



# Queensland Curtis LNG Project: LNG Facility and Associated Infrastructure

## *Landscape and Visual Impact Assessment*

for

Queensland Gas Company Limited (QGC)

July 2009

Queensland Curtis LNG  
Project: LNG Facility and  
Associated Infrastructure

*Landscape and Visual Impact  
Assessment*

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July 2009

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For and on behalf of  
Environmental Resources Management  
Australia

Approved by: David Pope



Signed:

Position: Partner

Date: 30 July 2009

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## CONTENTS

### GLOSSARY

### EXECUTIVE SUMMARY

|          |                                                                               |   |
|----------|-------------------------------------------------------------------------------|---|
| <b>1</b> | <b>INTRODUCTION</b>                                                           |   |
| 1.1      | LOCATION                                                                      | 3 |
| 1.2      | SCOPE OF ASSESSMENT                                                           | 3 |
| <b>2</b> | <b>METHODOLOGY</b>                                                            |   |
| 2.1      | STUDY METHODOLOGY                                                             | 3 |
| 2.1.1    | LANDSCAPE ANALYSIS – DESKTOP ASSESSMENT                                       | 3 |
| 2.1.2    | LANDSCAPE ANALYSIS – SITE ASSESSMENT                                          | 3 |
| 2.1.3    | LANDSCAPE CHARACTER TYPES                                                     | 3 |
| 2.1.4    | 3D VISUAL MODELLING OF THE PROJECT IN THE LANDSCAPE                           | 3 |
| 2.1.5    | SEEN AREA ANALYSIS                                                            | 3 |
| 2.1.6    | EVALUATION OF THE VISUAL IMPACT ON LANDSCAPE SIGNIFICANCE                     | 3 |
| 2.1.7    | ASSESSMENT OF THE IMPACT OF NIGHT LIGHTING                                    | 3 |
| 2.2      | STUDY LIMITATIONS                                                             | 3 |
| <b>3</b> | <b>PROJECT DESCRIPTION</b>                                                    |   |
| 3.1      | GENERAL                                                                       | 3 |
| 3.2      | LNG FACILITY                                                                  | 3 |
| 3.2.1    | MAIN COMPONENTS OF THE LNG FACILITY CONSIDERED IN THE LVIA                    | 3 |
| 3.2.2    | MAIN PROCESSES CONSIDERED IN THE LVIA DURING CONSTRUCTION OF THE LNG FACILITY | 3 |
| 3.2.3    | MAIN PROCESSES CONSIDERED IN THE LVIA DURING OPERATION OF THE LNG FACILITY    | 3 |
| 3.2.4    | ENVIRONMENTAL MANAGEMENT                                                      | 3 |
| 3.3      | THE CURTIS ISLAND BRIDGE AND APPROACH ROAD                                    | 3 |
| 3.3.1    | MAIN COMPONENTS OF THE BRIDGE AND APPROACH ROAD                               | 3 |
| <b>4</b> | <b>VIEWSHED</b>                                                               |   |
| 4.1      | EXTENT OF THE STUDY AREA                                                      | 3 |
| <b>5</b> | <b>LEGISLATIVE PROVISIONS</b>                                                 |   |
| 5.1      | WORLD HERITAGE LISTING                                                        | 3 |
| 5.1.1    | GREAT BARRIER REEF WORLD HERITAGE AREA                                        | 3 |
| 5.2      | NATIONAL SIGNIFICANCE                                                         | 3 |
| 5.3      | AREAS OF STATE SIGNIFICANCE                                                   | 3 |
| 5.3.1    | CURTIS COAST REGIONAL COASTAL MANAGEMENT PLAN                                 | 3 |
| 5.4      | GLADSTONE STATE DEVELOPMENT AREA                                              | 3 |
| 5.5      | LOCAL PLANNING SCHEMES                                                        | 3 |

## CONTENTS

|       |                                                                                                                                    |   |
|-------|------------------------------------------------------------------------------------------------------------------------------------|---|
| 6     | <b>EXISTING LANDSCAPE CHARACTER</b>                                                                                                |   |
| 6.1   | <b>TOPOGRAPHY</b>                                                                                                                  | 3 |
| 6.2   | <b>GEOLOGY, SOILS AND DRAINAGE</b>                                                                                                 | 3 |
| 6.3   | <b>VEGETATION</b>                                                                                                                  | 3 |
| 6.4   | <b>LAND USE</b>                                                                                                                    | 3 |
| 6.5   | <b>LANDSCAPE CHARACTER TYPES</b>                                                                                                   | 3 |
| 6.5.1 | <b>EUCALYPTUS WOODLANDS/FOREST ON UNDULATING TO HILLY TERRAIN</b>                                                                  | 3 |
| 6.5.2 | <b>MOUNTAINOUS HILLS AND RIDGES</b>                                                                                                | 3 |
| 6.5.3 | <b>UNDULATING RURAL LANDSCAPES</b>                                                                                                 | 3 |
| 6.5.4 | <b>INDUSTRIAL LANDSCAPES</b>                                                                                                       | 3 |
| 6.5.5 | <b>URBAN LANDSCAPES</b>                                                                                                            | 3 |
| 6.5.6 | <b>ESTUARINE LANDSCAPE</b>                                                                                                         | 3 |
| 6.5.7 | <b>WATERWAYS</b>                                                                                                                   | 3 |
| 6.6   | <b>LANDSCAPE SENSITIVITY</b>                                                                                                       | 3 |
| 7     | <b>SEEN AREA ANALYSIS</b>                                                                                                          |   |
| 7.1   | <b>AREAS FROM WHICH THE LNG FACILITY ARE POTENTIALLY VISIBLE</b>                                                                   | 3 |
| 7.2   | <b>AREAS FROM WHICH THE PROPOSED CURTIS ISLAND BRIDGE IS POTENTIALLY VISIBLE</b>                                                   | 3 |
| 7.3   | <b>AREAS FROM WHICH PROPOSED LNG LOADING BERTH IS POTENTIALLY VISIBLE</b>                                                          | 3 |
| 7.4   | <b>AREAS FROM WHICH BOTH THE LNG FACILITY AND PROPOSED CURTIS ISLAND BRIDGE ARE POTENTIALLY VISIBLE</b>                            | 3 |
| 7.5   | <b>SUMMARY OF THE VISIBILITY ANALYSIS</b>                                                                                          | 3 |
| 8     | <b>ASSESSMENT OF VISUAL IMPACT FROM PUBLICLY ACCESSIBLE VIEWPOINTS IN GLADSTONE AND SURROUNDING AREAS</b>                          |   |
| 8.1   | <b>VIEW POINT 1 – AUCKLAND POINT</b>                                                                                               | 3 |
| 8.2   | <b>VIEW POINT 2 – SPINNAKER PARK</b>                                                                                               | 3 |
| 8.3   | <b>VIEW POINT 3 – GOONDOON STREET GLADSTONE</b>                                                                                    | 3 |
| 8.4   | <b>VIEW POINT 4 – RADAR HILL</b>                                                                                                   | 3 |
| 8.5   | <b>VIEW POINT 5 – ROUND HILL LOOKOUT</b>                                                                                           | 3 |
| 8.6   | <b>VIEW POINT 6 – PORT CURTIS HIGHWAY</b>                                                                                          | 3 |
| 8.7   | <b>VIEW POINT 7 – PORT CURTIS WAY AT CALLIOPE RIVER ANABRANCH BRIDGE</b>                                                           | 3 |
| 8.8   | <b>VIEW POINT 8 – UN NAMED TRACK TARGINIE FORESHORE</b>                                                                            | 3 |
| 8.9   | <b>SUMMARY OF VISUAL IMPACT SIGNIFICANCE OF THE PROJECT FROM PUBLICLY ACCESSIBLE VIEWPOINTS IN GLADSTONE AND SURROUNDING AREAS</b> | 3 |
| 9     | <b>ASSESSMENT OF VISUAL IMPACT OF THE PROJECT FROM SURROUNDING WATERWAYS</b>                                                       |   |
| 9.1   | <b>VIEW POINT 9 – PORT CURTIS ADJOINING NORTH PASSAGE ISLAND</b>                                                                   | 3 |
| 9.2   | <b>VIEW POINT 10 – THE NARROWS - 500M SOUTH OF THE PROPOSED BRIDGE CROSSING</b>                                                    | 3 |
| 9.3   | <b>VIEW POINT 11 – THE NARROWS 1 KM NORTH OF PROPOSED BRIDGE CROSSING</b>                                                          | 3 |
| 9.4   | <b>VIEW POINT 12 – THE NARROWS 5 KM NORTH OF PROPOSED BRIDGE CROSSING</b>                                                          | 3 |
| 9.5   | <b>VIEW POINT 13 – TURTLE ISLAND</b>                                                                                               | 3 |

## CONTENTS

|        |                                                                                         |   |
|--------|-----------------------------------------------------------------------------------------|---|
| 9.6    | <i>VIEW POINT 14 –WITT ISLAND</i>                                                       | 3 |
| 9.7    | <i>VIEW POINT 15 – TIDE ISLAND</i>                                                      | 3 |
| 9.8    | <i>VIEW POINT 16 –THE PORT OF GLADSTONE CHANNEL</i>                                     | 3 |
| 9.9    | <i>SUMMARY OF VISUAL IMPACT SIGNIFICANCE OF THE PROJECT FROM SURROUNDING WATERWAYS</i>  | 3 |
| 10     | <i>ASSESSMENT OF VISUAL IMPACT DURING CONSTRUCTION</i>                                  |   |
| 10.1   | <i>STAGE 1 – SITE PREPARATION</i>                                                       | 3 |
| 10.2   | <i>STAGE 2 – CIVIL WORK, FOUNDATIONS AND STRUCTURES</i>                                 | 3 |
| 10.3   | <i>STAGE 3 - MECHANICAL AND ELECTRICAL INSTALLATION AND TESTING</i>                     | 3 |
| 10.4   | <i>STAGE 4 – SYSTEMS STRENGTH AND INTEGRITY</i>                                         | 3 |
| 10.5   | <i>STAGE 5- COMMISSIONING OF THE LNG FACILITY</i>                                       | 3 |
| 10.6   | <i>REHABILITATION</i>                                                                   | 3 |
| 10.7   | <i>SUMMARY OF THE CONSTRUCTION IMPACTS</i>                                              | 3 |
| 11     | <i>ASSESSMENT OF CUMULATIVE VISUAL IMPACTS</i>                                          |   |
| 11.1   | <i>WIGGINS ISLAND COAL TERMINAL</i>                                                     | 3 |
| 11.2   | <i>GLADSTONE PACIFIC NICKEL PROJECT</i>                                                 | 3 |
| 11.3   | <i>GLADSTONE LNG FACILITY – FISHERMAN’S LANDING</i>                                     | 3 |
| 11.4   | <i>SUN LNG FACILITY – FISHERMAN’S LANDING</i>                                           | 3 |
| 11.5   | <i>GLADSTONE LNG PROJECT (SANTOS) – CURTIS ISLAND</i>                                   | 3 |
| 11.6   | <i>SUMMARY OF CUMULATIVE VISUAL IMPACTS</i>                                             | 3 |
| 12     | <i>ASSESSMENT OF VISUAL IMPACT OF NIGHT LIGHTING OF THE LNG FACILITY AND THE BRIDGE</i> |   |
| 12.1   | <i>DESCRIPTION OF THE PROPOSED LIGHT SOURCE(S);</i>                                     | 3 |
| 12.2   | <i>EXISTING NIGHT LIGHTING CONDITIONS AND POTENTIAL PHYSICAL CHANGE</i>                 | 3 |
| 12.2.1 | <i>THE SITE</i>                                                                         | 3 |
| 12.2.2 | <i>THE MAINLAND</i>                                                                     | 3 |
| 12.2.3 | <i>IMPACT OF NIGHT LIGHTING DUE TO MARINE USAGE AND INCREASED TRANSPORT MOVEMENTS</i>   | 3 |
| 12.3   | <i>IDENTIFICATION OF LIGHT SENSITIVE RECEPTORS</i>                                      | 3 |
| 12.3.1 | <i>HUMANS</i>                                                                           | 3 |
| 12.3.2 | <i>REPTILES (EXCLUDING SEA TURTLES) AND AMPHIBIANS</i>                                  | 3 |
| 12.3.3 | <i>BIRDS</i>                                                                            | 3 |
| 12.3.4 | <i>MAMMALS</i>                                                                          | 3 |
| 12.3.5 | <i>MARINE TURTLES</i>                                                                   | 3 |
| 12.3.6 | <i>FISHES</i>                                                                           | 3 |
| 12.4   | <i>IMPACT ASSESSMENT ON LIGHT SENSITIVE RECEPTORS</i>                                   | 3 |
| 12.4.1 | <i>VISIBILITY MAPPING</i>                                                               | 3 |
| 12.4.2 | <i>POTENTIAL IMPACTS ON HUMANS</i>                                                      | 3 |
| 12.4.3 | <i>POTENTIAL IMPACTS ON REPTILES (EXCLUDING SEA TURTLES) AND AMPHIBIANS</i>             | 3 |
| 12.4.4 | <i>POTENTIAL IMPACT ON BIRDS</i>                                                        | 3 |
| 12.4.5 | <i>POTENTIAL IMPACTS ON MAMMALS</i>                                                     | 3 |
| 12.4.6 | <i>POTENTIAL IMPACTS ON MARINE TURTLES</i>                                              | 3 |
| 12.4.7 | <i>POTENTIAL IMPACT ON FISHES</i>                                                       | 3 |
| 12.5   | <i>SUMMARY OF POTENTIAL IMPACTS ON LIGHT SENSITIVE RECEPTORS</i>                        | 3 |



## CONTENTS

|      |                                                                                                               |   |
|------|---------------------------------------------------------------------------------------------------------------|---|
| 13   | <i>PROPOSED MANAGEMENT AND MITIGATION OF THE VISUAL IMPACT OF THE NIGHT LIGHTING</i>                          |   |
| 13.1 | <i>LIGHTING DESIGN GUIDELINES</i>                                                                             | 3 |
| 14   | <i>ASSESSMENT OF POTENTIAL VISUAL IMPACT FROM RESIDENTIAL PROPERTIES</i>                                      |   |
| 15   | <i>PROPOSED MANAGEMENT AND MITIGATION OF THE VISUAL IMPACT OF THE LNG FACILITY</i>                            |   |
| 15.1 | <i>CURTIS ISLAND</i>                                                                                          | 3 |
| 15.2 | <i>THE NARROWS</i>                                                                                            | 3 |
| 16   | <i>PROPOSED MANAGEMENT AND MITIGATION OF THE VISUAL IMPACT OF THE CURTIS ISLAND BRIDGE AND APPROACH ROADS</i> |   |
| 16.1 | <i>CURTIS ISLAND</i>                                                                                          | 3 |
| 16.2 | <i>THE NARROWS</i>                                                                                            | 3 |
| 17   | <i>CONCLUSION</i>                                                                                             |   |
| 17.1 | <i>VISUAL IMPACT OF THE LNG FACILITY</i>                                                                      | 3 |
| 17.2 | <i>VISUAL IMPACT OF THE PROPOSED BRIDGE</i>                                                                   | 3 |
| 17.3 | <i>IMPACT OF THE PROJECT LIGHTING</i>                                                                         | 3 |
| 17.4 | <i>CUMULATIVE IMPACT OF THE PROJECT</i>                                                                       | 3 |
| 17.5 | <i>SIGNIFICANCE OF THE IMPACT OF THE PROJECT</i>                                                              | 3 |

## REFERENCES

## ANNEXURES

|                |                                                 |
|----------------|-------------------------------------------------|
| <i>ANNEX A</i> | <i>PARAMETERS OF HUMAN VISION</i>               |
| <i>ANNEX B</i> | <i>PHOTOMONTAGE METHODOLOGY</i>                 |
| <i>ANNEX C</i> | <i>PHOTOMONTAGES (A3)</i>                       |
| <i>ANNEX D</i> | <i>BRIDGE CONCEPT DESIGN PLANS AND SECTIONS</i> |

## GLOSSARY

| Term                            | Definition                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Analysis (landscape)</b>     | The process of breaking the landscape down into its component parts to understand how it is made up.                                                                                                                                                                                                                                         |
| <b>Assessment (landscape)</b>   | An umbrella term for description, classification and analysis of landscape.                                                                                                                                                                                                                                                                  |
| <b>Classification</b>           | A process of sorting the landscape into different types using selected criteria but without attaching relative values to the different kinds of landscape.                                                                                                                                                                                   |
| <b>Constraints map</b>          | Map showing the location of important resources and receptors that may form constraints to development.                                                                                                                                                                                                                                      |
| <b>Cumulative effects</b>       | The summation of effects that result from changes caused by a development in conjunction with other past, present or reasonably foreseeable actions.                                                                                                                                                                                         |
| <b>Element</b>                  | A component part of the landscape (e.g., creeks, vegetation).                                                                                                                                                                                                                                                                                |
| <b>Enhancement</b>              | Landscape improvement through restoration, reconstruction or creation.                                                                                                                                                                                                                                                                       |
| <b>Indirect impacts</b>         | Impacts on the environment, which are not a direct result of the development but are often produced away from it or as a result of a complex pathway. Sometimes referred to as secondary impacts                                                                                                                                             |
| <b>Landcover</b>                | Combinations of land use and vegetation that cover the land surface.                                                                                                                                                                                                                                                                         |
| <b>Landform</b>                 | Combinations of slope and elevation that produce the shape and form of the land.                                                                                                                                                                                                                                                             |
| <b>Landscape</b>                | Human perception of the land conditioned by knowledge and identity with a place.                                                                                                                                                                                                                                                             |
| <b>Landscape capacity</b>       | The degree to which a particular landscape character type or area is able to accommodate change without unacceptable adverse effects on its character. Capacity is likely to vary according to the type and nature of change being proposed.                                                                                                 |
| <b>Landscape character</b>      | The distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement. It creates the particular sense of place of different areas of the landscape. |
| <b>Landscape character type</b> | A landscape type will have broadly similar patterns of geology, landform, soils, vegetation, land use, settlement and field pattern discernible in maps and field survey records.                                                                                                                                                            |
| <b>Landscape effects</b>        | Change in the elements, characteristics, character and qualities of the landscape as a result of development. These effects can be positive or negative.                                                                                                                                                                                     |
| <b>Landscape evaluation</b>     | The process of attaching value (non-monetary) to a particular landscape, usually by the application of previously agreed criteria, including consultation and third party documents, for a particular purpose (for example, designation or in the context of the assessment).                                                                |
| <b>Landscape factor</b>         | A circumstance or influence contributing to the impression of a landscape (for example, scale, enclosure, elevation).                                                                                                                                                                                                                        |
| <b>Landscape feature</b>        | A prominent eye-catching element, for example, ridgeline, hilltop or creek                                                                                                                                                                                                                                                                   |

| Term                                       | Definition                                                                                                                                                                                                                                                                                                                           |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Landscape impact</b>                    | A change to landscape values caused by development Impacts can be either positive or negative.                                                                                                                                                                                                                                       |
| <b>Landscape quality (or condition)</b>    | Landscape quality is based on judgements about the physical state of the landscape, and about its intactness, from visual, functional, and ecological perspectives. It also reflects the state of repair of individual features and elements which make up the character in any one place.                                           |
| <b>Landscape resource</b>                  | The combination of elements that contribute to landscape context, character and value.                                                                                                                                                                                                                                               |
| <b>Landscape sensitivity</b>               | The extent to which a landscape can accept change of a particular type and scale without unacceptable adverse effects on its character.                                                                                                                                                                                              |
| <b>Landscape Significance</b>              | The weighting of the relative importance of identified values (refer to landscape values)                                                                                                                                                                                                                                            |
| <b>Land use</b>                            | The primary use of the land, including both rural and urban activities.                                                                                                                                                                                                                                                              |
| <b>Landscape value</b>                     | The relative value or importance attached to a landscape (often as a basis for designation or recognition), which expresses national or local consensus, because of its quality, special qualities including perceptual aspects such as scenic beauty, tranquillity or wildness, cultural associations or other conservation issues. |
| <b>Magnitude</b>                           | A combination of the scale, extent and duration of an effect.                                                                                                                                                                                                                                                                        |
| <b>Methodology</b>                         | The specific approach and techniques used for a given study                                                                                                                                                                                                                                                                          |
| <b>Mitigation</b>                          | Measures, including any process, activity or design to avoid, reduce, remedy or compensate for adverse landscape and visual effects of a development project.                                                                                                                                                                        |
| <b>Perception (of landscape)</b>           | The psychology of seeing and possibly attaching value and/or meaning (to landscape).                                                                                                                                                                                                                                                 |
| <b>Precautionary principle</b>             | Principle applied to err on the side of caution where significant environmental damage may occur, but where knowledge on the matter is incomplete, or when the prediction of environmental effects is uncertain.                                                                                                                     |
| <b>Preference</b>                          | The liking by people for one particular landscape element, characteristic or feature over another.                                                                                                                                                                                                                                   |
| <b>Quality</b>                             | See <b>Landscape Quality</b>                                                                                                                                                                                                                                                                                                         |
| <b>Scenic amenity</b>                      | A measure of the relative contribution of each place in the landscape to the collective appreciation of open space as viewed from places that are important to the public                                                                                                                                                            |
| <b>Sense of place (<i>genius loci</i>)</b> | The essential character and spirit of an area: <i>genius loci</i> literally means 'spirit of the place'.                                                                                                                                                                                                                             |
| <b>Sensitive/sensitivity</b>               | See <b>Landscape Sensitivity</b>                                                                                                                                                                                                                                                                                                     |
| <b>Sieve mapping</b>                       | Technique for mapping environmental constraints, working from a series of overlays, sieving out less important factors.                                                                                                                                                                                                              |
| <b>Sustainability</b>                      | The principle that the environment should be protected in such a condition and to such a degree that ensures new development meets the needs of the present without compromising the ability of future generations to meet their own needs.                                                                                          |
| <b>Technique</b>                           | Specific working process.                                                                                                                                                                                                                                                                                                            |
| <b>Threshold</b>                           | A specified level in grading effects, for example, of magnitude, sensitivity or significance.                                                                                                                                                                                                                                        |

| Term                                | Definition                                                                                                                                                                                         |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Views/viewpoints and viewers</b> | Physical landscape resource, special interest or viewer group that will experience an effect.                                                                                                      |
| <b>Visual Absorption Capacity</b>   | The extent to which a landscape can accept change of a particular scale without visual impact (often relating to the ability of existing vegetation to screen a proposed development).             |
| <b>Visual amenity</b>               | The value of a particular area or view in terms of what is seen.                                                                                                                                   |
| <b>Visual effect</b>                | Change in the appearance of the landscape as a result of development. This can be positive (i.e. beneficial or an improvement) or negative (i.e. adverse or a detraction).                         |
| <b>Visualisation</b>                | Computer simulation, photomontage or other technique to illustrate the appearance of a development.                                                                                                |
| <b>Viewshed</b>                     | The area within which the project can theoretically be seen, determined by the location and height of the proposed structures in relation to the curvature of the earth and surrounding landforms. |
| <b>Worst-case situation</b>         | Principle applied where the environmental effects may vary, for example, seasonally to ensure the most severe potential effect is assessed.                                                        |
| <b>Zone of visual influence</b>     | Area within a viewshed which a proposed development may have an influence or effect on visual amenity based on proximity and the parameters of human vision                                        |

## EXECUTIVE SUMMARY

*The scope of this Landscape and Visual Impact Assessment (LVIA) is the proposed Liquefied Natural Gas (LNG) processing and export facility on Curtis Island which is a component of the Queensland Curtis LNG Project (QCLNG Project) proposed by Queensland Gas Company Limited (QGC), and the proposed Curtis Island Bridge and the ancillary approach road crossing of The Narrows. The proposed LNG Facility is located within the Curtis Island Industrial Precinct designated under the Gladstone State Development Area (GSDA), which permits High Impact Industry limited to natural gas (liquefaction and storage). The LNG Facility is also located within the administrative extent of the Great Barrier Reef World Heritage Area (WHA) but outside the Great Barrier Reef Marine Park. The proposed bridge across The Narrows is located on the administrative boundary of the Great Barrier Reef Marine Park.*

*Within the project's viewshed, landscape significance applies across an integrated hierarchy of legislation encompassing international, national, regional and local significance. The key document detailing landscape significance within the region is the Curtis Coast Regional Coastal Management Plan. The designated Areas of State Significance (Scenic Coastal Landscape) affected by the proposed QCLNG Project include islands and offshore features, coastal wetlands, and estuaries and inlets.*

*In addition, The Narrows is also listed on the Australian Heritage Commission Register of National Estate, as this area 'represents an uncommon passage landscape and one of only five narrow tidal passages separating large continental islands from the mainland in Australia.'*

*Whilst the GSDA designation of Curtis Island Industrial Precinct allows for high impact industrial development there remains the requirement for development to address the 'interconnectedness of coastal management issues including impacts on State Significant (Scenic Coastal Landscapes).*

*The viewshed of the LNG Facility comprises of: south western Curtis Island, the Port of Gladstone, The Narrows, Targinie foreshore, and the industrialised waterfront land of Gladstone. Within 4.2 km of the site, or the distance at which the project would potentially dominate the landscape, visibility of the project would be restricted to: a limited area in the south western section of Curtis Island, the waters of the Port of Gladstone, the entrance to The Narrows, and a limited section of Targinie Foreshore, in particular Fisherman's Landing.*

*Visibility mapping confirmed the LNG Facility would not be visible from the majority of Curtis Island or The Narrows owing to the linear ridgeline running along the north eastern boundary of the Curtis Island Industrial Precinct. The majority of Gladstone's urban areas would not be significantly affected owing to the distance to the proposed LNG Facility and intervening topography.*

*Views from residential properties would not be significantly affected by either the LNG Facility or the proposed bridge.*

*The impact of the proposed Curtis Island Bridge on the highly sensitive landscape area of The Narrows was also assessed. The proposed bridge would be located on the*

*cadastral boundary of the Great Barrier Reef Marine Park, and, based on the Concept Design investigations, partly within the Marine Park and partly outside. The pristine natural 'wilderness' area of the passage landscape is recognised at international, national and state level.*

*The cumulative effect of industry on either side of the Targinie passage would substantially alter the landscape character of the area. This alteration in landscape character is consistent with the proposed expansion of the Port of Gladstone and the extension to the GSDA. The proposed bridge across the 'entrance' to The Narrows would create a visual boundary between The Narrows 'pristine' natural landscape and the expanded port facilities. The bridge would visually enclose the Targinie passage, separating the two areas and disrupt the current continuity of the shoreline.*

*The main conclusions of the Landscape and Visual Impact Assessment of the LNG component of the QCLNG Project are:*

- The level of visual impact of the LNG Facility, bridge and access road on views from residential areas in Gladstone would be of negligible to minor significance, mainly owing to the attenuating effects of distance and intervening topography;*
- The level of visual impact of the LNG Facility, bridge and access road on views from the Targinie foreshore would be moderate to major adverse significance owing to their proximity to the viewpoint. This viewpoint was the only location on the mainland affected by this level of visual impact;*
- Views of the LNG Facility from the adjoining waterway, within approximately 1.4 km of the site, are expected to have the highest identified level of visual impact, which would be rated as major adverse significance;*
- The LNG Facility is expected to impact on landscape values of major significance on Curtis Island, however, the impact on the Great Barrier Reef World Heritage Area is already attenuated in this location by the presence of the Port of Gladstone in the viewshed. Therefore, this area is not 'pristine' or representative of the "exceptional natural beauty" assigned to the World Heritage and National Heritage values. In addition, the designation of the Curtis Island Industry Precinct as an extension to the Gladstone State Development Area (GSDA) reflects the intent of the Queensland Government to develop the area as an industrial precinct. Given this, the landscape and visual impact of the proposed LNG Facility is consistent with the designated land use and general expansion of industry around the Port of Gladstone; and*
- The pristine natural 'wilderness' area of The Narrows passage landscape as recognised at International, National and State level would be affected by the proposed bridge and approach road resulting in a level of visual impact of major adverse significance, a level of critical adverse significance was considered, however the presence of modification and industrial elements in the viewshed reduces the critical level to the next highest level of significance.*

This report has been prepared by Environmental Resources Management Australia Pty Ltd (ERM) on behalf of the proponent Queensland Gas Company (QGC) to assess the Landscape and Visual Impact of the proposed Queensland Curtis LNG (QCLNG) Project (“the project”). The scope of this Landscape and Visual Impact Assessment (LVIA) includes the Liquefied Natural Gas (LNG) processing and export facility on Curtis Island, and the proposed bridge crossing of The Narrows and approach road option. This report is one component of a number of technical assessments that forms part of the Environmental Impact Statement for the Queensland Curtis LNG Project.

**1.1****LOCATION**

The proposed LNG Facility is located in the south western section of Curtis Island, to the north of Gladstone, Queensland, *refer Figure 1.1*. The site of the LNG onshore investigation area is within the Gladstone State Development Area, Curtis Island Industrial Precinct (See *Figure 5.3*). The proposed bridge crossing of The Narrows is located between Friend Point, Targinie and Laird Point on Curtis Island, *refer Figure 1.1*.

**1.2****SCOPE OF ASSESSMENT**

The scope of this LVIA report includes the following:

- Description of the methodology used to undertake the study;
- Description of the visual elements of the project, including type, scale and location of the main elements of the LNG Facility, the Curtis Island Bridge and approach road;
- Mapping of the viewshed;
- Description of the landscape character within the viewshed including townscape character and landscape features;
- Analysis of all areas from which the LNG Facility, bridge and loading berth is potentially visible;
- Assessment of the potential visual impact of the project during construction and operation from publicly accessible viewpoints including waterways;
- Assessment of potential cumulative effects with other approved or committed projects;

- Assessment of the potential impact of night lighting on significant receptors (fauna and residences) and port users;
- Assessment of the potential visual impact of the project during construction and operation from residential properties;
- Recommendations to mitigate visual impacts of major structures and proposed screening vegetation; and
- Recommendations to mitigate night lighting impacts during construction and operational phases.



**Legend**

- Proposed QCLNG Site Boundary
- QCLNG Footprint Plant Layout
- Proposed Export Pipeline
- Possible Curtis Island Road Bridge Corridor
- Roads

**Source Note:**  
Aerial - Department of Infrastructure and Planning for QCLNG Project  
StreetPro Australia - Pitney Bowes MapInfo  
Curtis Island Road Bridge Corridor

**Figure 1.1**

**Site Location Plan**

|              |                               |
|--------------|-------------------------------|
| Client:      | BG/QGC                        |
| Project:     | Queensland Curtis LNG Project |
| Drawing No:  | 00861656_VA_GIS015_R1         |
| Date:        | 30/07/2009                    |
| Drawn by:    | JF                            |
| Reviewed by: | SC                            |
| Scale:       | 1:50,000                      |
| Projection:  | UTM MGA Zone 56               |
| Datum:       | GDA 94                        |

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## 2.1 STUDY METHODOLOGY

The LVIA methodology used as the basis for preparation of this report has been specifically developed by ERM for the assessment of infrastructure projects in the landscape. Each stage of the assessment methodology is briefly outlined below.

### 2.1.1 Landscape Analysis – Desktop Assessment

The initial desktop assessment was undertaken to ascertain the contextual framework of the project based on the major elements of the LNG processing and export facility on Curtis Island, The Curtis Island Bridge and approach road.

Geographical Information System (GIS) mapping was undertaken to define the viewshed and the Zones of Visual Influence (ZVI). The viewshed parameters included potential visibility of separate and cumulative elements of the LNG facility, marine facilities and the Curtis Island Bridge. The viewshed and ZVI are calculated according to the parameters of human vision (refer *Annex A*).

A literature review of landscape values was undertaken based on International, National, State, and Local designations; including World Heritage values, State Significant (Scenic Coastal Landscapes) and local planning scheme requirements. In particular, the landscape and community values identified in the Curtis Coast Regional Coastal Management Plan were reviewed.

### 2.1.2 Landscape Analysis – Site Assessment

A site assessment was undertaken over three days in December 2008 to verify the findings of the desktop assessment. The extent of visibility of the LNG Facility on Curtis Island, approach road option and the Curtis Island Bridge, was assessed and views recorded from lookouts, public parks, and along public roads within the viewshed. The visual assessment also included the waterways of Port Curtis, the Port of Gladstone, and The Narrows. The potential visibility of the project from residential properties located on islands within the Port of Gladstone was assessed from nearby locations on the water.

Panoramic photographs were taken from selected viewpoints where the LNG Facility on Curtis Island, approach road and the Curtis Island Bridge are potentially visible in order to prepare photomontages. This was undertaken in accordance with the methodology detailed in *Annex B*.

### 2.1.3

#### *Landscape Character Types*

The information collected in the desktop assessment and the site assessment was then used to map landscape character types. An assessment of the landscape character within the viewshed was undertaken including the scale, characteristic landscape features, topography, drainage, land use, and vegetation. Existing infrastructure in the area and man-made modifications to the landscape were also considered. The major viewpoints and view corridors with visual exposure to the LNG facility and the Curtis Island Bridge were assessed. In addition assigned landscape values as identified in the various policy designations were considered in providing a rating of landscape sensitivity for each landscape character type.

### 2.1.4

#### *3D Visual Modelling of the Project in the Landscape*

A basic 3D model of the LNG Facility and the Curtis Island Bridge was prepared using a computer program (3D Max), and placed within the Digital Terrain Model (DTM) for the preparation of photo-realistic colour photomontages. GIS data including the location and height of major visual elements, and GPS coordinates for the location and elevation of each of the photographed viewpoints were used to accurately place the 3D model within the photographs taken from each viewpoint.

Selected viewpoints were chosen for the preparation of photomontages based on views with the greatest visual exposure to the project that is, the greatest numbers of structures or part thereof, visible from the public locations. These photomontages, therefore, represent the 'worst case scenario'. The digital model was overlaid on the photographic panorama. As the topography (or other predetermined points) must align, this verifies the location and apparent height of the proposed LNG Facility and bridge. A detailed description of the methodology used in preparation of the photomontages is provided in *Annex B*. The extent of visibility can be ascertained through examination of the models positioned in the landscape.

Photographs and photomontages within the text, whilst technically correct, have been reproduced in larger format (A3) to assist with representation of the visual impact of the project in the landscape (refer *Annex C*).

### 2.1.5

#### *Seen Area Analysis*

A Seen Area Analysis was undertaken to identify those areas within the study area from which the project, or sections of the project, may be visible. The Seen Area Analysis provides an indication of where a project is screened by topography or, more importantly, maps those areas where topography does not screen views to the proposed project. For example, the LNG Facility is located on low-lying land adjoining Port Curtis, intervening ridges between the project site and surrounding areas may screen views to all, or part, of the proposed LNG Facility.

The areas from which all, or part, of the proposed project elements are visible has been mapped using GIS software. This GIS mapping is based solely on topography (5m Digital Terrain Model) and does not take into account screening by vegetation, minor topographic changes and built forms. These factors will reduce the visibility from many locations and the GIS analysis is a conservative map of the extent of potential visibility.

#### 2.1.6 *Evaluation of the Visual Impact on Landscape Significance*

The process for evaluating the visual impacts of the LNG Facility and Curtis Island Bridge on landscape significance was undertaken through both quantitative and qualitative assessment. The quantitative assessment evaluated the magnitude of change in the landscape determined through examination of GIS mapping layers, photography and photomontages as representations of the potential impact of the project on views from the surrounding areas. The qualitative assessment, or sensitivity of the landscape to changes of visual quality and landscape character, was evaluated against the assigned values under the various policy designations and the quality of the viewpoint. This provides the basis for identifying the relative visual impact on landscape significance.

The *magnitude of change* is influenced by:

- Location of the proposed development in the view;
- Compatibility of the development with the surrounding landscape;
- Duration of impacts in the construction and operation phases;
- Scale of the development in the view;
- Reversibility of change; and
- Potential blockage of view by intermediate landscape elements, e.g., such as vegetation, structures and topography.

The *sensitivity or quality* of the viewpoint is influenced by:

- The distance to the development;
- The number of observers present to see the development, i.e., whether the viewpoint has one observer or many observers;
- Whether the observer has a permanent or temporary view of the magnitude of change; i.e., from a living room window or a passing car; and
- Whether the observer has the opportunity for alternative views in other directions.

The designated landscape values influence the *sensitivity or quality* of the viewpoint as follows:

The quality of a viewpoint is also influenced by the designated landscapes values within the view, which in turn relates to the recognition and designation of community values at a policy level i.e. the international community values in relation to World Heritage Areas or national and state community values in relation to the Areas of State Significant (scenic coastal landscapes). Designated landscape values are often assigned through a process of comparative analysis which evaluates the rarity of a landscape type and quality of the landscape in comparison to similar landscape types. The protection and management of designated landscapes, view corridors and landscape features may include the identification of threats to those landscape values, and planning/performance criteria to minimise threatening processes.

Using these parameters, the significance of the landscape and visual impacts are defined using the following terms in *Table 2.1* and described in the following sections.

**Table 2.1** *Significance of Landscape and Visual Impacts*

| Magnitude of Change | Sensitivity / Quality |                   |                   |                   |
|---------------------|-----------------------|-------------------|-------------------|-------------------|
|                     |                       | Low               | Medium            | High              |
|                     | Large                 | Moderate          | Moderate to Major | Major to Critical |
|                     | Medium                | Minor to Moderate | Moderate          | Moderate to Major |
|                     | Small                 | Minor             | Minor to Moderate | Moderate          |
|                     | Negligible            | Negligible        | Negligible        | Negligible        |

The significance of landscape and visual impacts was evaluated using the following thresholds:

**Negligible Significance** – little or no magnitude of change from a viewpoint with low, medium or high sensitivity, i.e., minute level of effect that is barely discernable over ordinary day to day effects. The assessment of “negligible” impact significance is usually based on visibility. That is, the QCLNG Project or its relevant components are not visible even in good weather, or would be a minute element in the view across a man-modified landscape.

**Minor Significance** – small level of change from a viewpoint with low to medium sensitivity/quality, i.e., adverse effects that are noticeable but that will not cause any significant adverse visual impacts. In most cases mitigation will be effective in minimising or eliminating the impact.

**Moderate Significance** – small magnitude of change from a viewpoint with a medium to high sensitivity/quality, and/or medium magnitude of change from a viewpoint of low to high sensitivity/quality and/or large magnitude of change from a viewpoint with low to medium sensitivity/quality. A moderate impact may warrant being brought to the attention of the decision-maker and deserves careful attention in the decision. Dependent on the nature of the visual/landscape impact, mitigation may be effective in minimising or eliminating the impact.

**Major Significance** – medium magnitude of change from a viewpoint with high sensitivity/quality and/or large magnitude of change from a viewpoint of medium to high sensitivity/quality i.e., extensive adverse effects that cannot be completely avoided, remedied or mitigated. Impact warrants being given considerable weight in the decision. Alternative design options may be considered.

**Critical Significance** – large magnitude of change from a viewpoint with high sensitivity/quality i.e., extensive adverse effects that cannot be avoided, remedied or mitigated. This threshold normally applies to the first modification to an otherwise pristine natural landscape. This type of impact warrants being given considerable weight in the decision. Alternative options should be considered.

#### 2.1.7 *Assessment of the Impact of Night Lighting*

The potential impacts of artificial lighting emanating from the proposed LNG Facility and bridge have been assessed according to the following methodology:

- Definition and description of the proposed light source(s);
- Description of the existing conditions and potential physical change to the site and surrounding areas by the proposed development;
- Identification of the light sensitive receptors and description of their known susceptibility to light pollution;
- Define the habitation of light sensitive receptors relative to the proposed light sources;
- Identify potential impacts resulting from the proposed change; and
- Recommend remediation or design measures to improve or reduce potential impacts.

The LVIA study is based on preliminary conceptual designs for both the LNG Facility and the proposed bridge. Whilst undertaking the LVIA study at this preliminary stage in the engineering design has its benefits in that the LVIA can inform development of the engineering design, lack of engineering detail limits accurate development of the 3D models and representative photomontages. These limitations are acknowledged in the report and the photomontages should be considered as representative views of the project in the landscape based on preliminary designs. These limitations will not affect the overall outcome of the LVIA.

## 3.1

## GENERAL

QGC proposes to develop an integrated Liquefied Natural Gas (LNG) project in Queensland. The overall project will comprise three principal components, as outlined below:

- **Gas Field Component:** expansion of QGC's existing coal seam gas (CSG) operations in the Surat Basin of southern Queensland, to provide feed gas for two of the three LNG trains, and for domestic markets;
- **Pipeline Component:** development, construction and operation of a main gas pipeline, extending approximately 380 km from the gas fields to the proposed LNG Facility at Curtis Island, and capable of supplying gas for three LNG trains. Additionally, a network of gas connection pipelines will be developed, to link QGC's gas fields and to connect other nearby CSG fields to the main gas pipeline; and
- **LNG Component:** development, construction and operation of an LNG processing plant, export terminal and associated infrastructure at Curtis Island, Gladstone, with an ultimate capacity of up to 12 mtpa.

