8 AQUATIC ECOLOGY

This chapter summarises the values, potential impacts and mitigation measures associated with the existing freshwater aquatic conservation values in the area of the Pipeline Component of the Queensland Curtis LNG (QCLNG) Project. The details are provided within the Terrestrial and Freshwater Flora and Fauna Assessment, *Appendix 4.2.* Impacts and mitigation measures associated with marine aquatic conservation values are discussed in *Volume 5, Chapter 8*.

Values for the freshwater aquatic environments have been assessed through desktop studies and field surveys including:

- reviews of relevant published literature for the wider area
- reviews of databases e.g. Queensland Museum and the Department of Environment and Resource Management (DERM) WildNet, Matters of National Environmental Significance (MNES) online, Directory of Important Wetlands (Blackman et. al., 1999), and the DERM Biodiversity Planning Assessment (2008) which identifies ecological features and values of local, regional and state significance as recognised by the DERM and Queensland Museum
- initial field inspection of available sections of the Option 1 Export Pipeline and the Collection Header.

8.1 PROJECT ENVIRONMENTAL OBJECTIVE AND VALUES

The Project's environmental objective for freshwater aquatic ecology is to undertake Project activities such that impacts on abundance and distribution of aquatic flora, fauna and ecological communities are minimised.

The sections that follow outline the existing environmental values relating to the aquatic environment.

The estuarine and marine wetlands transected by the Export Pipeline are described in detail in *Volume 5, Chapter 8.*

Detailed field surveys of all preferred alignments will be conducted prior to alignment finalisation.

In addition to the ongoing above searches, ecologists have consulted with:

- DERM staff
- Department of Employment, Economic Development and Innovation
- landholders.

8.1.1 The Aquatic Environment

8.1.1.1 Description

The Collection Header traverses the Condamine River and several nationally significant wetlands occur downstream, including the Ramsar-listed Narran Lake Nature Reserve approximately 450 km to the south-west. The Export and Lateral Pipelines traverse a number of significant watercourse catchments including the Auburn, Dawson, Nogoa and Calliope.

A search of the Directory of Important Wetlands in Australia indicates that the only important wetland to be transected by the pipeline corridors is adjacent to The Narrows marine crossing to Curtis Island (refer to *Figure 4.8.1*). According to this directory, the Export Pipeline corridor crosses this wetland for a distance of 3 km between kilometre points (KPs) 372 and 375. Other important wetlands mapped as occurring in the broad vicinity of the pipeline corridors are:

- Palm Tree and Robinson Creek – approximately 25 km north of the Lateral at KP 50
- Boggomoss Springs – approximately 20 km east of Option 1 Export Pipeline at KP 150
- Gums Lagoon – 26 km south-west of Tara and approximately 45 km south of the Collection Header
- Lake Broadwater – 25 km south-west of Kogan and approximately 10 km west of KP 24 of the Collection Header.

None of the pipeline corridors are located within the catchment areas of any of these important wetlands.

The Pipeline corridors also transect a couple of small areas mapped by the Queensland Herbarium as wetlands. A small area (1 ha) of freshwater wetland RE 11.3.27, is mapped as occurring along the Export Pipeline corridor between KPs 12 and 13. As a result of land access constraints it was not possible to visit this area. However, this area will be inspected during the detailed assessment prior to alignment finalisation to confirm the precise location and avoidability of any wetland.

Marine wetlands RE 11.1.2 (Samphire forbland on marine clay plains) and RE 11.1.4 (mangrove woodland on marine clay plains) are mapped between KPs 372 and 375 along the Export Pipeline corridor just west of the marine crossing to Curtis Island. Due to access restrictions (waterlogging and cultural heritage) these areas could not be surveyed in the field and are therefore assumed to be in good condition.

Surface water features associated with the Pipeline Component of the Project are described in detail within *Volume 4, Chapter 9*.

8.1.2 National, State and Regionally Significant Aquatic Taxa

8.1.2.1 *Endangered, Vulnerable and Rare and Regionally Significant Aquatic Flora*

Habitat for freshwater aquatic flora within the pipeline corridors is limited to ephemeral watercourses. A small number of common aquatic plants including *Cyperus* and *Juncus* species were observed on the margins of these features.

