCS) range of less than about 30 to 50MPa (Table 4). The bedded nature of the sandstone may reduce overall rock mass strength, as will the presence of interbeds of lower strength siltstone/mudstone.

Bedrock and coastal limestone (where present) will be abrasive on dredging equipment, in particular quartz sandstones with a conglomeratic texture. In the context of this report, cutting the sandstone bedrock is possible, although production rates may be low. Since that conclusion, the work by the proposed foundation proponent as viewed in their data room validated the dredging to be less complex than the conclusion drawn from this desktop review.

In fact, conclusions drawn from the significant seismic and drilling programme completed by the proposed foundation proponent show that the materials are significantly less consolidated. Solutions significantly closer inshore would lead to lowest cost solutions for a foundation proponent.

Selection of suitable dredging equipment will have to take into account the available depth of water, currents and tidal variations.

The risk of encountering igneous rock along Dampier Peninsula during any dredging operation is minimal. North Head is close to relatively deep water, with the least navigational obstacles in the form of rocky shoals protruding above the sediment cover (Table 4).

For jetty length versus dredging optimization studies at the Dampier Peninsula sites, assume a rock elevation below the -10m CD contour of approximately -12m CD (dipping westward). Rock levels closer to shore are indicated on the marine charts (Figure 6).

Table 4 Summary of Site Conditions

Site	Anjo Peninsula	North Head	Flat Rocks	James Price Point	Quondong Point	Gourdon Bay
Geohazards	Loose blocks at northern tip Abrasive rocks for dredging	Collapsible pindan? Unstable limestone cliffs with ground subsidence Abrasive rocks for dredging	Collapsible pindan? Erodible cliffs in pindan Deep pindan Abrasive rocks for dredging	Collapsible pindan? Erodible cliffs in pindan Deep pindan Abrasive rocks for dredging	Collapsible pindan? Abrasive rocks for dredging	Collapsible pindan? Crumbling limestone cliffs Abrasive rocks for dredging
Extent of wave cut platform (m)	250	250	500	500	500	1000
Distance to -10m CD contour (km)	1	1	8	4.5	2	2
Distance to -15m CD contour (km)	1.5	4.5	10	6.5	5	7.5
Presence of submerged reefs	Remote possibility of basaltic shoals in deep water	None apparent in deep water	Limestone shoals in shallow to moderate waters	Limestone shoals in shallow to moderate waters	Limestone shoals in shallow water	Limestone shoals in deep water
Estimated rock strength (UCS) range	Sandstone<30 to 50MPa Quartzite>50MPa	Limestone<10 to 20MPa Sandstone<30-50MPa	Sandstone<30-50MPa Siltstone<10MPa	Beach conglomerate<20 to 30MPa Sandstone<30-50MPa	Ferruginous conglomerate<20 to 30MPa Sandstone<30-50MPa Quartzite>50MPa	Limestone<10MPa Mudstone<10MPa Sandstone<30 to 50MPa
Onsite availability of suitable construction materials	Good	Fair	Poor	Poor	Poor	Fair to poor
Distance to offsite contruction material prospects (km)	<10 (southwest)	65 (east-northeast)	20 (northeast)	30 (north-northeast)	40 (north-northeast)	35 (east)

Notes:
1. Potential collapsible soil mechanism requires further study
2. Distances and strengths are indicative only

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LOCATION MAP

BROOME

Jetty Zone

Flat Rocks Plant Zone
1000 Ha

Green
34
Red Cli

Shipping Zone

6.4km

Jetty Zone

James Price Plant Zone
1000 Ha

James Pric

(Red sand

James Price
Patches

5.2km

Jetty Zone

Quondong Plant Zone
1000 Ha

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LEGEND

BATHYMETRY (M) - DEC

DIA SITES

8_3 CHART DEPTHS ARE IN FATHOMS (UNDER ELEVEN IN FATHOMS AND FEET) REDUCED APPROXIMATELY TO INDIAN SPRING LOW WATER.

1 0.5 0 1 2

Datum: GDA94, Projection: MGA94, Zone 51S (Kilometres)

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REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING	REFERENCE DRAWING TITLE
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A3 SHEET SCALE 1:60,000

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BROWSE LNG PRECINCT
JAMES PRICE POINT
MARINE CHART

DRG No **FIGURE 6**

REV **0**

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4.7.5 Subsequent Geotechnical Investigations

The proposed foundation proponent undertook additional investigations of the geotechnical conditions in the precinct as noted previously. The outcome of these is mostly concerned with the interpretation of the dredging. The nearshore geology is less cemented and therefore dredging would be easier than was anticipated from the field visit.

As a result of these investigations and noted above also, the port solution and layout presented by the proposed foundation proponent changed from previous revisions of the Master Plan by bringing it closer to shore.

Onshore, the geology was as expected and there was no subsequent impact on the design process in this area. The proposed foundation proponent had developed solutions for the treatment and conditioning of the Pindan sands to achieve sufficient bearing capacity to support foundations within the plant site footprint.

4.8 Availability of Construction Materials on the Dampier Peninsula (including Gourdon Bay)

A resource plan of potential construction materials for the Dampier Peninsula is included on Figure 3. Primary igneous armour is not available and therefore any breakwater option will most likely require the use of precast concrete blocks. Similarly, the import of high quality aggregates is required (nearest existing hard rock quarries shown on Figure 3).

The most likely source of construction materials will be sand and rock won from any deep excavations. A mixture of these materials would constitute common fill. A significant factor for sourcing rock from these sites will be the depth of sand cover present, given that outcrop is largely restricted to the coastal headlands. If the depth of overburden is excessive, the following alternatives are a consideration:

- Develop a quarry or pits offsite (distances shown on Figure 3);
- Import from commercial operations east of Broome; and
- Supplement with granular dredged fill.

North Head would appear to be the most attractive of these sites in terms of construction materials due to the following:

- It has the most extensive area of Bossut Formation outcrop; and
- Is likely to contain a relatively thin overburden horizon (i.e. relatively shallow depth to bedrock).

Processing the sandstone on the Dampier Peninsula will produce similar materials to those outlined above at Anjo Peninsula. The Bossut Formation could also be a source of pavement material given the apparent lack of natural gravel at North Head. Crushed limestone is also likely to form a suitable

core material for breakwater construction (if sufficient quantity). Any friable or weathered sandstone (Emeriau Sandstone) encountered at shallow depths could also be used for these applications.

The suitability of Pindan soil as a foundation material requires further assessment. Depending on the outcome, supplementing sand fill materials with granular dredged fill requires consideration. This is most likely to affect the JPP and Flat Rocks sites where the Pindan sand appears to be relatively thick and Bossut Formation is generally lacking (onshore). Dredged spoil (in the form of calcarenite gravel) is also an alternative pavement material, along with sporadic ferruginous deposits at creek headwaters in this general area. Environmental approval to use dredge spoil for landfill purposes is required.

Given the issues with onsite availability of construction materials on Dampier Peninsula, it would be essential to balance plant levels with material supply and demand requirements.

Table 4 identifies the location of possible target areas that may be suitable for manufacturing large quantities of crushed rock products or winning higher quality natural gravels from offsite areas. All but the Gourdon Bay area are included in Figure 3. Heritage issues associated with these target areas is unknown.

The availability of construction materials on the Dampier Peninsula requires further investigation (both onsite and offsite). The conclusion drawn however, is the availability of conventional construction materials such as structural fill, aggregates, armour, road base, etc. is very limited in close proximity to the site. A solution to minimise the need for these materials is preferred and the final solutions should seek to maximise offsite pre-fabrication and work where possible.

4.9 Nearshore Summary

Nearshore there are a number of constraints to overcome through the engineering and design of the chosen site. These include:

- Rocky shoals in shallow waters: These will need dredging where they conflict with turning basins, channels or infrastructure within the port. Generally, access to deeper water is better to the south of JPP.
- Shallow rock close to shore: Sandstone and quartzite rock formations may be encountered nearshore in areas that require dredging. However, the work completed by the proposed foundation proponent showed that the risk of hard dredging requiring drill and blast is minimal and, in fact, materials were significantly less consolidated than that expected following review of the desktop data.
- Breakwaters are required to achieve 98% operability for port users. Without breakwaters, the port site exposure to prevailing winds and ocean conditions is extreme.
- During spring tides, scheduling of port users to work within available windows is required.
- This site has a large tidal range, HAT 8.7m, LAT 0m.

- Long Period Waves do affect the site during periods of significant swell wave conditions. The response of the harbour design can lead to resonance of these conditions requiring an assessment to be made of basin geometry and depths to minimise the effects. The harbour basin shape is to be developed in a manner that minimises the impact on future proponents in achieving the Basis of Design criteria for their port facilities.

Limited coastal protection will be required at this site for the 100-year storm surge as the site is above the storm surge level. Navigable water (-14m depth) is located approximately 4km from shore with the -10m contour located approximately 2km from shore.

4.10 Onshore Summary

4.10.1 Land Availability

A large area of land suitable for development of an LNG precinct is available at the site. The ground is generally flat and higher than the 100 year storm surge level. The shoreline offers multiple potential locations for the launching of jetties with good opportunities for the location of storage tanks and processing plants in close proximity to the coast.

4.10.2 Site Access

The site near JPP is located approximately 50km as the crow flies or 56km by road from the township of Broome. Access to the site is by road from Broome via Broome Road, Broome-Cape Leveque Road, and Manari Road. Broome Road is sealed and the Broome-Cape Leveque Road sealed to a point just south of Manari Road. Figure 7 illustrates the location of existing sealed and unsealed roads in the vicinity of JPP.

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A2	23.11.09	ISSUED FOR CLIENT INFORMATION	ARB							
0	30.07.09	ISSUED FOR CLIENT INFORMATION	BGC							

A1 SHEET SCALE 1:100000

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BROWSE LNG PRECINCT
EXISTING ACCESS ROADS/TRACKS

DRG No FIGURE 7 REV 0

LOCATION: I:\Projects\301012-01576 Browse Master Plan Update\8_Drawings\Figures\FIGURE 7.dgn
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4.10.3 Accommodation

Given the site's proximity to Broome, the previous assumption was to accommodate some or all of the construction and operational workforce within the town itself. However, due to the shortage of accommodation within Broome and the potential for the influx of workers to have undesirable short-term effects on the town, it was decided that the construction workforce be located in a dedicated accommodation area within the precinct.

Personnel transportation is an important issue during construction when significant numbers of construction personnel will commute to and from the site. With staff working up to 12-hour shifts, a long commute at either end of their working day is not desirable. Additionally, if staff were able to drive themselves then this would have a significant impact on road traffic to and from the site.

To allow for the accommodation of the workforce within the precinct, the State Government, Traditional Owners and proposed foundation proponent agreed to incorporate a 200ha area to allow for construction, operational, and maintenance workforces within the precinct. The areas incorporated within the Master Plan and the use to be made of these areas forms an important part of the viability of the proposed Master Plan. These areas must, therefore, be managed to allow fair and reasonable access to both foundation and future proponents as and when required.

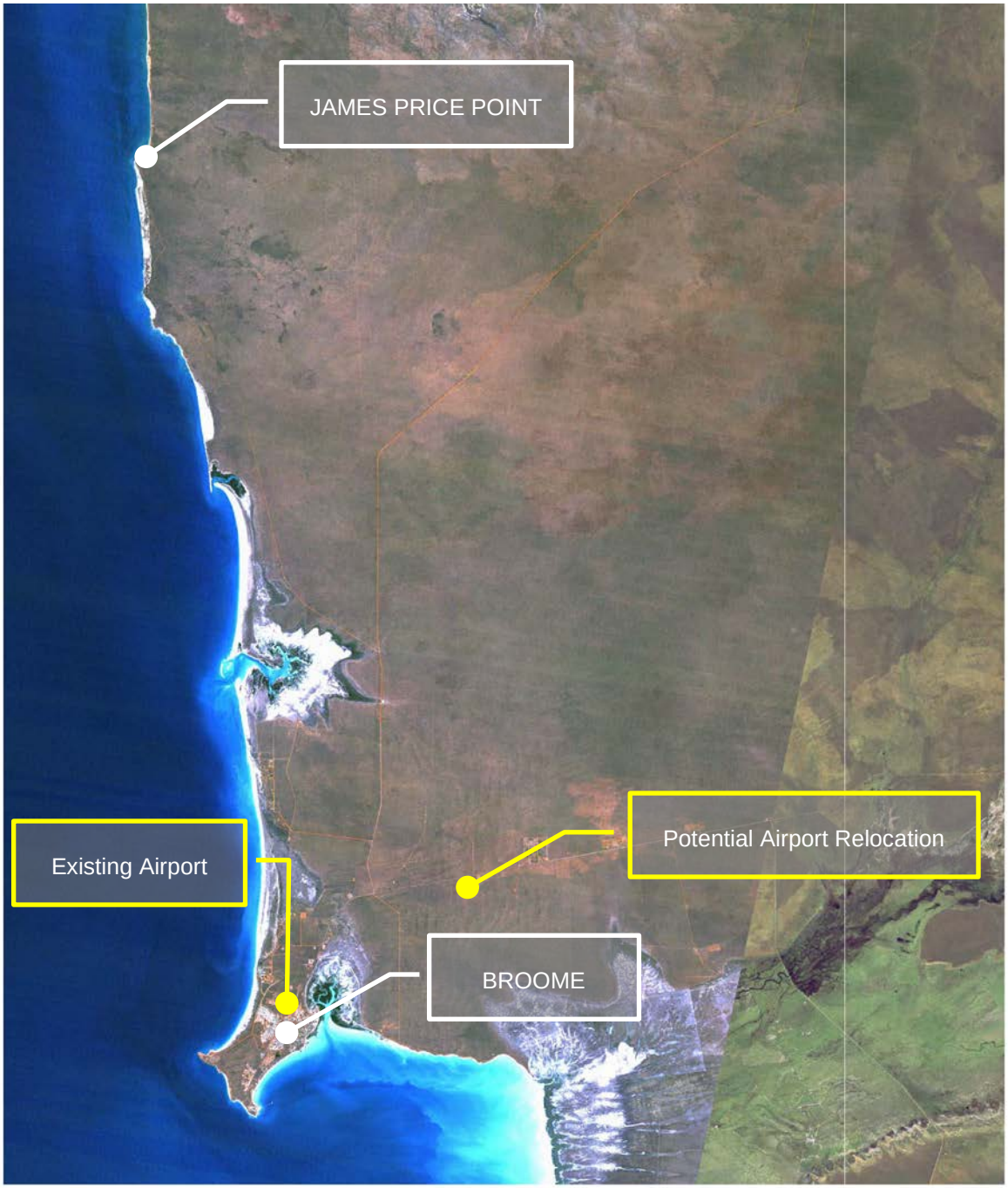
4.10.4 Airfield

The nearest airport is Broome International Airport (BIA) which is located in the centre of the Broome town site (refer Figure 8). This is a sealed airstrip and is currently the major airport for the Kimberley region. The suitability of this airport for the future, given its location in the centre of Broome, requires consideration in the context of the additional air and vehicular traffic that may be generated by the LNG precinct.

There is a proposal to relocate the airport from the centre of Broome to a location northeast of the town site. However, following discussion with BIA it appears unlikely that the airport will relocate in the immediate future given the significant investment in the current location and the anticipated cost of relocation.

The relocation of the airport to a new northeast location would reduce the distance to the site, freeing up additional urban land for development in the centre of Broome.

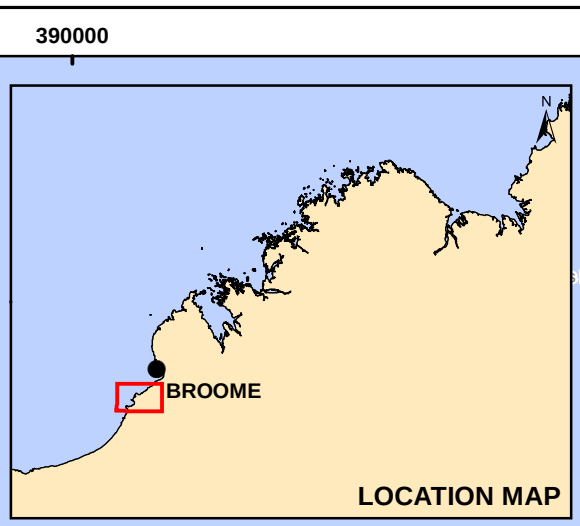
Figure 8 Existing and Potential Location of Broome Airport



4.10.5 Heritage and Environmental Constraints

A number of known Aboriginal heritage sites exist near JPP and the location known to be of great significance to Traditional Owners. In addition to the registered sites shown in Figure 9, detailed heritage surveys may identify additional sites. In 2009, the State entered into a Heritage Protection Agreement with the Traditional Owners and the proposed foundation proponent. This agreement not only guides the conduct of any heritage assessment and protection work, it provides as far as is practicable the best possible future protection of these sites.

A Strategic Environmental Review of the site has been undertaken by the State in accordance with the provisions of the State *Environmental Protection Act 1986* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. At the time of writing, the State is still awaiting completion of assessment processes by the State Environmental Protection Authority and the Commonwealth Government respectively. In 2013, the proposed foundation proponent was granted approvals under section 18 the *Aboriginal Heritage Act 1972* to conduct a range of activities on the site including for the purpose of constructing, operating and maintaining an LNG development, however it is noted that the approvals granted are not transferable, and new approvals would be required by a future proponent.



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N

Rock

Manari

Coulomb Point

James Price Point

GOOLARABOOLOO/JABIRRJABIRR

James Price Point

James Price Patches

Quondong Beach

Quondong Beach

Quondong Point

Tyre Corner

Grey Shoal

Farm Shoal

Barred Creek

LEGEND

- PLACE NAMES
- PROPOSED NDT SITES
- NDT ROADS
- ROADS
- MAJOR ROADS
- FACILITIES
- AIRSTRIPS
- HERITAGE WA
- HERITAGE - ABORIGINAL CULTURE
- ABORIGINAL HERITAGE SITES
- NATIVE TITLE REGISTER

3 1.5 0 3 6

Datum: GDA94, Projection: MGA94, Zone 51S (Kilometres)

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BROWSE LNG PRECINCT
JAMES PRICE POINT
ABORIGINAL HERITAGE

DRG No **FIGURE 9**

REV **0**

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N

LOCATION MAP

BROOME

Rock

Coulomb Point Nature Reserve
PROPOSED NATIONAL PARK

Manari

Coulomb Point

Mammals
Reptiles

Birds

PROPOSED NATIONAL PARK

Reptiles

James Price Point

James Price Point

James Price Patches

Quondong Beach

Quondong Beach

Quondong Point

Tyre Corner

Grey Shoal

Farm Shoal

Barred Creek

Birds

LEGEND

- PLACE NAMES
- PROPOSED NDT SITES
- NDT ROADS
- ROADS
- MAJOR ROADS
- FACILITIES
- AIRSTRIPS
- DEC MANAGED LANDS
- PROPOSED CONSERVATION RESERVE
- PROPOSED TENURE - CALM - 2007
- PROPOSED MARINE PROTECTED AREAS
- THREATENED FAUNA - 2007 (SHIFT AND BUFFERED 1500M)
- DEFL (SHIFT AND BUFFERED 1500M)
- DEC - THREATENED AND PRIORITY ECOLOGY COMMUNITIES (BUFFERED)

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Datum: GDA94, Projection: MGA94, Zone 51S (Kilometres)

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BROWSE LNG PRECINCT
JAMES PRICE POINT
ENVIRONMENT

DRG No **FIGURE 10**

REV **0**

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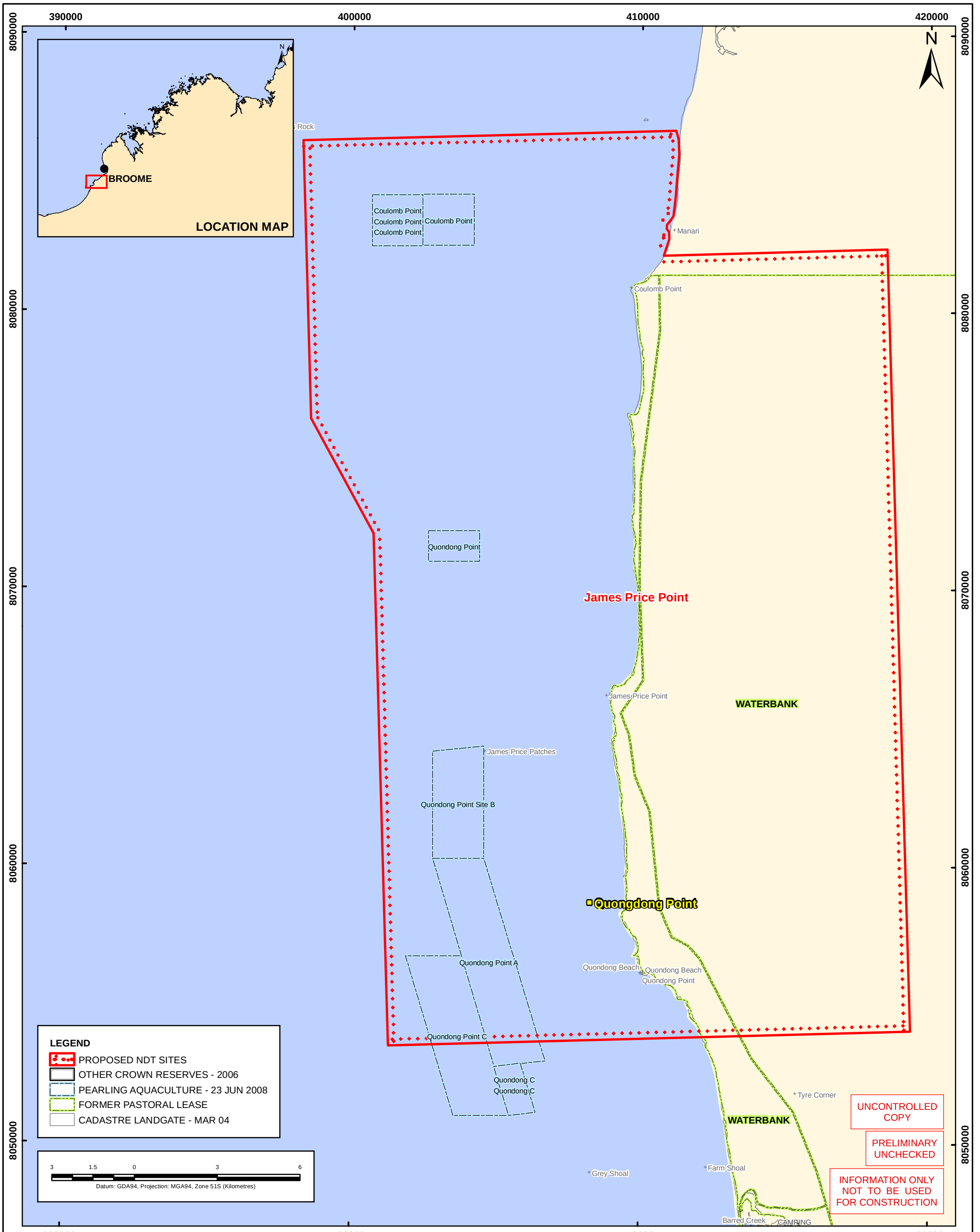

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BROWSE LNG PRECINCT
JAMES PRICE POINT
TENURE AND LICENCES

DRG No **FIGURE 11**

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5 BASIS OF DESIGN

This section discusses the various components of the Browse LNG precinct identifying key components, land requirements and the relationship of the different components to each other.

5.1 Heads of Agreement

In April 2009, Traditional Owners, the State Government and the proposed foundation proponent signed a Heads of Agreement for development of the Browse LNG Precinct. This agreement established a way forward for each of the signatories towards the establishment of an LNG precinct near JPP.

The Heads of Agreement also includes high-level descriptions of the precinct's key components including the land areas allowed for each.

Since then, with the issue of Notices of Intention to Take (NOITTs) the key areas of land was revised to include:

- A total precinct area of approximately 3,414.01ha, consisting of:
  - Port Land – 109.78ha
  - Industrial Precinct and Common User Area – 1980.00ha
  - Third Party Contractors' Site – 199.87ha
  - Accommodation Site – 199.86ha
  - Pipeline Corridors (North and South) – 437.05ha
  - Main Access Road, Third Party Contractors' Site Road, and Accommodation Road – 266.50ha
  - Service Corridors – 220.95ha
- In addition, under the Browse LNG Precinct Project Agreement a statutory buffer zone of approximately 3,000ha has been allocated.
- For future vesting of the port in the Broome Port Authority, an allocation of 1,467ha offshore will be utilised.

Exclusion of access to land will only apply to land and water within these precinct areas (not the buffer zone). These areas are shown on Figure 28.

On 30 June 2011, the Goolarabooloo Jabirr Jabirr native title claimants signed agreements that established a unique and comprehensive regime of benefits for Traditional Owners of the precinct site and the Indigenous communities across the Dampier Peninsula. These agreements supersede the Heads of Agreement.

5.2 Subsequent Agreements

Following execution of the Heads of Agreement the parties endorsed a further important agreement, the Heritage Protection Agreement, which is discussed further in the following section.

5.2.1 Heritage Protection Agreement

In relation to the Master Plan, the Heritage Protection Agreement identifies the following three key areas:

- “Area A” – Land to be used by the first proponent including an industrial block, workers accommodation area, access roads and pipelines.
- “Area B” – Land to be used by the second proponent including an industrial block, workers accommodation area, access roads and pipelines.
- “Area C” – Land that will be used for the Third Party Contractor Area (Support Industry), common user areas (service corridor, lay down area and internal buffer areas), land that is fenced (as part of the precinct) and access roads and pipelines within the boundaries or in support of the precinct.

5.3 User Requirements

At the commencement of the study, the NDT wrote to all Browse Basin tenement holders alerting them of the project and requesting them to prepare a Project Definition Document (PDD) for their project. The PDD requested a range of information from each proponent including:-

- A description of the proposal (built aspects and ongoing operations);
- A description of processing, inputs, products and discharges;
- Details of production design capacity and staging;
- The timeframe in which development is to occur;
- The proposed ultimate extent of areas required;
- Infrastructure to be developed or accessed in association with the proposal;
- Pipeline shore crossing details;
- Workforce numbers (construction/operation/maintenance), accommodation and transportation preferences;
- Bulk materials source/requirements;
- Waste storage/treatment or disposal;
- Emissions; and
- Domestic gas considerations.

WorleyParsons contacted seven of the key tenement holders (as identified by the NDT) to request meetings and completion of PDDs. Not all tenement holders were willing to meet with WorleyParsons or provide a PDD.

WorleyParsons met with three potential proponents, some of whom also provided PDD's. Some of the information discussed in these meetings and provided in the PDD's is 'commercial in confidence' and WorleyParsons was required to sign confidentiality agreements with some proponents. Consequently, the details of PDD's and records of meetings have not been included in this Master Plan report.

The main themes derived from the PDD's received and through the conduct of meetings that were held included:

- Proponents were generally unwilling to share infrastructure that is 'process critical'. This includes all infrastructure which may impact on plant performance, including:
  - Power supply;
  - Jetties and wharfs;
  - Storage; and
  - Any other infrastructure capable of bringing production to a halt.
- Proponents did identify the opportunity to share some 'non process critical' infrastructure including:
  - Access roads;
  - Accommodation;
  - Airfields; and
  - Fire and emergency services.

The willingness of proponents to share certain infrastructure elements but not others has influenced the land area required for the precinct. In some cases, land savings are achievable whereas in other cases, no saving over a typical standalone development is possible.

Prior to finalisation of the Master Plan, the State Government set out a number of more detailed requirements for the precinct including:

- An exclusion zone comprising:

    A. An industrial precinct (fenced) being:

        I. Two industrial blocks with each block exclusively accommodating standalone facilities for the relevant proponent allocated to the block (total of approximately 1,000ha); and

II. Common user area (service corridors, lay down areas and internal buffer areas, being a total of approximately 500 - 1,000ha); and

B. Land (fenced) and waters of the port (area to determined but likely to be approximately 1,000ha);

- A non-exclusion zone (also known as the 'ancillary land') (unfenced) as follows:

C. Workers' accommodation (up to 200ha);

D. Third Party Contractor area (200ha);

E. Access roads and service corridors; and

F. A buffer zone around the exclusion zone (approximately 3,000ha).

- The LNG precinct will:
  - contain single and multi-user port infrastructure in a logical arrangement aligned with the intent of the master planning principles, ensuring that the total cost and footprint is minimised yet remains efficient for all users;
  - be capable of accommodating in a viable and sustainable manner multiple stand-alone LNG processing facilities and operations; and
  - include a third party contractor area and workers accommodation area;
- The location and design of infrastructure and facilities for use within the common user area and the multi user port infrastructure will not be a barrier to the entry of an Additional Proponent;
- The impact on the environment (terrestrial and marine) is minimised.

5.4 Onshore Components

The following sections discuss the key onshore components of the LNG precinct and the areas required for their development.

5.4.1 LNG Processing

Within each LNG plant, activities can be broken into four core components as follows:

1. Storage Facilities

Storage facilities typically consist of large tanks used to store LNG or LPG condensate prior to loading on to ships for export, with each operator requiring multiple tanks. The amount of storage required by each operator will determine the size and number of storage tanks required, influenced further by the ultimate port configuration and its operability.

Large earth bunds surround the storage tanks located at the Karratha LNG plant. The provision of these bunds is not necessary for the protection of the tanks or the containment of spills but instead for visual amenity. If the visual amenity of having large tanks located close to the shoreline near JPP were an issue for the community, it would be possible to use earth bunds, perhaps in conjunction with sinking the tanks to assist in their screening.

