Gateway Upgrade Project

17. Aquatic Biology

17

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17. Aquatic Biology

17.1 Introduction

An aquatic biology assessment has been undertaken by FRC Environmental to provide information on aquatic habitats and the associated flora and fauna in areas that may have the potential to be affected by the GUP. Mitigation and management measures have been recommended, where appropriate, to minimise the identified potential impacts and the acceptability of residual impacts has been determined.

This section has been divided into the following parts:

- Survey and sampling methods;
- Description of existing aquatic biology, potential impacts and section specific mitigation measures for each of the three project sections, including:
  - Mt Gravatt-Capalaba Road to Cleveland Branch Rail Line;
  - Cleveland Branch Rail Line to Pinkenba Rail Line; and
  - Pinkenba Rail Line to Nudgee Road.
- General project mitigation measures; and
- Conclusions.

17.2 Survey and Sampling Methods

17.2.1 Survey Sites and Timing

Surveys of aquatic environments in the vicinity of the proposed alignment were undertaken in February and March 2004. Eight locations, either where the GUP crossed an existing watercourse, or where a significant water body lay downstream of the alignment, were surveyed. Survey locations are described in Table 17.1 and shown in Figures 17.1a to 17.1d. Locations are representative of upstream freshwaters, downstream brackish waters and tidal wetlands. Substantial rain had fallen in the months (and indeed week) prior to field work, significantly influencing water quality, particularly within the mid-reaches of Bulimba Creek (Bulimba Creek 2 and 3). Waters were essentially fresh and highly turbid.

Table 17.1 Description of Sampling Sites

Location	Description	Photograph
Mt Gravatt-Capalaba Road to Cleveland Branch Rail Line		
Bulimba Creek 1 Bulimba Creek adjacent to the Gateway Motorway and Mt Gravatt – Capalaba Rd, Mackenzie. (west of Motorway at CH5300)	Bulimba Creek here is freshwater, with abundant instream macrophytes (*Potamogeton pectinatus*), relatively deep pools and riffles. The channel varies between approx. 1 and 10m wide and 1.5m deep. Sediments are coarse sand and gravel. The waterline is densely fringed with smartweed (*Persicaria attenuata).* The upper eastern bank is highly degraded, and lined with dense para grass (*Urochloa mutica),* the western bank is composed of remnant rainforest and sclerophyll trees.	

Location	Description	Photograph
Bulimba Creek 2 Bulimba Creek upstream of Minnippi Parklands, Belmont (west of Motorway at CH11900)	Bulimba Creek here is mildly brackish and tidally influenced, becoming fresher in summer months. The channel is approx. 9m in width, and up to approx. 3m in depth. Sediments are fine silts. There is some weed invasion of the banks by species such as lantana *(Lantana camara)* and camphor laurel (*Camphora cinnamomum).* The riparian zone includes mangroves, including the milky mangrove (*Excoecaria agallocha);* and blue taro *(Xanthosoma violaceum)*.	
Bulimba Creek 3 Bulimba Creek at the Gateway Motorway, Murarrie (10m downstream of Motorway at CH14800)	At the Gateway Motorway, Bulimba Creek is strongly estuarine, but dominated by freshwater after heavy rainfall. The channel is approx. 10m wide, and up to 3.5m deep. Sediments are fine silts. The banks are relatively stable, with invasion of some weeds such as broadleaf pepper tree (*Schinus terebinthifolius).* The banks are dominated by the grey mangrove (*Avicennia marina)*.	
Cleveland Branch Rail Line to Pinkenba Rail Line		
Brisbane River Brisbane River at the Gateway Bridge, Eagle Farm	The Brisbane River's banks are highly degraded, in some places with severe erosion. The southern bank consists of rock and rubble, the northern bank fine silty sands and some rocks. There are some scattered grey mangroves in the vicinity of the alignment.	
Pinkenba Rail Line to Nudgee Road		
Lomandra Drive Drainage system adjacent to Lomandra Drive, Brisbane Airport (100m east of proposed deviation Motorway at approximate CH19550)	There are a number of small drainage channels in the vicinity of Lomandra Drive that may be affected. These drains are typically narrow (up to 2m wide and 1m deep) and lined with mangroves. Some of the drainage channels have freshwater sections, lined with bulrush (*Typha* spp.), common reed (*Phragmites australis)* and sedges.	

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FIGURE 17.1a
Aquatic Ecology Sampling Sites
Mt Gravatt-Capalaba Road to Old Cleveland Road

