# 17B AQUATIC ECOLOGY

## 17B.1 INTRODUCTION

This chapter examines the existing environment, potential impacts and mitigation measures associated with aquatic ecology for the proposed southern coal seam methane (CSM) water supply pipeline (the proposed pipeline). The focus of aquatic ecological assessment is on waterbodies and the associated physical, chemical and biological components of identified waterbodies.

For further information on the aquatic ecology assessment, the technical report associated with this chapter is TR 17B-1-V2.5 Aquatic Ecology Impact Assessment. Note that figures/documents with numbering ending in V3.5, for example, refer to figures/documents contained in Volume 3, Book 5 of the EIS. Figure 17B-1-V2.3 provides the proposed alignment of the pipeline, including locations of aquatic ecology sites sampled as part of the impact assessment.

## 17B.2 METHODOLOGY OF ASSESSMENT

### 17B.2.1 RELEVANT LEGISLATION

#### Commonwealth Legislation

#### *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*

Any actions that are likely to have a significant impact on a Matter of National Environmental Significance (MNES) are subject to assessment under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval process. MNES include:

- World Heritage properties
- National Heritage places
- wetlands of International importance
- threatened species and ecological communities
- migratory species
- Commonwealth marine areas
- nuclear actions.

Where relevant, MNES are further described below.

**World heritage properties (Great Barrier Reef)**

The EPBC Act regulates actions that will, or are likely to, have a significant impact on the World Heritage values of a World Heritage property. This includes relevant actions that occur outside the boundaries of a World Heritage Area.

The Fitzroy Basin drains to the Great Barrier Reef World Heritage Area, approximately 600 km downstream from the pipeline alignment. The proposed pipeline is not expected to result in a significant impact on the values of the Great Barrier Reef World Heritage Area.

**Wetlands of international importance (Ramsar Wetlands)**

The EPBC Act regulates actions that will, or are likely to, have a significant impact on the ecological character of a Ramsar wetland. This includes relevant actions that occur outside the boundaries of a Ramsar wetland. There are no Ramsar wetlands or wetlands of national importance in the proposed pipeline area.

The Fitzroy Basin drains into the Shoalwater and Corio Bays Ramsar site, a Wetland of International Significance (DEWHA 2008a). The Shoalwater and Corio Bays Ramsar wetland is approximately 620 km downstream from the proposed pipeline route; therefore the proposed pipeline is not expected to result in a significant impact on the ecological character of this Ramsar Wetland.

The Narran Lake Nature Reserve Ramsar wetland is part of a large terminal wetland system at the end of the Condamine River system (DEWHA 2008c). The Narran Lake Nature Reserve Ramsar wetland is approximately 540 km downstream from the proposed pipeline; therefore the proposed pipeline is not expected to result in a significant impact on the ecological character of this Ramsar Wetland.

**Threatened ecological communities and species**

*Boggomoss Communities*

On the Dawson River, approximately 100 km downstream from the proposed pipeline, mound springs from the Great Artesian Basin (Boggomoss Areas 1 and 2) are listed on the Register of the National Estate. The boggomoss communities are dependent on natural discharge of groundwater from the Great Artesian Basin and are listed as an Endangered Ecological Community under the EPBC Act.

The boggomoss snail (*Adclarkia dawsonensis*), or Dawson River snail, is listed as Critically Endangered under the EPBC Act. This snail lives in the boggomoss habitat on the Dawson River, approximately 100 km downstream of the creeks crossed by the proposed pipeline alignment (DEWHA 2008b).

Potential impacts of the proposed pipeline on these species are addressed in Section 17B.5.7.

*Fitzroy River Turtle*

The Fitzroy River turtle (*Rheodytes leukops*) is listed as vulnerable under the EPBC Act. Its distribution is restricted to the Fitzroy Basin, and it has been recorded from the Dawson River (EPA 2007b).

Impacts of the proposed pipeline on this species are addressed in Section 17B.5.7.

*Murray Cod*

The Murray Cod (*Maccullochella peeli peeli*) is listed as vulnerable under the EPBC Act. It is found in a range of warm-water habitats in the waterways of the Murray Darling Basin (DEWHA 2008d). Murray cod have not been recorded within 15 km of the proposed pipeline crossing of Dogwood Creek (EPA 2008). Impacts of the proposed pipeline on this species are addressed in Section 17B.5.7.

## State Legislation

### *Water Act 2000*

The *Water Act 2000* provides for the sustainable management of water and other resources. Under section 266 of this act, a Riverine Protection Permit is required from the Department of Natural Resources and Water (NRW) to:

- destroy vegetation in a watercourse
- excavate in a watercourse
- place fill in a watercourse.

The proposed pipeline alignment crosses a number of watercourses and permits will therefore be required for works associated with these crossings.

Additionally, where waters are to be taken from a watercourse, lake, spring or underground water (e.g. for use in dust suppression during construction works), a Water Permit may be required pursuant to section 237 of this act.

### *Fisheries Act 1994*

All waters of the state are protected against degradation by direct or indirect impact under section 125 of the *Fisheries Act 1994* (Fisheries Act).

Under Division 8 of the Fisheries Act, a Waterway Barrier Works Approval is needed to build any structure across a freshwater waterway. The purpose of this part of the Act is to provide a balance between the need to construct dams and weirs and the need to maintain fish movement. Such structures include temporary culverts and road crossings, which will be constructed as a part of the proposed pipeline. The Chief Executive (Department of Primary Industries & Fisheries) may direct the building of a specified fishway for the barrier, if required.

### *Nature Conservation Act 1992*

The Fitzroy River turtle (*Rheodytes leukops*) is also recognised as vulnerable under the *Nature Conservation Act 1992* (NC Act), as listed in the Nature Conservation (Wildlife) Regulation 2006 (NC Regulation).

Impacts of the proposed pipeline on this species are addressed in Section 17B-5-7.

## 17B.2.2 DESCRIPTION OF STUDY AREA

The proposed pipeline route crosses six major creeks and several smaller tributaries and gullies, which are part of two larger Catchments.

## Dawson River Catchment

The proposed pipeline route crosses Juandah Creek and several of its tributaries, namely Six Mile Creek, Sandy Flat Creek, and Frank Creek.

Juandah Creek flows into the Dawson River approximately 100 km downstream from the proposed pipeline. The Dawson River flows into the Fitzroy River, approximately 85 km south west of Rockhampton (Joo et al. 2000).

### Condamine River catchment

The proposed pipeline also crosses Dogwood Creek and several of its tributaries, namely L Tree Creek, Nine Mile Creek, Eleven Mile Creek, and Wallan Creek. Dogwood Creek flows into the Condamine River approximately 100 km downstream from the proposed pipeline (CSIRO 2008).

## 17B.2.3 STUDY METHODOLOGY

Aquatic floral and faunal surveys and collection of water quality data was undertaken during the dry season, from the 11 to the 28 August 2008.

### Study sites

Twenty waterways crossed by the proposed pipeline alignment were surveyed (refer Figure 17B-1-V2.3 and Table 17B-1). Whenever possible, surveys were completed at the proposed crossing location. Due to property access restrictions, some creeks were assessed at a nearby road crossing, while some creeks crossed by the proposed pipeline alignment could not be surveyed.