2. LNG Trains

Allowance has been made for multiple LNG trains to be constructed in each proponent area. The size and number of trains may vary between operators, with a restriction in that the total processing capacity cannot exceed 50Mtpa. Trains are air-cooled and as such require orientation to maximise the advantage of the prevailing winds. In locating the precinct near JPP, the trains are to be located on an east/west axis.

3. Flares

Each proponent will require up to two flares within their site.

A buffer zone cleared of vegetation is required around each flare; however, the buffer zones for each flare can overlap.

Different technologies exist for flares. For example, the large permanent flare similar to that located at the Karratha LNG plant is unlikely to be used; a smaller permanent ground flare will be used in conjunction, with a larger emergency flare, the latter used only during shutdowns or emergencies although subject to regular testing.

4. Utilities

Within each proponent's site, an allowance for utility infrastructure exists. The infrastructure and activities undertaken within this area include:

- Power Generation;
- Production of Potable Water (Desalination); and
- Waste and wastewater management.

5. Administration

Each LNG operation requires an area for administration. This area would include buildings and facilities associated with operating the plant and its day-to-day management. Components within the administration area might include offices, training rooms, security, mess and medical facilities.

5.4.1.1 TOTAL SITE AREA

A total land area of 1,000ha is available within the Master Plan for LNG production, excluding common user areas, access roads, service corridors and external buffer zones. This figure has been

derived based on information provided by the potential proponents in their PDD's and the Heads of Agreement, the areas of similar facilities in other locations, professional judgement and a desire to provide sufficient flexibility to future operators to avoid sensitive heritage sites that are likely to be identified within the Browse LNG precinct boundaries.

5.4.2 Common User Areas

Common User areas are portions of the site used by proponents for two primary purposes. The first, to store equipment, materials and components delivered to site and the second, to provide an area for earthworks. Preliminary geotechnical investigations undertaken by WorleyParsons indicate the presence of Pindan sands of varying depths across the site. Depending on the construction method chosen, significant earthworks may be required to remove this material and blend it with other materials to improve it. This requires a large space to store and work these materials.

An area of 500ha is set aside as a laydown area for each LNG proponent. Depending on the configuration of the site and the expected configuration of the development, it may be possible to share a single large laydown area or if necessary to have two separate areas. Allowance for two separate laydown areas provides the greatest flexibility.

It is preferable that laydown areas are located immediately adjacent to the site. Dependent on the needs of each proponent, these allocated areas could be divided into multiple areas across the site or used as one contiguous area.

5.4.3 Buffer Zones

Two types of buffer zones are required in the context of the LNG precinct. These include:

- Internal buffer zone – suitable clearances between operators, equipment and facilities situated within the precinct boundary fence.
- External buffer zone – suitable clearances from the boundary of the LNG precinct (fence line) to external land uses or activities, though this area is not fenced.

Internal buffer zones are not determined as part of this study as they will relate to the nature, size and positioning of individual components within the precinct itself. They will be subject to future detailed studies in confirming the layout proposals of each operator.

The purpose of external buffer zone is twofold; to protect industry from encroachment by sensitive land uses and to protect sensitive land uses from potential industrial impacts including:

- Noise;
- Smoke;
- Dust;
- Odour;
- Spills; and
- Vibration.

Sensitive land uses include uses where high concentrations of people may be located for a period such as accommodation or residential uses, schools, hospitals, shops and some public buildings (WAPC State Planning Policy 4.1, 2004).

Guidance on buffer zone requirements is available from several sources including the Western Australian Planning Commission and the Environmental Protection Authority. Whilst these agencies provide guidance and criteria for the determination of appropriate buffer zones and generic buffer zones for planning purposes, further detailed studies are required to determine the appropriate separation distances to compatible and sensitive land uses.

In consultation with the potential proponents, two generic buffer zones have been set for the LNG precinct. The first relates to an industrial buffer zone, in which no permanent land uses or activities are permitted. This zone has been set at 2,000m from the boundary fence of the LNG precinct. Land within this buffer zone (between the fence and the edge of the buffer zone) will not be cleared and can still be accessed for short term activities (including traditional and customary activities by Traditional Owners).

The second buffer zone is the sensitive land uses buffer zone. No sensitive land uses can be located within this zone, however, compatible industrial uses could be. This would allow the establishment of support industries within this zone if desirable. This zone has been set at 3,000m from the boundary fence of the LNG precinct. As with the industrial buffer zone, this zone is not fenced and can be accessed for short-term activities.

All existing and future proponents must ensure that their proposed facilities arrangement do not lead to constraints to the adjacent precinct users as it relates to the flexibility in using their land areas for the intent of producing LNG. This includes ensuring that there is no direct increase in risk associated with their activities on adjacent users, which might lead to unacceptable risk or from the consideration of any knock on effects. In simplest terms, “no user shall be constrained as a result of considerations of risk more than the other”.

The first proponent in establishing a precedent as the foundation proponent must develop their site such that the resulting risk to future proponents will not preclude the flexibility of the future proponent to develop their site in a similar manner,. This includes the ability for a second proponent to undertake construction works while the first proponent is in its operational phase.

The risks that would need to be satisfied include knock-on effects, which are when an accident in one facility causes damage to buildings and propagates to a neighbouring operation and initiates further hazardous incidents and cumulative risks, which are a combination of the risk profiles of the multiple parties.

In the absence of a quantitative measure within Western Australia for knock-on effects on adjoining third party facilities, it is recommended that New South Wales best practice is adopted, subject to approval by the Department of Mines and Petroleum as the risk regulator. The cumulative risk can be deemed to be complied with, based upon the Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986), if each proponent can demonstrate compliance with the criterion of fifty in a million per year.

5.4.4 Site Access

Access to the site will be by an all-weather road connected to Broome - Cape Leveque Road. Although the term 'all weather' road is used it is likely that the cost of constructing such a road, given the extreme nature of storm events in this region of Western Australia, would be prohibitive. This term therefore refers to a road constructed to a standard that would allow it to remain open in at least a one in 20-year storm event. Construction of the access road will be to highway standard.

The major generators of traffic to and from the precinct will be to service the third party contractor and workers accommodation sites, with minimal trips to Broome.

The construction of a MOF will result in limited demand for road freight to and from the precinct.

Anticipated traffic volumes on the access road are likely to be in the order of several hundred vehicles per day once construction of the access road is complete. Additionally, Main Roads WA is presently upgrading the Broome - Cape Leveque Road to seal its entire length, with construction continuing south from Beagle Bay. Programmed funding over the next several years will enable the unsealed section of this road to be completed. This will result in a small increase in traffic along this road, although volumes are likely to be low. Investigations into the traffic impacts of the precinct are ongoing.

Access to JPP, once the portion of Manari Road that transverses the port land is eventually closed, will be via the construction of bypass roads, to the north and south of the precinct and intersecting with the main access road. The intersection with the main access road will be located approximately 1 km south of the turnoff to the Third Party Contractor site to avoid creating a four way intersection, given that the anticipated traffic could include vehicles towing caravans and the like.

The construction of the Manari Road bypass will be to the same standard as the existing Manari Road, which is a seasonal (accessible during the dry season) graded road. The Shire of Broome will be responsible for the ongoing maintenance of this road.

5.4.5 Infrastructure Corridors

Typically, infrastructure corridors in large industrial areas provide a common area for essential infrastructure between different activities conducted within a precinct, port or other export facility. Infrastructure corridors commonly include a multi user road for access and egress to the port and multiple easements for carrying infrastructure, such as pipelines, for each proponent.

The width of a corridor depends on the infrastructure that it will carry, the prevailing topography (or other physical feature) that may require earthworks in order to ensure that suitable grades for roads and other infrastructure can be achieved, and any necessary separation distance between various infrastructure components. Use is made of these corridors to create buffer zones between different industrial plant and other land uses.

Allocation of areas within the corridor for key infrastructure such as pipelines, conveyors or other key project infrastructure, are on an as needs basis.

5.4.6 Third Party Contractors Area

During the construction and operation phases of the project, there will be a requirement for third party contractors to support activities within the precinct throughout the precinct's life cycle.

Existing industrial areas in Broome do not have the capacity neither are they considered suitable for this use given the distance from the precinct. Approximately 200 ha of land is allocated for a Third Party Contractor site.

Development of the site will occur in a way that allows logical expansion over time and when required for use. The location and layout of this site is subject to ongoing investigations and negotiations.

The general principles adopted for the location of the Third Party Contractor site within the Master Plan are that the site will:

- not be located closer than 2km to the precinct boundary;
- not be located within 1km of the workers accommodation area; and
- have efficient access to the precinct.

5.4.7 Accommodation

There are two broad issues to be satisfied with regard to accommodation. The first relates to the different types of accommodation provided during the life of the precinct and the second, its location.

5.4.7.1 Accommodation Types

Accommodation for three types of personnel is required for the LNG precinct. These include construction, operations and shutdown/maintenance personnel.

5.4.7.1.1 Construction Personnel

Traditionally, the accommodation of construction workforces is in large temporary camps in close proximity to the construction site, with workers transported to and from the site each day by bus by the site's owner. In the past, accommodation facilities have been relatively basic 'dongas' or demountable buildings although in more recent times considerable effort has gone towards improving the standard of accommodation in construction camps.

The scale of project generally dictates the size of construction camp required and the build-up of the workforce over the construction period. In the case of the Browse LNG precinct, the construction camp will potentially need to be large enough to accommodate the workforce associated with multiple projects running concurrently. Accommodation will also need to be of a sufficiently high standard to attract and retain the workforce to the project.

Each LNG project will have an anticipated construction workforce of approximately 6,000 personnel. It is unlikely that two LNG projects will commence simultaneously and as such allowance for a maximum construction workforce of approximately 10,000 should be provided for.

5.4.7.1.2 Operational Workforce

Following construction, workforce numbers will decline to approximately 2,000 personnel within the precinct in total. The accommodation allowance for the life of the project is for up to 2,000 permanent staff.

The area of land required to accommodate these personnel will vary depending on the density of housing provided and its location. An allocation of 50ha for each proponent is agreed, with a further 100ha subject to a shorter-term lease by the proponents on an as needs basis.

5.4.7.1.3 Shutdown/Maintenance Staff

During the life of each LNG project there will be periods where major maintenance work is required. During these major shutdowns, an additional workforce of approximately 1,000 personnel will need accommodation. Retention of a portion of the construction camp is essential to accommodate these personnel.

5.4.7.2 Accommodation Location

Broadly, there are two options with regard to the location of workers accommodation:

1. Locate the accommodation as close as practical to the site in a new standalone village/town; or
2. Locate the accommodation within an existing town site.

A number of assumptions underpin the following discussion regarding accommodation options for the Browse LNG Precinct. These include:

- Rather than split construction, permanent and maintenance accommodation across multiple sites, a single site is preferred. This will minimise the footprint of the project on the landscape and maximise opportunities to re-use infrastructure. This would also allow them to share the common community facilities.
- A portion of the accommodation constructed for the construction workforce retained and utilised as temporary accommodation for maintenance and other personnel.
- All proponents will utilise the same single location.
- Development of the location will require planning in such a way that allows multiple projects to add their personnel to the site over time with common infrastructure expanded and shared.
- Depending on the location of the accommodation, utility infrastructure would either be extended from the precinct or from Broome. If extended from Broome, upgrades to existing networks will be required.
- In the long term, when no longer required, the accommodation is to be given to Traditional Owners for their use.

As such, construction of a camp to accommodate construction, permanent and maintenance workers is required at a new site in close proximity to the LNG precinct. Principles applied to the location of the camp include:

- Being as close as practical to the precinct (but outside of the buffer zones);
- The siting being no closer than 2km from the coast;
- A land allocation of approximately 200ha (as per the Heads of Agreement); and
- Accommodation to be sited in an area with reasonable amenity bearing in mind its potential future use for other urban purposes.
- Allocation of the 200ha accommodation site will be subject to the needs of the proponents. Initially, each proponent allocation will be 50ha with the remaining 100ha subject to the terms of separate leases entered into between the State (LandCorp) and the proponents. Given the foundation proponent would have access to this area without the immediate constraints of a second proponent, a commercial arrangement with the State is possible.

Such an arrangement will need State agreement, however it may provide a mechanism whereby the foundation proponent has access to an area in excess of their fixed long-term allocation for a period up until the second proponent requires the land. The condition of any lease would require the lessee to relinquish access for use by the second proponent.

5.4.8 Airfield

The provision of a new airfield for exclusive use of the precinct is not proposed. The intention is to optimise the use of the existing Broome Airport and the upgrade of facilities to cater for expected increases in passenger volumes.

Transport to and from the airport to the precinct will be by bus, minimising any direct involvement with the Broome townsite.

5.4.9 Port Authority Requirements

The Broome Port Authority (BrPA) will oversee and regulate operations of the precinct port in accordance with the *Port Authorities Act 1999*.

A total site of 1ha will be required within the port lands for direct use by the BrPA, the Department of Agriculture, Fisheries and Forestry (DAFF) and Customs, located within the common user area of the port with road and port access.

BrPA should be engaged in the future development of performance specifications for all marine structures and support infrastructure.

5.4.10 Gas Pipeline Shore Crossing

Two offshore pipeline corridors probably carrying multiple pipelines in each corridor will be required to bring gas from the offshore fields to the LNG precinct. Once in the nearshore areas adjacent to the precinct, the location of shore crossings will need to be allocated; these locations will be adjacent to the precinct, but driven by the cost and need to provide protection to the pipeline in this exposed area of the beach profile.

Further detailed engineering studies are required to support the selected location of these crossings and determine details of these crossings. The selection of the crossing locations was not addressed in detail except to confirm that pipeline crossings are feasible (however the optimisation is outside of the scope of this assessment).

5.5 Port Layout

5.5.1 Operability

Operability and the ability to moor an LNG ship at an exposed berth has not been investigated to the level required, however, it is assumed that the requirement to achieve 98% plus operability will need to be met for this type of operation and balancing storage with lower operability is not likely to be a preferred option.

On this basis, the factoring of a breakwater in any design is a base case requirement, ensuring guaranteed operability due to exposure under prevailing waves.

As a result of the investigations undertaken in this study, the need for a breakwater has been validated and also the need to maintain a design which allows future proponents to achieve this design requirement are significantly influenced by the foundation proponent's stage 1 development. Considerations of short and long period wave influences are necessary and the overall staging and development plan including responsibility to fund breakwater and dredging is critical in negotiations and staging plans.

In this Master Plan, solutions and discussion on staging have been extensive and captured in the Precinct Definition Document. The foundation proponent will be required to produce a staging plan demonstrating the various stages of development of the precinct, including port and land side facilities. This staging plan should also demonstrate how a second proponent could reasonably develop their facility within the context of an operating precinct. This staging plan would need to be acceptable to key stakeholders, including the BrPA as the agency responsible for the administration of the port.

5.5.2 Ship Size and Types

The design basis for specific projects proposing to develop at the precinct have not been fully defined, however, for the purpose of providing some indication of key ship parameters which will influence design, the following ship characteristics have been selected;

- LNG ships
  - Capacity Range 125,000m^3 to 250,000m^3
  - Vessels types including membrane and Moss R., dictating windage and design for tug capacity,
  - Draft Range from 11.4m to 13.5m fully laden,
  - Beam ranging from 44m to 57m,
  - Length Overall 280m to 350m.
- LPG ships
  - Capacity Range 75,000m^3 to 100,000m^3
  - Membrane tankers only,
  - Draft Range from 11.5m to 12m fully laden,
  - Beam ranging from 36m to 38m,
  - Length Overall 230m to 245m.
- Condensate Tankers
  - Capacity Range 100,000 DWT to 150,000 DWT
  - Conventional Tanker/Bulk Carriers,
  - Draft Range from 14.8m to 17.0m fully laden, but design for access with tidal assistance to a user preferred load state,
  - Beam ranging from 42m to 48m,
  - Length Overall 245m to 275m.

The design of the port has been assumed to be dictated by the characteristics of the LNG carrier with the length, beam, windage and draft driven by the range of characteristics in this class of vessel. In the case of draft, while the bulk liquids tankers for condensate export can give rise to a deeper fully loaded draft case, the tidal access and channel depth design characteristics are assumed to be driven by the need to export the primary product being LNG.

5.5.3 Loading times

All marine facilities are assumed to be designed including the jetty topsides, berth operability and berth availability, and tug capacities to support the efficient mooring, loading and departure of vessels in a turnaround time of no more than 24 hours. This includes the largest and more complex vessels allowing for tidal, weather and all other constraints.

It is recognised that this loading time will be influenced more by the loading rate than the port layout and this will be driven by the project rather than the port, however, the port layout shall be selected to maximise the opportunity for the port to be able to support this target loading rate.

5.5.4 Capacity, Number of Berths and Staging

The Port shall be designed to accommodate multiple LNG projects (precinct users), and allow for the export of up to 50 Million tonnes per annum (Mtpa) of LNG, and other associated products including Condensate and LPG.

Each proponent will differ in the mix of these products and this will be driven by the nature of their gas reserves, what activities may be undertaken offshore. For example, stripping and offloading condensate offshore using a Floating Production Storage and Offloading (FPSO) facility, using Single Point Mooring (SPM) or new hose technologies which allow non-conventional berth structures, and the target market heating value for the LNG. This assumption, based on typical project port requirements, will result in the following mix of berths:

- Two multi-product berths which can handle LNG, LPG and Condensate, which in stage 1 may handle all products and in later stages may become an LPG and condensate only berth;
- Four dedicated LNG berths; and
- Separate jetties for each proponent.

The staging has been assumed to occur in a manner where the first berth will be the multi-product berth, however, the number of berths in Stage 1 may vary depending on the staging of the proponents project development. It is assumed that the proponents should be able to develop their project with any number of the three berths being installed at any time in the life of their project.

It is also assumed that the staging of individual projects within the precinct will be at separate times, and the use of all berths is for dedicated users. This dictates that the construction of individual user's facilities must be achievable whilst the pioneer project is already in operation.

In relation to other infrastructure such as breakwaters and dredging, the staging will be such that they may be shared and options which lead to maximising sharing along with independent options shall be considered as desirable and preferred (as indicated by Government).

5.5.5 Approach Channel, UKC and Depth

The approach channel, including its width and depth, has been taken as follows;

- Channel width of 300m being 5.25 to 6.8 times the beam of the design LNG ship range, and automatically providing for all other ship types;
- Channel depth of 13.5m with an allowance of 1.5 to 2.0m for the under keel clearance (UKC) on varying ship types requires some tide to accommodate access into the port area. The level of constraint assumed in the precinct port options assessment is less than 3% of the time; and

- The UKC requirements are reflected in the total channel depth allowance and whilst they are complex parameters driven by ship size and configurations, local metocean conditions, siltation rates, survey accuracy and on bottom conditions, an allowance of approximately 15% has been assumed subject to more detailed assessment of all parameters which affect UKC.

With respect to the large Condensate vessels, with Drafts of up to 17m, these will be accommodated with either variable/partial loading conditions depending on the tides, or by a deep draft berthing basin of up to 19.0m at the berth location.

Vessel handling studies inspected in the data room have validated these basic parameters subject to final design vessel size and type.

5.5.6 Turning Basin

A turning basin for stopping and turning the vessels will be an integral part of the design and will be configured to work together with the approaches and channel alignment to meet these critical aspects in ship manoeuvring at the harbour. A turning circle at the end of the channel approach of diameter equivalent to twice the length overall of the vessels is assumed to be required and this is dictated by the ship size, level of tug support, metocean conditions and ship manoeuvrability. In the case where these parameters are more adverse, they may lead to turning circle diameters which are greater than 2, approaching 2.5, but where they are superior, they may lead to reductions in turning circle areas.

Stopping and ship turning areas will be dictated by ship handling studies and remain to be verified when detailed design investigations are commissioned.

Vessel handling studies inspected in the data room have validated these basic parameters subject to final design vessel size and type.

5.5.7 Berth Pockets

Berth pockets will be provided to accommodate the additional draft and UKC which may be required to hold a vessel alongside where the departure areas are restricted by tidal or other water level events.

The depth and size of the berthing basin will be a project specific decision and will be supported by the design vessel load states for the dictating case. This decision will be supported adequately by operating requirements of the port and appropriate cyclone evacuation criteria.

5.5.8 Anchorages

The anchorage requirements for vessels using the port have not been considered as part of this study. The requirements for anchorage areas will be determined by each proponent's operational strategy and will be determined based on detailed design of the port and precinct.

The allocation of anchorages will then be negotiated within the port limits in conjunction with the BrPA.

5.5.9 Exclusion Zones

The exclusion zones are defined based on the manifold location for the purpose of this study work and will be as follows;

- 300m from the LPG ship manifold position, and all other cargo types are assumed to fall within this radius; and
- 200m from the LNG ship manifold position.

For the purpose of separation distances between jetty alignments, it is assumed that exclusion zones could be substantially less than this, assuming that the potential for conflict due to vessels and activities on top of the jetty are restricted or the jetties are separated.

For the purpose of this study and subject to rigorous risk assessment, it has been assumed that the separation of jetties can be combined or separate and separation in itself reduces the risks for the jetty pipeline topsides sufficient to accommodate any neighbour risks associated with a neighbouring operator.

Separation and exclusion zones for the overall port facility are to be decided and relate to different parameters such as risk to the public and will be decided by detailed analysis to determine the acceptable exclusion zone in and around the port area.

5.5.10 Constructability and Staging in Operating Environment

In an operating port environment, it is assumed that the constructing entity cannot be working in close proximity to operating pipelines and berth facilities of an existing operating entity.

The constructing entity must adhere to the exclusion zones for normal operations and allow for any additional risks in terms of collision or carrying out works which could lead to increased risk to the existing operating entity (beyond that which would be acceptable for a neighbouring project). The risks for particular operations would be subject to rigorous risk assessment to confirm where closer proximity may be adopted for particular operations (such as short duration construction activities), but this assessment is outside of the scope of this concept study.

The determination of such separation distances will be dictated by the nature of construction activities, the nature and frequency of operations of the operating entity, and the number of personnel and key infrastructure in the vicinity of the activity.

No pre-determined separation distances have been tabled, however, the sharing of jetties (where the two precinct users do not establish jetty infrastructure at the same time) is considered to have limited chance of successful implementation as noted above. Even with only reasonable limitations on the constructing entity, (to restrict activity to non-operating periods), a significant impost would be placed on the construction schedule, further supporting this conclusion.

Notwithstanding the above, this Basis of Design allows for shared and separate jetty infrastructure to meet these requirements. Breakwaters and dredging can be shared without these considerations as

they are assumed to not support operating pipelines and access. Eliminating options is beyond the scope of this Master Plan.

5.5.11 Port Infrastructure Sharing

As noted in section 5.5.10 Constructability and Staging in Operating Environment, on the grounds of risks to operations from construction activity in close proximity, the base case Master Plan solution assumes that the solutions for breakwaters and dredging will be shared to the maximum possible extent.

The jetties will need to be the subject of risk assessment, but shared jetty options are likely to lead to unacceptable risk to an operating entity during construction which may drive the need to separate jetty approach structures. Other port components such as the breakwater and dredging are not considered to be subject to the same levels of risk unless, for example, facilities are located on top of the breakwater structure. This assumption forms a key basis of solution selection and the land area allocations for the Master Plan.

The solutions tabled by the proposed foundation proponent present scenarios where the separation of marine facilities is greater than that considered optimum under these principles. This has led to the acceptance by Government of an alternative port arrangement and Master Plan, based on the technical preferences likely to be presented by any future foundation proponents.

5.5.12 Dredging

Dredging is assumed to be predominantly in the basement material which is Broome sandstone. The bathymetry indicates the presence of the wave cut platform features and the offshore reef system which has the calcarenite features superimposed upon the Broome sandstone.

Dredging of these basement materials with cutter suction dredging plant should be possible with the materials considered suitable for reclamation and use in construction as structural fill, subject to the proponent seeking environmental approval.

5.5.13 Breakwaters

The breakwaters are to be arranged in planform to achieve the 98% operability levels at the berths. Where this can be shown to be achievable without breakwaters or by adopting non-conventional berths for LNG, this can be factored into the design.

The design for breakwaters is to satisfy the very large design criteria associated with tropical cyclones and will be established in a high tide regime up to 9m and in water depths of around 7m to 10m below Chart datum.

The breakwater lengths and configurations are to be based on likely sheltering strategies for a pioneering proponent allowing the logical staging of the breakwaters to accommodate a second proponent.

5.5.14 Marine Structures

Marine structures shall incorporate the following items;

- Berthing and mooring dolphins,
- Loading platform,
- Jetty approach structure,
- Other associated structures with the berthing and loading of vessels.

Marine structures will be designed to accommodate the berthing and mooring requirements of the design vessels and accommodate the topsides, including roadways, services, product loading lines, vapour return lines, loading arms, and all other valving and equipment required to load vessels.

5.5.15 Integrated Marine Facilities

The Integrated Marine Facilities (IMF) include the provision of a supply base to support offshore operations, a shared MOF, tug pens and the heavy load out (HLO) facilities required by the proponents for the precinct and to support their offshore operations. In line with efficient and cost effective design principles for the precinct, a single harbour facility (breakwater and dredging) will be developed which will be shared by the multiple proponents and within which dedicated facilities and shared facilities can be developed. The terms of use of this facility will be confirmed between the proponents and the State to ensure access to all parties.

The MOF will provide for the handling of heavy lift vessels to support the loading of modules and other construction equipment and located where the corridors and haul roads can access both the precinct sites.

The establishment of the precinct will require utilities (including power, potable and wastewater) to be provided to users such as the BrPA, DAFF, Customs and Third Party Contractors areas. These facilities would need to be considered within the provision of utilities by the foundation proponent and would be subject to negotiations with the relevant utility regulator to ensure sufficient services are provided.

Pending the outcome of negotiations, the provision of dedicated user tug pens for each proponent is a likely outcome. This will ensure full cyclone haven requirements for the tugs and include appropriate shelter and moorings to meet this objective.

In addition to tug pens, proponents may seek to have dedicated supply base facilities including wharfage, lay downs and other support facilities that are dependent upon the respective proponents approach to operations.

Where the respective proponent decides that they can accommodate other dedicated facilities consistent with the use of the precinct in terms of the agreements, this will be allowed, but shall not

affect the dedicated users as outlined in the Precinct Definition Document. This will not alleviate the requirement for proponents to contribute to the shared facilities.

This facility will be designed to accommodate the large tides and will work to integrate dredging requirements with those of the main port facilities where possible.

The IMF harbour may itself become fully integrated with the main port where the economics of breakwater construction and dredging dictate that this is a preferred solution.

5.6 Onshore Precinct Assumptions Affecting the Marine Facilities

5.6.1 LNG Storage and Proximity to the Berth

The LNG storage area for each precinct user will be located within 4km of the proposed loading arms of the berth.

Notwithstanding the above requirement, in all cases the storage site for each precinct user will be located as close as possible to the shoreline and will in all cases provide for the equivalent placement of the storage tanks in relation to distance from the berth for each of the users.

5.6.2 Onshore Interfaces and Corridors

Efficient corridors will be identified in the onshore arrangement which will be shared and which efficiently service the LNG jetties and thereby the berths. The corridors will:

- Have suitable configuration and width to support the staged development of individual projects,
- Work to support or lead to minimum disruption to users, and
- Support the construction requirements of subsequent users of the precinct.

The corridors will be designed to be sufficiently wide to meet this requirement.

The desired corridor connection between marine facilities and onshore will be a single corridor to concentrate the shoreline intersect.

The corridor arrangement and its transition into the offshore port layout will be selected in such a manner, which does not impede or create a situation where pipelines, corridors and berths/jetties will impede other precinct users from being able to efficiently construct or operate their proposed facilities.

5.6.3 Marine Construction Support and Laydown Areas

Sufficient construction support and laydown areas will be provided adjacent to the shoreline and on each side of the corridor to allow each developer to construct their marine facilities in a manner which does not impact the ongoing activities of the other developer.

As these areas can be shared and will not be permanently required by a specific user, it is desirable in this sensitive area close to the shoreline that they be shared for marine construction activity.

5.6.4 Coastal Impacts

The final port arrangement and layout will work to limit the shoreline impact to one common area.

Jetties will have their abutments in the common area where the individual pipeline corridors (at opposite sides of the corridor) meet the shoreline and will work to minimise the impact and footprint on this area.

Areas provided here will be supported by detailed construction methodology statements and sequencing details.

6 MASTER PLAN

The following sections discuss the key elements of the Master Plan, their layout and relationship to each other based on the assumptions discussed in Section 5 Basis of Design.

6.1 Location

The agreed site of the Browse LNG Precinct is located approximately 1.5 km landward of JPP with the area for the Port located approximately 1.5 km south. Figure 12 illustrates the location of the precinct and includes coordinates. This location and general arrangement of uses was agreed through extensive consultation between the State Government, Traditional Owners and the potential foundation proponent.

In December 2009, the Premier officially announced the agreed location of the LNG precinct. Underpinning this location were the following key drivers:

- deeper water near the coast would substantially reduce the amount of dredging and associated costs;
- impacts on seagrass and other marine habitats would be able to be better managed;
- the land was flatter than the alternative site in the north, reducing the visual impact of the site from the ocean; and
- impacts on registered Aboriginal heritage sites could be managed.

NORTH

LEGEND

3696ha AREA WITHIN WHICH A 109.78ha AREA FOR A PORT LAND AREA AND A 1980ha AREA FOR AN LNG PRECINCT WILL BE LOCATED

BUFFER ZONE

NOTE

SHIPPING CHANNEL LOCATION IS INDICATIVE ONLY AND WILL BE FINALISED BASED ON DETAILED GEOTECHNICAL ASSESSMENT AND BATHYMETRIC DATA.

