



ATTACHMENT 6

ARROW LNG PLANT

Offsets Strategy

CONTENTS

1.	INTRODUCTION	1
1.1	Project Overview	1
1.2	Purpose of Document	2
2.	LEGISLATIVE REQUIREMENTS	3
2.1	Queensland Government Legislation and Policy	3
2.2	Commonwealth Government Legislation and Policy	4
3.	AVOIDANCE AND MINIMISATION	7
3.1	Site and Route Selection	7
3.2	Design	8
3.2.1	Tunnel Construction Method	8
3.2.2	Boatshed Point Vine Thicket Community	8
4.	ESTIMATED VEGETATION AND HABITAT LOSS	11
4.1	Native Vegetation	11
4.2	Marine Habitat	12
4.3	Methods for Calculating Vegetation and Habitat Loss	12
4.3.1	Native Vegetation	12
4.3.2	Marine Habitat	12
4.4	Vegetation and Habitat Loss	15
5.	OFFSET LIABILITY	21
6.	PRELIMINARY ASSESSMENT OF AVAILABILITY OF OFFSETS	23
7.	APPROACH TO DELIVERY OF OFFSETS	25
8.	DEVELOPMENT OF OFFSET	29

Figures

1	Littoral rainforest and coastal vine thickets of eastern Australia	9
2	Field validated regional ecosystem communities (Curtis Island)	13
3	Field validated regional ecosystem communities (mainland)	14
4	Arrow Energy's preferred hierarchy to deliver offsets	27

Tables

4.1	Extent of remnant vegetation in SEQ and Brigalow Belt bioregions	11
4.2	Estimated maximum extent of remnant vegetation clearance	16
4.3	Listed species and habitat	18
4.4	Extent of direct disturbance on marine habitats	19
5.1	Estimated offset requirements for Arrow LNG Plant	21
6.1	Estimate of availability of suitable areas for offsets (regional ecosystems)	23
6.2	Estimate of availability of suitable areas for offsets (regrowth)	24

Attachments

- 1 Draft Environmental Offset Strategy Arrow Energy 2012

1. INTRODUCTION

Arrow Energy proposes to develop a liquefied natural gas (LNG) plant on Curtis Island near Gladstone on the Queensland coast, known as the Arrow LNG Plant. The development includes facilities and ancillary infrastructure on Curtis Island, the mainland and in Port Curtis. Construction and operation of the facility and ancillary infrastructure will involve the clearing or disturbance of remnant vegetation and marine plants, and potential habitat for listed threatened species.

The proposed development has been declared a significant project under the *State Development and Public Works Organisation Act 1971* (Qld) for which an environmental impact statement has been prepared – Arrow LNG Plant Environmental Impact Statement (EIS).

The Queensland assessment process has been accredited under the bilateral agreement with the Australian Government, as the project was declared a 'controlled action' under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EBPC Act) for potential significant impacts on matters of national environmental significance (MNES). The controlling provisions are sections 12 and 15A World Heritage properties, sections 15B and 15C National Heritage places, sections 18 and 18A Listed threatened species and communities, and sections 20 and 20A Listed migratory species.

Queensland and Australian government policies require the provision of environmental offsets for unavoidable impacts on biodiversity, remnant vegetation, marine plants, listed species and habitat. This document sets out Arrow Energy's proposal for environmental offsets for the Arrow LNG Plant (the project).

1.1 Project Overview

The proposed development comprises an LNG plant to be constructed on Curtis Island and ancillary infrastructure required to facilitate the construction and operation of the facility. The LNG plant will be constructed at the southern end of Curtis Island behind Boatshed Point on the southern side of Ship Hill. The LNG plant site is covered in remnant vegetation that comprises dry sclerophyll open forest with patches of vine thicket on Boatshed Point and adjacent to the coast. Mangroves fringe the embayments east and west of Boatshed Point, and are backed by intertidal mudflats. The northeast part of the intertidal mudflat located west of Boatshed Point will be reclaimed for spoil disposal and to provide temporary laydown.

A materials offloading facility will be constructed at the southwest corner of Boatshed Point to enable the transfer of personnel, materials and equipment between the mainland and Curtis Island. A haul road along the western side of Boatshed Point will connect the materials offloading facility to the LNG plant site. Construction of the haul road and associated staging and laydown areas will involve reclamation of intertidal and subtidal seabed and minor encroachment on fringing mangroves. Dredging will be required to facilitate construction and operation of the facility and includes dredging to establish a swing basin to manoeuvre vessels and minor dredging to maintain a navigable channel from the Targinie Channel to Boatshed Point.

A construction camp will be built on the northern part of Boatshed Point to accommodate construction workers. A portion of the patch of vine thicket behind the Boatshed Point headland will be protected and connects to the Gladstone State Development Area Curtis Island Environmental Management Precinct via a wildlife corridor to be established and maintained along the eastern coast of Boatshed Point.

LNG will be exported through LNG loading lines that will run west from the LNG storage tanks to North China Bay where the LNG jetty will facilitate loading of LNG carriers. Construction of the jetty and LNG loading lines embankment will involve reclamation of intertidal mudflat and minor encroachment on fringing mangroves. Dredging will be required to facilitate construction of the LNG jetty. The berth and access channel were approved as part of the Western Basin Dredging and Disposal Project currently being undertaken by Gladstone Ports Corporation.

A launch site will be constructed on Calliope River behind the RG Tanna Coal Terminal to facilitate staging and transfer of personnel, materials and equipment to and from the materials offloading facility on Curtis Island. An access channel will be dredged from the Targinie Channel to the facility. Construction of the facility will involve capping of former ash ponds and minor impacts on fringing mangroves of the Calliope River.

The feed gas pipeline will be installed in a tunnel to be bored under Port Curtis. The launch site for the tunnel is located on intertidal mudflats and in coastal vegetation on the mainland south of Boat Creek. Clearing of remnant vegetation will be required to construct the access road and accommodate part of the facility. The majority of the facility is located on the intertidal mudflat behind the mangrove communities fringing Port Curtis which will not be disturbed by construction and operation of the infrastructure. The tunnel extends to the eastern side of Hamilton Point avoiding any impacts on the marine environment.

Temporary workers accommodation facilities, carparking, staging and laydown areas are proposed at several mainland sites. Development of the facilities will involve some clearing and disturbance of remnant vegetation.

1.2 Purpose of Document

This document presents Arrow Energy's strategy for environmental offsets for the Arrow LNG Plant to facilitate discussion with the Queensland Government Department of Environment and Heritage Protection (EHP) and Australian Government Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) on a suitable offset for unavoidable losses of remnant vegetation and habitat incurred in constructing the project.

