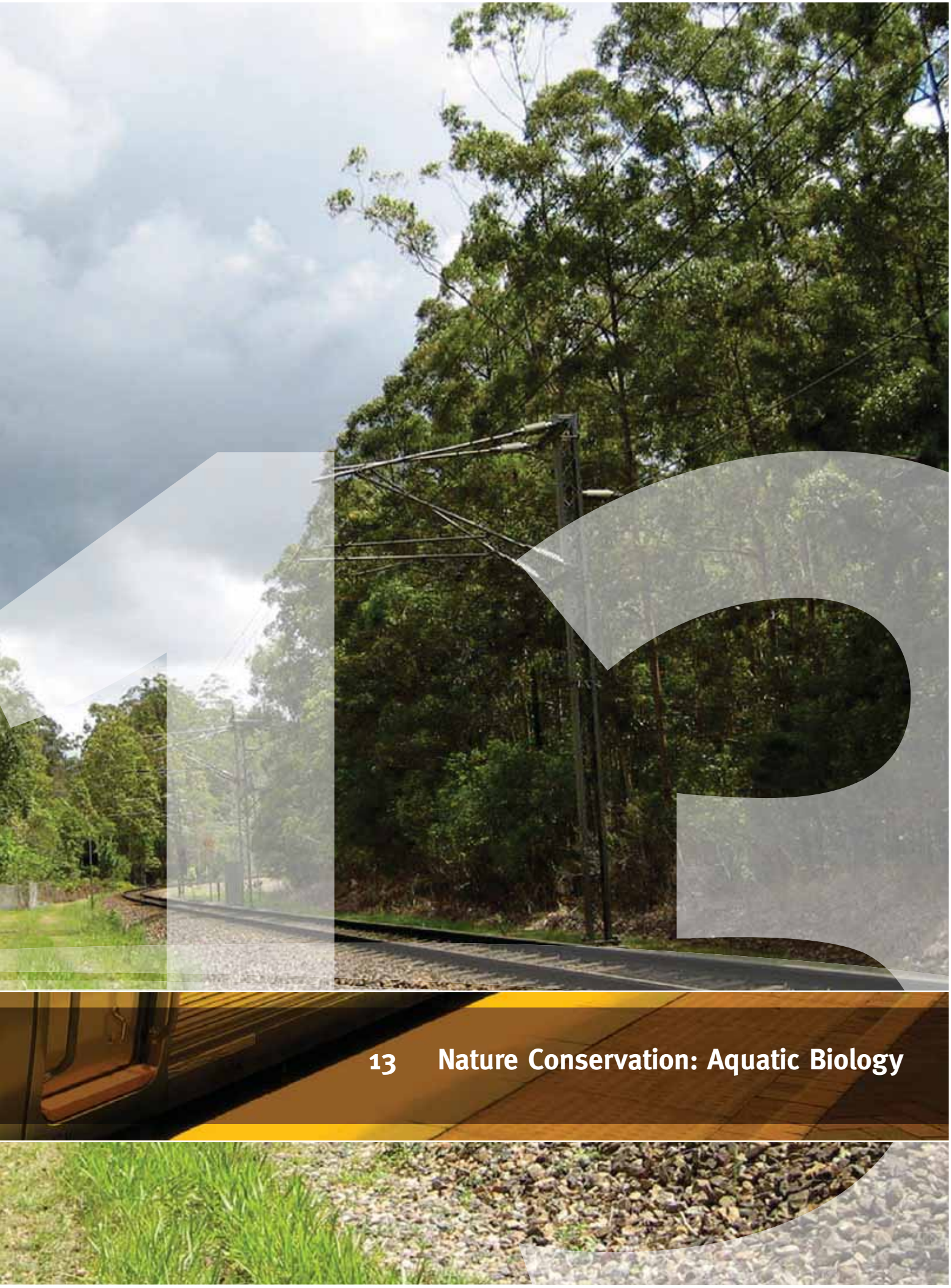


13 Nature Conservation: Aquatic Biology

13 Nature Conservation: Aquatic Biology

13.1 Introduction

13.1.1 Background and scope

The project is located within the three catchments of Pumicestone, Mooloolah and Maroochy (from south to north) and traverses a number of major waterways and minor drainage lines. Major waterways from Landsborough to Nambour include: Addlington Creek, South Mooloolah River, Mooloolah River, Eudlo Creek, Paynter Creek and Petrie Creek. The condition of the waterways varies, but generally speaking the condition of the waterways is better in the southern portion of the site (between Landsborough and Palmwoods) due to more expansive riparian vegetation and a lower density of development.