E 405967
N 8065950

E 408945
N 8065950

E 410377
N 8067108

E 412460
N 8067108

E 414077
N 8066979

E 410377
N 8065950

E 412577
N 8066958

E 410017
N 8065950

E 409116
N 8064895

E 410017
N 8063280

E 409125
N 8063695

E 410377
N 8063280

E 412460
N 8062037

E 410377
N 8061984

E 410527
N 8062058

E 412460
N 8061908

E 414077
N 8062037

E 405967
N 8061350

E 409267
N 8061350

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1	25.02.14	ISSUED FOR CLIENT INFORMATION	AMW							
0	19.06.13	RENUMBERED FROM FIGURE 10 & RE-ISSUED FOR CLIENT INFORMATION	ARB							
A1	05.07.10	ISSUED FOR CLIENT INFORMATION	MGB							

A1 SHEET SCALE 1:25000

OneWay™ to zero harm

WORLEYPARSONS PROJECT No. 301012-01576

WorleyParsons resources & energy

CUSTOMER
DEPARTMENT OF STATE DEVELOPMENT

BROWSE LNG PRECINCT
LNG PRECINCT LOCATION

DRG No FIGURE 12 REV 1

DATE & TIME: 13/03/2014 2:28:59 PM USER NAME: allan.walker LOCATION: I:\Projects\301012-01576 Browse Master Plan Update\8_Drawings\Figures\FIGURE 12.dgn

6.2 Land acquisition process

Previous revisions of the Master Plan identified the coordinates of the precinct as well as the areas for development within this precinct.

Ultimately, a series of negotiations between the parties was unsuccessful and in September 2010, the State Government commenced a compulsory acquisition process under the *Land Administration Act 1997* and *Native Title Act 1993* for the land required for the development. Sections 161 and 165 provide a process by which the State Government can compulsorily acquire land held under any form of title.

As part of the compulsory acquisition process, the State Government issued Notices of Intention to Take (NOITTs) that identified the area of land affected and shown in Figure 13. The NOITTs provision for the following areas of land:

Port Land	109.78ha
LNG Precinct and Common User Areas	1,980.00ha
Third Party Contractors' Site	199.87ha
Accommodation Area	199.86ha
Pipeline Corridors	437.25ha
Roads	266.30ha
Service Corridors	220.95ha
Total	**3,414.01ha**

On 20 June 2013, the Premier announced that the State would proceed to acquire all rights and interests over the land. This process was completed on 4 November 2013 by the Department of Lands in liaison with the Department of State Development, Department of the Premier and Cabinet, Department of Transport, Broome Port Authority and LandCorp.

NORTH

CO-ORDINATES MGA94 ZONE 51

1	411610mE	8069858mN
2	411610mE	8067108mN
3	412460mE	8067108mN
4	414077mE	8066979mN
5	414077mE	8064608mN
6	414077mE	8064418mN
7	414077mE	8062037mN
8	412460mE	8061908mN
9	411287mE	8061908mN
10	411087mE	8061908mN
11	410377mE	8063280mN
12	410017mE	8063280mN
13	410017mE	8063695mN
14	410017mE	8064895mN
15	410377mE	8065950mN
16	410377mE	8067108mN
17	411177mE	8067108mN
18	411177mE	8069358mN
19	410528mE	8069358mN
20	411287mE	8059941mN
21	412087mE	8059941mN
22	412087mE	8059162mN
23	411087mE	8059941mN
24	414209mE	8064608mN
25	414470mE	8064461mN
26	416077mE	8064800mN
27	416077mE	8062800mN
28	417077mE	8062800mN
29	417237mE	8064800mN
30	417237mE	8062270mN
31	416206mE	8061637mN
32	418125mE	8057374mN
33	417352mE	8056913mN
34	418490mE	8055005mN
35	419263mE	8055466mN
36	423526mE	8049731mN
37	423498mE	8048340mN
38	423909mE	8048871mN
39	423619mE	8047883mN

JAMES PRICE POINT

QUONDONG POINT

MANARI ROAD

INDUSTRIAL LAND USE BUFFER

SENSITIVE LAND USE BUFFER

TO BROOME, CAPE LEVEQUE ROAD

BROOME - CAPE LEVEQUE ROAD

LEGEND

- 3696ha AREA WITHIN WHICH A 109.78ha AREA FOR A PORT LAND AREA AND A 1980ha AREA FOR AN LNG PRECINCT WILL BE LOCATED
- 437.25ha AREA FOR A NORTHERN AND A SOUTHERN PIPELINE CORRIDOR
- PROPOSED SEALED ACCESS ROAD
- PROPOSED UNSEALED ROAD
- PROPOSED SERVICES CORRIDOR
- UNFENCED BUFFER ZONE (NOTE: NO PERMANENT DWELLINGS WITHIN BUFFER ZONES)
- 199.86ha AREA FOR ACCOMMODATION SITE
- 199.87ha AREA FOR A THIRD PARTY CONTRACTOR SITE

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1000 0 1000 2000 3000 4000 5000

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A5	22.07.10	ISSUED FOR CLIENT INFORMATION	MGB							
A4	05.07.10	ISSUED FOR CLIENT INFORMATION	MGB							
A3	30.06.10	ISSUED FOR CLIENT INFORMATION	MGB							

A1 SHEET SCALE 1:50000

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BROWSE LNG PRECINCT NOITT BOUNDARY

DRG No FIGURE 13 REV 1

DATE & TIME: 25/03/2014 6:07:56 PM USER NAME: allan.walker LOCATION: I:\Projects\301012-01576 Browse Master Plan Update\8_Drawings\Figures\FIGURE 13.dgn

6.3 Port

A number of different port layout scenarios investigated during development of the Master Plan explored opportunities to share jetties, channels, basins and other infrastructure in order to minimise the area required for the harbour footprint and the duplication of harbour infrastructure.

Investigated in isolation of the precinct, these options require optimisation to suit site-specific considerations. Adopting this approach removed the dimension of how site constraints influence proponents to enable them to focus on their ability to meet the Basis of Design for the Master Plan. These options are then developed within the context of the site in order to allow their assessment and the selection of a preferred concept.

The proponent's operating strategy will determine the detailed layout and precise area of the harbour, and the BrPA will be involved in the development and approval of these final strategies.

The above approach was necessary and proven to be successful in reaching a conclusion in this important aspect of the Master Plan.

6.3.1 Discussion of Possible Port Layout Scenarios

Eight different scenarios were prepared and discussed with Traditional Owners and the proposed foundation proponent for the precinct. Use of the different scenarios ensured an awareness of the options by the proposed foundation proponent and how these options align with the Master Plan Basis of Design, subject to concurrence. The Traditional Owners were also able to seek feedback and comment on the footprint for the marine facilities and the key components, and number of which were presented in each scenario.

Importantly, all parties were able to see the implications of infrastructure sharing and opportunities for optimisation by providing a suitable spread of scenarios for this important aspect of the Master Plan.

Figure 14 to Figure 21 present all of the scenarios tabled for discussion.

NORTH

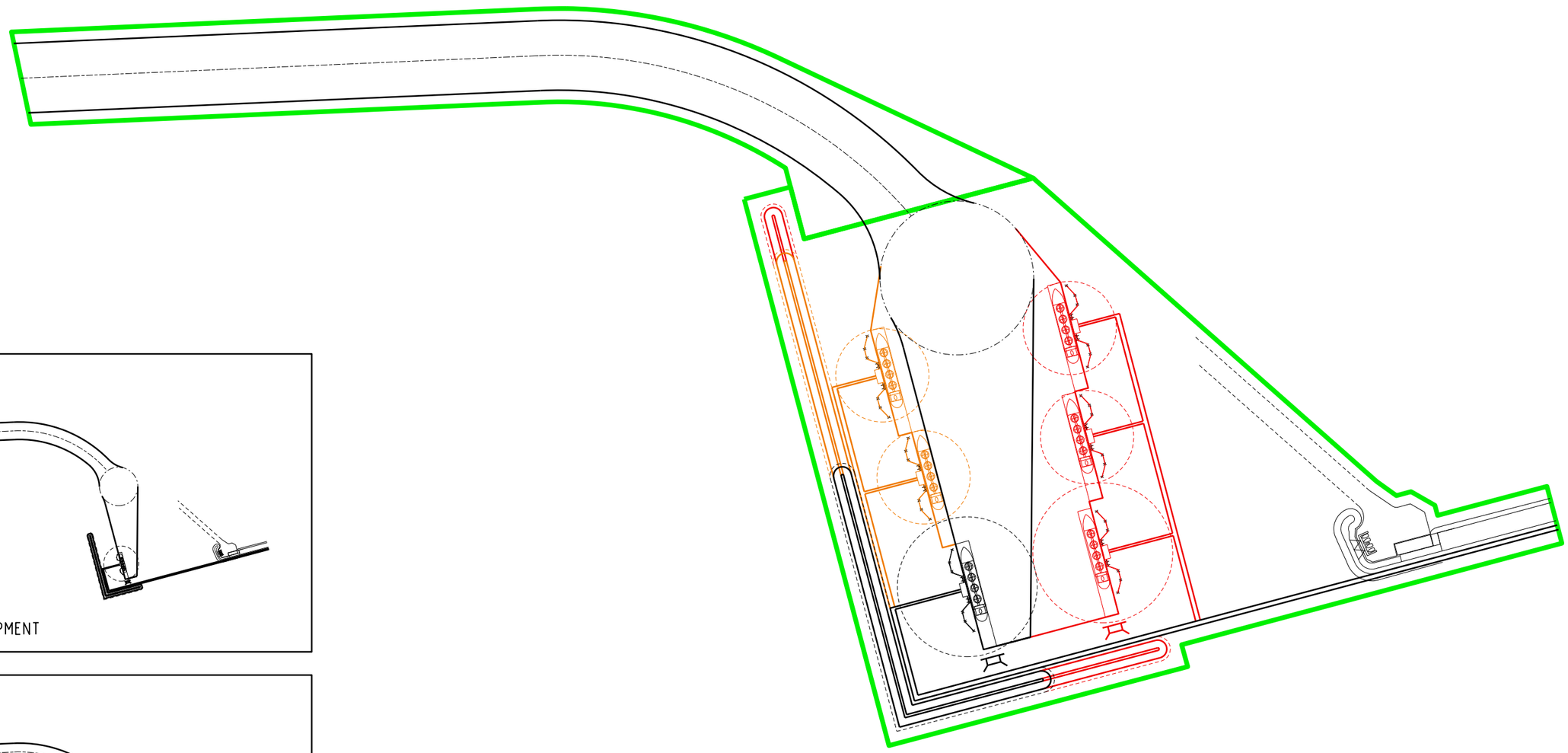
LEGEND

LNG PROVIDER 1 - STAGE 1 DEVELOPMENT

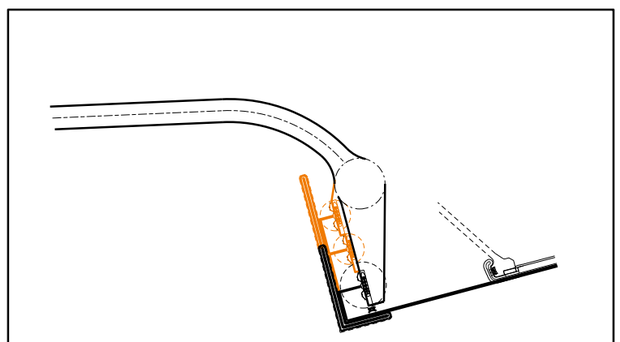
LNG PROVIDER 1 - STAGE 2 DEVELOPMENT

LNG PROVIDER 2 - ULTIMATE DEVELOPMENT

MARINE FOOTPRINT BOUNDARY



STAGE 1 DEVELOPMENT



STAGE 2 DEVELOPMENT

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SCALE OF METRES 1:10000

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A2	21.05.09	RE-ISSUED FOR CLIENT INFORMATION	MGC							
A1	08.05.09	ISSUED FOR CLIENT INFORMATION	BGC							

A1 SHEET SCALE 1:10000

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BROWSE LNG PRECINCT
PORT LAYOUT OPTION A

DRG No FIGURE 14

REV 0

DATE & TIME: 13/03/2014 2:28:56 PM USER NAME: allan.walker LOCATION: I:\Projects\301012-01576 Browse Master Plan Update\8_Drawings\Figures\FIGURE 14.dgn

NORTH

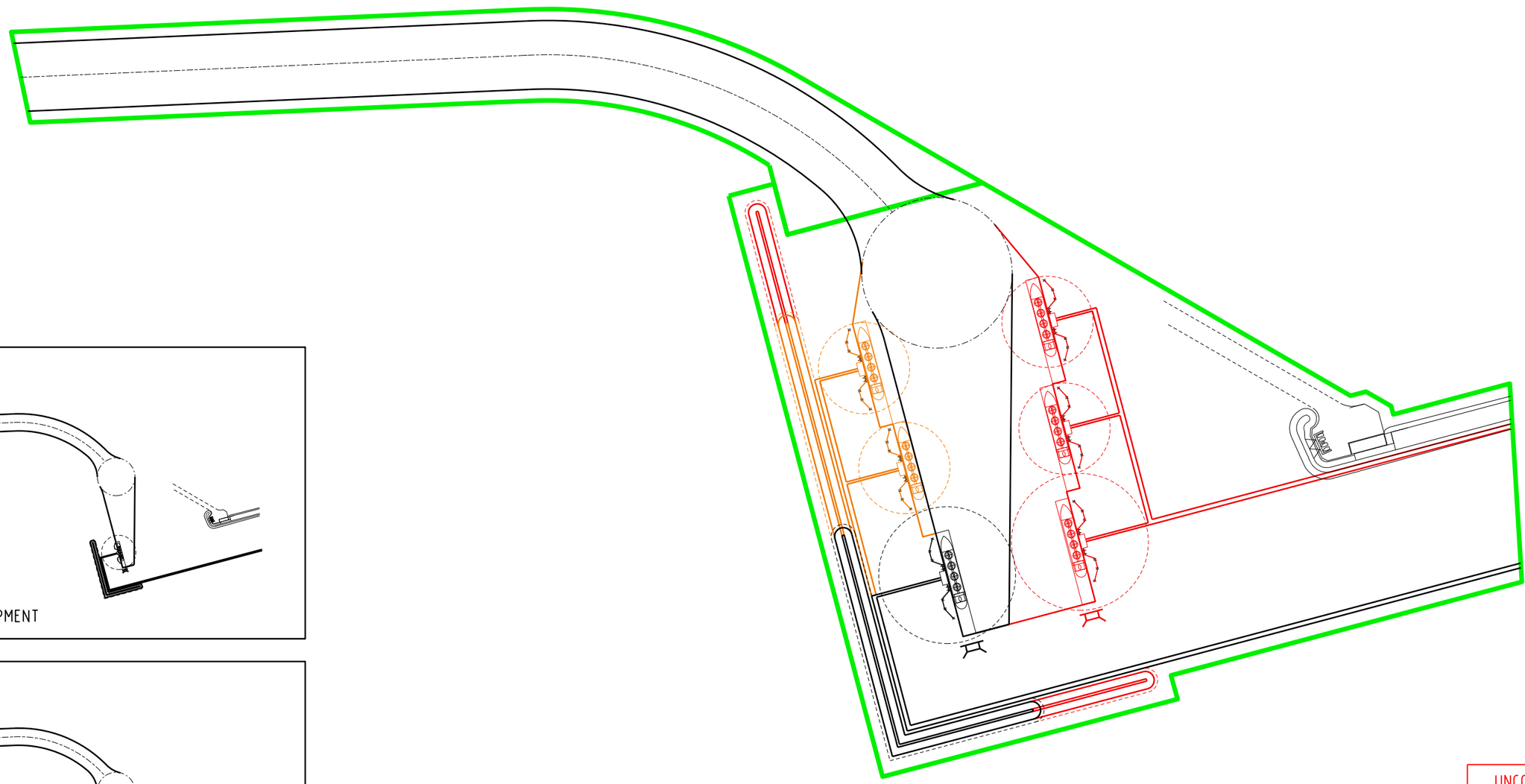
LEGEND

LNG PROVIDER 1 - STAGE 1 DEVELOPMENT

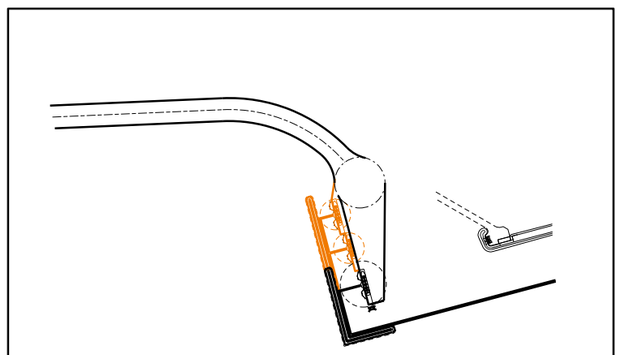
LNG PROVIDER 1 - STAGE 2 DEVELOPMENT

LNG PROVIDER 2 - ULTIMATE DEVELOPMENT

MARINE FOOTPRINT BOUNDARY



STAGE 1 DEVELOPMENT



STAGE 2 DEVELOPMENT

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SCALE OF METRES 1:10000

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A2	21.05.09	RE-ISSUED FOR CLIENT INFORMATION	MGC							
A1	08.05.09	ISSUED FOR CLIENT INFORMATION	BGC							

A1 SHEET SCALE 1:10000

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BROWSE LNG PRECINCT
PORT LAYOUT OPTION B

DRG No FIGURE 15

REV 0

DATE & TIME: 13/03/2014 2:28:41 PM USER NAME: allan.walker LOCATION: I:\Projects\301012-01576 Browse Master Plan Update\8_Drawings\Figures\FIGURE 15.dgn

NORTH

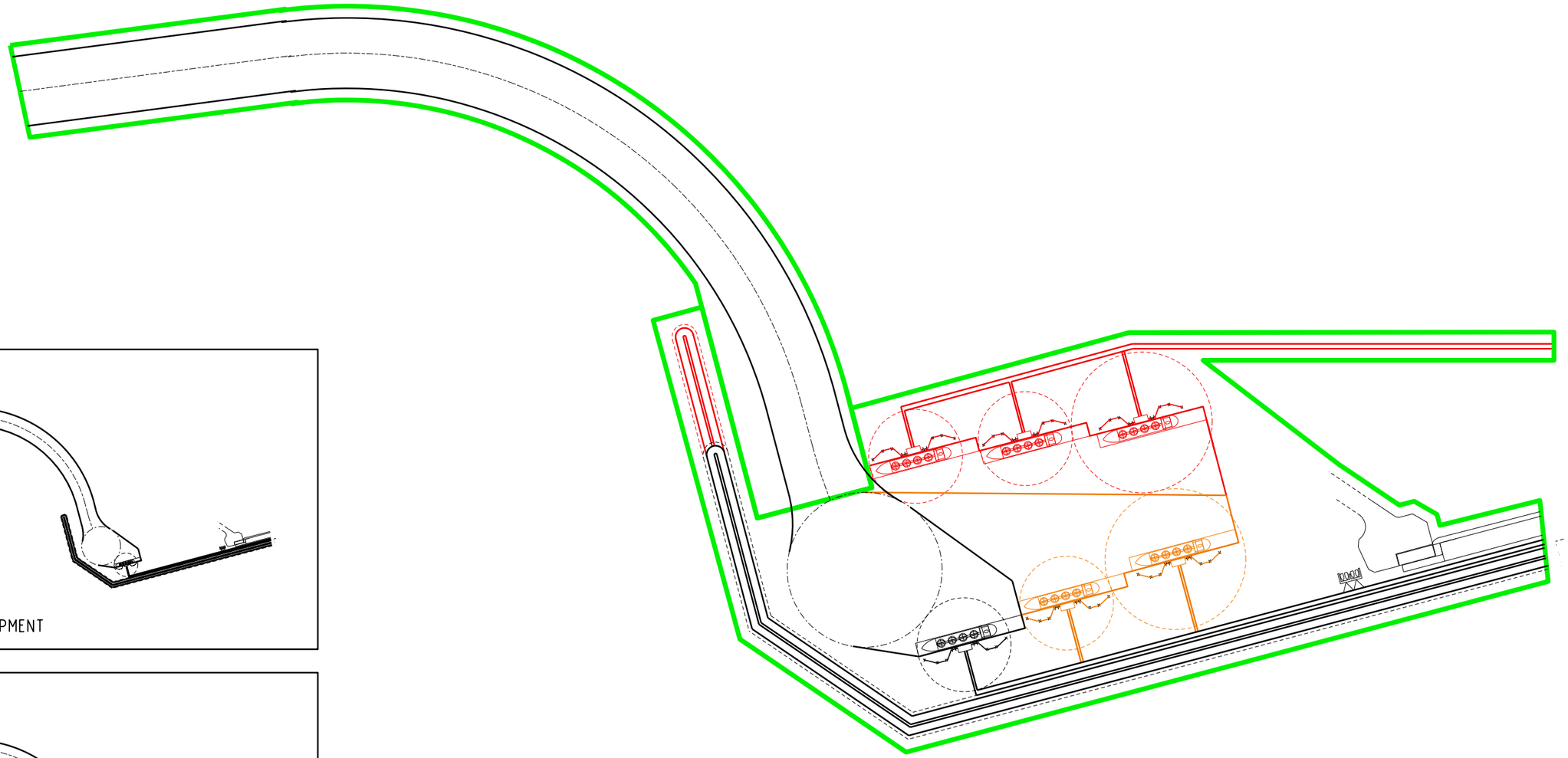
LEGEND

LNG PROVIDER 1 - STAGE 1 DEVELOPMENT

LNG PROVIDER 1 - STAGE 2 DEVELOPMENT

LNG PROVIDER 2 - ULTIMATE DEVELOPMENT

MARINE FOOTPRINT BOUNDARY



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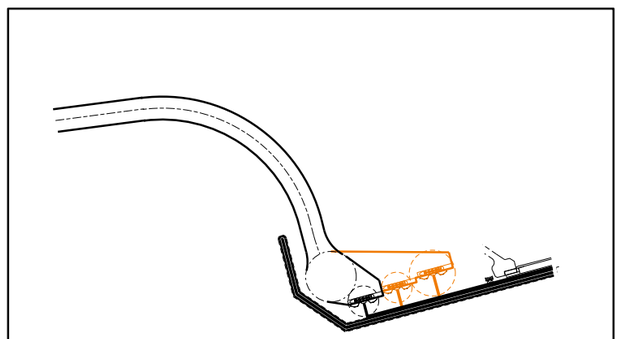

STAGE 2 DEVELOPMENT

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SCALE OF METRES 1:10000

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A2	21.05.09	RE-ISSUED FOR CLIENT INFORMATION	MGC							
A1	08.05.09	ISSUED FOR CLIENT INFORMATION	BGC							

A1 SHEET SCALE 1:10000

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BROWSE LNG PRECINCT
PORT LAYOUT OPTION C

DRG No FIGURE 16

REV 0

DATE & TIME: 13/03/2014 2:28:44 PM USER NAME: allan.walker LOCATION: I:\Projects\301012-01576 Browse Master Plan Update\8_Drawings\Figures\FIGURE 16.dgn

NORTH

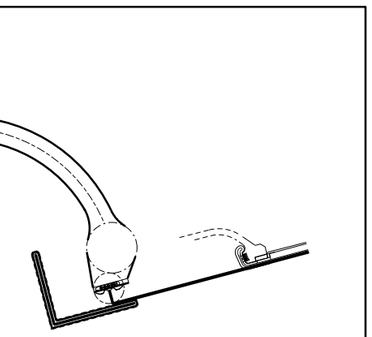
LEGEND

LNG PROVIDER 1 - STAGE 1 DEVELOPMENT

LNG PROVIDER 1 - STAGE 2 DEVELOPMENT

LNG PROVIDER 2 - ULTIMATE DEVELOPMENT

MARINE FOOTPRINT BOUNDARY



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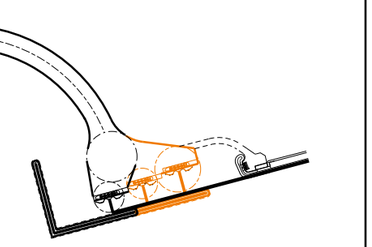

STAGE 2 DEVELOPMENT

SCALE OF METRES 1:10000

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A1	08.05.09	ISSUED FOR CLIENT INFORMATION	BGC							

A1 SHEET SCALE 1:10000

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BROWSE LNG PRECINCT
PORT LAYOUT OPTION D

DRG No FIGURE 17

REV 0

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NORTH

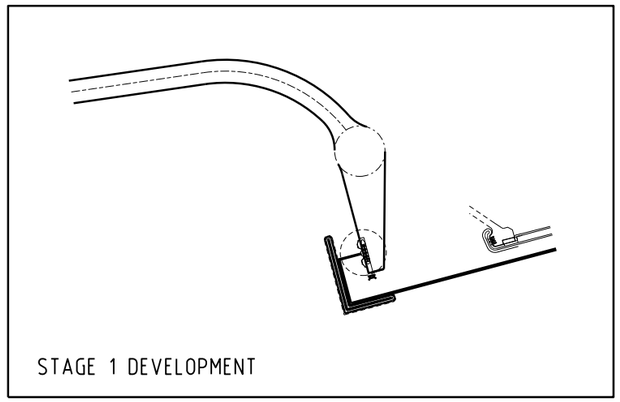
LEGEND

LNG PROVIDER 1 - STAGE 1 DEVELOPMENT

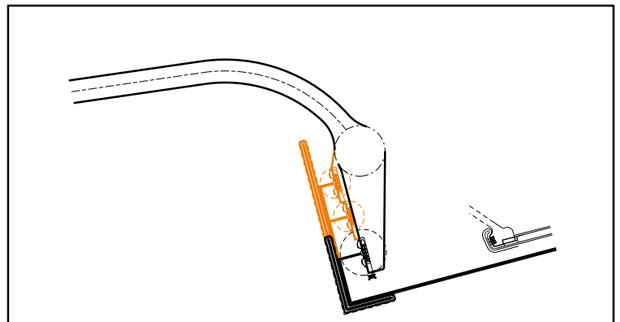
LNG PROVIDER 1 - STAGE 2 DEVELOPMENT

LNG PROVIDER 2 - ULTIMATE DEVELOPMENT

MARINE FOOTPRINT BOUNDARY



STAGE 1 DEVELOPMENT



STAGE 2 DEVELOPMENT

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SCALE OF METRES 1:10000

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A1	08.05.09	ISSUED FOR CLIENT INFORMATION	BGC							

A1 SHEET SCALE 1:10000

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BROWSE LNG PRECINCT
PORT LAYOUT OPTION E

DRG No FIGURE 18

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NORTH

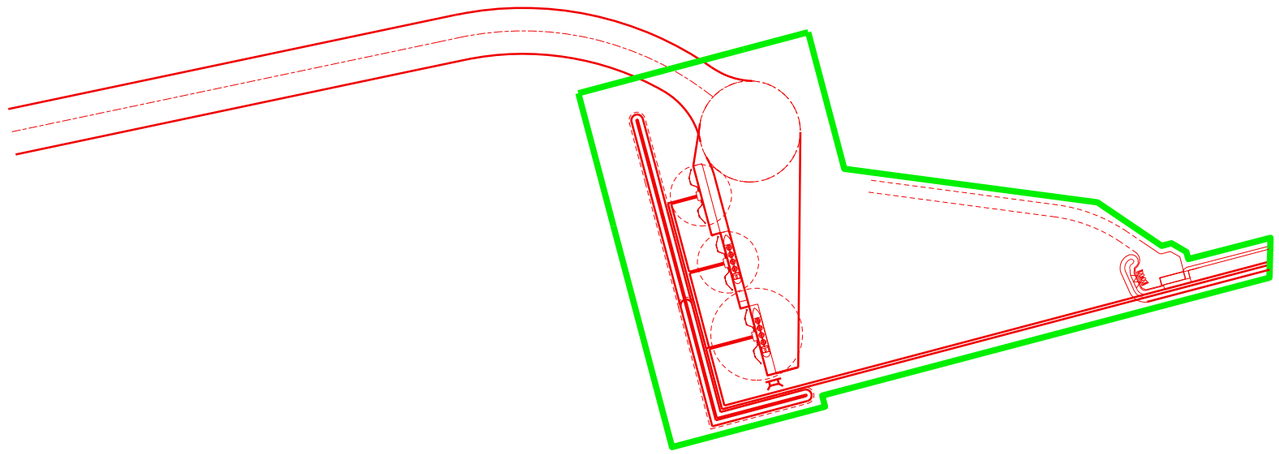
LEGEND

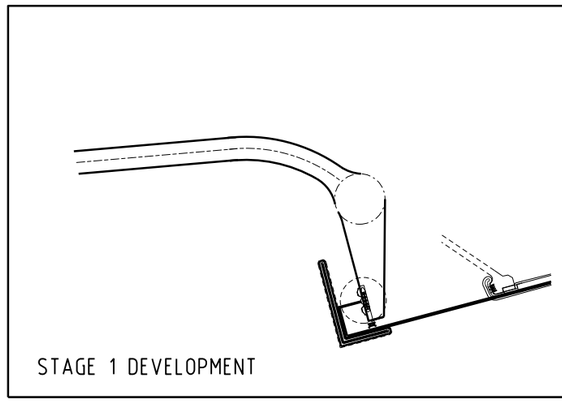
LNG PROVIDER 1 - STAGE 1 DEVELOPMENT

LNG PROVIDER 1 - STAGE 2 DEVELOPMENT

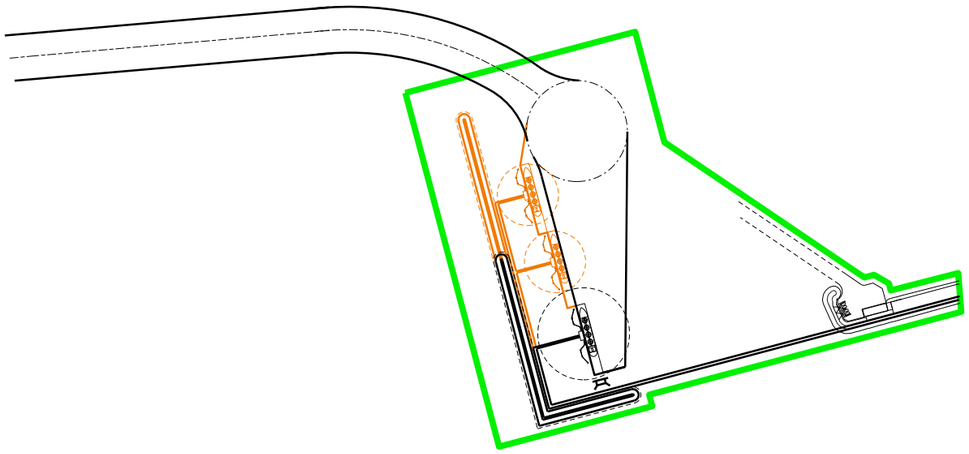
LNG PROVIDER 2 - ULTIMATE DEVELOPMENT

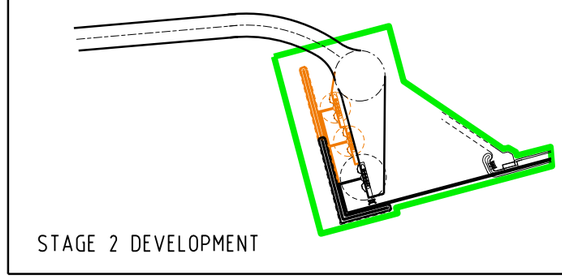
MARINE FOOTPRINT BOUNDARY





STAGE 1 DEVELOPMENT





STAGE 2 DEVELOPMENT

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A1	08.05.09	ISSUED FOR CLIENT INFORMATION	BGC							