It describes the measures taken to avoid and minimise impacts, the expected requirement for environmental offsets, and evidence that there are opportunities to achieve the required offset. It details Arrow Energy's preferred approach to the provision of environmental offsets.

2. LEGISLATIVE REQUIREMENTS

The project must satisfy the environmental offsets policy requirements of the Queensland and Australian governments, as it triggered assessment under both jurisdictions. Offsets delivered in accordance with Queensland Government policy can, where appropriate, satisfy the Australian Government's requirements. This section describes the legislative framework for environmental offsets.

2.1 Queensland Government Legislation and Policy

The Queensland Government Environmental Offsets Policy, June 2008 (EPA, 2008) sets out the requirements for environmental offsets for activities triggering assessment or the grant of environmental authorities or permits under the following relevant legislation:

- *Environmental Protection Act 1994* (Qld).
- *Vegetation Management Act 1999* (Qld).
- *Nature Conservation Act 1992* (Qld).
- *Fisheries Act 1994* (Qld).
- *Sustainable Planning Act 2009* (Qld).

The policy sets out seven principles for achieving economically sustainable outcomes in providing environmental offsets. The principles are summarised as:

- Offsets will not replace or undermine environmental standards or legislative requirements.
- Environmental impacts must first be avoided and minimised.
- Offsets must achieve an equivalency or a conservation gain.
- Offsets must provide environmental values as similar as possible to those being lost.
- Offset provision should minimise the time-lag between the impact and delivery of the offset.
- Offsets must provide additional protection for environmental values or management actions to improve environmental values.
- Offsets must be legally secure.

This overarching policy is supported by policies that address the specific requirements of the relevant legislation. Specific policies that apply to the provision of offsets for unavoidable losses are detailed below.

Policy for Vegetation Management Offsets (version 3) 30 September 2011 (DERM, 2011) which sets out the specific requirements for offsets under the Vegetation Management Act.

Queensland Biodiversity Offsets Policy (version 1) 3 October 2011 (DERM, 2011) which sets out the specific requirements of offsets of state significant biodiversity values. State significant biodiversity values are the relevant values defined in Areas of Ecological Significance mapping and Biodiversity Planning Assessments compiled by EHP. Assessment under the State Development and Public Works Organisation Act is exempt from the requirements of this policy. However, the Queensland Coordinator-General can have regard to the policy in setting conditions for the project. This policy is currently under review by the Queensland Government.

Marine fish habitat offset policy, Queensland Government, Department of Agriculture, Fisheries and Forestry, Version FHMOP 005.2 (DAFF, 2012), sets out the compensation (offset) requirements for disturbance or loss of fish habitat in marine environments.

Nature Conservation (Koala) Conservation Plan 2006 and Management Program 2006-2016, Queensland Government – Environment Protection Agency, 28 August 2006 (EPA, 2006). Policy 2 Offsets for net benefit to koalas and koala habitat sets out the requirements for providing no net loss and an improvement in koala habitat affected by development.

The adequacy of an environmental offset is determined by application of the ecological equivalence method which requires assessment of the vegetation to be lost and vegetation proposed as the offset. The method evaluates the ecological condition and special features of the project and offset sites to ensure the offset satisfies the objective of 'no net loss'. Application of the method is set out in Ecological Equivalence Methodology Guideline, Policy for Vegetation Management Offsets, Queensland Biodiversity Offset Policy, Version 1, 3 October 2011 (DERM, 2011).

2.2 Commonwealth Government Legislation and Policy

Actions that result in a significant impact on MNES are required to be offset under the provisions of the EPBC Act. The Environmental Offsets Policy, October 2012 (DSEWPoC, 2012) sets out the requirements for offsets.

The Environmental Offsets Policy applies to all new referrals or variations to approval conditions from 2 October 2012. It also applies to projects currently under assessment for which a decision has not yet been made and therefore will apply to the Arrow LNG Plant.

Implementation of the policy is guided by the Offsets assessment guide (DSEWPoC, 2012). It has been developed to give effect to the requirements of the policy, utilising a balance sheet approach to measure impacts and offsets. It places a higher value on offsets that are delivered in advance of the loss occurring and those that produce a conservation gain in the short-term. It incorporates the International Union for the Conservation of Nature (IUCN) figures for annual probability of extinction for IUCN Red List species.

The guiding principles for the provision of offsets in accordance with the Environmental Offsets Policy are:

- Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed development.
- Be efficient, effective, transparent, proportionate, scientifically robust and reasonable.
- Be built around direct offsets but may include other compensatory measures.
- Be of a size and scale proportionate to the impacts being offset.
- Be in proportion to the level of statutory protection that applies to the affected species or community.
- Effectively manage the risks of the offset not succeeding but may include other compensatory measures.

- Be additional to what is already required determined by law or planning regulations or agreed under other schemes or programs.
- Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

Supplementary Report to the Arrow LNG Plant EIS
Arrow LNG Plant

3. AVOIDANCE AND MINIMISATION

Site and route selection, and design are the most effective measures for avoiding and minimising impacts on remnant vegetation, marine plants and habitat. Arrow Energy has exhausted all opportunities to site and design the LNG plant and ancillary infrastructure to avoid and minimise potential disturbance and losses. A summary of the initiatives and design responses that have resulted in unavoidable losses being reduced to as low as reasonably practicable is set out below.

3.1 Site and Route Selection

An exhaustive search for sites for the proposed LNG plant was undertaken between Brisbane and Townsville on the Queensland coast. The search identified over 30 potential sites which were shortlisted to five sites. An evaluation of cultural, environmental, social, technical, and constructability constraints favoured the Curtis Island site over the other four sites, as it was:

- In an industrial precinct set aside for LNG development.
- Within an existing port (Port of Gladstone).
- Within a deep water harbour protected from ocean swells and close to existing shipping channels thereby reducing the need for extensive dredging.
- Adjacent to existing infrastructure and services.
- In proximity to proposed gas transmission pipelines for which licences were held.
- Located on land previously used for timber production and grazing.

Routes for the proposed feed gas pipeline which would take supply from proposed gas transmission pipelines are constrained by topography, specifically Mount Larcom Range which forces routes to the south through Yarwun Gap or to the north adjacent to Landing Road.