The Project will also incorporate a number of ancillary or additional activities, which may be developed by others, including:

- Treatment, transport and use of the associated water produced from the development of the Gas Field Component;
- Dredging of marine access channels and a turning basin to access the LNG Facility in the Port of Gladstone; and
- Provision of road and bridge access, including a services corridor, from the mainland to the LNG Facility at Curtis Island (the Curtis Island Bridge).

The Project will be one of Australia's largest capital projects and will supply up to 12 million tonnes per annum (mtpa) of LNG through the progressive development of three LNG trains. The first LNG train and associated gas fields and pipeline infrastructure is expected to be producing LNG in Q3 2013. The second train is anticipated to be in operation six to twelve months later, with the third train to be commissioned in subsequent years, subject to identification of adequate gas reserves.

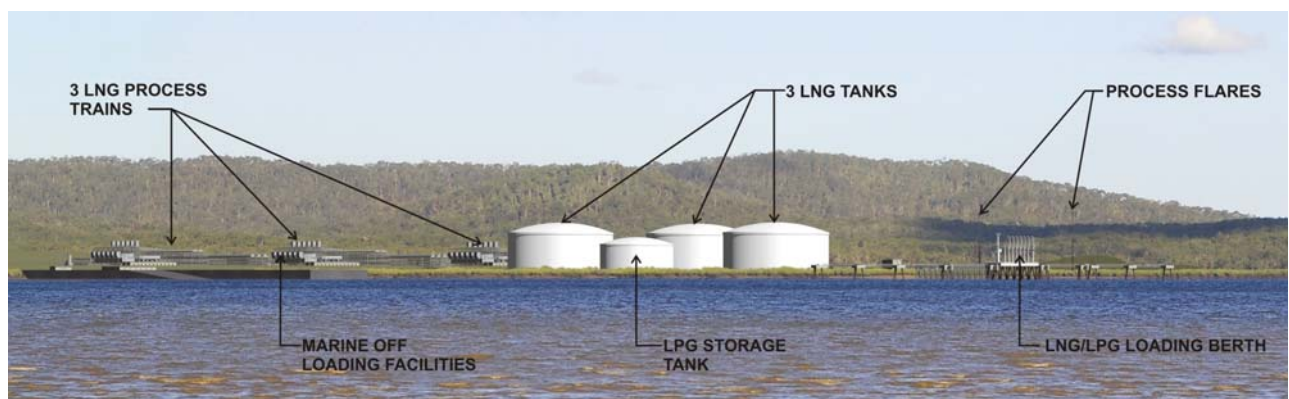


## 3.2.1

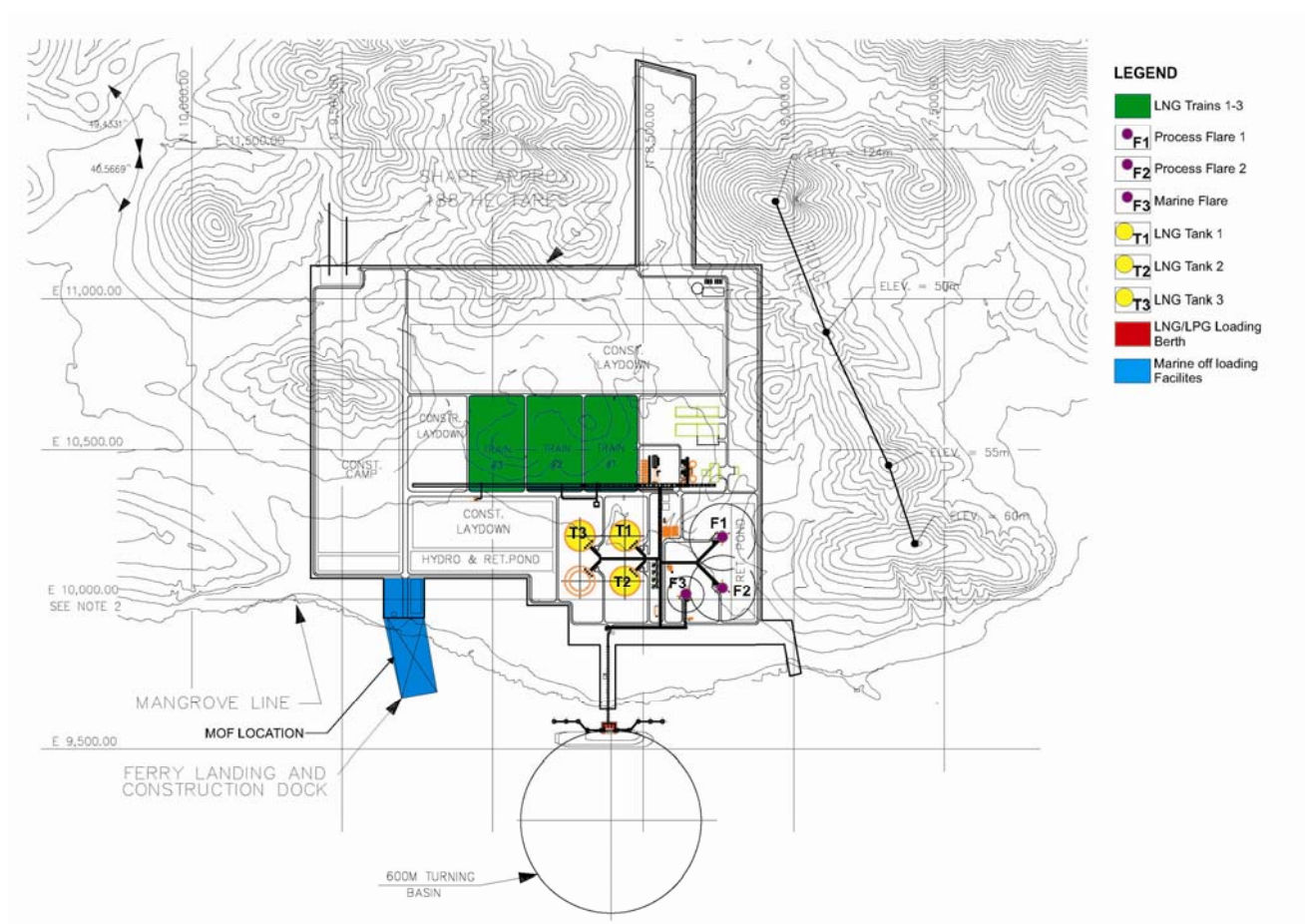
*Main components of the LNG Facility considered in the LVIA*

The LNG Facility on Curtis Island comprises of the development, construction and operation of an LNG processing plant, export terminal and associated infrastructure on Curtis Island, the main components of this facility are outline below:

- A multi-train LNG Facility with a production capacity of up to 12 mtpa (each train will have a nominal 4 mtpa production capacity, and contain a number of columns, cold boxes, banks of air coolers, and a refrigeration compression area with associated turbine stacks, height of exhaust stack 29m) designed for continuous 24-hour operation;
- Three LNG storage tanks with a capacity of up to 160,000 cubic metres each 100m diameter x approximately 46m high to the top of the concrete dome, topside structures and relief valve vents may be slightly higher (to service up to two trains) and a third tank to be constructed for the third train;
- An LPG storage tank with a capacity of up to 100,000 cubic metres, 68m diameter x 31.28m high;
- Two process flare stacks at 59.4m high, and a marine flare at 13.1m high;
- Associated utilities and infrastructure including air, water, nitrogen, refrigerant storage, power generation, fire protection and safety, fuel gas, stormwater management, waste management, flare and telecommunications systems and access roads;
- Associated common buildings, including administration, maintenance and control rooms, and motor control centres;
- A marine jetty containing specialised LNG loading facilities and LNG tanker berths; and
- Marine off loading facilities.



**Figure 3.1** *Main components of the LNG Facility - photomontage*



**Figure 3.2** *Main components of the LNG Facility - concept plan*

### 3.2.2 *Main processes considered in the LVIA during construction of the LNG Facility*

Construction, site clearing and bulk earthworks will be required over an area of approximately 300 hectares.

The peak workforce during the construction of the initial phase of the LNG component is expected to be approximately 1500. It is expected that a large proportion of the labour will be housed in a construction camp to be established on Curtis Island. An operational workforce of approximately 200 full-time personnel will operate the LNG Component.

### 3.2.3 *Main processes considered in the LVIA during operation of the LNG Facility*

The main operational process affecting the visual impact of the LNG Facility is the flaring of the processing flares. Whilst there will be no continuous flaring from the LNG plant except for a small pilot flame for ignition purposes. The processing flares will be required to operate in a number of different scenarios:

**Start-Up Flaring:** During start-up of a LNG Facility it will be necessary to flare gas at certain points in the process to ensure the gas specifications are met at all points in the facility. The amount of gas flared is likely to be forty percent of the normal flow rate, and last for up to twenty four hours.

**Emergency flaring:** This will be the maximum flow rate, and noise through the flare system, and is required to ensure the facility is brought to a safe condition as soon as possible. The emergency flare will only occur as a matter last resort, when other pressure containing safety devices have failed. The emergency pressure relief is expected to be very infrequent.

**Pressure Blowdown:** In the event of a confirmed fire at the LNG Facility it is necessary to evacuate all pressurised hydrocarbon inventories within the area of the fire. The pressure blowdown will last approximately forty minutes, and the rate at which the gas is released will be similar to the emergency flaring case described above.

There will also be periods of planned maintenance, where a whole train will be de-pressured. This will happen every three years for each train. The amount of gas flared will be minimized by producing LNG to the storage tanks to as low a pressure as possible, before the gas is flared to atmosphere. De-pressuring of a train will be controlled. An LNG train de-pressurisation will take less than eight hours.

### 3.2.4 *Environmental Management*

The following environmental management measures have been incorporated into the design of the LNG Facility to reduce the environmental impacts, including impacts on landscape and visual amenity as follows:

- Minimise as far as possible the removal of mangroves from the shoreline during construction and operation of the marine off loading berth and the jetty to the LNG loading berth. The retained areas of mangroves will providing visual screening and assist in minimising the disruption of natural shoreline vegetation;
- Vegetation on adjoining ridges and hills is to be retained where possible. This will minimise erosion and sedimentation as well as provide screening of the project from viewing locations to the south east;
- The planting of cut and fill slopes with natural vegetation;
- Retention of significant trees within the construction camp area to provide shade and visual amenity, retention of the tree cover in this area will reduce the visual impact of clearing and mitigate the impact of built form; and
- Consideration should be given to the use of recessive colours (colours that will blend with the natural landscape setting) for built forms, within the limitations of the operational parameters.

## 3.3.1

*Main components of the bridge and approach road*

The proposed Curtis Island Bridge and approach road were assessed in the LVIA as this infrastructure is being investigated by the Department of Infrastructure and Planning, Santos and QGC to provide access to the Curtis Island Industrial Precinct. The concept design for the bridge and road has been prepared by Connell Wagner for the Department of the Coordinator General. Refer to *Annex D* for concept design plans of the bridge and road. The main components of the bridge and approach road areas are as follows;

**Bridge:**

- Length 1500m, two traffic lanes (3.5m) and overall width 13.745 m;
- Vertical height clearance of 20.5 m from HAT, top of structure 27.5m;
- Span length 50m;
- Main structure to be grey concrete; and
- Abutments rock riprap and planted with screen vegetation.

**Road:**

- Two traffic lanes 3.5m each;
- Shoulder width 1.5m with 1:3 batters on outer slopes;
- Minimum RL 5.5 AHD; and
- Embankments and areas of disturbance to be planted with endemic vegetation.

The term 'viewshed' is generally defined as the area in which a project can be seen and is determined by the location and height of the proposed structures in relation to the curvature of the earth and surrounding landforms. For the purpose of this assessment the viewshed is further defined as the zone within which a person can see an object in the landscape without assistance, is able to interpret what is seen and therefore has influence on the perception and effect on visual amenity. Mapping of the viewshed is used as a basis for establishing the project's potential visibility and provides a basis for determining the extent of the study area for the LVIA.

Mapping of the viewshed can further be categorised into broadly defined Zones of Visual Influence (ZVI). The ZVI are based on measurements derived from the vertical field of view and thresholds applied to define how a person interprets what they see. Refer *Annex A* for further information on these parameters.

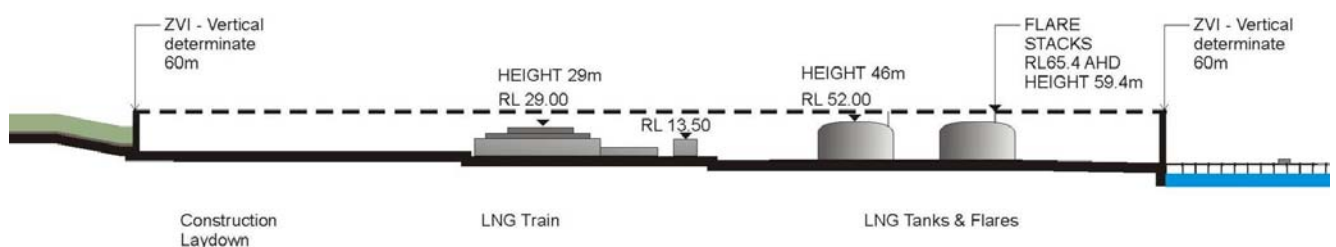
The initial viewshed and ZVI mapping does not take into consideration topography or the screening effects of vegetation and built forms. Detailed mapping of the visibility of the project that does take into consideration these parameters is provided in the Seen Area Analysis, *Section 7* of this report.

#### 4.1

#### EXTENT OF THE STUDY AREA

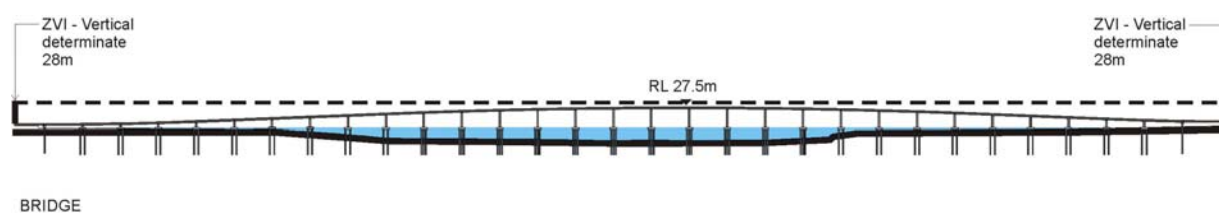
The study area will be the extent of the viewshed. For the purpose of establishing the extent of the viewshed, the LNG facility and proposed bridge across The Narrows have been considered separately. The viewsheds were calculated as follows (also refer to *Section 7* of this report):

- LNG Facility – The tallest elements of the LNG Facility are the Flare stacks at 59.4 m high (RL 65.4 AHD), the three LNG tanks are 46m high (RL 52 AHD) and the LNG trains stacks at 29m high (RL 40 AHD). For the purpose of calculating the extent of visibility the parameters used for the LNG Facility are a maximum vertical height of 60m positioned at each corner of the LNG Facility site, this presents a worst case scenario.



**Figure 4.1** Parameter for calculating the Viewshed of the LNG Facility

- The Curtis Island Bridge – The maximum height of the proposed bridge is 27.5m, and overall length 1500m, For the purpose of calculating the viewshed the maximum vertical height of 28m has been positioned at each end of the bridge, this represents a worst-case scenario.



**Figure 4.2**      *Parameter for calculating the Viewshed of the proposed bridge*

The viewshed for each scenario can be further classified into Zones of Visual Influence as detailed in *Table 4.1* and 4.2. *Figures 4.3* and 4.4 illustrate the thresholds of visual influence for the proposed LNG Facility and the proposed bridge.

**Table 4.1**      *Viewshed and zones of visual influence for the LNG Facility*

| Distance from an observer to the project site (based on 60m vertical field of view) | Zones of Visual Influence                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| >7 km.                                                                              | <p><i>Visually insignificant</i></p> <p>A very small element in the viewshed, which is difficult to discern and will be invisible in some lighting or weather circumstances.</p>                                                                                                                       |
| 7 – 4.2 km                                                                          | <p><i>Potentially noticeable, but not dominant in the landscape (long distance views)</i></p> <p>The degree of visual intrusion will depend on the landscape sensitivity and the sensitivity of the viewer.</p>                                                                                        |
| 4.2 – 1.4 km                                                                        | <p><i>Visually evident and can dominate the landscape (middle distance view)</i></p> <p>The degree of visual intrusion will depend on the project and its setting within the landscape and factors such as foreground screening and on the landscape sensitivity and the sensitivity of the viewer</p> |
| < 1.4km                                                                             | <p><i>Will be visually dominant in the landscape from most viewing locations ('close-up' view of the project)</i></p> <p>The project dominates the landscape in which it is sited.</p>                                                                                                                 |

**Table 4.2**      *Viewshed and zones of visual influence for the proposed bridge*

| Distance from an observer to the project site (based on 28m vertical field of view) | Zones of Visual Influence                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| >3.2 km.                                                                            | <p><i>Visually insignificant</i></p> <p>A very small element in the viewshed, which is difficult to discern and will be invisible in some lighting or weather circumstances.</p>                                                                                                                       |
| 3.2 - 2 km                                                                          | <p><i>Potentially noticeable, but not dominant in the landscape (long distance views)</i></p> <p>The degree of visual intrusion will depend on the landscape sensitivity and the sensitivity of the viewer.</p>                                                                                        |
| 2 km - 650m                                                                         | <p><i>Visually evident and can dominate the landscape (middle distance view)</i></p> <p>The degree of visual intrusion will depend on the project and its setting within the landscape and factors such as foreground screening and on the landscape sensitivity and the sensitivity of the viewer</p> |
| < 650m                                                                              | <p><i>Will be visually dominant in the landscape from most viewing locations ('close-up' view of the project)</i></p> <p>The project dominates the landscape in which it is sited.</p>                                                                                                                 |



**Legend**

- Proposed QCLNG Site Boundary
- QCLNG Footprint Plant Layout
- Proposed Export Pipeline
- Possible Curtis Island Road/ Bridge Corridor
- Roads

**Source Note:**

SheepPro Australia - Piney Bowes MapInfo  
Curtis Island Road Bridge Corridor

**Figure 4.3**

**Zones of Visual Influence  
for LNG Facilities**

|               |                               |
|---------------|-------------------------------|
| Client:       | QGC                           |
| Project:      | Queensland Curtis LNG Project |
| Drawing No:   | 00861655_VA_GIS007_R1         |
| Date:         | 30/07/2009                    |
| Drawing size: | A3                            |
| Drawn by:     | JF                            |
| Reviewed by:  | SC                            |



Scale: 1:100,000

Datum: GDA 94

Projection: UTM MGA Zone 56

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**Legend**

- Proposed QCLNG Site Boundary
- QCLNG Footprint Plant Layout
- Proposed Export Pipeline
- Possible Curtis Island Road/ Bridge Corridor
- Roads

**Source Note:**

SheepPro Australia - Piney Bowes MapInfo  
Curtis Island Road Bridge - Connell Wagner

**Figure 4.4**

**Zones of Visual Influence  
for Proposed Bridge**

|              |                               |
|--------------|-------------------------------|
| Client:      | QGC                           |
| Project:     | Queensland Curtis LNG Project |
| Drawing No:  | 00861655_VA_GIS003_R1         |
| Date:        | 30/07/2009                    |
| Drawn by:    | JF                            |
| Reviewed by: | SC                            |



Scale: 1:100,000

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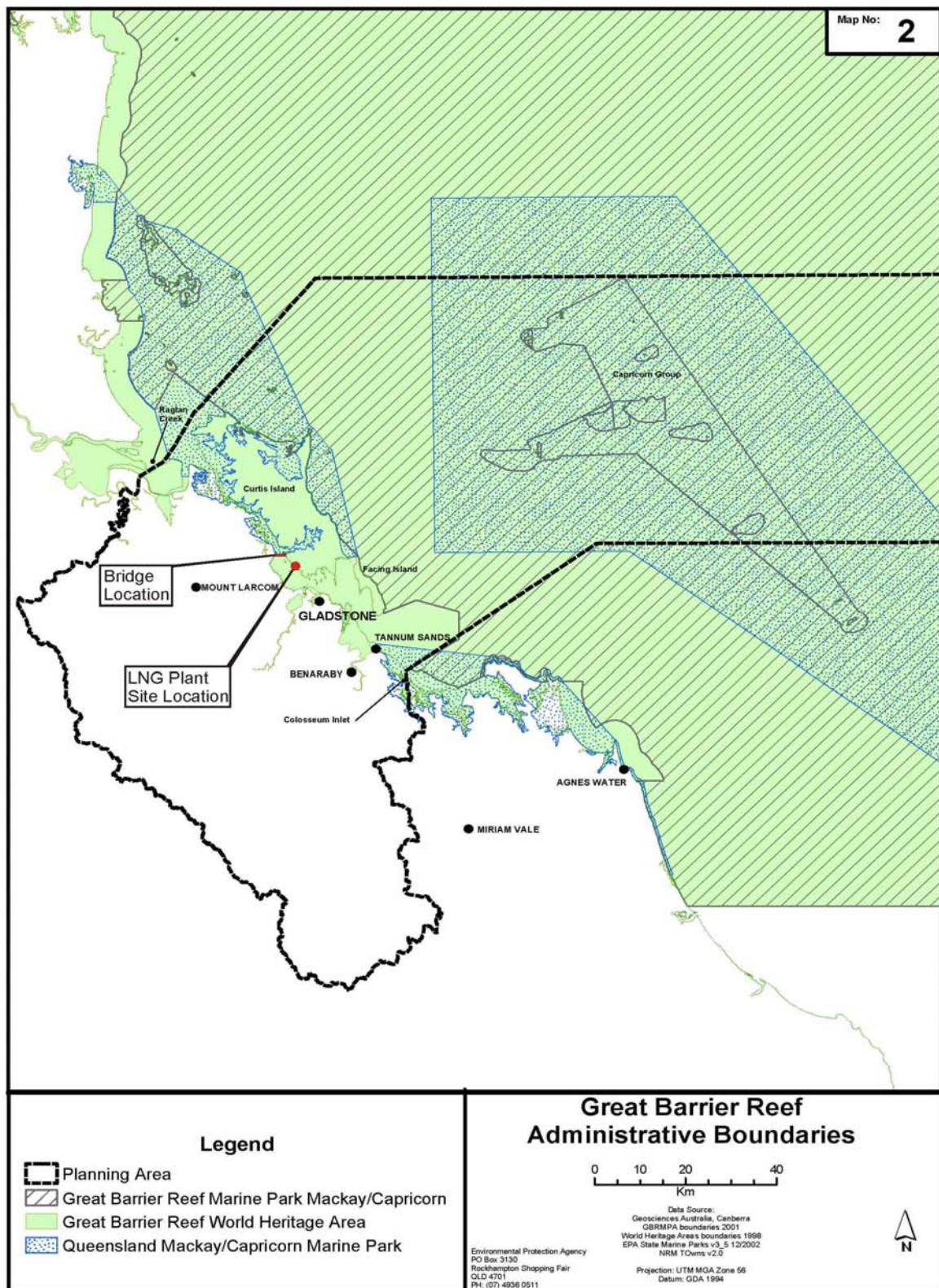


Within the project's viewshed, landscape values held by the community have been identified through various legislative provisions. Whilst there is a hierarchy of significance attached to these legislative provisions, classification uses a 'nested -scale' (that is, values are integrated across a hierarchy of scales) where broader legislative frameworks such as those applying to the international and national level can be scaled down to more detailed descriptions at the local/regional scale. Hence internationally significant values identified in the Great Barrier Reef World Heritage Area cover a large area with broad overarching values; the detail specific to these values as applied at the local/regional level are provided in the regional planning policies. The following is a brief summary of the legislative provisions applicable to the study area.

## **5.1 WORLD HERITAGE LISTING**

### **5.1.1 Great Barrier Reef World Heritage Area**

The project site is located within the Great Barrier Reef World Heritage Area which extends 2000 km along the coast of Queensland and covers approximately 35 million hectares. As detailed in *Figure 5.1* the proposed LNG Facility is located within the administrative extent of the Great Barrier Reef World Heritage Area but excluded from the Great Barrier Reef Marine Park Mackay Capricorn Management Area. The proposed bridge across The Narrows is located on the administrative boundary of the Great Barrier Reef Marine Park Mackay Capricorn Management Area refer *Figure 5.1*.



**Figure 5.1** *Location of the project within the Great Barrier Reef Administrative Boundaries<sup>1</sup>*

<sup>1</sup> From Curtis Coast Regional Coastal Management Plan base information from EPA 2001

The listing of the Great Barrier Reef Marine Park as a World Heritage Area (WHA) is based on a number of internationally significant values including its outstanding aesthetic attributes under Natural Criterion (VII) - Exceptional natural beauty and aesthetic importance, as detailed in the Department of Environment, Water, Heritage and the Arts – Australian Heritage Data base as follows:

***Criterion: (VII) Contains superlative natural phenomena***

*The Great Barrier Reef provides some of the most spectacular scenery on earth and is of exceptional natural beauty. The World Heritage values include:*

- a. the vast extent of the reef and island systems which produces an unparalleled aerial vista;*
- b. islands ranging from towering forested continental islands complete with freshwater streams, to small coral cays with rainforest and unvegetated sand cays;*
- c. coastal and adjacent islands with mangrove systems of exceptional beauty;*
- d. the rich variety of landscapes and seascapes including rugged mountains with dense and diverse vegetation and adjacent fringing reefs;*
- e. the abundance and diversity of shape, size and colour of marine fauna and flora in the coral reefs;*
- f. spectacular breeding colonies of seabirds and great aggregations of over-wintering butterflies; and*
- g. migrating whales, dolphins, dugong, whale sharks, sea turtles, seabirds and concentrations of large fish.*

The great diversity of landscape types across the Great Barrier Reef World Heritage Area is part of its recognised value. This diversity includes passage landscape systems such as The Narrows, and coastal islands such as Curtis Island with fringing mangroves as described in item c) above.

Whilst the aesthetic importance of the Great Barrier Reef World Heritage Area is largely dependent on naturalness, the “exceptional natural beauty” common throughout the Great Barrier Reef area is punctuated in places by nodes of development, including the two large industrialised ports of Gladstone and Townsville. Within these urban/industrialised nodes the values ascribed to the WHA do not directly apply, however the interface between natural undeveloped areas and urban areas is critical to the overall protection of WHA values. The management framework for this interface is set out in the Curtis Coast Regional Coastal Management Plan (refer Section 5.3)

The narrow channel between Curtis Island and the main land know as The Narrows is listed on the Australian Heritage Commission Register of National Estate. The Statement of Significance as detailed on the Heritage database is as follows:

*"The Narrows represent an uncommon passage landscape and one of only five narrow tidal passages separating large continental islands from the mainland in Australia. Of the five passages, Pumicestone Passage and Great Sandy Strait separate large sand islands from the mainland, leaving only Hinchinbrook Channel and Howard Island (NT) as geologically comparable to The Narrows. In contrast to the sub-tropical Narrows, Hinchinbrook Channel and the Howard Passage are wide tropical estuaries at a much earlier stage of development.*

*The Narrows are also an important indicator of past geomorphological processes, as many of Queensland's headlands and coastal ranges have been joined to the mainland by sedimentation processes identical with those operating within The Narrows. The geomorphological system includes the distinctive features of Balaclava Island, Kangaroo Island, Targinie Creek, Graham Creek and The Narrows.*

*Balaclava Island and The Narrows are in a zone of overlap and transition between tropical and temperate littoral vegetation communities. Importantly, this determines a switch in the competitive balance between southern mangrove communities dominated by the temperate/sub-tropical species, AVICENNIA MARINA and northern mangroves dominated by the tropical species of RHIZOPHORA. Three mangrove species are at, or near, their southern limit in the area.*

*The intertidal environments of Balaclava Island and The Narrows are influenced by two different hydrological systems, which interface at a tidal null point at Ramsays Crossing. The origin of the sedimentary environment of The Narrows from these two different hydrological systems has created a complex system of intertidal habitats.*

*The mangroves, saltmarsh and mud flats within the area are important to the maintenance of regional fish and crustacean populations. Targinie Creek is fringed by a well developed mangrove forest and is an excellent example of a tidal channel within The Narrows. Graham Creek joins the southern end of The Narrows and channels a significant portion of the freshwater runoff from the southern half of Curtis Island into The Narrows. The beach ridges at the southern end of Kangaroo Island contain a diverse assemblage of mangrove species".*

The interface between The Narrows and the Port of Gladstone, the 'entrance' to The Narrows, is the cadastral boundary of the Great Barrier Reef Marine Park, which runs parallel with Lairds Point on Curtis Island and Friend Point/ Kangaroo Island adjoining the mainland. The significant aesthetic values of this "uncommon" passage landscape are not however limited to this administrative area but are continuous with the natural coastal landscape of Curtis Island fringing the northern extent of The Port of Gladstone. Management of scenic values across this interface are detailed in the Curtis Coast Regional Coastal Management Plan (refer *Section 5.3.1*).

### **5.3**                    *AREAS OF STATE SIGNIFICANCE*

#### **5.3.1**                *Curtis Coast Regional Coastal Management Plan*

Areas of State Significance (Scenic Coastal Landscape) are identified in the Curtis Coast Regional Coastal Management Plan on Map 10 refer to *Figure 5.2*



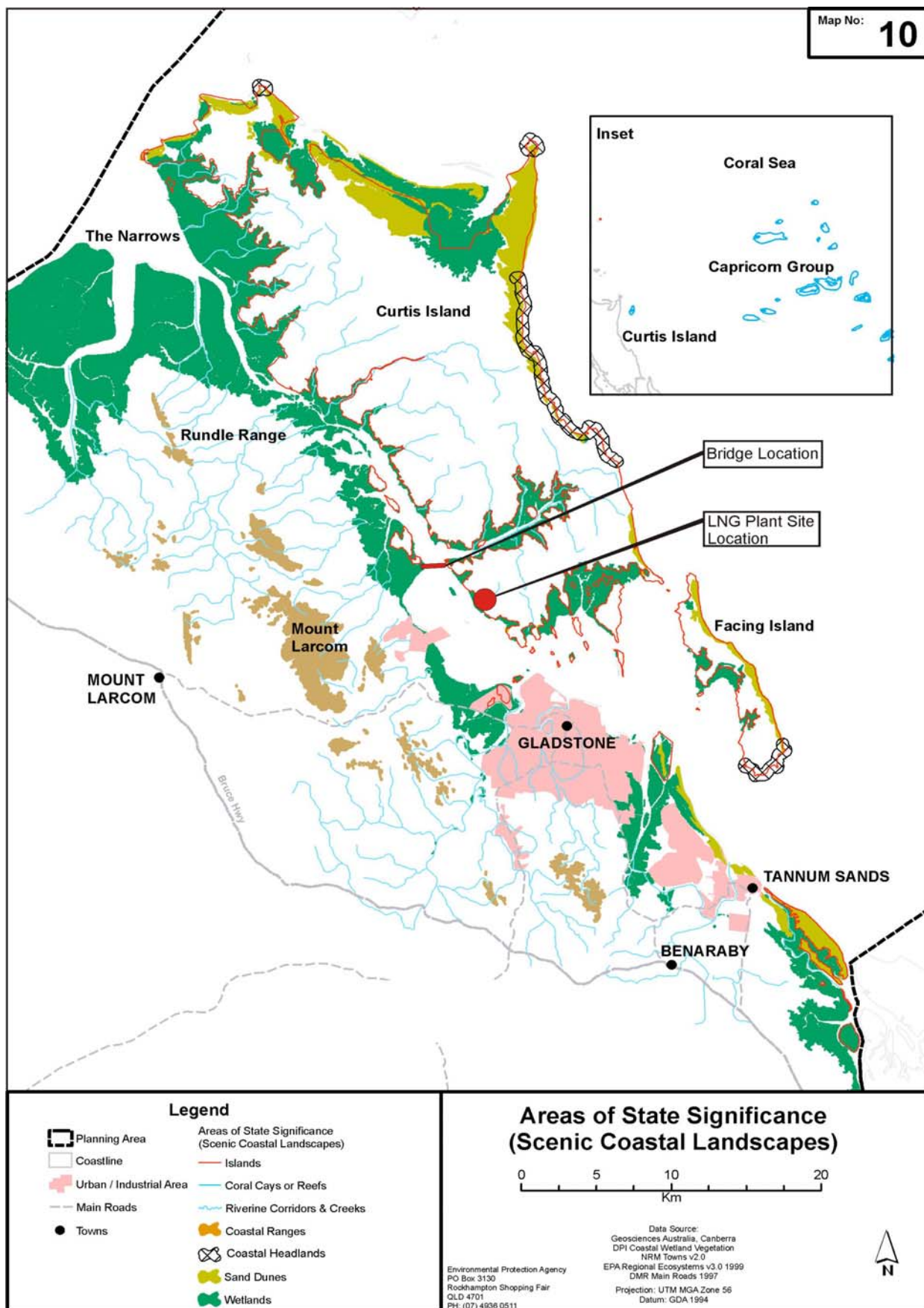


Figure 5.2 Location of the project within the Areas of State Significance<sup>2</sup>

<sup>2</sup> From Curtis Coast Regional Coastal Management Plan base information from EPA 2001

The designated areas of scenic coastal landscapes affected by the proposed project include; Islands and offshore features, coastal wetlands, and estuaries and inlets. The regional context *Section 2.7.1 Curtis Coast Regional Coastal Management Plan*, describes these areas as follows:

*"Areas of state significance (scenic coastal landscapes) in the Curtis Coast region include the landscape features identified on Map 10. Incompatible development within these areas can adversely impact on their scenic landscape values, particularly in relation to the coastal islands, Mt Larcom and the coastal ranges and remote natural areas such as The Narrows."*

*"The Gladstone Region is identified to be of 'High Scenic Management Priority' with Curtis Island and the Capricorn Group being of Level 1 Scenic Quality."*

The 'Desired coastal outcomes' for Curtis Island as described in the Curtis Coast Regional Coastal Management Plan include:

*'Maintenance of Curtis Island in a generally natural or non-urban state outside existing residential and tourist areas at South End, Black Head, Seal Hill and Station Point while providing opportunities for future development in appropriate locations.'*

*And, 'Development is sited and designed to protect the islands significant coastal resources and their values including protection of the island's scenic coastal landscapes.'*

Future development pressures on the island are acknowledged including the intent to develop future industry, port facilities and the proposed bridge to the mainland. Such future development is required to *'recognise the interconnectedness of coastal management issues on the island to ensure coastal resources and their values are not degraded.'*

The 'Desired coastal outcomes, 'specific to the proposed LNG locality (south west Curtis Island), includes the requirement that future development: *'considers the design and location of development ensuring any impacts on the coastal landscape values associated with the island are minimised.'*

The significant landscape values attributed to The Narrows are further detailed in the Curtis Coast Regional Coastal Management Plan, with the area *'given the highest level of protection in recognition of its pristine state and significant coastal resources and values'.*

In particular the *'maintenance of World Heritage values associated with the areas outstanding coastal landscape values including its scientific values as an indicator of past geomorphic processes and its scenic amenity values.'*

The Areas of State Significance (Scenic Coastal Landscapes) relevant to the proposed project locality are detailed in the following extracted section of *Schedule 1* of the Curtis Coast Regional Coastal Management Plan:

## Schedule 1

“Areas of state significant (scenic coastal landscapes) described in policy 2.7.1

| Landscape                     | Sites         | Description                                                                                                                                                                                                                                                                                                                                                                                                              | Desired coastal outcomes                                                                                                                                                                                                                                             | Measures                                                                                                                                                                              |
|-------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Islands and offshore features | Curtis Island | Large identifiable coastal islands close to shore and visually prominent from the mainland and harbour. These islands provide a strong structural element to the landscape and define the seaward edge of the coastal viewshed. They provide a high degree of contrast and visual diversity between intertidal and upland areas                                                                                          | The landscape values of islands and their contribution to the landscape values of the Curtis Coast region are protected and maintained.<br><br>Views from the mainland and viewpoints to the island are maintained and enhanced.                                     | Ensure the development remains unobtrusive and compatible with landscape values                                                                                                       |
| Coastal wetlands              | The Narrows   | Coastal wetlands in the Curtis Coast region comprise a range of mainly tidal wetlands such as mangroves salt marsh and clay pan with some freshwater wetlands. Coastal wetlands contribute significantly to scenic quality in terms of vegetation, wildlife and naturalness. The landscape qualities of the tidal wetlands are generally appreciated from boats, access points such as boat ramps and elevated lookouts. | The landscape values and ecological integrity of coastal wetlands are maintained.<br><br>The edges of mangrove vegetation in area of high scenic quality are managed to maintain or restore their visual continuity<br><br>Degraded wetland areas are rehabilitated. | Minimise visual breaks in areas of continuous mangrove vegetation.<br><br>Maintain existing vegetation along waterways to a maximum extent to form natural landscape edge and screen. |

| Landscape            | Sites       | Description                                                                                                                                                                                                                                                                                                                                                             | Desired coastal outcomes                                                                                                                                                                                                                    | Measures                                                                                                                                                                                                                                                                                                    |
|----------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Estuaries and inlets | The Narrows | The landscape qualities of estuaries and waterways are generally appreciated from boats and access points such as jetties and boat ramps, the shoreline and elevated lookouts. Estuarine and freshwater systems are dominant in the lower reaches by mangroves, clayplans and salt marsh. Many areas have a high degree of naturalness and offer a 'remote' experience. | <p>The landscape values and ecological integrity of mangroves, inlets and waterways are maintained.</p> <p>The edges of mangrove vegetation in areas of high scenic quality are managed to maintain or restore their visual continuity.</p> | <p>Minimise visual breaks in areas of continuous vegetation.</p> <p>Maintain existing vegetation along waterways to a maximum extent to form a natural landscape edge and screen.</p> <p>Ensure infrastructure in areas of high visual quality does not obscure views to water or intrude on waterways.</p> |

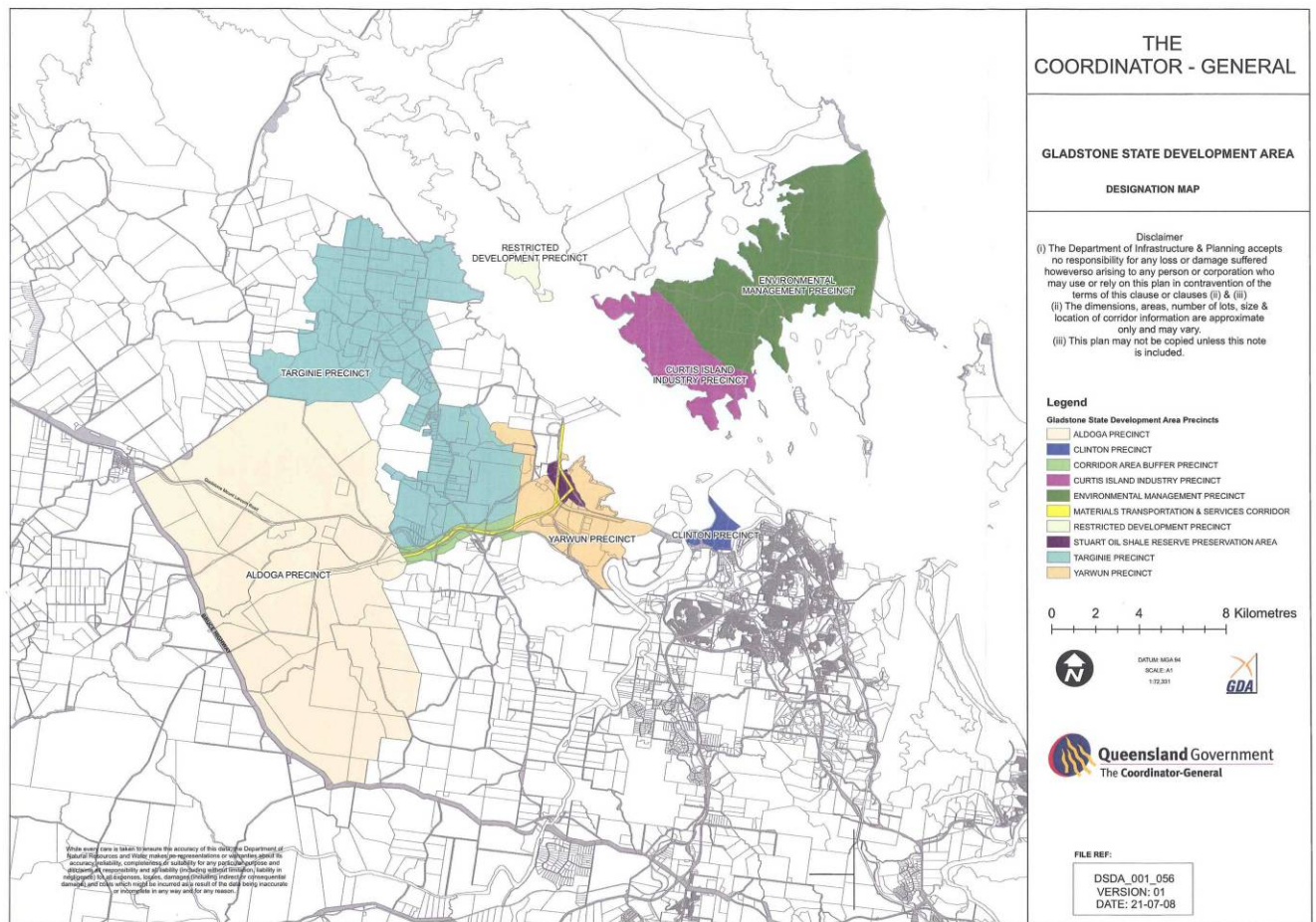
The desired environmental outcomes and measures to address impacts are detailed in *Sections 14 and 15* of this report.