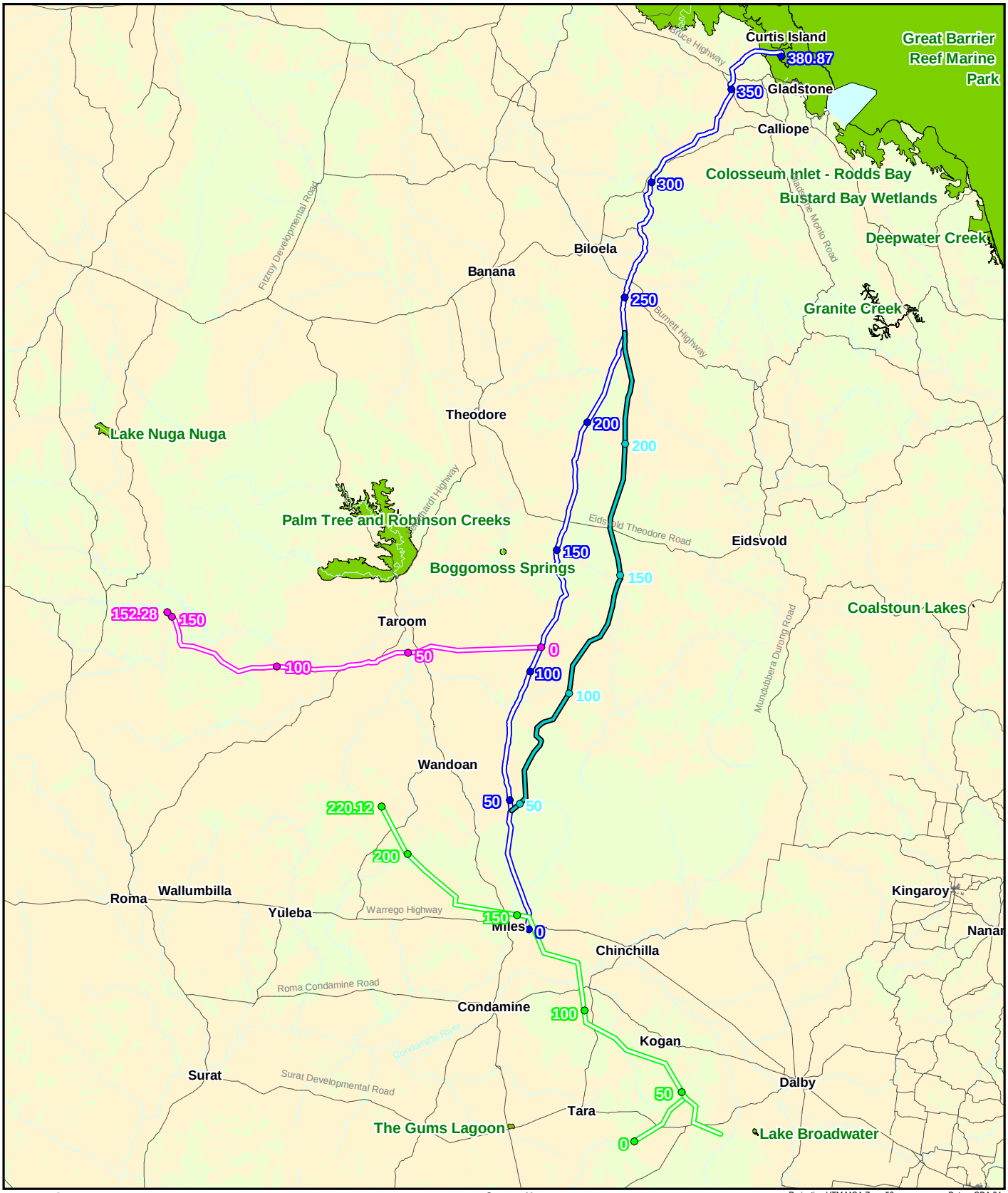
Although there are no records of Endangered, Vulnerable and Rare (EVR) aquatic flora species within any of the pipeline corridors, three (Queensland Lace Plant – *Aponogeton queenslandicus,* Blake's Spikerush – *Eleocharis blakeana* and *Fimbristylis vagans*) occur in the vicinity. Under the right seasonal conditions, there is the potential for these three EVR species to occur in freshwater pools in watercourses, farm dams and weirs along and downstream of the pipeline corridors (refer to *Table 4.8.1*).