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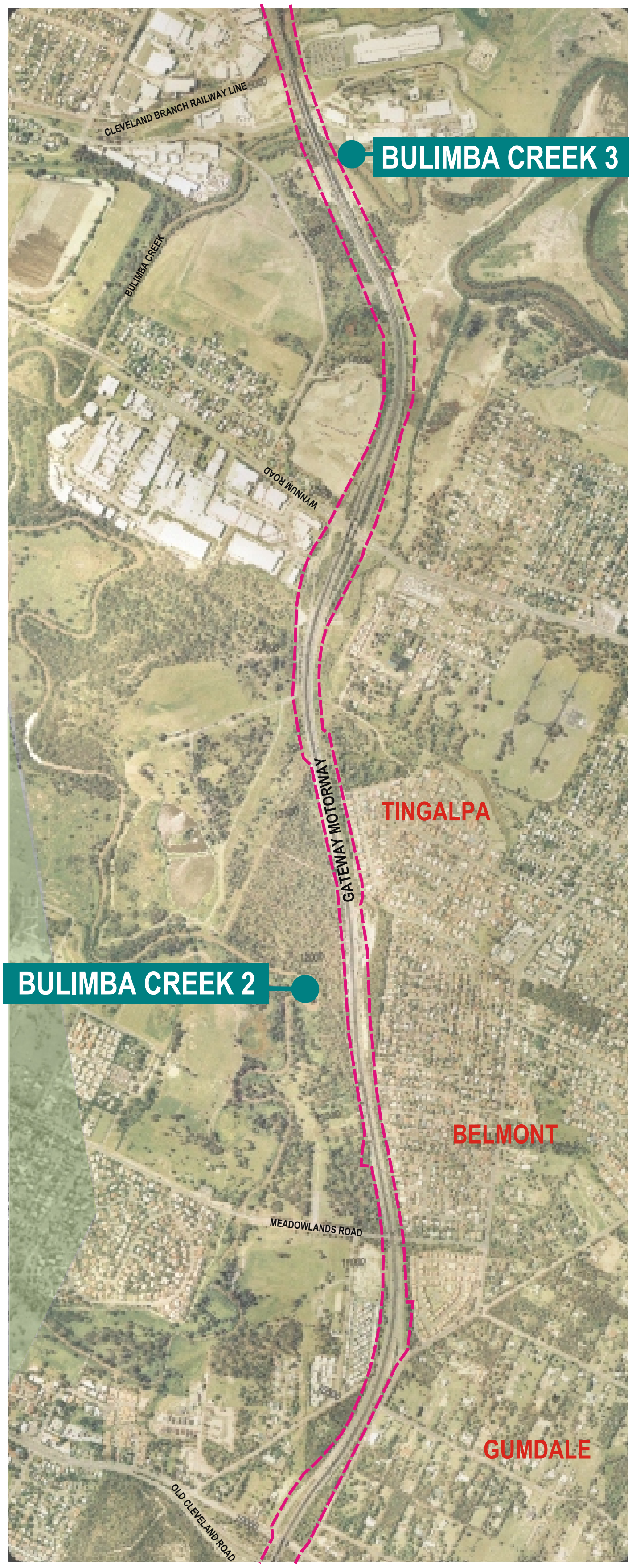

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FIGURE 17.1b
Aquatic Ecology Sampling Sites
Old Cleveland Road to Cleveland Branch Rail Line

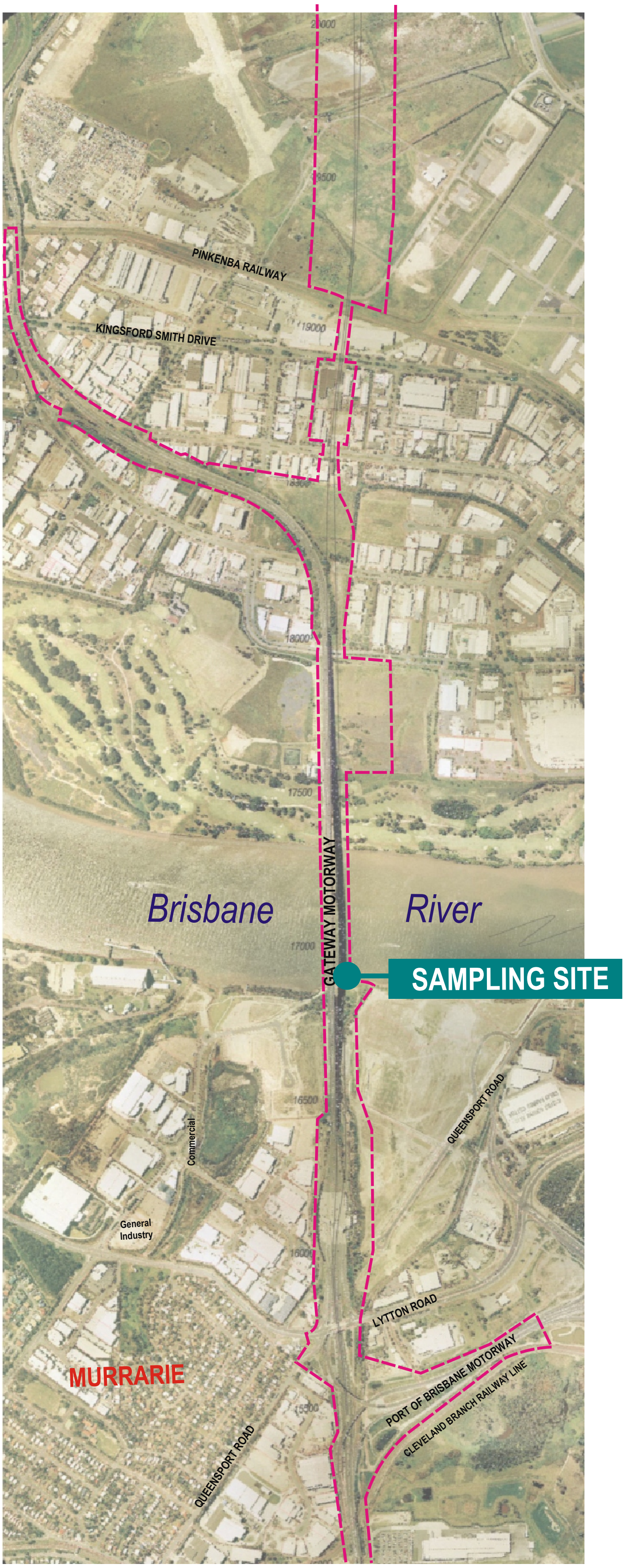

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FIGURE 17.1c
Aquatic Ecology Sampling Sites
Cleveland Branch Rail Line to Pinkenba Rail Line