A1 SHEET SCALE 1:20000

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BROWSE LNG PRECINCT
PORT LAYOUT OPTION F

DRG No FIGURE 19 REV 0

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NORTH

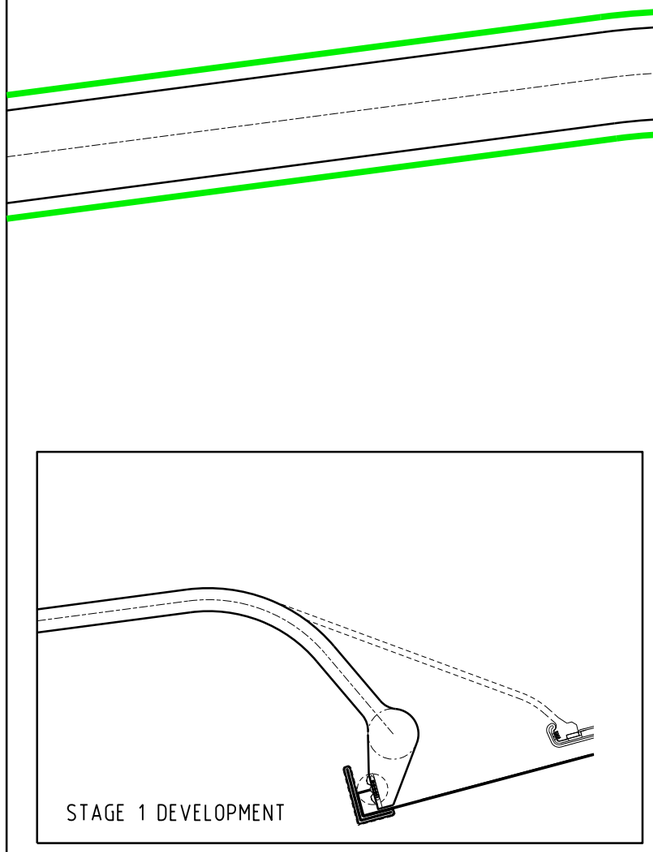
LEGEND

LNG PROVIDER 1 - STAGE 1 DEVELOPMENT

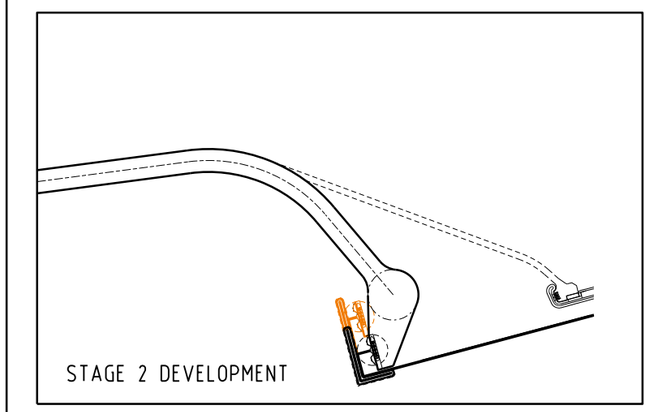
LNG PROVIDER 1 - STAGE 2 DEVELOPMENT

LNG PROVIDER 2 - ULTIMATE DEVELOPMENT

MARINE FOOTPRINT BOUNDARY



STAGE 1 DEVELOPMENT



STAGE 2 DEVELOPMENT

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SCALE OF METRES 1:10000

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A1	07.07.09	ISSUED FOR CLIENT INFORMATION	BGC							

A1 SHEET SCALE 1:10000

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BROWSE LNG PRECINCT
PORT LAYOUT OPTION G

DRG No FIGURE 20

REV 0

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NORTH

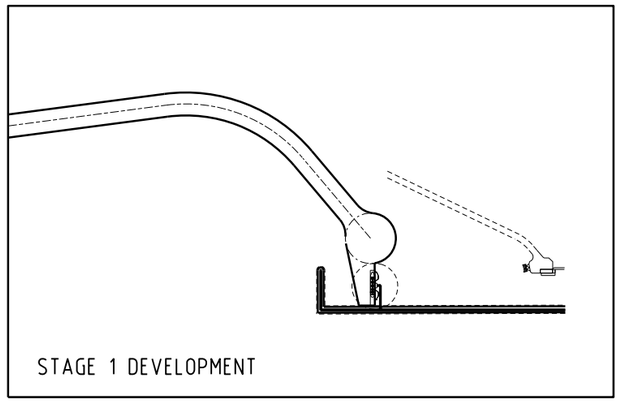
LEGEND

LNG PROVIDER 1 - STAGE 1 DEVELOPMENT

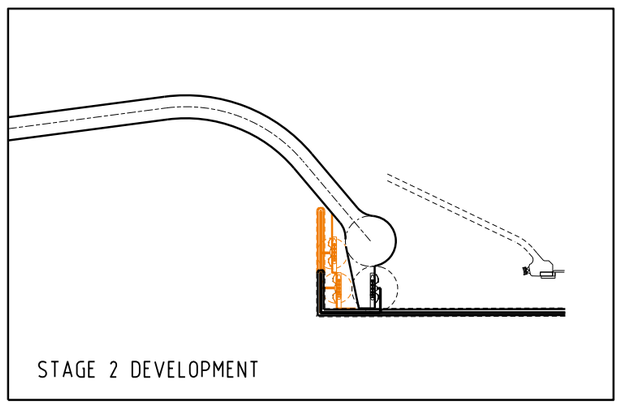
LNG PROVIDER 1 - STAGE 2 DEVELOPMENT

LNG PROVIDER 2 - ULTIMATE DEVELOPMENT

MARINE FOOTPRINT BOUNDARY



STAGE 1 DEVELOPMENT



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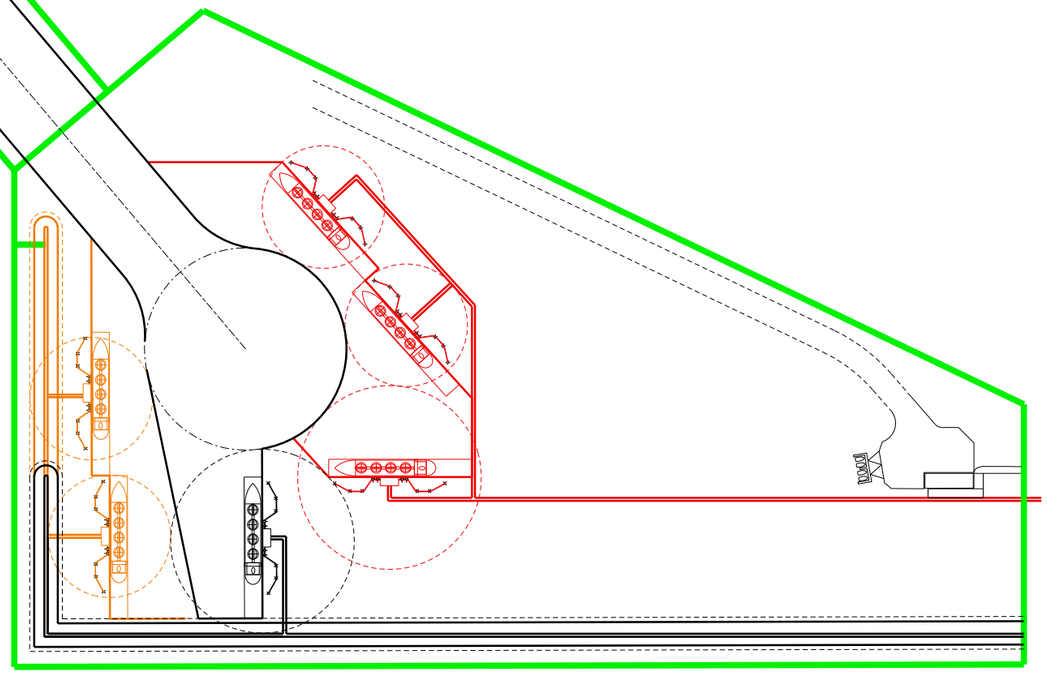

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A1	07.07.09	ISSUED FOR CLIENT INFORMATION	BGC							

A1 SHEET SCALE 1:10000

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BROWSE LNG PRECINCT
PORT LAYOUT OPTION H

DRG No FIGURE 21

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Key characteristics of each port layout option as tabled by the study team to DSD, the proposed foundation proponent and Traditional Owners to support the decision making process are as follows:

6.3.1.1 Layout A (Figure 14)

- Single jetty
- Second proponent shares the jetty with the first proponent
- Second proponent would be required to extend the breakwaters constructed by the initial proponent
- Cryogenic pipelines for the second proponent would most likely require construction by the initial proponent
- Shared channel, basin, breakwaters and MOF

6.3.1.2 Layouts B & C (Figure 15 and Figure 16)

- Similar concepts utilising two separate jetties within a common breakwater
- Second proponent can construct their jetty without impacting on operations of the initial proponent
- Second proponent would be required to extend the breakwaters constructed by the initial proponent
- Shared channel, basin, breakwaters and MOF

6.3.1.3 Layout D (Figure 17)

- Single jetty
- Initial proponent constructs the jetty and occupies berths closest to shore with second proponent required to extend jetty outwards
- Cryogenic pipelines for the second proponent would most likely require construction by the initial proponent
- Shared channel, basin, breakwaters and MOF

6.3.1.4 Layout E (Figure 18)

- Similar concept to layouts B & C
- Initial proponent constructs furthest from coastline with second proponent constructing closer to shore
- Shared breakwaters
- Shared channel, basin, breakwaters and MOF

6.3.1.5 LAYOUT F (FIGURE 19)

- Two separate ports constructed in close proximity to one another on the coastline
- Both proponents would construct completely separate facilities
- Separate channel, basin, breakwaters and MOF

6.3.1.6 LAYOUTS G & H (FIGURE 20 AND FIGURE 21)

- Similar concept to layouts B & C
- Two separate jetties constructed with varying berth arrangements
- Shared channel, basin, breakwaters and MOF

Table 5 compares the eight different port options prepared for the LNG precinct.

Table 5 Comparison of Port Options

Port Option	Shared Breakwater	Shared Channel	Shared Basin	Shared MOF	Shared Jetty
A	Yes	Yes	Yes	Yes	Yes
B	Yes	Yes	Yes	Yes	No
C	Yes	Yes	Yes	Yes	No
D	Yes	Yes	Yes	Yes	Yes
E	Yes	No	No	Yes	No
F	No	No	No	No	No
G	Yes	Yes	Yes	Yes	No
H	Yes	Yes	Yes	Yes	No

The selection of layouts G and H were preferred as the basis for land area allocation for the Browse LNG Precinct Master Plan. These options maximise the amount of shared infrastructure (breakwaters, channel, basin and MOF) whilst allowing the proponents to retain 100% control over their process critical infrastructure (jetties, loading lines, etc.).

6.3.2 Refinement of Port Layout

Subsequent to Revision 2 of the Master Plan being finalised, the proposed foundation proponent prepared two port layout options as part of its FEED process and presented these to the State to facilitate the approvals process for the proposed foundation proponent of the Browse LNG Precinct.

These two options were based on the proposed foundation proponent's technical requirements and on outcomes of the further investigations it undertook at the site, including the collection of additional data such as improved bathymetry and nearshore geotechnical investigations. These findings supported a solution with more dredging and less breakwaters leading to the siting of a harbour basin closer in-shore.

Further, the proposed foundation proponent's technical preference for a solution resembling Layout C as shown on Figure 16 (with a northern breakwater to provide suitable levels of shelter to the second proponent, if the proposed foundation proponent's preferred channel alignment is adopted), was tabled. Whilst this solution leads to a greater overall harbour footprint (dredging and breakwaters), the foundation proponent presented this option as a preferred alternative solution. Based on the

layout presented by the proponent, the onshore precinct layout was further refined. The outcomes of these changes are shown in Figure 22, which indicates a central 300m corridor narrowing to 100m through the port area.

NORTH

E 410377
N 8067108

E 412191
N 8067108

E 410377
N 8065950

JAMES PRICE POINT

E 410017
N 8065950

E 410017
N 8064895

E 410585
N 8064658

PROPONENT AREA B
AREA: 500ha

E 410585
N 8064358

E 409106
N 8064895

E 412192
N 8064658

E 410017
N 8064345

AREA: 53.507ha

E 410017
N 8064345

E 409125
N 8063695

E 410017
N 8064350

AREA: 51.266ha

E 412273
N 8064358

E 409125
N 8063695

INDIAN OCEAN

E 410017
N 8063695

MANARI ROAD

E 410017
N 8063280

PROPONENT AREA A
AREA: 500ha

E 410377
N 8063280

E 412273
N 8061908

HWM

E 410377
N 8061984

E 410527
N 8062058

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BROWSE LNG PRECINCT
ONSHORE LAYOUT

DRG No FIGURE 22 REV 0

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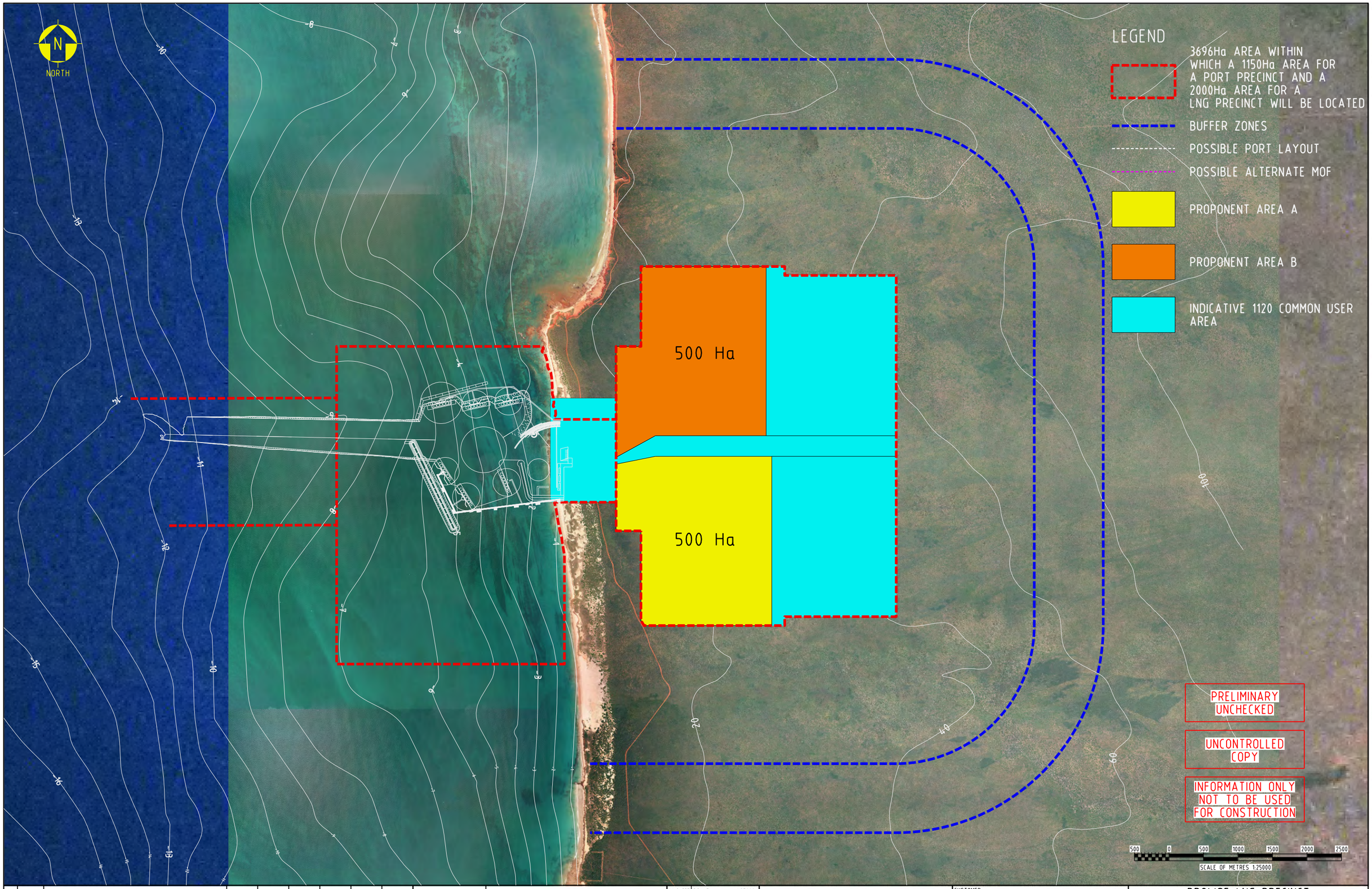
In discussion with the potential foundation proponent, the testing of alternative scenarios against the Master Plan occurred. This process resulted in the presentation of the scenario of an alternative port layout option, subsequently adopted as the base case for development of the precinct. This base case layout is shown in Figure 23 and can be compared with the Master Plan developed in the early master planning study previously agreed with all stakeholders and shown as Figure 24.

The base case still achieves many of the requirements of the Master Plan and provides flexibility to achieve the intent of the Basis of Design. This revised base case solution for the Master Plan does however result in a greater extent of dredging and breakwater infrastructure. Whilst this is the case, as the potential foundation proponent has stated the issues with clustering the jetty abutments nearshore was untenable to them and as a first stage proponent the cost for initial development and moving the harbour inshore presented a significant benefit.

The stage 1 development proposed at the time of the master planning is as shown in Section 7.1 and whilst this may vary in detailed engineering, it reflects the outcome of some significant engineering and investigations. Access to the proposed foundation proponent's data room for due diligence and establishment of key technical clarifications was provided to DSD and the process of negotiation on a final base case Master Plan solution was extensive.

This master planning work included investigations to confirm if the second proponent did have sufficient flexibility in its design scope spatially to accommodate breakwaters and dredging expansion to meet the Basis of Design as it relates to berth operability. This was confirmed and on this basis while the revised base case does present a higher overall cost for dredging and breakwaters, the operational advantages it presented resulted in agreement by DSD to its selection as the base case. The original Master Plan as selected in earlier presentations and shown as Figure 24 remains as a viable alternative.



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BROWSE LNG PRECINCT BASE CASE PORT LAYOUT

DRG No FIGURE 23

REV 0

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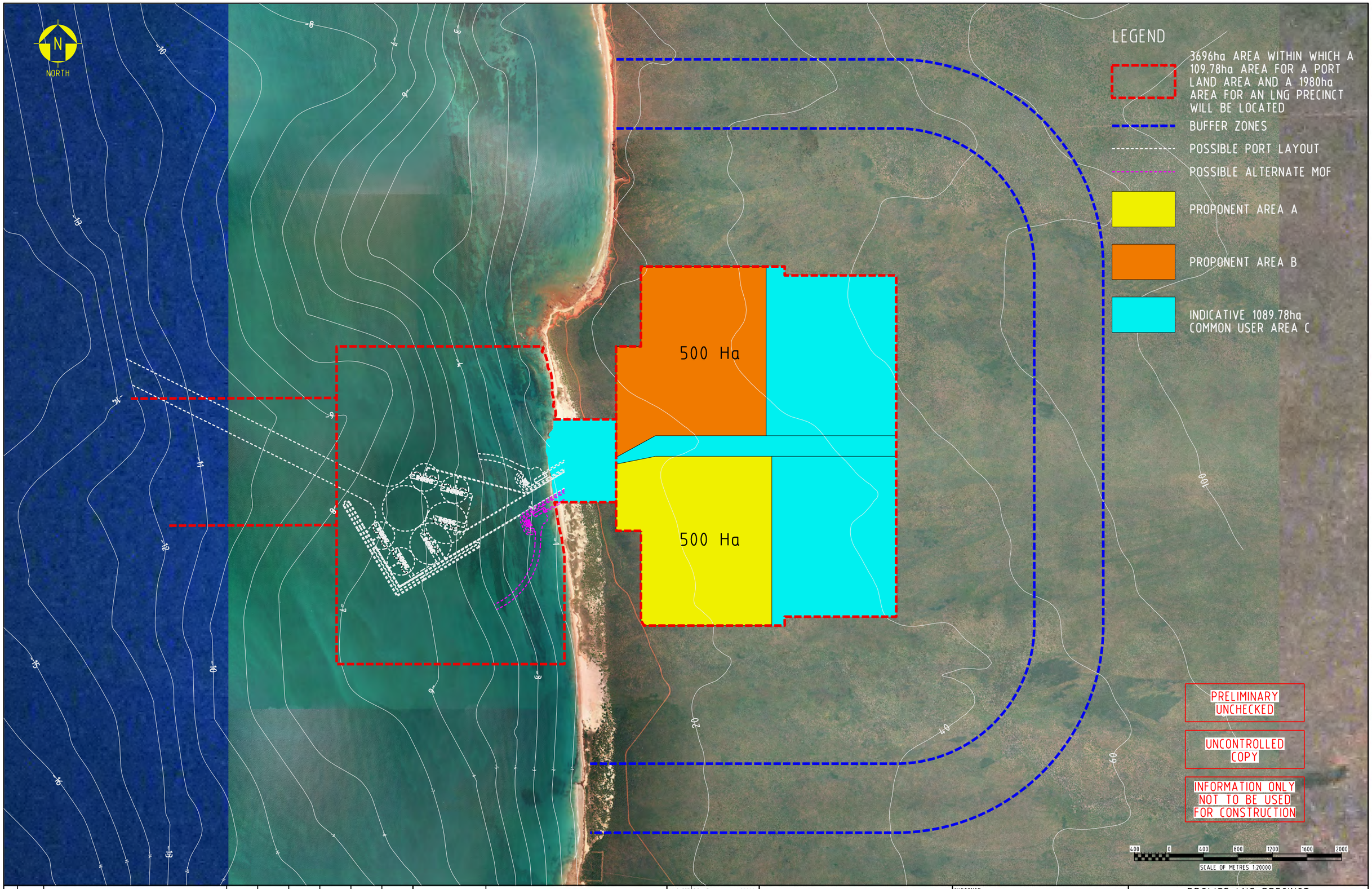

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BROWSE LNG PRECINCT LNG PROCESSING AND COMMON USER AREAS - ULTIMATE

DRG No FIGURE 24

REV 1

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6.4 IMF Facility

The IMF was also the subject of significant discussion. As the intended scope of this facility is to accommodate Supply Base activities, it has become more substantial in terms of footprint. This, together with the revised main port facility, harbour basin design, resulted in a solution with a single IMF harbour remaining the only viable option.

For the purposes of the Master Plan, the base case port layout only accommodates a single IMF including all MOF, tug pen and supply base activities; however in discussions with the potential foundation proponent, the option of separate IMFs were explored. Investigations revealed that the provision of more than one IMF would not function effectively.

Agreement for provision of a single MOF with certain other facilities dedicated for each user subject to negotiations with the State and the Port Authority followed further discussion on this option. Following significant discussion and investigation, the option of sharing a single IMF harbour basin was agreed by all parties to present an efficient use of the available space and capable of accommodating all of the needs of each proponent as per the Basis of Design and taken forward into the base case. Figure 30 shows the revised base case layout.

6.5 Onshore Layout

The following sections discuss the major onshore components of the LNG precinct, their size, layout and orientation. The location of the Browse LNG precinct provided to WorleyParsons resulted from extensive discussions and negotiations with Traditional Owners. Figure 12 illustrates the proposed location of the precinct to the south of JPP.

The precinct is set back approximately a kilometre from the coastline and positioned in such a way as to continue to allow access to JPP itself in the future. This also provides a greater opportunity to minimise the visual impact of the site from the ocean.

6.5.1 LNG Processing

A total of 500ha per proponent is allocated for LNG processing. As discussed in section 5.4.1 LNG Processing, this area includes allowance for ancillary services including power generation, water treatment and other processes.

Figure 25 shows the allocation of two LNG proponent areas each consisting of 500ha, one to the north and one to the south of a central infrastructure corridor. These areas are sufficient to cater for a total production capacity of approximately 50Mtpa produced by multiple proponents.

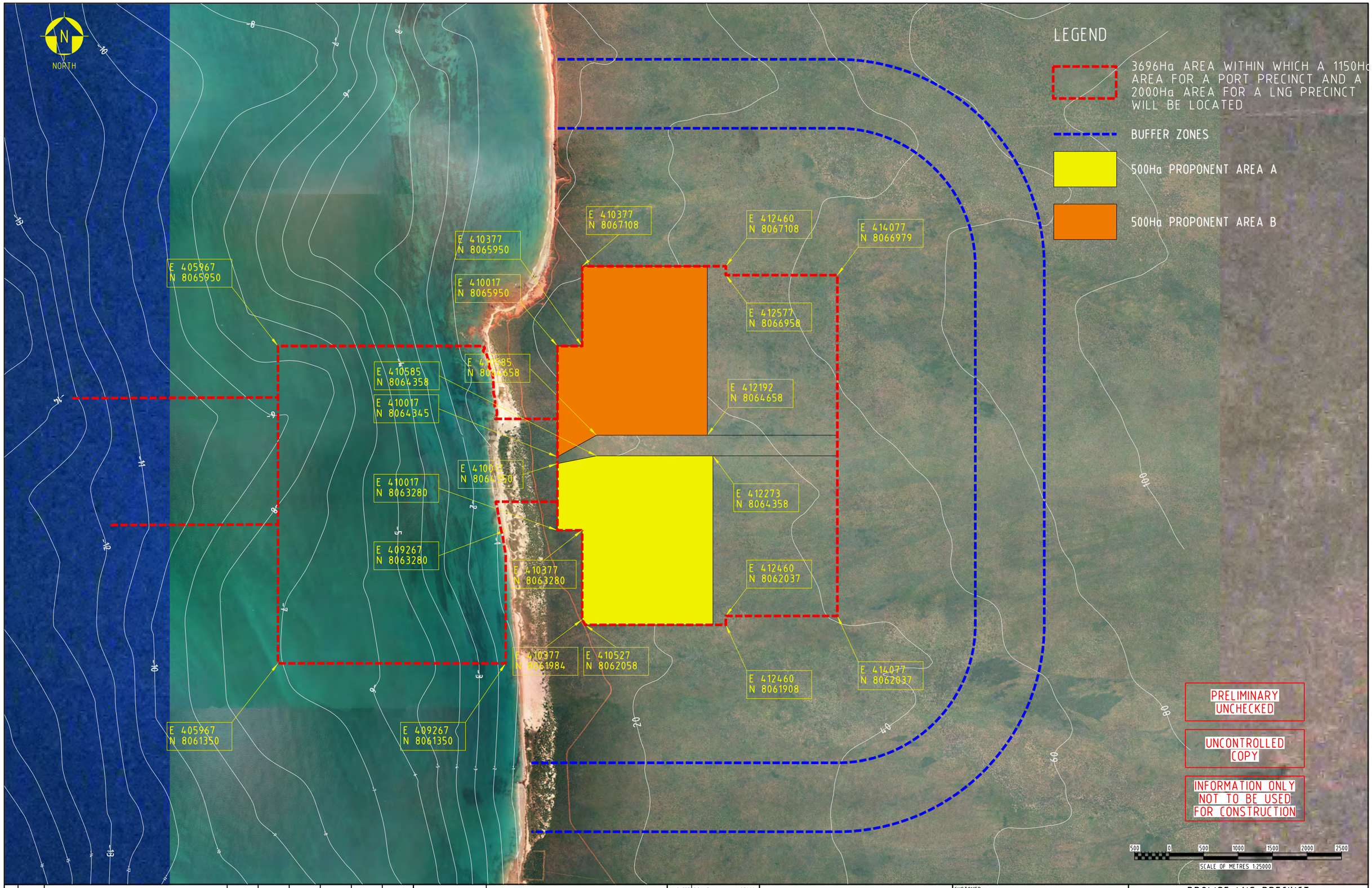
In comparison to other LNG projects the area provided for LNG processing benchmarks against the larger site areas, however a number of physical constraints have driven the requirement for this size site. These include:

- The Browse LNG Precinct has a thick layer of Pindan sand and overall there is limited geotechnical knowledge of the site. Further work is required to assess the most appropriate construction techniques and methods for improving site conditions. However, it is appreciated

that these materials may be utilised in the site and will require some conditioning prior to re-use. This requirement dictates the need for significant laydown or conditioning areas where this work could take place.