The database searches also identified three artesian springs EVR flora species as occurring in the vicinity (refer to *Table 4.8.1)*, namely:

- Artesian Milfoil (Myriophyllum artesium)
- Salt Pipewort (Eriocaulon carsonii subsp. orientale)
- Swamp Fern (Thelypteris confluens).

The preferred habitat of Artesian Milfoil and Salt Pipewort is artesian mound springs and associated bore drains. Swamp Fern occurs in both mound springs and swamps. No such springs, drains or swamps are crossed by the pipeline corridors, although the Lateral Pipeline is within one to two kilometres of a mound spring containing these species at KP 8.

No regionally significant aquatic flora has been identified as occurring in the vicinity of the Export Pipeline.



Legend:

- Export Pipeline & Kilometre Point
- Export Pipeline Option 2 & Kilometre Point
- Lateral Pipeline & Kilometre Point
- Upstream Infrastructure Corridor & Kilometre Point
- Important Wetlands

Source Note:

1:250,000 Topographic Vector copyright Geoscience Australia
Important Wetlands copyright Department of Primary Industries
Coastal Wetland Vegetation

Projection UTM MGA Zone 56 Datum GDA 94

0 20 40 60 80

Kilometres

N

QUEENSLAND CURTIS LNG
A BG Group business

Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business

Title **Important Wetland Areas - Overview**

ERM
Environmental Resources Management Australia Pty Ltd

Drawn	Mipela	Volume 4	Figure 4.8.1
Approved	CD	File No	EO5-P-MA-96192
Date	29.05.09	Revision	A

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ERM does not warrant the accuracy of any such Maps and Figures.

Table 4.8.1 EVR Aquatic Flora Species Recorded in the Vicinity of the Pipeline Corridors

Common Name	Scientific Name	Status	Source	Comments
Queensland Lace Plant	*Aponogeton queenslandicus*	R1	1, 2	A seasonally emergent aquatic plant found in throughout much of coastal Queensland Herbarium records of one sighting just outside the most northern CSG field
Blake's Spikerush	*Eleocharis blakeana*	R1	2	Known in wet, poorly drained soils Records along Auburn Rd, Chinchilla and Lake Broadwater
Salt Pipewort	*Eriocaulon carsonii subsp. orientale*	E1 & 2	1, 2, 3	Known in wet poorly drained soils, mound springs areas
None known	*Fimbristylis vagans*	R1	1, 2	Wet creek/drainage lines Wetland plant recorded in the nearby Lake Broadwater Area
Artesian Milfoil	*Myriophyllum artesium*	E1	1, 2	Mound springs and bore drains
Swamp Fern	*Thelypteris confluens*	V1	1	Occurs in swampy areas or mound springs

Status: R = Rare, E = Endangered
Source: 1 = WildNet, 2 = Herbrecs, 3 = *EPBC Act* Protected Matters search

8.1.2.2 *EVR and Regionally Significant Aquatic Fauna*

According to Queensland Museum records, 55 fish species have been known to occur in watercourses in the broad vicinity of the pipeline corridors. All common and significant freshwater fish species (also those marine species that can potentially occur in freshwater areas) are listed in *Table 4.8.2.*

Of these species, the Murray Cod and the Australian Lungfish are listed as ''vulnerable'' fauna species under the *Environment Protection and Biodiversity and Conservation Act* (Cth) (*EPBC Act*). Additionally, the Southern Purple-spotted Gudgeon is identified as ''priority taxa'' under Biodiversity Assessment and Mapping Methodology (BAMM) criteria H (Environmental Protection Agency 2008c).