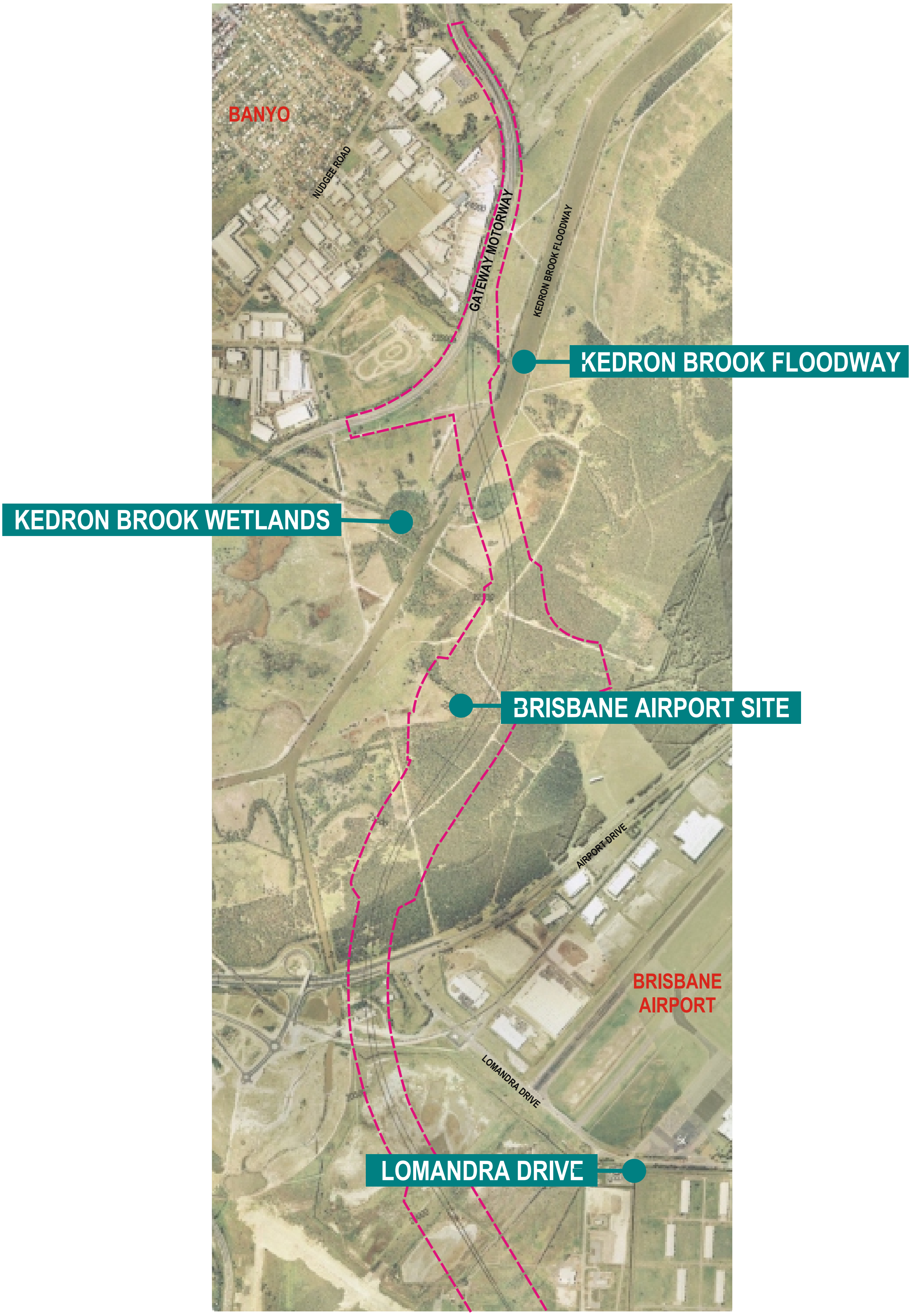

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FIGURE 17.1d
Aquatic Ecology Sampling Sites
Airport Drive to Nudgee Road

Location	Description	Photograph
The Brisbane Airport The wetlands of the Brisbane Airport precinct, including Schultz Canal (CH21500 to 22950)	The wetlands of the Brisbane Airport are dominated by grey and river mangroves (*Aegiceras corniculatum)*, and often grow in association with marine couch (*Sporobolus virginicus)* and sea blite (*Suaeda australis)*. Many of the wetlands are highly degraded due to low tidal flushing.	
Kedron Brook Floodway and Tributaries	At the Gateway Upgrade alignment the Kedron Brook Floodway is approximately 30m wide, and 4m deep. Sediments are sandy silts. Grey mangrove dominates the riparian fringes of the Floodway, river mangrove grow lower on the bank. There are also occasional red mangrove (*Rhizophora stylosa).* Saltmarsh plants such as sea blite grow in the understorey marine couch grows on the upper bank, above the erosion scarp (which is up to 1.5m in height).	
Kedron Brook Wetlands Wetlands to the west of Kedron Brook Floodway and east of the Gateway Motorway.	The wetlands here are a matrix of saltmarsh dominated by marine couch sea blight and sea purslane (*Sesuvium portulacastrum),* small mangrove-lined channels, brackish sedgelands and stands of paperbark (*Melaleuca quinquenervia)* and swamp oak (*Casuarina glauca).*	

Survey Methods

Surveys at each site were based on a variety of methods, including:

- In situ water quality monitoring;
- Characterisation of waterways, including riparian and instream vegetation/wetland mapping;
- Dip netting for fishes and macro-invertebrates;
- Seine netting, multi-panel gill netting and trapping;
- Collection of phytoplankton samples; and
- Benthic invertebrate quadrats.

A combination of these methods was used at each site, in response to site specific conditions (refer Table 17.2). Results from previous studies in the area, such as the *Brisbane Airport Fauna Study* (FRC Environmental 2003), and *Minnippi Parklands Project, Ecology of Bulimba Creek and Tributaries* (FRC Environmental 2004) have also been referred to in this section.