- There are known Aboriginal heritage sites within the precinct boundaries.
- There are known rare flora species within the precinct boundaries.

During future detailed planning phases for development of the site, sufficient space will be available to position equipment and infrastructure in such a way that minimises any disruption and preserves, where possible, heritage sites and significant flora and fauna.



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BROWSE LNG PRECINCT
LNG PROCESSING AREAS

DRG No FIGURE 25 | REV 0

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6.5.2 Common User Areas

The Master Plan identifies a number of Common User areas throughout the precinct. The intention is that these areas can be utilised by all proponents at various times throughout the precinct's construction and operation providing that the activities undertaken within them do not adversely affect the operations of other proponents. The types of activities envisaged within these areas include:

- Construction and maintenance materials laydown;
- Equipment storage;
- Earthworks (blending and working of materials);
- Roads and temporary vehicles parking; and
- Pipelines and other infrastructure.

It is likely that for practical purposes these areas will require delineation for different users where multiple proponents are operating or constructing their projects simultaneously.

Revegetation and rehabilitation of a large proportion of those areas used for laydown, earthworks and storage purposes would be possible once the build out of the precinct is complete and the land area is no longer required.

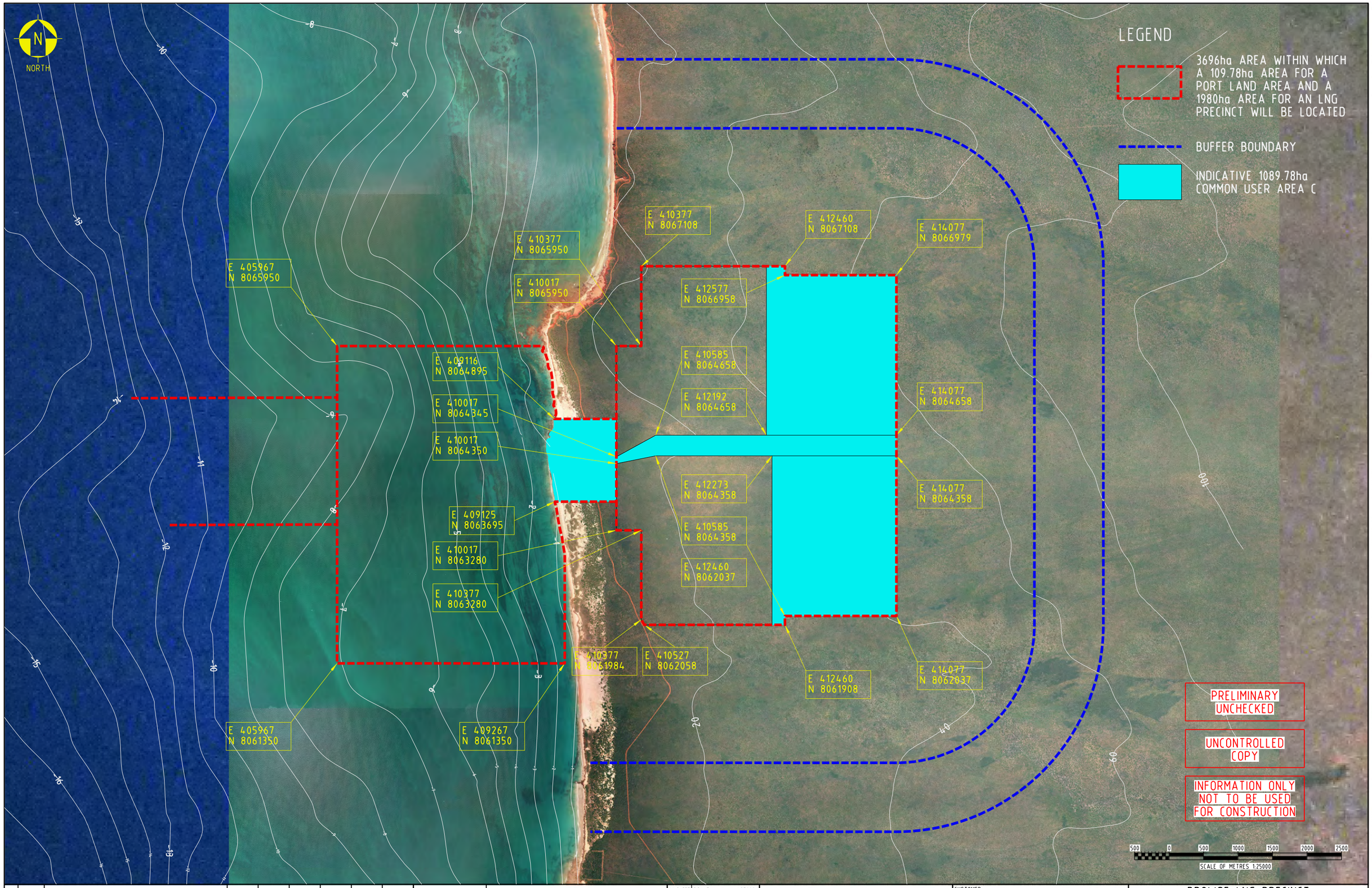
This excludes the central infrastructure corridor, which would be required for the duration of the precinct's life and the two smaller areas to the north and south of the corridor at the shoreline crossing.

The allocation of a common user corridor provides for the conveyance of products, modules, materials and vehicles. The 300m wide corridor provides access to the area of port land for common use, where the BrPA facilities will be located. This space has an added function by providing a buffer between adjacent fence lines, which supports the solution from a neighbour risk perspective.

Although defined 'common user area' the corridor itself is reserved for the construction of a road providing access to the respective land areas and the port, including a services corridor for the provision of power, water and other utilities and products. The corridor is intended to fulfil a conveyance role and is not intended to be used for storage or laydown in the manner of the other common user areas.

In total, the precinct allocates a total Common User area of 1,090ha.

Access to the port on port related business requires a right of access to other potential users.



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BROWSE LNG PRECINCT COMMON USE AREAS

DRG No FIGURE 26

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6.5.3 Port Authority Administration and Support Facilities

Immediately adjacent to the port, two common user areas have been set aside to the north and south of the central corridor. The Master Plan makes allowance within the port area for the construction of a port facilities building. The area identified will accommodate a shared MOF as well as the Port Authority Administration Centre (including DAFF and Customs). This location, adjacent to the central infrastructure corridor, will ensure port access.

BrPA is the agency responsible for the administration of the port and clarification of its responsibilities for the control of the port and its administration functions, and those activities and functions the proponent will provide, are subject to future negotiations. Should a supply base for offshore facilities be required in the future, the area could accommodate such use.

Through discussions with the BrPA during the development of the Master Plan, an area was designated for the above common user facilities. The final arrangement of this area and the layout of the MOF and adjacent facilities remain the subject of final negotiations on potential access arrangements as shown in the agreed Master Plan concept in Figure 27. This is not a definitive arrangement but one that provides a basis for engaging with the BrPA and other users to confirm the integration of their own facilities within the overall precinct layout.

The existing drainage network fulfils a role in both the control of stormwater movement and in maintaining the vine thicket. A whole-of-catchment drainage strategy is required to be provided by proponents to indicate how they will address their impact upon the network and how they will maintain the floodwater dynamics. The potential foundation proponent will need to demonstrate this by providing a drainage strategy corresponding to the various development stages and the ultimate precinct development to be approved by Government. The strategy should reflect the interdependency of the various phases of development and demonstrate the viability of the drainage system (and the facilities it serves) in the longer term under fully developed conditions.

NORTH

INDIAN OCEAN

FUTURE PROPONENT
PORT AREA (52.0ha)

BPA AREA = 1.5ha

CARPARK

SERVICES
CORRIDOR

BERTH POCKET

HLO WHARF

BERTHING AREA

HLO WHARF

BERTH POCKET

50m

30m

210m

30m

50m

190m

390m

50m

35m

10m

AQIS/STAGING AREA = 4.2ha

SERVICES
CORRIDOR

FOUNDATION PROPONENT
PORT AREA (50.0ha)

MANARI ROAD

LEGEND:

- AQIS/STAGING AREA
- BPA
- HAUL ROAD
- ACCESS ROAD
- FUTURE PROPONENT PORT AREA
- FOUNDATION PROPONENT PORT AREA
- COMMON USER CORRIDOR

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BROWSE LNG PRECINCT
PORT AUTHORITY FACILITIES

DRG No FIGURE 27

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6.5.4 Third Party Contractors' Site

A site for the 200ha Third Party Contractors' Site is located to the north of the proposed precinct access road. This site is located approximately 2km from the site boundary between the buffer zones to the precinct and adjacent to the access road.

6.5.5 Accommodation

The site for the 200ha workers accommodation site is located approximately 9km south of the precinct itself and adjacent to the proposed precinct access road.

6.6 Road Access

The construction of a new access road to the precinct from the Broome - Cape Leveque Road is part of the precinct's development. Currently, Manari Road provides access to the site at a location close to the coast. Although recently upgraded in some sections to provide temporary access, it remains a seasonal road with access limited in the wet. There are no plans for further upgrades of this road due to concerns raised by the Traditional Owners about the impact of this on country.

The sealed section of the Broome - Cape Leveque Road truncates at a location just south of Manari Road and approximately 13km north of Broome Road. To meet the needs of this project, the sealed section of road is likely to require upgrading to an acceptable 'highway' standard.

This road will also provide access to both the accommodation area and the third party contractor site. The Broome - Cape Leveque Road will continue to carry existing volumes of tourist and other traffic, with the additional traffic to the precinct originating from Broome or the Great Northern Highway.

In addition to the road itself, the service corridor will carry utility infrastructure to and from the precinct.

Just south of the precinct a layover area is required for road trains prior to entering the precinct. Factoring this requirement in any future planning for the precinct Access road is required.

6.6.1 Site Access Road Alignment

Figure 28 illustrates a 750m alignment corridor for the precinct access road from which a final 190m road and service corridor was identified. This corridor was determined using only low-resolution aerial photography and contours. A more detailed study to determine the actual road alignment within the corridor has since been undertaken by Main Roads WA. The 750m wide corridor was considered wide enough to identify a suitable road alignment given the prevailing topography of the area and is defined enough for the purposes of this Master Plan.

Further investigations will also be required to determine bridging requirements at the creek crossing to the south of the precinct. There is currently no information available regarding this watercourse. It is also possible that other creeks exist along the proposed alignment, which are not shown in the current base mapping and require further investigation.

NORTH

CO-ORDINATES MGA94 ZONE 51

1	411610mE	8069858mN
2	411610mE	8067108mN
3	412460mE	8067108mN
4	414077mE	8066979mN
5	414077mE	8064608mN
6	414077mE	8064418mN
7	414077mE	8062037mN
8	412460mE	8061908mN
9	411287mE	8061908mN
10	411087mE	8061908mN
11	410377mE	8063280mN
12	410017mE	8063280mN
13	410017mE	8063695mN
14	410017mE	8064895mN
15	410377mE	8065950mN
16	410377mE	8067108mN
17	411177mE	8067108mN
18	411177mE	8069358mN
19	410528mE	8069358mN
20	411287mE	8059941mN
21	412087mE	8059941mN
22	412087mE	8059162mN
23	411087mE	8059941mN
24	414209mE	8064608mN
25	414470mE	8064461mN
26	416077mE	8064800mN
27	416077mE	8062800mN
28	417077mE	8062800mN
29	417237mE	8064800mN
30	417237mE	8062270mN
31	416206mE	8061637mN
32	418125mE	8057374mN
33	417352mE	8056913mN
34	418490mE	8055005mN
35	419263mE	8055466mN
36	423526mE	8049731mN
37	423498mE	8048340mN
38	423909mE	8048871mN
39	423619mE	8047883mN

JAMES PRICE POINT

QUONDONG POINT

MANARI ROAD

BROOME - CAPE LEVEQUE ROAD

INDUSTRIAL LAND USE BUFFER

SENSITIVE LAND USE BUFFER

TO BROOME

LEGEND

- 3696ha AREA WITHIN WHICH A 109.78ha AREA FOR A PORT LAND AREA AND A 1980ha AREA FOR AN LNG PRECINCT WILL BE LOCATED
- 437.25ha AREA FOR A NORTHERN AND A SOUTHERN PIPELINE CORRIDOR
- PROPOSED SEALED ACCESS ROAD
- PROPOSED UNSEALED ROAD
- PROPOSED SERVICES CORRIDOR
- UNFENCED BUFFER ZONE (NOTE: NO PERMANENT DWELLINGS WITHIN BUFFER ZONES)
- 199.86ha AREA FOR ACCOMMODATION SITE
- 199.87ha AREA FOR A THIRD PARTY CONTRACTOR SITE

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BROWSE LNG PRECINCT PROPOSED PRECINCT ACCESS ROAD AND LOCATIONS FOR 3RD PARTY CONTRACTOR AND ACCOMODATION AREAS

DRG No FIGURE 28 REV 1

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6.6.1.1 Design Standards

The following high-level design standards have been determined based on the following Main Roads WA documentation:

- Guidelines for the Selection of Rural Road Reserve Widths;
- Selection of Cross Sectional Elements; and
- Austroads design guidelines.

Given the road's relatively low traffic volume (by urban standards), a nominal reserve width of 100m is deemed sufficient to cater for the road. Construction will consist of a single carriageway accommodating two 3.7m lanes and two sealed shoulders of 2.5m each. Based on the above guidelines, the engineering space required for such a road, excluding associated embankments, cuttings and drainage facilities is normally 20m (in addition to the road carriageway). Due to the limited information available regarding the engineering alignment, the allocation of 44m on either side of the road reserve provides for the containment of embankments, cuttings, drainage and associated infrastructure.

Main Roads WA is responsible for the construction of this road and for ensuring the standards appropriate for design during the planning process.

In addition to the road, the service corridors for utility infrastructure are as follows:

- 30m for a gas pipeline; and
- 60m for power lines.

6.6.2 Access to Browse LNG Precinct

Manari Road currently provides continuous access along the coast between Quondong Point and Coulomb Point to JPP to the north of the precinct, intersecting the two sections of land set aside for the port development. Construction of the port necessitates the closure of that portion of Manari Road intersecting the port lands, preventing future access to JPP from the south, or access to Coulomb Point from the north.

Construction of a new unsealed (seasonal) access road to connect the northern and southern portions of Manari Road will occur prior to any closure of Manari Road, and these will intersect the proposed access road. Design layout to preclude the creation of any crossroads is essential in minimising risk to road users, the intention being to ensure the southern bypass intersect the precinct access road south of the Third Party Contractor site road.

6.7 Utilities

There are currently no existing utilities within the precinct or locale. The foundation proponent would be responsible for providing utilities to the precinct for their own development. Further to this, as the

BrPA and Third Party Contractors site are required components of the precinct, the foundation proponent will need to provide capacity for their use. The required capacity is subject to negotiations with the BrPA and LandCorp as the agencies responsible for these developments.

Where servicing is not initially required, the foundation proponent is to ensure that the precinct is capable of being fully serviced, with plans developed to show how utility infrastructure including transmission capacity can be expanded efficiently to service the intended capacity, including the Third Party Contractors site and Accommodation area.

7 DEVELOPMENT STAGING AND EXECUTION STRATEGY

The site development staging and execution strategy are critical to the master planning only to the extent that stakeholders require an understanding of how these factors may influence the land allocations and arrangements required to support multiple projects and projects under development in an operating environment.

Further, the need for pioneering works will play a substantial role on the execution strategy for the project. Whilst it is a greenfields site, it is in close proximity to Broome and a screening study of infrastructure opportunities was considered.

The preparation of the staging plans is within the definition of key requirements from the Basis of Design and the Ultimate Development Master Plan for the precinct. The final development agreement will recognise these areas in this context.

7.1 Development Scenarios and Staging Plans

With multiple proponents, development of the precinct could occur in numerous ways. This section outlines some of the potential development scenarios and staging plans possible in order to achieve full development of the precinct.

7.1.1 Scenarios

The design of the precinct is to cater for up to three separate LNG producers, one large and two smaller producers, or two large producers. The underlying principle for development of the precinct is the efficient utilisation of the available land for development.

It is important to ensure that proponents have sufficient resources available to optimise development on the portion of the site for which they have access. Given the constrained size of the precinct, failure to do so will result in under-utilisation of the precinct and consequently demand for additional land in the future.

The basic premise of the Master Plan is to consider the envelope of development and technologies for the range of LNG technology types and solutions that may prevail for items such as conditioning of soils, foundation solutions, degree of modularisation etc. This gives a sound basis for ensuring flexibility to the proponents to work within the range of industry practices prevalent today (for greenfields development of LNG and future expansions) and within the design life of the precinct.

The foundation of the Basis of Design for the precinct is the need to support two to three precinct users, with the first user developing up to 25Mtpa of LNG and the second and third combined users developing an additional 25Mtpa on a second shared site. The precinct's maximum output is contained at 50Mtpa.

7.1.2 Staging

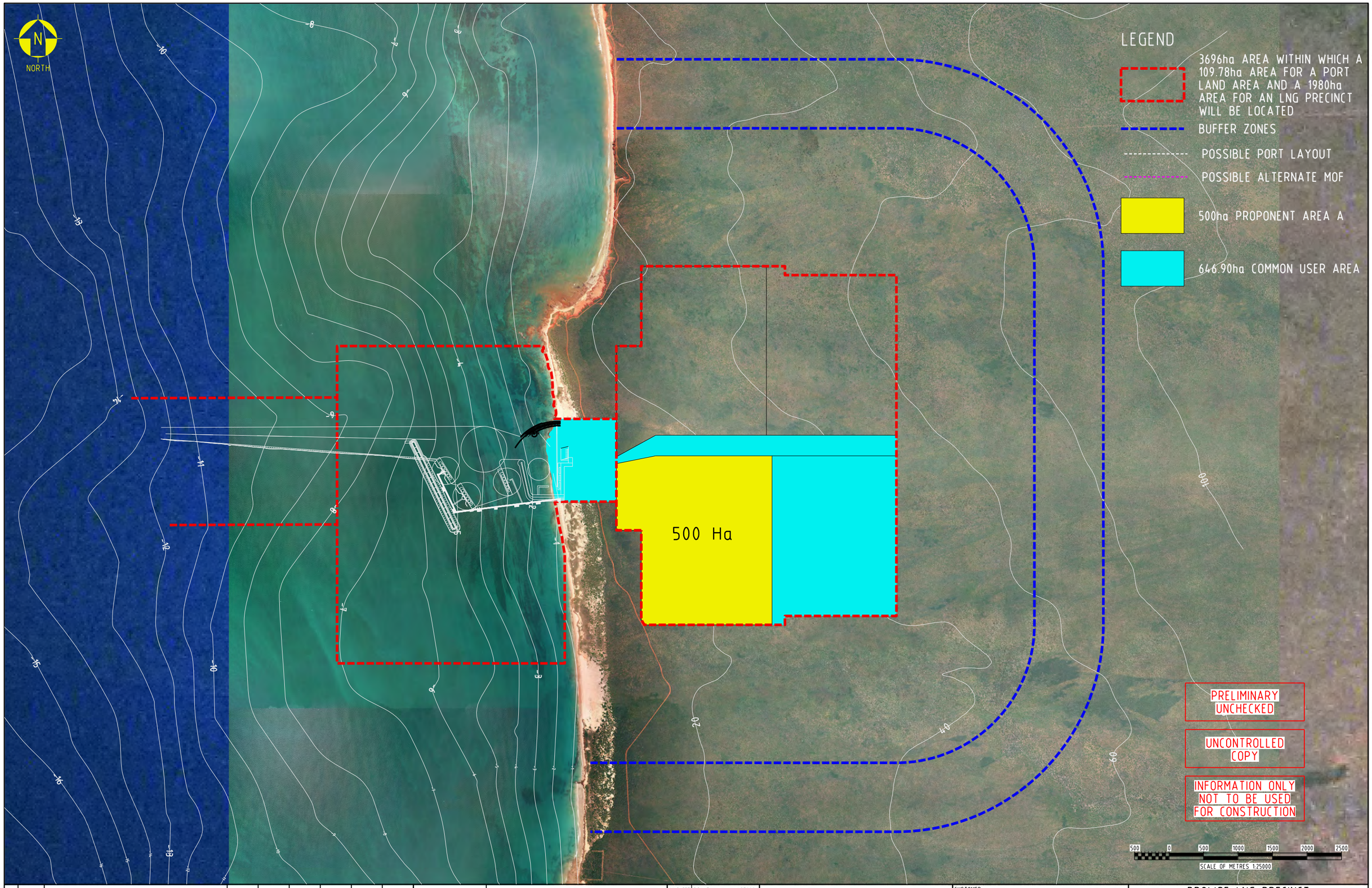
With multiple proponents, there are a number of ways of staging the precinct's full development. Assuming that the ultimate development involves only two large proponents, and that the southern area is preferable for the foundation proponent and therefore developed first, the precinct's development could assume any one of the following combinations:

- Scenario 1
  - Southern area stage 1 development
  - Southern area ultimate development
  - Northern area stage 1 development
  - Northern area ultimate development
- Scenario 2
  - Southern area stage 1 development
  - Northern area stage 1 development
  - Southern area ultimate development
  - Northern area ultimate development
- Scenario 3
  - Southern area stage 1 development
  - Northern area stage 1 development
  - Northern area ultimate development
  - Southern area ultimate development

The number of possible scenarios would double if the foundation proponent chose to develop the northern section first. This would increase further if there were ultimately three proponents in the precinct.

The importance of these phasing scenarios is that each will represent a different commercial outcome to both the foundation proponent and any subsequent proponents. For example, one layout option and development scenario may greatly reduce the amount of infrastructure required by the foundation proponent but subsequently result in an impost on the second proponent. While this may not represent a physical barrier to entry for the second proponent, it could create a commercial barrier to entry and would therefore be subject to approval and/or negotiation with the State. It will be necessary to develop an infrastructure sharing arrangement, which is not necessarily staging based, but more closely reflects the actual benefit to each proponent. In such considerations, recognition of common use infrastructure should be taken into account, such as utilities, roads, breakwaters and dredging.

Figure 29 and Figure 30 illustrate the proposed staging of the development from greenfields site to build out. Figure 30 also shows the preferred port option (Layout G) within the port area including two alternative MOF configurations to the north and south of the two jetties.



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WORLEYPARSONS PROJECT No. 301012-01576

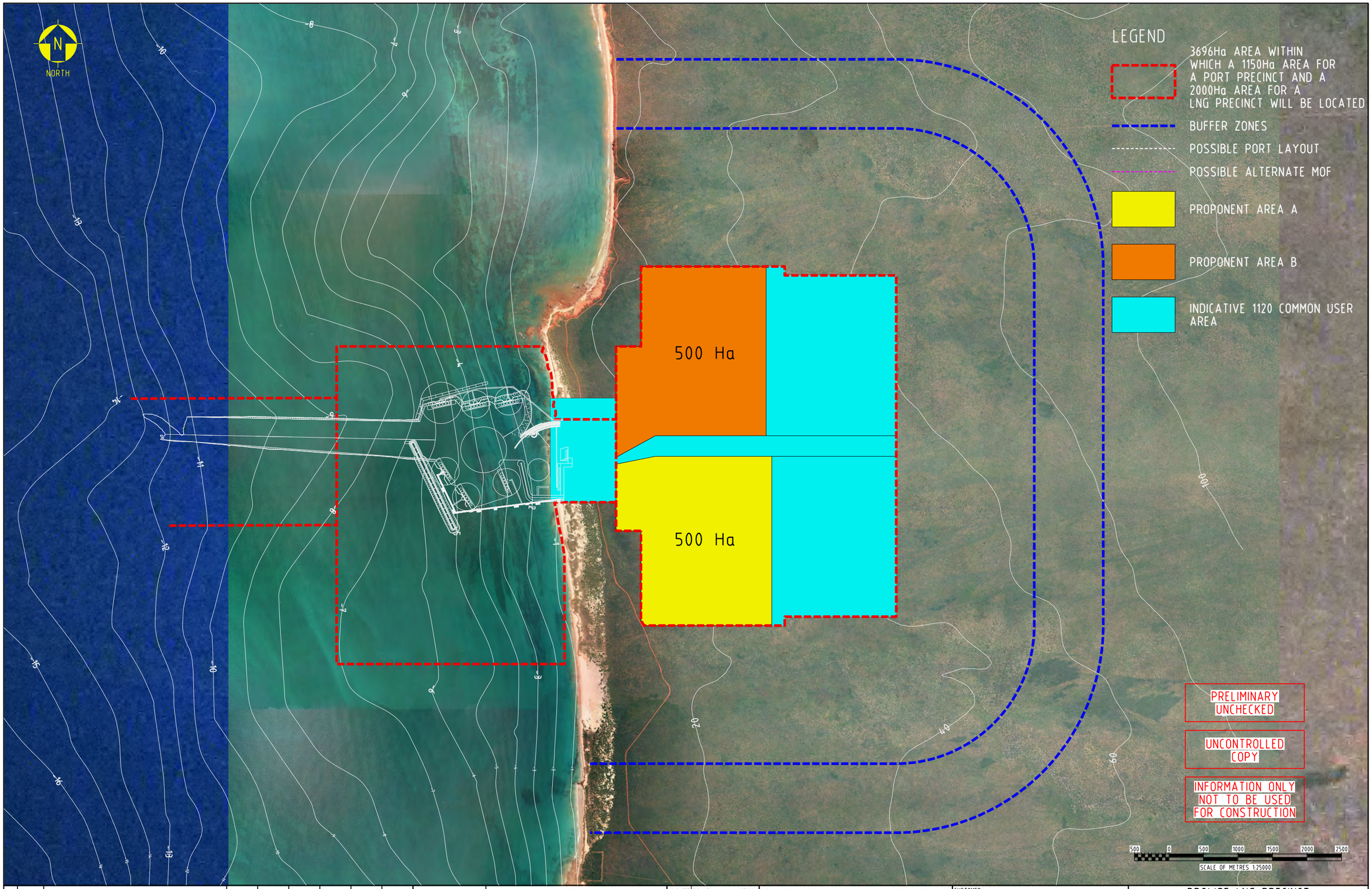
WorleyParsons resources & energy

CUSTOMER: DEPARTMENT OF STATE DEVELOPMENT

BROWSE LNG PRECINCT
PRECINCT DEVELOPMENT - STAGE 1

DRG No FIGURE 29 | REV 1

DATE & TIME: 25/03/2014 6:11:14 PM USER NAME: allan.walker LOCATION: I:\Projects\301012-01576 Browse Master Plan Update\8_Drawings\Figures\FIGURE 29.dgn



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BROWSE LNG PRECINCT
PRECINCT DEVELOPMENT - ULTIMATE

DRG No FIGURE 30

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7.2 Regional Infrastructure

Whilst the precinct will be largely self-contained, there are opportunities for the project to take advantage of regional infrastructure to complement the proposed execution strategy. In particular, a review of the surrounding region shows the following opportunities and assumptions included in the master planning exercise:

- Airport Facilities: The local international airport at Broome provides the opportunity to fly in the workforce from beyond the region if required.
- Broome Port: Import of bulk goods and support to marine vessels and vessels arriving that require shelter while preparing the site.
- Customs and DAFF services operating out of Broome (although ultimately supported on site).
- Police, emergency services and ambulances to address any pioneering works activities as a minimum.
- Accommodation for pioneering works which could be absorbed into the Broome base.

On-site generation of electricity, production of potable water, waste and wastewater management is needed to complement these available infrastructure capacities. Potable water options include ground water supply and treatment (subject to approval to access this resource) for the pioneering works, but more than likely will be driven by much larger capacity requirements for the construction (which will require a desalination plant or similar).

Once established, the permanent works utilities will support the project fully.

7.3 Shared Infrastructure

Discussions held at the commencement of this study identified that proponents are generally unwilling to share any infrastructure that they consider process critical. With this in mind, a key objective of the Master Plan is to minimise the area of land required for the precinct by ensuring an efficient layout of infrastructure and maximising opportunities to share non-process critical infrastructure.

Significant opportunities exist for shared infrastructure within the marine area of the precinct such as breakwaters, manoeuvring areas, tug pens and a common user MOF. Onshore-shared infrastructure is limited to the workforce accommodation area, the third party contractor site, common user areas, service corridors (including roads and utilities), operational requirements (including fire fighting and medical facilities) and the precinct access road.

In the detailed consultation with proponents, the development of an Integrated Marine Facility (IMF) which includes the Materials Offload Facilities (MOF), tug pens, Heavy Load Out (HLO) wharfs and supply base support facilities within the main harbour basin was considered necessary in view of the remote location of the precinct. On this basis, the IMF as referenced in the Master Plan refers to a combined facility including a supply base capability.

The extent to which these facilities are shared or are dedicated to separate proponents will be negotiated with the Government based on availability of space and commercial requirements of both the foundation proponent and future proponents. Government policy expectations, for example as included in Appendix 3 Precinct Definition Document and Appendix 6 Access Principles will guide those negotiations.

With the revision of the base case between Revision 2 and the current Revision 4 of the Master Plan, the base case assumes the sharing of the shipping channel, turning basin and IMF and only partial sharing of the breakwaters. Onshore, there have been no deviations from the previous scenario and the workforce accommodation area, third party contractors' site and access road to the site are all shared infrastructure. As outlined in Section 5.4.7, the accommodation area would be partially shared and partially exclusive use in order to maximise the area available to each proponent to support major development or expansion planning.

This approach forms the basis of the master planning footprint.

7.4 Construction and Pioneering Works

The construction and pioneering works form a very important part of successful master planning particularly as they relate to a greenfields development.