This report presents a description of existing (baseline) aquatic flora and fauna conditions within the project area, together with an assessment of the key potential impacts associated with the project and an outline of the strategies that will be implemented to mitigate these potential impacts. The key ecological functional groups considered are:

- aquatic macrophytes and habitats
- macroinvertebrates
- fish (freshwater)
- turtles (freshwater).

Note that this section does not consider semi-aquatic mammals (e.g. platypus, water rat etc.) or amphibians, which are addressed in **Chapter 12, Terrestrial fauna**.

13.1.2 Aims

The aims of the baseline fauna investigations were to identify the aquatic fauna occurring in areas that would be potentially impacted by the project. Specifically, in order to address the terms of reference, the aims of this study are to:

- identify aquatic fauna or flora present, or likely to be present including fish species, aquatic invertebrates and aquatic macrophytes
- provide a description of the distribution, and other patterns, of aquatic flora and fauna
- describe aquatic fauna habitat requirements and the sensitivity of aquatic flora to changes in flow regime, water levels and water quality
- describe aquatic substrate and stream type, including extent of tidal influence and common levels such as Highest Astronomical Tide and Mean High Water Spring Tide
- identify the key aquatic ecology constraints and potential impacts of the proposal
- describe methods used to mitigate impacts on aquatic ecosystems with particular focus on: stream diversions, stream crossings, construction timing (to avoid spawning periods) and methodology (to minimise discharges and disruption), rehabilitation and offsets, creation of biting insect habitat and monitoring of aquatic health.

13.1.3 Relevant legislation and policy

There are several pieces of relevant Queensland and Commonwealth legislation and policies that need to be considered for relevance to aquatic ecosystems. This legislation refers either directly to the watercourse and water resource (*Water Act 2000*) or to species of flora and fauna that may rely on these resources for habitat requirements. These are listed in **Table 13.1.3.**

Table 13.1.3: Relevant Commonwealth and State legislation

Legislation/ Policy	Implications	Level
Environment Protection Biodiversity Conservation Act 1999 (EPBC Act)	This Act aims to protect Threatened species. It requires referral to the federal government for development that may impact listed species.	Commonwealth
Nature Conservation Act 1992 (NC Act) (and Regulations and Conservation Plans)	This Act aims to protect Threatened species and recognised conservation areas. It requires application to the Department of Environment and Resource Management for the take of Threatened fauna species.	Queensland
Land Protection (Pest and Stock Route Management) Act 2002 (LP Act)	This Act defines noxious pests (including aquatic plants), which are formally referred to in the Act as Declared Pests. It requires management of some Declared Pests.	Queensland
Fisheries Act 1994	Protects fisheries habitat and certain fish species of conservation significance or concern. This Act requires assessment of temporary or permanent barriers to fish movement.	Queensland
Fisheries Regulation 1995	This Act defines noxious fish, which are formally referred to as Declared Pests.	Queensland
Water Act 2000	This Act governs water allocations from waterways and ground water sources. It also protects the physical features of the waterways themselves, in terms of bed, banks and riparian vegetation. Clearing of riparian vegetation or alteration of the watercourse requires assessment under this law.	Queensland

13.2 Methodology

13.2.1 Review of existing information

Information pertaining to the project area was available due to work that has already been carried out in the region by various government and private bodies for other projects. Some of this information was able to be utilised in a desktop review of the project area.