Table 17.2 Survey Methods Used at Each Site

Site	Water Quality Monitoring	Dip Netting	Seine Netting	Gill Netting	Fish Trapping	Phytoplankton Sampling	Benthic Invertebrate Quadrats	Wetland Vegetation Mapping
Bulimba Creek 1	✗	✗	✗		✗	✗		
Bulimba Creek 2	✗	✗						
Bulimba Creek 3	✗	✗		✗	✗	✗		
Brisbane River	✗	✗					✗	
Lomandra Drive	✗	✗			✗			
Brisbane Airport		✗				✗		
Kedron Brook Floodway and Tributaries	✗	✗			✗	✗		✗
Kedron Brook Wetlands								✗

Survey work was conducted under General Fisheries Permit No. PRM01220C and Animal Ethics Permit Registration No. 0047.

17.2.2 Sampling Methods

Water Quality Monitoring

Water quality was monitored in situ using a Yeokal 611 multi-probe water quality meter. Dissolved oxygen, turbidity, pH, salinity, oxidation reduction potential (ORP) and temperature were measured at the surface (0.5m deep).

Characterisation of Waterways/Wetland Mapping

Observations were made on waterway attributes such as width, depth, sediment type and flow. Aquatic and riparian flora was noted. Marine plant communities in the vicinity of the GUP were mapped onto rectified aerial photographs. Extensive ground truthing was conducted of the more complex marine plant communities at the Brisbane Airport, Kedron Brook floodplain, Kedron Brook wetlands and along the alignment in the vicinity of Wynnum Road. Marine plant communities lining Bulimba Creek and the Brisbane River were also characterised.

Dip Netting

Dip nets with 100μm and 3mm mesh were used amongst fringing vegetation and large woody debris. Each sample collected represented approximately 10m of bank. Dip netting was undertaken between 10:00 and 15:00 across the survey.

Trapping and Netting

Fish trapping involved the setting of six small traps baited with cat biscuits, and four large 'opera house' traps, baited with a portion of mullet. All traps were fitted with 'platypus excluder rings', and were left to soak overnight, with a soak time of at least 12 hours.

A multi-panel gill net of 25mm, 50mm and 75mm mesh was set within Bulimba Creek (each panel was 15m in length); a 50m seine net with 20mm mesh was used at the freshwater site in Bulimba Creek (Bulimba Creek 1).

Phytoplankton

Phytoplankton were concentrated from 2L water samples by centrifuge, and examined under a compound light microscope at magnifications up to 400x.

Benthic Invertebrate Quadrats

Benthic invertebrate communities were characterised at the Brisbane River with the use of quadrats. Twenty 50cm by 50cm quadrats were randomly placed on the substrate. Crab holes, crabs and other invertebrates within the quadrat were recorded.

State of the Rivers, AusRivAs and SIGNAL Assessment of Freshwater Reaches

In this survey the freshwater section of Bulimba Creek was visually assessed using modified versions of the 'State of the Rivers' and AusRivAS (DNR 2001) habitat assessment methods. The focus of the visual survey was to determine the ecological character of the waterways, including particular ecological attributes such as the presence or likely presence of 'listed' rare or endangered species and the degree of habitat modification. The stream section was then scored according to the 'Habitat Assessment Field Sheet' from the Queensland AusRivAS methodology (DNR 2001). In this assessment nine criteria are numerically assessed from excellent to poor, with a maximum score of 20 and minimum of zero, with the final habitat assessment being the numerical score.

The taxonomic composition of macroinvertebrate communities is often used to determine the 'health' of waterways. The SIGNAL (Stream Invertebrate Grade Number — Average Level) Index was developed by the National River Health Program as a tool for the bio assessment of water pollution. Each family of macroinvertebrate has a grade number between one and ten based on their sensitivity to various pollutants (Chessman et al. 1997, Chessman 2001). A low number means that the macro invertebrate is tolerant of a range of environmental conditions, including common forms of water pollution (eg suspended sediments and nutrient enrichment). A high number means that the macro-invertebrate is sensitive to most forms of pollution. The SIGNAL Index is calculated by averaging the pollution sensitivity grade numbers of the families of macroinvertebrates present at each site. A SIGNAL Index thus gives an indication of water quality in the river from which the samples were taken. The higher the SIGNAL Index the better the condition of the site.

In 2001 SIGNAL scores were revised and more taxa added, so that the system could be used throughout Australia (Chessman 2001). The revised system of scoring is known as SIGNAL 2. SIGNAL 2 scores were used in this study.

Samples of invertebrates for SIGNAL 2 indices were taken according to Chessman (2003), using 100m mesh dip net and sampling pools, riffles and edges. The weighted SIGNAL 2 scores were calculated for the three habitat types, and for all habitats combined.

17.2.3 Sampling Event

Water quality was monitored at a number of sites between 18 and 23 March 2004. There were heavy rains the evening of the 17 March 2004. Therefore water quality monitoring reflects wet season conditions, each of the waterways was in some way affected by freshwater flows.

17.2.4 Seasonal and Temporal Variation of Estuarine Fauna

The composition of estuarine faunal communities is highly variable on a seasonal scale. Many aquatic species are only present in estuarine areas for restricted periods of time. Several marine species, such as tailor and many of the penaeid prawns reside in estuaries as juveniles and migrate offshore with development. Adult female mud crabs migrate out of estuaries and offshore to spawn, with new recruits returning to the estuaries as post larvae. Other marine species, like the snapper *(Pagrus auratus)*, migrate inshore into sheltered estuarine embayments for spawning. Several freshwater groups, such as long-finned eels migrate through estuaries to spawn in the marine environment.

TOR Requirements:
The aquatic flora and fauna occurring in the areas affected by the Project should be described, noting the abundance and distribution in the waterways and wetlands.

A description of the habitat requirements and the sensitivity of aquatic flora and fauna species to changes in flow regime, water levels and water quality in the Project area are to be provided. The discussion of the aquatic flora and fauna present or likely to be present at any time during the year in the area should include:

- Fish species, marine mammals and reptiles and aquatic invertebrates
- Any rare and threatened marine species and the occurrence, or likely occurrence, of their habitat in the wider project area

- Aquatic plants
- Aquatic and benthic substrate
- Habitat downstream of the project or potentially impacted due to currents in associated lacustrine and marine environments.