At all sites (with the exception of site 14 on a minor tributary to Nine Mile Creek, sites 14a and 14b on minor tributaries to L Tree Creek, site 16a on a minor tributary to Juandah Creek, and site 23 at the headwaters of Six Mile Creek), the stream order, broad habitat type, channel pattern, water level and flow, substrate character and cover, bed and bank stability, and riparian cover were described. Only brief observations and photographs were taken at sites 14, 14a, 14b, 16a and 23, as these sites were on minor watercourses within no defined channel or banks. Water was present at seven of the sites surveyed (all in the Condamine Subcatchment), allowing water quality measurements and aquatic flora and fauna surveys to be done at each of these sites.

**Table 17B-1: Date and type of survey completed at watercourses on the proposed southern coal seam methane water supply pipeline alignment**

| Site | Channel name | Date survey completed | | | |
|---|---|---|---|---|---|
| | | Aquatic habitat | Water quality | Macrophytes | Fauna |
| 4 | Tributary to Dogwood Creek | 15/08/08 | Dry | Dry | Dry |
| 5 | Dogwood Creek | 27/08/08 | 27/08/08 | 27/08/08 | 28/08/08 |
| 6 | Dogwood Creek | 28/08/08 | 28/08/08 | 28/08/08 | 28/08/08 |
| 7 | Tributary to Eleven Mile Creek | 15/08/08 | Dry | Dry | Dry |
| 8 | Tributary to Eleven Mile Creek | 15/08/08 | Dry | Dry | Dry |
| 9 | Wallan Creek | 15/08/08 | 15/08/08 | 15/08/08 | 26/08/08 |
| 10 | Eleven Mile Creek | 15/08/08 | 15/08/08 | 15/08/08 | 22/08/08 |
| 11 | Tributary to Eleven Mile Creek | 15/08/08 | Dry | Dry | Dry |
| 12 | Eleven Mile Creek | 15/08/08 | Dry | Dry | Dry |
| 13 | Tributary to Nine Mile Creek | 12/08/08 | 12/08/08 | 26/08/08 | 26/08/08 |
| 14 | Tributary to Nine Mile Creek | — | — | — | — |

| Site | Channel name | Date survey completed | | | |
|---|---|---|---|---|---|
| | | Aquatic habitat | Water quality | Macrophytes | Fauna |
| 14a | Tributary to L Tree Creek | — | — | — | — |
| 14b | Tributary to L Tree Creek | — | — | — | — |
| 15 | Tributary to L Tree Creek | 12/08/08 | 12/08/08 | 21/08/08 | 21/08/08 |
| 16 | LTree Creek | 14/08/08 | 14/08/08 | 21/08/08 | 21/08/08 |
| 16a | Tributary to Juandah Creek | — | — | — | — |
| 17 | Tributary to Juandah Creek | 14/08/08 | Dry | Dry | Dry |
| 18 | Juandah Creek | 14/08/08 | Dry | Dry | Dry |
| 22 | Tributary to Sandy Flat Creek | 14/08/08 | Dry | Dry | Dry |
| 23 | Six Mile Creek | — | — | — | — |

## Methods

### *Aquatic Habitat*

Sites were described and scored using AusRivAS protocols (DNRM 2001).

Regionally, the typical aquatic habitat and other relevant attributes of the streams and creeks in the Southern Tributaries Subcatchment of the Dawson River and the Condamine River Subcatchment of the Maranoa, Balonne and Lower Condamine System was described via literature review.

### *Water quality*

Water quality data was collected on water temperature, electrical conductivity, pH and dissolved oxygen.

No Water Quality Objectives (WQOs) have been prescribed for the waterways within the study area. Water quality parameters at each of the sites have therefore been compared to Queensland Water Quality Guidelines (QWQG) values for upland (altitude >150 m) streams in the central coast region (EPA 2007a).

### *Aquatic flora*

Aquatic flora data was recorded for each site as follows:

- the presence of all native and exotic macrophytes, and their form
- the percent cover of each species at each site (cover may exceed 100% due to overlap).

### *Aquatic macro-invertebrate communities*

At each site, a macro-invertebrate sample from each aquatic habitat found was collected in accordance with the Queensland AusRivAS Sampling Manual (DNRM 2001).

#### Sample processing

Samples were frozen and returned to frc environmental's Brisbane benthic laboratory for processing.

**Data analysis**

At each site and for regional data available from NRW, taxonomic richness, PET richness and Signal 2 scores were calculated.

***Fish communities***

**Sample collection**

Fish communities were surveyed using a combination of backpack electrofishing, seine and set nets, baited traps and dip nets. Electrofishing was the preferred method and was attempted at all sites where conditions were appropriate.

At each site, the presence and abundance of each species by life history stage (juvenile, intermediate, adult) and the apparent health of individuals was recorded. Specimens that were unable to be identified in the field were euthanised and returned to the laboratory for identification.

Sampling of fishes was conducted under General Fisheries Permit No. 54790 and Animal Ethics Approval No. CA 2006/03/106.

**Data analysis**

Taxonomic richness, total abundance, abundance of rare and threatened species, abundance of exotic species, and the abundance of each life history stage was determined.

***Turtle and other aquatic vertebrate communities***

The likely presence of turtles and other aquatic vertebrates in the study area and throughout the region was described through literature review and database searches, specifically: the Commonwealth *Protected Matters Search Tool* (DEWHA 2008a); and the State *Wildlife Online* database (EPA 2007b, 2008).

# 17B.3 EXISTING ENVIRONMENT

## 17B.3.1 AQUATIC HABITAT

Sites along the proposed pipeline alignment were typically assessed as having a moderate River Bioassessment Program habitat assessment score. These relatively low scores were related to moderate to extensive bank erosion, low habitat variability (with no runs or riffles observed), and substrates dominated by finer sediments such as sand and silt.

Overall, the reach environs of the creeks surveyed have been moderately affected by human activities. Pasture, grazed and ungrazed forests are the dominant land uses surrounding the creeks in the study area and in the broader area. Erosion at road crossings was a major form of disturbance. There has been some clearing of riparian vegetation along the proposed pipeline alignment, although large trees still grow on the creek banks at many sites. Several roads and fences that cross creeks in the study area are likely to cause alterations of flow and restrict aquatic fauna passage under particular flow regimes. Similar impacts were observed throughout the Southern Tributaries and Condamine River subcatchments, although the extent of disturbance was lower throughout the Condamine subcatchment.

Riparian zone condition throughout the study area was poor and characteristic of the region. Riparian zones were generally 10 – 20 m wide and dominated by grasses. Riparian vegetation was dominated by native species, although exotic species were found at all sites. Erosion was prominent in waterways throughout the region and there was some bank erosion at most sites in the study area.

Stream beds were relatively stable; however, there was scouring along outside meanders or downstream of obstructions and deposition of sediments in pools or upstream of obstructions in places. Channel diversity was generally low to moderate in the region, and was extremely low across the proposed pipeline alignment; isolated pools were the only habitat category observed.

Some physical aquatic habitat for fauna was found at most of the sites and was typically in the form of tree roots and woody debris. In-stream habitat diversity was highest at sites with a higher cover of trees in the riparian zone and a higher cover of overhanging vegetation. Throughout the region, disturbances to the riparian zone have led to a reduction in the cover and diversity of in-stream habitat such as large woody debris.