Information review

The information review considered a range of relevant published studies, consultancy reports and data sources, including but not limited to:

- existing water quality data for the project area and catchment, including the Ecosystem Health Monitoring Program (EHMP), the Department of Environment and Resource Management Watershed Database and the Mooloolah and Maroochy State of Rivers (SOR) reports
- various information sources that describe structural habitat characteristics and aquatic ecology for the catchments, including the above mentioned SOR and EHMP reports
- Mary Basin catchment Water Resource Planning (WRP) technical reports and appendices
- freshwater fish records for the Mooloolah and Maroochy River catchments documented in various publications, EHMP 2007, EHMP 2004, Pusey et al. 2004.)

All data was reviewed, and wherever relevant, used as supplementary data for comparison with the results of the current survey.

Spatial data

Several GIS datasets were assessed, including:

- rectified aerial photography of the project area and surrounds
- cadastre
- Regional Ecosystem (RE) vegetation mapping (Version 5.0 with December 2006 amendments)
- Biodiversity Planning Assessment (BPA) mapping (Version 3.4 – March 2005)
- Ramsar wetland areas
- Department of Environment and Resource Management estate (National Parks, Conservation Parks etc).

Public databases

Public access databases with restricted location precision were searched to identify Endangered, Vulnerable and Rare (EVR) aquatic flora and fauna known to occur, or to have occurred, in the project area, namely:

- Wildlife Online is a Queensland internet database of the Department of Environment and Resource Management accessible to the public which stores records of plant collections and fauna sightings (and other groups including algae, fungi etc.) for a search area defined by the user. EVR and other notable species can be selected from the search outputs.
- EPBC Act Protected Matters Report is a Commonwealth Department of Environment and Water Resources internet-based database. It lists matters of national environmental significance, or other matters protected by the EPBC Act, that are likely to occur within a search area defined by the user. These include EPBC Act listed EVR species, migratory and other notable species of national environmental significance, including Ramsar wetlands, World and National Heritage places and other relevant Commonwealth lands.
- Coastal Habitat Resources Information System (CHRIS) is a Queensland Department of Primary Industries and Fisheries database providing information on commercial fisheries catches and protected coastal habitat areas.

Searches were conducted in public databases by specifying coordinates (defining a rectangle) that encompassed the entire project area. Note that these database outputs should be considered as indicative only, and have been considered in this report in the context of habitats present within the project area and the potential for these habitats to support listed species and communities.

13.2.2 Field investigations

The project area defined for the future upgrade of the Northern Coast Line between Landsborough and Nambour is approximately 3 km wide, extending approximately 22 km from Landsborough to Nambour. The average width of the project within this project area is approximately 60 m. The major catchments represented in the project area are the Maroochy River Catchment to the north and the Mooloolah River Catchment to the south. Together these catchments drain an approximate combined total area of 859 km^2, which includes South Mooloolah River, Eudlo Creek, Paynter Creek and Petrie Creek. The project area traverses the Pumicestone (Mellum Creek) catchments, Mooloolah and Maroochy. The main drainage within the project area is the Mooloolah River, which is situated in the Mooloolah Catchment. Other main drainages include Eudlo, Petrie and Paynter Creeks, which are located in the Maroochy Catchment. Addlington Creek is included in the Pumicestone catchment.

Aquatic habitats, flora, fauna and in-situ water quality surveys were undertaken to provide detailed site-specific information on the distribution and patterns of aquatic ecology values within the project area. Sampling was conducted at sites within and adjacent to the project, and was repeated on two occasions, September 2007 and January 2008, to encompass potential seasonal differences in aquatic communities.

Sampling sites and timing

Five main drainages were investigated within the project area, namely drainages of Ewen Maddock Dam (Addlington Creek and tributaries), South Mooloolah River, Eudlo Creek, Paynter Creek and Petrie Creek. Within these drainage systems a total of 14 sites (**Figure 13.2a and Table 13.2.2**) were selected for field surveys. Site selection was based on the following criteria:

- sites which were considered to be representative of the range of aquatic meso-habitat types found within each major drainage and the project area generally
- sites which were representative of habitats favoured by the key Threatened species potentially occurring within the project area (e.g. 'wallum' habitat, which is favoured by Oxleyan Pygmy Perch (*Nannoperca oxleyana*) and Honey Blue Eye (*Pseudomugil mellis*)).