Four species were identified as introduced species (indicated by asterisk in *Table 4.8.2*).

Table 4.8.2 Fish Recorded in the Vicinity of the Pipeline Corridors

Common Name	Scientific Name	Status
Yellow Fin Bream	*Acanthopagrus australis*	No status
Agassiz's Olive Glassfish	*Ambassis agassizii*	No status

Common Name	Scientific Name	Status
Estuary Perchlet	*Ambassis marianus*	No status
Banded Grunter	*Amniataba percoides*	No status
Long Finned Eel	*Anguilla reinhardtii*	No status
Salmon Catfish	*Arius graeffei*	No status
Snubnose Garfish	*Arrhamphus sclerolepis*	No status
Silver Perch	*Bidyanus biyanus*^	No status
Not Applicable	*Caragobius sp*	No status
Goldfish*	*Carassius auratus**	No status
Darling River Hardyhead	*Cratercephalus amnicularis*^	No status
Marjorie's Hardyhead	*Craterocephalus marjoriae*	No status
Fly-speck Hardyhead	*Craterocephalus stercusmuscarum*	No status
Spotted Sickle Fish	*Drepane punctata*	No status
Mosquito Fish*	*Gambusia holbrooki*	No status
None known	*Geophagus brasiliensis**	No status
Mouth Almighty	*Glossamia aprion*	No status
Castelnau's Herring	*Herklotsichthys castelnaui*	No status
Empire Gudgeon	*Hypseleotris compressus*	No status
Firetailed Gudgeon	*Hypseleotris galii*	No status
Western Carp Gudgeon	*Hypseleotris klunzingeri*	No status
Gudgeon Species	*Hypseleotris sp*	No status
Bottlenose Jewfish	*Johnius australis*	No status
Sharpnose Hammer Croaker	*Johnius borneensis*	No status
Common Ponyfish	*Leiognathus equulus*	No status
Spangled Perch	*Leiopotherapon unicolor*	No status
Greenback Mullet*	*Liza subviridis**	No status
Tade Mullet	*Liza tade*	No status
Diamond-tail Mullet	*Liza vaigiensis*	No status
Murray Cod	*Maccullochella peelii peelii*	V2
Golden Perch	*Macquaria ambigua*	No status
Duboulay's Rainbowfish	*Melanotaenia duboulayi*	No status
Murray River Rainbowfish	*Melanotaenia fluviatilis*	No status
Eastern Rainbowfish	*Melanotaenia splendida*	No status
Southern Purple-spotted Gudgeon	*Mogurnda adspersa*^	No status
Bony Bream	*Nematalosa erebi*	No status
Australian Lung Fish	*Neoceratodus forsteri*	V2
Eeltail Catfish	*Neosilurus hyrtlii*^	No status
Bullrout	*Notesthes robusta*	No status
Northern Mud Gudgeon	*Ophiocara porocephala*	No status

Common Name	Scientific Name	Status
Sleepy Cod	*Oxyeleotris lineolatus*	No status
Silver Mullet	*Paramugil georgii*	No status
Mottled Sole	*Pardachirus rautheri*	No status
Flathead Gudgeon	*Philypnodon grandiceps*	No status
Guppy*	*Poecilia reticulate**	No status
Not Known	*Polydactylus sp*	No status
Rendah's Catfish	*Porochilus rendahli*	No status
Not Known	*Pseudogobius sp*	No status
Pacific Blue Eye	*Pseudomugil signifier*	No status
Australian Smelt	*Retropinna semoni*	No status
Spotted Arowana	*Scleropages leichardti*	No status
Southern Saratoga	*Scortum hillii*	No status
Common Eeltail Catfish	*Tandanus tandanus*	No status
Long-arm Mullet	*Valamugil cunnesius*	No status
Green Swordtail*	*Xiphophorus helleri**	No status

Status V2 = *EPBC Act* Vulnerable;
* Introduced species; ^ BAMM Report EPA 2002.

According to Queensland Museum records, at least 13 crustacean species could potentially occur in watercourses located in the vicinity of the pipeline corridors (refer to *Table 4.8.3*). None of these species are listed as EVR species or ''priority taxa'' under BAMM criteria (EPA 2008c).