## 5.4

### GLADSTONE STATE DEVELOPMENT AREA

Future expansion of the Port of Gladstone either side of the Targinie Passage has been secured through the designation of the Gladstone State Development Area, in particular the Curtis Island Industrial Precinct and the Targinie Precinct, refer *Figure 5.3*. The proposed LNG Facility is located within the Curtis Island Industrial Precinct which allows for High Impact Industry limited to natural gas (liquefaction and storage), Infrastructure Facility, Local Infrastructure and Materials Transport Infrastructure, with the potential for Extractive Industry and Forestry.

Whilst this designation provides the strategic planning provisions for large-scale industrial development, specifically the location and type of development, there remains the requirement for development to address the '*interconnectedness of coastal management issues*'. In particular, the landscape and visual impact of a project on designated values and the requirement to minimise impacts that may degrade these landscape values.



**Figure 5.3** Gladstone State Development Area designation map

## 5.5 LOCAL PLANNING SCHEMES

The project site is located within the Calliope Shire Planning Scheme’s Rural Locality; policies within this zone are superseded by the Gladstone State Development Area designation.

Gladstone’s City Council Planning scheme does not encompass the project site, however planning policies refer to the landscape values attributable to the coastal hinterland and reiterates the Curtis Coast Regional Coastal Management Plan’s requirement to ensure development is compatible with these values.



The classification of landscape character types is based on the identification of areas with similar visual characteristics in terms of topography, geological features, soil, vegetation, and land use. The following sections describe the underlying patterns of these elements to derive the landscape character types within the study area.

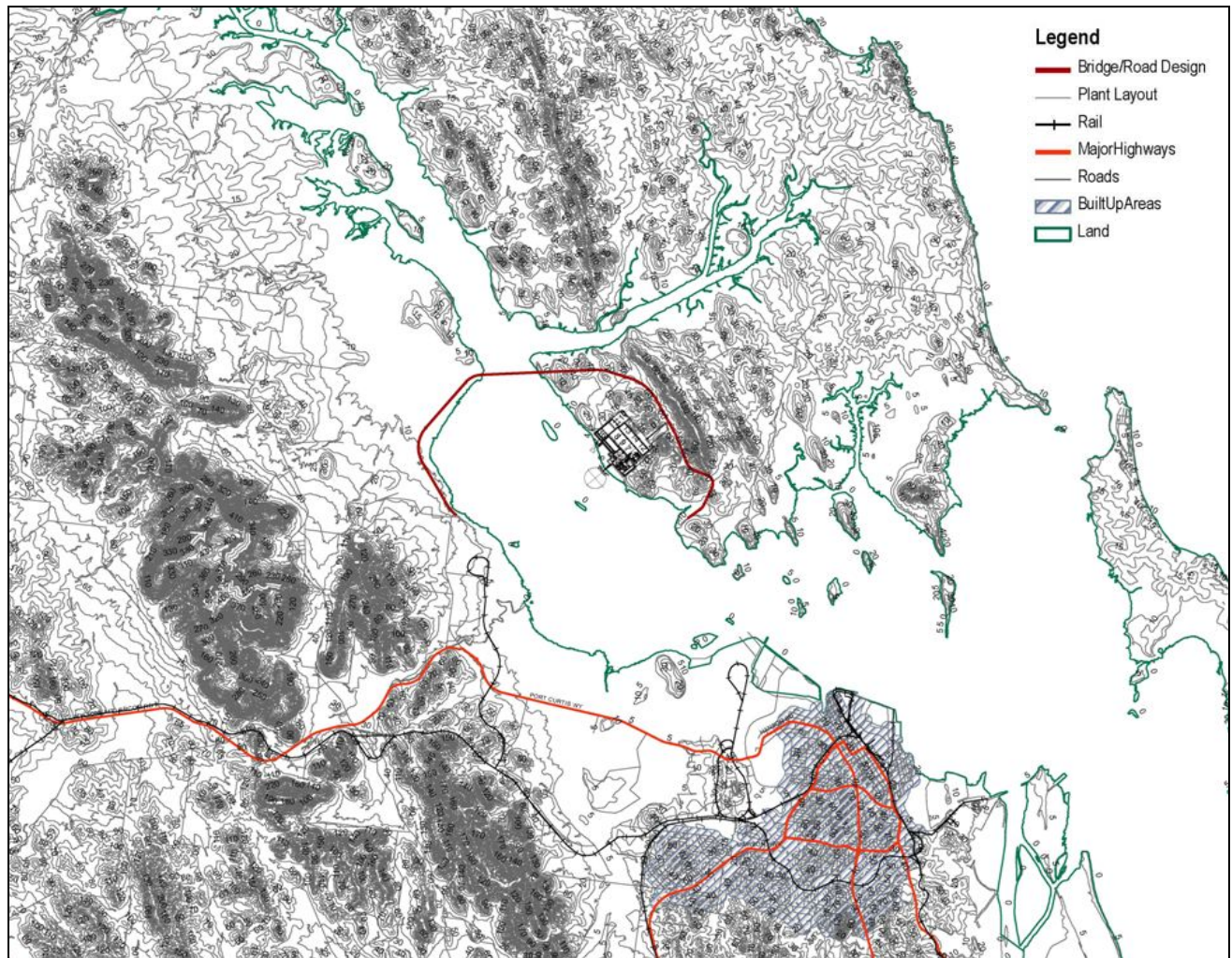
## **6.1**

### **TOPOGRAPHY**

The LNG Facility and proposed Curtis Island Bridge are located within Port Curtis at the transition zone between The Narrows passage landscape and the Port of Gladstone. At this section of Port Curtis the waterways are approximately 4km wide and framed to the west by the distinctive ridges and mountainous terrain of the Mount Larcom Ranges, and to the east by the undulating to hilly landform of Curtis Island. The Mount Larcom range provides a natural vegetated backdrop to the low lying alluvial coastal plains along Targinie foreshore areas which, although retaining some natural areas, are interspersed by large industrial complexes and reclaimed foreshore areas.

The undulating to hilly terrain predominant on Curtis Island has a number of linear strike ridges running along the length of the island. Ship hill located to the east of the site (170 AHD) is the southern tip of one of these ridges, which runs the entire length of the site. The coastal fringe in this south western section of the island comprises of a strip of low swampy coastal plains and mangrove flats extending north into Graham Creek and The Narrows channel.

Between Lairds Point and Friend Point the waters of Port Curtis narrows to form the entrance to The Narrows. The distinctive geological characteristics of The Narrows are recognised in the National Estate listing which identifies the tidal passage landscape between the mainland and Curtis Island, as 'uncommon' in Australia. This passage landscape is characterised by a complexity of waterways, fringing mudflats, mangroves, intertidal wetlands and salt marshes.



**Figure 6.1**      *Topography*

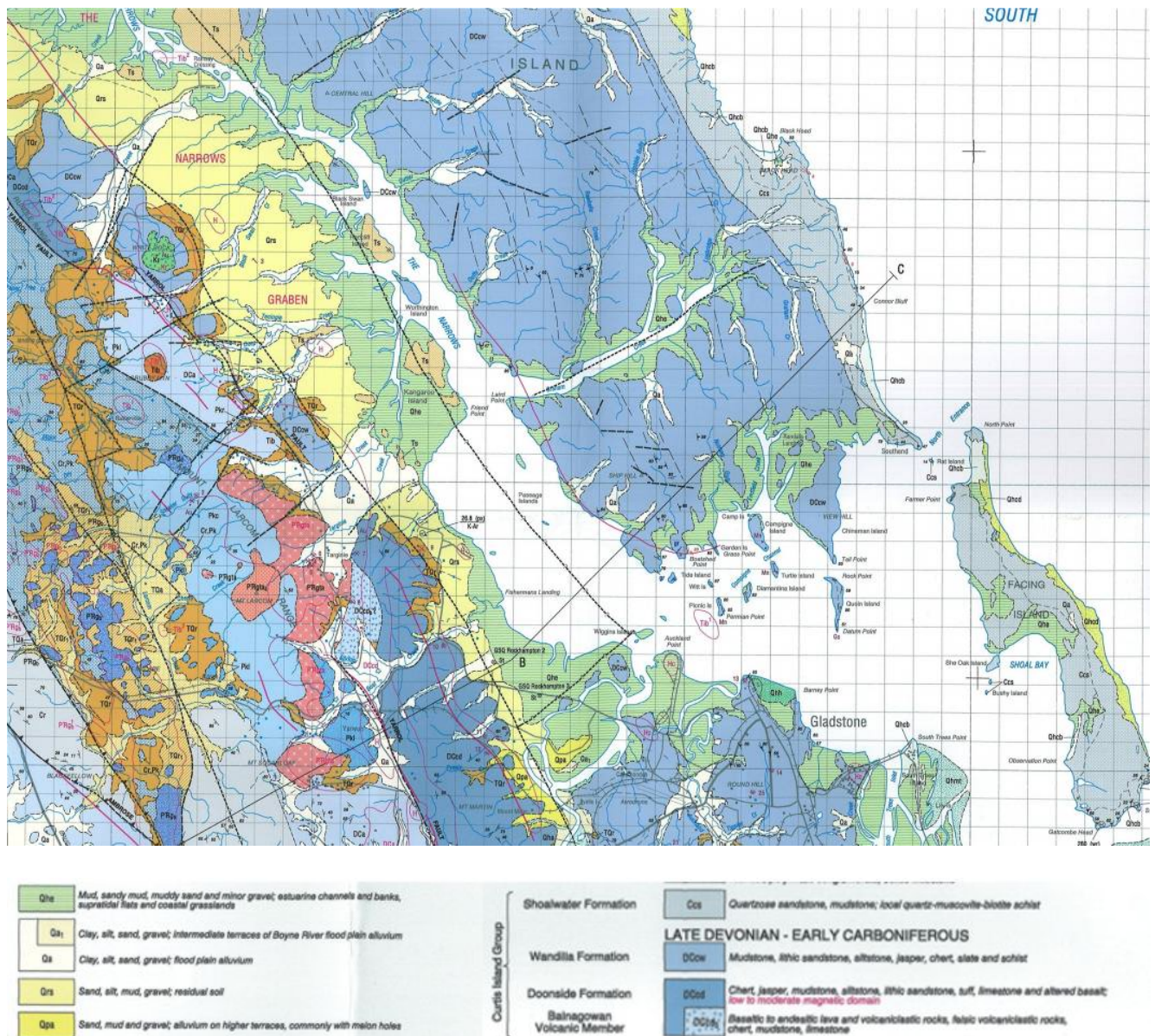
## 6.2      *GEOLOGY, SOILS AND DRAINAGE*

The main geological unit in the project area is the Wandilla Formation, which makes up the majority of Curtis Island and extends to the south through Gladstone. Wandilla Formation consists mainly of mudstones and arenite, with subordinate chert and minor limestone. Holocene sediments comprising of tidal flats and surficial alluvial material occur on the western margin of the site on Curtis Island and on the eastern shore at Friend Point.

Soils within the project site are grey sodosols, brown and red Chromosols. Inland there is a change to bleached silty surface, brown and grey, sodic duplex soils on the lower colluvial slopes.

Major drainage systems within the study area include: the Calliope River system, Sandy, Targine and Mosquito Creeks draining the mainland areas into Port Curtis; Graham Creek and smaller perennial water courses drain Curtis Island into Port Curtis and The Narrows. Many of these drainage systems enter the marine zone via intertidal to intratidal flats, which grade into mangroves and salt flats.





**Figure 6.2** *Geology of the Curtis Island region.*

### 6.3 **VEGETATION**

Vegetation across the study area largely consists of the native eucalyptus forests and woodlands of Curtis Island, fringing foreshore mangroves and saltpan vegetation of Port Curtis and The Narrows, and remnant and regrowth vegetation on the mainland. Whilst Curtis Island is predominantly a natural vegetated landscape, Targinie foreshore, Gladstone and Gladstone waterfront are predominantly industrialized landscapes. Natural vegetation occurs within the industrialised areas, however modification of the landscape is visually evident throughout the majority of the viewshed.

Vegetation within the south-western section of Curtis Island predominantly consists of *Corymbia citriodora*, *Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics on the hills, with patches of *Eucalyptus tereticornis* woodland to open forest on alluvial plains in low lying areas. Foreshore areas support Mangrove shrubland to low closed forest on marine clay plains and estuaries, with isolated patches of Saltpan vegetation including grassland and herbland on marine clay plains.

Similar vegetation types occur along Targinie foreshore.

The location of the tidal passage landscape in the '*zone of overlap and transition between tropical and temperate littoral vegetation communities*' further distinguishes the unique characteristics of The Narrows.

## 6.4 LAND USE

The proposed LNG Facility is located within the Curtis Island Industrial Precinct designated under the Gladstone State Development Area (GDSA). This area is currently covered by Eucalyptus woodland. Past land uses have included cattle grazing and timber harvesting. Since designation of the GDSA investigations for various future industrial projects within the precinct have commenced.

Land use in the Targinie areas includes; rural/agricultural uses interspersed by a significant number of heavy industrial complexes and associated infrastructure. Existing industries located within the Targinie area include: Alumina refineries, cement plants, LNG facilities, chemical storage, the Oil Shale plant, and Gladstone Power Station. Continued expansion of industry in this area is evident throughout the landscape including the reclamation of foreshore areas, such as the expansion of Fisherman's Landing. Reclamation works are also occurring to the north of the Calliope River as part of the proposed Wiggins Island Coal terminal. A large part of Targinie has been designated for further industrial and infrastructure expansion under the GDSA.

Land use in Gladstone and surrounding areas include urban, residential, industrial, infrastructure and marine uses. The urban areas of Gladstone are generally set-back from the waters of Port Curtis, with the Port of Gladstone waterfront forming a buffer between the town centre and the water. Gladstone City Centre is located on higher ground over-looking Gladstone marina, with urban and residential areas extending inland, including in some places across higher elevated land with views out across Port Curtis. Industrial/waterfront land use surrounding the city centre includes the RG Tanna Coal Terminal to the northwest, Auckland Point Wharf and the Barney Point industrial areas to the east.

Seven landscape character types have been identified within the study area, as follows:

- Eucalyptus woodlands/forest on undulating to hilly terrain;
- Mountainous hills and ridges;
- Undulating rural landscapes;
- Industrial landscapes;
- Urban landscapes;
- Estuarine Landscapes; and
- Waterways.

#### 6.5.1

##### *Eucalyptus woodlands/forest on undulating to hilly terrain*

Extensive areas of remnant native vegetation cover the south western section of Curtis Island and mainland areas to the west of The Narrows. Patches of remnant vegetation also remain in the Targinie area. This landscape type is characterised by gently undulating to hilly landform with Eucalyptus woodland/forest cover. Most of these areas, notably Curtis Island, have very few roads or tracks and therefore accessibility is limited. The extensive areas covered by this landscape type provide an important backdrop to the urban and industrialised areas of The Port of Gladstone.



**Photograph 6.1**

***Eucalyptus Woodland/Forest on Undulating to Hilly Terrain Landscape Character type***





**Figure 6.3** *Eucalyptus Woodland/Forest on Undulating to Hilly Terrain Landscape Character type*

Significant landscape values identified in the Curtis Coast Regional Coastal Management Plan include the coastal ranges of Curtis Island visible from the mainland. These large areas of remnant vegetation are generally uncommon at a regional scale as a result of clearing for agriculture. Large areas of intact indigenous vegetation also have significant associated biodiversity values, as well as high landscape values.

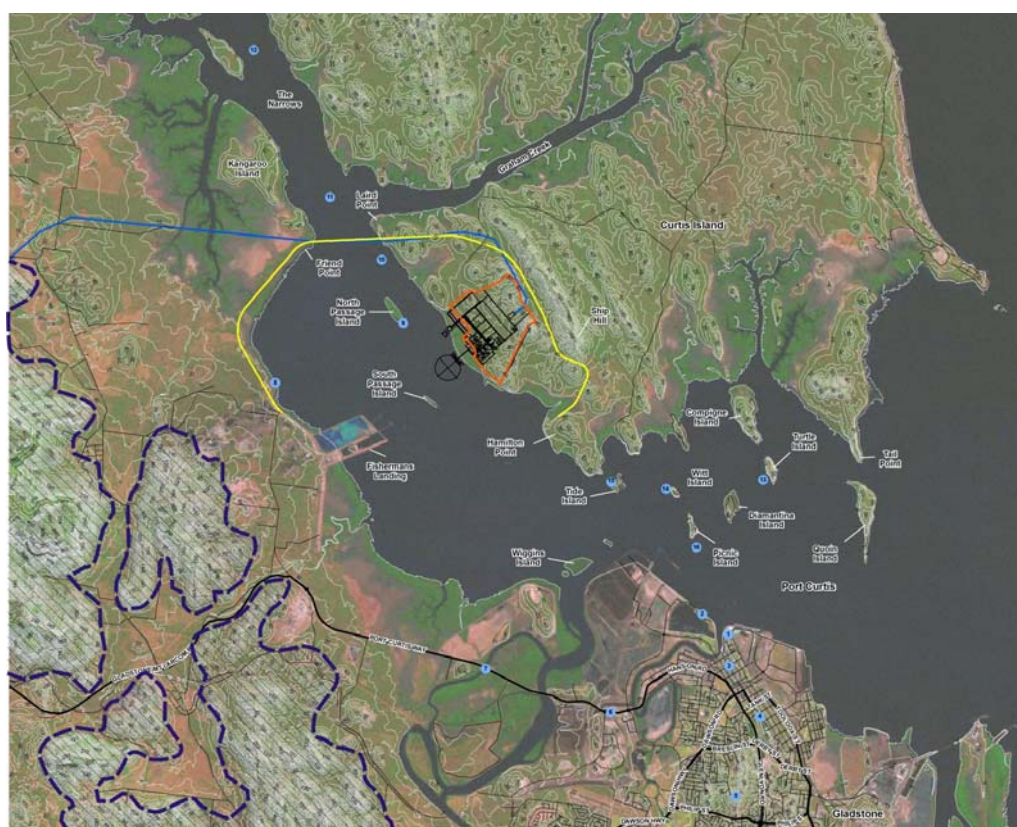
#### **6.5.2** *Mountainous hills and ridges*

The mountainous hills and ridges of the Mount Larcom ranges form a distinctive skyline to the west of the study area. This landscape type is characterised by very steep, to steep landform and generally covered by Eucalyptus woodland/forest, with some vine forest vegetation and rock outcrops forming distinctive peaks. The Mount Larcom ridgeline is visible throughout the study area and forms an important landscape feature from both the waterways of Port Curtis, The Narrows, and Gladstone's urban areas.

Significant landscape values identified in the Curtis Coast Regional Coastal Management Plan include the 'distinctive peaks such as Mt Larcom' identified as 'major contributors to scenic quality', and the strike range system on Curtis Island.



*Photograph 6.2 Mountainous hills and ridges*



**Figure 6.4**     *Mountainous hills and ridges*



### 6.5.3

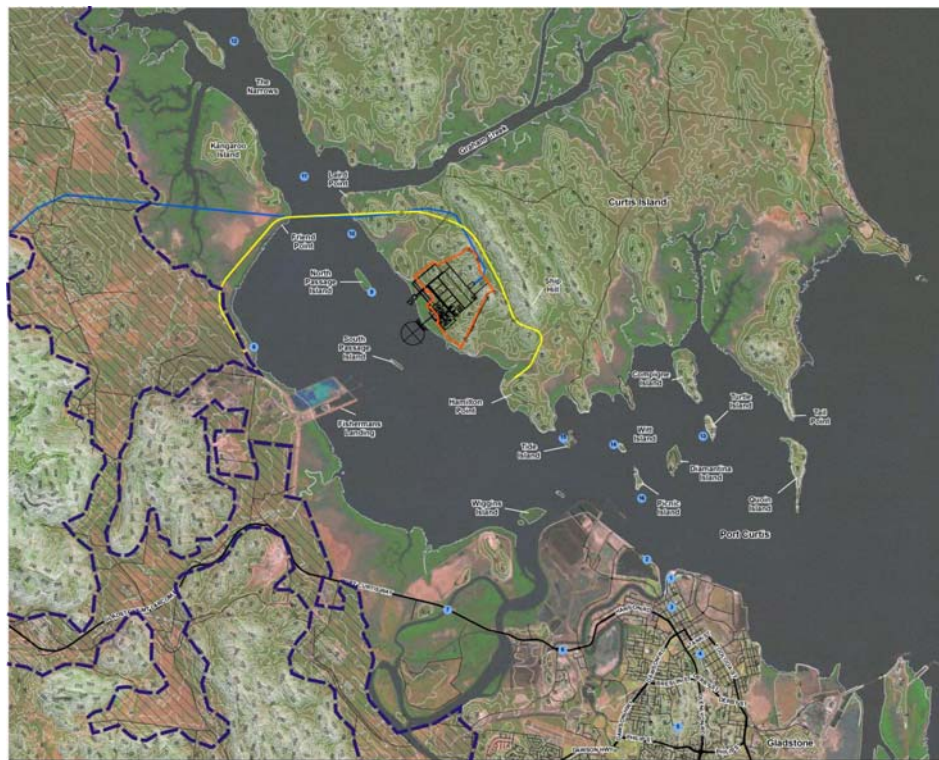
#### *Undulating rural landscapes*

Undulating rural landscapes are mainly located to the north of the Targinie industrial areas. Agricultural activities in these areas include low intensity cattle grazing and fruit production. The characteristics of these areas are generally dry grassland pastures with native tree cover, and the occasional orchard production area interspersed across the landscape.



*Photograph 6.3*

*Undulating rural landscape*



*Figure 6.5*

*Undulating rural landscape*

This landscape character type covers large areas of the region and generally displays evidence of man-modification. No significant landscape values are identified in the Curtis Coast Regional Coastal Management Plan. Rural landscapes often contain localised scenic values, however none have been identified in the Targinie area.

#### 6.5.4

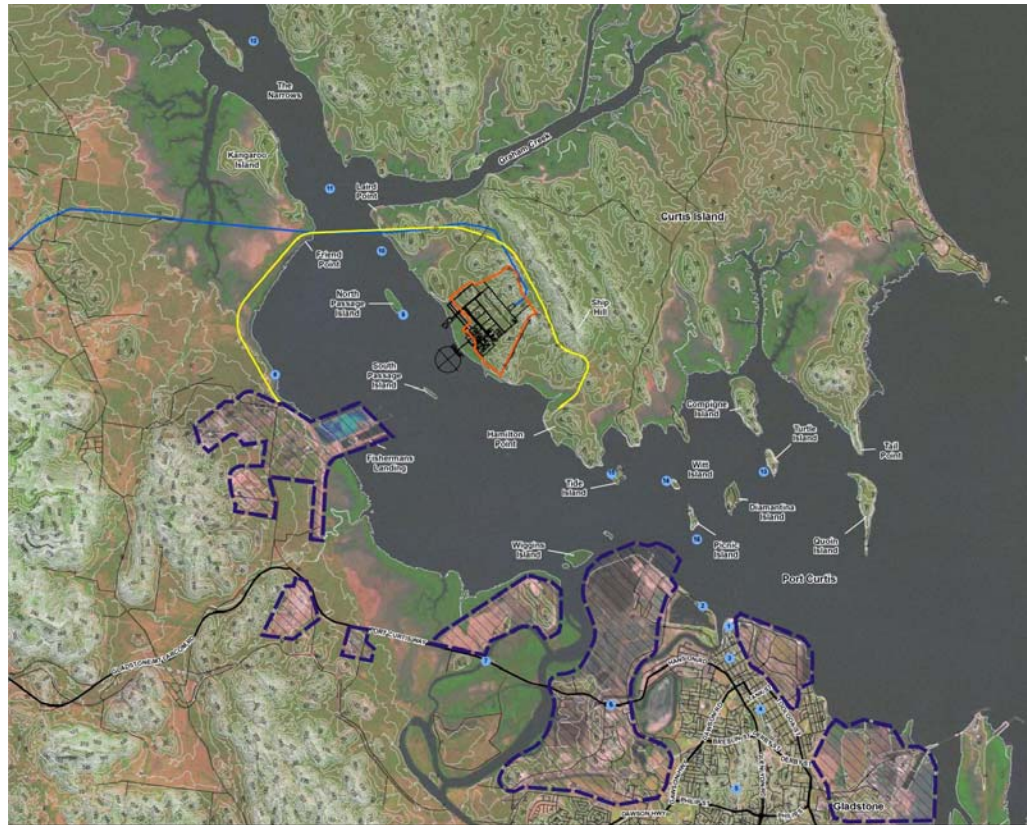
#### *Industrial landscapes*

The characteristics of the industrialised landscape in Gladstone and surrounding areas include; significant man-modification of the landscape, removal of vegetation, and large industrial structures (often extending above the skyline). Industries such as the Alumina refinery and Power Station include large stacks emitting gaseous waste into the atmosphere. The resultant visual impact on the landscape is both extensive and negative. Industrialised landscapes include reclaimed foreshore areas, such as Fisherman's Landing, which have created a distinctive change in the character of the Targinie shoreline.



*Photograph 6.4 Industrial Landscape*





**Figure 6.6** *Industrial Landscape*

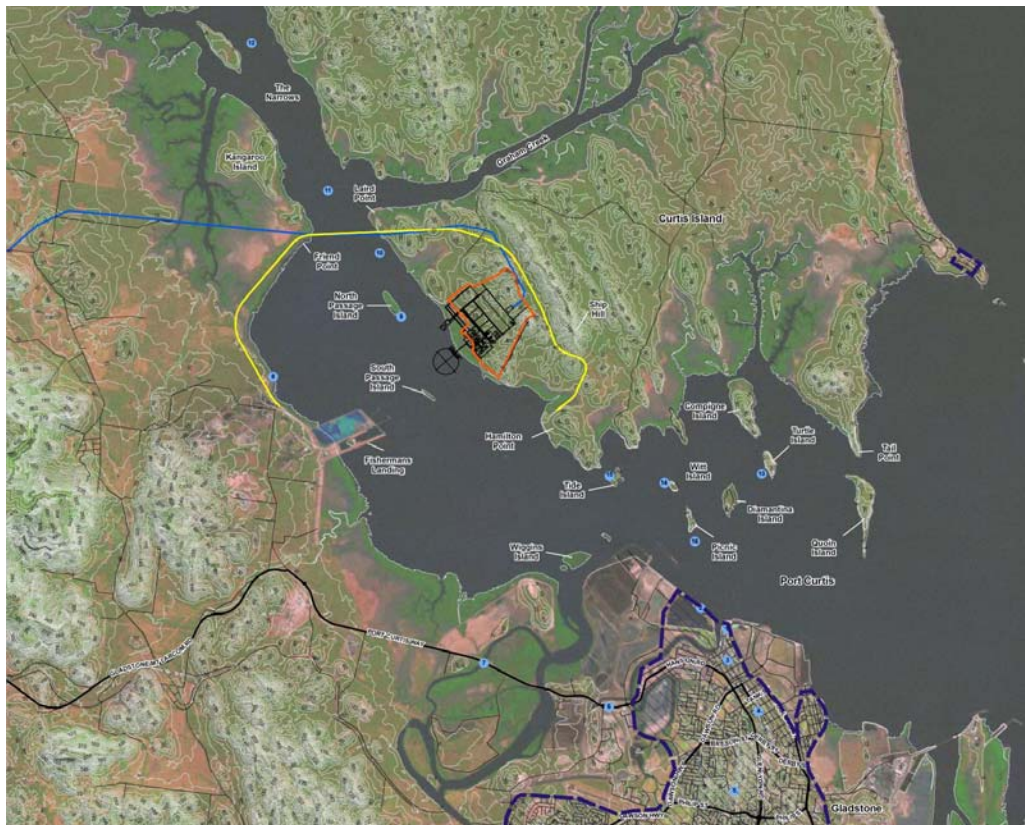
Industrial landscapes are highly modified and degraded landscape with little visual quality; these areas have low visual quality and are intrusive visual elements in the surrounding landscape.

#### **6.5.5** *Urban landscapes*

The urban centre of Gladstone is laid in a grid pattern across higher ground overlooking Auckland Inlet and Port Curtis. The urban grid creates axial views from the town centre across the landscape and, due to the elevated location of the city centre, these extend across the waters of Port Curtis to the islands beyond. This grid pattern, the elevation location, extensive views and relative low-rise development in Gladstone form part of the city's character. A distinctive feature of Gladstone is the close proximity of heavy industry and port facilities surrounding the city centre. The industrialised nature of the port is visually evident in most views from the city.



*Photograph 6.5 Urban Landscape*



*Figure 6.7 Urban Landscape*

Urban landscapes centred on the City of Gladstone are highly modified with moderate to low visual amenity.



#### 6.5.6

#### *Estuarine landscape*

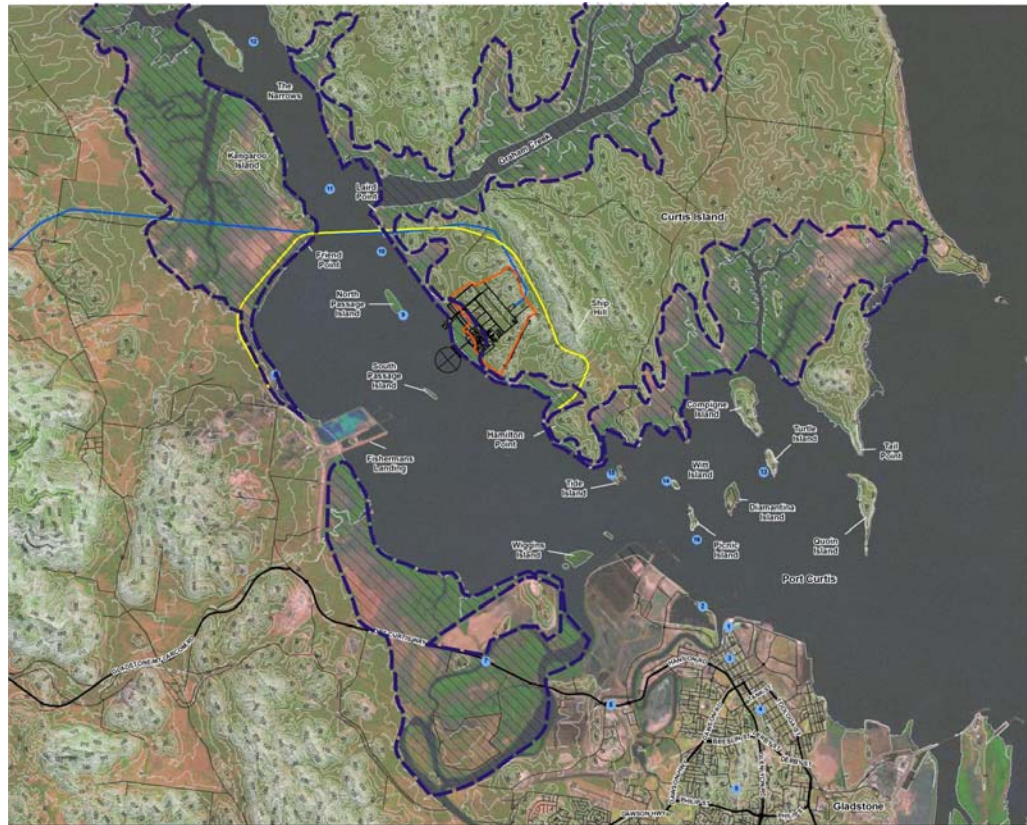
Estuarine landscapes form part of the natural coastal shoreline and vary in width from narrow edges of tidal mudflats and mangroves to wide expanses of mangrove shrubland, and coastal wetlands. Tidal mudflats are common along most foreshore areas, whilst these areas are flat with relatively little vegetation, they are integral to the character of the landscape. Tidal mudflats cover extensive areas to the north of the Calliope River through to Fisherman's Landing, and are also a feature of The Narrows landscape, notably north of Kangaroo Island.

Mangrove shrubland are also a common characteristic of the tidal waterways around Port Curtis and The Narrows. Mangrove vegetation generally grows in dense groups to an approximate height of 3 to 5m. These fringing Mangroves form a green edge to the waterways and are an important feature of the marine/terrestrial interface. Where the mangroves have been removed as a result of foreshore reclamation, such as Fisherman's Landing, the visual impact is significant in contrast to the surrounding natural shorelines.

Estuarine areas are classified in the CCRC Management Plan as having State Significance, *'contributing significantly to scenic quality and generally appreciated from boats, access points and elevated lookouts'*.



*Photograph 6.6 Estuarine Landscape*



**Figure 6.8** *Estuarine Landscape*

### 6.5.7 *Waterways*

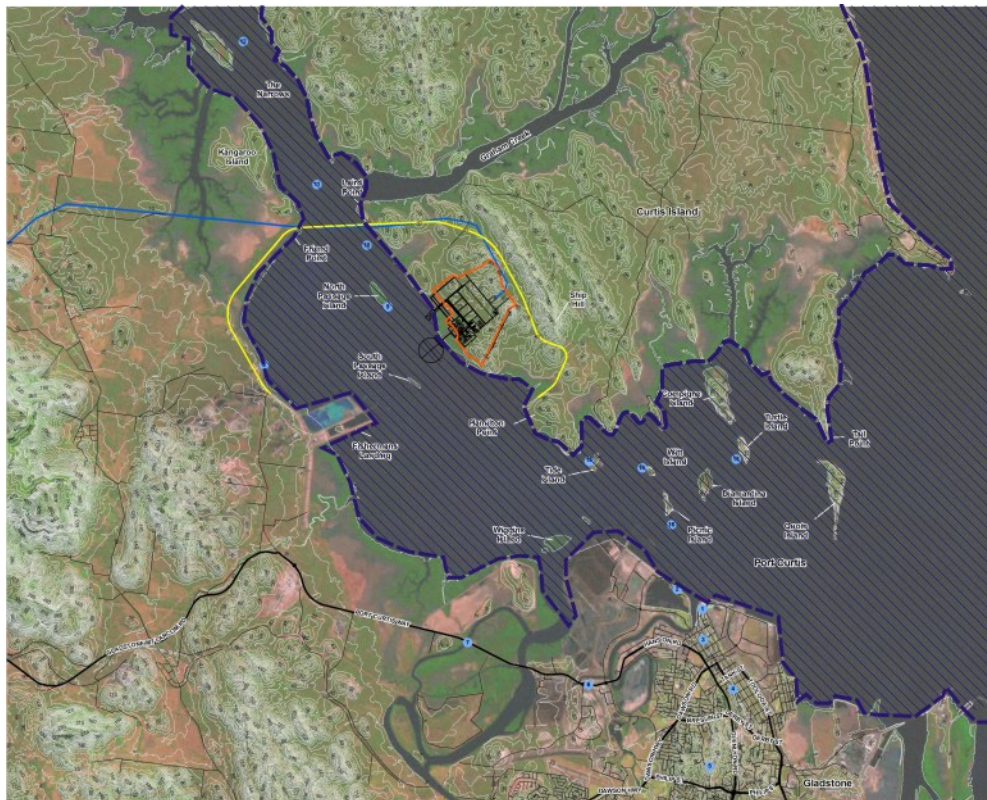
The visual enclosure created by Curtis Island and the Mount Larcom ranges provides a distinctive character to the waterways within the study area. This sense of enclosure combined with the fringing tidal vegetation and the large expanses of natural woodland extending across Curtis Island and north to The Narrows creates an area of high scenic quality. The significant scenic values of The Narrows contrasts with the industrialised nature of Gladstone and Targinie waterfronts.

The waterways include a number of small islands between Gladstone and the southern edge of Curtis Island. Several of these islands include private residences.





*Photograph 6.7*      **Waterways**



*Figure 6.9*      **Waterways**

Landscape sensitivity refers to the extent to which a landscape can accept change of a particular type and scale without unacceptable adverse effects to existing visual quality and landscape character. The extent to which a landscape can accept such change is dependent on both the physical characteristics of the landscape and the relative importance of the landscape values identified within each landscape character type.

Table 6.1 summarises the landscape sensitivity of the various landscape character types within the viewshed.

**Table 6.1**      *Landscape Sensitivity*

| Landscape character type                                                                     | Level of importance*                             | Scenic values*                                                                                                                     | Landscape sensitivity* |
|----------------------------------------------------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Eucalyptus woodlands/forests on undulating to hilly terrain                                  | State/Regional                                   | State significance in relation to Curtis Island and Regional significance in relation to the mainland areas                        | High                   |
| Mountainous hills and ridges                                                                 | State/Regional                                   | State Significance                                                                                                                 | High                   |
| Undulating Rural Landscape                                                                   | Local                                            | Low                                                                                                                                | Low                    |
| Industrial landscape                                                                         | None                                             | None                                                                                                                               | Low                    |
| Urban landscape                                                                              | None                                             | None                                                                                                                               | Low                    |
| Estuarine Landscapes                                                                         | International/<br>National and<br>State/Regional | When forming part of The Narrows:<br>international/national significance<br><br>Port Curtis areas –<br>State/regional Significance | High                   |
| Waterways                                                                                    | International/<br>National and<br>State/Regional | When forming part of The Narrows:<br>international/national significance<br><br>Port Curtis areas –<br>State/regional Significance | High                   |
| * Refer Section 5 for criteria for assigning landscape sensitivity and scenic amenity values |                                                  |                                                                                                                                    |                        |

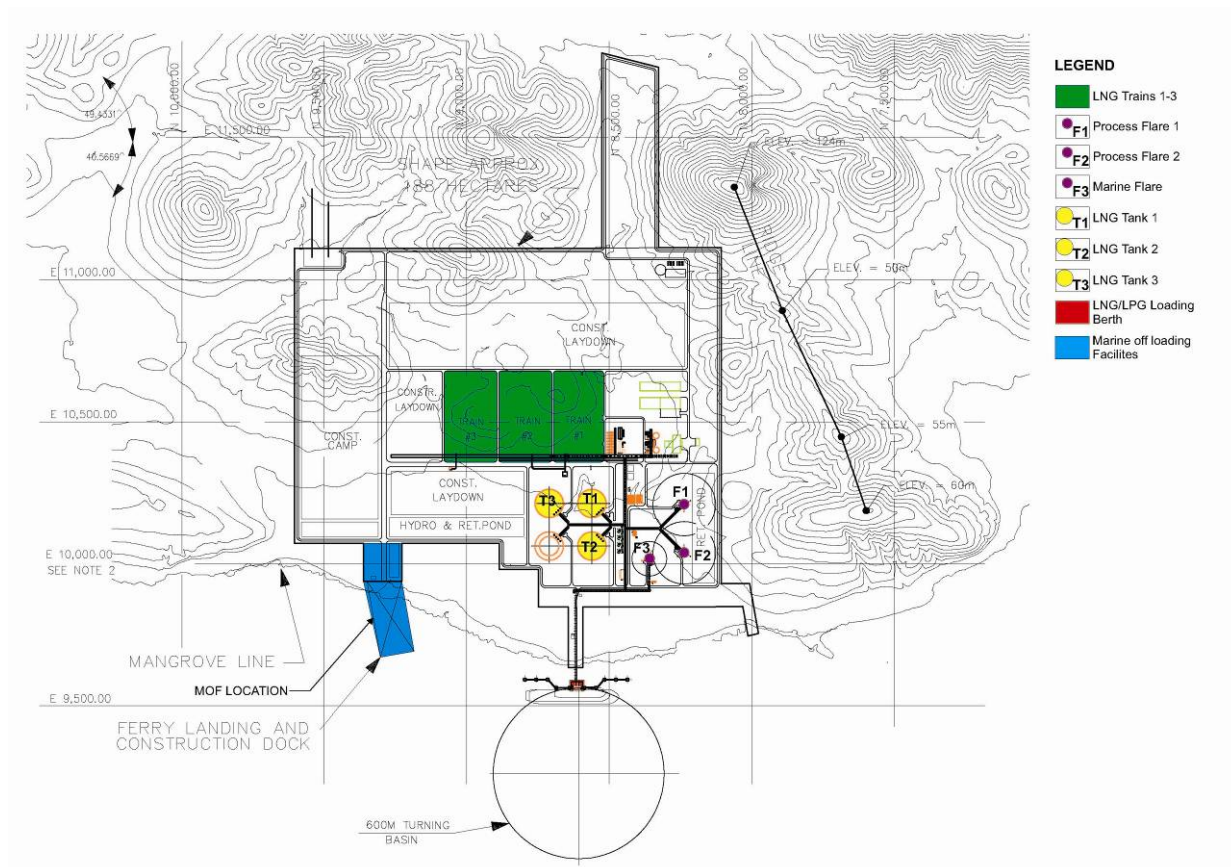
The Seen Area Analysis has been undertaken based on the main structural elements for the project; the LNG Facility and the Curtis Island Bridge. These have been assessed for their potential visibility as separate entities and in combination. The LNG loading berth has also initially been assessed as a separate entity in order to evaluate the visibility of the marine based structures of the LNG processing facilities in comparison to the potential visibility of the main core LNG Facility areas. The results of the GIS mapping for each element and the combined outcomes are presented below.