Table 13.2.2: Summary of Samples Sites within the Project Area

Catchment	Sub-Catchment	Site No:	Drainage Name	Stream Order[1]
Mooloolah	Mooloolah River	1	Addlington Creek	2
		2	Minor drainage into Ewen Maddock Dam	1
		3	Minor drainage into Ewen Maddock Dam	1
		4	Unnamed tributary of Mooloolah River	4
		5	South Mooloolah River	4
		6	Unnamed tributary of Mooloolah River	4
Maroochy	Eudlo Creek	7	Eudlo Creek	3
		8	Unnamed tributary of Eudlo Creek	1
		9	Unnamed tributary of Eudlo Creek	2
	Paynter Creek	10	Unnamed tributary of Paynter Creek	1
		11	Paynter Creek	4
		12	Paynter Creek	4
	Petrie Creek	13	Petrie Creek	5
		14	Petrie Creek	5

1 *Stream Order is a numerical ordering classification of each watercourse segment according to its position within a catchment (refer to Glossary for diagrammatic representation)*

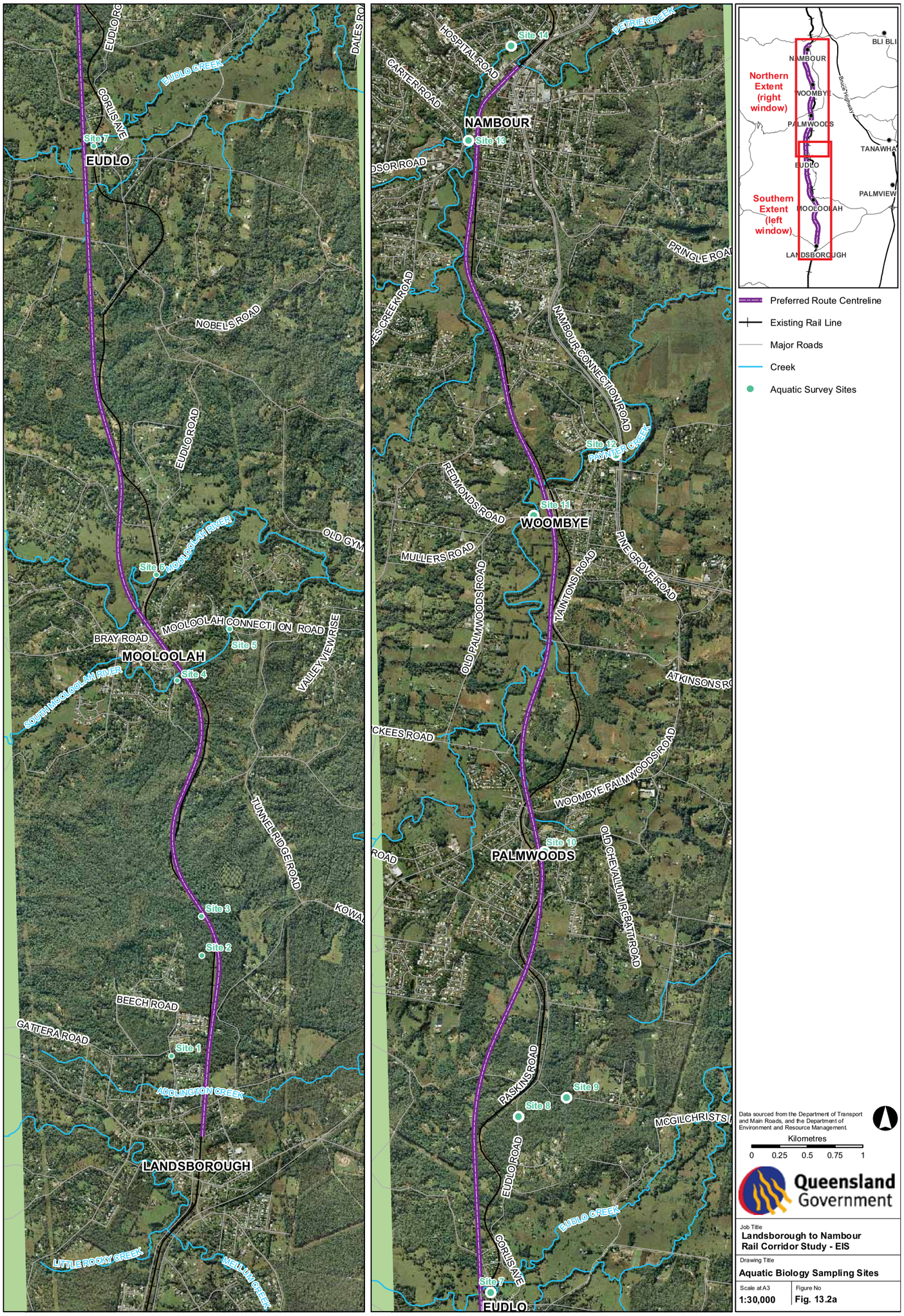
Aquatic habitat and macrophyte methods

A general description of the habitat characteristics of each site was undertaken, documenting riparian vegetation characteristics, stream substrate composition and profile, adjacent land uses and overall condition.

At each site, 50 m long transects (tape measures) were placed parallel to the stream on each bank. The area bound by the tapes represented the site. The location of site boundaries and significant features (e.g. trees) were recorded with a hand-held GPS to allow re-positioning of the site boundaries for repeat sampling.

The aquatic habitat and macrophyte sampling methodology was adapted from Arthington (1996) and incorporated two related methods. The first is based on five adjacent, evenly spaced, in-stream transects running parallel to the banks with: two bank transects, a centre-of-stream transect and two remaining transects either side of the centre of stream transect. Four random points were selected along each of the five transects, totalling 20 sampling points.