The northern route was found to be a longer route and to have significant environmental and cultural heritage issues in comparison to the southern route. The Narrows crossing involves the management of potential and actual acid sulfate soils along the length of the pipeline route where it crosses the wetland adjacent to Targinie Creek and Kangaroo Island. Migratory bird roosting and foraging sites have been identified on the wetland and in the fringing mangroves. The Narrows crossing between Friend and Laird points is immediately south of the habitat protection zone of the Great Barrier Reef Coast Marine Park, which extends up Graham Creek and to the mouth of Targinie Creek. Kangaroo Island and Graham Creek are significant cultural sites for the Indigenous community. Although pursued, a joint industry solution involving a bundled pipeline crossing of The Narrows, proved too difficult due to incompatibility in the timing of the various projects.

The southern route is a shorter more direct route enabling connection to Arrow Energy's proposed Arrow Surat Pipeline for which a pipeline licence is held. The route avoids significant wetland habitat and sites of cultural heritage significance. It significantly reduces the extent of vegetation clearance on Curtis Island for pipeline infrastructure.

A detailed discussion of the LNG plant site and pipeline route alternatives evaluated is set out in Chapter 5 Assessment of Alternatives of the Arrow LNG Plant EIS. Chapter 4 Assessment of Alternatives of the supplementary report to the EIS provides an update on further refinement of ancillary infrastructure, the focus of which has been to utilise existing facilities where possible.

3.2 Design

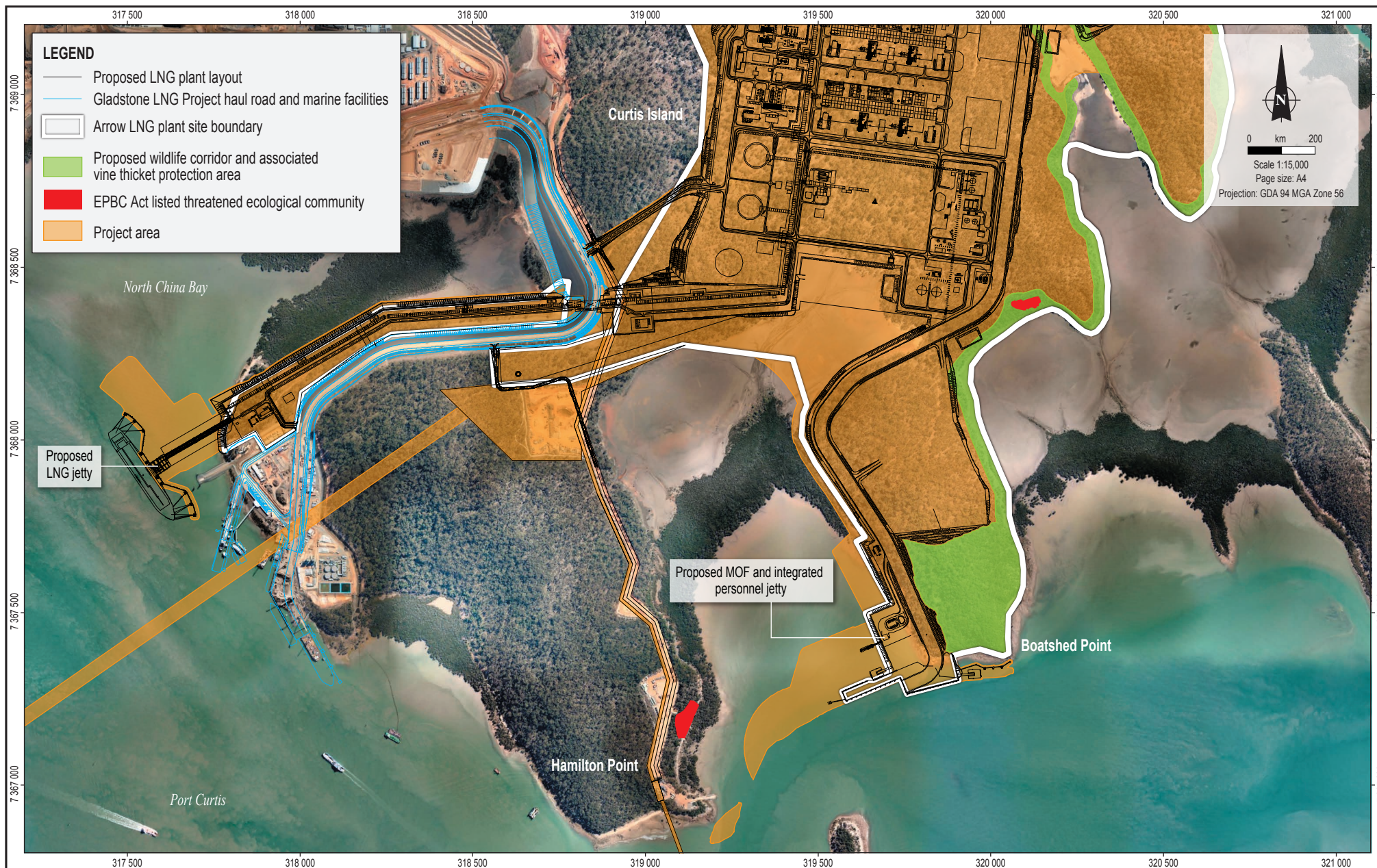
Design of the LNG plant and ancillary infrastructure has been an iterative process that has resulted in opportunities to avoid and minimise impacts being investigated and where possible adopted. A summary of the key decisions that resulted in impacts being avoided or reduced are described in the following sections.

3.2.1 Tunnel Construction Method

Adoption of the southern route for the feed gas pipeline offered the most significant opportunity to avoid and minimise impacts on remnant vegetation and habitat. Several construction methods were evaluated for the Port Curtis crossing with a tunnel being adopted as the preferred method. The tunnel avoids impacts on the marine environment including mangroves and seagrass, as the launch and reception shafts are located above the low water mark on the mainland and Curtis Island respectively. The mainland tunnel launch site – sited predominantly on the intertidal mudflats south of Boat Creek – has been located to minimise impacts on coastal vegetation. The tunnel also passes under an area of important shorebird foraging habitat to the east of fringing mangroves at the mainland tunnel launch site. The tunnel has been extended to the east side of Hamilton Point reducing the extent of vegetation to be cleared for the feed gas pipeline construction right of way.