### 7.1

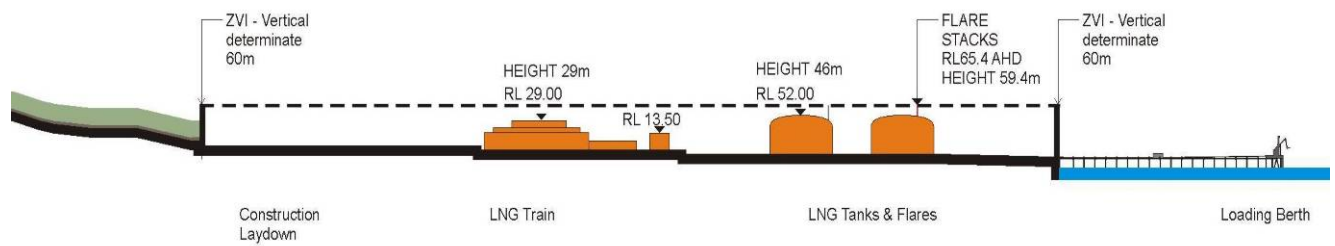
#### AREAS FROM WHICH THE LNG FACILITY ARE POTENTIALLY VISIBLE

The main structural elements used to assess the visibility of the proposed LNG Facility on Curtis Island are shown in *Figures 7.1a & 7.1b* and detailed below:

- LNG Flare stacks (2) at 59.4 m high (RL 65.4 AHD),
- LNG tanks three (3) at 46m high (RL 52 AHD) and 92m diameter
- LNG trains - Refrigeration Compressor Turbine Stacks (3) at 29m high (RL 40 AHD).



**Figure 7.1a** Parameters for the LNG Facility visibility assessment - Plan



**Figure 7.1b** Parameters for the LNG Facility visibility assessment - Section

Figure 7.2 shows the GIS based mapping of visibility of the LNG Facility. These zones represent the number of structural elements potentially visible, where dark blue represents the greatest number of elements visible, through light blue representing the least number of structures visible.

The pattern of potential visibility across the views shed correlates to the landform. Assessment of the mapping identifies the following key findings:

- The zone of greatest potential visibility of the LNG Facility is the adjoining waterways and channel running northwest to southeast through the study area;
- The linear ridge to the east of the project site extending north from Ship Hill effectively blocks views towards the proposed LNG Facility from the Curtis Island Environmental Management Precinct and the settlement of South End to the east;
- The LNG Facility is not visible from Curtis Island National Park due to the distance from the project site and intervening topography;
- The majority of the LNG Facility will not be visible from the waters of The Port of Gladstone and the outlying islands in this area. The tallest element of the project (Flare Stacks) may be visible and more detailed assessment of this potential visibility is contained in Section 9 of this report;
- The majority of Gladstone's urban areas will not have views of the proposed LNG Facility. Localised patches of potential visibility are located on elevated ground around Radar Hill and residential areas to the west. The distance from these areas to the proposed LNG Facility is approximately 11 km and therefore outside the distance at which the tallest element in the proposed plant will be visually significant (refer Section 7);
- Port Curtis Way and Targinie foreshore have a high potential visibility of the proposed LNG Facility;
- The proposed road along Targinie foreshore will have a high potential visibility of the proposed LNG Facility;

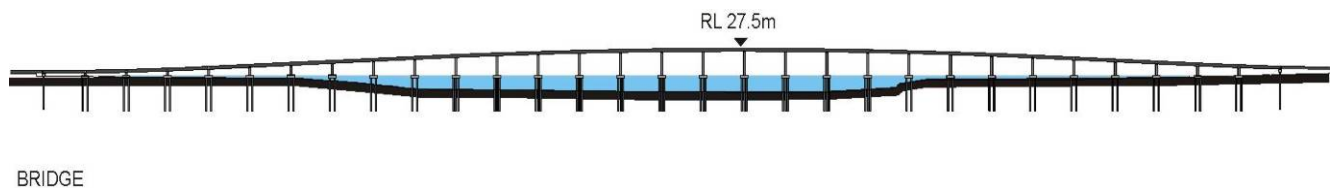


- The hills and ridges of the Mount Larcom ranges block all views of the proposed project to the west of the study area;
- Potential visibility of the LNG Facility extends north along the low lying land adjoining The Narrows; and
- The tallest elements of the LNG facility are potentially visible from The Narrows channel, however the visual influence of these elements in the landscape is likely to only effect the 'entrance' to the channels as distances from the entrance north exceeds the 7 km sphere of visual significance.

## 7.2 *AREAS FROM WHICH THE PROPOSED CURTIS ISLAND BRIDGE IS POTENTIALLY VISIBLE*

The main structural elements used to assess the visibility of the proposed Curtis Island Bridge are indicated in *Figure 7.3*

- Maximum height of the proposed bridge is 27.5m; and
- Overall length 1500m.



**Figure 7.3** *Parameters for the proposed Curtis Island Bridge visibility assessment - section*

*Figure 7.4* shows the GIS based mapping of visibility of the proposed bridge. Since the proposed bridge and approach road are relatively simple structures in comparison to the proposed plant, only potential visible or not visible zones have been identified.

The pattern of potential visibility across the viewshed for the proposed bridge has been mapped and the following key findings identified:

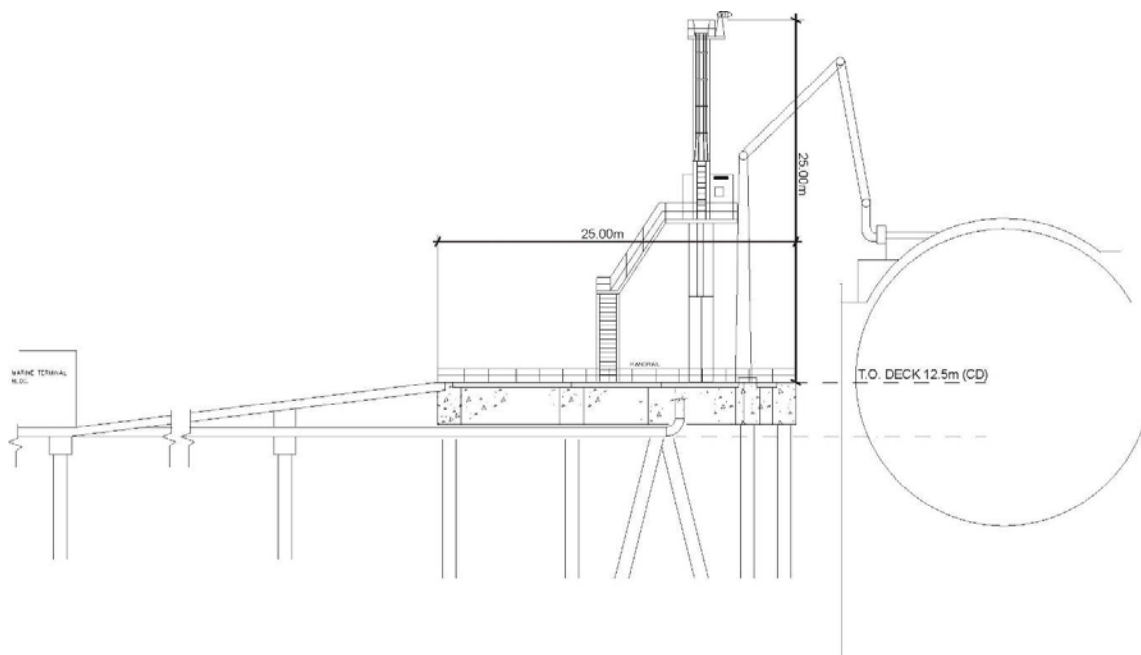
- The zone of greatest potential visibility of the proposed bridge is similar to the LNG Facility, in that it extends in a northwest to southeast direction, consistent with the alignment of the channel and ridgelines;
- Visibility of the proposed bridge from Curtis Island is limited to the immediate shoreline and extending along Graham Creek. Potential views from ridgelines on Curtis Island within close proximity to the site maybe possible, however these locations are not accessible to the public;
- The proposed bridge is not visible from Curtis Island National Park due to the distance from the project site and intervening topography;

- Areas of potential visibility are indicated as extending northeast along the visual sightline of Graham Creek to the eastern side of Curtis Island. This is unlikely given the height of the bridge relative to the height of adjoining vegetation which has not been included in the model. This area is also well outside the extent of visual influence and therefore will not be significant;
- The proposed bridge will not be visible from the waters north of The Port of Gladstone and the outlying islands in this area;
- The majority of Gladstone's urban areas will not have views of the proposed bridge. In addition areas which may have views will not be significantly impacted by the proposed bridge due to the distance which exceeds 10km;
- Port Curtis Way may potentially have views of the proposed bridge, however as a result of the relatively low profile of the bridge at this distance the impact will not be visually significant;
- The hill and ridges of the Mount Larcom ranges block all views of the proposed project to the west of the study area;
- Few areas of Targinie will have views of the bridge with the exception of the shoreline;
- The Targinie shoreline will have views of the approach road and bridge; and
- The location of the bridge spanning the entrance to The Narrows, will have a visual impact on The Narrows passage landscape within the immediate vicinity of the bridge. However the visual influence of the bridge on the passage landscape is likely to only affect the 'entrance' to the channels and will not be visually significant beyond the 3.2 km sphere of visual influence.

### 7.3

#### ***AREAS FROM WHICH PROPOSED LNG LOADING BERTH IS POTENTIALLY VISIBLE***

The potential visibility of the LNG loading berth has been assessed as a separate entity due to the visually more exposed location of the marine section of the LNG Facility extending into Port Curtis. The main structural elements used to undertake the assessment are indicated in *Figure 7.5*



**Figure 7.5** *Parameters for the proposed LNG loading berth visibility assessment*

Figure 7.6 shows the GIS based mapping of visibility of the LNG loading berth. Since the proposed LNG loading berth is a relatively simple structure only potential visible or not visible zones have been identified.

The pattern of potential visibility across the ZVI for the proposed LNG loading berth has been mapped and the following key findings identified:

- Potential visibility is very similar to other elements of the LNG Facility indicating the loading berth is not significantly more visible than the other land based elements of the LNG Facility; and
- The location of the loading berth extending into the waters of Port Curtis increases the visibility of the LNG Facility from the waters north of The Narrows passage entrance. This visibility is unlikely to be significant as a result of the distance to The Narrows entrance which exceeds the zone of visual influence at which the loading berth will have any significant visual influence.

#### **7.4** *AREAS FROM WHICH BOTH THE LNG FACILITY AND PROPOSED CURTIS ISLAND BRIDGE ARE POTENTIALLY VISIBLE*

The combined visibility mapping of the LNG Facility and The Curtis Island Bridge is shown in Figure 7.7

The combined mapping of potential visibility across the viewshed confirms the areas of greatest potential visibility include the waters of Port Curtis and The Narrows immediately adjacent to the proposed LNG Facility and the bridge. Targinie foreshore and areas extending inland to a distance of

approximately 5km also potentially have views of both structures. However the screening potential of vegetation within these areas is likely to significantly reduce this visibility.

The linear ridgeline located to the east of the site effectively blocks all views of both the LNG Facility and the bridge from the majority of Curtis Island.

Some areas of Gladstone potentially have views of both elements of the project, however the distance between the project and Gladstone rendered these structures relatively insignificant.

## 7.5

### *SUMMARY OF THE VISIBILITY ANALYSIS*

The preceding visibility analysis shows that within a 7km radius of the proposed LNG Facility (the approximate distance at which the tallest LNG structures becomes potentially noticeable in the landscape), the main areas of visibility comprises of the waters of Port Curtis, The Narrows, Targinie foreshore, and the industrialised waterfront land of Gladstone. Within 4.2 km of the site, (the approximate distance at which the tallest of the project structures becomes visually evident and can dominate the landscape), potential visibility of the project is reduced to the waters of Port Curtis, the entrance to The Narrows, and only a section of Targinie Foreshore, in particular Fisherman's Landing and the shoreline extending to Friend Point (the proposed route of the approach road to The Curtis Island Bridge).

The GIS mapping confirmed the proposed project will not be visible from the majority of Curtis Island due to the linear ridgeline running along the boundary of the Curtis Island Industrial Precinct and protecting the Curtis Island Environmental Management Precinct from visual impact to the east.

The mapping also confirmed the majority of Gladstone's urban areas will not have views of the project and any potential views will not be significantly impacted due to the distance from the proposed project.

These findings have been further tested on site through the selection and assessment of publicly accessible viewpoints.



- Legend**
- Structure Locations
  - Bridge/Road Design
  - Plant Layout
  - Rail
  - Major Highways
  - Roads
  - Built Up Areas
  - Land
- Seen Area Analysis of Tanks, Flares and Train Stacks**
- No Structures Visible
  - 1 - 5 Structures Visible
  - 6 - 10 Structures Visible
  - 11 - 15 Structures Visible
  - 16 - 20 Structures Visible
  - 21 - 24 Structures Visible



Source Note:  
Source: Mapinfo Pty Ltd

Figure 7.2

Visibility of Plant Tanks, Flares  
and Train Stacks

|              |                               |
|--------------|-------------------------------|
| Client:      | QGC                           |
| Project:     | Queensland Curtis LNG Project |
| Drawing No:  | 0086165s_VA_GIS010_R0         |
| Date:        | 09/03/2009                    |
| Drawn by:    | JF                            |
| Reviewed by: | SC                            |

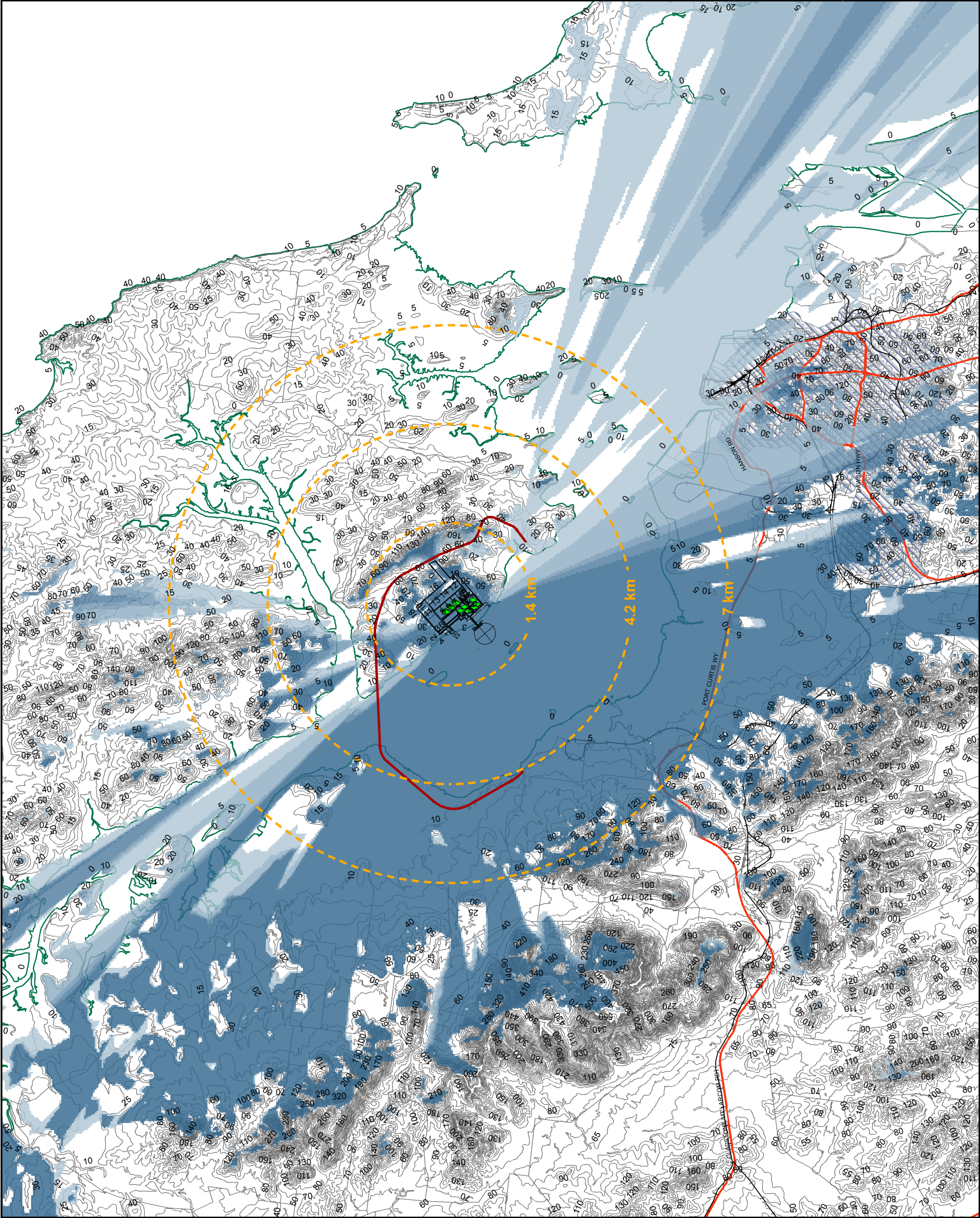


Scale: 1:100,000

Projection: UTM MGA Zone 56  
Datum: GDA94

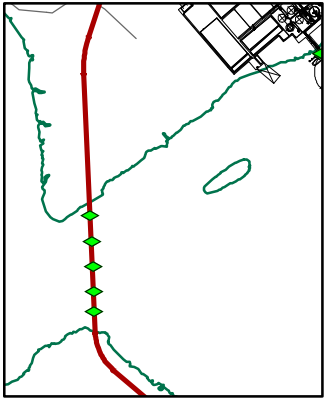
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- Legend**
- Narrows Bridge Observer Points
  - Bridge/Road Design
  - LNG Facility Layout
  - Rail
  - Major Highways
  - Roads
  - Built Up Areas
  - Land
  - Visibility of Curtis Island Bridge
  - Not Visible
  - Visible



Source Note:  
Source: Mapinfo Pty Ltd

Figure 7.4

Visibility of Curtis Island Bridge

|              |                               |
|--------------|-------------------------------|
| Client:      | QGC                           |
| Project:     | Queensland Curtis LNG Project |
| Drawing No:  | 0086165s_VA_GIS009_R0         |
| Date:        | 09/02/2009                    |
| Drawn by:    | JF                            |
| Reviewed by: | SC                            |

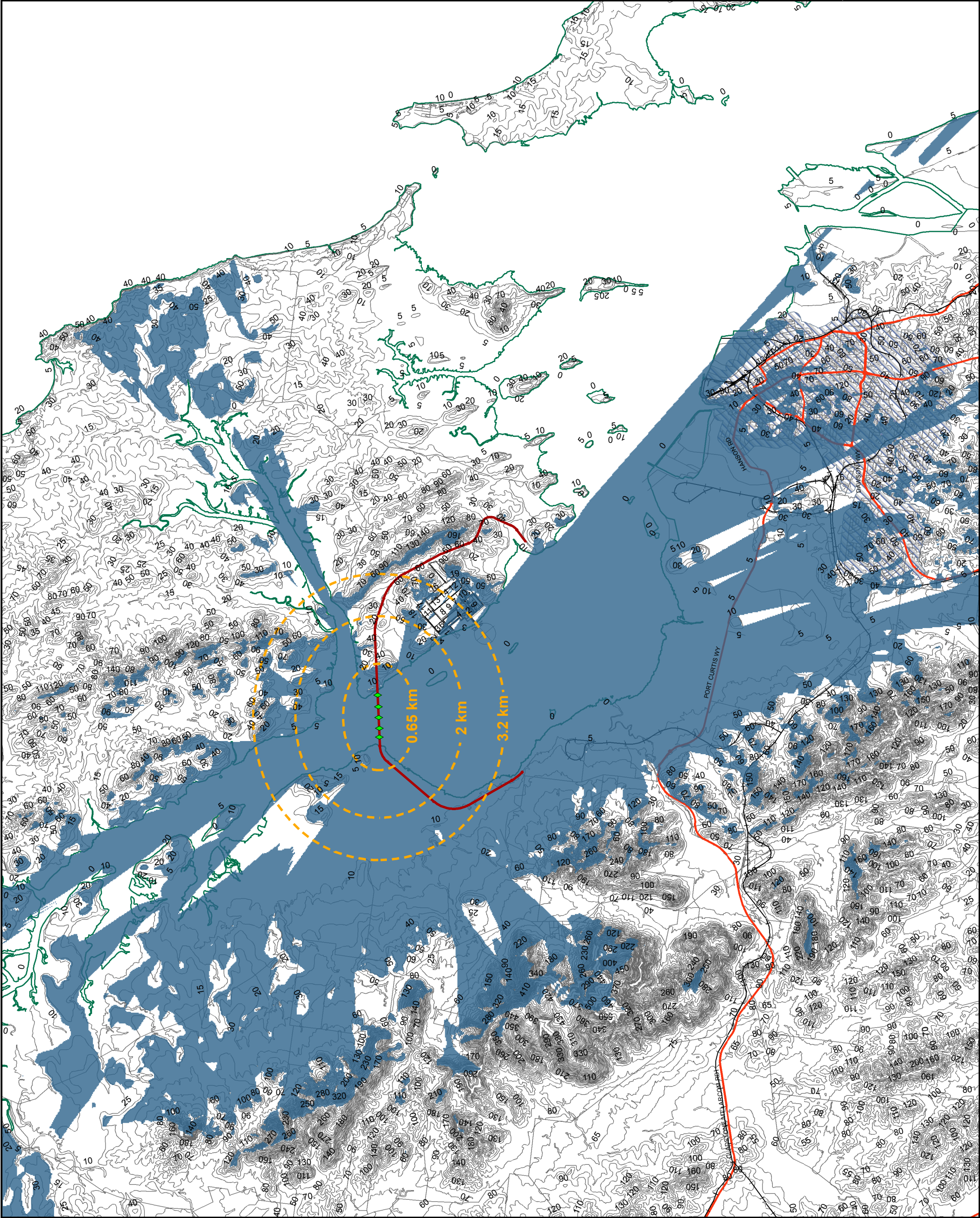


Scale: 1:100,000

Projection: UTM MGA Zone 56 Datum: GDA94

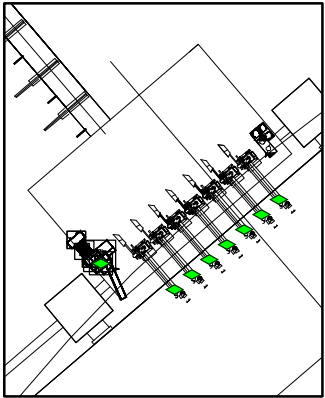
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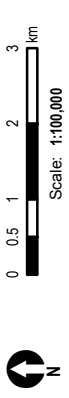
- Legend**
- Loading Arms and Fire Monitor
  - Bridge/Road Design
  - Plant Layout
  - Rail
  - Major Highways
  - Roads
  - Built Up Areas
  - Land
  - Visibility of Loading Arms and Fire Monitor
  - No Structures Visible
  - 1 - 8 Structures Visible



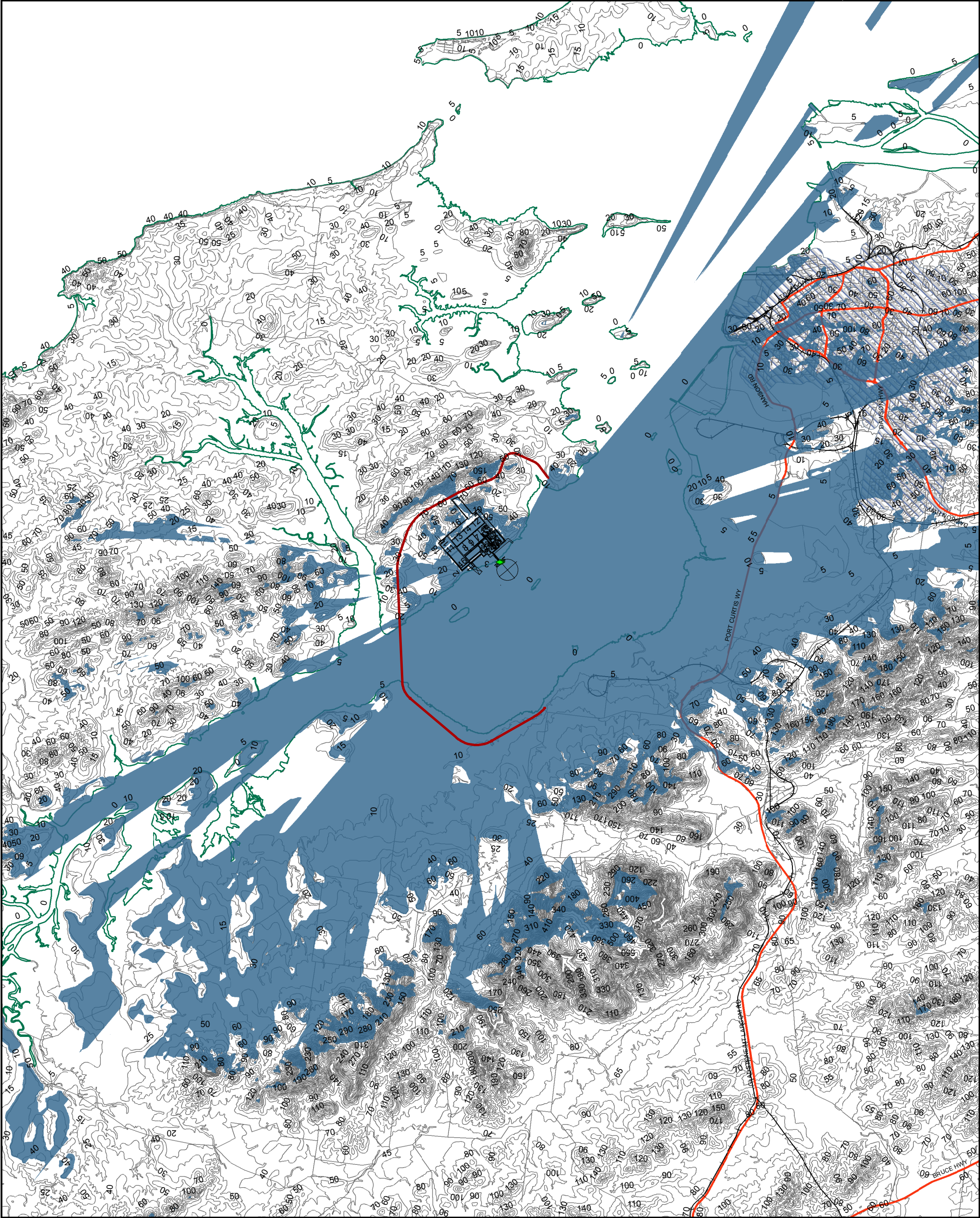
Source Note:  
Source: MapInfo Pty Ltd

**Figure 7.6**  
**Visibility of LNG/LPG Loading Berth**

|              |                               |
|--------------|-------------------------------|
| Client:      | QGC                           |
| Project:     | Queensland Curtis LNG Project |
| Drawing No:  | 0086165s_VA_GIS015_R0         |
| Date:        | 09/02/2009                    |
| Drawn by:    | JF                            |
| Reviewed by: | SC                            |

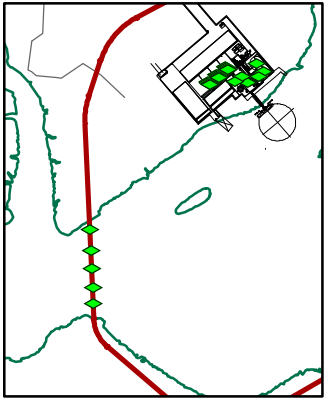


Projection: UTM MGA Zone 56  
Datum: GDA94  
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- Legend**
- Structure Locations
  - Bridge/Road Design
  - LNG Facility Layout
  - Rail
  - Major Highways
  - Roads
  - Built Up Areas
  - Land
  - Combined Visibility of Plant and Bridge
  - No Components Visible
  - 1 Component Visible
  - 2 Components Visible



Source Note:  
Source: MapInfo Pty Ltd

Figure 7.7

Visibility of LNG Facility and Bridge

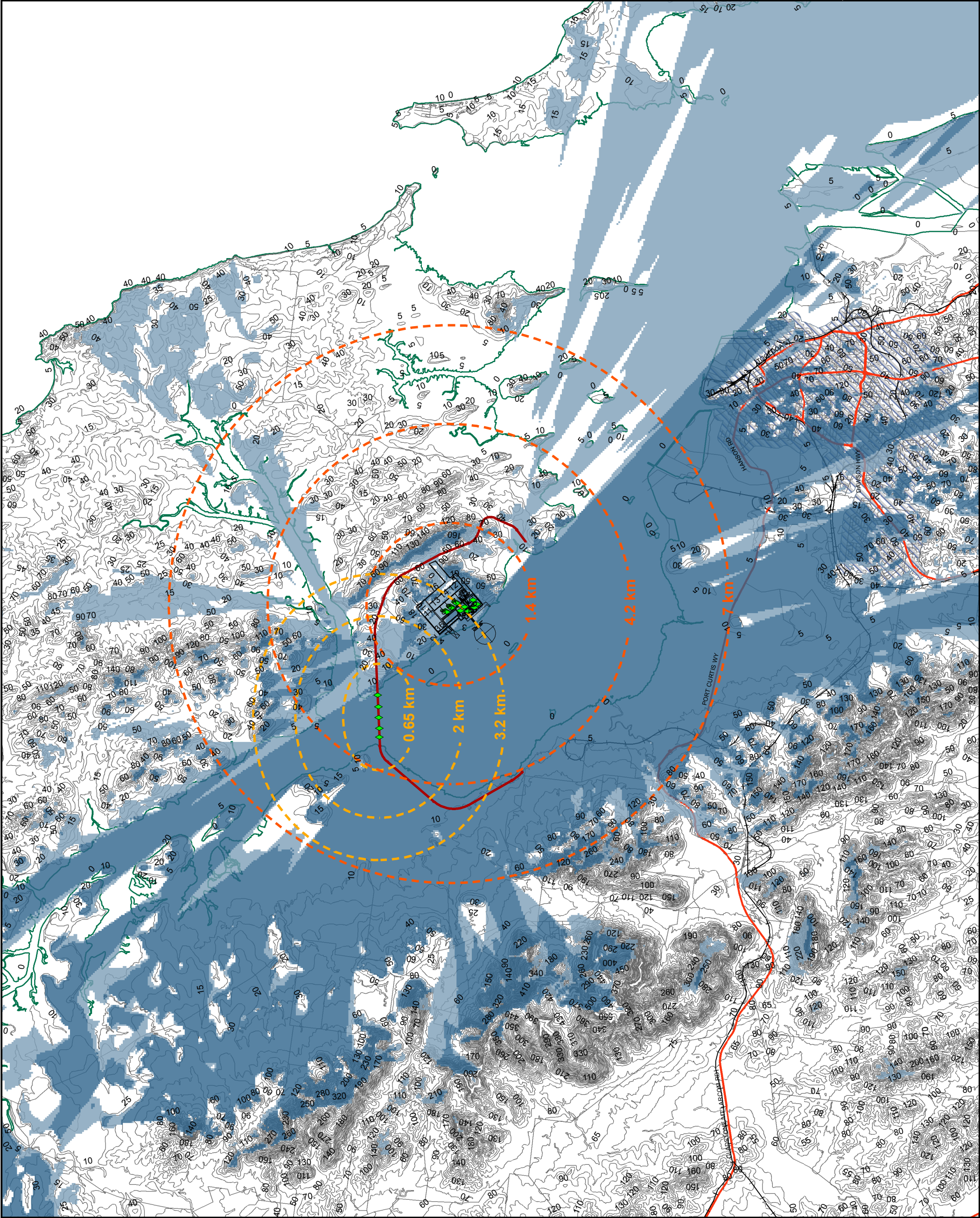
|              |                               |
|--------------|-------------------------------|
| Client:      | QGC                           |
| Project:     | Queensland Curtis LNG Project |
| Drawing No:  | 0086165s_VA_GIS012_R0         |
| Date:        | 09/02/2009                    |
| Drawn by:    | JF                            |
| Reviewed by: | SC                            |



Scale: 1:100,000  
Datum: GDA94  
Projection: UTM MGA Zone 56

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## ASSESSMENT OF VISUAL IMPACT FROM PUBLICLY ACCESSIBLE VIEWPOINTS IN GLADSTONE AND SURROUNDING AREAS

The selection of publicly accessible viewpoints provides representative views of the LNG Facility, The Curtis Island Bridge, and approach road, from publicly accessible locations within the viewshed. The selected viewpoints include all public lookouts within Gladstone with views northwards towards the project site. Views were also assessed from publicly accessible roads in Gladstone and the Targinie area. The viewpoints selected represent a reasonable range of views upon which to evaluate the likely visual impact of the proposed project on public viewpoints. This analysis also assessed the landscape character and visual quality within the viewshed and its capacity to absorb the potential visual changes proposed by the project both during construction and operation.

Sixteen viewpoint locations were selected as representative of the project impacts, eight (8) viewpoints from mainland locations and eight (8) locations on the adjoining waterways, refer *Figures 8.1* and *9.1*. The following viewpoints locations were undertaken for Gladstone and surrounding areas:

|            |                        |            |                                   |
|------------|------------------------|------------|-----------------------------------|
| <b>VP1</b> | Auckland point Lookout | <b>VP5</b> | Round Hill Lookout                |
| <b>VP2</b> | Spinnaker Park         | <b>VP6</b> | Port Curtis Highway               |
| <b>VP3</b> | Goondoon St. Gladstone | <b>VP7</b> | Port Curtis Way at Calliope River |
| <b>VP4</b> | Radar Hill             | <b>VP8</b> | Targinie Foreshore                |



**Figure 8.1** *Selected Viewpoints from publicly accessible locations in Gladstone and Surrounding areas*

## 8.1

### VIEW POINT 1 – AUCKLAND POINT

Viewpoint 1 is located at Auckland Point Lookout with views over The Port of Gladstone and the islands of Port Curtis to Curtis Island in the background. Foreground views are dominated by industrial and port facilities, with Gladstone Marina to the west.

The Narrows passage can be seen extending to the horizon in the west, beyond the existing coal loading facilities of the RG Tanna Coal Terminal.

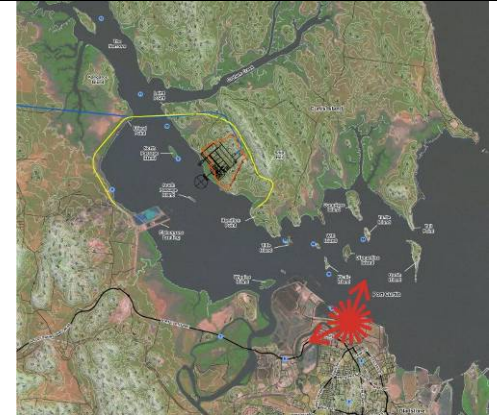
Views of the site for the proposed QCLNG Facility on Curtis Island are not visible. It is just possible to discern the entrance to The Narrows from this location, however at 14km away visibility is limited.

VP1 N7363104.9 E322160.8

Elevation: 33m AHD

Distance from viewpoint to project:

- LNG Facility 8.5km (approx)
- Curtis Island Bridge 14km (approx)



*Photograph 8.1 Auckland Point Lookout*



*Photograph 8.2 View looking northeast from Auckland Point Lookout*



**Photograph 8.3** *Enlargement of view looking towards project site with Coal terminal port facilities in the middle ground.*

The landscape character types within the viewshed are mainly waterways with foreground areas dominated by industry and urban land uses. Across the skyline are the mountainous ridges of Mount Larcom and linear strike ridges of Curtis Island. The scenic values of Curtis island as identified in the State Significant Coastal landscapes policy '*providing a strong structural element to the landscape and defining the seaward edge of the coastal viewshed*' is clearly evident from this viewpoint. In contrast to the aesthetic qualities of the 'natural' landscape in the background, foreground views are dominated by port industrial facilities that extend east to west along the waterfront. In addition, the Targinie foreshore is punctuated with industrial facilities spread across the coastal fringe and hinterland areas.

Views of the proposed QCLNG Project from this location will largely be screened by intervening topography and vegetation to the southeast of the site, including Hamilton Point. The proposed Curtis Island Bridge at 14 km from this location may be visible during clear weather, however this visibility will be limited to a thin line on the horizon with no discernable impact on the visual quality of The Narrows landscape from this location. The magnitude of change in the landscape from this vantage point is therefore negligible as a result of the limited potential visibility and distance exceeding the zone at which the project is visually noticeable.



**Viewpoint 1.** *Summary of visual impact from Viewpoint 1*

| Item                                               | Description         | Evaluation (Construction)        | Evaluation (Operation)           |
|----------------------------------------------------|---------------------|----------------------------------|----------------------------------|
| Landscape sensitivity                              | High                | High                             | High                             |
| Viewer numbers                                     | High                | High                             | High                             |
| Distance to nearest project structures             | Approx. 8.5km south | Low                              | Low                              |
| Visibility of the project structure (LNG Facility) | Limited             | Low                              | Low                              |
| Visibility of the project structure (Bridge)       | Limited             | Low                              | Low                              |
| Magnitude of change (LNG Facility)                 | Negligible          | Negligible                       | Negligible                       |
| Magnitude of change (bridge)                       | Negligible          | Negligible                       | Negligible                       |
| <b>Overall significance of the visual impact</b>   |                     | <b>LNG Facility - Negligible</b> | <b>LNG Facility - Negligible</b> |
|                                                    |                     | <b>Bridge - Negligible</b>       | <b>Bridge - Negligible</b>       |

## 8.2

### VIEW POINT 2 – SPINNAKER PARK

Viewpoint 2 is located at Spinnaker Park situated on the outer sea wall of Gladstone Marina. This waterfront location provided extensive views (180°) across Port Curtis. Views towards Curtis Island and The Narrows are partially screened by the RG Tanna Coal Terminal located to the northwest. Views west from this location have few permanent visual intrusions and present a relatively natural coastal landscape.

The most visible landscape unit in this location is waterways and industrial landscapes.

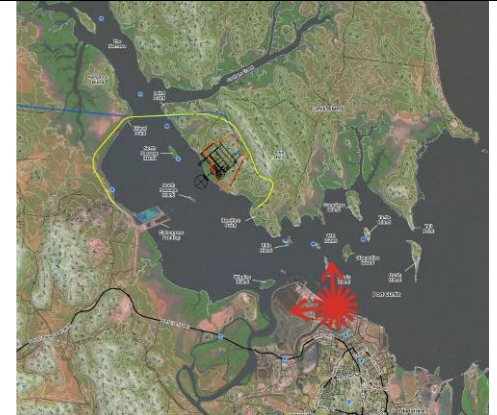
VP2. N7363587.7 E321547.7

Elevation: 6m AHD

Distance from viewpoint to project structures:

LNG Facility 8 km (approx)

Curtis Island Bridge 13 km (approx)



**Photograph 8.4** View looking northwest from Spinnaker Park, the RG Tanna Coal Terminal blocks views in this direction towards Curtis Island and The Narrows.



**Photograph 8.5** *The view north from Spinnaker Park across Port Curtis, provides a more natural outlook and greater visual quality.*



**Photograph 8.6** *View looking west from Spinnaker Park with Auckland Point Wharf prominent in the middleground.*

The scenic values of Curtis Island and the waters of Port Curtis are evident from this location, although impacted by the industrialised waterfront of The Port of Gladstone. The proposed LNG Facility and Curtis Island Bridge will not be visible from this location due to the screening of views to the northeast by the RG Tanna Coal Terminal. In addition, proposed expansion of Port Facilities, notably Wiggins Island Coal Terminal, which is proposed to the northeast of the existing structures, will further block views towards the project from this location.

As the project results in no change to the visual quality of views from this location there is negligible impact on landscape values.