Regionally, aquatic habitat was generally rated as poor or very poor.

## 17B.3.2 WATER QUALITY

### Temperature

Recorded water temperatures in the study area were between 10.6°C and 20.4°C. There are no guidelines available for water temperature (ANZECC & ARMCANZ 2000; EPA 2007a).

### Dissolved oxygen

Dissolved oxygen (DO) levels were within the QWQG range (90 – 110% sat.) in Wallan Creek (site 9), Eleven Mile Creek (site 10) and tributaries to Nine Mile and L Tree Creeks (sites 13 and 15), but were below the QWQG range in Dogwood (sites 5 and 6) and L Tree Creeks (site 16). Low DO concentrations at Dogwood and L Tree Creeks were probably due to high biological oxygen demand, low mixing and shading.

### pH

Within the study area, pH tended to be acidic (< 7) across most sites, but it ranged from 5.6 at Dogwood Creek (site 5) to 7.8 at L Tree Creek (site 16). Eleven Mile Creek (site 10) and a tributary to L Tree Creek (site 15) were the only creeks with a pH value within the QWQG range (6.5 – 7.5). The pH at Dogwood (sites 5 and 6) and Wallan (site 6) Creeks was below the QWQG range, while the pH at L Tree Creek (site 16) and a tributary to Nine Mile Creek (site 13) was above the QWQG upper limit (EPA 2007a).

### Electrical conductivity

Electrical conductivity ranged from 37 µS/cm at Dogwood Creek (site 5) to 523 µS/cm at L Tree Creek (site 16). Electrical conductivity was below the QWQG upper limit (340 µS/cm) for all sites except Wallan and L Tree Creeks. It should be noted that the QWQG value for conductivity is a preliminary guideline only (EPA 2007a).

**Water quality summary**

Due to surrounding land uses, waterways within the region are impacted by relatively high inputs of nutrients, pesticides and other contaminants. By their nature, ephemeral streams such as those in the study area are commonly subject to a range of severe (natural) stresses and as such, the water quality of the creeks within the study area may be characterised by elevated turbidity, salinity and nutrient enrichment (Chessman, B. [Centre for Natural Resources NSW] pers. comm. 2003, 21 October).

## 17B.3.3 AQUATIC FLORA

Up to nine species were recorded across the seven sites that held water. All species had an emergent growth form, with no floating or submerged species recorded.

At all sites, cover by any one species was less than or equal to 10%, except for at Wallan Creek (site 9), where common reed (*Phragmites australis*) covered 20% of the lower bank and bed area.

Several macrophytes could only be identified to genus level, due to the absence of seeds or flowers. The most abundant and common macrophyte was the common rush (*Juncus usitatus*), which was present at six of the seven sites where macrophytes were observed.

Filamentous algae was observed at Dogwood Creek (sites 5 and 6) and had an estimated cover of 2%.

Regionally, very little information is available concerning aquatic marophytes. What is available suggests that emergent macrophytes are the most common form of aquatic flora, although some sites within the Condamine River Catchment also contained submerged macrophytes and floating vegetation (Van Manen 2001).

The limited cover of macrophytes, and in particular the lack of submerged species, is likely to be related to the largely ephemeral nature of the study area waterways and turbid water. Ephemeral waterways do not offer appropriate habitat for submerged macrophytes. Turbidity may not allow sufficient light penetration through the water column for the growth of macrophytes.

## 17B.3.4 AQUATIC MACRO-INVERTEBRATE COMMUNITIES

Non-biting and phantom midge larvae, diving beetles, water bugs and water fleas dominated the invertebrate communities of the study area.

The calculated index scores indicate the following:

- Taxonomic richness was generally higher in edge habitats (6 – 24 taxa recorded) than in bed habitats (3 – 9 taxa recorded). This is a reflection of more diverse habitat existing in edge habitat
- PET richness was generally low and is probably indicative of degraded water and habitat quality
- SIGNAL 2 results suggest that the surveyed waterways are probably impacted by agricultural pollution associated with surrounding land uses.

### Macro-crustacean communities

Four macro-crustacean species were recorded in the study area, as given in Table 17B-2.

All four species of macro-crustacean were captured at Wallan and Eleven Mile Creeks (sites 9 and 10). Macro-crustacean community richness was two species at each site in Dogwood Creek (sites 5 and 6) and one at each of the other sites surveyed.

**Table 17B-2: Abundance of macro-crustaceans at each site (all survey methods combined)**

| Family | Latin name | Common name | 5 | 6 | 9 | 10 | 13 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|
| Atyidae | *Caradina sp.* | freshwater shrimp | 5 | — | 1 | 1 | — | — | — |
| Atyidae | *Paratya sp.* | freshwater shrimp | 48 | 6 | 64 | 21 | 2 | — | — |
| Palaemonidae | *Macrobrachium sp.* | river prawn | — | 1 | 3 | 3 | — | — | — |
| Parastacidae | *Cherax depressus* | orange fingered yabby | — | — | 3 | 17 | — | 9 | 17 |

### Regional

Regionally, the macro-invertebrate communities of the downstream Dawson River are likely to be more diverse and contain more taxa sensitive to pollution and disturbance than communities within the Juandah Creek catchment that are crossed by the proposed pipeline. This is considered to largely reflect the more permanent nature of waterways studied by NRW.

Macro-invertebrate communities of Dogwood Creek (Condamine Catchment) were generally indicative of better conditions than those sampled in smaller tributaries within the subcatchment. Again, the waterways sampled by NRW are likely to have more permanent water, and therefore offer more stable habitat for macro-invertebrates.

### Aquatic macro-invertebrate summary

Aquatic macro-invertebrate community structure within the study area was generally indicative of poor to moderate aquatic habitat and/or water quality, reflecting the results of water quality and aquatic habitat assessments at the sites. Differences in macro-invertebrate community structure appeared to be related to site-specific differences in habitat availability and diversity. Crayfish (yabbies) and prawns/shrimp were common in the study area.

## 17B.3.5 FISH COMMUNITIES

Eleven fish species were captured from the seven sites surveyed. Abundance varied across the sites, with no fish caught on L Tree Creek (site 16) and 147 fish caught at the tributary to Nine Mile Creek (site 13). Results are summarised in Table 17B-3.

All life history stages (juvenile, intermediate and adult) were captured for five of the species caught (i.e. Agassiz's glassfish, bony bream, carp gudgeon, goldfish, and mosquitofish). Across the study area, juveniles were most abundant life stages for most species (e.g. bony bream, goldfish, and mosquitofish) and adults were the most abundant life stage for Agassiz's glassfish and carp gudgeon. The largest species (on average) was bony bream and the smallest species (on average) was carp gudgeon.

Three introduced species (i.e. goldfish, common carp and mosquitofish) were captured during the survey. In total, 104 introduced fish were captured at 5 of the 7 sites surveyed. No introduced species were captured at L Tree Creek and its tributary (sites 15 and 16). Introduced species accounted for 10% of the total catch at Dogwood Creek (site 5) and 36% of the total catch at Eleven Mile Creek (site 10).