3.2.2 Boatshed Point Vine Thicket Community

Ecological surveys undertaken for the EIS identified a patch of semi-evergreen vine thicket (Regional Ecosystem 12.11.4) on the headland of Boatshed Point in which an undescribed species was found. *Cupaniopsis* sp. has been formerly recognised by the Queensland Herbarium as an undescribed species. Its recognition has resulted in the reclassification of *Cupaniopsis shirleyana* in the Gladstone region, as specimens of that species have been found to be the undescribed *Cupaniopsis* sp. The proposed construction camp and materials offloading facility have been redesigned to minimise and avoid impacts on the semi-evergreen vine thicket respectively. In addition, a wildlife corridor along the east coast of Boatshed Point linking the semi-evergreen vine thicket patch to remnant vegetation in the Environmental Management Precinct of the Gladstone State Development Area will be established to provide connectivity and enhance ecological function, as shown in Figure 1. The proposed wildlife corridor protects a patch of the EPBC Act listed critically endangered littoral rainforest and coastal vine thicket of eastern Australia thereby avoiding impacts on this community.



Source:
EPBC Act listed threatened ecological communities from Ecosure and 3D Environmental.
Project area and proposed wildlife corridor from Coffey Environments.
Imagery from Nearmap (captured 7 August 2012).

coffey
environments

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arrow
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**Littoral rainforest and coastal vine thickets
of eastern Australia (critically endangered)
communities on Curtis Island**

Figure No:

1

Supplementary Report to the Arrow LNG Plant EIS
Arrow LNG Plant

4. ESTIMATED VEGETATION AND HABITAT LOSS

This section provides an overview of the bioregions in which vegetation will be cleared, the methods used to determine the extent of vegetation clearance and an estimate of the vegetation to be cleared.

4.1 Native Vegetation

The project area lies close to the point where the South Eastern Queensland and Brigalow Belt bioregions come together. Consequently, many species in the Gladstone region are at the limits of their northern or southern distribution.

The project area is predominantly located in the Burnett-Curtis Hills and Ranges sub-bioregion of the South Eastern Queensland (SEQ) bioregion. The SEQ bioregion extends from the New South Wales border to just north of Gladstone. It encompasses coastal and subtropical ecosystems distributed along the Queensland coast, the associated coastal plain and coastal ranges.

Despite extensive clearing of vegetation and habitat for agriculture, and coastal and hinterland development, the SEQ bioregion is recognised for its high number of rare and threatened, and endemic flora species. It supports subtropical rainforests and coastal heathlands of significance. Fragmentation and loss of remnant vegetation are the most significant threatening process within the bioregion, particularly as many of the vulnerable ecosystems are naturally restricted. Exotic weeds are another threat to the most threatened vegetation types which include eucalypt forests and woodlands with grassy or shrubby understoreys.

One site, the temporary workers accommodation facility site 8 (TWAf 8), is located in the Brigalow Belt bioregion at the junction of the Marlborough Plains and Mount Morgan Ranges sub-bioregions. The Brigalow Belt bioregion, which extends north and inland from the Queensland coast near Gladstone, hosts species with links to the Wet Tropics and Central Queensland Coast bioregions. Encompassing coastal plains, coastal ranges and alluvial plains inland of the Great Dividing Range, native vegetation in the bioregion has been subject to broad-scale clearing for agricultural. Fragmentation and loss of remnants are the major threatening processes along with exotic weeds. Threatened vegetation communities include eucalypt woodlands with grassy and shrubby understoreys, and brigalow (*Acacia harpophylla*) forests and woodlands.

The extent of remnant vegetation in the bioregions and sub-bioregions is set out in Table 4.1.

Table 4.1 Extent of remnant vegetation in SEQ and Brigalow Belt bioregions

Bioregion/ Sub-bioregion	Pre-clearance Remnant Vegetation (ha)	Remnant Vegetation 2009 (ha)	Remnant Vegetation Remaining
South Eastern Queensland bioregion	6,186,528	1,016,438	16%
Burnett-Curtis Hills and Ranges sub-bioregion	2,745,369	649,571	24%
Brigalow Belt bioregion	36,486,511	15,222,470	42%
Marlborough Plains sub- bioregion	1,179,545	637,334	54%
Mount Morgan Ranges sub-bioregion	1,275,891	411,819	32%

Source: Accad, A; Neldner, V.J; Wilson, B. A; and Niehus, R.E. (2012) *Remnant Vegetation in Queensland. Analysis of remnant vegetation 1997-2009, including regional ecosystem information.* (Queensland Department of Science, Information Technology, Innovation and the Arts: Brisbane).

4.2 Marine Habitat

A range of physical environments and habitat types which support significant biodiversity were identified in Port Curtis. These habitats, including benthic, reef and rocky substrates, intertidal mudflats, saltmarsh, mangroves and seagrass beds, provide important habitat for large macrobenthic, plankton and fish communities. The project area does not encroach on any declared fish habitats. All marine plants in Port Curtis, including seagrass, mangrove and saltmarsh are protected under the *Fisheries Act 1994* (Qld).

4.3 Methods for Calculating Vegetation and Habitat Loss

Vegetation and habitat loss was calculated using the area of disturbance. The area of disturbance (project area) is defined as the footprint of the proposed facilities plus a buffer that accounts for constructability issues.

The buffer width varies and is dependent on the activity, type of equipment and estimated working space requirements. For example, earthworks are assumed to extend 20 m beyond top of batter to account for workspace, removal of hazard trees and construction of top of batter cut-off drains. Similarly, a buffer of 5 m on dredge footprints allows for overcut, cutter suction or backhoe dredge cuttings spillage (top of cut spill berm) and dislodged material.

The project area was overlaid on revised regional ecosystem mapping to estimate the maximum area of vegetation to be cleared and on benthic community mapping to estimate the loss of marine plants and habitat. The following sections describe the data used to calculate native vegetation and marine plants and habitat losses.

4.3.1 Native Vegetation

Regional ecosystem mapping compiled by EHP informed the terrestrial ecology surveys undertaken to determine the extent and types of vegetation to be cleared. The ecological surveys identified anomalies in the description of vegetation communities which led to revised regional ecosystem mapping for the project area.

The revised mapping was used to assess the significance of impacts on remnant vegetation, and to calculate the extent of clearance of affected regional ecosystems. Figure 2 and Figure 3 show the regional ecosystems covering the project area on Curtis Island and the mainland respectively.

4.3.2 Marine Habitat

Regional ecosystem and benthic community mapping informed the marine and estuarine ecological surveys. Regional ecosystem mapping used to identify the extent of mangroves, saltmarsh, and intertidal mudflat was subject to ground-truthing to validate the extent and description of the extant communities. Field surveys of proposed marine infrastructure and dredge sites were used to validate benthic community mapping sourced from Department of Primary Industry, Queensland Fisheries Service.



Source:
Place names from DME. Watercourses from Alluvium.
Ecological assets (values based on regional ecosystem ground truth data) from Ecosure and 3D Environmental.
Project area from Coffey Environments.
Imagery from Nearmap (captured 7 August 2012).