**Viewpoint 2**     *Summary of visual impact from Viewpoint 2*

| Item                                               | Description                                           | Evaluation (Construction)        | Evaluation (Operation)           |
|----------------------------------------------------|-------------------------------------------------------|----------------------------------|----------------------------------|
| Landscape sensitivity                              | High but impacted by intrusive industrial development | Moderate                         | Moderate                         |
| Viewer numbers                                     | High                                                  | High                             | High                             |
| Distance to nearest project structures             | Approx. 8km                                           | Low                              | Low                              |
| Visibility of the project structure (LNG Facility) | Negligible                                            | Negligible                       | Negligible                       |
| Visibility of the project structure (Bridge)       | Negligible                                            | Negligible                       | Negligible                       |
| Magnitude of change (LNG Facility)                 | Negligible                                            | Negligible                       | Negligible                       |
| Magnitude of change (Bridge)                       | Negligible                                            | Negligible                       | Negligible                       |
| <b>Overall significance of the visual impact</b>   |                                                       | <b>LNG Facility - Negligible</b> | <b>LNG Facility - Negligible</b> |
|                                                    |                                                       | <b>Bridge - Negligible</b>       | <b>Bridge - Negligible</b>       |

### 8.3

#### VIEW POINT 3 – GOONDOON STREET GLADSTONE

Viewpoint 3 is located at the corner of Yarroon Street and Goondoon street Gladstone's 'main' street.

This section of the town centre is elevated above the industrialised waterfront and has long-range views out across the waters of Port Curtis to Curtis Island in the background.

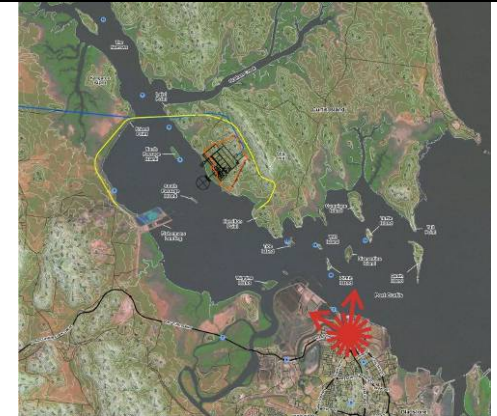
The most visible landscape unit in this location is urban, and industrial landscapes, with distant views towards of the undulating hills and ridges of Curtis Island.

VP3. N7362357.9 E322180.3

Elevation: 28m AHD

Distance from viewpoint to project structures:

- LNG Facility 10km (approx)
- Curtis Island Bridge 15km (approx)



*Photograph 8.7 View looking northeast from corner of Goondoon and Yarroon streets Gladstone.*



**Photograph 8.8** Streetscape character along Goondoon Street.



**Photograph 8.9** Streetscape character along Goondoon Street – approach to viewpoint 3.

The proposed LNG Facility is located approximately 10km to the north of this viewpoint and will be screened from the town by topography and intervening port facilities which form a buffer between the urban/retail areas of Gladstone City and the waterfront. The proposed Curtis Island Bridge will also not be visible from this location due to the distance (15 km).

As the project will not be visible from this location there is no change to visual quality or alteration to landscape values.

### **Viewpoint 3** Summary of visual impact from Viewpoint 3

| Item                                               | Description  | Evaluation (Construction)        | Evaluation (Operation)           |
|----------------------------------------------------|--------------|----------------------------------|----------------------------------|
| Landscape sensitivity                              | Low          | Low                              | Low                              |
| Viewer numbers                                     | High         | High                             | High                             |
| Distance to nearest project structures             | Approx. 10km | Low                              | Low                              |
| Visibility of the project structure (LNG Facility) | Negligible   | Negligible                       | Negligible                       |
| Visibility of the project structure (Bridge)       | Negligible   | Negligible                       | Negligible                       |
| Magnitude of change (LNG Facility)                 | Negligible   | Negligible                       | Negligible                       |
| Magnitude of change (Bridge)                       | Negligible   | Negligible                       | Negligible                       |
| <b>Overall significance of the visual impact</b>   |              | <b>LNG Facility - Negligible</b> | <b>LNG Facility - Negligible</b> |
|                                                    |              | <b>Bridge - Negligible</b>       | <b>Bridge - Negligible</b>       |



## 8.4

### VIEW POINT 4 – RADAR HILL

Viewpoint 4 is located at Radar Hill over looking Gladstone City centre. Distant views of The Port of Gladstone and Curtis Island are possible from this elevated vantage point.

The most visible landscape unit in this location is urban, with the natural coastal landscape of Curtis Island in the far distance. Prominent features of the landscape setting of Gladstone from this viewpoint include the waters of Port Curtis and the ridgelines of Curtis Island and to the west the ridges and peaks of the Mount Larcom complex.

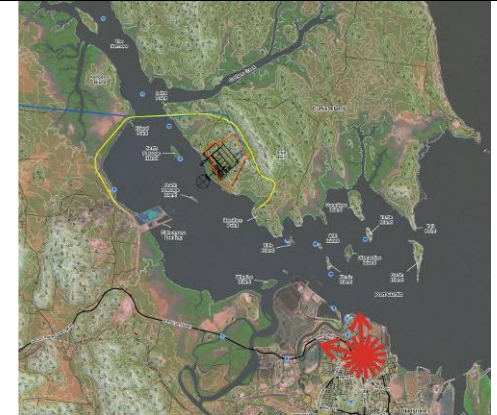
VP4 N7361153.3 E322909.5

Elevation: 53m AHD

Distance from viewpoint to project structures:

LNG Facility 10.5km (approx)

Curtis Island Bridge 16km (approx)



**Photograph 8.10** View looking northeast from Radar Hill towards Curtis Island on the horizon.

This viewpoint and adjacent residential areas was identified in the Seen Area Analysis as potentially having views of the project. Evaluation of the view from this elevated location indicate the proposed LNG Facility and Curtis Island Bridge will not significantly impact visual quality due to the distance to the site, intervening topography and industrial/port facilities in The Port of Gladstone.

The magnitude of change on the sensitive landscape areas of Curtis Island and The Narrows is negligible.

**Viewpoint 4**     *Summary of visual impact from Viewpoint 4*

| Item                                               | Description  | Evaluation (Construction)        | Evaluation (Operation)           |
|----------------------------------------------------|--------------|----------------------------------|----------------------------------|
| Landscape sensitivity                              | Low          | Low                              | Low                              |
| Viewer numbers                                     | High         | High                             | High                             |
| Distance to nearest project structures             | Approx. 10km | Low                              | Low                              |
| Visibility of the project structure (LNG Facility) | Limited      | Low                              | Low                              |
| Visibility of the project structure (Bridge)       | Negligible   | Negligible                       | Negligible                       |
| Magnitude of change (LNG Facility)                 | Negligible   | Negligible                       | Negligible                       |
| Magnitude of change (Bridge)                       | Negligible   | Negligible                       | Negligible                       |
| <b>Overall significance of the visual impact</b>   |              | <b>LNG Facility - Negligible</b> | <b>LNG Facility - Negligible</b> |
|                                                    |              | <b>Bridge - Negligible</b>       | <b>Bridge - Negligible</b>       |

Viewpoint 4 is located at the Round Hill Lookout. This elevated location is the most significant vantage point in Gladstone providing extensive views over the City of Gladstone and a perspective of the landscape setting of the city and port. Curtis Island forms a natural backdrop to the urban and industrialised areas of the mainland. From this distance Curtis Island appears visually unmodified by human intervention, displaying a high level of naturalness and therefore forms an important element in the scenic amenity of the area.

The most visible landscape unit in this location is urban/industrial with waterways and Eucalyptus forests in the background.

VP5. N7359289.4 E322343.2

Elevation: 140m AHD

Distance from viewpoint to project structures:

- LNG Facility 11.8 km (approx)
- Curtis Island Bridge 17.1 km (approx)



**Photograph 8.11** View looking northeast from Round Hill Lookout



The site for the proposed LNG Facility is located 11.8 km from this viewpoint, the tallest of the LNG structures will be visible from this viewpoint due to the angle of viewing from higher ground reducing the screening potential of topography and vegetation. However at this distance the visual impact is low. The reflectivity of construction materials used for major elements such as the LNG tanks is likely to influence visibility. Similarly the proposed Curtis Island Bridge will be visible as a thin line on the horizon, however at 17km this will have minimal visual impact on the landscape quality from this viewpoint. In addition the current major port infrastructure visible along the water front will increase as a result of future approved development within The Port of Gladstone including the proposed Wiggins Island terminal.

Whilst this panoramic view encompasses a wide expanse of highly sensitive landscape areas extending across the horizon, the foreground and middleground views are of moderate to low visual quality. Construction of the LNG Facility on Curtis Island will result in a permanent change in the landscape character, however from this distances the magnitude of change will be small. The impact of the Project on visual quality results in a minor to moderate impact on landscape values.

**Viewpoint 5**      *Summary of visual impact from Viewpoint 5*

| Item                                               | Description                                                           | Evaluation (Construction)               | Evaluation (Operation)                  |
|----------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------|-----------------------------------------|
| Landscape sensitivity                              | Majority of the areas is low, with high sensitivity in the background | Medium                                  | Medium                                  |
| Viewer numbers                                     | High                                                                  | High                                    | High                                    |
| Distance to nearest project structures             | Approx. 11km                                                          | Low                                     | Low                                     |
| Visibility of the project structure (LNG Facility) | Limited                                                               | Low                                     | Low                                     |
| Visibility of the project structure (Bridge)       | Low                                                                   | Low                                     | Low                                     |
| Magnitude of change (LNG Facility)                 | Small                                                                 | Small                                   | Small                                   |
| Magnitude of change (Bridge)                       | Small                                                                 | Small                                   | Small                                   |
| <b>Overall significance of the visual impact</b>   |                                                                       | <b>LNG Facility - Minor to Moderate</b> | <b>LNG Facility - Minor to Moderate</b> |
|                                                    |                                                                       | <b>Bridge - Minor to Moderate</b>       | <b>Bridge - Minor to Moderate</b>       |

## 8.6

### VIEW POINT 6 – PORT CURTIS HIGHWAY

Viewpoint 6 is located on Port Curtis Way approx 3 km to the west of Gladstone city centre, at the bridge over the rail line to RG Tanna Coal Terminal. This western fringe of Gladstone comprises of a large industrial precinct extending from the water front to Gladstone airport and including major industrial facilities and infrastructure such as Gladstone Power Station.

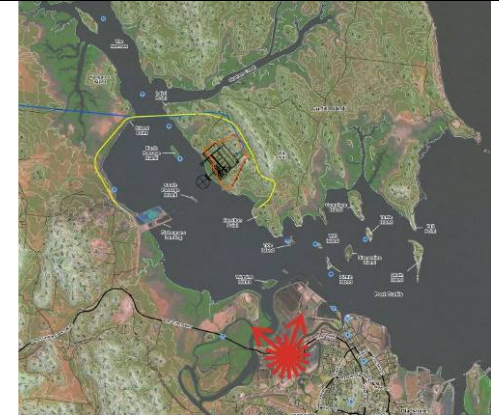
The most visible landscape unit in this location is industrial landscape with poor visual quality.

VP6 N7361263.7 E319381.3

Elevation: 14m AHD

Distance from viewpoint to project structures:

- LNG Facility 8.7 km (approx)
- Curtis Island Bridge 14 km (approx)



**Photograph 8.12** View looking north from Port Curtis Way, approx 3km to the west of Gladstone City centre.

The site for the proposed LNG Facility is located 8.7 km from this viewpoint. The proposed LNG Facility maybe visible from this direction as a slight visual change in the background of the view. Since the majority of this view is industrialised landscape with low visual quality the impact of a slight change in the distance will not have any impact on the landscape values.

**Viewpoint 6**     *Summary of visual impact from Viewpoint 6*

| Item                                               | Description | Evaluation (Construction)        | Evaluation (Operation)      |
|----------------------------------------------------|-------------|----------------------------------|-----------------------------|
| Landscape sensitivity                              | Low         | Low                              | Low                         |
| Viewer numbers                                     | High        | High                             | High                        |
| Distance to nearest project structures             | Approx. 9km | Moderate                         | Moderate                    |
| Visibility of the project structure (LNG Facility) | Limited     | Low                              | Low                         |
| Visibility of the project structure (Bridge)       | Negligible  | Negligible                       | Negligible                  |
| Magnitude of change (LNG Facility)                 | Small       | Negligible                       | Small                       |
| Magnitude of change (Bridge)                       | Negligible  | Negligible                       | Negligible                  |
| <b>Overall significance of the visual impact</b>   |             | <b>LNG Facility - Negligible</b> | <b>LNG Facility - Minor</b> |
|                                                    |             | <b>Bridge - Negligible</b>       | <b>Bridge - Negligible</b>  |



Viewpoint 7 is located at the bridge over the Calliope River Anabran, to the west of Gladstone. This area largely comprises of open tidal flats with some areas of reclaimed land.

Vegetation in the area comprises of low saltpan vegetation and low mangrove vegetation along the water edges. Reclaimed land to the north of the Calliope River has been identified as future major industry/infrastructure and is the site of the proposed Wiggins Island Coal Terminal rail corridor.

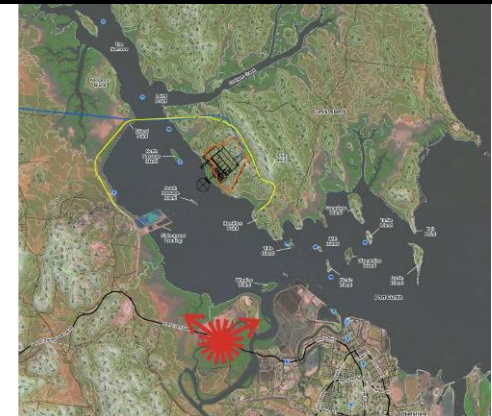
The most visible landscape unit in this location is Estuarine Landscape with some areas of industrial/reclaimed land. Industrial facilities are visible to the north of this location as well as high voltage powerlines traversing the area.

VP7 N7362292.0 E316428.4

Elevation: 9m AHD

Distance from viewpoint to project structures:

- LNG Facility 7.2 km (approx)
- Curtis Island Bridge 11 km (approx)



**Photograph 8.13** View looking north from Port Curtis Way at the bridge over the Calliope River Anabran.

The site for the proposed LNG Facility is located 7.2 km from this viewpoint. The project may be visible from this direction but visibility will be limited due to intervening topography and vegetation. In addition future major industry proposed for the reclaimed land to the north of the anabran will modify the existing view to a more industrialised character and screen views to Curtis Island from this location.

Construction of the LNG Facility on Curtis Island will result in a negligible to minor change to the visual quality of the landscape from this viewpoint. The proposed bridge across The Narrows will not be visible from this location.

Viewpoint 7. *Summary of visual impact from Viewpoint 7*

| Item                                               | Description | Evaluation (Construction)        | Evaluation (Operation)      |
|----------------------------------------------------|-------------|----------------------------------|-----------------------------|
| Landscape sensitivity                              | Low         | Low                              | Low                         |
| Viewer numbers                                     | High        | High                             | High                        |
| Distance to nearest project structures             | Approx. 7km | Moderate                         | Moderate                    |
| Visibility of the project structure (LNG Facility) | Limited     | Low                              | Low                         |
| Visibility of the project structure (Bridge)       | Negligible  | Negligible                       | Negligible                  |
| Magnitude of change (LNG Facility)                 | Small       | Negligible                       | Small                       |
| Magnitude of change (Bridge)                       | Negligible  | Negligible                       | Negligible                  |
| <b>Overall significance of the visual impact</b>   |             | <b>LNG Facility - Negligible</b> | <b>LNG Facility - Minor</b> |
|                                                    |             | <b>Bridge - Negligible</b>       | <b>Bridge - Negligible</b>  |

Viewpoint 8 is located on an un-named track adjoining the Targinie foreshore accessible from Forest Road and to the north of Fisherman's Landing. The track provides access to a dirt boat ramp however accessibility is limited to 4 x 4 vehicles.

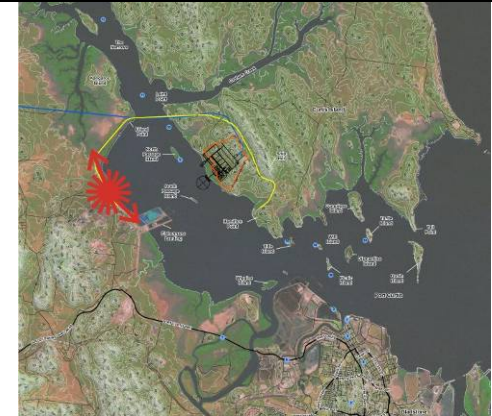
The landscape character of the areas is coastal landscape with views across Port Curtis to Curtis Island in the background. The views extend north to the entrance to The Narrows and south to Gladstone. The view is predominately of natural coastal landscape of high scenic quality, especially to the north where there are no visible built elements. To the south the industrial facilities located on Fisherman's Landing, and extending beyond to The Port of Gladstone, are visual intrusions into the natural setting.

VP 8. N7369049.3 E311457.2

Elevation: 6m AHD

Distance from viewpoint to project structures:

- LNG Facility 4 km to loading berth (approx)
- Curtis Island Bridge 3.5 km (approx)



This viewpoint is located directly opposite the proposed LNG Facility on Curtis Island and close to the alignment of the proposed approach road to the Curtis Island Bridge. The proposed LNG Facility will be visible from this location. The closest structure, at a distance of approx 4 km will be the marine loading berth. The main Plant will be set back behind the line of mangroves which are to be retained where possible along the intertidal zone. This will assist in reducing the impact of the proposed LNG Facility on the waters edge. The visual bulk of the proposed Plant will also be set below the vegetated ridgeline of Ship Hill and therefore not intrude onto the skyline.

The proposed bridge will be visible at a distance of 3.5 km from this location at the entrance to The Narrows.

Existing development on Fisherman's Landing currently impacts views from this location. The visual impact of industrial structures extending above the skyline creates prominent elements in the landscape and this in conjunction with the man modified waters edge of Fisherman's Landing creates a significant impact in the immediate area.

The visual impact of the proposed project in the landscape has been represented in the photomontages prepared for this location, refer *Figures 8.2 and 8.3*.

The magnitude of change in the landscape as a result of the construction and operation of the LNG Facility has been rated as medium due the low profile of the project in relation to the ridgeline in the background, the retention of the natural shoreline (in part) and the presence of existing industry within the



viewshed. The magnitude of change resulting from the proposed bridge has also been rated as medium as it conforms to similar criteria. The impact of these changes on the highly sensitivity landscapes of Curtis Island and The Narrows has been evaluated as moderate to major significance.



**Photograph 8.14** *Wide-angle view looking east towards LNG Facility site from Targinie Foreshore*



**Photograph 8.15** *Wide-angle view looking north towards the Curtis Island Bridge site from Targinie Foreshore*



**Photograph 8.16** *View of the proposed LNG facility site from Targinie Foreshore*



**Figure 8.2** *Photomontages of the proposed LNG facility viewed from Targinie Foreshore*





**Photograph 8.17** *View of the proposed bridge site from Targinie Foreshore*



**Figure 8.3** *Photomontages of the proposed Bridge viewed from Targinie Foreshore*



*Viewpoint 8. Summary of visual impact from Viewpoint 8*

| <b>Item</b>                                        | <b>Description</b>                | <b>Evaluation (Construction)</b>        | <b>Evaluation (Operation)</b>           |
|----------------------------------------------------|-----------------------------------|-----------------------------------------|-----------------------------------------|
| Landscape sensitivity                              | High with some intrusive industry | High                                    | High                                    |
| Viewer numbers                                     | Low                               | Low                                     | Low                                     |
| Distance to nearest project structures             | Approx. 4km                       | High                                    | High                                    |
| Visibility of the project structure (LNG Facility) | High                              | High                                    | High                                    |
| Visibility of the project structure (Bridge)       | High                              | High                                    | High                                    |
| Magnitude of change (LNG Facility)                 | Medium                            | Medium                                  | Medium                                  |
| Magnitude of change (Bridge)                       | Medium                            | Medium                                  | Medium                                  |
| <b>Overall significance of the visual impact</b>   |                                   | <b>LNG Facility – Moderate to Major</b> | <b>LNG Facility – Moderate to Major</b> |
|                                                    |                                   | <b>Bridge – Moderate to Major</b>       | <b>Bridge – Moderate to Major</b>       |

**SUMMARY OF VISUAL IMPACT SIGNIFICANCE OF THE PROJECT FROM PUBLICLY ACCESSIBLE VIEWPOINTS IN GLADSTONE AND SURROUNDING AREAS**

The landscape sensitivity and magnitude of change resulting from the construction and operation of the project, and the significance of the visual impact has been summarized in *Tables 8.1 and 8.2*.

**Table 8.1** *Summary of visual impact significance from each viewpoint during construction of the project*

| Viewpoint | Location                          | Impact Significance<br>LNG Facility | Impact Significance<br>Bridge |
|-----------|-----------------------------------|-------------------------------------|-------------------------------|
| VP1       | Auckland Point                    | Negligible                          | Negligible                    |
| VP2       | Spinnaker Park                    | Negligible                          | Negligible                    |
| VP3       | Goodoon St Gladstone              | Negligible                          | Negligible                    |
| VP4       | Radar Hill                        | Negligible                          | Negligible                    |
| VP5       | Round Hill                        | Minor to Moderate                   | Minor to Moderate             |
| VP6       | Port Curtis Way                   | Negligible                          | Negligible                    |
| VP7       | Port Curtis Way at Calliope River | Negligible                          | Negligible                    |
| VP8       | Un named track Targinie Foreshore | Moderate to Major                   | Moderate to Major             |

**Table 8.2** *Summary of visual impact significance from each viewpoint during operation of the project*

| Viewpoint | Location                          | Impact Significance<br>LNG Facility | Impact Significance<br>Bridge |
|-----------|-----------------------------------|-------------------------------------|-------------------------------|
| VP1       | Auckland Point                    | Negligible                          | Negligible                    |
| VP2       | Spinnaker Park                    | Negligible                          | Negligible                    |
| VP3       | Goodoon St Gladstone              | Negligible                          | Negligible                    |
| VP4       | Radar Hill                        | Negligible                          | Negligible                    |
| VP5       | Round Hill                        | Minor to Moderate                   | Minor to Moderate             |
| VP6       | Port Curtis Way                   | Minor                               | Negligible                    |
| VP7       | Port Curtis Way at Calliope River | Minor                               | Negligible                    |
| VP8       | Un named track Targinie Foreshore | Moderate to Major                   | Moderate to Major             |

## ASSESSMENT OF VISUAL IMPACT OF THE PROJECT FROM SURROUNDING WATERWAYS

The spectacular scenery of the Great Barrier Reef Marine Park is often most easily appreciated from the water. Tourism and recreational boating in particular are important vehicles for people's appreciation of the landscape values from the waterways of Port Curtis. Whilst not everyone has access to the water, those people who do travel on the waterways for recreation generally place a high degree of significance on the landscape qualities of the area. The 'pristine' natural landscape of The Narrows passage as experienced from the water is an important consideration, as is the interface between The Narrows and The Port of Gladstone.

As previously indicated eight viewpoint locations were selected from the adjoining waterways, refer Figure 9.1.

- |                                                         |                                                       |
|---------------------------------------------------------|-------------------------------------------------------|
| <b>VP9</b> Port Curtis adjoining North Passage Island   | <b>VP12</b> The Narrows 5 km north of proposed bridge |
| <b>VP10</b> The Narrows – 500m south of proposed bridge | <b>VP13</b> Turtle Island                             |
| <b>VP11</b> The Narrows 1 km north of proposed bridge   | <b>VP14</b> Witt Island                               |
|                                                         | <b>VP15</b> Tide Island                               |
|                                                         | <b>VP16</b> The Port of Gladstone Channel             |



**Figure 9.1** Selected Viewpoints from adjoining waterways



## 9.1

### VIEW POINT 9 – PORT CURTIS ADJOINING NORTH PASSAGE ISLAND

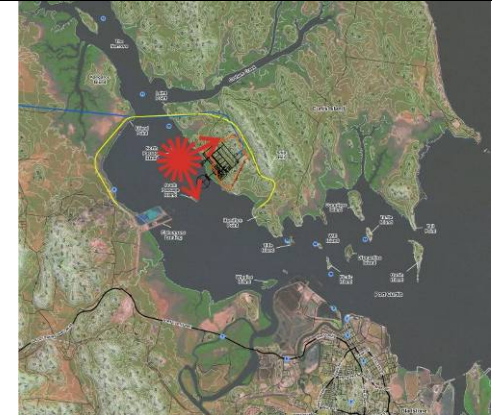
Viewpoint 9 is located opposite the site of the proposed LNG Facility, approximately 1.0km east and to the south of North Passage Island. VP9 E314480.2, N7370464.5

From this vantage point the linear ridge extending from Ship Hill forms the horizon line. The main landscape character type is eucalyptus forest, estuarine landscapes and waterways. The industrialised landscape of Gladstone waterfront can be seen in the distance to the south.

Elevation: 1.5m AHD

Distance from viewpoint to project structures:

- LNG Facility 1 km to loading berth (approx)
- Curtis Island Bridge 2 km (approx)



The proposed LNG Facility will be clearly visible from this location and likely to be visually dominant given the close proximity of the viewpoint within 1km of the project. A photomontage of the proposed facility has been prepared from this location, refer *Figure 9.2*.

The magnitude of change in the landscape as a result of the construction and operation of the LNG Facility has been rated as large as, although the project retains some of the natural shoreline and the presence of existing industry within the viewshed moderates the sensitivity, the LNG tanks from this direction are higher than the ridgeline in the background hence breaching the horizon. This interruption of the skyline increases the prominence of the project in the landscape and hence increases the magnitude of change. As the sensitivity of landscape was evaluated as high, and the initial magnitude of change is large, the level of visual impact was evaluated as major adverse significance when viewed from the immediate adjoining waterway.

The presence of modified landscapes and industrial elements in the viewshed moderates the impact significance from critical status on the grounds that the landscape within the viewshed can not be considered 'pristine'.

Views north from this viewpoint will include the Bridge, similar to those shown in VP 10 and has been evaluated as having a visual impact of major adverse significance.



**Photograph 9.1** *View looking east from North Passage Island across the water to the proposed LNG Facility site.*



**Figure 9.2** *Photomontage of proposed LNG Facility looking east from North Passage Island*

*Viewpoint 9 Summary of visual impact from Viewpoint 9*

| Item                                               | Description | Evaluation (Construction)   | Evaluation (Operation)      |
|----------------------------------------------------|-------------|-----------------------------|-----------------------------|
| Landscape sensitivity                              | High        | High                        | High                        |
| Viewer numbers                                     | Low         | Low                         | Low                         |
| Distance to nearest project structures             | Approx. 1km | High                        | High                        |
| Visibility of the project structure (LNG Facility) | High        | High                        | High                        |
| Visibility of the project structure (Bridge)       | High        | High                        | High                        |
| Magnitude of change (LNG Facility)                 | Large       | Large                       | Large                       |
| Magnitude of change (Bridge)                       | Large       | Large                       | Large                       |
| <b>Overall significance of the visual impact</b>   |             | <b>LNG Facility - Major</b> | <b>LNG Facility - Major</b> |
|                                                    |             | <b>Bridge - Major</b>       | <b>Bridge - Major</b>       |



## 9.2 VIEW POINT 10 – THE NARROWS - 500M SOUTH OF THE PROPOSED BRIDGE CROSSING

Viewpoint 10 is located at the entrance to The Narrows 500m south of the crossing of the proposed bridge.

The dominant landscape character looking north from this viewpoint is the estuarine landscapes and waterways of the passage landscape, eucalyptus woodland/forest and the mountainous ridgeline of the Mount Larcom ranges on the western horizon. From this point onwards there is not evidence of man-modifications to the landscape and the view is of the ‘pristine’ natural landscape of The Narrows.

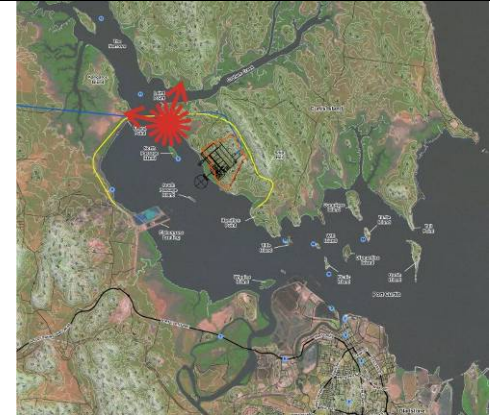
Looking south from this viewpoint the landscape although predominantly water also contains views of industrial facilities.

VP10. N7371962.9 E313969.0

Elevation: 1.5m AHD

Distance from viewpoint to project structures:

- LNG Facility 2.2 km to marine facility (approx)
- Curtis Island Bridge 500 m (approx)



The proposed Curtis Island Bridge will visually dominate the landscape from this location. The photomontage of the proposed bridge has been prepared for this location Figure 9.3

The magnitude of change in the landscape as a result of the construction and operation of the bridge across The Narrows has been rated as large as a result of: the scale of the project, the incompatibility of the structure in the landscape, prominence of the structure across the skyline, and also operational impacts of traffic, and in particular heavy transport vehicles, on the landscape values. This, in combination with the highly sensitive landscape of The Narrows notable National recognition as a place of wilderness and pristine natural state, results in the impact of the proposed bridge on visual quality and landscape values as being rated as having major adverse significance. A level of critical adverse impact was considered, however the presence of modification and industrial elements in the viewshed reduces the impact to slightly below the highest level of significance.

Views south from this viewpoint will include the LNG Facility, similar to those shown in VP 11 and will have a medium magnitude of change in the landscape and results in a moderate to major impact significance.



*Photograph 9.2 View Looking north towards proposed bridge at a distance of approximately 500m from proposed crossing.*



*Figure 9.3 Photomontage of proposed bridge at a distance of approximately 500m from proposed crossing*



**Photograph 9.3** View looking south towards Gladstone with North Passage Island visible in the middleground

Viewpoint 10 (north)      Summary of visual impact from Viewpoint 10 looking north

| Item                                               | Description  | Evaluation (Construction)               | Evaluation (Operation)                  |
|----------------------------------------------------|--------------|-----------------------------------------|-----------------------------------------|
| Landscape sensitivity                              | High         | High                                    | High                                    |
| Viewer numbers                                     | Low          | Low                                     | Low                                     |
| Distance to nearest project structures             | Approx. 500m | High                                    | High                                    |
| Visibility of the project structure (LNG Facility) | Moderate     | Moderate                                | Moderate                                |
| Visibility of the project structure (Bridge)       | High         | High                                    | High                                    |
| Magnitude of change (LNG Facility)                 | Medium       | Medium                                  | Medium                                  |
| Magnitude of change (Bridge)                       | Large        | Large                                   | Large                                   |
| <b>Overall significance of the visual impact</b>   |              | <b>LNG Facility - Moderate to Major</b> | <b>LNG Facility - Moderate to Major</b> |
|                                                    |              | <b>Bridge - Major</b>                   | <b>Bridge - Major</b>                   |



### 9.3

#### VIEW POINT 11 – THE NARROWS 1 KM NORTH OF PROPOSED BRIDGE CROSSING

Viewpoint 11 is located in The Narrows approximately 1 km north of the proposed bridge. Views south from this location encompass the interface between The Port of Gladstone and the entrance to The Narrows passage as it opens up into the waters of Port Curtis.

The most visible landscape type from this location is waterways, estuarine landscapes and eucalyptus woodlands, with in the far distance, evidence of the industrialised landscape of The Port of Gladstone and Targinie. The importance of the Mount Larcom ranges with its distinctive western skyline is also evident from this location. The impact of the constructed waterfront of Fisherman's Landing is clearly visible in contrast to the natural vegetated shoreline of The Narrows.

VP11. N7373476 E312757

Elevation: 1.5m AHD

Distance from viewpoint to project structures:

- LNG Facility 4.2 km to marine facility (approx)
- Curtis Island Bridge 1km (approx)



The proposed bridge across The Narrows entrance will be clearly visible from this location and may dominate the view due to the close proximity of the viewpoint. The LNG Facility on Curtis Island will also be visible in the background. A photomontage of the proposed bridge and LNG Facility has been prepared refer *Figure 9.4*



**Photograph 9.4** *View Looking southeast towards Curtis Island, at approx 1km from the proposed location of The Curtis Island Bridge.*



**Figure 9.4** *Photomontage of proposed bridge and LNG Facility at approx 1 km from entrance to The Narrows*



*Photograph 9.5 View Looking southwest towards Targinie, at approx 1km from the proposed location of The Curtis Island Bridge.*



*Figure 9.5 Photomontage of proposed bridge at a distance of approximately 1 km*

As for the previous viewpoint, the magnitude of change in the landscape as a result of the construction and operation of the bridge across The Narrows has been rated as large, as a result of: the scale of the project, the incompatibility of the structure in the landscape, prominence of the structure across the skyline, and also operational impacts of traffic and in particular heavy transport vehicles on the landscape values.



The sensitivity of the landscape is rated as medium to high as a result of the impacts of existing large scale industry on the visual quality and landscape values of the area. The landscape impact of the bridge when viewed against the backdrop of The Port of Gladstone has been rated as of major adverse significance.

The magnitude of change in the landscape as a result of the construction and operation of the proposed LNG Facility is rated as medium as although the view of the proposed facility is similar to viewpoint 9, the LNG Facility have a lower profile in the landscape and is viewed from a greater distance, the scale of impact is therefore of moderate significance.

*Viewpoint 11 Summary of visual impact from Viewpoint 11*

| Item                                               | Description | Evaluation (Construction)               | Evaluation (Operation)                  |
|----------------------------------------------------|-------------|-----------------------------------------|-----------------------------------------|
| Landscape sensitivity                              | Medium/High | Medium/High                             | Medium/High                             |
| Viewer numbers                                     | Low         | Low                                     | Low                                     |
| Distance to nearest project structures             | Approx. 1km | High                                    | High                                    |
| Visibility of the project structure (LNG Facility) | Moderate    | Moderate                                | Moderate                                |
| Visibility of the project structure (Bridge)       | High        | High                                    | High                                    |
| Magnitude of change (LNG Facility)                 | Medium      | Medium                                  | Medium                                  |
| Magnitude of change (Bridge)                       | Large       | Large                                   | Large                                   |
| <b>Overall significance of the visual impact</b>   |             | <b>LNG Facility - Moderate to major</b> | <b>LNG Facility - Moderate to major</b> |
|                                                    |             | <b>Bridge - Major</b>                   | <b>Bridge - Major</b>                   |

## 9.4

### VIEW POINT 12 –THE NARROWS 5 KM NORTH OF PROPOSED BRIDGE CROSSING

Viewpoint 12 is located in The Narrows approximately 5 km north of the proposed bridge. Views south from this location are predominately of The Narrows landscape with, in the far distance, the industrialised landscape of The Port of Gladstone.

The most visible landscape type from this location is waterways, estuarine landscapes and Eucalyptus woodlands. Gladstone's industrialised waterfront is just visible from this location in contrasts to the natural landscape of The Narrows.

VP12. N7376946 E310950

Elevation: 1.5m AHD

Distance from viewpoint to project structures:

- LNG Facility 8 km to marine facility (approx)
- Curtis Island Bridge 5 km (approx)



**Photograph 9.6** View Looking south from The Narrows, 5km north of the location of the proposed bridge



*Photograph 9.7 View looking west to existing crabber's hut*

The proposed bridge across The Narrows entrance will be visible from this location however at 5km away the visual influence will not be significant. The magnitude of change in the landscape as a result of the construction and operation of the bridge has been rated as small. This rating results from the reduced scale of the bridge in the landscape although the compatibility of the structure across The Narrows entrance remains intrusive.

The LNG Facility is not visible from this location therefore the visual impact is negligible.



*Viewpoint 12 Summary of visual impact from Viewpoint 12*

| <b>Item</b>                                        | <b>Description</b> | <b>Evaluation (Construction)</b> | <b>Evaluation (Operation)</b> |
|----------------------------------------------------|--------------------|----------------------------------|-------------------------------|
| Landscape sensitivity                              | High               | High                             | High                          |
| Viewer numbers                                     | Low                | Low                              | Low                           |
| Distance to nearest project structures             | Approx. 5km        | Low                              | Low                           |
| Visibility of the project structure (LNG Facility) | Low                | Low                              | Low                           |
| Visibility of the project structure (Bridge)       | Low                | Low                              | Low                           |
| Magnitude of change (LNG Facility)                 | Negligible         | Negligible                       | Negligible                    |
| Magnitude of change (Bridge)                       | Small              | Small                            | Small                         |
| <b>Overall significance of the visual impact</b>   |                    | <b>LNG - Negligible</b>          | <b>LNG - Negligible</b>       |
|                                                    |                    | <b>Bridge - Moderate</b>         | <b>Bridge - Moderate</b>      |

Viewpoint 13 is located just off Turtle Island to the south of Curtis Island. This island includes one residential dwelling which is located to the north east of the island.

Views northwest towards the project site from this location are predominately of Curtis Island and adjoining smaller islands, the nearest being Diamantine and Witt Islands. The one residential property on the island faces north east and is screened from the proposed project site by intervening topography.

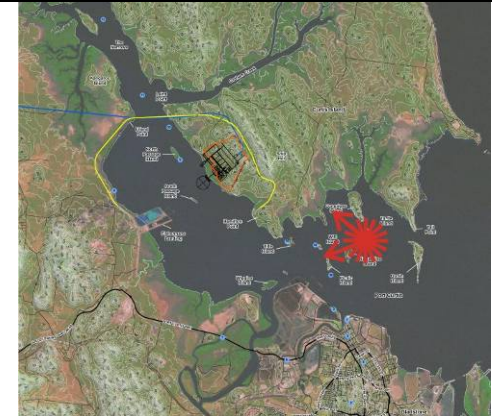
The most visible landscape type from this location is the waters of Port Curtis, eucalyptus woodlands on Curtis Island and estuarine landscape along the shoreline. Gladstone's industrialised landscapes are evident from this location.

VP13. N73666763, E322985

Elevation: 1.5m AHD

Distance from viewpoint to project structures:

- LNG Facility 7 km (approx)
- Curtis Island Bridge 11 km (approx)



*Photograph 9.8 View looking west towards Witt Island*



**Photograph 9.9** *View looking northwest towards Curtis Island*

The visibility analysis indicated a number of the taller LNG structures may potentially be visible from this location. The flare stacks at 59.4m (RL 65.4m AHD) are higher than the adjoining ridgeline when viewed from this direction as a result of a low point of approx 45 AHD. These ridges are currently vegetated with Eucalyptus woodland to an approximate height of 15 - 20m which would increase the screening potential to approximately 60 - 65m AHD. The flare stacks may therefore be slightly visible above the wooded ridgeline, however this visual impact will result in a small magnitude of change in the landscape. The occasional flaring of the stacks may result in a slight increase in visual impact during operation of the LNG Facility, although this will be an infrequent occurrence and temporary impact. The high landscape sensitivity, and small magnitude of change results in a visual impact of moderate significance.



*Viewpoint 13 Summary of visual impact from Viewpoint 13*

| <b>Item</b>                                        | <b>Description</b> | <b>Evaluation (Construction)</b> | <b>Evaluation (Operation)</b> |
|----------------------------------------------------|--------------------|----------------------------------|-------------------------------|
| Landscape sensitivity                              | High               | High                             | High                          |
| Viewer numbers                                     | Low                | Low                              | Low                           |
| Distance to nearest project structures             | Approx. 7km        | Low                              | Low                           |
| Visibility of the project structure (LNG Facility) | Low                | Negligible                       | Low                           |
| Visibility of the project structure (Bridge)       | Negligible         | Negligible                       | Negligible                    |
| Magnitude of change (LNG Facility)                 | Small              | Negligible                       | Small                         |
| Magnitude of change (Bridge)                       | Negligible         | Negligible                       | Negligible                    |
| <b>Overall significance of the visual impact</b>   |                    | <b>LNG - Negligible</b>          | <b>LNG - Moderate</b>         |
|                                                    |                    | <b>Bridge - Negligible</b>       | <b>Bridge - Negligible</b>    |

Viewpoint 14 is located to the north west of Witt Island. This island includes one residential dwelling which is located to the north east of the island.

Views northwest towards the project site from this location are similar to viewpoint 13, that is, views of Curtis Island and adjoining smaller islands, the nearest being Tide Islands. The one residential property on the island faces north east and is screened from the project site.

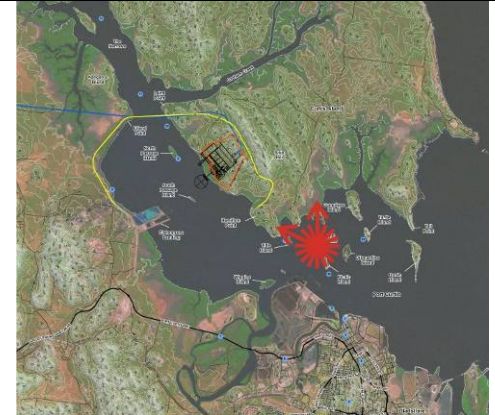
The most visible landscape type from this location is the waters of Port Curtis, eucalyptus woodlands on Curtis Island and estuarine landscapes along the shoreline.