**Table 17B-3: Abundance of fish species at each site**

| Family | Latin name | Common name | 5 | 6 | 9 | 10 | 13 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|
| Ambassidae | *Ambassis agassizii* | Agassiz's glassfish | | | | | 8 | 1 | |
| Ariidae | *Tandanus tandanus* | freshwater catfish | | 1 | | | | | |
| Clupeidae | *Nematalosa erebi* | bony bream | 1 | 7 | | | | | |
| Clupeidae | | unidentified | | 1 | | | | | |
| Cyprinids | *Cyprinus carpio* | common carp* | 1 | 1 | | | | | |
| Cyprinids | *Carassius auratus* | goldfish* | 7 | 14 | | 8 | 30 | | |
| Eleotridae | *Hypseleotris* species 1 | carp gudgeon | 117 | 23 | 36 | 76 | 107 | 12 | |
| Melanotaeniidae | *Melanotaenia fluviatilis* | Murray River rainbowfish | | 1 | | | | | |
| Percichthyidae | *Macquaria ambigua* | golden perch | | | 1 | | | | |
| Poeciliidae | *Gambusia holbrooki* | mosquitofish * | 5 | | 3 | 35 | | | |
| Retropinnidae | *Retropinna semoni* | Australian smelt | 3 | | | | | | |
| Terapontidae | *Leiopotherapon unicolor* | spangled perch | | 2 | | | 2 | | |

**introduced species*

## Regional perspective

Within the upper Dawson River Catchment, 20 species have been recorded near the study area. Within the Condamine River Catchment, 25 species have been recorded near the study area.

Six species (i.e. sleepy cod, eastern rainbowfish, Southern saratoga, Rendahl's catfish, pacific blue eye and leathery grunter) have been recorded in the upper Dawson River catchment but have not been recorded in the Condamine River catchment. Conversely, eleven species (i.e. Australian smelt, common carp, crimson spotted rainbowfish, firetail gudgeon, guppy, Lake's carp gudgeon, mountain galaxias, Murray cod, Murray River rainbowfish, river blackfish, and silver perch) have been recorded in the Condamine River catchment but have not been recorded in the upper Dawson River catchment.

Murray cod (*Maccullochella peeli peeli*) occurs throughout the Murray Basin. Murray cod were not found in this study, and have not been recorded within 15 km of the proposed pipeline crossing section of Dogwood Creek (EPA 2008). As this species prefers deeper-water habitats around in-stream habitat structures such as boulders, logs, undercut banks and overhanging vegetation (Allen et al. 2002), it is unlikely to occur in the majority of creeks along the proposed pipeline alignment, although it is possible that this species is present in Dogwood Creek from time to time.

### Fish movement

Of the fish likely to be found in the study areas, most undertake freshwater migrations (Cotterell 1998, Marsden & Power 2007). Adult golden and spangled perch move upstream to spawn and juveniles move downstream for dispersal. This movement typically occurs in spring and summer, and is triggered by large flow events (Cotterell 1998). Glassfish, rainbowfish and gudgeons move within freshwaters to disperse to new habitats. This movement also typically occurs following flow events and in the case of the study area, could only occur when the creeks are flowing.

### Fish community summary

Most of the species that were captured from the study area can tolerate a large range of water quality conditions. Spangled perch, Agassiz's glassfish and carp gudgeons are tolerant species that can live in water characterised by low dissolved oxygen levels, high conductivity and relatively high turbidity. Golden perch have narrower water quality tolerances than the other species collected.

## 17B.3.6 TURTLE AND OTHER AQUATIC VERTEBRATE COMMUNITIES

No turtles were captured or observed in the study area. Similarly, no aquatic amphibians or reptiles were recorded in this study.

Based on available information, no conservationally significant aquatic amphibians or reptiles have been recorded from, or are likely to occur in the study area (DEWHA 2008a; EPA 2007b, 2008).

### Regional

*Emydura macquarii krefftii* (Krefft's river turtle) were captured from Juandah Creek, downstream of the Project MLA areas, in March 2008 (refer to Volume 1, Chapter 17B). This species were also caught from two sites during a recent survey of the upper Dawson River catchment (frc environmental 2007). It is known to inhabit rivers, creeks and lagoons through eastern Queensland from just north of Brisbane to Princess Charlotte Bay (Wilson & Swan 2008).

Other freshwater turtle species that may occur in the Dawson Catchment (Cogger 1996) include:

- eastern snake-necked turtle (*Chelodina longicollis*)
- saw-shelled turtle (*Elseya latisternum*).

The eastern snake-necked turtle has been recorded within 20 km of the proposed pipeline alignment (EPA 2007b). However, these turtles are only likely to inhabit larger waterways (Cogger 1996) and are unlikely to be abundant in the study area.

The Fitzroy River turtle (*Rheodytes leukops*) is only found in the Fitzroy River and its tributaries, in central Queensland. This species is listed as Vulnerable under the NC Act; the EPBC Act; and the International *IUCN Red List of Threatened Species 2007* (IUCN 2007).

This species is found in shallow, fast-flowing riffle zone habitats characterised by well-oxygenated water (Cann 1998, Tucker et al. 2001). Females nest on sandy banks with a deep layer of sand and a low vegetative cover. Nests are typically laid in deep chambers situated from 1 – 4 m above the water level, and have been observed up to 15 m back from the waters edge (Cogger et al. 1993, Cann 1998).

No fast-flowing habitats or turtle nesting banks were observed during surveys along the proposed pipeline route. Due to a lack of suitable habitat, the Fitzroy River turtle is unlikely to occur within the study area. However, it may be present downstream of the proposed pipeline, in the upper Dawson River, as it has previously been recorded in the river (EPA 2007b).

Turtle species occurring in the Murray-Darling Basin, including the Condamine catchment (Wilson & Swan 2008), include:

- broad-shelled river turtle (*Chelodina expansa*)
- eastern snake-necked turtle (*Chelodina longicollis*)
- Macquarie turtle (*Emydura macquarii*).

No turtles have been recorded from within 15 km of the proposed pipeline crossing section of Dogwood Creek (EPA 2008).

### Turtle and other aquatic vertebrate communities summary

Freshwater turtles are only likely to inhabit larger waterways (Cogger 1996) and are unlikely to be abundant in the ephemeral creeks along the proposed pipeline alignment (though they may be present in Dogwood Creek).

## 17B.3.7 SUMMARY OF AQUATIC ENVIRONMENTAL VALUES

The Environmental Values (EV) of aquatic ecosystems within the study area are relatively low and consistent with those of the region generally. EVs are influenced primarily by the ephemeral nature of the region's waterways; although agricultural development (particularly grazing) within the region has significantly influenced water quality and the physical characteristics of aquatic habitat (Van Manen 2001, Telfer 1995). Degraded creeks in the catchment are characterised by riparian vegetation loss, erosion, presence of weed species, poor water quality and sedimentation (Van Manen 2001, Telfer 1995). These are all features of the creeks along the proposed pipeline alignment and the area surveyed during this study. The riparian and aquatic habitats of the creeks crossed by the proposed pipeline, and that are within forested areas, are in better in condition than those adjacent to grazing land.