Figure 13.2a: Acquatic Biology Sampling Sites



Whilst every care has been taken to ensure the accuracy of this data, the Department of Transport and Main Roads makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) and costs which might be incurred as a result of the plan being inaccurate or incomplete in any way and for any reason.

The following parameters were measured within 1 m^2 quadrats placed at each sample point along each transect:

- wetted stream width
- percentage riparian cover (projected foliage cover)
- depth
- mean water velocity
- substrate composition (mud/sand/fine gravel/coarse gravel/cobble/rock/bedrock)
- percentage cover of each macrophyte species
- percentage cover of filamentous algae
- percentage cover of overhanging vegetation
- percentage cover of emergent vegetation
- percentage cover of leaf litter
- percentage cover of large woody debris (>15 cm diameter)
- percentage cover of small woody debris (<15 cm diameter).

The second method estimated the percentage cover of the following attributes along the banks on either side of the stream, excluding terrestrial vegetation except for the immediate riparian strip:

- canopy cover
- aquatic macrophytes
- filamentous algae
- periphyton
- overhanging vegetation
- submerged vegetation
- emergent vegetation
- leaf litter
- large woody debris (>15 cm diameter)
- small woody debris (<15 cm diameter)
- undercut banks
- overhanging roots.

Macrophyte surveys were conducted using visual observations and, if necessary, by hand collecting samples for identification. Similarly, substrate composition was estimated by eye from hand picked samples in shallow areas and by an extended scoop in deeper sections.

Fish

In order to adequately sample the range of fish species present, a number of sampling methods were utilised during surveys. These included the following sampling apparatus:

- **Gill nets** (25, 50, 75 mm stretched mesh, 2.5 m drop, 30 m wide) - multi-panel gill nets were set oblique to the shore for two-hour soak times, field operators 'sat' on these nets so that any animals captured were immediately released from the net.
- **Baited box traps** (0.5 mm mesh) - baited box traps were used at all sites, and represented the key trapping techniques for small bodied Endangered, Vulnerable or Rare (EVR) species. Fifteen collapsible, baited baitfish traps were deployed across the range of microhabitat types present. All traps were deployed for approximately one hour.
- **Fyke net** - where stream dimensions permitted, a fyke net was set for two hours with the entrance facing downstream, parallel to the bank. The dimension of the net was approximately 5 m long with a single 1 m entrance and dual wings.
- **Push seine net** (3 m long, 2 m high, 5 mm stretched mesh) - a push seine net was used to sample small fish. Numerous hauls were undertaken within each microhabitat types present, depending on channel dimensions and the number of snags present.
- **Scissor seine net** (2 m long, 2 m drop, 0.5 mm mesh) - a scissor seine net was used to sample small fish. Three 10 m hauls were conducted in each microhabitat at each site where waterway dimensions permitted.

Gear types appropriate to the characteristics of each site were used. Consequently not all sampling methods were deployed at each site. For example, a push seine net and a scissor seine net were not applicable in deep streams.

All fish caught were identified and counted. A proportion of individuals were measured and wounds, lesions or deformities were recorded if present. Native fish were released alive, whilst any introduced fish species collected were euthanised. When identification was difficult in the field, one or two specimens were retained for identification in the laboratory.

Water quality

In-situ measurements of selected physical water quality parameters were undertaken at all sites, coinciding with aquatic flora and fauna sampling (i.e. 14 sites sampled on two occasions, September 2007 and January 2008).

Sampling procedures followed those outlined in the QEPA (1999) sampling manual. Physical water quality parameters were measured in-situ using a calibrated water quality meter (Yeokal Model 611) at approximately 0.2 m in depth. Measurements were obtained for the following parameters:

- water temperature (^oC)
- conductivity (uS/cm)
- total dissolved salinity (g/L)
- dissolved oxygen (mg/L and % saturation)
- pH
- reduction-oxidation (Redox) potential (mV)
- turbidity (NTU).

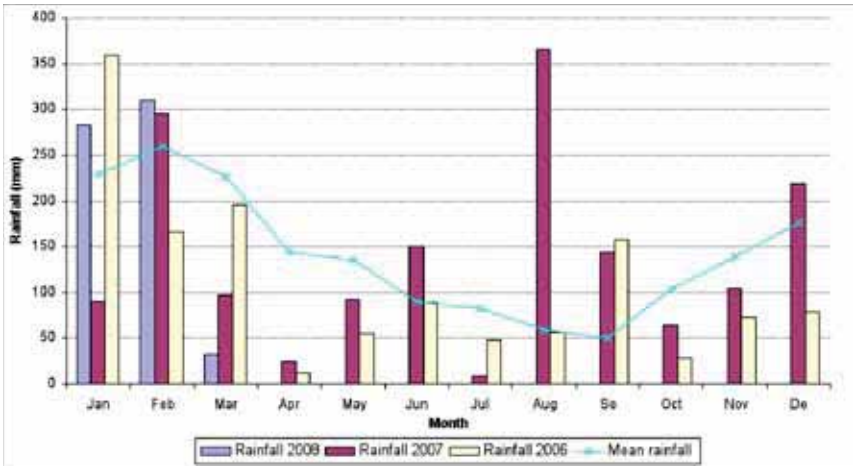
13.2.3 Limitations of study

Flora and fauna sampling was conducted on two occasions and, hence, encompassed some temporal variation. However, fish communities, in particular, can show marked variation in composition, richness and abundance at various time scales (e.g. seasonally, annually etc.). It is probable that not all species occurring in the area were detected. Variability in fish communities is thought to be linked to a number of factors, including inter-annual changes in seasonal flow and drought conditions, seasonal trends in fish movements (which occur in response to changes in water temperature and flows), and biological interactions (i.e. food availability, predation, competition etc.).

Although the region had experienced drought conditions during the past few years, the months prior to the sampling events had experienced higher than average rainfall.

Figure 13.2b illustrates the total and average monthly rainfall in the 27 months leading up to the completion of all baseline sampling[2]. Consequently, waterways within the project area were experiencing high flows during the sampling times and conditions could be considered to be representative of wet climatic periods. Prior to these rainfall events the project area and wider region had been experiencing severe drought conditions.