The need for sufficient laydown areas to support this magnitude of construction effort and the ease of transport through the site will result in cost effective outcomes. Much of these areas are considered shared or Common User areas, as they are only required during the construction duration. The precinct Master Plan has considered these requirements and the construction timing and workfronts (i.e. number of areas that construction works are being concurrently undertaken in) in some detail to come up with the Common User areas as shown in the Master Plan. Further, assessment against similar benchmark projects were discussed in some detail with the potential foundation proponents. The resulting allocation of Common User areas is 1090ha (including the central infrastructure corridor) over the entire site in strategic locations to support the logical construction sequencing.

The added complexity of developing this site is in the treatment of Pindan sands, which may require substantial land areas to pre-treat and replace over the extent of the site. Each proponent may have differing approaches to their foundation solutions and the land areas will vary accordingly. However, for master planning purposes the assumption is that the Pindan sands will be improved by removing, conditioning and replacing substantial amounts of material in the Common User areas.

Further to the onshore support areas and driven by a modular solution the project design and installation will require a suitable marine load-out facility to handle these modules, which could be up to 5,000 tonnes per unit. This in itself will require an efficient MOF and Heavy Load Out (HLO) facilities within the IMF. The Master Plan has worked to integrate one single IMF within the Master Plan fitting within the marine facilities envelope.

Common industry practice is for the delivery model for large complex projects to be managed under one Engineering Procurement and Construction Management (EPCM) contractor. This allows the client to vary construction packaging to suit the availability and capacity of construction contractors

and meet the market, leading to the number and mix of contractors on-site. Where this is the case, multiple construction contractors may be on-site at any given time. These contractors will require site areas allocated to them along with accommodation and associated services and utilities.

Again, it is the intention that the delivery model and allocation of the Common User areas will also allow this type of flexibility in contract packaging to allow the most cost and schedule effective delivery models.

Notwithstanding this, the normal considerations of an effective EPCM contractor would be to look to horizontal packaging of areas of the works which would see common piling contractors across the site, common concreting, common earthworks packages, one heavy lift contractor etc. to bring efficiency to the project wide delivery. Where this is the case, areas allocated to these contractors will be optimised.

Again based on the experiences of similar projects, the Master Plan is structured to minimise the risk that alternative packaging and mix of works can be accommodated within the allocated areas.

8 RECOMMENDATIONS FOR FURTHER INVESTIGATION

The work undertaken as part of this master planning process has led to a number of key conclusions and recommendations. These all form key aspects of the ongoing development of the Master Plan into a final verified and integrated solution for the precinct. These recommendations and conclusions are as follows:

- Completion of a full metocean and operability assessment to optimise and finalise the port footprint and key infrastructure components;
- As part of the above operability assessment, any potential foundation proponent must include validation of long period wave impacts on future berth operability. There is also a need to complete a probabilistic estimate of tsunami events to validate the extent of inundation on the nearshore facilities;
- Pioneering solutions study to determine impacts on surrounding infrastructure and the most efficient way to stage initial development of the site;
- Refinement of the IMF solution to resolve the location of the IMF and its arrangement within the port precinct, define the onshore areas to support the IMF, access arrangements and refining the plan for integration of the BrPA's requirements;
- The Basis of Design for the LNG precinct does not include allowance for construction of a supply base to support offshore operations from the site near JPP as part of the IMF facility. If it is considered desirable to include a supply base within the precinct, further work is required to determine the location and function requirements of a supply base, the marine scope, the timing of the marine scope and how dredging and other activities might interface and provide synergies, and the onshore land area requirements;
- Constructability and lay down area utilisation assessment, including consideration of parallel development or expansion phases and staging issues, is required to confirm the feasibility of supporting the development of the LNG plant, the required release of land within the precinct and the agreement for access and use of the land;
- A detailed risk assessment is required to confirm the appropriate internal and external buffer zones for the precinct and separation distances for separate operating activities and a mix of possible operating and construction activities;
- Central Infrastructure Corridor study to determine the alignment of infrastructure within the corridor including roads, pipelines and utilities, and the land area sharing and philosophy to support the agreements with potential developers. In particular the issues of crossing of infrastructure such as heavy haul roads over pipelines and facilities to support multiple developments from one facility such as a HLO wharf would need to be part of this assessment;
- Further geotechnical investigations are required as inputs to many of the above studies, and in particular to refine and develop further the port arrangement as dredging will be a key cost driver and onshore where foundations will dictate footprint solutions tabled for consideration;

- Furthermore, given the issues around the prevalence of Pindan Sands in the region, the depth, profile and “real” collapse potential at the sites inspected requires further investigation;
- Establish a database of information to support the knowledge base for the precinct. Requesting the provision of all base site data such as geological, oceanographic and other relevant base data would allow Government to be an informed developer of the precinct as it relates to its ongoing development. This data could be confidential and only available to government for assessment purposes and the request incorporated in any agreement with proponents. This is not an uncommon request at other multi user facilities of a similar nature;
- Further work is required to determine the most appropriate strategy for the accommodation of construction and operational workforces, and this will be based on a number of considerations including input from Proponents and specialists in this area;
- Further develop the drainage design solution to ensure alignment with the environmental commitments and commitments to the Traditional Owners during the staged and ultimate developments; and
- Further work is required to confirm alignment of the access road corridor between the Broome-Cape Leveque Road, including the corridor utilisation and cost.

Appendix 1 Master Plan Development, including Site Screening and Selection

Background

The Master Plan was developed over multiple phases, prior to the current iteration. Those phases include:

Phase 1 – Data Collection, Review and Consolidation

During this phase of the study, WorleyParsons gathered a range of background information relating to each site, sourced primarily from DSD and other sources held by WorleyParsons. A range of base maps developed from the different data sets were used to focus the project team's efforts during site inspection and the development of preliminary site layouts undertaken in Phase 2.

Phase 2 – Site Visit and Technical Review

In September 2008, WorleyParsons, accompanied by staff from DSD and the proposed foundation proponent (as an observer), commenced a six day site visit to each of the four potential hub locations. Another potential proponent provided an observer for the visit to the Anjo Peninsula. Traditional Owners and representatives of the Kimberley Land Council (KLC) accompanied the project team on site.

During these site visits the project team was limited in its inspection by varying levels of access to the sites, however it inspected a representative area of each site with particular focus on the LNG process plant location, potential jetty(s) locations and overall marine conditions.

Extensive low-level observation and ground level photographs of each site were undertaken and, where possible, GPS coordinates recorded for later photograph identification. Appendix 2 provides a selection of the photographic record.

WorleyParsons submitted a report documenting Phase 2 of the study to the Northern Development Taskforce (NDT) in November 2008. This report is publicly available through the DSD website at www.dsd.wa.gov.au.

Phase 3 – Development of Master Plan for the Preferred Site

For the selection of a preferred site near JPP, WorleyParsons prepared a Master Plan addressing the following key aspects of the precinct:

- Gas processing technology and footprint scenarios;
- Numbers of potential proponents and how they might be integrated effectively;
- Onshore laydown and construction support areas;
- LNG marine facilities;

- Corridors connecting key components of infrastructure together; and
- Construction of marine support facilities.

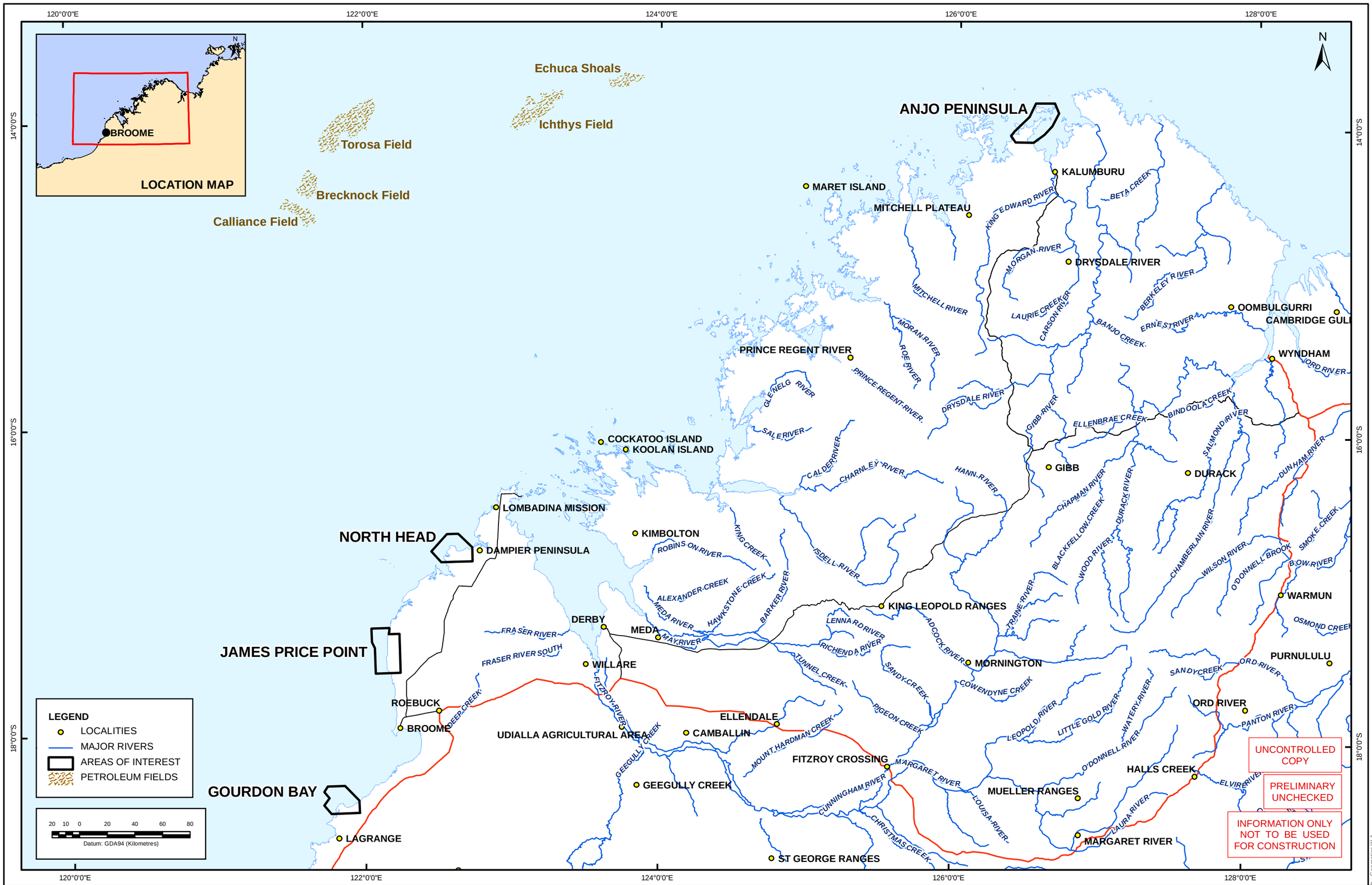
Investigations and negotiations regarding workforce accommodation and support industry areas were ongoing at the time of completion of this report.

This Master Plan provides the technical basis to undertake the assessment of the precinct under the Strategic Assessment process conducted by DSD.

Study Methodology

Through Phase 2 of the study, WorleyParsons identified indicative suitable areas for development at each of the four short listed development site options. Suitable locations for jetties and onshore facilities were identified and areas for onshore development. Figure 31 shows the regional context of each of the four short listed sites in relation to the offshore gas reserves and each other. The scope of potential sites is based on a practical consideration of distance from the offshore gas reserves. Figures 32 to 35 illustrate the proposed location of onshore and offshore development areas at each site following the completion of project Phases 1 and 2.

An extensive consultation process facilitated by DSD and involving local stakeholders and the proposed foundation proponent developed a preferred location/layout for the precinct. Following the selection of a site near JPP as the preferred site (refer to Appendix 1), the site selection considerations and preliminary master planning options in the site comparisons used in Phase 2 were a starting point for the development of a full Master Plan for this location.



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BROWSE LNG PRECINCT SITE CONTEXT

DRG No FIGURE 31 REV 0

Produced by: Michelle Smith - Geomatics W.A.

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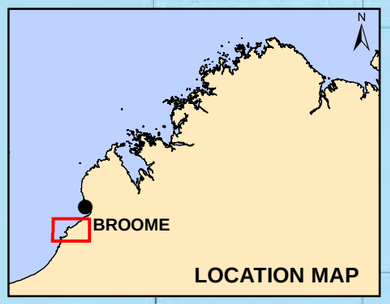

CAUTION: THIS MAP IS NOT TO BE USED FOR MARITIME NAVIGATION PURPOSES

Refer to the appropriate hydrographic chart for depth information

GOURDON BAY

LAGRANGE BAY

Cape Villaret
submerged
Yardoogarra Bore
Yardoogarra
Goldwyer Well
No 11 Bore
No 12 Bore
Hill Top Bore
oil well (abandoned)
Top Bore
gravel pits
numerous small
HIGHWAY
mast (61m)
CHURCH HILL
BARN HILL
Barn Hill Outstation
Deep Bore (disused)
Cape Gourdon
NORTHERN
GREAT
Cape Du Boulay
Cape Latouche Treville
Gourdon Bay
SADDLE HILL
Looroo Well
Yardoogara
gravel pits
Port Smith
Nygah Nygah
PORT SMITH ROAD
quarry
Cooldes Bore
Middle Reef
Boat Reef
Outer Reef
False Cape Bossut
False Cape Ck
Pindan Well (disused)
Nilbrica Bore (disused)
Nilbrica Well
Injidinah Bore
market garden
Wangpoo Bore
numerous claypans
Shallow Bore
gravel pit
Shamrock
mast (61m)
The Dam
INJIDINAH ABORIGINAL RESERVE
Injidinah Swamp
Tips Tank
Gilberts Bore
Dondis Dam
Bamboo Landing
Shell Patch (submerged)
Spit Patch
Black Rock Point
Larry Innes Well (disused)
small gravel pits
Bidyadanga Community
sewage treatment plant
BIDYADANGA RD
Islet Point
Rocky Point
Casuarina Reef
Red Islet
Spit Point
Cape Bossut
Ledge Point
Briens Bore
Herbs Bore
gravel pit
Errols (Seaview) Bore
Rollah Well
Bossut Well
Tryon Point
Wanamulnyndong
Kalyaydayan
Billabong Dam
Admiral Bay
Billabonga Well
Cabbage Gum Well
Deep Well
Warralong Well
Mugully Well (disused)
gravel pit
FRAZIER DOWNS ROAD
Redwing Bore
Frazier Downs
Langet Well (disused)
bore

LEGEND

20KM AREA OF INTEREST

5 2.5 0 5 10

Datum: GDA94, Projection: MGA94 Zone 51S (Kilometres)

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BROWSE LNG PRECINCT GOURDON BAY

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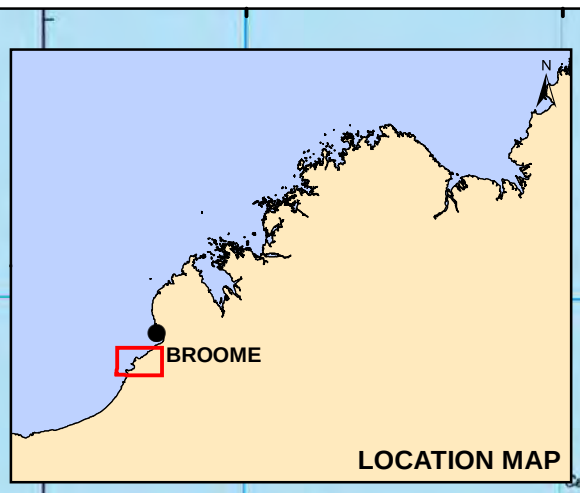

JAMES PRICE POINT

COULOMB POINT NATURE RESERVE

NUMEROUS CLEARED LINES MAY POSE A NAVIGATION HAZARD

PERMITS MAY BE REQUIRED FOR ENTRY INTO OR TRAVELLING THROUGH ABORIGINAL LANDS & COMMUNITIES

LEGEND

20KM AREA OF INTEREST

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BROWSE LNG PRECINCT
JAMES PRICE POINT

DRG No **FIGURE 33**

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NORTH HEAD

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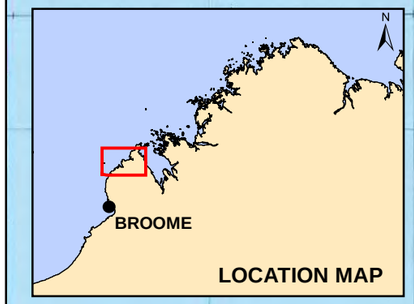

LEGEND

20KM AREA OF INTEREST

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PERMITS MAY BE REQUIRED FOR ENTRY INTO OR TRAVELLING THROUGH ABORIGINAL LANDS & COMMUNITIES

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BROWSE LNG PRECINCT
NORTH HEAD
AREA OF INTEREST

DRG No **FIGURE 34** REV 0

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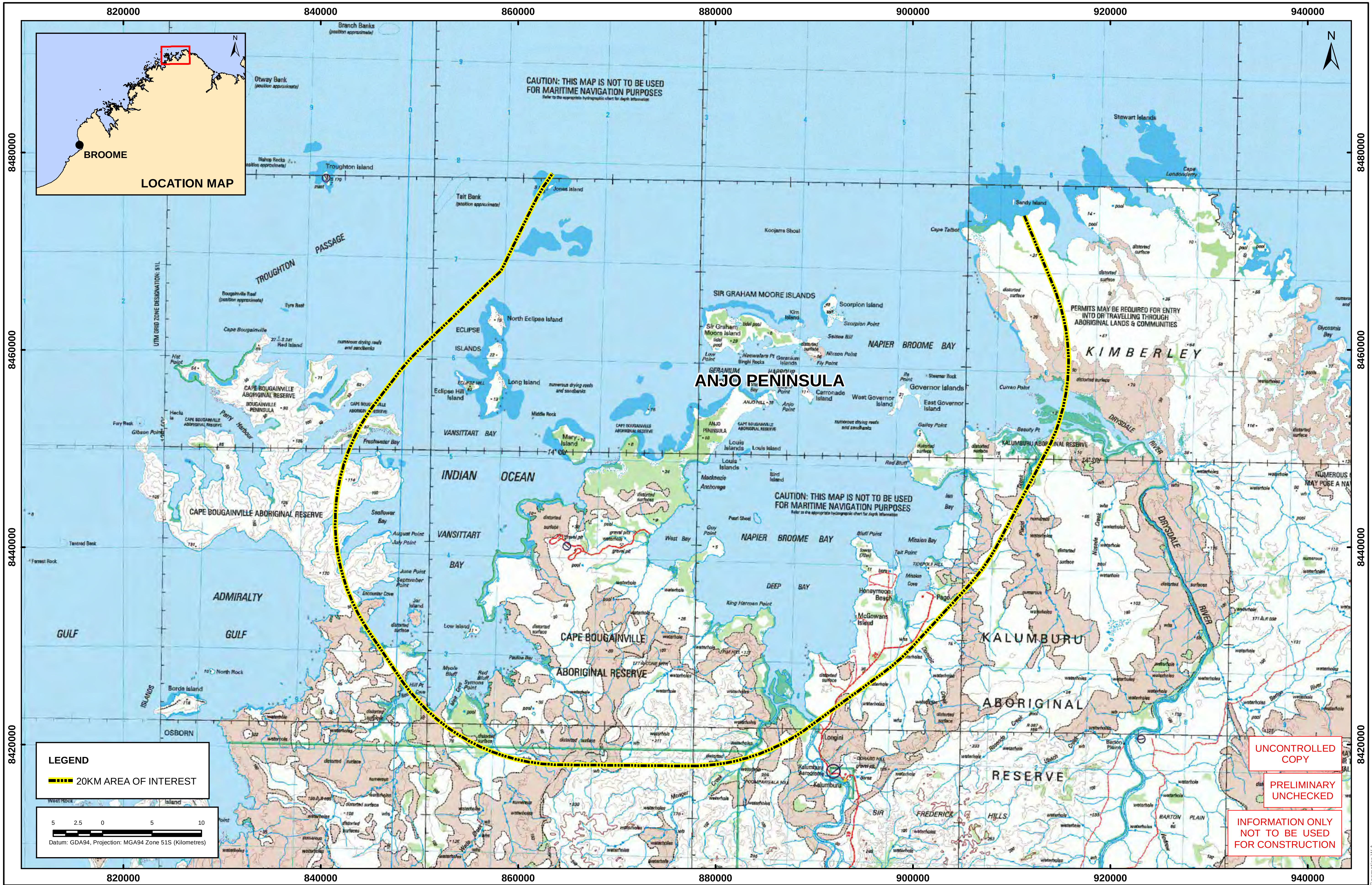

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BROWSE LNG PRECINCT
ANJO PENINSULA

DRG No **FIGURE 35** REV 0

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Site Screening

WorleyParsons undertook an analysis of the four sites at Anjo Peninsula, North Head, JPP and Gourdon Bay based on a range of key engineering and project development attributes (to support an onshore LNG processing precinct and associated marine facilities layout). The site analysis described the state of knowledge, which was available at that time including:

- The site setting;
- Onshore or landside characteristics including proximity to arterial roads and any existing infrastructure;
- Onshore geology and drainage challenges;
- Marine bathymetric drivers or distance to deep water;
- Degree of shelter to prevailing Oceanographic Conditions;
- Likely seabed geology; and
- The likely availability or challenges in finding naturally occurring construction materials in close proximity.

The Phase 2 reporting outlines the findings of the above analysis and this is available from DSD. Likewise, a range of appendices with supporting information was included and therefore excluded from this report. The site analysis incorporated a range of public domain and site inspection reporting in support of the analysis and was as comprehensive as possible in its determination of site assessments. The participation of prospective proponents allowed the proponents preliminary project requirements to be defined and incorporated as a key consideration in this site selection.

Site Selection

Based on the analysis of a range of key engineering and project development attributes (to support an onshore LNG processing precinct and associated marine facilities layout) the final selection of the preferred site between Anjo Peninsula, North Head, JPP and Gourdon Bay resulted in the selection of JPP. These considerations included overall cost and operation items with the findings of this analysis presented to DSD. Combined with other information, this analysis, including heritage, environmental and native title considerations (prepared separately), formed the basis for DSD reporting back to Government.

In December 2008, the Environmental Protection Authority (EPA) completed an assessment of the four short listed sites for the Browse LNG Precinct. Of the two sites located on the Dampier

Peninsula, the area around JPP was the preferred location for the development as this was the least environmentally constrained.

On 23 December 2008, the Premier Colin Barnett announced that the Government's preferred site for the Browse LNG Precinct was near JPP. This site was selected on the basis that it was most likely to work best for the Kimberley community, for the environment and for industry.

A copy of the Premier's press release is included in Appendix 7.

Following this announcement, DSD engaged with local stakeholders (including Traditional Owners) and potential proponents to define the location and layout of the precinct. WorleyParsons supported DSD in this process of engagement and in the provision of engineering and plant design aspects of the LNG onshore and marine facilities.

Appendix 2 Selected Phase 2 Site Photos

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GOVERNMENT OF WESTERN AUSTRALIA

NORTHERN DEVELOPMENT TASKFORCE

BROWSE ONSHORE LNG PRECINCT
GOURDON BAY
SITE VISIT PHOTOS

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REV A

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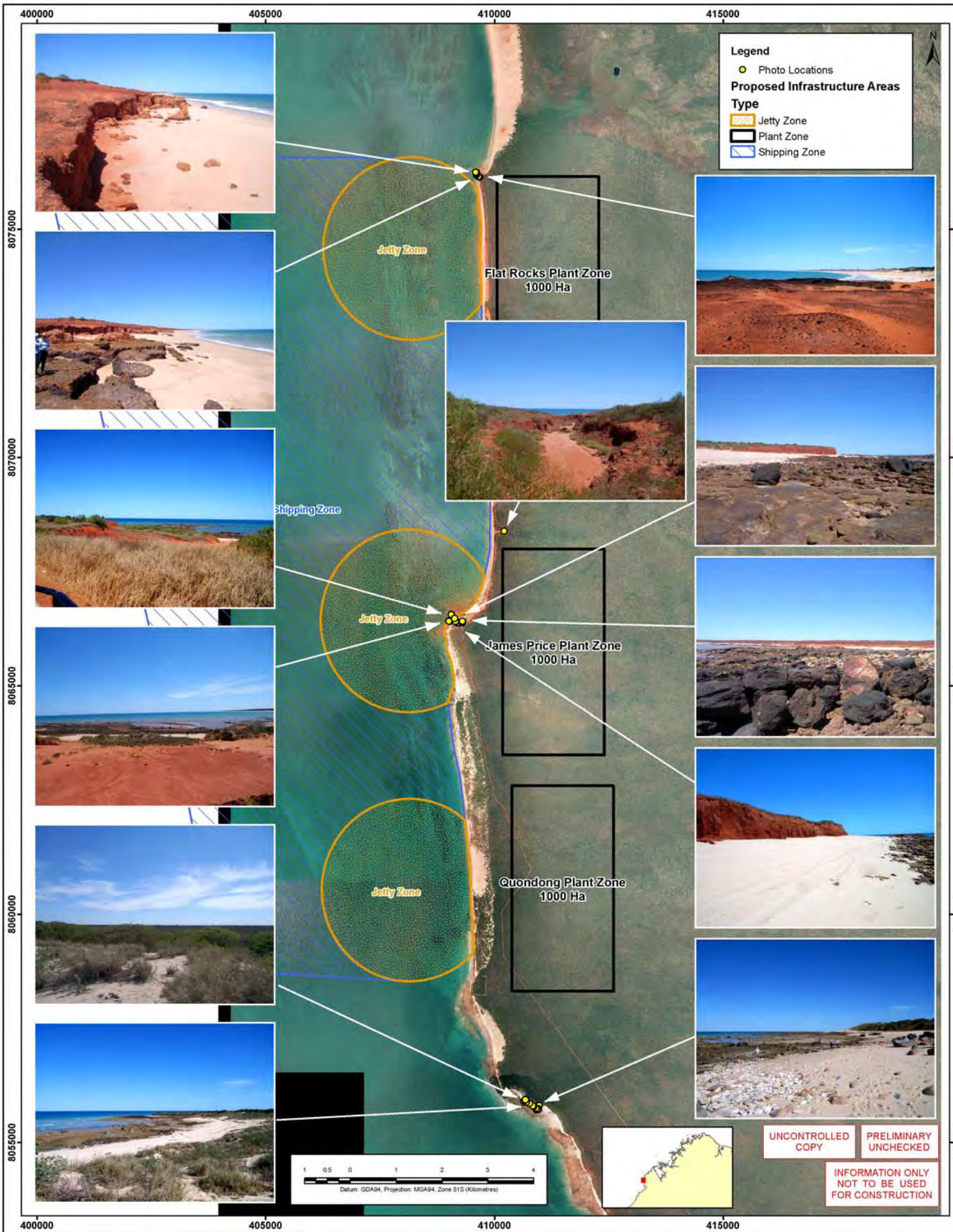

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CUSTOMER: NORTHERN DEVELOPMENT TASKFORCE

BROWSE ONSHORE LNG PRECINCT
JAMES PRICE POINT
SITE VISIT PHOTOS

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CUSTOMER

NORTHERN DEVELOPMENT TASKFORCE

BROWSE ONSHORE LNG PRECINCT NORTH HEAD SITE VISIT PHOTOS

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REV A

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OneWay to Zero Harm

WORLEYPARSONS PROJECT No. 301012-00633

WorleyParsons resources & energy

EcoNomics

CUSTOMER

GOVERNMENT OF WESTERN AUSTRALIA

NORTHERN DEVELOPMENT TASKFORCE

BROWSE ONSHORE LNG PRECINCT
ANJO PENINSULA
SITE VISIT PHOTOS

DRG No 301012-00633-00-GI-DLP-00001012 REV A

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Appendix 3 Precinct Definition Document

BROWSE LNG PRECINCT

DEFINITION DOCUMENT

19/09/2011

Contents

1. PREAMBLE

1.1. The Western Australian State Government (the State) is establishing the Browse Liquefied Natural Gas (LNG) Precinct (The Precinct) at a site near James Price Point, approximately 60km north of Broome, in the Kimberley, to enable processing of natural gas from the offshore Browse Basin.

1.2. The Precinct will be capable of accommodating LNG processing and shipping facilities for a minimum of two proponents developing these resources. The Precinct will support the development of LNG projects at the site.

1.3. The State's objective is to ensure the efficient use of the land to accommodate up to 50 million tonnes per annum (Mtpa) of LNG production and export.

1.4. The State's objective will be achieved by optimising the allocation and use of land within the Precinct, and establishing common user infrastructure to facilitate both the efficient use of that land, and the capacity of the site to support its development.

1.5. The State will achieve this objective without compromising the viability of the Precinct, and by supporting individual project requirements within Precinct constraints, as established within the *Worley Parsons Browse LNG Precinct Master Plan Report (Document Number 00633a24 Rev 2 of July 2010)* (Worley Parsons Browse Master Plan) and through further ongoing work.

2. DOCUMENT INTENT

2.1. This document is intended to:

i. Articulate the State's approach to planning The Precinct.

ii. Provide clarity to proponents regarding the State's requirements for planning and design of projects within the Precinct area.

2.2. This document provides explanatory detail regarding clauses within the Preliminary Development Agreement (PDA) and should also be considered in context with the:

i. Native Title Agreement;

ii. Strategic Assessment Report;

iii. Worley Parsons Browse Master Plan, which was developed in consultation with the Foundation Proponent; and

iv. Requirement for The Precinct to supply Domestic Gas to Western Australia.