Water quality is generally poor and is characterised by high turbidity and variable DO levels. Biodiversity is relatively low, with only fish and macro-invertebrate species that are tolerant of varying and often harsh conditions inhabiting the study area. Introduced species, including the declared noxious mosquitofish and carp, were found in the waterways crossed by the proposed pipeline route. Nevertheless, the creeks along the proposed pipeline alignment do provide 'upstream' dispersal habitat for the native fish species that were recorded in the study area (and possibly breeding habitat for some species).

No Rare or Threatened species of aquatic fauna have been recorded from the waterways of the study area.

## 17B.4 DESCRIPTION OF PROPOSED DEVELOPMENT

The proposed pipeline will be 93 km long and the proposed alignment will mainly be located on the eastern side of the Leichhardt Highway and other roads in order to minimise vegetation clearing along the alignment.

A 600 mm diameter underground pipeline is proposed from the Condamine Power Station to the Project MLA areas.

Installation and operation of the pipeline has the potential to impact on aquatic ecology through:

- operation of vehicles and equipment along the pipeline alignment. No vehicle or equipment maintenance, or fuel storage facilities are to be undertaken along the pipeline alignment
- vegetation clearing and earth moving along a 20 m wide footprint of the alignment, including adjacent to creeks, and within the bed and banks
- construction of creek crossings for temporary access roads, and the proposed pipeline, including obstructions to flow and aquatic fauna passage. The proposed pipeline alignment crosses the following creeks:
    - Frank Creek within the Project MLA area, in the vicinity of the access road
    - Juandah Creek, and five of its first or second order tributaries
    - Six Mile Creek (near its headwaters)
    - Sandy Flat Creek (near its headwaters)
    - L Tree Creek and four of its first order tributaries
    - Nine Mile Creek and one of its first order tributaries
    - Eleven Mile Creek, crossing the creek twice, and one of its first order tributaries
    - Wallan Creek
    - Dogwood Creek, plus one major and four of its minor first order tributaries.
- supply and storage of raw water from outside of the catchment of the MLA areas. Raw water will be supplied as CSM by-product water, consisting of up to 4,000 mg/L total dissolved solids (TDS). Scour outlets will be placed in the proposed pipeline sags, approximately one every 1 km to 2 km, to minimise the volume of water that needs to be emptied during maintenance. Water released from scour outlets will be directed into mobile water tankers (via 'cam-loc' coupling) and trucked to the mine site for release

into either the raw water storage dam (if the water quality meets water quality requirements), or the tailings dam.

# 17B.5 POTENTIAL IMPACTS

Due to the nature of the activity, potential impacts are generally restricted to the construction phase.

## 17B.5.1 OPERATION OF VEHICLES AND EQUIPMENT

Fuels and oils required for the operation of construction machinery are toxic to aquatic flora and fauna.

Spilt fuel or oil is most likely to enter the creeks via accidental spillage on the access route near creek crossings or when there are construction activities adjacent to creeks. The proposed pipeline alignment crosses the major creeks in the area and a significant fuel spill to any of these creeks is likely to have a significant impact.

## 17B.5.2 VEGETATION CLEARING AND EARTHMOVING

Vegetation clearing, topsoil stripping, trenching and stockpiling can increase sediment run off to creeks and elevate turbidity. Clearing along the route has the potential to increase turbidity within local drainage systems and result in sedimentation of waterways.

### Increased turbidity

Increased turbidity may impact on aquatic flora and fauna. Increased turbidity may also adversely affect submerged macrophytes as light availability (required for photosynthesis) is reduced. Reduced light penetration, caused by increased turbidity, can also lead to a reduction in temperature throughout the water column (DNR 1998).

At the time of survey, waterways along the proposed pipeline alignment were generally highly turbid and substrates were generally dominated by silt. Faunal communities of the study area are adapted to living in turbid water. Given these background conditions, the introduction of small amounts of additional sediment is unlikely to have ecologically significant impacts on faunal communities. Substantial increases however may have a significant impact on aquatic flora and fauna communities.

### Input of nutrients or contaminants

Aquatic biota could be impacted by nutrients or contaminants washed into the waterways with the sediment (e.g. nutrients from fertilisers). Nutrient inputs can lead to algal or macrophyte blooms, which produce high levels of DO in the water when photosynthesising during the day. However at night, in the absence of photosynthesis, oxygen is consumed due to respiration. This can cause DO to be reduced to very low levels which are harmful to fish and biota.

Nutrient levels in the sediments are likely to be relatively low in the study area. In any case, the highly turbid water of the creeks is likely to prevent significant algae blooms for much of the year. Eutrophication of the waterways is therefore considered to be a low risk to aquatic ecology.

### Decreases in available aquatic fauna habitat

Vegetation clearing near and within creeks will decrease the amount of available habitat (instream and offstream) for aquatic fauna.

Instream habitat is an important habitat component and territory marker for many fish and macroinvertebrates. Many species live on or around instream habitat as it provides shelter from temperature fluctuations, current and predators; contributes organic matter to the system; and is important for successful reproduction. Australian fish species typically spawn either on instream vegetation or on hard surfaces like cobbles, boulders, and woody debris. The impacts of decreased habitat structures will be localised.

The deposition of fine sediments and subsequent decrease in stream bed roughness has the potential to fill in the existing pools. Within the minor (first order) tributaries throughout the study area, this would be unlikely to have a significant impact as these streams appear to only carry flood flows and do not generally hold water. However, in larger watercourses such as Dogwood, Wallen, Eleven Mile, L Tree, Juandah and Frank Creeks, sediment deposition would lead to a decline in habitat diversity and a reduction in the number of pools available as ‘refuge’ habitat in the dry season. These impacts would lead to a decline in the abundance diversity of both invertebrate and fish communities in the creeks.

After construction, the newly formed bed and banks may continually erode given the high flows that occur in the region in the wet season. The potential impact will be that the creeks increase in width and lose channel definition and as a result downstream flow may be decreased. The impacts of decreased bed and bank stability will generally be localised.

## 17B.5.3 CONSTRUCTION OF CREEK CROSSINGS

Construction of temporary vehicle and permanent pipeline creek crossings will disturb bed and bank stability, leading to increases in localised erosion, potentially leading to increases in turbidity and sediment deposition.

### Obstruction of fish passage

Many of the fish native to ephemeral systems of central and western Queensland migrate up and downstream and between different habitats at particular stages of their lifecycle. Fish passage is already restricted in creeks along the proposed pipeline alignment. During the installation of the pipeline, instream obstructions will be temporary. However, poorly-designed crossings have the potential to have further long term and permanent impacts on fish movement within the study area.

## 17B.5.4 SUPPLY AND STORAGE OF RAW WATER

CSM by-product water is expected to be high in TDS compared with the TDS concentration in the natural waterways. If CSM by-product water enters the creeks crossed by the proposed pipeline, it may impact on aquatic ecology.

The declared noxious fish carp (*Cyprinus carpio*) is known from this catchment. If carp are present in the location from which water is sourced from the Condamine Power Station (e.g. a raw water dam), the proposed pipeline poses a significant threat for carp to be transferred to the waterways of the Project MLA areas and thus the Fitzroy Basin, where they do not currently occur.