17.3 Mt Gravatt-Capalaba Road to Cleveland Branch Rail Line

17.3.1 Description of Existing Aquatic Biology

Water Quality of Bulimba Creek

At the time of survey, Bulimba Creek at all sites surveyed was essentially fresh, during low flow conditions site 2 is likely to be mildly brackish and site 3 is likely to be strongly estuarine.

Dissolved oxygen was low at all sampling sites, and did not meet the BCC Water Quality Objectives (BCC 2000) or the ANZECC & ARMCANZ (2000) guidelines (Table 17.3). This is likely to be a consequence of catchment-generated high chemical and biochemical oxygen demands. Turbidity was high in Bulimba Creek, all sites here exceeded BCC Water Quality Objectives (BCC 2000) and ANZECC & ARMCANZ (2000) guidelines. Within the mid-reaches of Bulimba Creek, this is again likely to be a consequence of recent, high rainfall within the catchment transporting suspended solids to the creek. High turbidity resulting from catchment inflow, vessel traffic, wind and tide driven resuspension and nutrient enrichment (supporting phytoplankton) is likely to be a common characteristic of the estuarine reaches of Bulimba Creek, and not solely associated with recent rainfall. The high turbidity at Bulimba Creek site 1 is likely to be a result of stormwater inflow. Moderately high temperatures reflect the season during which the surveys were undertaken.

Table 17.3 In situ Surface Water Quality Parameters of Sampling Sites (March 2004)

Parameter	ANZECC/ ARMCANZ Trigger Level		BCC Water Quality Objectives	Bulimba Creek 1	Bulimba Creek 2	Bulimba Creek 3
Dissolved oxygen	**mg/L**	6*				
	% Sat.	85 – 110 (F) 80 – 110 (E)	80 – 105 (F) 80 – 100 (E)	74.6	54.5	54.3
ORP[1]	-		-	255	340	340
pH	6.5 – 8.0 (F) 7 - 8.5 (E)		6.5 – 8.5 (F)	6.52	6.63	6.63
Salinity (ppt)	-		-	0.10	0.11	0.26
Conductivity (μS/cm)	125 – 2200 (F)		-	218	249	545
Temperature (°C)	-		-	23.0	23.6	25.94
Turbidity (NTU)	6 – 50 (F) 0.5 – 10 (E)		20 (E and F)	66.7	93.6	35.1

Parameter	ANZECC/ ARMCANZ Trigger Level	BCC Water Quality Objectives	Bulimba Creek 1	Bulimba Creek 2	Bulimba Creek 3
Sediments	-	-	Coarse sand	Silty	Silty
Date Sampled			18/03/04	18/03/04	18/03/04
Time Sampled			10:30	12:00	12:45

Table Notes:
1. ORP = Oxidation Reduction Potential
2. F = Trigger levels and BCC Water Quality Objectives are for freshwater
3. E = Trigger levels and BCC Water Quality Objectives are for estuarine waters
4. Shaded values exceed BCC (2000) water quality objectives and ANZECC/ARMCANZ (2000) trigger levels
5. * = Dissolved oxygen levels above 6mg/L or 80-90% saturation are recommended for Australia freshwaters in ANZECC (1992)

Further discussion of the water quality of Bulimba Creek is contained in Section 12.

Aquatic Flora of Bulimba Creek

No species of aquatic flora listed as rare or threatened under either State or Commonwealth legislation were recorded in Bulimba Creek, or are likely to be present.

The Gateway Motorway (and proposed GUP) runs adjacent to Bulimba Creek at Mackenzie (Bulimba Creek 1). The creek here affords moderately good aquatic habitat. It has good substrate cover, physical habitat (presence of pools, riffles and runs) and bank vegetative stability (refer Table 17.4).

Table 17.4 Habitat Assessment for Bulimba Creek 1 (Mackenzie)

Habitat Variable	Bulimba Creek 1
Bottom substrate/available cover	good
Embeddedness	good
Velocity/depth category	excellent
Channel alteration	fair
Bottom scouring and deposition	good
Pool/riffle, run/bend ratio	good
Bank stability	poor
Bank vegetative stability	good
Streamside cover	fair

In places at Bulimba Creek 1 the banks are highly eroded, and contain a high proportion of invasive weed species. The eastern bank in particular is highly degraded and covered with para grass (*Urochloa mutica)*. The western bank supports remnant rainforest vegetation. Within the streambed, smartweed (*Persicaria attenuata)* forms a dense shrubbery (refer Photo 17.1).

Photo 17.1

Dense *Persicaria* grows along the waters' edge at Bulimba Creek 1, at Mackenzie

The phytoplankton sample collected at Bulimba Creek 1 comprised a diverse community indicative of a waterbody that is nutrient enriched and rich in decaying organic matter. The phytoplankton was dominated by euglenophytes of which *Trachelemonas* was the predominant genus represented by many species. Other euglenophytes recorded at this site include several species of *Phacus, Euglena* and *Lepocinclis.* Other plankton that are also considered indicators of nutrient enrichment recorded at this site include large pennate diatoms (*Fragilaria*, *Synedra ulna*, *Synedra* spp) small and medium sized pennate diatoms (*Cocconeis*, *Pinnularia*), centric diatoms (*Melosira*), green algae (*Scenedesmus)*, blue green algae (*Nodularia)* and zooplankton (testate amoeba, *Arcella*).

Euglenophytes are good indicators or organic enrichment being common in organically enriched ponds, ditches and lakes. *Phacus* for example is widespread and common, typically in nutrient enriched water and *Trachelemonas* species are more common where organic material is concentrated and temperatures are high. The testate amoeba *Arcella*, which feeds only on bacteria, is frequently found in sewage ponds undergoing extended aeration.