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environments

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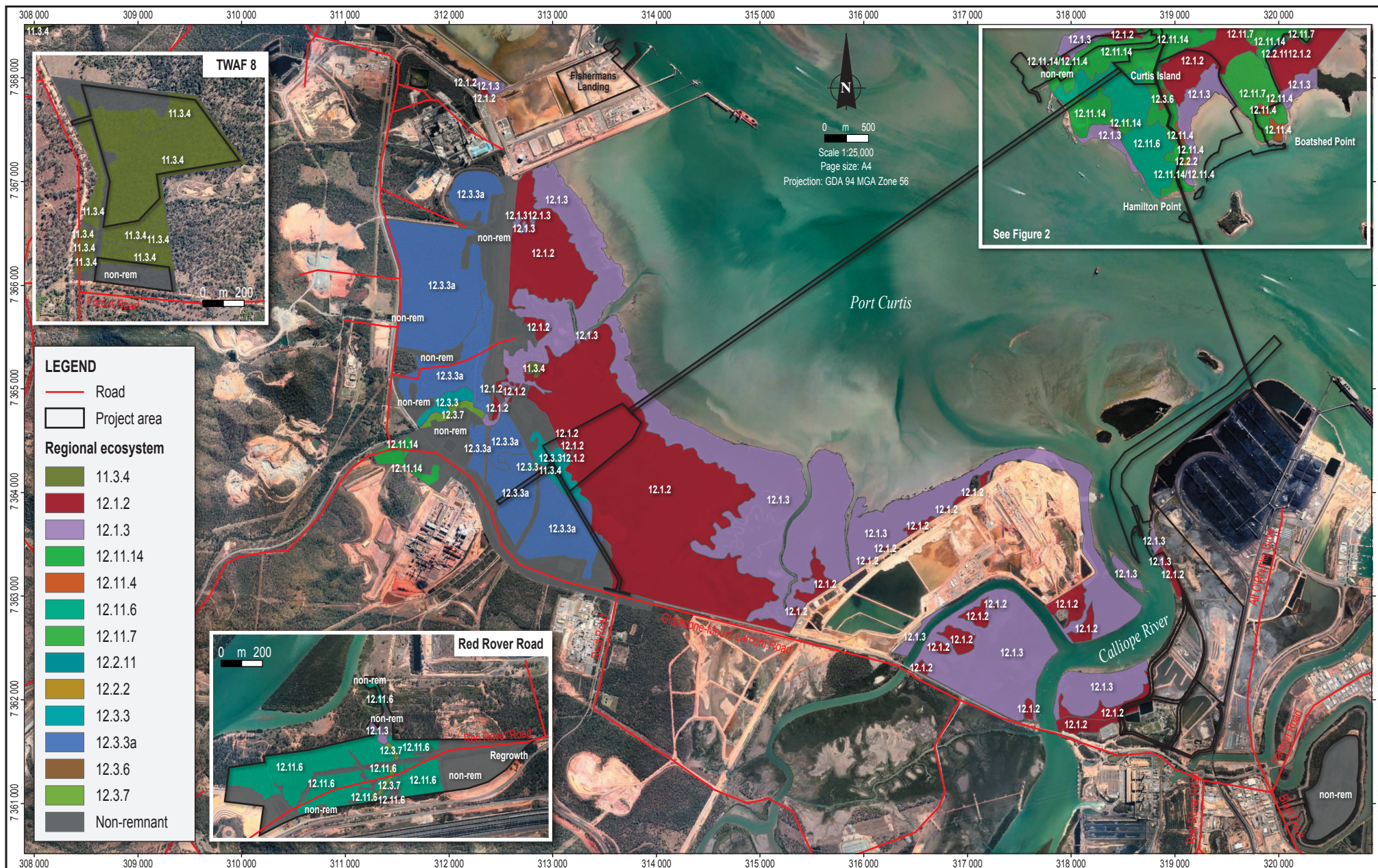
Arrow LNG Plant

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go further

**Field validated regional ecosystem
communities (Curtis Island)**

Figure No:

2



Source:
Place names, roads and watercourses from DME.
Ecological assets (values based on regional ecosystem ground truth data) from Ecosure and 3D Environmental.
Project area from Coffey Environments.
Imagery from Nearmap (captured 7 August 2012).

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Date:
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MXD:
7033CB_16_GIS053_v0_3
File Name:
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Arrow LNG Plant

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go further

**Field validated regional ecosystem
communities (mainland)**

Figure No:

3

4.4 Vegetation and Habitat Loss

The project area described in the supplementary report to the EIS encompasses a range of options under consideration. To determine the estimated maximum loss of vegetation and habitat, two cases were identified: a base case which includes the preferred options and an alternative case which includes the less preferred options. The base case includes all Curtis Island facilities, launch site 1, the mainland tunnel launch site and temporary workers accommodation facility 7 (TWAF 7). The alternative case includes the base case components except for TWAF 7 which is replaced by Red Rover Road and TWAF 8.

Vegetation and habitat loss for both cases was calculated to determine the estimated maximum loss of vegetation and habitat. The base case clearance takes into account areas that have already been cleared for other infrastructure including the water supply and sewer mains on Hamilton Point and GLNG infrastructure at Hamilton Point and in North China Bay.

Table 4.2 lists the regional ecosystems to be cleared for construction of the project. The analysis estimates the maximum potential clearance area of remnant vegetation required to construct the project is 303.52 ha for the base case and 344.1 ha for the alternative case.

The affected regional ecosystems provide habitat for several listed species identified, or likely to occur, in the project area. The species are listed in Table 4.3 along with their conservation status and the vegetation communities (regional ecosystems) that provide habitat for the species.

The loss of marine habitat presented in Table 4.4 updates the information provided in the EIS.