3. REQUIRED OUTCOMES

3.1. The State requires that The Precinct will:

i. Consolidate LNG processing and export on a single site to prevent *ad hoc* development on the Kimberly coast.

ii. Minimise the overall footprint of LNG development in the Kimberley.

iii. Be consistent with the outcomes of the Strategic Assessment Report (SAR) and the requirements of the Environmental Protection Authority (EPA), and/or relevant legislative requirements.

iv. Allow for the provision of domestic gas to Western Australia.

v. Achieve the State's objective of providing up to 50Mtpa of LNG production and export within the defined footprint.

vi. Include both common user and exclusive use areas with port infrastructure designed and located to support the entry of one or more additional proponents.

vii. Be developed by individual proponents in a manner which:

a. does not impede other proponent/s from achieving development capacity;

b. does not create conditions at the site boundaries or within the site (including the airshed and coastal footprint), which limit the flexibility of other proponents to develop a site plot plan; and

c. ensures that infrastructure is shared efficiently between proponents whenever appropriate.

4. THE PROJECT

4.1. The Precinct is a multi-user LNG processing and export precinct.

4.2. The Precinct consists of:

i. Exclusion zone:

a. fenced industrial precinct (2,000 hectares (ha)), which includes:

- two individual industrial blocks of up to 500ha each (1,000ha total); and
- common user area (1,000ha); and

b. land (fenced) and waters of the Port (approximately 1,000ha).

ii. Non-exclusion (unfenced) zone:

a. workers accommodation area (including exclusive use areas) (up to 200ha);

b. light industrial area (including exclusive use areas) (up to 200ha);

c. access roads; and

d. a buffer zone around the exclusion zone (approximately 3,000ha).

iii. Refer to figure one, appendix one (Browse LNG Precinct Layout).

4.3. The State[1] **will provide exclusive tenure for the Foundation Proponent** over:

i. A dedicated 500ha industrial block for the Foundation Proponent's stand-alone facilities and for ancillary or associated facilities.

ii. Part of the accommodation area (equal to or less than 100ha);

iii. Those parts of The Precinct that are required for the Foundation Proponent's purposes, including (process critical) jetties, supply base, tug and support vessel pens and pipelines (other than the 'non-exclusive' areas described in *item 4.5*).

iv. Any supply base facilities are strictly for the purpose of servicing the supporting producing facilities supplying feedstock to The Precinct.

[1] As indicated in the Preliminary Development Agreement.

v. It is the State's intention that the Foundation Proponent will be granted exclusive tenure to an area within an efficiently designed integrated marine facility for its supply base, tug and support vessel pens. This facility will be designed to be expandable to accommodate future proponents (for example, additional supply base area, tug and support pens) in such a way as to minimise the overall footprint. This facility would also include any other essential multi-user infrastructure such as 'Roll on Roll off (RORO)', 'Lift on Lift off (LILO)', Materials Offload Facility (MOF), Heavy Load Out (HLO) or other similar utilities.

4.4. The State **may consider exclusive tenure for (a) future proponent/s** over:

i. A dedicated industrial block for the future commercial proponent's stand-alone facilities and for ancillary or associated facilities.

ii. An agreed upon area within the accommodation area.

iii. An agreed upon area within the light industrial area through a State negotiated lease agreement.

iv. Those parts of the Port Area required for the future proponent's purposes including (process critical) jetties, supply base, tug and support vessel pens and pipelines (other than the 'non-exclusive' areas described in *item 4.5*).

4.5. The State **will provide non-exclusive use** over:

i. Part of the accommodation area and light industrial area (with the exception of the exclusive areas as described in *items 4.3 and 4.4*).

ii. Common user areas (including common user lay-down areas and construction lay-down areas).

iii. Multi-user Port infrastructure[2] and service infrastructure[3].

4.6. The State, through LandCorp, will enter into an agreement with the Native Title party, which will establish the Native Title Party as the Site Manager for the Third Party Contractors Site.

4.7. The Native Title Party will be required to provide the Foundation Proponent's third party contractors with access to the Third Party Contractors' Site as required, on a timely basis and on reasonable commercial terms commensurate with commercial rental rates for industrial land in Broome.

4.8. It is envisaged that third party service providers would be available to provide services to the Foundation Proponents as well as future proponents. The State, through LandCorp, will work with Traditional Owners to ensure that land is made available as required, and on the basis that future proponents are not disadvantaged on the basis of land availability at the Third Party Contractors Site.

5. PRECINCT DESIGN PRINCIPLES

5.1. The Precinct will:

i. Contain common user Port infrastructure.

ii. Be capable of accommodating, in a viable and sustainable manner, multiple stand-alone LNG processing and exporting facilities and operations.

iii. Include a light industrial area.

[2] Multi-user areas of the Port include breakwaters for export facilities, MOF, HLO, tug boats and other facilities; dredging required for the marine facility, HLO wharves; shipping channels; and utilities including power and water.
[3] Service Infrastructure includes: access roads, transport corridors, common user utilities and pipelines.

iv. Consist of infrastructure and facilities located and designed to support the entry of one or more additional proponents.

v. Minimise and mitigate its impact on the terrestrial and marine environment.

vi. Include in its design, the requirement for The Precinct to provide domestic gas to Western Australia.

5.2. The design (including any component of the Browse LNG Precinct) will:

i. Minimise the overall footprint of the area.

ii. Enable the sharing of infrastructure networks and corridors.

iii. Not present any material barriers to entry of additional proponent/s.

iv. Ensure that elements of the Foundation Proponent's project will not interfere with other proponent/s' ability to construct, operate and maintain separate facilities.

5.3. Infrastructure and facilities will be located and designed to maximise the sharing of reticulation and network systems, under the following circumstances:

i. Where the location and design can reduce, or avoid the duplication of non-process critical infrastructure.

ii. Where the location and design can contribute to the reduction of the overall project footprint[4].

iii. Where the location and design can be appropriately scaled at minimal cost[5].

5.4. The design and planning of the Precinct will be determined in the State Government approved Port Master Plan and approved Statutory Structure Plan.

5.5. Consistent with the Heavy Use Industrial Land Strategy, the State will undertake the statutory planning of The Precinct. The favoured option to plan The Precinct is by way of an Improvement Plan and Improvement Scheme in accordance with the *Planning and Development Act 2005*. The Foundation Proponent's and future proponents' projects shall be consistent with the Improvement Plan and Improvement Scheme.

5.6. LNG Processing and Critical Utilities

i. Up to 500h will be allocated for a proponent's core LNG processing and associated production activities. This area shall include:

a. Appropriate separation and layout to incorporate any elevated risk: proponents shall comply with the risk criteria detailed in the document "*EPA Guidance Statement GS2 - Guidance for Risk Assessment and Management: Off-site individual risk from Hazardous Industrial Plant. No.2 July 2000.*

b. Storage Facilities: the storage of LNG and other export products produced by proponents in tanks or other forms of storage and including all materials handling pumping, vapour management and associated facilities shall be stored on the LNG processing plant footprint.

c. LNG trains: the physical infrastructure which shall define the LNG trains shall constitute all:

[4] The State considers that the primary areas where such synergies are critically important are through the sharing of the port breakwater and channels.
[5] This includes telecommunications, water inlets and outfalls, power poles or water pipelines for support areas

- gas receiving facilities;
- LNG condensate;
- LPG processing facilities;
- site works, including site preparation and associated works footprints;
- product handling facilities; and
- any infrastructure required to support these facilities as determined necessary by the proponent to receive gas, and process the gas into the proposed export products ready for storage.

d. Flares: the sites required for flares shall be incorporated within the proponents' allocated site area and shall include all buffers and exclusion zone allowances required for safe and acceptable operations. The selection of flare type including the use of elevated or ground flares is at the discretion of the proponent/s, but shall meet all agreements and approvals provisions for the use of the land. The Foundation Proponent shall minimise light emissions from flares as far as practicable.

e. Utilities: the proponents will have a requirement to support the LNG process with critical utilities including the administration and other core facilities.

5.7. Site Development Principles

i. The site development shall be carried out in a manner which does not affect the drainage design requirements of the remainder of The Precinct or create other conditions which are considered by the State to have either direct or indirect adverse impacts on the remaining lands of The Precinct

ii. The proponents shall provide alignment of any above ground or underground facilities outside of the site boundary of their LNG processing site.

iii. The use and disposal of any materials from the site development shall have a detailed management plan and remediation plan approved by the State, where such activity occurs in any of the common user areas or on areas that have the potential to impact the development of the remainder of The Precinct.

iv. The site development shall include it its design, the requirement for The Precinct to provide domestic gas to Western Australia.

5.8. Common User Areas

i. Common user areas are areas where proponents can obtain access for the construction, expansion or maintenance of their LNG project facilities. Allocation of land within common user areas will be managed by the State and will and allocated on the basis of submissions made by the proponents.

ii. Common user areas will be used by proponents for the following primary purposes:

a. To store and lay-down equipment, materials and components as they are brought to site to prepare them in readiness for installation. Conditioning of existing site soil can be completed in readiness for these materials to be used in final earthworks.

b. As contractor site areas, third party contractor site areas, Engineering, Procurement, Construction Management (EPCM) contractor offices and site areas, car parking, construction personnel induction, and security access checks during the construction period.

c. For other approved activities of a temporary nature or with a well defined period of use.

iii. The allocation of any land within common user areas includes up to 500ha of land adjacent to each proponent's site. Flexibility exists to utilise additional land within the common user area for temporary activities on the basis that availability of this land will be subject to timing and use requirements of subsequent proponents.

iv. The conditions of use are subject to agreement on the basis that the sites shall be remediated where instructed by the State to an agreed timeline following the required period of use. Where the State deems that the works undertaken at the site are of value to the State for future use, the State shall maintain the right to request that these be left in place. The responsibility for later removal and site remediation within an agreed timeline commensurate with the design life of those facilities would then be with the subsequent proponent utilising these works.

5.9. Buffer Zones

i. Internal Buffer Zones shall be provided, which meet acceptable operating practices, and which provide suitable clearances between operators, equipment and facilities within The Precinct boundary fence.

ii. External or Boundary Buffer Zones, where there is no proponent adjacent to the site, are the clearances required from the boundary of The Precinct (fence line), and shall be 2,000 metres for an Industrial Buffer Zone and 3,000 metres for a Buffer Zone.

iii. All existing and future proponents must ensure that activities do not impact on the flexibility or amenity of another proponent within the site. This will be achieved by ensuring adequate Buffer Zones exist within the proponents' industrial areas, as described in *item 5.5.i.a (appropriate separation and layout to incorporate any elevated risk)*.

5.10. Site Access

i. Site access by road will be defined as the road alignment required to connect the site to the Great Northern Highway, and including all of the intersection works and associated facilities for the required design conditions.

ii. The State, through Main Roads WA, will design, construct and maintain an all weather road, providing safe vehicle movements to support normal operations and construction activities. The funding mechanism for this road construction is yet to be determined.

iii. The Foundation Proponent will construct all internal roads within The Precinct to its operation and to the Port necessary for its initial project. The internal road network must be designed to incorporate subsequent expansions necessary for future proponents, and should also be mindful of the development and expansion of associated service corridors

iv. The connection to Broome and the Great Northern Highway will be built to a highway standard.

v. The extent of the access to the site will include the road alignment within the central infrastructure corridor from the site boundary to the Port land side area to a position to be agreed between the State and the proponents.

vi. The site access by road will also support site evacuation and emergency services activities in events of no less than twenty year recurrence interval extremity, and within normal cyclone operating procedures including allowance for wind and flood conditions.

5.11. Infrastructure Corridors

i. The infrastructure corridors are allocated for use by the proponents, the State and other approved third parties requiring access around the site to carry out any required or approved activities.

ii. Infrastructure corridors have been allowed within the site to accommodate a multi-user road for access to and from the Port and multiple easements for carrying pipelines and other infrastructure for each proponent.

iii. The allocation of easements within the infrastructure corridors will be made by the State based on applications by the proponents for easements to accommodate activities such as pipeline corridors, heavy transport such as module transport road alignments, or other approved activities, which support either operations or construction activities of a permanent or temporary nature.

iv. The design of facilities within the infrastructure corridor will be completed in a manner which is commensurate with the proposed uses by others and the intended users of the corridor.

5.12. Support Industry Accommodation

i. A total area of 200ha has been allocated for accommodation facilities for the purposes of temporarily accommodating the construction workforce, any future shutdown or maintenance workforce activities required adjacent to the site, and any permanent workforce accommodation required by all of the proponents.

ii. The allocation of land for accommodation will be made by the State and on the basis that each proponent may be allocated up to 100ha of land within the accommodation precinct. Adequate scope for the typical development stages for LNG will be accommodated within this land allocation.

iii. All proponents shall develop an accommodation strategy, including camp arrangements and management, a mix of motelling and allocated units, and a program of works, and make all such considerations to ensure the land allocation supports their proposed development strategy.

iv. Flexibility exists to utilise additional land for temporary activities on the basis that these will be subject to the timing and requirements of the subsequent proponents' activities, and shall be agreed with the State on a case-by-case basis. The total area and location occupied by a proponent shall not prevent a future proponent from achieving its requirements within the accommodation area.

5.13. Port Authority Requirements

i. The Port waters, seabed area and land areas will be identified, finalised and surveyed.

ii. The Port area will be formally vested in the Broome Port Authority (the Port Authority), and the *Port Authorities Act 1999* applies.

iii. The Port land and seabed areas will be subject to one or more Qualified Certificates of Crown Land Title at, or around the time that vesting occurs to allow the registration of proponent's leases.

iv. The State will attend to any rezoning required for The Precinct in the Port area.

v. Some of the State's roles and responsibilities contemplated under this document may be assumed by the Port Authority subject to appropriate legislative requirements.

5.14. Gas Pipeline Shore Crossing and Onshore Alignment

i. A trunkline shore crossing alignment for the offshore trunkline(s) landing to The Precinct has been identified in the near-shore area and is shown in *Figure one, Browse LNG Precinct Layout.*

ii. The trunkline alignment will be included within the identified corridor to the extent that this corridor is defined in *Figure one, Browse LNG Precinct Layout* to the shoreline and the alignment identified to the proponent's LNG processing site.

iii. Pipeline alignments beyond the shore crossing alignment will be located to avoid vessel approaches into the Port and with sufficient protection to avoid vessel or other impact risks creating limits to the Port approach, The Precinct or LNG Port activities.

5.15. Airshed capacity and design requirements

i. The airshed capacity is the capacity of the atmosphere to absorb all air emissions associated with the construction and operations of The Precinct plant site. The emissions shall include, but not be limited to: dust, noise, odours, noxious emissions, sulphur, CO and CO2, which will form the basis of factors that may affect the approvals of the Foundation Proponent or future proponents.

ii. The State will ensure, through the derived proposals process under *the Environmental Protection Act 1986* and through any other means necessary, that the Foundation Proponent has selected suitable technologies for this site and the associated prevailing conditions, such that it will not prevent future expansions of The Precinct to its full capacity (50Mtpa).

iii. The Foundation Proponent shall assume that future proponents' gas composition can vary across a range of agreed (with the State) compositions, which will not preclude advances of production technology. It will, however, be assumed for emissions purposes that the LNG processing technologies are similar to those of the Foundation Proponent.

iv. This requirement will also remain for future proponents in sequence, and future proponents will be required to demonstrate similar reciprocal and future obligations to other users.

5.16. Additional Proponent Risk and Qualitative Risk Assessment (QRA) Requirements

i. As defined in *item 5.5.i*, the site area will include the total land area, including allowance for all process and plant related facilities. The arrangement of

facilities within the site shall be designed and arranged such that it does not preclude the un-encumbered use of adjoining land.

ii. Furthermore as an example of *item 5.15.i*, the perimeter fence line to the proponents' site shall not have elevated risk, which requires adjacent land uses to be limited in the context of their proposed land use, or limits flexibility in arrangement of its proposed facilities.

iii. A QRA shall be carried out to assess boundary conditions using industry accepted techniques and provided to the State to demonstrate that the above criteria can be met.

5.17. Maritime Security

i. The Port Authority will appoint a Port Security Officer and prepare an approved maritime security plan in accordance with the *Maritime Transport and Offshore Facilities Security Act 2003* and associated Regulations. The Foundation Proponent and all other proponents will be required to prepare and implement an approved maritime security plan.

ii. All operators of facilities and providers of services at the Port must have a maritime security plan.

iii. Maritime security plans and strategies shall meet all requirements of the *Australian Maritime Transport and Offshore Facilities Security Act 2003 and associated Regulations.*

iv. All infrastructure required to meet the requirements of the *Australian Maritime Transport and Offshore Facilities Security Act 2003 and associated Regulations* shall be established by the Foundation Proponent for the site.

5.18. Dredging Material Use and Management Onshore

i. Where dredge material is bought ashore for the purposes of site earthworks and development it shall be subject to the requirements of management plans approved by the EPA and the State. State plans will govern the use of dredging material and any remediation of ponds or remaining fines.

ii. As the Foundation Proponent will utilise most of the dredge material to be won from the site associated with the site establishment and first stage development of the Port, any excess dredge material or waste materials either from the dredging process or removed from the existing materials on site shall require approval from the State to ensure the management of these materials does not limit or preclude The Precinct development strategy.

5.19. Water for Construction and for Operations

i. Identified water resource to support construction and operations at the site is considered a key strategic asset for The Precinct. This resource will be subject to approvals for the use and allocation of capacity to ensure it does not create limitations to the use and development of The Precinct in total.

ii. Ground water resource and the available sustainable capacity of this resource shall be identified by the proponents and utilised in a manner in conjunction with the maximum capacity of desalinated water. The use of this water shall be subject to the provision of a total strategy demonstrating systematic and staged construction and that full operational conditions can be met.

iii. The Foundation Proponent will prepare a water supply and utilisation strategy for The Precinct, for approval by the State. This strategy will be consistent with the Native Title Agreement and will show how sustainable supply of a sufficient capacity can support full operating capacity of The Precinct at 50Mtpa of LNG. It shall also show how the water supply can be staged with up to two construction phases and how existing operations might be met.

6. PORT DESIGN PRINCIPLES

6.1. The Port Area and Marine Facility will be placed under the jurisdiction of the Port Authority and subject to the *Port Authorities Act 1999*.

6.2. The Port Authority will have an on-site presence at The Precinct.

6.3. Sufficient land within the Port Area will be allocated to the Port Authority for administrative and operational purposes, including lay-down area, on-site premises and presence for monitoring and safety control.

6.4. The Foundation Proponent will fund the development of the premises (as outlined in *item 6.8*) for the Port Authority.

6.5. The Port Authority will:

i. Have control over the Port Area and Marine Facility, including safety, security and harbour master control.

ii. Administer the Port vessel scheduling system, the allocation of berths and be the leaser, licensor or grantor of the appropriate land tenure and Marine Facility usage rights for proponents.

iii. Take ownership of common user infrastructure, with costs for the Foundation Proponent to be recovered on agreed terms from future proponents.

iv. Plan and allow for the establishment of a common user easement area to provide for regulated access between the landside areas and the exclusive use marine infrastructure.

v. Develop and make available, exclusive land and seabed use areas, subject to the appropriate lease or license arrangements, for:

a. MOF;

b. HLO areas;

c. lay-down areas; and

d. tug boats and tug pen facilities.

6.6. Port infrastructure and facilities will be located and designed in a manner which maximises the sharing of marine infrastructure in the most efficient manner and considering the following principles:

i. Where the location and design can reduce, or avoid the duplication of infrastructure which has limited impact on ship loading or operation of core marine activity of ship loading (including breakwaters and dredging).

ii. Where the location and design can contribute to the reduction of the overall project footprint.

iii. Where the location and design can be appropriately scaled at minimal cost.

6.7. The design and planning of the Port will be determined in the State Government approved Port Master Plan.

6.8. The Port landside facilities shall:

i. Contain the common user Port landside area adjoining The Precinct processing plant area allocations, the central access and product corridor leading to the Port and the marine facilities.

ii. Fall under the jurisdiction and management of the Port Authority. Land will be allocated by the Port Authority in order to provide efficient connection between dedicated and common user marine facilities.

iii. Where approved by the Port Authority, possibly contain storage facilities for export products or materials handling facilities necessary for the loading of LNG export vessels.

iv. Contain the connection between the Integrated Marine Facility (IMF) and The Precinct areas allocated for the proponents' dedicated LNG process facilities including any heavy haul road alignments, and necessary storage capacity subject to agreement with the Port Authority.

v. Contain Port Authority administration, management and some maintenance facilities as necessary for the efficient running of the Port and the management of common user areas within the Port and IMF.

6.9. The Port marine facilities shall include:

i. Marine infrastructure necessary for the creation of a safe harbour, including:

a. all breakwaters;

b. dredge areas which shall be utilised by all users (departure channel and ship handling/manoeuvring areas, but excluding any berthing slots adjacent to the LNG berths and utilised while loading ships);

c. navigation aids and markers; and

d. other facilities. These areas shall be defined and subject to approval by the State and its agent or harbour master for the Port.

6.10. The breakwater and dredging shall be the subject of common user infrastructure provisions whether part of the export harbour or the IMF facilities, or any facility incorporated in the design of this nature.

6.11. Marine structures (excluding the breakwater, navigation aids, MOF, HLO and dredging) will be subject to the provisions of the exclusive use infrastructure requirements. These structures shall include jetties and berths for the loading of LNG/LPG, condensate or other hydrocarbon products resulting from the gas processing facilities.

i. The MOF and HLO shall be common user infrastructure, other than for periods of time when exclusive use is necessary and approved by the State (for example, during the construction phase, or an expansion phase where modules and other materials need priority load-in rights).

6.12. The IMF facilities including all MOF, HLO, supply base and tug facilities must provide an integrated solution for the LNG onshore and shipping operations and for the support of any offshore activities.

6.13. The HLO facilities and associated lay-down and heavy haul road alignments, general cargo and MOF facilities will be subject to the provisions of common user infrastructure as outlined in *items 6.17* and *6.18*.

6.14. The supply base facilities and sufficient associated wharfage, and the tug pen facilities will be subject to the provisions of exclusive use infrastructure, as outlined in *items 6.21* and *6.22*, in view of the nature of their usage.

6.15. The Port infrastructure and facilities shall be designed and staged to achieve the objectives and requirements specified in this document, and shall achieve the export capacity of 50Mtpa for all proponents, and the approved capacity allocation per proponent. This design shall:

i. Be subject to State approval.

ii. Maximise the use of the limited coastline connecting the land areas and the available marine developable area in the most cost effective manner.

iii. Ensure that the proponents' total expansion or staging strategy is not compromised and is aligned with having exclusive use over some critical facilities and maximise sharing of other facilities (including but not limited to the facilities outlined in *item 6.18.i – item 6.18.ix*)

6.16. The Foundation Proponent will fund and build the initiating infrastructure for the Port facility, including the:

i. Shipping channel with capacity for shipping to support 50Mtpa of LNG exports and associated gas processing products.

ii. Breakwater.

iii. Navigation aids.

iv. Turning basin.

v. Load out jetty.

vi. Product loading facility.

vii. Stage one of the Integrated Marine Facility including exclusive and non-exclusive facilities.

viii. Port administration premises.

ix. Utilities to support the establishment of the stage one Port Authority facilities at the site for the overall management and operations of the Port.

6.17. Common user infrastructure

i. Common user infrastructure shall be deemed to be areas where the proponents can obtain short term access for the construction, expansion or maintenance of their LNG project facilities and which shall be shared by all Port users. These facilities will be managed and maintained by the State and its agent for the Port, being the Port Authority. Where allocation of capacity is necessary, this will be made by the Port Authority.

ii. Common user infrastructure facilities will be designed in a manner that:

   a. optimises the efficiency of the facilities;

   b. reduces the overall footprint of the facilities;

   c. allows for sufficient access to the facilities; and

   d. allows for expansion by future proponents.

iii. Common user infrastructure shall include:

   a. Breakwaters required to create a sheltered and safe harbour within which the loading berths for the export port facilities and IMF can be located.

   b. Breakwaters required for the MOF, HLO, tug boats and other facilities.

c. Shipping channels including any dredged or marked channels with a capacity to support the shipping for the full Port capacity requirements.

d. Dredging required for all Port manoeuvring areas such as anchorage areas, and turning areas within the Port.

e. Dredging required for the Marine Facility, MOF, HLO, tug boat and other facilities.

f. HLO wharves with provisions for priority use basis and sharing of overall capacity provided by the multiple users.

g. MOF berths and general cargo berths for the IMF facility, for which periodic exclusive use is not allocated under agreements with the proponents.

h. Land areas within the IMF which are required by third party contractors and users for operations and maintenance of the facility.

i. Utilities to the Port landside area to support the proposed activities of the Port Authority as management authority of the Port facilities.

iv. All common user infrastructure will be built and funded by the Foundation Proponent and transferred to the State for the ongoing management and maintenance. A cost recuperation financial model (from third party usage) shall be established, including maintenance obligations and the right of future use.

6.18. Exclusive use infrastructure

i. Exclusive use infrastructure will be designed in a manner that:

a. Does not compromise the objectives of the design for common user infrastructure, and in particular will achieve the minimum footprint and meet all other objectives of this document.

b. Provides sufficient flexibility to the proponents to allow their operations and expansion to take place in an efficient manner with minimum or no interference from other Port users.

c. Ensures the eventual footprint can be condensed to minimise the use of the available footprint and maximise the sharing of the common user facilities, such as breakwaters and dredging for future proponents. This is considered to be reflected in *the Worley Parsons Browse LNG Precinct Master Plan Report (Document Number 00633a24 Rev 2 of July 2010), option G,* as a basis for export facilities arrangement and can be achieved with a single IMF developed in a logical manner.

d. Is engineered to allow integration with other facilities (such as pipeline crossings), within the Port area and the integration of heavy haul road alignments and pipeline alignments for all users.

ii. Exclusive use infrastructure shall include:

a. Jetties used to support and convey product loading lines from the shoreline to the loading berths.

b. Berths where the loading of LNG and other products from the LNG plant can be safely carried out.

c. Berthing pockets adjacent to the berths within which the moored export vessels can be moored and any movement or motions of a sound

mooring system can be accommodated at all tides and without encroaching into the common manoeuvring area.

d. Supply base landside facilities and dedicated wharfs within the IMF basin and Port landside reclamation areas required to support offshore supply activity.

e. Tugs and tug pen facilities required to support shipping and key supply chain objectives.

f. Storage and pipeline corridors within the Port land area identified and included under an appropriate usage agreement.

6.19. Proponents will, subject to technical and safety considerations:

i. Have the right to own and operate process related infrastructure on an exclusive basis, including export jetties and berths.

6.20. Ship Size Range

i. LNG Ships: the basis of design for the Port ship size and ship size distribution for LNG ships shall be based upon the following parameters and shall provide sensitivity around ship size range analysis on throughput:

   a. Capacity Range: 125,000m3 to 260,000m3;

   b. Vessel types including membrane and Moss R., dictating windage and design for tug capacity;

   c. Draft Range from: 11.4m to 13.5m fully laden;

   d. Beam ranging from: 44m to 57m; and

   e. Length Overall: 280m to 350m.

ii. LPG Ships: the basis of design for the Port ship size and ship size distribution for LPG ships shall be based upon the following parameters

   a. Capacity Range: 75,000m3 to 100,000m3;

   b. Membrane tankers only;

   c. Draft Range from: 11.5m to 12m fully laden;

   d. Beam ranging from: 36m to 38m; and

   e. Length Overall: 230m to 245m.

iii. Condensate Ships: the basis of design for the Port ship size and ship size distribution for Condensate ships shall be based upon the following parameters:

   a. Capacity Range: 100,000 DWT to 150,000 DWT;

   b. Conventional Tanker/Bulk Carriers;

   c. Draft Range from: 14.8m to 17.0m fully laden, but design for access with tidal assistance to a user preferred load state; and

   d. Beam ranging from: 42m to 48m, Length Overall 245m to 275m.

iv. The design of the Port shall be based upon meeting fully the characteristics of the LNG carrier, with the length, beam, windage and draft driven by the range in vessel characteristics in this class of vessel. While the bulk liquids tankers for condensate export can give rise to a deeper fully loaded draft case, the tidal

access and channel depth design characteristics are driven by the need to export the primary product, being LNG

6.21 Capacity, Number of Berths and Staging Principles

i. The Port shall be designed to accommodate multiple LNG projects and allow for the export of up to 50 Mtpa of LNG. In addition, other associated products including condensate and LPG, shall also be handled at shared berths or separate dedicated berths.

ii. A total of no less than four dedicated LNG berths, together with shared berths where LNG and other products may be combined, shall be provided for as the basis for planning and the associated detailed design principles for the Foundation Proponent.

iii. Two multi-product berths are required. These must be able to handle LNG, LPG and condensate in Stage one, but may only be required to handle LPG and condensate in later stages. As these berths will need to handle LPG products, they will dictate separation distances that must be included in planning and design.

iv. There will be separate jetties for each proponent of The Precinct with the understanding that up to 3 jetties may be required:

   a. staging of the marine development shall be possible with minimal interruption to other users and shall not compromise the objective of achieving a minimum footprint; and

   b. onshore alignment of loading lines and jetty abutments must be arranged and provided to the Port Authority for approval.

6.22. Operability and Availability of Proponents berths and other users

i. Port availability to handle inbound ballasted ships and outbound laden ships shall be no less than 98% of the time, specified as the port availability in relation to ship handling constraints only.

ii. The ability of the berths to safely moor and load LNG ships of all sizes in the range specified shall be no less that 98% of the time specified as the port operability and shall apply at all berths proposed in the ultimate or final port development scenario.