VP14 N7366546 E320691

Elevation: 1.5m AHD

Distance from viewpoint to project structures:

- LNG Facility 5.3 km (approx)
- Curtis Island Bridge 9 km (approx)



**Photograph 9.10** View looking northwest to Curtis Island



**Photograph 9.11** View of Witt Island showing residential properties located on the north eastern side of the island.

Views from the north eastern side of Witt Island are similar to those from Turtle Island, except the view range to Curtis Island is shorter. The Flare stacks of the LNG may potentially be visible above the tree line but this alteration in the landscape will be slight, flaring of the plant may occasionally be visible but will be of a temporary nature. The high landscape sensitivity and small magnitude of change results in a visual impact of moderate significance.

*Viewpoint 14 Summary of visual impact from Viewpoint 14*

| Item                                               | Description   | Evaluation (Construction)  | Evaluation (Operation)     |
|----------------------------------------------------|---------------|----------------------------|----------------------------|
| Landscape sensitivity                              | High          | High                       | High                       |
| Viewer numbers                                     | Low           | Low                        | Low                        |
| Distance to nearest project structures             | Approx. 5.3km | Medium                     | Medium                     |
| Visibility of the project structure (LNG Facility) | Low           | Negligible                 | Low                        |
| Visibility of the project structure (Bridge)       | Negligible    | Negligible                 | Negligible                 |
| Magnitude of change (LNG Facility)                 | Small         | Negligible                 | Small                      |
| Magnitude of change (Bridge)                       | Negligible    | Negligible                 | Negligible                 |
| <b>Overall significance of the visual impact</b>   |               | <b>LNG - Negligible</b>    | <b>LNG - Moderate</b>      |
|                                                    |               | <b>Bridge - Negligible</b> | <b>Bridge - Negligible</b> |



Viewpoint 15 is located to the north west of Tide Island. This island has one residential dwelling located on the east side of the island, which is the closest residence to the site of the LNG Facility.

Views northwest towards the project site from this location are screened by Hamilton Point on Curtis Island. The residential property on the island faces east and does not have views towards the project site.

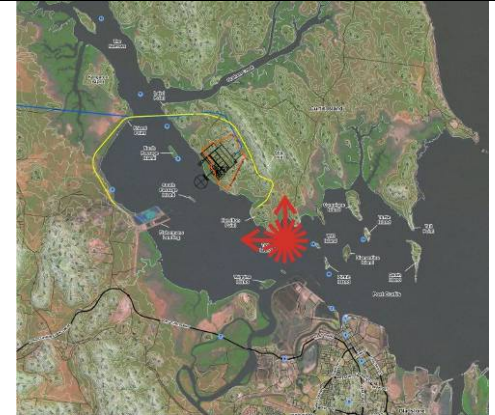
The most visible landscape type from this location is the waters of Port Curtis, Eucalyptus woodlands on Curtis Island, estuarine landscape along the shoreline, and the mountainous ridgeline of Mount Larcom on the western horizon.

VP15. N7366696 E319389

Elevation: 1.5m AHD

Distance from viewpoint to project structures:

- LNG Facility 4.2 km (approx)
- Curtis Island Bridge 8 km (approx)



**Photograph 9.12** View from Tide Island looking northwest



**Photograph 9.13** *View from Tide Island looking north*



**Photograph 9.14** *View of the residential property on Tide Island which faces east and is screened from the project site.*

Views from the north eastern side of Tide Island are similar to previous viewpoints (13 & 14), except the close proximity of Curtis Island and in particular Hamilton Point provide a greater level of screening and effectively block views of the proposed LNG Facility and proposed bridge

The screening provided by Hamilton Point will result in a negligible visual impact from this viewpoint during construction and operation of the LNG Facility.

*Viewpoint 15 Summary of visual impact from Viewpoint 15*

| Item                                               | Description    | Evaluation (Construction)  | Evaluation (Operation)     |
|----------------------------------------------------|----------------|----------------------------|----------------------------|
| Landscape sensitivity                              | High           | High                       | High                       |
| Viewer numbers                                     | Low            | Low                        | Low                        |
| Distance to nearest project structures             | Approx. 4.2 km | Moderate                   | Moderate                   |
| Visibility of the project structure (LNG Facility) | Negligible     | Negligible                 | Negligible                 |
| Visibility of the project structure (Bridge)       | Negligible     | Negligible                 | Negligible                 |
| Magnitude of change (LNG Facility)                 | Negligible     | Negligible                 | Negligible                 |
| Magnitude of change (Bridge)                       | Negligible     | Negligible                 | Negligible                 |
| <b>Overall significance of the visual impact</b>   |                | <b>LNG- Negligible</b>     | <b>LNG- Negligible</b>     |
|                                                    |                | <b>Bridge - Negligible</b> | <b>Bridge - Negligible</b> |



Viewpoint 16 is located approximately 1km from Gladstone marina on the waters of Port Curtis. This viewpoint is approximately on the cruise route of the ferry to South End and Heron Island.

Views northwest towards the project site encompass The Port of Gladstone extending north towards The Narrows, and Curtis Island. Mount Larcom ranges form a distinctive feature on the horizon.

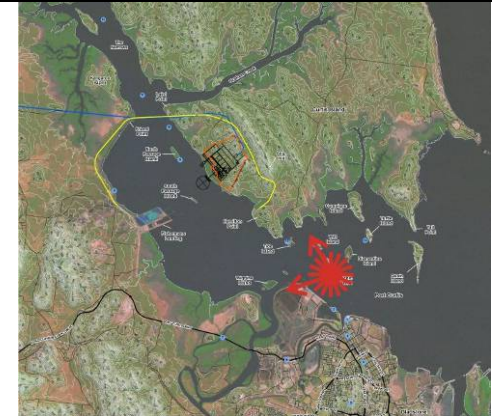
The most visible landscape type from this location is the waters of Port Curtis, industrial landscape associated with The Port of Gladstone, Eucalyptus woodlands on Curtis Island, estuarine landscapes along the shoreline, and the mountainous ridgeline of Mount Larcom.

VP16. N7365161.6 E321411.5

Elevation: 1.5m AHD

Distance from viewpoint to project structures:

- LNG Facility 6.5 km (approx)
- Curtis Island Bridge 10.5 km (approx)



**Photograph 9.15** View Looking northwest from the cruise route of the ferry to South End and Heron Island.

The LNG Facility and proposed bridge will not be visible from this location as a result of the intervening topography on Curtis Island, and result in negligible magnitude of change and a negligible significance of visual impact.

*Viewpoint 16 Summary of visual impact from Viewpoint 16*

| Item                                               | Description    | Evaluation (Construction)  | Evaluation (Operation)     |
|----------------------------------------------------|----------------|----------------------------|----------------------------|
| Landscape sensitivity                              | Medium         | Medium                     | Medium                     |
| Viewer numbers                                     | Medium         | Medium                     | Medium                     |
| Distance to nearest project structures             | Approx. 6.5 km | Moderate                   | Moderate                   |
| Visibility of the project structure (LNG Facility) | Negligible     | Negligible                 | Negligible                 |
| Visibility of the project structure (Bridge)       | Negligible     | Negligible                 | Negligible                 |
| Magnitude of change (LNG Facility)                 | Negligible     | Negligible                 | Negligible                 |
| Magnitude of change (Bridge)                       | Negligible     | Negligible                 | Negligible                 |
| <b>Overall significance of the visual impact</b>   |                | <b>LNG - Negligible</b>    | <b>LNG- Negligible</b>     |
|                                                    |                | <b>Bridge - Negligible</b> | <b>Bridge - Negligible</b> |

**SUMMARY OF VISUAL IMPACT SIGNIFICANCE OF THE PROJECT FROM  
SURROUNDING WATERWAYS**

The landscape sensitivity and magnitude of change resulting from the construction and operation of the project, and the significance of the visual impact has been summarized in *Table 9.1* and 9.2.

**Table 9.1** *Summary of visual impact significance from each viewpoint during construction of the project*

| Viewpoint   | Location                                    | Impact<br>Significance | Impact<br>Significance |
|-------------|---------------------------------------------|------------------------|------------------------|
|             |                                             | LNG Facility           | Bridge                 |
| <b>VP9</b>  | Port Curtis adjoining North Passage Island  | Major                  | Major                  |
| <b>VP10</b> | The Narrows – 500m south of proposed bridge | Moderate to Major      | Major                  |
| <b>VP11</b> | The Narrows 1 km north of proposed bridge   | Moderate to Major      | Major                  |
| <b>VP12</b> | The Narrows 5 km north of proposed bridge   | Negligible             | Moderate               |
| <b>VP13</b> | Turtle Island                               | Negligible             | Negligible             |
| <b>VP14</b> | Witt Island                                 | Negligible             | Negligible             |
| <b>VP15</b> | Tide Island                                 | Negligible             | Negligible             |
| <b>VP16</b> | The Port of Gladstone Channel               | Negligible             | Negligible             |



**Table 9.2**      *Summary of visual impact significance from each viewpoint during operation of the project*

| Viewpoint   | Location                                    | Impact<br>Significance | Impact<br>Significance |
|-------------|---------------------------------------------|------------------------|------------------------|
|             |                                             | LNG Facility           | Bridge                 |
| <b>VP9</b>  | Port Curtis adjoining North Passage Island  | Major                  | Major                  |
| <b>VP10</b> | The Narrows – 500m south of proposed bridge | Moderate to Major      | Major                  |
| <b>VP11</b> | The Narrows 1 km north of proposed bridge   | Moderate to Major      | Major                  |
| <b>VP12</b> | The Narrows 5 km north of proposed bridge   | Negligible             | Moderate               |
| <b>VP13</b> | Turtle Island                               | Moderate               | Negligible             |
| <b>VP14</b> | Witt Island                                 | Moderate               | Negligible             |
| <b>VP15</b> | Tide Island                                 | Negligible             | Negligible             |
| <b>VP16</b> | The Port of Gladstone Channel               | Negligible             | Negligible             |

Construction of the QCLNG Facility and associated infrastructure will be undertaken in five stages, as follows:

- Stage 1 Site preparation;
- Stage 2 Civil Work, foundations and structures;
- Stage 3 Mechanical and Electrical Installation;
- Stage 4 Systems Strength and integrity testing; and
- Stage 5 Commissioning of the LNG Facility.

The construction activities relevant to this assessment are discussed in the following sections.

### 10.1 STAGE 1 – SITE PREPARATION

Site preparation will involve the following:

- Establishment of erosion and sedimentation control measures, and perimeter fencing;
- Clearing of vegetation;
- Grubbing root mat;
- Stripping of top soils;
- Hauling and placement of cleared timber, vegetation matter and topsoil to designated disposal sites on Curtis Island within the QCLNG plot boundary;
- Bulk earthworks, involving cut and fill works to establish the construction benches for the proposed LNG Facility; and
- Establishment of the Materials Offloading Facility (MOF) at the west of the site. This area will also receive the personnel, cargo and materials required for the subsequent construction activities.

As the site preparation activities draw towards completion, establishment of the following facility will take place:

- Installation of temporary power generation, and associated fuel storage systems;
- Locating mechanical equipment;
- Construction of access roads;

- Construction of a temporary drainage system;
- Installation of reverse osmosis plant and temporary waste water treatment plant;
- Installation of a water and power distribution networks. For the most part this will be buried and protected;
- Erection of a temporary concrete batching plant;
- Erection of temporary site works buildings and construction camp; and
- Mobilization of construction equipment.

The initial earthworks will primarily involve heavy machinery, including excavators, scrapers, graders, compactors and heavy dump trucks.

Raw materials for construction are anticipated to be transported from Gladstone. This will take place over a period of approximately 24 months.

The construction materials will be offloaded at Curtis Island into trucks waiting on the MOF.

Delivery of raw materials will be matched to the construction requirements where possible to minimise delivery frequencies and to maintain stock piles at the lowest levels that can support sustained construction activities.

This stage has the potential for a high level of visual impact. This will be due to the noticeable visual change associated with the removal of vegetation and presence of construction equipment and infrastructure.

There are no landscape techniques that can be employed to mitigate the visual impacts associated with the construction activities. However construction management practices can be employed to maintain construction areas in a safe, neat and orderly manner.

## 10.2

### *STAGE 2 – CIVIL WORK, FOUNDATIONS AND STRUCTURES*

Foundation construction for the LNG Facility will commence with the LNG storage tanks. This will involve placement of a reinforced concrete base within the processing facility. This will be followed by the construction of the large reinforced foundations for the compressors, pipe racks and other major equipment.

There will be additional foundations outside of the main processing areas. These will be required for the interconnecting pipe racks, buildings, structures and supporting equipment that are located outside of the main processing areas. These will be smaller than the foundations and equipment within the main processing area.

Foundations construction will use excavators, bob-cats, dump trucks and walk behind compaction equipment.

The construction of the marine facility for the export of LNG cargo will also commence at in this stage. Construction of the jetty will involve the installation of piled foundations, driven using floating pile drivers.

Concrete pile caps will be cast over the water, from temporary deck structures supported off the installed piles.

The piled foundations will extend into an area that contains mangroves. These will be allowed to re-establish at the completion of all construction works.

It is anticipated that the dredging programme that is under the direction and supervision of the Gladstone Ports Corporation (GPC) will also commence during this stage.

Due to the construction activity and permanent visual change associated with the erection of permanent structures, this stage also has the potential for a high level of visual impact from areas that can see the site.

There are no landscape techniques that can be employed to mitigate the visual impacts associated with the construction activities. However construction management practices can be employed to maintain construction areas in a safe, neat and orderly manner.

### 10.3

#### *STAGE 3 - MECHANICAL AND ELECTRICAL INSTALLATION AND TESTING*

This stage will involve receiving equipment and material associated with the construction of the LNG Facility and associated infrastructure.

Deliveries for the above ground, (mechanical installation) will commence when the MOF and temporary facilities are available to receive them.

Deliveries will include structural steel, mechanical equipment, electrical equipment, piping materials, as well as general materials that will be required during construction. All deliveries during this stage will be via barge.

Installation of mechanical equipment will involve the erection of structural steel, and setting of the mechanical and electrical equipment on existing foundations. This will be undertaken using a combination of mobile and fixed cranes.

When all equipment is set in place, the task of interconnecting all of these components will commence. This will involve installing the pipe spools, structural steel, power and instrumentation cables between all equipment. Equipment engaged in this work will involve mobile cranes, and working from elevated mobile platforms and scaffolding.

This stage will see the installation of the remainder of the large permanent infrastructure associated with the LNG Facility.



There are no landscape techniques that can be employed to mitigate the visual impacts associated with the construction activities. However construction management practices can be employed to maintain construction areas in a safe, neat and orderly manner.

#### **10.4**                      *STAGE 4 – SYSTEMS STRENGTH AND INTEGRITY*

This stage will involve testing of all mechanical, electrical and control systems associated with the project.

Other than ongoing construction activity, there will be no additional visual impact beyond that discussed in the previous stages.

#### **10.5**                      *STAGE 5- COMMISSIONING OF THE LNG FACILITY*

Upon satisfactory completion and testing of the mechanical, electrical and control systems, the completed plant is handed over to the Commissioning and Start-Up team.

#### **10.6**                      *REHABILITATION*

Once the site is fully operational and over time, the project description and construction methodology has made provision for the existing mangroves to re-establish along the shoreline.

#### **10.7**                      *SUMMARY OF THE CONSTRUCTION IMPACTS*

The site establishment, civil works and mechanical installation stages (Stages 1,2 and 3) have the greatest potential for visual impact. These stages will include vegetation removal, construction activity and erection of the permanent plant and infrastructure associated with the LNG Facility. These stages will therefore comprise permanent and noticeable visual change in the landscape.

There are no onsite landscape techniques that can be employed to mitigate the visual impacts associated with the construction activities beyond those already detailed under the environmental management measures. However construction management practices can be employed to maintain construction areas in a safe, neat and orderly manner.

The assessment of cumulative visual impacts takes into consideration the potential impacts of future development within the viewshed in conjunction with the project's impacts. Whilst there is a significant number of potential industrial developments planned for the Gladstone State Development Areas (GSDA), include the Curtis Island Industrial Precinct, several of these project are currently under investigation and have limited information available for consideration in this assessment. Five projects have been considered in this assessment, three major industrial developments with completed Environmental Impact Assessments and two projects currently under investigation as follows:

Major industrial developments with completed Environmental Impact Assessments:

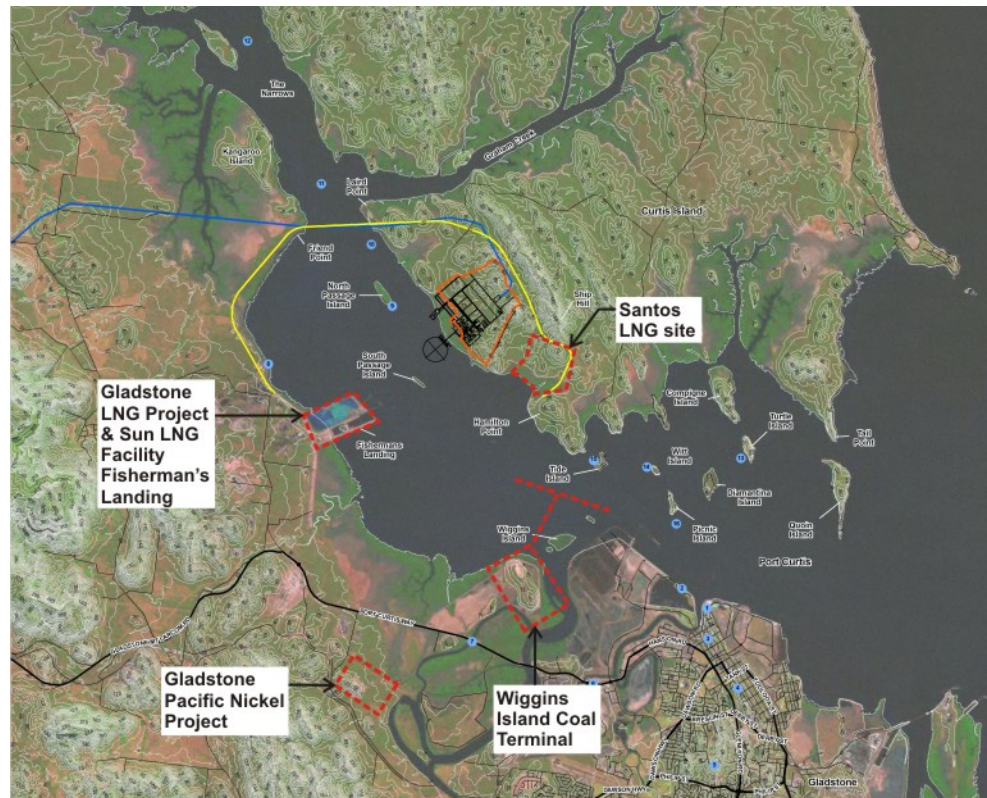
- Wiggins Island Coal Terminal;
- Gladstone Pacific Nickel Project; and
- Gladstone LNG Project – Fisherman's Landing.

Major industrial developments under investigation:

- Sun LNG – Fisherman's Landing; and
- Gladstone LNG Project (Santos) – Curtis Island.

Assessment of impacts is based on the level of information available. Whilst consideration has been given to the two projects currently under investigation, limited detail on the projects has subsequently limited the extent of evaluation.

The location of the above project in relation to the proposed LNG Facility and bridge are outlined in *Figure 11.1*.



**Figure 11.1** *Location of approved future development within the study area*

If these projects proceed they will have some visual impact on the landscape character of the study area as briefly outlined below.

### **11.1** *WIGGINS ISLAND COAL TERMINAL*

The major components of the Wiggins Island project include the wharfs, coal terminal and connecting jetty. The scale of the proposed development, being larger than the existing RG Tanna coal terminal, will significantly increase the current visual impact of industry from Gladstone's urban areas. The proposed wharf is twice the size of the existing coal terminal wharfs, which dominate views between Gladstone and the waters of the Port of Gladstone. The scale of the project will impact on the current landscape character of the waterways by increasing the scale of the industrialised waterfront surrounding Gladstone.

Views towards the proposed site of the LNG Facility and proposed bridge from Gladstone currently include the RG Tanna Coal Terminal. The proposal to increase the wharfs in this area will further inhibit views towards Curtis Island and The Narrows. The RG Tanna coal terminal also creates significant night lighting impact which will further increase as a result of the proposed development. The Wiggins Island Terminal will therefore increase the industrialised waterfront around Gladstone and provide further screen to the QCLNG project from Gladstone urban areas

## 11.2 *GLADSTONE PACIFIC NICKEL PROJECT*

The site for the Gladstone Pacific Nickel refinery is within the viewshed of a number of major industrial facilities and as such will increase the extent and scale of the industrial landscape. The refinery encroaches into the existing rural and estuarine landscape areas, although this change is a continuation of the industrialised precinct extending from Gladstone to Targinie.

In relation to the proposed LNG Facility on Curtis Island, the proposed refinery will not impact significantly on the existing viewshed of the LNG Facility and therefore cumulative impact will not be significant.

## 11.3 *GLADSTONE LNG FACILITY – FISHERMAN’S LANDING*

The visual impact of the proposed LNG facilities on Fisherman’s Landing will increase the industrial character within this section of Port of Gladstone. Fisherman’s Landing is almost directly opposite the site for the proposed LNG Facility on Curtis Island and therefore within a similar viewshed. As noted in the visual impact assessment, *Sections 8 and 9*, Fisherman’s Landing currently has a significant impact on the natural shoreline character being an artificially create bunding with no vegetation in contrast to the natural vegetated estuarine landscape of The Narrows and Curtis Island.

The presence of large scale industrial development either side of the passage to the Narrows will significantly alter the existing character within this section of the passage landscape. The location of the proposed bridge across The Narrows will visually enclose these waters, and with industrial and infrastructure elements located either side of the Targinie passage, the landscape character will be significantly altered. This will be in stark contrast to the existing ‘natural’ landscape on Curtis Island merging with the ‘natural wilderness’ of The Narrows.

## 11.4 *SUN LNG FACILITY – FISHERMAN’S LANDING*

Limited information is available for the Sun LNG Facility however the location at Fisherman’s Landing will further increase the industrial character within this section of the Port of Gladstone. The impacts resulting from the expansion of Fisherman’s Landing as detailed above also apply to this project.

## 11.5 *GLADSTONE LNG PROJECT (SANTOS) – CURTIS ISLAND*

Limited information is available for the Santos LNG Facility on Curtis Island, however it is assumed this project will have similar components to the proposed QCLNG Project. The position of the proposed Santos LNG Facility, in close proximity to the QCLNG Project, will create a continuous high impact



industrial development, broken only by the retention of vegetated ridgelines between the two sites.

The proposed Santos LNG Facility is located closer to Gladstone than the QCLNG Project and is visually more exposed to views from the south. It can be assumed that two LNG Facilities in close proximity will significantly alter the existing landscape character of this section of the Curtis Island shoreline. Retaining natural topographic features and vegetation between the two proposed facilities will provide important visual breaks when viewed from the surrounding areas, as well as providing screening between the two sites at a local level.

## **11.6** *SUMMARY OF CUMULATIVE VISUAL IMPACTS*

The most significant cumulative visual impact of the projects will be the combined visual impacts of the QCLNG project and the Santos LNG Facility with the proposed expansion of the industrial facilities on Fisherman's Landing. The positioning of the industrial/infrastructure elements of the proposed bridge, LNG Facilities on Curtis Island and LNG facilities on Fisherman's Landing will have the visual effect of enclosing this section of Port Curtis and separating it from The Narrows. The location of large industry within the viewshed, where these elements are visually dominant in the landscape, will alter the existing character of the areas creating an industrialised precinct, and visually linking with the industrial landscapes of Gladstone waterfront.

The following Chapter describes an investigation of potential impacts caused by artificial light emanating from the proposed LNG Facility and bridge. A discussion of potential impacts is included, with proposed impact management described in *Section 13*.

Light pollution can be defined as the introduction of artificial light to an area, often to the detriment of an organism or ecosystem.

Reference is made to the following description of the effects of artificial night lighting on ecology, by Poot, H et al (2008); *"Artificial night lighting affects the natural behaviour of many animal species. It can disturb development, activity patterns, and hormone-regulated processes, such as the internal clock mechanism; see references in Rich and Longcore (2006). Probably the best-known effect, however, is that many species are attracted to, and disoriented by, sources of artificial light, a phenomenon called positive phototaxis."*

Light impact assessment is a means of examining the relationship between a light sensitive receptor (such as a marine turtle, a migratory bird, or a person), its environment, and how it might be affected by light pollution.

Light impacts on fauna species within the vicinity of the project has been based on information provided by the ERM ecology team, whilst all effort has been made to be comprehensive, it should be recognised this is a preliminary investigation and further detailed analysis may be required.

## **12.1 DESCRIPTION OF THE PROPOSED LIGHT SOURCE(S);**

At the time of this assessment, detailed lighting plans were not available to assess the location, direction or output of individual luminaires. As such, this assessment is based on a generalised assessment of locating industrial lighting across the project site and the impacts on the surrounding areas. Recommendations are provided in *Section 13* for consideration in the development of an appropriate project specific lighting design.

## **12.2 EXISTING NIGHT LIGHTING CONDITIONS AND POTENTIAL PHYSICAL CHANGE**

The following describes the existing site conditions and surrounding areas at night, and the potential physical change due to the proposed project.

### **12.2.1 The Site**

At the time of the assessment, the project site had no existing artificial light sources located within it. However, the site location is opposite the existing

industrial facilities on Fisherman's Landing, Targinie precinct and Port of Gladstone facilities. Due to the distance from the existing Port of Gladstone facilities Curtis Island is expected to be subjected to light spill caused by the adjacent artificial illumination.

The introduction of an LNG facility on Curtis Island is expected to dramatically alter the existing levels of ambient lighting. Additionally, the areas immediately surrounding the LNG Facility are also expected to be illuminated to some extent.

### 12.2.2

#### *The Mainland*

The mainland areas within the viewshed comprise of three significant sources of artificial light: Targinie and Fisherman's Landing directly adjacent the LNG Facility, the Coal Terminal and Gladstone waterfront, and Gladstone township. Each of these locations comprise of industry standard illumination, and as a result, emit high levels of artificial light. When combined, a significant glow exists above and surrounding the mainland that is visible from both Curtis Island and the surrounding areas, refer *Photographs 12.1* and *12.2*.



*Photograph 12.1*    *Night lighting visible from Gladstone's main street.*



**Photograph 12.2** *Night lighting visible from Auckland Point with RG Tanna Coal Terminal in middle ground.*

Within the areas identified in the Seen Area Analysis as having potential visibility of the project light associated with the LNG Facility is expected to be highly visible at night. Where no lighting currently exists, the introduction of any new artificial light sources would contrast significantly with the surrounding dark landscape. A level of glow is also expected to emanate from the proposed LNG Facility visible from adjacent waterways and mainland areas with views of the LNG Facility.

### **12.2.3** *Impact of night lighting due to marine usage and increased transport movements*

Though currently an active industrial port, marine traffic is expected to increase within the Port of Gladstone and in particular the Targinie passage, owing to the proposed LNG Facility and other future industrial developments. These increases in marine usage are expected to generate varying levels of artificial illumination, however this illumination will be intermittent and generally 'in motion'. This form of artificial lighting has less potential for impacts than fixed and constant lighting.

Additionally, possible future vehicular and rail movements will increase within areas where currently they do not exist, as a result of the introduction of the proposed bridge and approach road. Fixed road lighting is expected to be minimal, however vehicular/rail movement will generate light and movement through areas that are currently in darkness.

## **12.3** *IDENTIFICATION OF LIGHT SENSITIVE RECEPTORS*

Species expected to inhabit or migrate through the proposed project area have been identified and rated on their susceptibility to impacts caused by artificial light pollution. Those species identified with susceptibility to light pollution are based on desk-top research into documented knowledge of light impacts. The general study of light pollution and its effects on wildlife is a relatively new discipline, according to Rich and Longcore (2006), with the exception of birds and sea turtles. Published papers on the subject are generally theoretical and do not specifically address light pollution or artificial lighting, making it



difficult to conduct comprehensive literature reviews on the subject. This lack of literature is duly noted within the description of each receptor below.

**Table 12.1**      *Receptor Identification – Terrestrial Species*

| Species                 | Present on Site<br>or<br>Surrounding<br>Areas | Documented<br>Susceptibility to<br>Impacts Caused by<br>Light Pollution | Potential<br>Susceptibility to<br>Impacts Caused by<br>Light Pollution |
|-------------------------|-----------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------|
| Humans                  | Yes                                           | Limited                                                                 | Low                                                                    |
| Reptiles and Amphibians | Yes                                           | Limited                                                                 | Low                                                                    |
| Birds                   | Yes                                           | Available                                                               | High                                                                   |
| Mammals                 | Yes                                           | Limited                                                                 | Low                                                                    |

**Table 12.2**      *Receptor Identification – Marine Species*

| Species        | Present on Site<br>or<br>Surrounding<br>Areas | Documented<br>Susceptibility to<br>Impacts Caused by<br>Light Pollution | Potential<br>Susceptibility to<br>Impacts Caused by<br>Light Pollution |
|----------------|-----------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------|
| Mammals        | Yes                                           | None                                                                    | Low                                                                    |
| Marine Turtles | Yes                                           | Available                                                               | High                                                                   |
| Fish           | Yes                                           | Limited                                                                 | Low                                                                    |

### **12.3.1**      *Humans*

Light impacts to humans can be classified in two forms; behavioural changes and changes in perception. Both are described below.

#### *Behavioural Changes*

The introduction of artificial lighting to an unlit environment ultimately alters human behaviour in two forms: facilitating navigation, and providing a visible landmark or source of interest. Waterways and natural environments are generally more difficult to navigate without the assistance of artificial illumination, and consequently are utilised less by people. Conversely, the placement of an artificial light source in a location that is otherwise dark, provides a source of interest.

#### *Changes in Perception*

Human perception towards artificial light is more obscure, with many factors contributing to alterations in perception. The population, location of the proposed light source, and the light source itself, are all contributing factors to

how a person perceives the introduction of an artificial light source in the landscape.

For example, the LNG Facility may be perceived by different communities with highly contrasting values. As the LNG Facility is currently located within the Great Barrier Reef World Heritage Area, a regional, national or global population obviously perceive the site to hold high natural value in its current state. Conversely, designation of the GSDA for industrial use places high importance on its potential for economic benefit.

The implications of artificial illumination to both behaviour and perception within humans are discussed further within this chapter.

### 12.3.2 *Reptiles (Excluding Sea Turtles) and Amphibians*

According to Rich and Longcore (2006), relatively little is known about most species of reptiles, particularly impacts caused by artificial illumination. Similarly with amphibians, despite the general lack of literature available, potential impacts have been identified, as follows.

#### *Reptiles (Excluding Sea Turtles)*

Within the assimilation of the sparse literature available, Rich and Longcore (2006) identified two specific effects of artificial illumination on reptiles; these were termed “positive” and “negative”.

The “positive” effects relate to enhanced or extended foraging at night lights. Rich and Longcore (2006) further state that some species of reptiles prey on invertebrates attracted to night lights. In a simplistic sense this is a positive effect because both diurnal and nocturnal species can forage successfully under these conditions.

The adverse effects of such a situation were identified as the “negative” impacts, which Rich and Longcore (2006) state as increased predation risk and decreased foraging success. Again, direct information on negative consequences of artificial lights in free-ranging reptiles is not readily available.

#### *Amphibians*

Rich and Longcore (2006) state that anurans (frogs and toads), may be particularly susceptible to adverse effects from light pollution. Artificial night lighting can affect frogs as much as or more than other taxa for a number of reasons:

- Most species of frogs and toads are partly or completely nocturnal, putting them at risk for exposure to light pollution;

- Nocturnal frogs and toads are predators and prey of other nocturnal animals, and artificial night lighting may cause changes in prey or predator density or behaviour; and
- Frogs and toads may be less mobile than many other animals because of their modes of locomotion and their dependence on sources of moisture, making them less able to compensate for changes in night lighting by moving.

Rich and Longcore (2006) also highlight the need for further research on the effects of light pollution on anurans.

### 12.3.3

#### *Birds*

Little is known about how birds are attracted to light at night (Verheijen 1985). It is clear, however that, like humans, birds use vision to orient themselves, and thus light plays a significant role in their behaviour and navigation. The behavioural response to artificial illumination (and consequent impacts) differs between two distinct groups of birds; migratory and non-migratory, each of which are discussed below.

#### *Migratory Birds*

This type of bird has been described by Rich and Longcore (2006) as birds that move seasonally over tens of degrees of latitude and longitude, often exhibiting movements of hemispheric proportions. These creatures are especially vulnerable to increasing sources and extents of artificial lighting.

Light-associated mortality of nocturnal avian migrants involving collisions of hundreds or thousands or more birds with lights and lighted structures has been well documented for more than a century (Rich and Longcore, 2006).

During studies conducted in the North Sea by Marquenie et al, (ND), a potential impact zone of 3-5km (radius) was nominated for offshore platform illumination. Any birds travelling within this zone were noted to deviate from their intended route, and either circle or land on the nearby platform. This zone could be utilised for quantifying impact identification, however is most appropriate for offshore light sources.

Shorebird foraging patterns are closely linked to tidal fluctuations and migratory species in particular are known to forage for extended periods of time during low tides in the night hours, particularly during their migrations. As such migratory waders are likely to be acutely impacted by light pollution generated by the artificial light spill onto these areas.

### *Non migratory Birds*

The relationship between artificial light and non migratory birds is somewhat different, and relates primarily to the degree of exposure. Non-migratory birds tend to exist within a more local region, and thus are expected to be more exposed to changes within their range of travel. This is most important, as artificial light pollution has been documented to influence both circadian and circannual rhythms of birds. Molenaar et al. 1997 states that night length (or sleep duration) directly effects growth, metabolism, skeletal development, sexual development, courtship and mating, reproductive cycle, migration and moulting.

In addition it is likely that the impact of artificial light pollution is likely to be more pronounced in nocturnal species than in diurnal species. Nocturnal species of concern include Powerful Owl, Barking Owl (discussed in *Section 12.3.4*) and migratory waders.

#### **12.3.4 Mammals**

Compared with investigations on birds, lepidopterans, other insects, and turtles, few studies, or even anecdotal reports, document the effects of artificial night lighting on mammals in the wild (Rich and Longcore, 2006). However, the discussion of the following biological factors provides Rich and Longcore (2009) with sufficient evidence to propose plausible effects of artificial night lighting on mammals:

- Light and the ecology and physiology of mammals;
- The anatomy and physiology of vision in mammals;
- The influence of moonlight on behaviour of nocturnal mammals;
- The circadian clock in mammals; and
- The circannual clock and lunar clock in mammals.

Based on these factors, Rich and Longcore (2006), identified the potential influences of artificial lights at night on mammals to include:

- Disruption of foraging behaviour;
- Disruption of biological clocks;
- Increased death in collisions on roads, and through predation; and
- Disruption of dispersal movements and corridor use.

There is no direct evidence to suggest that artificial light sources impact on the migratory, feeding or breeding behaviours of marine mammals. Dolphins may indirectly be attracted to lighted structures in marine environments as these areas tend to attract marine fauna, creating food sources (i.e. aggregations of fish).



Witherington and Martin (1996) state that light pollution on nesting beaches is detrimental to sea turtles because it alters critical nocturnal behaviour. Specific behavioural response to the availability of light by marine turtles has been defined by Witherington and Martin (1996) as:

- Disorientation: Loss of orientation. Being unable to maintain constant directional movement; and
- Misorientation: Orientation in the wrong direction. For hatchling sea turtles on the beach, travel in any direction other than the general vicinity of the ocean.

There are many variables that influence the range and severity of effects of light pollution on the behaviour of marine turtles. The following key factors have been identified most crucial to the relationship between light and marine turtles:

- Turtle vision;
- The maturity of the turtle (adult and hatchling);
- The application of light on turtles; and
- The resulting changes in behaviour.

Much of the behaviour of marine turtles is primarily guided by light cues. According to Witherington and Martin (1996), marine turtles have a tendency to orientate towards brightness. Researchers have learned about sea turtles' perception of brightness by using electroretinography (ERG) to measure the relative electrical potential across the retinas of turtles exposed to different wavelengths of light. ERG data suggest that turtles are most sensitive to light in the violet to orange region of the visible spectrum, from 400 to 640 nanometres (nm).

Field based sea turtle hatchling arena experiments carried out on Barrow Island found that green turtle hatchlings can see blue light (450 to 500nm), green light (500 to 570nm), yellow light (570 to 590nm) and orange light (590 to 610nm) however, they are typically more responsive to shorter wavelength lights (< 400 to 590nm) and commonly show a greater spectral sensitivity within the violet and blue region of the spectrum (Pendoley, 2005).

It is also noted by Witherington and Martin (1996) that the ocean selectively absorbs red, high (long) wavelength light and therefore, it is not surprising that marine turtles are most sensitive to light within the lower (shorter) wavelength (violet) region of the visible spectrum.

There exist multiple theories regarding extent of the visible range of a sea turtle, in comparison to human visibility. One factor that has been confirmed is that marine turtles see ultra violet (UV) wavelengths as visible light.

The importance of UV light is described by Fritsches and Warrant (2005) in Swimmer and Brill (2006), who state that anatomical and optical results indicate that sea turtles can see in the UV waveband, while blue water fishes cannot (Fritsches et al., 2000), thereby suggesting UV light as a possible “secret communication channel” in sea turtles. Preliminary behavioral experiments (conducted by Fritsches and Warrant) in February 2005 indicate that sea turtles (loggerhead hatchlings) actually respond to steady UV light (Light Emitting Diode (LED) with peak at 370 nm) when swimming. These experiments take advantage of the natural tendency of the hatchlings to orient towards a light source and clearly showed that these animals can see UV light.

As UV exists within the range of approximately 10 – 400nm, the visible range of a marine turtle could be much lower than 400nm. According to light manufacturer OSRAM (2007), the earth’s atmosphere blocks UV radiation below approximately 340nm. Based on this information, it is unlikely that a marine turtle’s eyesight would respond to UV radiation (below 340nm) as light.

### *Adults*

The three specific impacts that light has on adult turtles are listed by Witherington and Martin (1996) as being: the disruption of the nest-site selection; nesting behaviour abandonment and abbreviation; and sea finding. Adult marine turtles typically require (among other factors) a dark location to lay eggs. However, nesting populations of marine turtles have been known to continue to nest despite the introduction of artificial light (eg, Varanus Island, Barrow Island). The extent of impact is unclear, as long term research is required to determine a change of nesting success due to artificial light.

### *Hatchlings*

Hatchlings emerging from a nest may be disorientated by artificial lighting. Hatchlings use light as a cue to locate the ocean. They are attracted to artificial lights and will move towards these lights rather than their natural behaviour towards the ocean (safety and shelter).

Extensive light attraction studies have been conducted on turtle hatchlings in arena surveys, most recently by Dr Kellie Pendoley at Barrow Island (2005). These studies demonstrated hatchling response to light sources typically found in industrial situations, at varying distances. Hatchling behaviour on a beach (in response to artificial light) was documented with distances between the hatchlings and the light sources up to 800m. These studies demonstrated that when on land, hatchlings were not significantly affected by artificial light at a distance of 800m, where the light density was up to 0.07 lux.

After entering the ocean, sea turtle hatchlings may use at least two different orientation cues to direct their seaward migration (Lohmann, 1992). Hatchlings initially orient by swimming into waves (Lohmann and Lohmann,

1992). As waves enter shallow water and approach the shore, the propagation direction is refracted until it is nearly perpendicular to the beach (Denny, 1988). Thus, swimming into waves initially results in a seaward course. Magnetic direction is thought to be another key orientation cue.

Marine turtle hatchlings have limited swimming strength and speed and are subject to environmental conditions such as ocean currents, waves and tidal flow. Little is known, however, of the extent to which hatchlings still use vision for orientation, and consequently, the impact of light pollution on their behaviour, once they enter the ocean. Hatchlings have been observed to temporarily swim around an illuminated vessel, anchored within 500m of a nesting beach, and then depart within minutes (Usher, 2007).

#### 12.3.6 *Fishes*

Despite the well-known and profound influence of light on the behaviour of aquatic organisms, especially invertebrate and vertebrate animals, little research has addressed the consequences of human disruption of diel, lunar, and seasonal cycles of illumination (Rich and Longcore, 2006).

However, the discussion of the following biological factors provides Rich and Longcore (2009) with sufficient evidence to propose plausible effects of artificial night lighting on teleosts (bony fish):

- The visual system of teleosts;
- The influence of species type;
- The influence of maturity;
- Ambient illumination; and
- Lighting type.