Table 4.2 Estimated maximum extent of remnant vegetation clearance

Regional Ecosystem	VMA Status	Area Cleared Within Project Area (ha)						Total Arrow LNG Plant Clearance (base case) (ha)	Total Arrow LNG Plant Clearance (alternative case) (ha)	Area of Regional Ecosystem to be Cleared as a Proportion of that Available Within the Bioregion (%)
		CI	LS1	MTLS	TWAF 7	RRR	TWAF 8			
RE 11.3.4 <i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains	Of Concern	-	-	-	-	-	23.91	-	23.91	0.01
RE 12.1.2 Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	Least concern	17.49	4.5	32.5	0.52	-	-	55.01	49.99	0.19
RE 12.1.3 Mangrove shrubland to low closed forest on marine clay plains and estuaries	Least concern	2.48	2.01	-	0.21	0.61	-	4.70	5.10	0.01
RE 12.11.14 <i>Eucalyptus crebra</i> , <i>Eucalyptus tereticornis</i> woodland on metamorphics ± interbedded volcanics	Of concern	74.74	-	-	-	-	-	74.74	74.74	0.25
RE 12.11.4 Semi-evergreen vine thicket on metamorphics ± interbedded volcanics	Of concern	0.66	-	-	-	-	-	0.66	0.66	0.02
RE 12.11.6 <i>Corymbia citriodora</i> , <i>Eucalyptus crebra</i> open forest on metamorphics ± interbedded volcanics	Least concern	68.14	-	-	-	22.71	-	68.14	90.85	0.04
RE 12.11.7 <i>Eucalyptus crebra</i> woodland on metamorphics +/- interbedded volcanics	Least concern	59.45	-	-	-	-	-	59.45	59.45	0.19

Table 4.2 Estimated maximum extent of remnant vegetation clearance (cont'd)

Regional Ecosystem	VMA Status	Area Cleared Within Project Area (ha)						Total Clearance (base case) (ha)	Total Clearance (alternative case) (ha)	Area of Regional Ecosystem to be Cleared as a Proportion of that Available Within the Bioregion (%)
		CI	LS1	MTLS	TWAF 7	RRR	TWAF 8			
RE 12.2.11 <i>Corymbia</i> spp., <i>Eucalyptus</i> spp., <i>Acacia</i> spp. open forest to low closed forest on beach ridges in northern half of bioregion	Least concern	0.47	-	-	-	-	-	0.47	0.47	<0.01
RE 12.3.3 <i>Eucalyptus tereticornis</i> woodland to open forest on alluvial plains	Endangered	29.86	-	7.87	-	-	-	37.73	37.73	0.09
RE 12.3.6 <i>Melaleuca quinquenervia</i> , <i>Eucalyptus tereticornis</i> , <i>Lophostemon suaveolens</i> woodland on coastal alluvial plains	Least concern	2.62	-	-	-	-	-	2.62	2.62	0.02
RE 12.3.7 <i>Eucalyptus tereticornis</i> , <i>Melaleuca viminalis</i> , <i>Casuarina cunninghamiana</i> fringing forest	Least concern	-	-	-	-	0.59	-	-	0.59	<0.01

MTLS = mainland tunnel launch site, RRR = Red Rover Road site, LS1 = launch site 1, CI = Curtis Island. Clearance as a proportion of the bioregion following Accad (2008). The above clearance figures represent the maximum amount that could be cleared, the actual amount is expected to be less.

Table 4.3 Listed species and habitat

Species	Listing	Conservation Status	Regional Ecosystem
Squatter pigeon (southern subspecies) (<i>Geophaps scripta scripta</i>)	EPBC Act Nature Conservation Act	Vulnerable Vulnerable	RE 11.3.4 <i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains. RE 12.3.3 <i>Eucalyptus tereticornis</i> woodland to open forest on alluvial plains.
Water mouse (<i>Xeromys myoides</i>)	EPBC Act	Vulnerable	RE 12.1.2 Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains. RE 12.1.3 Mangrove shrubland to low closed forest on marine clay plains and estuaries.
Eastern curlew (<i>Numenius madagascariensis</i>)	Nature Conservation Act	Near-threatened	RE 12.1.2 Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains. RE 12.1.3 Mangrove shrubland to low closed forest on marine clay plains and estuaries.
Beach stone curlew (<i>Esacus magnirostris</i>)	Nature Conservation Act	Vulnerable	RE 12.1.2 Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains. RE 12.1.3 Mangrove shrubland to low closed forest on marine clay plains and estuaries.

Table 4.4 Extent of direct disturbance on marine habitats

Habitat	Total Area of Disturbance EIS (ha)	Revised Location of Disturbance	Area of Disturbance (base case) (ha)	Area of Disturbance (alternative case) (ha)	Revised Total Area of Disturbance (ha)
Mangroves*	5.80	Launch site 1 and access road – Calliope River	2.01	–	Base case 4.7
		Curtis Island infrastructure: Boatshed Point MOF and integrated personnel jetty / haul road and loading lines leading to LNG jetty and LNG jetty	2.48	2.48	Alternative case 3.09
		Proposed TWAFF 7 (laydown, carparking and staging area)	0.21	–	
		Red Rover Road (potential accommodation, staging, carparking and laydown area)	–	0.61	
Saltpan vegetation on marine clay plains (previously saltmarsh)*	58.20	Mainland tunnel launch site	32.5	32.5	Base case 55.01
		Curtis Island infrastructure: Boatshed Point MOF and integrated personnel jetty / haul road and loading lines leading to LNG jetty	17.49	17.49	Alternative case 49.99
		Launch site 1 and access road – Calliope River	4.50	–	
		Proposed TWAFF 7 (laydown, carparking and staging area)	0.52	–	
Seagrass beds [†]	0.00	Potential launch site 4N	–	0.00	0.00
Benthic zone and intertidal mudflat [°]	5.31	LNG jetty	3.72	3.72	Base case 5.64
		Boatshed Point access channel and dredge footprint	1.92	1.92	
Reef and rock substrate [°]	0.40	Potential launch site 4N	–	0.14	Alternate case 0.14

* Areas calculated to inform studies completed for the SREIS are based on Ecosure and 3D Environmental ground-truthed regional ecosystem 2011 data set and DERM regional ecosystem v6.1 2011 data set.

[†] Areas calculated and presented in the EIS and SREIS are based on the full 2002 data set sourced from the Department of Employment, Economic Development and Innovation.

[°] Areas calculated and presented in the EIS and SREIS are based on the full 2002 data set sourced from Department of Primary Industry and Fisheries.

Supplementary Report to the Arrow LNG Plant EIS
Arrow LNG Plant

5. OFFSET LIABILITY

Queensland Government policy requires offsets for endangered and of concern regional ecosystems, essential habitat, high value regrowth containing endangered and of concern regional ecosystems and essential habitat, threatened species (endangered, vulnerable and near threatened), and marine fish habitat. Commonwealth Government policy requires offsets for significant impacts on listed threatened species and ecological communities, migratory species and World Heritage values.

The assessment of potential impacts on squatter pigeon and water mouse has determined that project activities will not have a significant residual impact on these EPBC Act listed species. Consequently, no offset is required for these species. However, offset requirements under Queensland legislation will benefit these species. Table 5.1 provides an estimate of the terrestrial vegetation communities and marine habitat for which offsets are required.