The toxic cyanobacteria, *Nodularia,* was recorded in low numbers at this site. *Nodularia* is a widespread blue green algae and can form extensive blooms. Blooms of *Nodularia* can cause death of livestock and native animals. It produces hepatoxins that can kill liver cells causing liver problems and gastroenteritis in humans.

Whilst the plankton included indicators of organic enrichment, cell numbers were at acceptable levels and species diversity was good.

Further downstream at Belmont (Bulimba Creek 2), Bulimba Creek is brackish, with relatively stable banks. Occasional milky mangrove *(Excoecaria agallocha)* grow to approximately 6m in height along the banks.

Mangrove lilies *(Crinum pedunculatum)*, common reed *(Phragmites australis)* and blue taro *(Xanthosoma violaceum)* line the low water mark (refer Photo 17.2). Mangrove fern *(Acrostichum speciosum)* grows in sheltered backwaters. Weed species encroach on the banks where mangroves are absent. Flow at this site is moderately fast, and mildly tidal (tidal waters extend approximately 4km upstream).

Photo 17.2

Mangrove lilies and blue taro grow along the low water mark of Bulimba Creek at Belmont

Mangrove communities in Bulimba Creek at the Gateway Motorway crossing (Bulimba Creek 3), are dominated by grey *(Avicennia marina)* and river *(Aegiceras corniculatum)* mangrove (refer Photo 17.3 and 17.4). Along the creek grey mangroves reach approximately 7m in height, whilst river mangroves are commonly 4m in height. Mangrove lilies grow in some areas. Mangroves are the only form of marine plants present at Bulimba Creek crossing at Murarrie (refer Photo 17.4). A number of terrestrial weed species encroach on the upper bank, such as Easter Cassia *(Senna pendula var. glabrata)* and broad-leaf pepper tree *(Schinus terebinthifolius)*. Flow at this site is strongly tidal and at the time of sampling, highly affected by freshwater inflow.

Photo 17.3

The banks of Bulimba Creek at Murarrie are fringed by dense grey and river mangrove

Photo 17.4

The Gateway Motorway crossing of Bulimba Creek at Murarrie

A small mangrove lined channel (refer Figure 17.4a) runs adjacent to the Gateway Motorway that contains grey mangroves, river mangroves, mangrove lilies and mangrove ferns *(Acrostichum speciosum)*. Saltmarsh (namely marine couch) grows behind the mangroves where the ground is not elevated.

Some areas along the proposed alignment route have been mapped as mixed marine and terrestrial communities (refer Figure 17.4a). These include areas where the broad-leaf pepper trees grow behind the mangroves in association with marine couch *(Sporobolus virginicus)*. There are also Casuarina forests and scattered Casuarina and/or Eucalypt trees with a marine couch understorey. Additionally, marine couch meadows often contained terrestrial grasses and fresh-brackish water plants such as the common reed *(Phragmites australis)*, salt couch *(Paspalum vaginatum)*, streaked arrow grass *(Triglochin striata)*, bunchy sedge *(Cyperus polystachyos)*, river clubrush *(Schoenoplectus validus)* and *Bacopa monnieri*.

The phytoplankton sample collected from Bulimba Creek at Murarrie was dominated by a small naked dinoflagellate belonging to the genus Gymnodinium. Other plankton included large pennate diatoms (*Nitzschia cf obtusa, Stenopterobia, Fragilaria*), undifferentiated large and small pennate diatoms, centric diatoms (*Coscinodiscus, Melosira moniliformis*) euglenophytes (*Trachelemonas cf ureolata, Trachelemonas volvocina, Euglena acus, Euglena* spp.), cryptophytes (*Cryptomonas, Chroomonas*) and an unidentified dinoflagellate resembling Alexandrium (*cf Alexandrium*, a toxic genus). The sample also contained an abundance of fine-grained sediment.

Gymnodinioid dinoflagellates are frequently associated with polluted brackish environments and can form large blooms. Several small gymnodinioid dinoflagellates are toxic and so any faunal kills reported from Bulimba Creek should be monitored for potentially toxic species.

Indicators of organic enrichment at this site include euglenophytes, cryptophytes, and the pennate diatom, *Fragilaria*. Euglenophytes and cryptophytes (*Chroomonas* and *Cryptopmonas*) are generally common in environments rich in decaying organic matter. However, whilst present, their numbers were low.

Species diversity was good, comprising a mixed population of estuarine and freshwater species. Cell counts were at acceptable levels on the date surveyed.

KEY

Mixed Terrestrial and Marine Community	Mangroves
Mixed Eucalypt Open Forest and Woodland	Saltmarsh
Melaleuca and Eucalypt Woodland	Mangroves and Saltmarsh

3 Terrestrial Ecology Survey Sites
RE 12.9/10.4 Regional Ecosystem Classification
Project Corridor

Note: Amenity landscaping occurs within the GUP corridor at various locations.
Vegetation community mapping outside GUP corridor is based on limited field investigations

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SCALE

FIGURE 17.4a
Ecological Features
Old Cleveland Road to Cleveland Branch Rail Line

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Wetlands downstream of the GUP on Bulimba Creek are classified as of 'local significance' (refer Figure 17.2).

The ecological value of aquatic flora is discussed in Appendix M1.

Aquatic Fauna of Bulimba Creek

No species of fish or invertebrate recorded either from the EIS surveys or from previous studies are listed under either State or Commonwealth legislation as being rare or threatened. However, a number of listed species may potentially use aquatic habitats in the vicinity of the GUP, these species are discussed below and are listed in Appendix M8.