Table 4.8.3 Crustacean Species Recorded in the Vicinity of the Pipeline Corridors

Common Name	Species Name	Status	Recorded sightings according to Queensland Museum
Shrimp	*Alpheus* spp.	No status	Calliope River and The Narrows near Gladstone
Brine Shrimp	*Artemia salina*	No status	Callide Creek
Shrimp	*Atyidae* spp.	No status	Briffney Creek near Gladstone
Fairy Shrimp	*Branchinella australiensis*	No status	Nangram Lagoon located near Condamine
Shrimp	*Caridina indistincta*	No status	Lake Broadwater
Orange-fingered Yabby	*Cherax depressus*	No status	Dawson River near Taroom
Common Yabby	*Cherax destructor*	No status	Lake Broadwater
Waterbug	*Lepidurus viridus*	No status	In a watercourse in the vicinity of Tara
Long-arm Shrimp	*Macrobrachium australiense*	No status	Condamine River near Chinchilla
Shrimp	*Macrobrachium novaehollandiae*	No status	Boyne River in the vicinity of Benaraby

Common Name	Species Name	Status	Recorded sightings according to Queensland Museum
Crayfish	*Notodelphyidae sp.*	No status	Auckland Creek near Gladstone
Glass Shrimp	*Paratya australiensis*	No status	Lake Broadwater
Waterbug	*Tachaea caridophaga*	No status	Dawson River near Taroom

8.1.3 Declared and Environmental Aquatic Weeds and Introduced Fish

No aquatic weeds are known from watercourses in the vicinity of the pipeline corridors, although the propensity for such weeds to spread via waterbird vectors would suggest that some species may occur, at least in the more permanent waterholes and large dams.

The introduced Goldfish, Mosquito fish, Guppy and the Green Swordtail have been recorded in the Project area. It is highly likely that numbers and distribution fluctuate according to stream flows and that these species are present in many parts of the broader area. No surveys were conducted to examine the distribution or abundance of these or other fish species in any watercourse in the vicinity of the pipeline corridors.

8.2 POTENTIAL IMPACTS

8.2.1 Potential Impacts to Aquatic Environments and Taxa

The Collection Header is situated upstream of several nationally significant wetlands, including the Ramsar-listed Narran Lake Nature Reserve approximately 450 km to the south-west. Due to the remoteness of this wetland to the pipeline corridors there is low potential for the proposed activities to impact on this wetland.

According to the Directory of Important Wetlands in Australia the Export Pipeline transects approximately 3 km of the important wetland, The Narrows near Curtis Island. Potential impacts on this wetland have been assessed in a separate study and are presented in *Volume 5, Chapter 8.*

Important wetlands mapped in the broad vicinity of the Project's three pipeline corridors include Palm Tree and Robinson Creek, Boggomoss Springs, Gums Lagoon and Lake Broadwater. The proposed activities are unlikely to impact on these areas because none of these wetlands and/or their catchment areas occurs within or close to the pipeline corridors.

The pipeline corridors transect three REs which represent wetland communities, according to Queensland Herbarium mapping. They are:

- RE 11.3.27 (freshwater wetlands)
- RE 11.1.2 (Samphire forbland on marine clay plains)
- RE 11.1.4 (mangrove woodland on marine clay plains).

Land access constraints prevented inspecting the small area (1 ha) of RE 11.3.27 that is mapped as occurring along the Export Pipeline corridor between KPs 12 and 13. Subject to constructability constraints, minor realignment has been recommended to avoid this wetland area. However, this area will be inspected during the detailed assessment prior to alignment finalisation to confirm the precise location and avoidability of any wetland.

The estuarine wetlands, RE 11.1.2 and RE 11.1.4, are mapped between KPs 372 and 375 along the Export Pipeline corridor, just before the marine crossing of The Narrows to Curtis Island. Access restrictions associated with weather and cultural assessments prevented a survey in the field, and it has been assumed these wetlands are in good condition. Potential impacts on this wetland have been assessed in a separate study and are presented in *Volume 5, Chapter 8.*

Other potential impacts that the proposed pipelines have on watercourses and associated aquatic species in the area are:

- direct clearance and disturbance by machinery
- indirect impacts – altered water and sediment and nutrient flows if watercourse disturbance is not effectively managed
- release of contaminants, nutrients and/or silt.