### 17B.5.5 BITING INSECTS

Within the study area, creeks, farm dams, stock water troughs and other areas of standing water (for example along roads or in backyards of domestic dwellings) currently have the potential to provide breeding habitat for mosquitoes and biting midges.

Construction activities that result in pooled water will potentially provide an increase in mosquito and biting midge breeding habitat in the study area. An increase in the population of mosquitoes and biting midges has the potential to impact on human health.

### 17B.5.6 SIGNIFICANT CONSERVATION HABITAT

There is no significant conservation habitat located within, or immediately downstream of the proposed pipeline alignment.

The proposed pipeline is not likely to impact on boggomoss springs, as there are no springs within, or in the immediate vicinity of, the proposed pipeline alignment (DEWHA 2008a).

The Great Barrier Reef World Heritage Area and the Shoalwater and Corio Bays and Narran Lake Nature Reserve Ramsar sites are unlikely to be impacted by the proposed pipeline. Given that they are over 300 km downstream of the proposed pipeline alignment, water quality that far downstream of the study area will not be impacted by installation of the proposed pipeline.

### 17B.5.7 THREATENED SPECIES AND ECOLOGICAL COMMUNITIES

As discussed in Section 17B.3.6, it is unlikely that the Fitzroy River turtle inhabits the ephemeral creeks along the proposed pipeline alignment. The proposed pipeline is unlikely to have a significant impact on this species.

The boggomoss snail (*Adclarkia dawsonensis*) is found associated with boggomoss habitat located approximately 100 km downstream of the proposed pipeline alignment, on the Dawson River. Boggomoss communities are unlikely to be impacted by the proposed pipeline.

Murray Cod (*Maccullochella peeli peeli*) may be impacted by the installation of the proposed pipeline. This would only occur if it is present in Dogwood Creek and if in-stream habitat structures such as boulders, logs, undercut banks and overhanging vegetation are affected. However, the likelihood of an impact is low (due to the low likelihood of Murray Cod being present and the narrow construction footprint in the creek). The consequence of any impact would also be low and reversible if aquatic habitat is replaced after construction (that is, there would be no significant impact to the Murray Cod population).

## 17B.6 MITIGATION MEASURES

The following mitigation measures should be considered for implementation during construction. Other additional or alternative measures may also be identified and implemented, provided that they reduce the risk of potential environmental harm to the aquatic environment.

The proposed pipeline will be constructed in accordance with AS 2885 and the Australian Pipeline Industry Association's *Code of Environmental Practice – Onshore Pipelines* (APIA, 2005) (Code of Environmental Practice).

## 17B.6.1 OPERATION OF VEHICLES AND EQUIPMENT

Risks associated with the spillage of fuels and other contaminants can be substantially reduced where:

- no vehicle maintenance is conducted in areas associated with the proposed pipeline construction, with maintenance only conducted at designated maintenance areas in the Project construction compound area of the MLAs
- portable refuelling stations, for refuelling of machinery in the field, are bunded to meet AS 1940 and placed above the $Q_{100}$ flood level of nearby waterways and dams
- all spills of contaminants (such as diesel, oil, hydraulic fluid etc.) are immediately reported to the Project's Environmental Officer
- appropriate spill containment kits are available, and used for the cleanup of spills in the field. Equipment that is susceptible to spills and/or leakages should have a spill kit onboard or within 5 m of the equipment at all times. The kits should contain equipment for clean-up of both spill on land or in dry creek beds, and spills to water (such as floating booms).

## 17B.6.2 VEGETATION CLEARING AND EARTHMOVING

Risks associated with the clearing of vegetation will be substantially reduced through the development and implementation of an erosion and sediment control plan (as a part of the environmental management plan) to minimise the quantity of sediment run off into waterways during pipeline installation. This erosion and sediment control plan will incorporate the following elements where possible and practicable:

- construction of the pipeline in the dry season
- use of erosion control matting, or other appropriate erosion control measures
- monitoring turbidity during construction
- rehabilitation of native vegetation after clearing, including the establishment of ground cover
- rehabilitation of instream aquatic habitat after clearing, including bed and bank rehabilitation.

### Timing

The risk of sediment runoff impacting nearby waterways will be further reduced where construction of road and pipeline crossings of creeks, particularly of major waterways (i.e. Dogwood, Wallen, Eleven Mile, L Tree, Juandah and Frank creeks) is done in the dry season.

### Erosion control and sediment control

During and after construction, water quality and ecosystem health of nearby waterways will be protected by:

- erosion control matting (or mulch), placed along ditches and drainage lines running from all cleared areas, especially on slopes and levee banks
- diversion drains, bunds or 'whoa-boys' installed across cleared slopes to direct runoff towards surrounding vegetation and away from creeks
- monitoring water quality.

Further discussion on erosion and sediment control measures is provided in Chapter 9 Geology, Mineral Resources, Overburden and Soils.

### Rehabilitation of vegetation

After construction, water quality and ecosystem health of nearby waterways will be protected by rehabilitation of the landscape by:

- salvaging and appropriately storing and maintaining clumps of native grass, shrubs and trees prior to clearing
- use of native vegetation of local provenance for replanting where possible
- replanting along creek margins (e.g. following construction of creek crossings). The width of the replanted riparian vegetation should match the existing riparian vegetation; however, 5 m would be the minimum width. Planted trees in the riparian zone should provide canopy cover and have root systems that can stabilise the banks and disturbed area.

## 17B.6.3 CREEK CROSSINGS

### Construction of permanent creek crossings

Impacts associated with the construction of permanent pipeline crossings will be minimised by:

#### *Dry season*

- Crossings are located to result in minimal disturbance to vegetated areas.
- Construction undertaken during the dry season where possible and practicable (minimising the likelihood of rainfall and runoff carrying sediment and other pollutants into the creeks).
- Stormwater and erosion control measures are implemented.
- Crossing construction methods minimise disturbance to aquatic habitat and fish passage.

#### *Wet season*

Where practical, a trenchless crossing method is used (e.g. horizontal directional drill), in accordance with the following recommendations (AE 2001):

- the drilling is done in a manner that does not cause a disturbance in the water, to the exposed bed or shore of the water body, or to an area of undisturbed vegetation that measures 10 m from each bank of the active channel

- where pressurized drilling fluids or water are used, the waterbody is monitored in case drilling fluids are released into the waterbody. Contingency and monitoring measures are put in place, including:
  - instructions to monitor for potential seepage into the water body of drilling fluids or water used, including monitoring and recording drilling fluid volumes on a continuous basis during and after the drilling operation
  - instructions on how to mitigate for the effect of any seepage into the water body of drilling fluids or water used.