Based on these factors, Rich and Longcore (2006), identified the potential influences of artificial lights at night on fishes to include:

- Disruption of foraging behaviour;
- Increase of predation risk;
- Disruption of migration; and
- Disruption of reproduction.

The following describes the methodology for the assessment of light impacts. Within this chapter, reference is made to the ecology studies that run parallel to this study, and the findings of both marine and terrestrial ecology survey data. This information (which includes the proximity of receptors habitation to the site) combined with the literature cited previously, form the basis of the selected impact assessment method.

Due to the limited quantity of field survey information available, the identification process involves mapping and evaluation against known species present.

#### 12.4.1

##### *Visibility Mapping*

The methodology for the assessment of light impacts works on the premise of line of sight and is used to determine the potential impacts of light spill. Light spill refers to any light emitted from an artificial light source which is extraneous to that required to illuminate a particular object, surface or plane. Put in simple terms, light spill refers to the visibility of a light source (this excludes glow).

Visibility mapping was prepared previously within this report for the proposed Curtis Island Bridge and LNG Facility. The Seen Area Analysis describes the total area of visibility of the project and when combined with the habitat mapping documented in the fauna studies for this project (currently limited to marine turtles and birds), the viewshed analysis also defines a map of where light spill is likely to occur, and the potential visibility for sensitive fauna and human habitation, refer Figure 12.1.

#### 12.4.2

##### *Potential Impacts on Humans*

###### *Human Behaviour*

Current patterns of visitation to the project site are generally infrequent and temporary. There are few accessible tracks through this section of Curtis Island. The adjoining waterways to the site are currently used by marine traffic for both commercial and recreational activities.

Based on the proximity of the human habitation to the project site, and the existing artificial illumination in the surrounding area, the potential impacts will be limited to an increase of lights on adjoining navigational waterways. These impacts are considered to be minor with no measureable behavioural changes to activities currently undertaken in the area.



Based on the proximity of human habitation to the project, and the existing artificial illumination in the surrounding area, two main factors determine the impact on human perception of the project night lighting as follows:

- The location of the project on Curtis Island, a relatively natural landscape with no current man-modified night lighting impacts, and situated within the Great Barrier Reef World Heritage Area (GBRWhA); and
- The classification of the site as part of an industrial precinct under the GSDA designation.

The proposed LNG Facility on Curtis Island and other proposed future industrial development within the Curtis Island Industrial Precinct will substantially change the perception of this section of Curtis Island as a natural backdrop to the Port of Gladstone and link these new industrial expansion areas with existing waterfront industries. The perception of artificial illumination within and immediately surrounding the project site has the potential to reduce the perceived landscape value of this section of natural coastline. However, limited visibility of the project site from Gladstone and surrounding residential areas will reduce the significance of this perceived impact. High levels of existing industrial lighting surrounding the Port of Gladstone will also reduce the significance of the Project's night lighting impacts when viewed from the mainland areas.

#### **12.4.3 *Potential Impacts on Reptiles (Excluding Sea Turtles) and Amphibians***

The terrestrial field surveys identified 19 reptiles and nine frog species. The Green Tree Frog (observed and heard) was recorded during spotlighting. The numbers of individuals and capture/observation techniques are provided in the terrestrial fauna report. The grassy and shrubby understorey of the forests and woodlands within the study area also support an abundance of small skinks (*Carlia*, *Menetia* and *Cryptoblepharus* spp).

*Figure 12.1* demonstrates the areas of potential light spill based on the visibility analysis. In the absence of spatial data of reptile and amphibian habitation, this figure could also be used to determine the extent of potential impacts to both reptiles and amphibians. All areas indicated as either blue or light blue is considered the 'impact zone' and could facilitate both negative and positive impacts on both reptiles and amphibians, as identified within the receptor identification section of this report. For both reptiles and amphibians, impacts such as increased foraging and predation are expected to be moderate within the impact zone. However these localised impacts are not expected to effect the greater populations of either amphibians or reptiles.

#### 12.4.4

#### *Potential Impact on Birds*

The nesting and foraging habitat areas for birds identified during the terrestrial field surveys are indicated on *Figure 12.1* of this report. As the project site is a land based location (and a destination for birds), flight paths of migratory birds are not considered necessary for assessment.

The following species have been selected based on their current conservation preservation status, and proximity to the project site:

*Beach Stone-curlew* – A pair of Beach Stone-curlews was recorded flying along the edge of the site at dusk on one evening of the survey. This pair may occasionally forage along the mangrove fringe adjacent to the LNG Facility site and is suspected to roost on the small island to the west of the site. However, it is predicted that Beach Stone-curlews would continue to forage near the LNG Facility site although they may avoid areas of high activity.

*Eastern Curlew* – Small numbers of Eastern Curlews (up to 3 during the survey) forage on the LNG Facility site at high and low tide.

*Powerful Owl* – The LNG Facility site represents part of a foraging home range used by one, possibly two, Powerful Owls. It is probable that the impacts of light pollution on this species will be pronounced, reducing the home-range of the owl pair inhabiting the territory most exposed to the light pollution, and potentially disrupting breeding habitat, foraging areas and potential prey species.

*Square-tailed Kite* – Square-tailed Kites are known to occur in the Gladstone area and habitat within the LNG Facility site is suitable for foraging and nesting (Marchant & Higgins 1993).

*Black-chinned Honeyeater* - If present, the Black-chinned Honeyeater is likely to be an uncommon visitor to the study area and would most likely occur during peak flowering periods of Grey Ironbark and Forest Red Gum (Higgins *et al.* 2001).

The QCLNG site contains an unusually high abundance of Southern Boobook and Barking Owl pairs. Up to four pairs of Boobook and three family groups of Barking Owl have been recorded within the proposed plant site. It is probable that the illumination from the site will decrease the value of habitat for these species with increased illumination levels in proximity of the site.

Of the roosting and foraging areas identified to exist within and surrounding the project site, those located to the south and west of the LNG Facility site are expected to be subjected to light spill (refer *Figure 12.1*). It is at these locations that any potential impacts are expected to occur.

For the roosting sites, any potential impacts on these locations area expected to be low to moderate, and difficult to differentiate from natural fluctuations or trends. Potential impacts may include detrimental change to growth, metabolism, skeletal development, sexual development, courtship and

mating, reproductive cycle, and moulting. The impacts are also expected to be cumulative, given the existing light sources, and potential industrial growth on neighbouring sites. Without quantitative data on bird numbers, and relativity to a greater population, the extents of such impacts are unknown. It is possible that displacement of birds to alternative roosting sites may occur.

Within the foraging site, however, an increase in food source is expected with the introduction of artificial illumination. This could also result in adverse effects caused by increased foraging competition, and ultimately predation. Similar to the roosting sites, the impacts are also expected to be cumulative, given the existing light sources, and potential industrial growth on neighbouring sites. Without quantitative data on bird numbers, and relativity to a greater population, the extents of such impacts are unknown.

#### 12.4.5 *Potential impacts on Mammals*

During the terrestrial fauna surveys, a total of 490 trap nights resulted in no captures of ground dwelling mammals. The following native species were recorded during spotlighting:

- Micropchiropteran bats (observed);
- Megachiropteran bats (observed);
- Sugar Glider (observed and heard);
- Squirrel Glider (observed and heard);
- Yellow-bellied Glider (observed); and
- Brushtail Possum (observed).

No listed threatened or migratory terrestrial mammal species were recorded during field surveys.

Without quantitative data on mammal numbers, and relativity to a greater population, the extents of such impacts are unknown. However the following impacts are expected to occur to a localised population of mammals:

- Disruption of foraging behaviour;
- Disruption of biological clocks;
- Decrease in viable roosting and nesting habitat;
- Increased death in collisions on roads, and through predation; and
- Disruption of dispersal movements and corridor use.

Two species of dolphin are found in the area, Snubfin (*Orcaella heinsohni*) and Indo - Pacific Humpback Dolphin (*Sousa chinensis*). As indicated previously dolphins may indirectly be attracted to lighted structures in marine environments as these areas tend to attract marine fauna, creating food sources. Impacts on behaviour would be localised and of minor significance.

#### **12.4.6 *Potential Impacts on Marine Turtles***

The eastern, seaward-facing beaches are used as breeding sites by a number of sea turtles including the Flatback (*Natator depressus*) and Loggerhead (*Caretta caretta*). These nesting beaches are indicated on *Figure 12.1*.

Of these nesting beaches identified to exist nearby the Site, based on the visibility mapping, none are expected to be subjected to light spill (refer *Figure 12.1*).

With each nesting beach expected to remain in darkness, adult marine turtles are not expected to be impacted by artificial illumination from the proposed infrastructure. The ambient glow from the LNG Facility is not expected to affect marine turtle hatchlings due to the distance from the nesting areas.

#### **12.4.7 *Potential Impact on Fishes***

Estuarine fish species have been identified to exist within The Narrows, and along the intertidal area along the southern boundary of the project site.

Whilst it is recognised that fish activity is expected to increase with the introduction of artificial illumination, this is expected to be localised. The existing illumination of nearby coastline suggests that impacts caused by artificial illumination currently exist, and any increase caused by the proposed development could contribute to cumulative impacts. Such impacts however, are generally difficult to discern from natural fluctuations in population.

### **12.5 *SUMMARY OF POTENTIAL IMPACTS ON LIGHT SENSITIVE RECEPTORS***

The summary tables, *refer Tables 12.1, 12.2, 12.3 and 12.4*, contain threatened and nocturnal species likely to be impacted by night lighting at the study site. The compilation of the threatened species list is based on the desktop and field ecological assessments undertaken as part of the EIS, and contains species known to occur within the study area and those with a low or moderate likelihood of occurring within the study area. Greater detail on the species present is provided in Chapter 7 - Terrestrial Ecology and Chapter 8 - Marine Ecology.



**Table 12.1 Potential impacts on threatened and nocturnal reptile and amphibian species.**

| Light Receptor                                                                               | Likelihood of occurrence  | Significance Rating |          | Expected Potential Impact (Range of Impact) |
|----------------------------------------------------------------------------------------------|---------------------------|---------------------|----------|---------------------------------------------|
|                                                                                              |                           | NC Act              | EPBC Act |                                             |
| Reptiles and Amphibians                                                                      |                           |                     |          |                                             |
| Caretta caretta (Loggerhead Turtle)                                                          | Potentially within region | E                   | E, M     | Negligible/Low (Regional)                   |
| Chelonia mydas (Green Turtle)                                                                | Potentially within region | V                   | V, M     | Negligible/Low (Regional)                   |
| Dermochelys coriacea (Leatherback Turtle)                                                    | Potentially within region |                     | V, M     | Negligible/Low (Regional)                   |
| Egernia rugosa (Yakka Skink)                                                                 | Potentially within region |                     | V        | Negligible/Low (Regional)                   |
| Eretmochelys imbricata (Hawksbill Turtle)                                                    | Potentially within region |                     | V, M     | Negligible/Low (Regional)                   |
| Lepidochelys olivacea (Pacific Ridley, Olive Ridley)                                         | Potentially within region |                     | E, M     | Negligible/Low (Regional)                   |
| Natator depressus (Flatback Turtle)                                                          | Potentially within region | V                   | V, M     | Negligible/Low (Regional)                   |
| E = Endangered, V = Vulnerable, R = Rare, M = Migratory,                                     |                           |                     |          |                                             |
| NC Act = Queensland <i>Nature Conservation Act 1992</i>                                      |                           |                     |          |                                             |
| EPBC Act = Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> |                           |                     |          |                                             |

**Table 12.2 Potential impacts on threatened and nocturnal bird species.**

| Light Receptor                                          | Likelihood of occurrence | Significance Rating |          | Expected Potential Impact |
|---------------------------------------------------------|--------------------------|---------------------|----------|---------------------------|
|                                                         |                          | NC Act              | EPBC Act |                           |
| <b>Birds</b>                                            |                          |                     |          |                           |
| Erythrotriorchis radiatus (Red Goshawk)                 | Low                      |                     | V        | Low (Regional)            |
| Esacus neglectus (Beach Stone Curlew)                   | Confirmed                | V                   |          | High (Regional)           |
| Numenius madagascariensis (Eastern Curlew)              | Confirmed                | R                   |          | High (Local)              |
| Lophoictinia isura (Square Tailed Kite)                 | Moderate                 | R                   |          | Low (Regional)            |
| Melithreptus gularis gularis (Black Chinned Honeyeater) | Moderate                 | R                   |          | Low (Regional)            |
| Podargus strigoides (Tawny Frogmouth)                   | Confirmed                |                     | None     | Moderate (Local)          |
| Ninox connivens (Barking Owl)                           | Confirmed                |                     | None     | High (Local)              |
| Ninox novaeseelandiae (Southern Boobook Owl)            | Confirmed                |                     | None     | High (Local)              |
| Ninox strenua (Powerful Owl)                            | Confirmed                |                     | V        | High (Local)              |

It should be noted for all bird species (particularly migratory species) that robust impact quantification is difficult without population numbers. The following levels of impact should be used as a guide only, with further studies recommended.

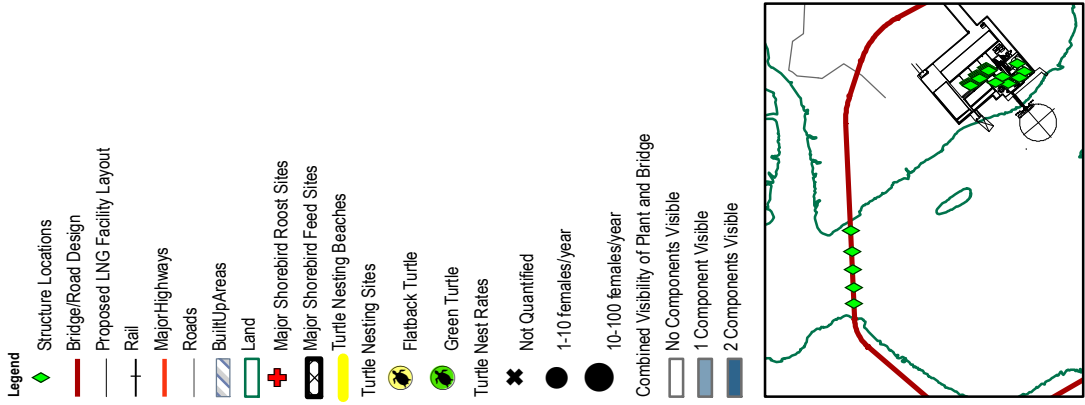
**Table 12.3 Potential impacts on threatened and nocturnal mammal species.**

| Light Receptor                                              | Likelihood of occurrence | Significance Rating |          | Expected Potential Impact (Range of Impact) |
|-------------------------------------------------------------|--------------------------|---------------------|----------|---------------------------------------------|
|                                                             |                          | NC Act              | EPBC Act |                                             |
| <b>Mammals</b>                                              |                          |                     |          |                                             |
| <i>Trichosurus vulpecula</i> (Brush-tailed Possum)          | Confirmed                | None                |          | Low (Local)                                 |
| <i>Chalinolobus picatus</i> (Little Pied Bat)               | Low                      | R                   |          | Moderate (Local)                            |
| <i>Pteropus alecto</i> (Black Flying Fox)                   | Confirmed                | None                |          | Moderate (Local)                            |
| <i>Petaurus breviceps</i> (Sugar Glider)                    | Confirmed                | None                |          | Moderate (Local)                            |
| <i>Petaurus norfolcensis</i> (Squirrel Glider)              | Confirmed                | None                |          | Moderate (Local)                            |
| <i>Petaurus australis australis</i> (Yellow-bellied Glider) | Likely                   | None                |          | Moderate (Local)                            |
| <i>Orcaella heinsohni</i> (Snubfin Dolphin)                 | Confirmed                |                     | M        | Low (Local)                                 |
| <i>Sousa chinensis</i> (Indo – Pacific Humpback Dolphin)    | Confirmed                |                     | M        | Low (Local)                                 |

**Table 12.4 Potential impacts on fish species.**

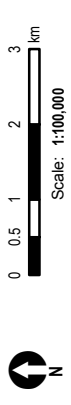
| Light Receptor | Likelihood of occurrence       | Significance Rating | Expected Potential Impact (Range of Impact) |
|----------------|--------------------------------|---------------------|---------------------------------------------|
| <b>Fishes</b>  | On site and surrounding waters | None                | Low (Local)                                 |





**Figure 12.1**  
**Potential Light Spill Areas and**  
**Fauna Habitat Locations**

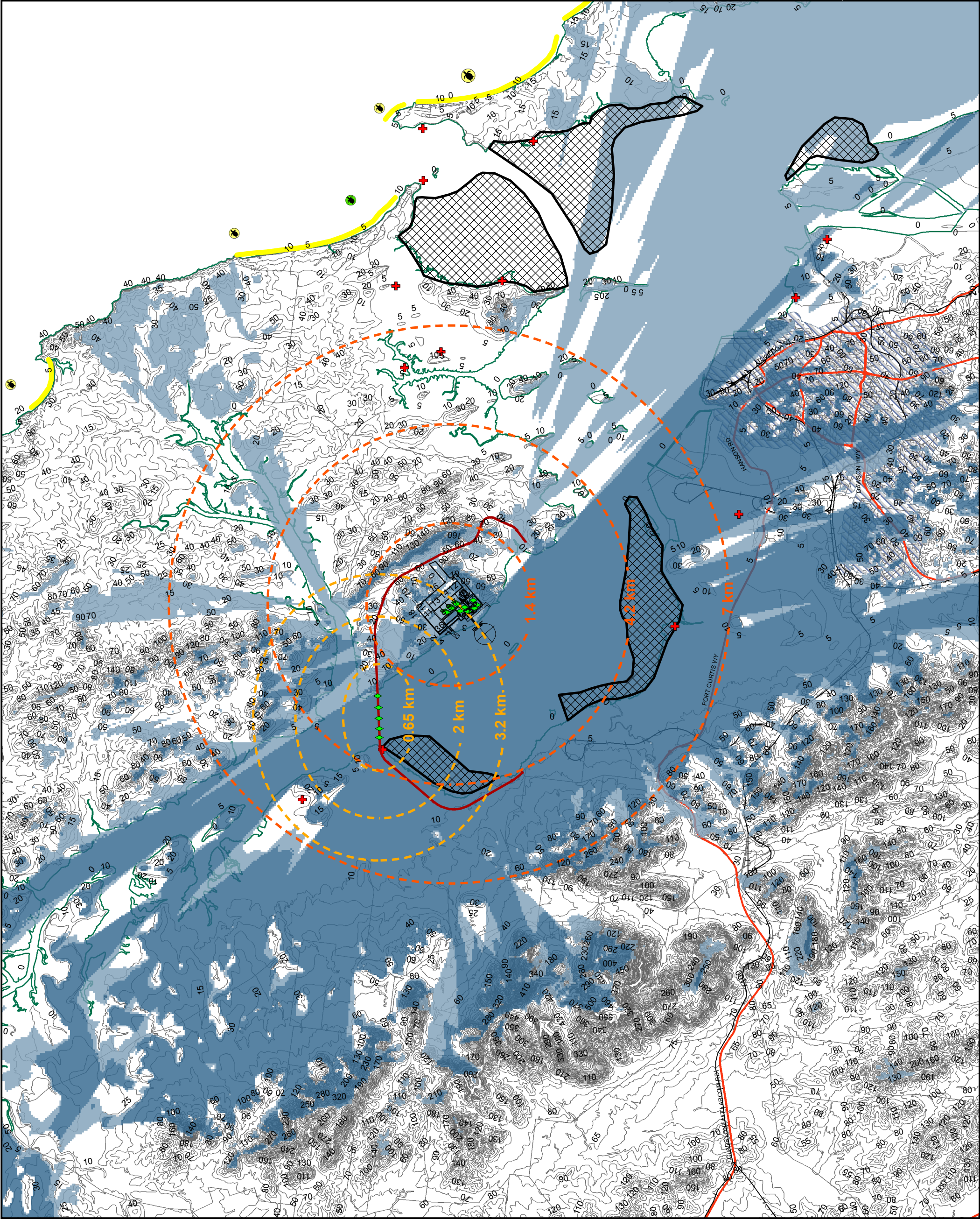
|              |                               |
|--------------|-------------------------------|
| Client:      | QGC                           |
| Project:     | Queensland Curtis LNG Project |
| Drawing No:  | 0086165s_VA_GIS013_R0         |
| Date:        | 13/03/2009                    |
| Drawn by:    | JF                            |
| Reviewed by: | SC                            |



Projection: UTM MGA Zone 56  
Datum: GDA 94

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## ***PROPOSED MANAGEMENT AND MITIGATION OF THE VISUAL IMPACT OF THE NIGHT LIGHTING***

There is no single solution to light impacts on sensitive receptors. As such the implementation of a range of management strategies should be considered in order to provide sufficient management and mitigation of the potential impacts.

As discussed previously, light can cause impacts through two primary forms, light spill (direct line of sight) and glow. Current management practices include:

- Minimising the use of lighting during construction;
- Non reflective surface treatment;
- Lighting management plans for facilities;
- Flaring management plans; and
- Limiting the height of lighting as much as possible, directing lights inward and downward to reduce light spill and placing shades to further reduce light spill, provided safety of personnel is not compromised.

The following provides a range of strategies that aim to mitigate the effects of both light spill and glow:

- Lighting design guidelines (efficient lighting design);
- Micro siting and physical light barriers;
- The use of non or low light reflecting surfaces;
- Timing schedules for construction period; and
- A lighting design audit and (construction and operation) light audit.

### ***13.1***

#### ***LIGHTING DESIGN GUIDELINES***

The following guidelines have been prepared to guide the design of the project to reduce potential sources of light pollution and therefore any light impacts on sensitive receptors:

- If it does not have to be lit, do not light it;
- If it does have to be lit, light it and nothing else;
- All lighting should only be available for the duration of the illumination requirement;

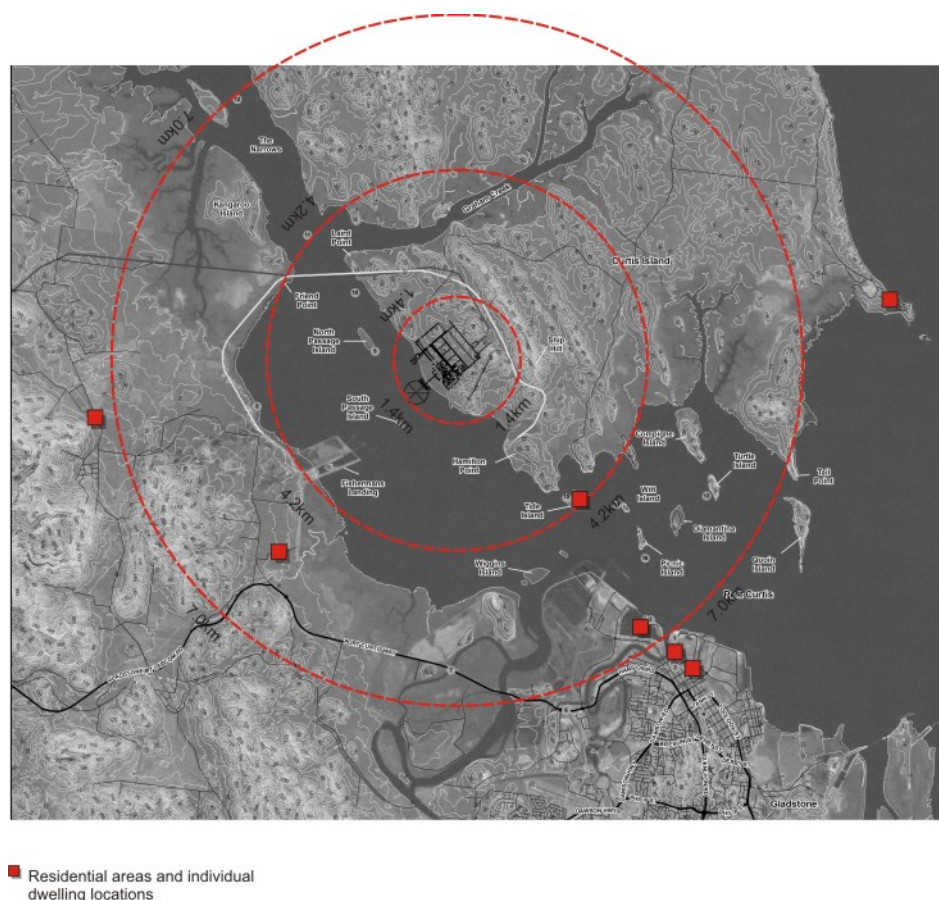
- Install physical barriers between pedestrian and vehicular traffic and light pedestrian pathways with low light emission ground level lighting shielded from ecologically sensitive areas;
- Do not light vehicular roadways unless necessary. Provide low or ground level reflectors and reflective road lines;
- All lighting with the exception of emergency lighting should be localized. General lighting should be for emergency lighting only;
- Select low reflectivity paint for plant and structures where functionally possible;
- External lighting should only be as elevated as is necessary to provide sufficient occupational health and safety (OHS) lighting;
- External lighting for maintenance and inspection should be movement or time sensitive as to turn off when not required;
- Micro siting should be undertaken for luminaires to ensure conformation with existing site conditions; and
- Irradiated light from all illuminated surfaces is typically the major component of the creation of glow. The use of low or non-reflective surfaces should be considered as a factor for minimising light glow above the industrial facilities.

The following chapter describes an investigation of potential visual impacts caused by the proposed LNG Facility and bridge on surrounding residential properties.

The viewshed of the proposed LNG Facility extends to a distance of 7.0 km from the LNG Facility site and 3.2 km for the proposed bridge as described in *Section 4* of this report. The viewshed and zones of visual influence show that the major visual impact or distance at which the proposed LNG Facility has the potential to become visually evident and dominate views is within 4.2 km of the project. The distance at which the proposed bridge has the potential to become visually evident and can dominate views within 2 km of the project.

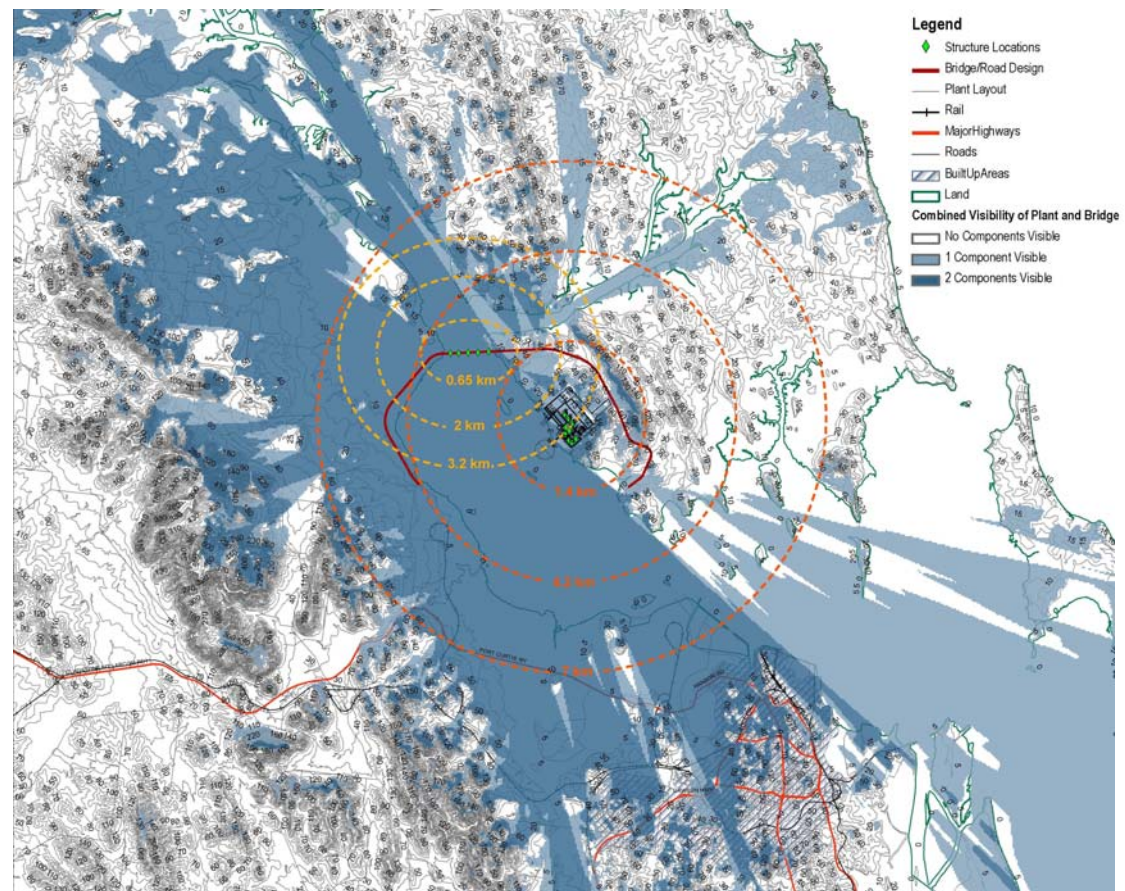
An assessment of the location of residential properties within the viewshed was undertaken based on analysis of aerial photographs and some 'ground truthing'. The assessment of residential status (owner, renting, etc) was limited. Residential properties within the GSDA, notably the Targinie Precinct and Curtis Island Industrial Precinct, are subject to the provisions of the GSDA legislation and tenure is understood to be limited.

Figure 14.1 shows the known residential locations or clusters of dwellings within the 7.0 km viewshed of the proposed LNG Facility.



**Figure 14.1** Residential dwellings within the viewshed

Figure 14.2 shows an extract of the combined seen area analysis of both the LNG Facility and proposed bridge.



**Figure 14.2** *Combined Seen Area Analysis Bridge and LNG Facility*

The mapping shown in Figures 14.1 and 14.2 indicated there are few residential dwellings within the viewshed of proposed LNG Facility or the proposed bridge.

The low numbers of residences (1) within 4.2 km of the LNG Facility shows that the project potential affects a very limited number of people at their place of residence. The nearest residential dwelling to the proposed LNG Facility is located on Tide Island which is approximately 4.2 km to the south east of the LNG Facility. Two other residences are located on Witt and Turtle Islands, however these are located outside the 4.2km zone of visual influence. Assessment of views from Tide Island, and adjoining islands, refer Section 9 Viewpoint 15, identified no visual impact on the residential properties will occur in this area as the properties on the three closest islands (Tide, Witt and Turtle Islands) face east and are screened by intervening topography.

No residential properties were identified within 2km of the proposed bridge, confirming the bridge will not have any significant impact on residential views.



The majority of residential areas within Gladstone are outside of the viewshed, therefore most of the available views are at such a distance that the project will not significantly impact visual quality (refer *Section 8*).

Overall the impact on residential properties is not significant as a result of the following:

- There are no residential properties with views of the project within 4.2km of the LNG Facility and within 2km of the proposed bridge. Therefore there are no properties where views of the LNG Facility will be visually dominant in the landscape;
- Residential properties within the viewshed (7km) of the LNG Facility are limited in number. The residential properties within the Targinie Industrial Precinct are subject to the GDSA legislative provisions and tenure is limited;
- There are no residential properties within the viewshed of the proposed bridge (3.2 km); and
- The majority of residential areas in Gladstone are outside the viewshed. Viewpoint analysis undertaken from Gladstone (*Section 8* of this report) confirm views to Curtis Island and The Narrows from these areas are currently impacted by industrial development and the proposed project will not significantly impact these views.

For these reasons, it is considered that the visual impact to residential properties as a result of the construction and operation of the proposed LNG Facility and proposed bridge will be low to negligible.

The scale and function of any LNG facility precludes significant modification to the design for the purpose of mitigating visual impact. However, the preliminary stage of the QCLNG Project enables some design principles to be established as design parameters for further development of the engineering design. This assessment has been based on a 'mitigated' design, that is, it is based on the assumption the project mitigation measures as detailed in the project description (*Section 3* of this report) form part of the Project. For example, photomontage representations of the LNG Facility incorporate the retention of existing vegetation as screening to the site as well as the design and colour of major structures, as this is the intended management outcome recommended in this report.

The following section describes how the proposed management and mitigation measures meet, or partially meet, the desired outcomes for the protection of Areas of State Significant (Coastal Landscape) values as detailed in the Curtis Coast Regional Coastal Management Plan. As previously identified, while the GSDA designation allows for heavy impact industry development in this location, there remains the requirement to minimise the impact on designated values where possible. The following summary details the desired outcomes and measures as designated in Schedule 1 of the Areas of State Significant (Coastal Landscape) Policy and the management and mitigation measures proposed to achieve these outcomes.

### 15.1

#### **CURTIS ISLAND**

The desired outcomes to protect and maintain the landscape values of Curtis Island and '*ensure the development remains unobtrusive and compatible with landscape values*' will partially be met through the following management and mitigation measures:

- Screening of the project from the vast majority of Curtis Island and in particular the adjoining Environmental Management Precinct, has been achieved through the location of the project in relation to the Ship Hill linear ridgeline located to the north. Vegetation along these ridgelines is to be retained and protected;
- Retaining the vegetated ridges and hills on the skyline will also assist in reducing the visual impact by retaining the natural landscape horizon;
- The landscape values of Curtis Island as viewed from Gladstone are largely maintained due to the retention of the minor ridgeline located to the south east of the site. Vegetation along these hills and ridgelines are to be managed and maintained to ensure their long term integrity as important screening elements in the landscape;

- Views of Curtis Island from Targinie and the waters of the Port of Gladstone opposite the site do not have the benefit of the screening potential of topography or vegetation. Retention of the mangroves along the shoreline, where possible, will contribute to reducing the visual impact by maintaining a continuity of the natural shoreline on Curtis Island and 'softening' the interface between the constructed edge of the LNG Facility and the waters edge; and
- Where practical and within the design parameters of the LNG Facility, consideration should be given to the selection of colours of material that will be 'recessive' (colours that recede into the background) and compatible with the landscape setting.

## 15.2

### *THE NARROWS*

The desired outcomes to protect and maintain the landscape values of The Narrows will partially be met through the following management and mitigation measures:

- The main bulk of the LNG Facility has been located behind the mangrove line, with only the Marine Facilities extending beyond the shoreline. This retains the edges of mangrove vegetation and visual continuity of the shoreline and achieves the desired outcome to 'Maintain existing vegetation along waterways to a maximum extent to form a natural landscape edge and screen.' Whilst the screening potential of the mangroves is low due to their low growth height (approx 5m), their importance lies in retaining continuity of the natural shoreline; and
- The requirement to 'ensure infrastructure in areas of high visual quality does not obscure views to water or intrude on waterways is partially achieved through setting the main LNG Plant back from the shoreline.

## **PROPOSED MANAGEMENT AND MITIGATION OF THE VISUAL IMPACT OF THE CURTIS ISLAND BRIDGE AND APPROACH ROADS**

As for the LNG Facility, the scale and function of the proposed Curtis Island Bridge precludes significant modification for the purpose of mitigating visual impact. The preliminary stage of the Curtis Island Bridge design however does enable some design principles to be established for the reduction of visual impact. This assessment has been based on a 'mitigated' design, that is, it is based on the assumption the project mitigation measures as detailed in the project description (*Section 2* of this report) form part of the project.

The following section described how the proposed management and mitigation measures meet, or partially meet, the desired outcomes for the protection of Areas of State Significant (Coastal Landscape) values as detailed in the Curtis Coast Regional Coastal Management Plan.

### **16.1**

#### **CURTIS ISLAND**

The desired outcomes to protect and maintain the landscape values of Curtis Island and '*ensure the development remains unobtrusive and compatible with landscape values*' will partially be met through the following management and mitigation measures:

- Screening of the approach roads and abutment to the proposed bridge with endemic planting on embankments and disturbed areas;
- Detailed design of abutments to minimise visual impact such as the use of riprap rock and planting;
- Retention of the mangroves shoreline, where possible, by limiting the extent of disturbance during construction and reinstatement as part of the landscape rehabilitation process; and
- Use of recessive materials, colours, and textures on the bridge to reducing light reflection and increase compatibility with the landscape setting.



The desired outcomes to protect and maintain the landscape values of The Narrows will partially be met through the following management and mitigation measures:

- The measures outlined for Curtis Island also apply to the reduction of visual impact on the landscape values of The Narrows; and
- The requirement to '*ensure infrastructure in areas of high visual quality does not obscure views to water or intrude on waterways*' is difficult to achieve with a structure that crosses the waterway, however minor reduction in visual intrusion can be achieved through design of the support structure which should be as slender and few as possible within the parameters of the structural requirements.

### 17.1 VISUAL IMPACT OF THE LNG FACILITY

The impact of the LNG Facility on visual quality within the viewshed is summarized below:

- The level of visual impact of the LNG Facility on views from residential areas in Gladstone would be of negligible to minor adverse significance, mainly owing to the attenuating effects of distance and intermediate topography;
- The level of visual impact on views from the Targinie foreshore would be of moderate to major adverse significance. This viewpoint was the only location on the mainland affected at this level of significance;
- No locations on the mainland are expected to be impacted to a major to critical level by the proposed LNG Facility;
- There would be no significant difference in the visual impact of the LNG Facility during the construction and operational stages when viewed from the mainland;
- The level of visual impact on views from the waterways of the Port of Gladstone and The Narrows would increase in significance within approximately 4.2 km of the LNG Facility site, as at this distance the project becomes potentially visually dominant in the view;
- Views of the LNG Facility, within approximately 4.2 km of the site, are expected to have a level of visual impact which would be rated as moderate to major adverse significance;
- Views of the LNG Facility from the adjoining waterway, within approximately 1.4 km of the site, are expected to have the highest identified level of visual impact which would be rated as major adverse significance;
- The level of visual impact on views of the LNG Facility from within The Narrows and 1 km north of the entrance are expected to be of moderate to major adverse significance;
- The level of visual impact on views of the LNG Facility from 5 km north of The Narrows entrance are expected to be of negligible significance;
- The level of visual impact on views of the LNG Facility from the waterways adjoining Turtle, Witt and Tide Islands is expected to be of negligible significance during construction and moderate significance during operation. The visual impact during operation is expected to be higher owing to the height and occasional operation of the flare stacks; and

- The LNG Facility is expected to have negligible visual impact on views from residential properties within the viewshed.

## 17.2

### *VISUAL IMPACT OF THE PROPOSED BRIDGE*

The impact of the proposed bridge and approach road on visual quality within the viewshed is summarized below:

- The level of visual impact on views of the proposed Curtis Island Bridge from Gladstone and surrounding areas are expected to be low to negligible in significance, mainly owing to distance;
- The level of impact on views within approximately 2 km of the bridge and access road from the waterways of The Narrows and the Port of Gladstone would be of major adverse significance when viewed from the south against the backdrop of The Narrows. A level of critical adverse significance was considered, however the presence of modification and industrial elements in the viewshed reduces the critical level to the next highest level of significance;
- The level of visual impact on views of the proposed bridge from the north of The Narrows against the background of the Port of Gladstone are expected to be of major adverse significance;
- The level of visual impact on views of the proposed bridge from 5km north of The Narrows entrance are expected to be of moderate significance;
- Targinie foreshore is the only location on the mainland which would have uninterrupted views of the bridge which are expected to have a visual impact of moderate to major adverse significance owing to the proximity to the viewpoint;
- The proposed bridge is not expected to cause visual impact of major to critical adverse significance on views from the mainland;
- No substantial difference is expected in the level of visual impact of the bridge on views from the mainland during the construction and operation stages. The level of visual impact of the access roads would be lower during the operation phase owing to the implementation of landscape mitigation measures along the road easement;
- There would be no views of the bridge from the waters adjoining Turtle, Witt and Tide Islands; and
- The bridge is expected to have negligible visual impact on residential properties.

### 17.3

#### *IMPACT OF THE PROJECT LIGHTING*

The proposed LNG Facility and Curtis Island Bridge would substantially alter the current lighting levels of the immediate areas which are currently natural landscapes.

The impact of the LNG Facility lighting would not significantly affect residential areas as a result of the distance between the site and these residential areas, as well as the effect of existing industrial lighting in the area.

The navigation of waterways would not be affected by night lighting of the LNG Facility as the Port of Gladstone and Targinie foreshore (Fisherman's Landing) already include substantial levels of industrial lighting.

Some fauna species will be impacted by the LNG Facility lighting and management and mitigation measures will be applied to reduce these impacts. Overall, the substantial level of lighting within the Port of Gladstone area is unlikely to be increased significantly by the development of any one project, including the QCLNG Project.

### 17.4

#### *CUMULATIVE IMPACT OF THE PROJECT*

The cumulative impacts of the QCLNG Project in combination with other planned future development within the viewshed, is expected to be most significant in relation to the proposed industrial projects on Curtis Island and Fisherman's Landing. The cumulative effect of industry on either side of the narrow waterway leading to The Narrows passage would substantially alter the character of the area. This alteration in landscape character is consistent with the proposed expansion of the Port of Gladstone and the GSDA.