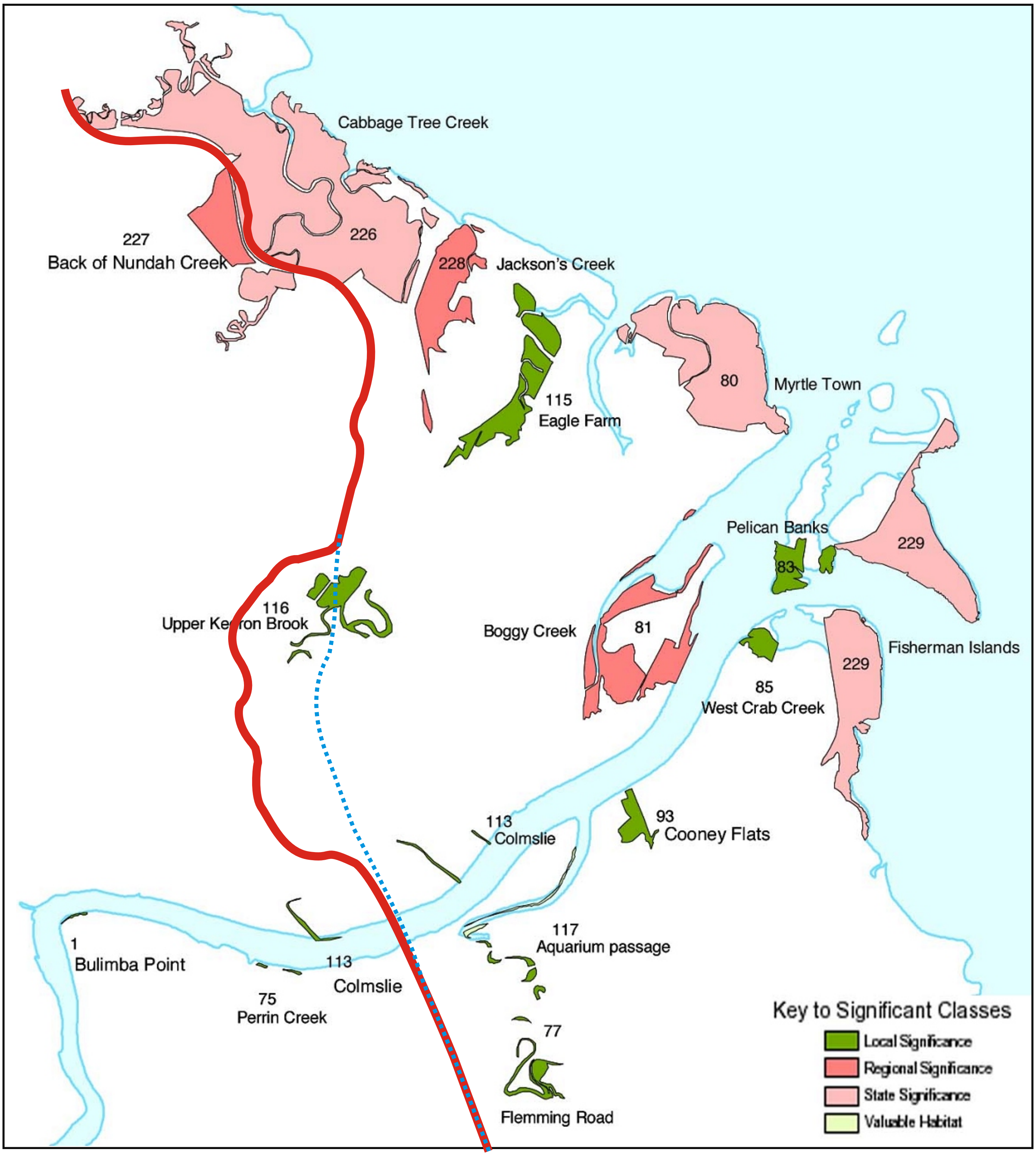
Bulimba Creek 1

The freshwater reaches of Bulimba Creek support a fish fauna of relatively low diversity. Gambusia *(Gambusia hollbrooki)* were abundant (numerically dominant) and freshwater mullet *(Myxus pertardi)* were common (refer Appendix M8). Long-finned eels *(Anguilla reinhardtii)*, empire gudgeons *(Hypseleotris compressa)*, crimson-spotted rainbowfish *(Melantaenia duboulayi)*, swordtails *(Xiphophorus halleri)* and platys *(X. maculatus)* were collected in low numbers.

Freshwater fish of coastal streams in SEQ are quite diverse under natural conditions, and are characterised by an overlap of temperate and tropical fish species (Midgeley 1978 cited in Kinhill Cameron McNamara Pty Ltd 1995). Prior to European settlement, the freshwater reaches of creeks in the Brisbane region are likely to have contained several additional fish species, such as freshwater catfish *(Tandanus tandanus)*, fly-specked hardyhead *(Craterocephalus stercusmuscarum)*, and ornate rainbowfish *(Rhadinocentrus ornatus)*. Flathead gudgeon *(Philypnodon grandiceps)*, dwarf flathead gudgeon *(Philypnodon sp.)*, purple-spotted gudgeon *(Mogurnda adspersa)* and striped gudgeon *(Gobiomorphus australis)* are also likely to have been present. Gambusia, platy and swordtail were introduced to Australia and are typical of streams that are highly degraded and Gambusia has been declared 'noxious' under the *Fisheries Act 1994*. The relative abundance of exotic species together with the low diversity and abundance of native fish and invertebrates is indicative of significant degradation.

It is likely that platypus inhabit Bulimba Creek's freshwater reaches, this species is known in some instances to inhabit highly modified streams with no riparian vegetation flowing through agricultural land, in artificial dams, and in forested habitats with dense riparian vegetation (Fanning et al. 1997). However the reach adjacent to the GUP does not provide ideal platypus habitat, the creek here has little overhanging vegetation and the banks contain few roots. Platypus require access to pool and riffle habitat as the major source of food, and to firm banks for the construction of burrows and the nest used for rearing young (Grant 1995).

The water rat *(Hydromys chrysogaster)*, a native rodent with a wide distribution that feeds primarily on invertebrates and fish (Lake 1995), is also likely to utilise the freshwater habitats of Bulimba Creek in the vicinity of the alignment.