Table 5.1 Estimated offset requirements for Arrow LNG Plant

Regional Ecosystem	Conservation Status / Offset Requirement	Area (ha)	Multiplier	Potential Area (ha)	Beneficial Value
RE 11.3.4 <i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains	VMA Of concern Queensland Biodiversity Offsets Policy	23.91*	Ecological equivalence method	23.91* minimum	Potential habitat for squatter pigeon
RE 12.3.3 <i>Eucalyptus tereticornis</i> woodland to open forest on alluvial plains	VMA Endangered Queensland Biodiversity Offsets Policy	37.73	Ecological equivalence method	37.73 minimum 7.87 (mainland habitat)	Potential habitat for squatter pigeon (mainland only) Essential habitat for koala (no records)
RE 12.11.4 Semi-evergreen vine thicket on metamorphics ± interbedded volcanics	VMA Of concern Queensland Biodiversity Offsets Policy	0.66	Ecological equivalence method	0.66 minimum	
RE 12.11.14 <i>Eucalyptus crebra</i> , <i>Eucalyptus tereticornis</i> woodland on metamorphics ± interbedded volcanics	VMA Of concern Queensland Biodiversity Offsets Policy	74.74	Ecological equivalence method	74.74 minimum	
RE 12.1.2 Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	VMA Least concern Marine fish habitat offset policy (marine plants)	55.01	1:1 for fish habitat connectivity restoration 5:1 for fish habitat exchange or increased security	55.01 275.05	Habitat for water mouse Habitat for eastern curlew and beach stone curlew

Table 5.1 Estimated offset requirements for Arrow LNG Plant (cont'd)

Regional Ecosystem	Conservation Status / Offset Requirement	Area (ha)	Multiplier	Potential Area (ha)	Beneficial Value
RE 12.1.3 Mangrove shrubland to low closed forest on marine clay plains and estuaries	VMA Least concern Marine fish habitat offset policy (marine plants)	4.7	1:1 for fish habitat connectivity restoration 5:1 for fish habitat exchange or increased security	4.7 23.5	Habitat for water mouse Habitat for eastern curlew and beach stone curlew
Benthic zone and intertidal mudflat ^o	Marine fish habitat offset policy (marine plants)	5.64	1:1 for fish habitat connectivity restoration 5:1 for fish habitat exchange or increased security	5.64 28.2	
Reef and rock substrate	Fish habitat	0.14	1:1 for fish habitat connectivity restoration 5:1 for fish habitat exchange or increased security	0.14 0.70	

* Impacts on RE 11.3.4 will only occur if TWAF 8 is developed. It is a less preferred option for a mainland accommodation and laydown facility.

Queensland and Commonwealth government policies require 'no net loss' of vegetation and habitat and promote 'net gain' to protect ecological resources and enhance ecosystem function.

The ecological equivalence method provides for the objective assessment of vegetation and habitat to be lost and the suitability of potential offset sites. The assessment provides a quantitative measure of the area of each regional ecosystem necessary to offset the estimated losses. While it is expected application of the ecological equivalence method to the affected vegetation communities will reduce the quantum of regional ecosystems and habitat for which offsets are required due to the existing condition of the communities, the condition of potential offsets will determine the ultimate area required to meet the offset liability.

Offsets for fish habitat may attract a multiplier which will be determined in consultation with the Queensland Department of Agriculture, Fisheries and Forestry.

6. PRELIMINARY ASSESSMENT OF AVAILABILITY OF OFFSETS

A preliminary assessment of the availability of affected regional ecosystems in each bioregion has been undertaken using GIS analysis of regional ecosystem and regrowth mapping. The analysis involved the sequential application of filters to identify suitable patches/tracts of affected regional ecosystems, and hence potentially viable offsets. The filters applied to regional ecosystem and regrowth mapping are:

- Identification of the area of each affected regional ecosystem available in the associated bioregion.
- Removal of patches/tracts that are not considered viable i.e., area is less than 5 ha.
- Removal of patches/tracts contained in urban and rural residential subdivisions.
- Classification of patches/tracts according to land tenure:
 - Freehold.
 - National Park, conservation park, conservation reserve, State Forest.
 - Other tenures including leasehold.

Table 6.1 lists the area of each regional ecosystem required to be offset in relation to the area potentially available for offset i.e., the result of the application of the filters to regional ecosystem. Table 6.2 shows the results of a similar analysis for regrowth mapping.

Table 6.1 Estimate of availability of suitable areas for offsets (regional ecosystems)

Regional Ecosystem	Estimated Minimum Offset Liability (ha)	Estimated Area of Potential Vegetation Offset (ha)
RE 11.3.4 <i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains	23.91	42,746
RE 12.3.3 <i>Eucalyptus tereticornis</i> woodland to open forest on alluvial plains	37.73	109,945
RE 12.11.4 Semi-evergreen vine thicket on metamorphics ± interbedded volcanics	0.66	2,890
RE 12.11.14 <i>Eucalyptus crebra</i> , <i>Eucalyptus tereticornis</i> woodland on metamorphics ± interbedded volcanics	74.74	14,116
RE 12.1.2 Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	55.01	2,012
RE 12.1.3 Mangrove shrubland to low closed forest on marine clay plains and estuaries	4.7	473

Table 6.2 Estimate of availability of suitable areas for offsets (regrowth)

Regional Ecosystem	Estimated Minimum Offset Liability (ha)	Estimated Area of Potential Vegetation Offset (ha)
RE 11.3.4 <i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains	23.91	44,562
RE 12.3.3 <i>Eucalyptus tereticornis</i> woodland to open forest on alluvial plains	37.73	170,093
RE 12.11.4 Semi-evergreen vine thicket on metamorphics ± interbedded volcanics	0.66	3,298
RE 12.11.14 <i>Eucalyptus crebra</i> , <i>Eucalyptus tereticornis</i> woodland on metamorphics ± interbedded volcanics	74.74	28,189
RE 12.1.2 Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	55.01	2,063
RE 12.1.3 Mangrove shrubland to low closed forest on marine clay plains and estuaries	4.7	479

The preliminary assessment of the availability of regional ecosystems indicates that there are sufficient remnant vegetation resources in which to identify potential offset sites.

7. APPROACH TO DELIVERY OF OFFSETS

Arrow Energy has developed a draft environmental offset strategy (Attachment 1) that sets out its approach to the delivery of offsets. The objectives of the strategy are to:

- Identify the government framework and policies that must be addressed.
- Identify the key guiding principles to guide offset planning, implementing and management.
- Identify the types of plans to be developed to enable projects to proceed.
- Support projects to proceed by providing a coordinated method to address offset management.
- Reduce implementation costs and improve environmental outcomes by exploring innovative solutions.
- Determine the preferred methods to implement offsets.
- Identify actions to support offset management.