If a trenchless crossing method is not possible, isolation and open-cut methods are also appropriate under wet conditions at numerous crossings (refer Appendix 17B-1-V2.4 Aquatic Ecology Impact Assessment). The workspace should be isolated, irrespective of if there is an isolated pool or flowing water. The isolation should be designed such that (AE 2001):

- it is completed within one work-day, to minimise the impact on aquatic fauna
- measures are taken to prevent erosion of the area at, and surrounding, the outlet of a bypass/dewatering pump or flume. This can be done by dissipating the energy of the released water using devices that include, but are not limited to, tarps, flip buckets, plates, and appropriately sized granular materials
- upstream and downstream dams are installed on the edge of the temporary workspace, to maximise the workspace. These dams should:
  - be constructed of an appropriate material for each creek (e.g. steel plates, flumes, sand bags or 'aquadam')
  - be made impermeable by using polyethylene liner and sand bags.
- if flowing water is present, 100% downstream flow is maintained by using pumps with a capacity that exceeds expected flows. Backup pumps and generators should be on site and operational if required
- pump intakes have a screen, with openings no larger that 2.54 mm, to ensure that no fish are entrapped
- fish are salvaged from the isolated workspace and translocated
- the upstream dam is slowly removed, to allow water to flush the sediment from the workspace area
- sediment-laden water is be pumped into sumps or onto vegetation
- operation of the clean-water pump to sustain partial flow below the downstream dams is continued until the downstream dam is removed.

### Construction of temporary vehicle creek crossings

Impacts associated with the construction of temporary road crossings will be minimised if they:

- are constructed during the dry season
- the bed and bank habitat is rehabilitated after removal of the temporary crossing.

Due to the limited water flow within the creeks of the region, opportunities for fish to migrate should be maximised (Cotterell 1998). The construction of temporary creek crossings can minimise disruption of fish passage if:

- the crossing structures at each site follow the recommendations presented in Appendix 17B-1-V2.4 Aquatic Ecology Impact Assessment
- if culverts are used for temporary crossings, they should be designed such that they are (Cotterell 1998):
  - as short and wide as possible; whist being designed to allow the passage of anticipated flood volumes and associated debris, and to allow enough water depth within the culvert to facilitate fish movement (estimated at >0.5 m depth for the fish species likely to be present)
  - installed without a 'drop off' at the culvert outlet or inlet, as this impedes fish migration upstream and downstream
  - constructed with minimum disturbance to the outer banks on stream bends, as these are usually the most unstable and prone to erosion
  - surrounded by riparian vegetation (planted after construction, if necessary) to stabilise banks, provide food and habitat for fauna and prevent predation of aquatic fauna by birds.

## Water quality monitoring

Appendix 17B-1-V2.4 Aquatic Ecology Impact Assessment outlines recommended water quality monitoring during the installation of the vehicle and pipeline creek crossings. The aim of this monitoring is to determine whether sediment runoff during construction is likely to impact upon aquatic fauna. As a guide, it presents preliminary water quality objectives for the waterways to be crossed by the pipeline. These guidelines aim to maintain the natural fish communities of the region, based on the water quality recorded during the current studies, and published environmental tolerances.

**Table 17B-4: Preliminary water quality objectives for the water quality required in the creeks crossed by the pipeline, to maintain the natural fish communities of these creeks**

| Parameter | Range required to sustain the fish communities sampled during this Study |
|---|---|
| Temperature (° C) | < 34 |
| Dissolved Oxygen (mg/L) | 1.5 – 10.0 |
| pH | 6.5 – 8.5 |
| Conductivity (µS/cm) | 19.5 – 770 |
| Turbidity (NTU) | < 200*, or 10% above background values, whichever is higher |

* Most species found in this study have been recorded from waterways with much higher turbidity (up to 600 NTU; frc environmental pers obs.)

It is recommended that water quality be measured with a hand-held probe:

- at the crossing site immediately prior to construction, to determine background conditions
- daily during construction
- daily after construction until water quality returns to background conditions (as indicated by monitoring in the nearby 'comparison' creek).

Where water quality objectives in the creek are exceeded, it is recommended that construction ceases and that stormwater and erosion control measures be revised prior to re-commencement of construction.

### Rehabilitation of instream aquatic habitat

After installation of the pipeline and removal of a temporary crossing, impacts may be mitigated by:

- rehabilitation of the bed and bank structure such that original dimensions and shape of the creek are achieved. Bank recontouring should include stabilisation methods (crib walls or soil wraps) where appropriate (refer Appendix 17B-1-V2.4 Aquatic Ecology Impact Assessment)
- revegetation of creek banks
- salvaging existing bed material prior to construction and placing it back into the creek at completion of construction. If the existing bed material is unable to be salvaged, a comparable sediment size material is recommended to cover the bed and should be approximately 10 cm thick. If the sediment is fine (mud and/or silt), it is recommended that the bed material be replaced with sand, to prevent future erosion. If the sediment is coarser (gravel, cobble, pebbles and/or boulder), new material must be washed prior to placing in the creek (as usually, new coarse substrate is covered in a fine dust, which will become suspended in the water)
- aquatic habitat structures are replaced within the channel. Prior to construction, any instream structures (woody debris, large cobbles) may be salvaged. Felled trees may also be placed into creeks to create woody debris habitat.

### Stranding of fish and other aquatic fauna

If an isolation method is used, fish and other aquatic fauna may become stranded once the work area is isolated. Stranded fish must be captured and translocated, following the Department of Primary Industries and Fisheries (DPI&F) *Fish Salvage Guidelines* (DPI&F 2004), which recommend that:

- fish should be captured from the creek using gear appropriate to the waterways and species present
- translocation should be done in the cooler months if possible, to minimise stress to the fish
- fish should be removed from the existing channel before water flow is isolated from the channel
- fish should be handled, transported and released so as to minimise damage to the fish.

The capture of fish using electrofishing, traps, bait nets or cast nets requires a General Fisheries Permit, issued by the DPI&F. The capture, handling and translocation of fish and other fauna will also require an Animal Ethics approval.

In large pools, traps should be set to capture turtles. If caught, turtles should also be transported and released to a relatively permanent waterhole in the study area, in accordance with ethical handling procedures.

### 17B.6.4 SUPPLY AND STORAGE OF CSM BY-PRODUCT WATER

Water supplied from the proposed pipeline should be stored in an appropriate on-site dam. The dam should be designed so that this water is not released into natural waterways.

The pipeline should be regularly inspected and maintained so that water does not leak from the pipeline into surrounding natural waterways.

The use of water from a raw water dam or similar at the Condamine Power Station could increase the opportunity for carp to become established in the Fitzroy Basin. Prior to commissioning of the pipeline, a detailed assessment of the source water will be conducted, to determine whether carp are present. If they are present, as risk assessment of the likelihood of transfer will be completed before proceeding with the pipeline.

Whether carp are present or not, it would be prudent to fit filter screens to the intake pipe, to prevent carp eggs and larvae from entering the pipe. However, this will be subject to risk assessment and detailed design. If a risk assessment determines a moderate to high potential for the presence of carp, then a screen to filter carp eggs will be installed. Carp have eggs as small as 800 µm, though their larvae are larger in size (Mather 1997). A screen mesh size of 500 µm is therefore recommended.

Before water is transferred through the pipeline, it is recommended that each of the screens be tested with particles of known sizes (e.g. 500 and 800 m latex spheres). Cleaning and testing of the screens should become part of their routine maintenance, to ensure they are always fully functioning and ready for use.

The WJV will also ensure that the supply dam and the dams on the site are free from noxious species on a regular basis.

### 17B.6.5 BITING INSECTS

Mosquito breeding habitat may be minimised through:

- minimising the area of standing water, and ensuring drainage within four days
- grading to ensure sufficient drainage
- during construction, routinely filling incidental depressions and holes that may hold standing water
- regularly clearing drainage lines to ensure that water continues to flow and no ponded areas are created.