6.23. Channel Capacity and Capacity Expansion

i. The channel capacity shall be developed to achieve the Port availability criteria and shall demonstrate a capacity of 50Mtpa of LNG together with export capacity of LPG of up to 10 Mtpa and condensate of 10 up to Mtpa. These numbers are assumed at this stage and are subject to detailed analysis.

ii. The channel capacity shall be assessed against pessimistic and optimistic scenarios of vessel size distribution and shall be based around loading rates which are achievable and practical with current technologies, and with vessel constraints of the vessel with greatest potential to constrain loading.

iii. A staging scenario shall be proposed by the Foundation Proponent, where they propose a lesser stage one capacity than that of the ultimate development. This staging scenario shall demonstrate the incremental expansion strategy and how this might be achieved around an operating Port with multiple users.

iv. The channel dimensions shall be:

    a. channel width no less than 300m;

    b. channel depth no less that 13.5m with an allowance of 1.5m to 2.0m for the under keel clearance (UKC) on varying ship types; and

    c. large condensate vessels would be accommodated with either variable/partial loading conditions depending on the tides, or by a deep draft berthing basin of up to 19.0m at the berth location.

v. Cyclone procedures will dictate channel design requirements and be based on a sound understanding of the metocean criteria.

6.24. Manoeuvring Areas

i. All manoeuvring areas shall be based upon the Port availability criteria of 98% and shall be supported by comprehensive and detailed ship handling simulation and analysis of results to provide a probabilistic assessment of manoeuvring area allocation.

ii. Manoeuvring areas shall be of a shape to accommodate the ship handling requirements, and also to provide a perimeter around which a minimum of six berthing basins and berths can be accommodated in line with all other objectives of the Port.

6.25. Exclusion Zones

i. The Port areas shall provide for the exclusion zones which are typically used to accommodate ship loading without introducing unacceptable risks. The Port area shall be subject to a QRA to identify the required allowances for which the planning and layout of facilities will be designed and arranged. Analysis shall ensure the risk placed on adjacent proponents within the Port is commensurate with the risk that does not preclude the unencumbered use of berths, jetties or manoeuvring areas within the Port.

    a. For example, the LPG exclusion zone shall not encroach upon any access jetties, berths, ships or anticipated tug operating areas identified as an exclusion zone.

ii. A QRA shall be carried out to assess quantify the potential risk and consequence using industry accepted techniques and provided to the State to demonstrate that the exclusion zones provided for are based on sound criteria. This assessment will also consider a range of vessel and loading characteristics and facilities.

6.26. Construction and Staging in an Operating Environment

i. The interruption of operations of an existing or future proponent, as a result of expansion or initial construction by another, is considered undesirable. It is therefore necessary whilst achieving all other objectives to support solutions where such interruption can be minimised and to define this in the context of solution options.

ii. The Port design shall allow the effective operations of facilities of one proponent to continue during any construction or staging works of the other. Planning and design will take this into consideration and a detailed analysis supporting the

proposed solutions will be provided for consideration by the State as a requirement for approval for the Foundation Proponent's solution

6.27. Marine Construction Support and Lay-down Areas

i. Marine construction support and lay-down areas will be subject to the constraint presented by the limited shoreline intersection and available Port land area on the foreshore as indicated in *item 6.30*. As such, the proponents must define the proposed strategy for the marine implementation, construction support including any marine facilities requirements and how these shall be achieved in consultation with the Port Authority.

ii. Where the staging of construction is proposed in future, this shall also be clarified to allow for the effective planning and arrangement of permanent works within this limited area to maximise the flexibility of the site.

iii. A marine works project execution plan for the first stage and ongoing staging works shall be provided to the State. This Plan will cover support infrastructure and land requirements for laydown areas where they encroach upon the Port land area or corridor on the site.

6.28. Coastal Impacts

i. The final Port arrangement and layout will work to limit the shoreline impact to one common user area.

ii. Jetties will have their abutments in the common user area where the individual pipeline corridors meet the shoreline and will work to minimise the impact and footprint on this area.

6.29. Offshore footprint and minimising the total environmental impacts

i. The Port site area or footprint shall include the physical footprint of the facilities and shall also incorporate any areas where significant marine biology or features must be retained making them a feature or facility in the context of a Port area which cannot be developed.

ii. The Port area and environment shall be designed considering any approved discharges including brine from water desalination or other sources for the full development capacity of The Precinct. The Port planning and design shall consider all proponents' seawater discharge requirements and be designed to ensure the full solution can be integrated into the Port site area.

iii. The Foundation Proponent shall provide a design to the State, which meets the above objectives and ensures The Precinct planning objectives as noted herein and in the remainder of this document shall be met.

7. INDUSTRIAL PRECINCT PRINCIPLES

7.1. The development of the industrial precinct will be consistent with the approved statutory planning mechanism described in *item 5.6.*

7.2. The State, through the Department of State Development and its land administration agencies, will determine terms and conditions, including cost recovery for access to land and location of landside projects and facilities.

7.3. Sharing of service infrastructure (including access roads, transport corridors, common drainage systems, conduits for telecommunications and power, and

reticulated water and sewer pipelines) for the Industrial Precinct will be consistent with the principles detailed in *section 5* of this document.

7.4. The State may consider appointing facilities service providers to reduce costs and limit social and environmental impacts.

7.5. Regulated-use facilities (where proponents have regulated access) will be operated and managed to enable third party access on fair and equitable terms, while protecting the legitimate business interests of the proponents funding and operating the facility.

7.6. Access agreements for infrastructure facilities are to be consistent with the *Competition Principles Agreement*, relevant State legislation where applicable and will have regard to the legitimate business interests of the funding proponent.

7.7. Proponents will, subject to technical and safety considerations, have the right to own and operate process related infrastructure on an exclusive basis, including:

i. Power supply.
ii. Storage facilities.
iii. LNG trains.
iv. Flares.
v. Utilities.
vi. Administration.

8. NON-EXCLUSION AREAS PRINCIPLES

8.1. Proponents will have, subject to negotiations and technical and safety considerations, exclusive tenure over up to 100ha of land for workers' accommodation required for project support.

Appendix 4 Kimberley Region Resource and Geology Map Commentary

Geology of Kimberley Region

The geology of the Kimberley region is essentially divided into the following simplified tectonic domains, with reference to Figure A1:

- Canning Basin containing a thick pile of folded and faulted sedimentary rocks developed less than 500 million years ago (Ma). At the Dampier Peninsula and adjoining coastal plain these sedimentary rocks are represented by the upper members of the pile deposited in shallow marine (Broome Sandstone & Melligo Sandstone) to fluvial-deltaic environments (Frezier Sandstone & Emeriau Sandstone). Browse Basin is situated further offshore to the north containing the gas fields
- Hooper and Lamboo Complexes containing metamorphic and igneous rocks formed around 1870 to 1850 Ma (Hassan, 2004). These complexes form arcuate zones of moderate relief bound by major faults
- Kimberley Basin containing sedimentary and volcanic rocks developed around 1835 to 1790 Ma (Hassan, 2004). The terrain within this basin is rugged with spectacular scenery arising from a dissected plateau (e.g. Mitchell Falls). Along the margins, the rocks are folded forming prominent scarps, while within the core of the basin the sediments are flat lying. In terms of the Anjo Peninsula the main rocks belong to the Kimberley Group and include the King Leopold Sandstone (shallow marine) and Carson Volcanics (subaerial lava flows)

To the south of the Kimberley region is the Pilbara Craton that consists of granite-greenstone terrane formed more than 2500 Ma.

Rocks within the above domains are covered by a variable thickness of regolith deposits derived from transportation (alluvium & colluvium), weathering (residual soils) or chemical induration (laterite) processes during the last 70 Ma. The coastal belt has been modified by many fluctuations in sea level associated with glacial events over the last 2 Ma. The last glacial event occurred some 18,000 years ago resulting in a fall in sea level over 100m. The present day sea level was achieved some 5,000 to 6,000 years ago flooding the Kimberley mainland and giving rise to the Bonaparte and Buccaneer Archipelagos.

Appendix 5 Engineering Geology Terms

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EXPLANATORY NOTES FOR SOIL DESCRIPTION AND CLASSIFICATION

Geotechnical logging is carried out in general accordance with Australian Standard AS 1726 - 1993 "Geotechnical site investigations". The description of soils is based on the Unified Soil Classification system and includes type, plasticity, particle characteristics, colour and minor components. Classification of soils is based on particle size distribution and plasticity, in accordance with Appendix A of AS 1726 - 1993. The terminology used by WorleyParsons to describe the condition of soils for logging purposes is summarised below. Sheet 2 provides assistance for field description and soil classification.

MOISTURE CONDITION

Term	Symbol	Field Guide
Dry	D	Looks and feels dry. Cohesive soils usually hard, friable or powdery. Granular soils are cohesionless and free running
Moist	M	Feels cool and darkened in colour. Cohesive soils can be moulded by hand. Granular soils tend to cohere
Wet	W	Feels cool and darkened in colour. Cohesive soils usually weakened and free water forms on hands when remoulding. Granular soils tend to cohere

CONSISTENCY OF COHESIVE SOILS

Term	Symbol	Undrained Shear Strength (kPa)	Field Guide
Very Soft	VS	Less than 12	Exudes between fingers when squeezed in hand
Soft	S	12 to 25	Can be moulded by light finger pressure
Firm	F	25 to 50	Can be moulded by strong finger pressure
Stiff	St	50 to 100	Cannot be moulded by fingers, can be indented by thumb
Very Stiff	VSt	100 to 200	Can be indented by thumb nail
Hard	Hd	More than 200	Can be indented with difficulty by thumb nail

DENSITY OF GRANULAR SOILS

Term	Symbol	Density Index (%)
Very Loose	VL	Less than 15
Loose	L	15 to 35
Medium Dense	MD	35 to 65
Dense	D	65 to 85
Very Dense	VD	More than 85

PLASTICITY OF FINE GRAINED SOILS

Term	Range of Liquid Limit (%)
Low Plasticity	Less than 35
Medium Plasticity	35 to 50
High Plasticity	More than 50

MINOR COMPONENTS

Term	Field Guide	Material Proportion
Trace of	Presence just detectable	Coarse grained soils less than 5% Fine grained soils less than 15%
With some	Presence easily detectable	Coarse grained soils between 5 to 12% Fine grained soils between 15 to 30%

SAMPLE/TEST (FOR LOG SHEETS)

Details of field testing (and samples retrieved) including the following:

SPT	Standard Penetration Test (blows per 150mm and N value), HB - hammer bouncing, RW - rod weight
U	63mm diameter Thin Walled Tube Sample
HV	Hand Vane Test
PP	Pocket Penetrometer Test
Bs	Bulk Sample
PSP	Perth Sand Penetrometer (blows per 150mm)
DCP	Dynamic Cone Penetrometer (blows per 150mm)
	Disturbed Sample Interval (laboratory test result can be provided or alternatively type of test indicated "X")

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FIELD DESCRIPTION, IDENTIFICATION AND CLASSIFICATION OF SOILS

MAJOR DIVISIONS			PARTICLE SIZE (mm)	FIELD IDENTIFICATION PROCEDURES				GROUP SYMBOL
COARSE GRAINED SOILS (More than half of material less than 60mm is larger than 0.06mm)	The smallest particle visible to the naked eye is approximately 0.06mm	BOULDERS	200					BO
		COBBLES	60					CO
		GRAVELS (More than half of coarse fraction is larger than 2.0mm)	coarse 20	Well graded gravels, gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength			GW
			medium 6	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels	Predominately one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength			GP
			fine 2.0	Silty gravels, gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength			GM
				Clayey gravels, gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength			GC
		SANDS (More than half of coarse fraction is smaller than 2.0mm)	coarse 0.6	Well graded sands, gravelly sands, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength			SW
			medium 0.2	Poorly graded sands and gravelly sands, little or no fines, uniform sands	Predominately one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength			SP
				Silty sands, sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength			SM
			fine 0.06	Clayey sands, sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength			SC
FINE GRAINED SOILS (More than half of material less than 60mm is smaller than 0.06mm)		SILTS and CLAYS (Liquid limit less than 50%)		Inorganic silts, clayey silts and sandy silts with low plastcity	Field assessment based on fraction smaller than 0.2mm			ML
					Dry strength	Dilatancy	Toughness	
					None to low	Quick to slow	None	
				Inorganic clays, gravelly clays, sandy clays and silty clays with low to medium plasticity	Medium to high	None to very slow	Medium	CL, CI
				Organic silts and silty clays of low plasticity	Low to medium	Slow	Low	OL
		SILTS and CLAYS (Liquid limit more than 50%)		Inorganic silts and micaceous or diatomaceous fine soils of high plasticity	Low to medium	Slow to none	Low to medium	MH
				Inorganic clays of high plasticity	High to very high	None	High	CH
				Organic clays and silts of medium to high plasticity	Medium to high	None to very slow	Low to medium	OH
		HIGHLY ORGANIC SOILS		Peat and other highly organic soils	Identified by colour, odour, spongy feel and generally by fibrous texture			Pt

SOURCE: Based on Table A1, AS 1726-1993

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EXPLANATORY NOTES FOR ROCK DESCRIPTION AND CLASSIFICATION

Geotechnical logging is carried out in general accordance with Australian Standard AS 1726 - 1993 "Geotechnical site investigations". The terminology used by WorleyParsons to describe the condition of rocks and associated materials for logging purposes is summarised below.

WEATHERING CLASSIFICATION

Term	Symbol	Definition
Residual Soil	RS	Soil derived from the weathering of rock, the mass structure and substance fabric are no longer evident, there is a large change in volume but the soil has not been significantly transported
Extremely Weathered Material	XW	Material is weathered to such an extent that it has "soil" properties i.e. it either disintegrates or can be remoulded in water. Original fabric still evident
Highly Weathered Rock	HW	Rock is weathered to such an extent that it shows considerable change in appearance and loss in strength. Material is still a rock but of relatively low strength
Moderately Weathered Rock	MW	Rock is weathered to such an extent that it shows a visible change in appearance with significant loss in strength
Slightly Weathered Rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock
Fresh Rock	FR	Rock shows no sign of decomposition or staining

Notes:

1. AS 1726 - 1993 suggests the term "distinctly weathered" to cover the range from extremely weathered to slightly weathered. For projects where it is judged that there is no advantage in differentiating between highly weathered and moderately weathered, "distinctly weathered" may be adopted using the definition given in AS 1726 - 1993.
2. Moderately weathered and highly weathered definitions above are taken from AS 1726 - 1981 "SAA Site Investigation Code".

ROCK MATERIAL STRENGTH

Term	Symbol	Point Load Index $I_{s(50)}$ (MPa)	Field Guide
Very Low	VL	Less than 0.1	Material crumbles under firm blows with sharp end of geological pick, can be peeled with a knife, pieces up to 30mm thick can be broken by finger pressure
Low	L	0.1 to 0.3	Easily scored with knife, indentations 1 to 3mm show with firm blows of a pick point, has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling
Medium	M	0.3 to 1	Readily scored with knife, a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty
High	H	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow, rock rings under hammer
Very High	VH	3 to 10	Hand specimen breaks after more than one blow of a pick, rock rings under hammer
Extremely High	EH	More than 10	Specimen requires many blows with pick to break, rock rings under hammer

Notes:

1. The term "extremely low" is not used as a rock material strength term. Although it is stated in AS 1726 - 1993 the accompanying field guide clearly states that materials in that strength range are soils in engineering terms.
2. Anisotropy of rock samples may affect field assessment of strength.
3. Uniaxial Compressive Strength (UCS) values are to be stated where tested for project specific correlation with Point Load Strength Index.

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CEMENTATION CLASSIFICATION

Term	Symbol	Definition
Uncemented	Uc	Clean grains exhibiting soil properties
Very weakly cemented	Vwk	Cement on some grains, collapsing feel under very light finger pressure
Weakly cemented	Wk	Cement on many grains, collapsing feel under finger pressure, breaks down to individual grains
Moderately weakly cemented	Mwk	Cement on most grains, breaks down to lumps under finger pressure, can crush to individual grains under knife blade
Moderately cemented	Mo	Cement on most grains, can break fragments off by hand and crush to small lumps under knife blade
Well cemented	We	Practically all grains cemented together, cannot break fragments off by hand, dull sound under hammer
Very well cemented	Vwe	Most primary pores filled with cement, requires firm blow with hammer to break off fragments, rings when struck

Note:

1. The above field classification system uses terms commonly adopted by geotechnical engineering practice in Western Australia.

DEFECT SPACING

Term	Symbol	Definition
Extremely Wide	Ew	More than 6m
Very Wide	Vw	2 to 6m
Wide	W	600mm to 2m
Moderate	M	200 to 600mm
Close	C	60 to 200mm
Very Close	Vc	20 to 60mm
Extremely Close	Ec	Less than 20mm

Note:

1. Above terms and definitions sourced from ISRM Suggested Methods - 1981 "Rock Characterisation, Testing and Monitoring".

ROCK MASS WEATHERING

Weathering of the rock mass in relation to the distribution of weathered materials and the effect of defects is described below.

Grade	Description
I	No visible sign of weathering except perhaps staining on defect surfaces
II	Almost all rock is discoloured by slight weathering
III	Less than half of the material is moderately to extremely weathered, some residual boulders/corestones may be present
IV	More than half of the material is moderately to extremely weathered, occasional corestones may be present
V	The material is extremely weathered with mass structure largely intact
VI	Refer to soil classification system

Note:

1. The above weathering grades apply to relatively large scale exposures. For boreholes, weathering terms discussed previously apply.
2. Defect persistence (areal extent) and aperture (openness) to be recorded where appropriate.

ROCK MASS BLOCK SHAPE

Blocky	Equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greater than cross section

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AN AID TO THE FIELD CLASSIFICATION OF ROCKS FOR ENGINEERING PURPOSES (CHART A)

GRAIN SIZE (mm)	BEDDED ROCKS (MOSTLY SEDIMENTARY)						OBVIOUSLY FOLATED ROCKS (MOSTLY METAMORPHIC)		ROCKS WITH MASSIVE STRUCTURE AND CRYSTALLINE TEXTURE (MOSTLY IGNEOUS)					
More than 20	GRAIN SIZE DESCRIPTION			AT LEAST 50% OF GRAINS ARE OF CARBONATE		AT LEAST 50% OF GRAINS ARE OF FINE GRAINED VOLCANIC ROCK	SALINE ROCKS	GRAIN SIZE DESCRIPTION			GRAIN SIZE DESCRIPTION	Pegmatite			Pyroxenite
20	RUDACEOUS		**CONGLOMERATE** Rounded boulders, cobbles and gravel cemented in a finer matrix Breccia Irregular rock fragments in a finer matrix	LIMESTONE AND DOLOMITE (undifferentiated)	Calcirudite	Fragments of volcanic ejecta in a finer matrix Rounded grains **AGGLOMERATE** Angular grains **VOLCANIC BRECCIA**	Halite Anhydrite	COARSE	**GNEISS** Well developed but often widely spaced foliation, sometimes with schistose bands Migmatite Irregularly foliated, mixed schists and gneisses	**MARBLE** **QUARTZITE** Granulite **HORNFELS** Amphibolite Serpentinite	COARSE	**GRANITE** [1]	Diorite [1,2]	**GABBRO** [3]	Peridotite
6 2	ARENACEOUS Coarse / Medium / Fine		**SANDSTONE** Angular or rounded grains, commonly cemented by clay, calcitic or iron minerals Quartzite Quartz grains and siliceous cement Arkose Many feldspar grains Greywacke Many rock chips		Calcarenite	Cemented volcanic ash **TUFF**	Gypsum	MEDIUM	**SCHIST** Well developed undulose foliation, generally much mica		MEDIUM	These rocks are sometimes porphyritic and are then described, for example, as as porphyritic granite Microgranite [1]	Microdiorite [1,2]	Dolerite [3,4]	
0.6 0.2 0.06														
0.002 Less than 0.002	ARGILLACEOUS	**MUDSTONE** **SHALE** Fissile	**SILTSTONE** Mostly silt **CLAYSTONE** Mostly clay	Calcareous mudstone	Calcisiltite Calcilutite	Fine grained **TUFF** Very fine grained **TUFF**		FINE	**PHYLLITE** Slightly undulose foliation, sometimes spotted **SLATE** Well developed plane cleavage (foliation)		FINE	These rocks are sometimes porphyritic and are then described as porphyries **RHYOLITE** [4,5]	**ANDESITE** [4,5]	**BASALT** [4,5]	
Amorphous or crypto-crystalline		Flint: occurs as bands of nodules in chalk Chert: occurs as nodules and beds in limestone and calcareous sandstone					COAL LIGNITE		Mylonite Found in fault zones, mainly in igneous and metamorphic areas			Obsidian [5]	Volcanic glass		
		Granular cemented - except amorphous						CRYSTALLINE				colour: Pale ← – – – – – – → Dark			
		SILICEOUS		CALCAREOUS		SILICEOUS	CARBON-ACEOUS	SILICEOUS		Mainly SILICEOUS		ACID Much quartz	INTERMEDIATE Some quartz	BASIC Little or no quartz	ULTRA BASIC

SEDIMENTARY ROCKS
Granular cemented rocks vary greatly in strength, some sandstones are stronger than igneous rocks. Bedding may not show in hand specimens and is best seen in outcrop. Only sedimentary rocks, and some metamorphic rocks derived from then, contain fossils.

Calcareous rocks contain calcite (calcium carbonate) which effervesces with dilute hydrochloric acid.

METAMORPHIC ROCKS
Most metamorphic rocks are distinguished by foliation which may impart fissility. Foliation in gneisses is best observed in outcrop. Non-foliated metamorphics are difficult to recognise except by association. Any rock baked by contact metamorphism is described as a 'hornfels' and is generally somewhat stronger than the parent rock. Most fresh metamorphic rocks are strong although perhaps fissile.

IGNEOUS ROCKS
Composed of closely interlocking mineral grains. Strong when fresh and non-porous.

Mode of occurrence: 1 Batholiths; 2 Laccoliths; 3 Sills; 4 Dykes; 5 Lava flows; 6 Veins.

SOURCE: Table 6, AS 1726-1993

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Chart A gives guidance to the classification of rock types. The following chart has been adopted to suit local calcareous rocks based on modifications to the Clark and Walker (1977) and Gordon (2003) systems.

CLASSIFICATION CHART ADOPTED FOR WESTERN AUSTRALIAN COASTAL ROCKS (CHART B)

MATERIAL TYPE	ADDITIONAL DESCRIPTIVE TERMS BASED ON ORIGIN OF CONSTITUENT PARTICLES				
	NOT DISCERNIBLE		BIOCLASTIC OOLITES	SHELL CORAL ALGAL PISOLITES/ CLASTS	
	GRAIN SIZE 0.002mm	0.060mm	2mm	60mm	
CALCRETE FACIES	CALCRETE CAPROCK (Duricrust) / GROUNDWATER CALCRETE (Fluid Deposition)		CALCRETED CALCARENITE	CALCRETED CALCIRUDITE	TOTAL CARBONATE CONTENT % (constituent particles plus matrix)
EOLIANITES, BEACHROCK AND SHALLOW MARINE DEPOSITS	CALCILUTITE	CALCISILTITE	CALCARENITE	CALCIRUDITE	90
	Clayey CALCILUTITE	Siliceous CALCISILTITE	Siliceous CALCARENITE	Conglomeratic CALCIRUDITE	50
	Calcareous CLAYSTONE	Calcareous SILTSTONE	Calcareous SANDSTONE	Calcareous CONGLOMERATE	10

Notes:

1. Lithological terms based on grain size and field assessment (e.g. hand lens and dilute HCl) of carbonate composition
2. Degree of cementation to be assessed using terms provided in Explanatory Notes
3. Estimated rock strengths to be assessed using terms provided in Explanatory Notes
4. For other sedimentary rock classifications refer to Chart A

References:

Gordon, R. (2003) "Coastal Limestones", Australian Geomechanics, Vol 38, No. 4, December 2003, The Engineering Geology of Perth - Part 2, pp 7-23

Clark, A.R. and Walker, B.F. (1977) "A Proposed Scheme for the Classification and Nomenclature for Use in the Engineering Description of Middle Eastern Sedimentary Rocks", Geotechnique 27(1), pp 93-99

Appendix 6 Infrastructure Access Principles

BROWSE LNG PRECINCT PRINCIPLES

1. Access arrangement for facilities and other infrastructure within the Browse LNG Precinct only apply to Multi-user Port Authority Port Facilities on the basis set out in this schedule.

2. Access arrangements do not apply to areas within the Browse LNG Precinct which are the subject of exclusive land tenure including all facilities and other infrastructure established within the exclusive land tenure area.

3. The Joint Venturers must not build or operate facilities or other infrastructure within the Common User Areas or any exclusive use tenure area in a manner that creates a technical or commercial barrier to use of the Common User Areas for an Additional Proponent.

4. The Joint Venturers are not required to build any facilities or other infrastructure within the Browse LNG Precinct with a greater capacity than is required to accommodate the approved capacity requirements for the Project.

5. However, Joint Venturers must establish Multi-User Port Authority Port Facilities and land based infrastructure or facilities in Common User Areas on the basis that the facilities and other infrastructure are capable of efficient expansion by an Additional Proponent.

6. Once an Additional Proponent has satisfied the State's terms and conditions for entry into the Browse LNG Precinct then the State will consult with the Joint Venturers and determine a methodology for cost recovery in respect of Multi-user Port Authority Port Facilities and land based infrastructure and facilities within Common User Areas.

7. The parties acknowledge that the Port Authority will manage third party access to the Multi-user Port Authority Port Facilities and the expanding of the capacity of Multi-user Port Authority Port Facilities to accommodate such use.

8. Multi-user Port Authority Port Facilities may be accessed by the Joint Venturers and Additional Proponents on a fair and equitable basis taking into account the legitimate commercial interests of the Port Authority and each party to whom access is to be provided or is being provided as the case may be and the efficient operation of the Port and the Browse LNG Precinct.

9. The parties acknowledge that LandCorp and the Department from time to time primarily responsible for assisting the LA Act Minister in the administration of the LA Act will manage access to land and land requirements for expanded infrastructure and facilities within the Common User Areas outside the Port Area.

10. The Common User Areas outside the Port may be accessed by the Joint Venturers and Additional Proponents on a fair and equitable basis taking into account the legitimate commercial interests of the State and each party to whom access is to be provided or is being provided as the case may be and the efficient operation of the Browse LNG Precinct.

12. An Additional Proponent is to have access to Common User Areas outside the Port in order to develop, operate and maintain its own facilities and other on its dedicated site.

13. Access by the Joint Venturers and Additional Proponents to Common User Areas outside the Port are only to be for the purpose of:

    (a) establishing, operating and maintaining their separate facilities and other infrastructure;

    (b) sharing of facilities and other infrastructure between them;

    (c) an Additional Proponent expanding the Joint Venturers' infrastructure and facilities.

14. Access arrangements by the Joint Venturers and Additional Proponents to the construction and laydown areas are to be determined and managed by LandCorp.

Appendix 7 Premier's Media Statement

GOVERNMENT OF WESTERN AUSTRALIA

Ministerial Media Statements

Search Media Statements

Colin Barnett
Premier; Minister for State Development

Fri 04 December, 2009

Site agreed for Browse LNG processing precinct

Portfolio: Premier

An area just south of James Price Point has been identified as the exact location for the proposed Browse LNG precinct.

Premier Colin Barnett said the site was selected following extensive consultation with Traditional Owners and consideration of heritage, technical and environmental data.

He said final selection had centred on two potential locations for LNG processing and related port facilities - one just north and one just to the south of James Price Point.

The southern site had been chosen because:

- deeper water near the coast would substantially reduce the amount and costs of dredging and blasting required
- impacts on seagrass and other marine habitats would be able to be better managed
- the land was flatter than the alternative site in the north, reducing the visual impact of the site from the ocean
- impacts on registered Aboriginal heritage sites could be managed.

“This is another important step forward for a project that will bring major benefits for Aboriginal people, the Kimberley and Western Australia,” Mr Barnett said.

“The State Government, the Kimberley Land Council, representing Traditional Owners, and Woodside Energy Ltd have entered into a Heritage Protection Agreement for the precinct

“This establishes a process for identifying, protecting and managing Aboriginal sites within the precinct area.

“It also enables us to continue working together on developing a master plan for the layout of the precinct and determining the location of worker accommodation and a light industrial area to support the LNG processes.”

The Premier said the proposed design for the precinct would ensure

its economic efficiency while reducing impacts on registered Aboriginal heritage sites and monsoonal vine thickets and make the site less visible from the ocean.

When operating at full capacity, with two processors, the total land area of the precinct, to which public access would be restricted, would be about 2,000 to 2,500 hectares - just 0.2 per cent of the 1,400,000 hectare Dampier Peninsula.

Some precinct features included:

- LNG storage tanks set back approximately 750 metres from the shore line
- LNG processing trains a further kilometre inland from the tanks
- the precinct fenced area to include only 1.3-1.5 kilometres of coast line.

Public access would be maintained in buffer zones - which include James Price Point - around the precinct, for activities such as harvesting and gathering of food, traditional ceremonies, driving, walking and fishing.

Access along Manari Road would be maintained to the southern precinct boundary.

Access to James Price Point and further north would be enabled via a new road from the existing Broome-Cape Leveque Road.

Mr Barnett paid tribute to the Traditional Owners, particularly the members of the negotiation committee established to select the site.

“The Traditional Owners have made it very clear they want to protect their heritage, culture and the environment and are rightly worried about the impact of an LNG precinct on their traditional land,” he said.

“They are also very focused on using the opportunities generated by the development to provide real economic opportunities for their people.

“The State Government is strongly committed to working to make this happen.”

The Premier said negotiations were on track to finalise an Indigenous Land Use Agreement by early 2010 and for finalisation of the Strategic Assessment Report documentation for presentation to State and Federal environmental regulatory authorities.

Premier's office - 9222 9475

Attachments

JPP Location Plan.pdf
JPP Location staging plan.pdf

Page last revised:25 Mar 2008

Appendix 8 Table of references and studies cited

The potential foundation proponent provided a range of other information as well as access to their data room, however this information cannot be listed below due to confidentiality provisions.

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