Figure 13.2b: Total and mean monthly rainfall over the two years leading up to the study (Data from Bureau of Meteorology Nambour weather station)



13.2.4 Assessment of impacts

The primary potential impacting processes of the project, in regard to aquatic flora, fauna and their habitats, were identified and described with specific references to the key aquatic ecology survey sites and adjacent areas. Each of these aquatic ecology impacts was assessed and assigned one of the significance criteria described in **Table 13.2.4a**. These terms are used throughout the impact assessment. Definitions of the duration of temporal impacts used in the assessment are also provided in **Table 13.2.4b**.

Following the assignment of the significance levels to the various impacts, the impact assessment proposes the mitigation methodologies that could be implemented to reduce or alleviate potential impacts. The significance of any residual potential impacts (i.e. after mitigation) were also assessed and assigned their resultant significance level.

Table 13.2.4a: Significance criteria for aquatic ecology impact assessment

Significance	Description
High Adverse	Impact a major problem. These impacts are likely to be important considerations adversely affecting species or the aquatic habitat of species of National importance (as identified in the EPBC Act, or State significance (as identified in the Nature Conservation (Wildlife) Regulation 2006). Impacts are to the extent that the Threatened species is removed indefinitely or known habitat can no longer function to provide essential resources for the Threatened species. In a more general sense, a high adverse impact can be defined as an impact on a significant area of habitat such that the result is that the abundance and / or diversity of aquatic flora and fauna species is decimated. These impacts are concerns to the project, depending upon the relative importance attached to the issue during the decision making process. Mitigation measures and detailed design work will not remove the impacts upon the affected Threatened species. Adverse residual impacts would predominate.

2 *Rainfall at Nambour weather station; average based on 54 years of rainfall data (BoM)*

Table 13.2.4a: continued

Significance	Description
Moderate Adverse	Impact moderate. These impacts are likely to be important at a national, State or local (as identified within local laws or local planning scheme codes or guidelines) scale. Impacts are to the extent that the aquatic habitat of the Threatened species is reduced in size or quality and / or there are ongoing activities that are likely to have adverse implications for the Threatened species in the long-term. Ongoing activities may include: increased water activities (e.g. boating and recreation), fishing, water extraction, release of contaminants etc. In a more general sense, a moderate adverse impact can be defined as an impact on a significant area of habitat such that the result is a noticeable reduction in the abundance and / or diversity of aquatic flora and fauna. These impacts represent issues where adverse outcomes would be experienced, but mitigation measures and detailed design work can ameliorate some of the consequences upon Threatened species and their aquatic habitats. Some residual impacts would still arise. The cumulative impacts of such issues may lead to an increase in the overall impacts upon a particular area or on a particular resource and hence may become key decision making issues.
Low Adverse	Impact recognisable but acceptable. These impacts are likely to be important only at a local scale and are unlikely to be of significant importance in the decision making process. Impacts are minor or short term and can be ameliorated by detailed design work and mitigation measures. Residual impacts are minimal or non-existent and do not cause a decline in aquatic flora and fauna diversity or abundance or affect the ability of a Threatened species to exist. These impacts are generally of relevance for enhancing the subsequent design of the project and in the consideration of mitigation or compensation measures.
Negligible	Minimal change. No impacts or those which are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.
Beneficial	Impacts beneficial to the environment. There is an increase in the area or quality of habitat affected by the proposal and / or the ability of a riverine community to provide ecosystem services is enhanced. Similarly, an existing threatening activity or process is ameliorated. These impacts are large a result of mitigation measures.

Table 13.2.4b: Definitions of temporal scale of impacts

Relative Duration	Definition
Permanent	Period in excess of 50 years
Long-term	From 20-50 years
Medium term	From 7-20 years
Short term	From 1-7 years
Temporary	Up to 1 year

13.3 Description of environmental conditions

The project area incorporates three catchment areas and numerous creeks and drainage lines, as described in the following section. These waterways traverse a variety of land uses including conservation, rural, rural residential, residential and small townships. As such the extent and quality of the riparian zones varies significantly. The diversity and abundance of aquatic flora and fauna across the project area was expected to vary between catchments, as a reflection of riparian zone condition and water quality. Generally, the Mooloolah catchment was anticipated to have higher quality habitat because of the larger areas of remnant vegetation still present within the catchment. Field survey effort was evenly distributed throughout the project area, to provide a representation of the aquatic ecosystems in each of the major waterways potentially affected by the project.