### 17B.6.6 THREATENED SPECIES AND ECOLOGICAL COMMUNITIES

The proposed pipeline is unlikely to have any impact on any threatened aquatic species or ecological communities.

## 17B.7 RESIDUAL IMPACTS

On the provision that the mitigation measures in this Chapter are followed, the residual impacts to aquatic ecology is expected to be to be very low, with no permanent local or regional impacts.

The use of water from a raw water dam or similar at the Condamine Power Station could increase the opportunity for carp to become established in the Fitzroy Basin. Prior to commissioning of the pipeline, a detailed risk assessment of the potential to transfer carp through the pipeline should be undertaken.

## 17B.8 CONCLUSIONS

Surrounding land uses, including vegetation clearing, cattle grazing and cropping, have negatively impacted the physical habitat of the study area and the wider catchment. Water quality is relatively poor, and reflects the predominantly agricultural nature of the region and the ephemeral nature of the creeks. The aquatic habitat of the creeks along the proposed pipeline route are considered to be in poor to moderate condition overall; and aquatic habitats in creeks adjacent to forested areas were in better condition than those adjacent to grazing land. Despite the surrounding impacts, many of the creeks surveyed contained large trees in the riparian zone and a variety of aquatic habitats available to fauna.

Biodiversity in the study area is slightly lower than in the more permanent waters of the region. Only fish and macro-invertebrate species that are tolerant of varying and often harsh conditions inhabit the study area. Introduced species, including the declared noxious mosquitofish and carp, were found in the waterways crossed by the proposed pipeline alignment. However, while typically less diverse than the faunal communities in the Dawson or Condamine Rivers downstream, macro-invertebrate and fish communities found within the creeks along the proposed pipeline alignment are likely to contribute to the success of downstream populations through migration. Freshwater turtles were not found in the study area. No Rare or Threatened aquatic floral or faunal species were found in the study area or are considered likely to occur, based on the habitats present.

The potential impacts of fuel handling and stormwater runoff on the creeks along the proposed pipeline alignment and downstream waterways, will be minimised to an acceptable level by implementation of current best-practicable practice environmental management programs.

Where no equipment that is used in surface waters in the Condamine catchment has contact with the CSM water, unless it has been thoroughly cleaned with bleach, and where the Proponent ensures that the supplied and stored CSM water is free from noxious carp on a regular basis, the likelihood of transferring carp from the Condamine catchment to the Fitzroy Basin via the proposed pipeline is considered to be negligible.

Of the potential impacts of the proposed pipeline, the construction of creek crossings, which can affect riparian and aquatic habitats and fish movement, poses the greatest threat to aquatic ecology. However, the significance of this impact will be reduced by implementation of appropriate mitigation measures. In particular, after creek crossings are completed, the bed and banks will be constructed so that they replicate the natural channel in terms of channel morphology, sediment types and riparian vegetation.

## 17B.9 REFERENCES

AE (Alberta Environment) 2001, *Guide to the code of practice for pipelines and telecommunication line crossing a water body, including guidelines for complying with the Code of Practice*, Alberta Government of Canada.

Allen, G. R., Midgley, S. H. & Allen, M. 2002, *Field Guide to the Freshwater Fishes of Australia*, eds J. Knight K & W. Bulgin, Western Australia Museum.

ANZECC & ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality,* National Water Quality Management Strategy, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand.

Australian Pipeline Industry Association (2005) *Code of Environmental Practice – Onshore Pipelines.*

Cann, J., 1998; *Australian Freshwater Turtles,* Beaumont Publishing Pty Ltd, Singapore.

Cogger, H. G. 1996, *Reptiles and Amphibians of Australia*, Reed Books Australia, Port Melbourne.

Cotterell, E. 1998, *Fish Passage in Streams, Fisheries Guidelines for Design of Stream Crossings*, Fish Habitat Guideline FHG001, Fisheries Group, Department of Primary Industries, Brisbane.

CSIRO 2008, *Water Availability in the Condamine-Balonne*, A report to the Australian Government from the CSIRO Murray-Darling Basin Sustainable Yields Project, CSIRO, Australia, 169 pp.

DEWHA 2008a, *Protected Matters Search Tool,* [online database] http://www.environment.gov.au/erin/ert/epbc/index.html, accessed 8 September 2008.

DEWHA 2008b, Adclarkia dawsonensis — *Boggomoss Snail, Dawson Valley Snail,* [online] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=67458, accessed 8 September 2008.

DEWHA 2008d, *Species Profile – Murray Cod*, [online] http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66633, accessed 18 September 2008.

DNR 1998, *Fitzroy Basin Water Allocation and Management Planning*, *Technical Reports*, A summary of information and analyses conducted for the WAMP process to date in the Fitzroy Basin, Resource Management Program, Department of Natural Resources.

DNRM 2001, *Queensland Australian River Assessment System (AusRivAS) Sampling and Processing Manual*, August 2001, Queensland Department of Natural Resources and Mines, Rocklea.

DPI&F 2004, *Fish Salvage Guidelines*, Queensland Department of Primary Industries & Fisheries, Brisbane.

EPA 2007a, *Queensland Water Quality Guidelines 2006*, March 2006, Environmental Protection Agency, Brisbane.

EPA 2007b, *Wildlife Online*, [online database], http://www.epa.qld.gov.au/nature_conservation/wildlife/wildlife_online/, accessed 28 August 2007.

EPA 2008, *Wildlife Online*, [online database], http://www.epa.qld.gov.au/nature_conservation/wildlife/wildlife_online/, accessed 18 October 2008.

frc environmental 2007, *Nathan Dam on the Dawson River: Aquatic Flora and Fauna Dry Season Field Survey,* report prepared for SunWater, November 2007.

IUCN 2007, *IUCN Red List of Threatened Species* [online], www.iucnredlist.org, accessed 31 October 2007.

Joo, M., McNeil, V. H., O'Brien, E. & Fearon, R., 2000, *Nutrient emission modelling in the Dawson River Basin using catchment management support system (CMSS)*, Report prepared for the Department of Natural Resources.

Marsden, T. & Power, T. 2007, *Proposal for Raising Eden Bann Weir and construction of Rookwood Weir, An Assessment of the Potential Requirements for Fish Passage*, Queensland Department of Primary Industries & Fisheries.

Mather, P. B. 1997, *In Vitro Simulation of Screening and Trials on Toxicity of Chlorine*, Report to Austa Electric.

Telfer, D., 1995, *State of the Rivers, Dawson River and Major Tributaries*, Department of Natural Resources and Mines, Brisbane.

Tucker, A. D., Limpus, C. J., Priest, T. E., Cay, J., Glen, C. & Guarino, E. 2001, 'Home ranges of Fitzroy River turtles (*Rheodytes leukops*) overlap riffle zones: potential concerns related to river regulation, *Biological Conservation*, 102: 171–181.

Wilson, S. & Swan, G. 2008, A Complete Guide to Reptiles of Australia, Second Edition, New Holland, Chatswood.

Van Manen, N. 2001, State of the Rivers, Maranoa, Balonne and Lower Condamine Rivers and Major Tributaries, Department of Natural Resources and Mines, Brisbane.