The proposed Curtis Island Bridge across the 'entrance' to The Narrows would create a visual boundary between The Narrows 'pristine' natural landscape and the expanded port facilities. The bridge would result in a visual separation between the Targinie passage and The Narrows disrupt the current continuity of the shoreline.

### 17.5

#### *SIGNIFICANCE OF THE IMPACT OF THE PROJECT*

The key findings of the LVIA are:

- No significant visual impact from the LNG Facility, proposed approach road and Curtis Island Bridge is expected on views from local residences;
- The pristine natural 'wilderness' area of The Narrows passage landscape as recognised at International, National and State level would be affected by the proposed bridge and approach road resulting in a level of visual impact of major adverse significance. A level of critical adverse



significance was considered, however the presence of modification and industrial elements in the viewshed reduces the critical level to the next highest level of significance; and

- The LNG Facility is expected to impact on landscape values of major significance on Curtis Island, however, the impact on the Great Barrier Reef World Heritage Area is already attenuated in this location by the presence of the Port of Gladstone in the viewshed. Therefore, this area is not 'pristine' or representative of the "exceptional natural beauty" assigned to the World Heritage and National Heritage values. In addition, the designation of the Curtis Island Industry Precinct as an extension to the Gladstone State Development Area (GSDA) reflects the intent of the Queensland Government to develop the area as an industrial precinct. Given this, the landscape and visual impact of the proposed LNG Facility is consistent with the designated land use and general expansion of industry around the Port of Gladstone.

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Annex A

## Parameters of Human Vision



## A.1

### VIEWSHED BASED ON THE PARAMETERS OF HUMAN VISION

The visual impact of a development can be quantified by reference to the degree of influence on a person's field of vision. The diagrams on the following pages illustrate the typical parameters of human vision. These provide a basis for assessing and interpreting the impact of a development by comparing the extent to which the development would intrude into the central field of vision.

#### A.1.1

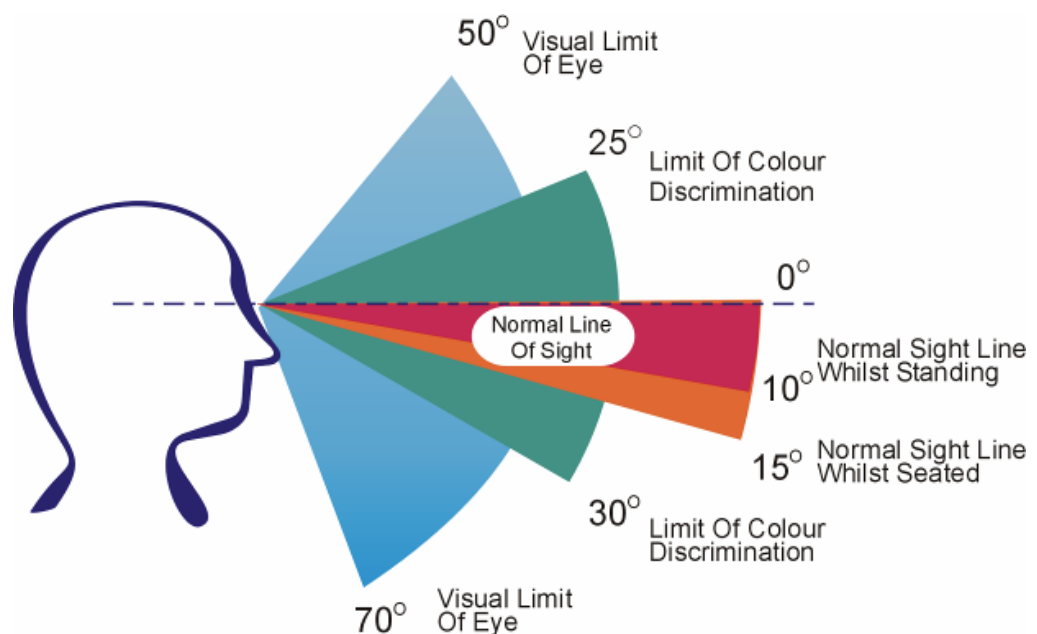
##### *Vertical Field of View*

The central field of vision for most people covers an angle of between 50° to 60°. Within this angle, both eyes observe an object simultaneously. This creates a central field of greater magnitude than that possible by each eye separately.

This central field of vision is termed the 'binocular field' and within this field images are sharp, depth perception occurs and colour discrimination is possible.

The typical line of sight is considered to be horizontal or 0°. A person's natural or normal line of sight is normally a 10° cone of view below the horizontal and, if sitting, approximately 15°.

Objects, which take up 5% of this cone of view (5% of 10° = 0.5°) would only take up a small proportion of the vertical field of view, and are only visible when one focuses on them directly. However, they are not dominant, nor do they create a significant change to the existing environment when such short objects are placed within a disturbed or man-modified landscape.



**Figure A.1** *Vertical Field of View*

The table below shows the relationship between impact and the proportion that the development occupies within the vertical line of sight.

**Table A.1**      *Visual Impact based on the Vertical Field of View*

| Distance from an observer to the project site (based on 60m vertical field of view) | Zones of Visual Influence                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| >7 km.                                                                              | <p><i>Visually insignificant</i></p> <p>A very small element in the viewshed, which is difficult to discern and will be invisible in some lighting or weather circumstances.</p>                                                                                                                       |
| 7 – 4.2 km                                                                          | <p><i>Potentially noticeable, but not dominant in the landscape (long distance views)</i></p> <p>The degree of visual intrusion will depend on the landscape sensitivity and the sensitivity of the viewer.</p>                                                                                        |
| 4.2 – 1.4 km                                                                        | <p><i>Visually evident and can dominate the landscape (middle distance view)</i></p> <p>The degree of visual intrusion will depend on the project and its setting within the landscape and factors such as foreground screening and on the landscape sensitivity and the sensitivity of the viewer</p> |
| < 1.4km                                                                             | <p><i>Will be visually dominant in the landscape from most viewing locations ('close-up' view of the project)</i></p> <p>The project dominates the landscape in which it is sited.</p>                                                                                                                 |

These calculations suggest distances at which the magnitude of visual impact of the built form associated with the Project is reduced with distance.

At distances greater than 7 km, a fully visible 60 m high element would be insignificant within the landscape. At distances from 1.4 km to 4.2 km the built form would be potentially noticeable and at distances less than 1.4 km the built form (without intervening topography or vegetation) would be a dominant element in the landscape.

Annex B

## Photomontage Methodology

## B.1

## PHOTOMONTAGE METHODOLOGY

It is essential that photomontages are both technically accurate, in that they locate the development in the correct location, and are also perceptually accurate, in that they give a good representation of what will be constructed on site.

### B.1.1

#### *Lens Size*

A 50mm lens on a 35mm film camera is often used for visual assessments as it is called a “normal” lens because it produces roughly the same horizontal angle as the human eye (about 50°). However because of the 1:1.5 proportion of a photograph it also captures a vertical angle of approximately 35°. This is much greater than a person’s central vertical field of view and therefore vertical elements, especially in the middle and far distance, are reduced in scale. In some cases the images that have been produced using a 50mm “normal” lens have been criticised for their on site perceptual accuracy.

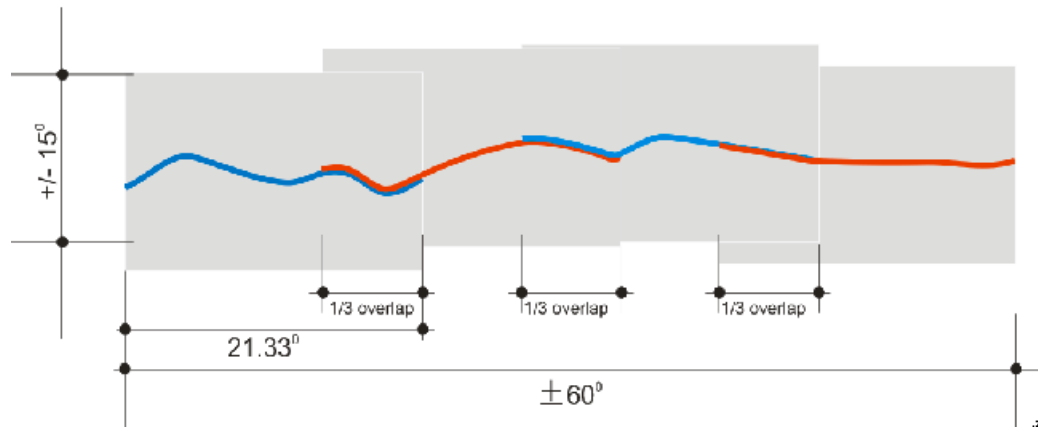
Photographs that formed the basis of the photomontages in this report were taken with a Nikon 60mm f2.8D lens on a Nikon D2X digital camera. The 60mm lens on the Nikon D2X, is the equivalent of a **90mm lens on a 35mm film camera**, and was chosen to take the photographs that are used in the photomontages because it more accurately captures the apparent vertical size of objects in the middle and far distance and hence provides a perceptually more correct image than the more typically used 50mm lens. A 60mm lens on this camera (Nikon D2X digital) has a picture angle of 26.5° and a horizontal angle of view of approximately 21.3°. [http://nikonimaging.com/global/products/lens/af/micro/af\\_micro60mmf\\_28d/](http://nikonimaging.com/global/products/lens/af/micro/af_micro60mmf_28d/)).

### B.1.2

#### *Photomontage - background photograph construction*

When four photographs are overlapped approximately 1/3, the resultant image has a horizontal angle of approximately 60°, which is very similar to the central cone of view of human vision. The vertical angle of the 60mm lens is 17° and when the photomontages are slightly cropped the resultant vertical angle is about 15°, which again closely matches the vertical field of view.





**Figure B.1** *Four photographs overlapped 1/3 to create an image approximately the same as the central cone of view of human vision, ie 50-60° horizontal and 15° vertical.*

The GPS locations of each panorama are also recorded at the time the photographs are taken. The Nikon D2X camera also records the GPS coordinates as picture data.

### **B.1.3** *Photomontage – background model construction*

Cadastral data as well as proposed turbine locations and the physical characteristics of the turbines are modelled within a computer program (3D Max). A virtual camera is set up in the model at the GPS coordinates for each of the photographs that are being used within the panorama.

The digital model is overlaid on the photographic panorama. As the topography (or other predetermined points) must align, this verifies the location and apparent height of the proposed wind turbines.

After the background has been aligned, this is removed leaving only the wind turbines, which are rendered, either to match the lighting conditions at the time the photographs were taken, or, more typically, to maximise their visibility by increasing their contrast against the background sky.

### **B.1.4** *Photomontage verification*

ERM has retaken photographs of wind turbines after construction to compare these with photomontages that were prepared prior to construction, to verify both the technical and perceptual accuracy of images.

All of the verification visits have proven that the resultant photomontages are technically accurate, and the results of one of these tests are attached to this report. However it was felt that earlier photomontages, especially those based on a 50 or 60mm lens on a 35mm camera tended to make the wind turbines less visible in the landscape. Over time the lens size has slowly increased to ensure the perceptual veracity of the photomontages.

As stated earlier the photomontages used within this report are based on a lens with the characteristics of a 90mm lens on a 35mm film camera.

#### **B.1.5**      *Image size*

It is stressed that the small images used within the report are only for referencing comments made within the text. While technically correct, they do not accurately portray a perceptually accurate image to assess the visual impact. For this reason larger (A3) images are appended to this report (*Annex C*) and A1 size images, which accurately portray the perceptual visual impact, will also be provided.

All the photomontages have been prepared with a 60° field of view, as this more accurately represents the size of objects within a photomontage (Refer *Annex A*). However to avoid criticism that the photomontages do not show the full extent of the potential visual impact, in many cases a 120° field of view has also been used to fully model the extent to which wind turbines will be visible across the horizon.

Annex C

## Photomontages (A3)





VIEW OF THE PROPOSED BRIDGE SITE FROM TARGINIE FORESHORE (PRESENT)



PHOTOMONTAGE OF THE PROPOSED BRIDGE VIEWED FROM TARGINIE FORESHORE



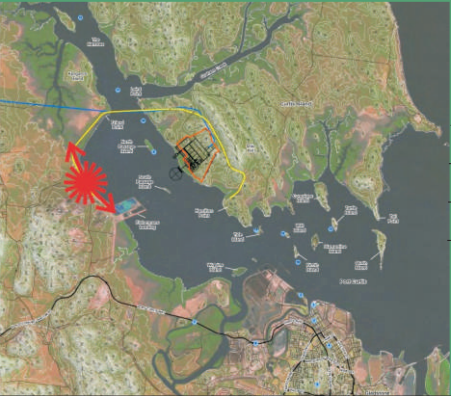
**QUEENSLAND  
CURTIS LNG**  
A BG Group – QGC Alliance

COORDINATES & ELEVATION

N7369049.3 E311457.2  
Elevation: 6m AHD

Distance from viewpoint to project structures:  
LNG Facility 4 km to loading berth (approx)  
Curtis Island bridge 3.5 km (approx)

This photomontage is based on survey data, GIS analysis, and 3D CAD modelling. Whilst all care is taken in preparing the model based on the available scientific data, the accuracy or completeness of base information has not been independently verified by ERM. The photomontage has been prepared using a digitally rendered 3D model to convey an impression of the proposed development for the purpose of representing an exiting view and potential changes to the view. The photomontage does not represent an accurate photo-realistic image of the proposed development.



**PHOTOMONTAGES  
VIEWPOINT 8A**

|             |          |               |    |
|-------------|----------|---------------|----|
| Project No: | 0086165  | Drawing No:   | 8a |
| Date:       | 30/07/09 | Drawing size: | A3 |
| Drawn by:   | TF       | Reviewed by:  | SC |

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VIEW OF THE PROPOSED LNG FACILITY SITE FROM TARGINIE FORESHORE



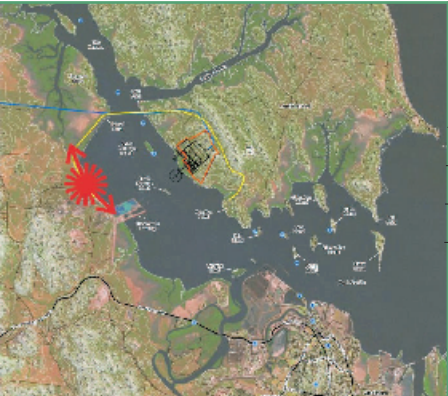
PHOTOMONTAGE OF THE PROPOSED LNG FACILITY VIEWED FROM TARGINIE FORESHORE

COORDINATES & ELEVATION

N7369049.3 E311457.2  
Elevation: 6m AHD

Distance from viewpoint to project structures:  
LNG Facility 4 km to loading berth (approx)  
Curtis Island bridge 3.5 km (approx)

This photomontage is based on survey data, GIS analysis, and 3D CAD modelling. Whilst all care is taken in preparing the model based on the available scientific data, the accuracy or completeness of base information has not been independently verified by ERM. The photomontage has been prepared using a digitally rendered 3D model to convey an impression of the proposed development for the purpose of representing an exiting view and potential changes to the view. The photomontage does not represent an accurate photo-realistic image of the proposed development.



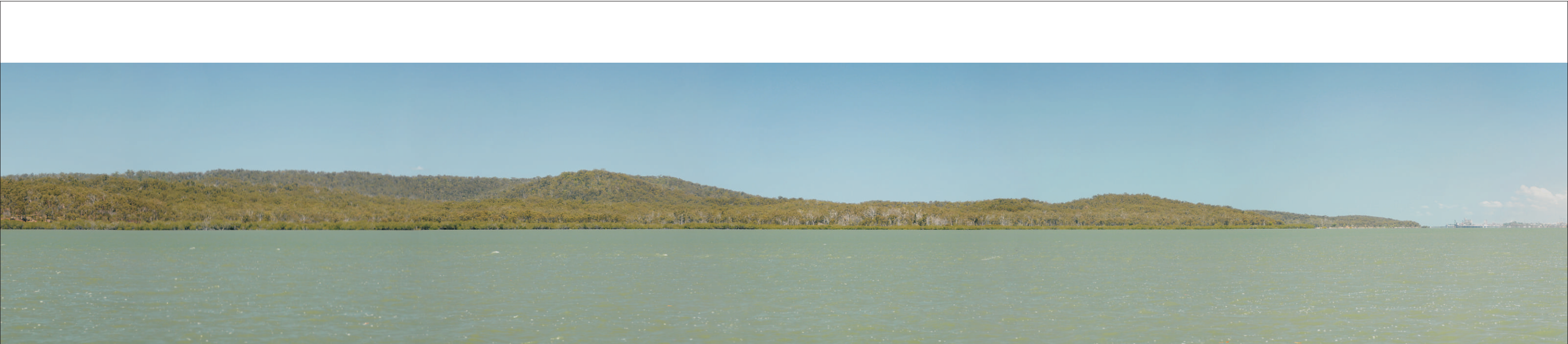
PHOTOMONTAGES  
VIEWPOINT 8b

|             |          |               |    |
|-------------|----------|---------------|----|
| Project No: | 0086165  | Drawing No:   | 8b |
| Date:       | 30/07/09 | Drawing size: | A3 |
| Drawn by:   | TF       | Reviewed by:  | SC |

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PREPARED FOR: QGC





VIEW LOOKING EAST FROM NORTH PASSAGE ISLAND ACROSS THE WATER TO THE SITE OF THE PROPOSED LNG FACILITY



PHOTOMONTAGE OF PROPOSED LNG FACILITY LOOKING EAST FROM NORTH PASSAGE ISLAND



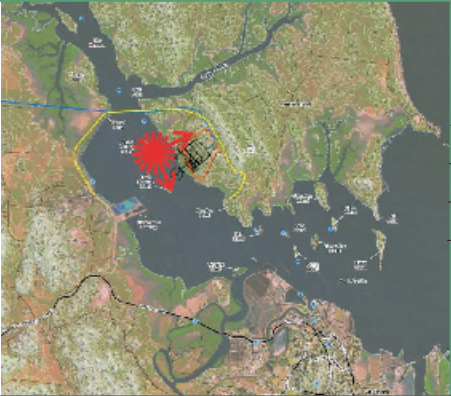
COORDINATES & ELEVATION

GPS 314480.2, 7370464.5

Elevation: 1.5m AHD

Distance from viewpoint to project structures:  
LNG Facility 1 km to loading berth (approx)  
Curtis Island bridge 2 km (approx)

This photomontage is based on survey data, GIS analysis, and 3D CAD modelling. Whilst all care is taken in preparing the model based on the available scientific data, the accuracy or completeness of base information has not been independently verified by ERM. The photomontage has been prepared using a digitally rendered 3D model to convey an impression of the proposed development for the purpose of representing an exiting view and potential changes to the view. The photomontage does not represent an accurate photo-realistic image of the proposed development.



**PHOTOMONTAGES**  
**VIEWPOINT 9**

|             |          |               |    |
|-------------|----------|---------------|----|
| Project No: | 0086165  | Drawing No:   | 9  |
| Date:       | 30/07/09 | Drawing size: | A3 |
| Drawn by:   | TF       | Reviewed by:  | SC |

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VIEW LOOKING NORTH TOWARDS SITE OF PROPOSED BRIDGE AT A DISTANCE OF APPROXIMATELY 500M



PHOTOMONTAGE OF PROPOSED BRIDGE AT A DISTANCE OF APPROXIMATELY 500M



COORDINATES & ELEVATION

N7371962.9 E313969.0

Elevation: 1.5m AHD

Distance from viewpoint to project structures:  
LNG Facility 2.2 km to marine facility (approx)  
Curtis Island bridge 500 m (approx)

This photomontage is based on survey data, GIS analysis, and 3D CAD modelling. Whilst all care is taken in preparing the model based on the available scientific data, the accuracy or completeness of base information has not been independently verified by ERM. The photomontage has been prepared using a digitally rendered 3D model to convey an impression of the proposed development for the purpose of representing an exiting view and potential changes to the view. The photomontage does not represent an accurate photo-realistic image of the proposed development.



**PHOTOMONTAGES**  
**VIEWPOINT 10**

|             |          |               |    |
|-------------|----------|---------------|----|
| Project No: | 0086165  | Drawing No:   | 10 |
| Date:       | 30/07/09 | Drawing size: | A3 |
| Drawn by:   | TF       | Reviewed by:  | SC |

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Environmental Resources Management Australia





VIEW LOOKING SOUTHEAST TOWARDS CURTIS ISLAND, AT APPROX 1KM FROM THE PROPOSED LOCATION OF THE CURTIS ISLAND BRIDGE



PHOTOMONTAGE OF PROPOSED BRIDGE AND LNG FACILITY AT APPROX 1 KM FROM ENTRANCE TO THE NARROWS



COORDINATES & ELEVATION

N7373476 E312757

Elevation: 1.5m AHD

Distance from viewpoint to project structures:  
LNG Facility 4.2 km to marine facility (approx)  
Curtis Island bridge 1 km (approx)

This photomontage is based on survey data, GIS analysis, and 3D CAD modelling. Whilst all care is taken in preparing the model based on the available scientific data, the accuracy or completeness of base information has not been independently verified by ERM. The photomontage has been prepared using a digitally rendered 3D model to convey an impression of the proposed development for the purpose of representing an exiting view and potential changes to the view. The photomontage does not represent an accurate photo-realistic image of the proposed development.



**PHOTOMONTAGES**  
**VIEWPOINT 11A**

|             |          |               |     |
|-------------|----------|---------------|-----|
| Project No: | 0086165  | Drawing No:   | 11a |
| Date:       | 30/07/09 | Drawing size: | A3  |
| Drawn by:   | TF       | Reviewed by:  | SC  |

**QUEENSLAND CURTIS LNG PROJECT**

PREPARED FOR: QGC



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Environmental Resources Management Australia





VIEW LOOKING SOUTHWEST TOWARDS TARGINIE, AT APPROX 1KM FROM THE PROPOSED LOCATION OF THE CURTIS ISLAND BRIDGE



PHOTOMONTAGE OF PROPOSED BRIDGE AT A DISTANCE OF APPROXIMATELY 1 KM



COORDINATES & ELEVATION

N7373476 E312757

Elevation: 1.5m AHD

Distance from viewpoint to project structures:  
LNG Facility 4.2 km to marine facility (approx)  
Curtis Island bridge 1 km (approx)

This photomontage is based on survey data, GIS analysis, and 3D CAD modelling. Whilst all care is taken in preparing the model based on the available scientific data, the accuracy or completeness of base information has not been independently verified by ERM. The photomontage has been prepared using a digitally rendered 3D model to convey an impression of the proposed development for the purpose of representing an exiting view and potential changes to the view. The photomontage does not represent an accurate photo-realistic image of the proposed development.



**PHOTOMONTAGES**  
**VIEWPOINT 11b**

|             |          |               |     |
|-------------|----------|---------------|-----|
| Project No: | 0086165  | Drawing No:   | 11b |
| Date:       | 30/07/09 | Drawing size: | A3  |
| Drawn by:   | TF       | Reviewed by:  | SC  |

**QUEENSLAND CURTIS LNG PROJECT**

PREPARED FOR: QGC



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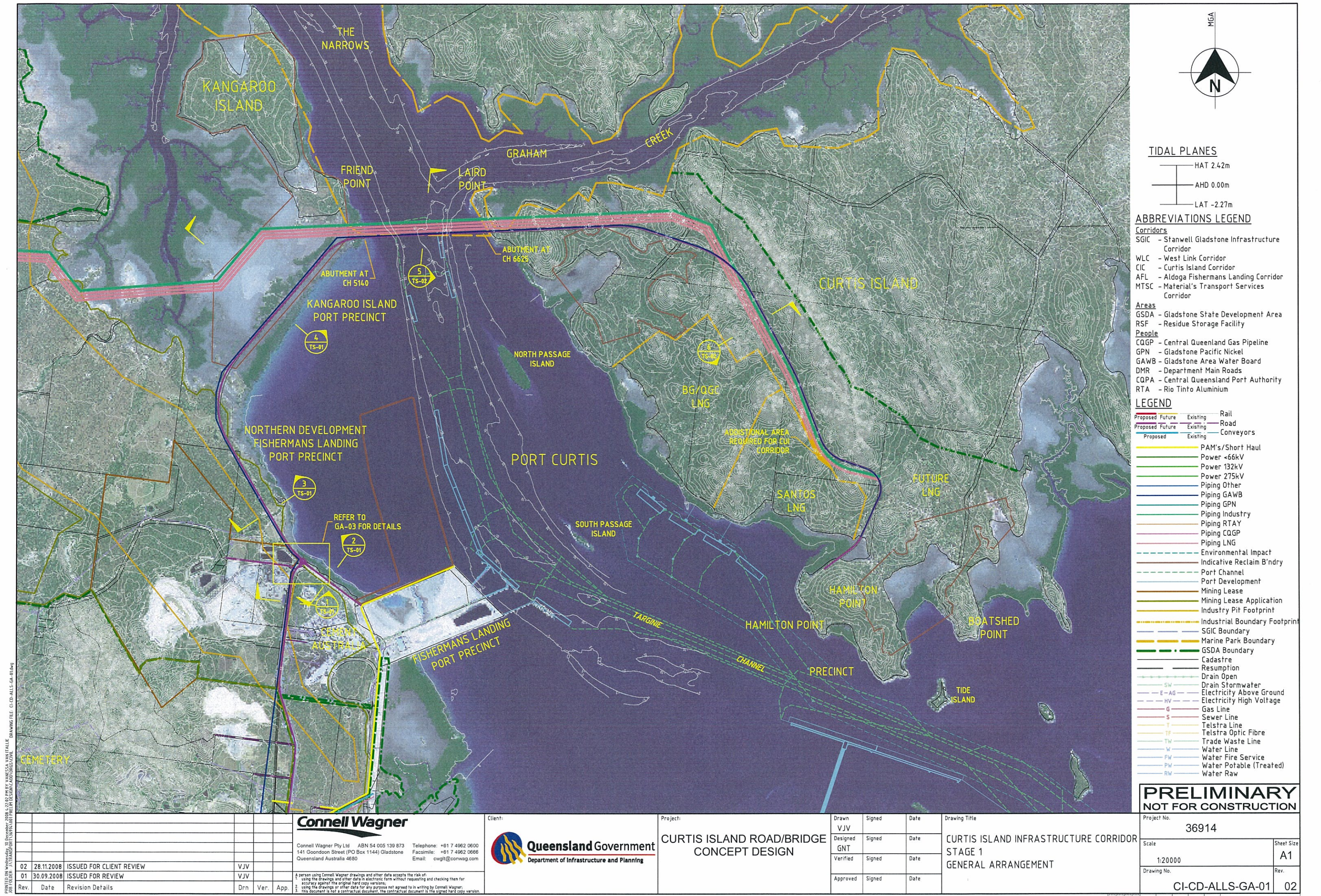
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Annex D

## Bridge Concept Design Plans and Sections





PRINTED ON Wednesday, 10 December 2008 2:22:02 PM BY VANESSA VANITALLIE  
JOB FOLDER: J:\TRANSPORT\14916\1491601 PRELIM DESIGN\CD\ALLS-GA-01.dwg  
DRAWING FILE: CI-CD-ALLS-GA-01.dwg

| Rev. | Date       | Revision Details         | Dwn | Ver. | App. |
|------|------------|--------------------------|-----|------|------|
| 02   | 28.11.2008 | ISSUED FOR CLIENT REVIEW |     |      | VJV  |
| 01   | 30.09.2008 | ISSUED FOR REVIEW        |     |      | VJV  |

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Queensland Australia 4680 Email: cwglt@connwag.com

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Client:  
 **Queensland Government**  
Department of Infrastructure and Planning

Project:  
**CURTIS ISLAND ROAD/BRIDGE  
CONCEPT DESIGN**

| Drawn    | Signed | Date | Drawing Title                                                           |
|----------|--------|------|-------------------------------------------------------------------------|
| VJV      |        |      | CURTIS ISLAND INFRASTRUCTURE CORRIDOR<br>STAGE 1<br>GENERAL ARRANGEMENT |
| Designed | Signed | Date |                                                                         |
| Verified | Signed | Date |                                                                         |
| Approved | Signed | Date |                                                                         |

**PRELIMINARY  
NOT FOR CONSTRUCTION**

Project No. 36914

Scale 1:20000

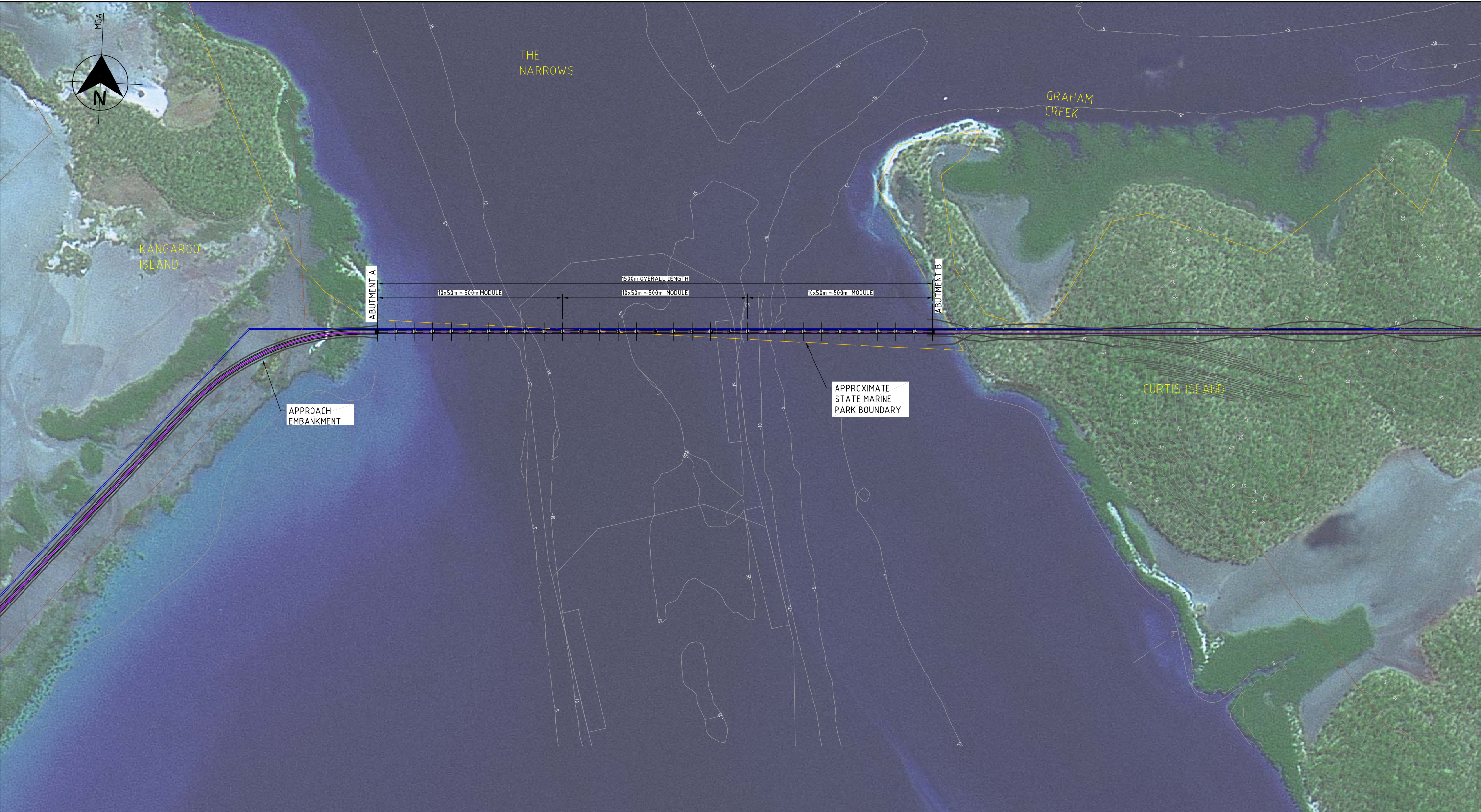
Drawing No. CI-CD-ALLS-GA-01

Sheet Size A1

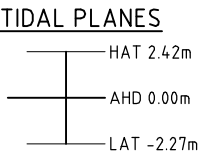
Rev. 02

20 10 0 10 20 30 40 50 100m





PLAN  
SCALE 1:5000



| Rev. | Date     | Revision Details             | Drn | Ver. | App. |
|------|----------|------------------------------|-----|------|------|
| 03   | 11/12/08 | BRIDGE SUBSTRUCTURE REVISED  | JLP |      |      |
| 02   | 28/11/08 | RAIL ALIGNMENT REMOVED       | JLP |      |      |
| 01   |          | BRIDGE PLANNING REPORT ISSUE | JLP |      |      |

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Department of Infrastructure and Planning

Project:

CURTIS ISLAND ROAD / BRIDGE  
CONCEPT DESIGN

| Drawn    | Signed | Date |
|----------|--------|------|
| JLP      |        |      |
| Designed | Signed | Date |
| YPT      |        |      |
| Verified | Signed | Date |
|          |        |      |
| Approved | Signed | Date |
|          |        |      |

Drawing Title

CURTIS ISLAND INFRASTRUCTURE CORRIDOR  
PREFERRED ALIGNMENT - 110km/hr - 50m SPAN  
GENERAL ARRANGEMENT  
SHEET 1 OF 3

**PRELIMINARY**  
NOT FOR CONSTRUCTION

Project No.  
**36914**

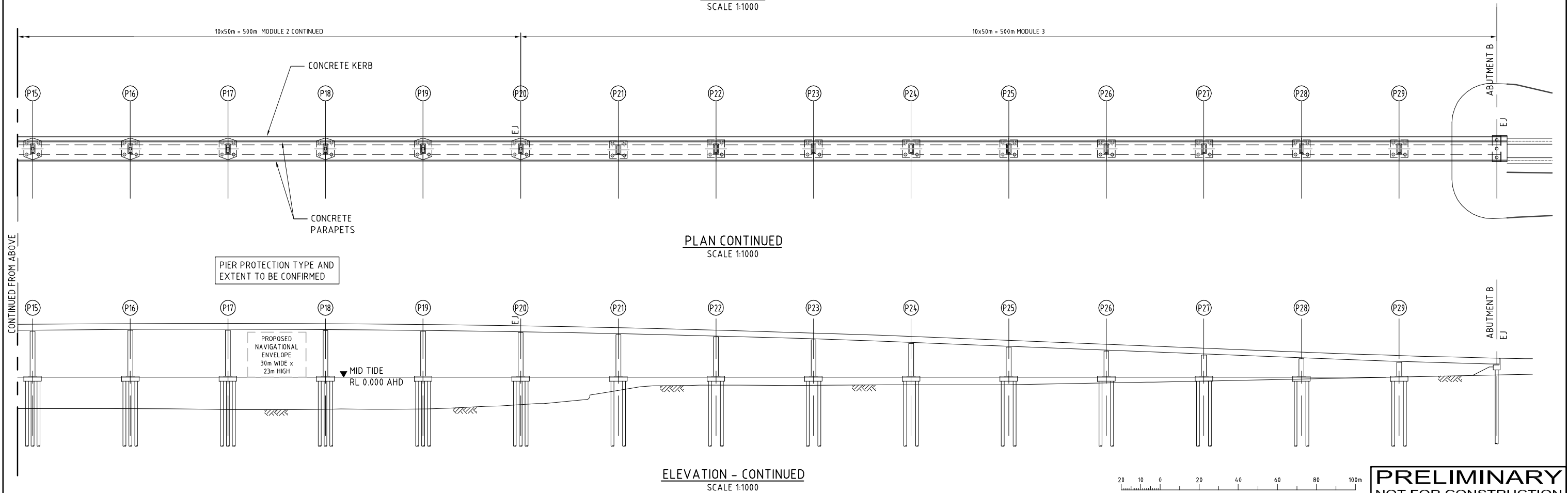
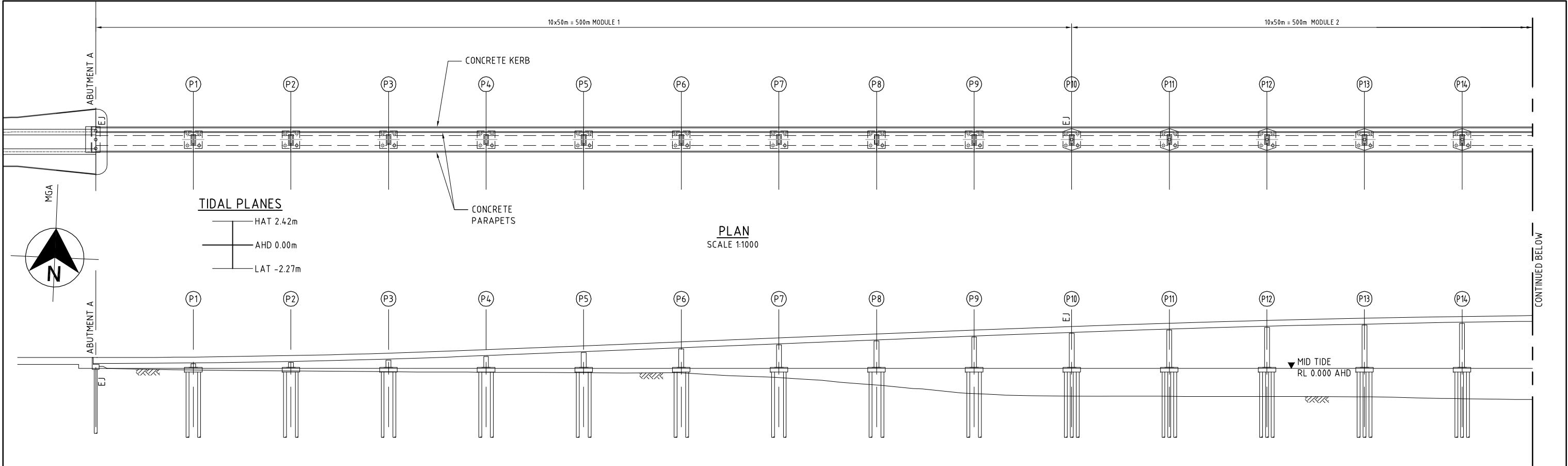
Scale  
1:5000

Drawing No.  
**CI-CD-BR-B-GA-001**

Sheet Size  
**A1**

Rev.  
**03**





| Rev. | Date     | Revision Details             | Drn | Ver. | App. |
|------|----------|------------------------------|-----|------|------|
| 03   | 11/12/08 | BRIDGE SUBSTRUCTURE REVISED  | JLP |      |      |
| 02   | 28/11/08 | VERTICAL ALIGNMENT REVISED   | JLP |      |      |
| 01   |          | BRIDGE PLANNING REPORT ISSUE | JLP |      |      |

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Project:

**CURTIS ISLAND ROAD / BRIDGE  
CONCEPT DESIGN**

|                 |        |      |
|-----------------|--------|------|
| Drawn<br>JLP    | Signed | Date |
| Designed<br>YPT | Signed | Date |
| Verified        | Signed | Date |
| Approved        | Signed | Date |

Drawing Title

**CURTIS ISLAND INFRASTRUCTURE CORRIDOR  
PREFERRED ALIGNMENT - 110km/hr - 50m SPAN  
GENERAL ARRANGEMENT  
SHEET 2 OF 3**

**PRELIMINARY  
NOT FOR CONSTRUCTION**

Project No. 36914

Scale 1:1000

Drawing No. CI-CD-BR-B-GA-002

Sheet Size A1

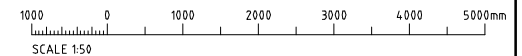
Rev. 03

Diagram showing vertical profile with elevations:

- HAT 2.42m
- AHD 0.00m
- LAT -2.27m



| PILE SCHEDULE  |              |                               |
|----------------|--------------|-------------------------------|
| ABUTMENT /PIER | NO. OF PILES | ESTIMATED LENGTH OF PILES (m) |
| A              | 3            | 35                            |
| P1 - P9        | 4            | 35                            |
| P10 - P20      | 5            | 50                            |
| P21 - P29      | 4            | 35                            |
| B              | 3            | 35                            |



**PRELIMINARY**  
NOT FOR CONSTRUCTION

|             |                   |                  |
|-------------|-------------------|------------------|
| Project No. |                   | 36914            |
| Scale       | 1:50              | Sheet Size<br>A1 |
| Drawing No. | CI-CD-BR-B-GA-003 | Rev.<br>03       |

[illegible]

Client:  **Queensland Government**  
Department of Infrastructure and Planning

Project:

CURTIS ISLAND ROAD / BRIDGE  
CONCEPT DESIGN

|                 |        |      |
|-----------------|--------|------|
| Drawn<br>JLP    | Signed | Date |
| Designed<br>YPT | Signed | Date |
| Verified        | Signed | Date |
| Approved        | Signed | Date |

|                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------|
| Drawing Title                                                                                                             |
| CURTIS ISLAND INFRASTRUCTURE CORRIDOR<br>PREFERRED ALIGNMENT - 110km/hr - 50m SPAN<br>GENERAL ARRANGEMENT<br>SHEET 3 OF 3 |