Based on the results of both the review of existing information and field investigations, this section describes the existing environmental conditions in terms of the aquatic ecology values of the project area. These specifically include:

- aquatic habitats
- aquatic macrophytes
- freshwater fish
- macro-invertebrates
- aquatic flora and fauna species of conservation or other special significance.

13.3.1 Aquatic habitats

Overview

The project area traverses the mid and upper reaches of three southeast Queensland catchments, namely, the Pumicestone, Mooloolah and Maroochy catchments. The total area of each catchment within the project area was 2.88, 22.09 and 41.37 km^2, respectively (**Table 13.3.1**). Based on the SEQ catchment digital terrain model and stream order mapping (WBM 2005), a total of 163.4 km of stream length have been mapped within the project area, most of which are minor drainages (stream orders 1 and 2) (**Table 13.3.1**, **Figure 13.3a**).

Five main drainage systems traverse the project area, including Petrie Creek, Paynter Creek, Eudlo Creek, Mooloolah River and minor drainages of Ewen Maddock Dam. Mellum Creek represents the principle drainage for the Pumicestone catchment within the southern end of the project area. However, drainages of this waterway do not intersect the proposed rail corridor within the project area.

Table 13.3.1: Stream order lengths (km) and area data for the project area and associated sub catchments

	Pumicestone Catchment		Mooloolah River Catchment		Maroochy River Catchment				Total	
	Mellum Creek Sub-Catchment		Mooloolah River Sub-Catchment		Eudlo Creek Sub-Catchment		Petrie/Paynter Creeks Sub-Catchment			
	Project area	Total	Project area	Total	Project area	Total	Project area	Total	Project area	Total
Area (km^2)	2.88	276	22.09	223	15.43	79	25.94	120	66.34	698
Stream order 1	3.21	261	24.28	238	18.79	96	31.02	142	77.3	737
Stream order 2	0.85	152	14.32	115	8.71	50	12.36	71	36.24	388
Stream order 3	3.25	69	3.64	58	10.21	33	4.29	32	21.39	192
Stream order 4	0	55	9.42	45	1.11	7	13.45	34	23.98	141
Stream order 5	0	21	0	35	0	12	4.52	17	4.52	85
Stream order total length	7.30	558	51.67	491	38.83	198	65.63	296	163.43	1543

Habitat types

The following broad aquatic habitat features occur within the project area:

- *Semi-perennial freshwater rivers and streams* are commonly restricted to the main arms of the 5 larger drainage systems characterised by stream orders of 3 to 5 (i.e. Eudlo Creek, South Mooloolah River etc.). At the time of sampling these were generally semi-contiguous to continuous low flowing pool environments and interspersed with areas of glide and riffle habitat. During periods of low rainfall, some streams may not flow but contain contiguous pools.
- *Low order ephemeral streams and drainages* are well represented throughout the project area, with many currently containing temporary pools as a result of recent flood events. Aquatic habitat features vary in response to flow conditions, potentially including temporal run, glide, riffle and pool habitats during periods of prolonged rainfall, and isolated pools during low flow periods.
- *Palustrine wetlands* were mainly recorded at and adjacent to Dularcha National Park.

Each of these aquatic habitat features contains a range of meso-habitat (and micro-habitat) types, including the following:

- permanent/semi-permanent pools within natural defined channels
- ephemeral low-order drainages with defined channels
- run habitats

During the period of sampling this habitat type was well represented within the project area due to the relatively high rainfall prior to the sampling period.

- riffle habitats, which were also well represented throughout the project area
- low-lying wetland environments.

At the time of sampling, low-lying wetland environments were well represented in Dularcha National Park, reflecting the high rainfall experienced prior to sampling.