The principles for environmental offsets defined by Arrow Energy are:

- Offsets will meet the requirements of current government policy.
- Offsets will only be used once the hierarchy to minimise impact (avoid, minimise, mitigate) has been followed.
- Offsets will contribute to managing and protecting biodiversity.
- Offset will be implemented strategically and economically.

Arrow Energy has proposed a suite of management plans designed to reflect the phases of identification and development of an environmental offset. The proposed management plans are:

Environmental Offset Strategic Management Plan which sets out the high-level assessment of impacts on biodiversity values, the estimated offset liability and an estimate of the availability of potential offsets. This attachment fulfils that requirement.

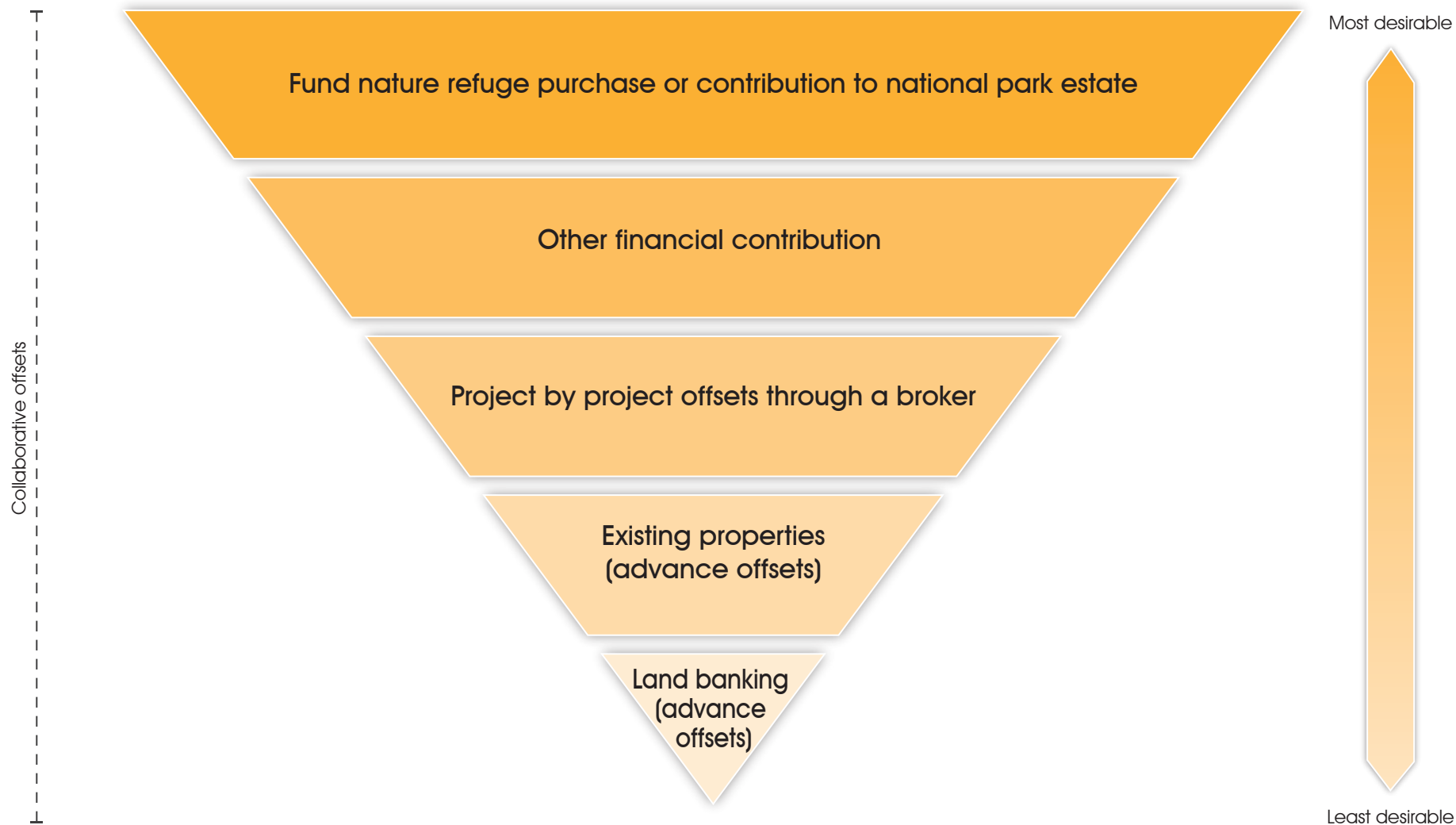
The **Environmental Offset Operational Management Plan** which identifies the appropriate methods to offset impacts.

Project Environmental Offset Management Plan which details the proposed offset, how it will be delivered and managed over the life of the offset, nominally until remnant status has been achieved.

Queensland and Australian government policies provide for a range of options for offsets including direct and indirect offsets, and funding arrangements for research and management of ecosystems established through brokerage or banking services. These options have informed Arrow Energy's preferred hierarchy for the delivery of offsets (Figure 4).

Arrow Energy's preferred method to fulfil its offset obligations is to source properties in which the government has a biodiversity interest, as this option requires less management inputs than other options over the life of the offset. The delivery of this type of offset may be as a nature refuge, additional national park estate, or the purchase of a property where the long term management can be passed to another party. This method allows for multiple offsets to be grouped, but

accepts that the offset site selected may not meet all the ecological equivalence criteria for all the values that need to be offset.



Note:
Reproduction of Figure 4 of Arrow Energy's Draft Environmental Offset Strategy 2012

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Arrow Energy
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Arrow's preferred hierarchy to deliver offsets

Figure No:
4

Supplementary Report to the Arrow LNG Plant EIS
Arrow LNG Plant

8. DEVELOPMENT OF OFFSET

Consistent with Arrow Energy's environmental offset strategy, the company will consult with relevant agencies on its assessment of the offsets required for the Arrow LNG Plant. The discussions will confirm the vegetation communities, species and habitat to be offset and the quantum of the offset.

Further analysis using GIS will identify potential opportunities for offsets having regard to Queensland and Australian government environmental offset policies and Arrow Energy's preferred hierarchy of offsets. An Environmental Offsets Operational Management Plan will be developed and presented to the Queensland and Australian governments for approval following which detailed management plans will be developed to implement and manage the offset.

Supplementary Report to the Arrow LNG Plant EIS
Arrow LNG Plant