Due to their sensitivity, areas mapped as ephemeral wetlands within the broader Pipeline Component area could potentially be impacted through sedimentation, eutrophication and accidental release of contaminants. However, significant direct or indirect impacts to freshwater wetlands are considered unlikely provided the recommended mitigation measures in *Section 8.3* are implemented. The potential impact to estuarine wetlands is considered in *Volume 5, Chapter 8.*

8.3 MITIGATION AND REHABILITATION

8.3.1 Mitigation Measures

Mitigation measures to reduce potential impacts on wetlands and aquatic plants will include the following:

- effective weed hygiene practices to avoid introduction and spread of aquatic weeds
- non-linear infrastructure to be located away from major river and creek systems where possible
- in cases where traversing a watercourse is unavoidable, design clearance paths at 90 degrees to the watercourse
- crossings will be developed, where practicable, in no- or low-flow conditions, and rehabilitation completed as soon as possible after works are finalised
- where practicable, large and particularly hollow-bearing trees will be

retained to stabilise watercourse banks

- hydrotest water will be treated and disposed of in accordance with the CSIRO Manufacturing and Infrastructure Technology report (2005) recommendations, and will not be released to a watercourse
- monitoring will be conducted for potential impacts adjacent to areas where clearing within wetland communities (i.e. REs 11.1.2, 11.1.4 and 11.3.27) is unavoidable.

Under the *Fisheries Act 1994* (Qld) and the DPIF Operational Policy (FHMOP 008[1]) on Waterway Barrier Works, the construction of infrastructure that would impede waterways and therefore impact on fish passage, would require approval.

QGC will comply with applicable requirements of the *Fisheries Act* and associated operational policies and guidelines. The construction and operation of Pipeline Component infrastructure is not anticipated to restrict the flow of water in waterways or significantly restrict fish movement.

8.3.2 *Rehabilitation*

Rehabilitation measures to minimise potential impacts on freshwater wetlands and aquatic plants will include the following:

- natural bank contours and surface levels will be restored to minimise impacts on hydrology and sediment and nutrient flows
- revegetation will be completed as soon as possible after construction
- local province plant species will be sown to stabilise banks and prevent erosion where required
- weeds will be regularly monitored and controlled during the life of the Project. (A Weed Management Plan that addresses the construction, rehabilitation and operation phases of the Project will be prepared prior to construction. This plan will include hygiene protocols to minimise the likelihood of the introduction and spread of environmental, agricultural and declared weeds.)
- rehabilitation will be monitored monthly for six months after works are completed and then bi-annually for two years.

1 Peterken, C. (2001) Waterway Barrier Works Approvals and Fishway Assessments: Departmental Procedures, Queensland Department of Primary Industries Fish Habitat Management Operational Policy FHMOP 008

8.3.3 Environmental Offsets

Offsets will be established where clearing is unavoidable within wetland communities (i.e. REs 11.1.2, 11.1.4 and 11.3.27). This will be included within the Offset Strategy for the Project as detailed in *Volume 3, Chapter 7*.

8.4 CONCLUSION

QGC has endorsed a number of proposed mitigation measures to ensure aquatic (freshwater) ecology is protected during the construction, operation and decommission of the Pipeline Component of the Queensland Curtis LNG (QCLNG) Project. This will ensure that the proposed pipeline works will not have a significant impact on aquatic ecology features and values in or downstream of the proposed activities.

A summary of the impacts outlined in this chapter is provided in *Table 4.8.4.*

Table 4.8.4 Summary of Impacts for Aquatic Ecology

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term
Impact extent	Local
Impact likelihood	Unlikely

Overall assessment of impact significance: minor, provided that proposed management measures are implemented to ensure that the structure and function of freshwater ecosystems are maintained.