Source: Maclean et al. 2001

KEY

GUP Corridor

Existing Gateway Motorway

FIGURE 17.2
Coastal Wetlands Significance

Bulimba Creek at Mackenzie also supports a low diversity of aquatic invertebrates. Long-armed prawns *(Macrobrachium australiense)* were abundant, freshwater snails of the families Thiaridae and Viviparidae were also common. The larvae of several terrestrial insect families were present in low numbers (refer Appendix M8). Nine freshwater macroinvertebrate families were recorded in total, only one of which is within the Plecoptera (stoneflies), Ephemeroptera (mayflies) and Trichoptera (caddissflies) (PET) family.

Bulimba Creek had a SIGNAL 2 score of 3.5 from edge habitats, 3.7 from riffle habitats and 4 from pool habitats; the score for combined habitats was 3.7. This relatively low score further indicates that the creek is subject to some form of pollution, or contains degraded habitats.

The dotted axes used in Figure 17.3 are positioned to reflect the current understanding of macroinvertebrate communities within the eastern Queensland region (Chessman 2001), and divide the graph into four quadrants. The red dot represents Bulimba Creek 1, while blue dots are other streams in SEQ.

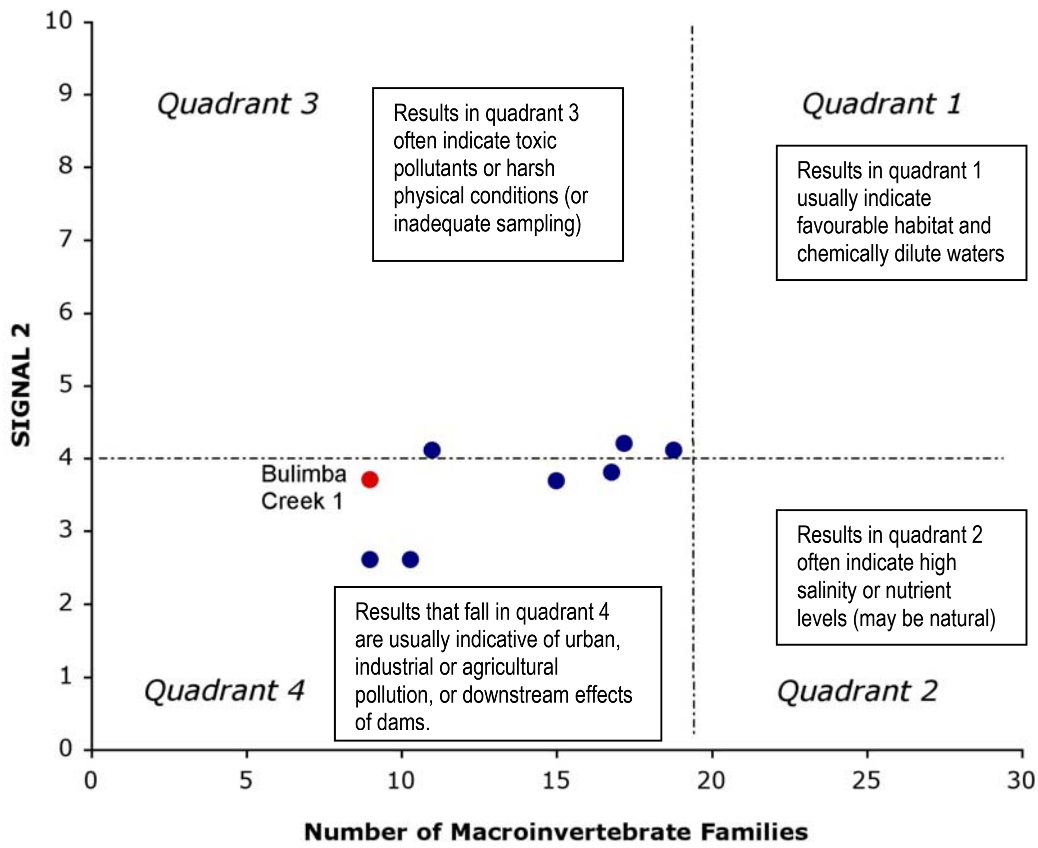


Figure 17.3 SIGNAL 2 Biplot for Habitats Sampled at Bulimba Creek 1

In this survey FRC Environmental compared SIGNAL 2 indices and number of macroinvertebrate families from other streams in SEQ (Tingalpa Creek, north and south Maroochy River, Glindemann Creek, Albert River and Canungra Creek) from previous surveys conducted by FRC Environmental and from DNRM's biological monitoring program (DNRM 2003).

The SIGNAL 2 Bi-plot indicates that the macroinvertebrate community of Bulimba Creek at Mackenzie is affected by either urban, industrial or agricultural pollution, as the results lie in Quadrant 4 (refer Figure 17.3). The majority of the other streams plotted also have a macroinvertebrate community affected by pollution, suggesting that 'pollution' is a common characteristic of freshwater environments in SEQ.

Bulimba Creek 2 and 3

The fish fauna of Bulimba Creek's brackish reaches is dominated by freshwater species with tolerance for wide fluctuations in salinity. Occasional 'marine' species tolerant of low salinity, such as the yellowfin bream were also recorded. Blue catfish *(Arius graffei)*, bony bream *(Nematolosa comei)*, Pacific blue eye *(Pseudomugil signifer)* and glass perchlet *(Ambassis marianus)* are common in the creek (FRC Environmental 2004). Each of these species are both common and widespread in the region, and characteristic of mildly/occasionally brackish waters. Majorie's hardyheads *(Craterocephalus marjoriae)* were collected in low numbers. Dusky flathead *(Platycephalus fuscus)*, long-finned eel, yellowfin bream *(Acanthopagrus australis)*, and a number of gobies and gudgeons more commonly associated with marine waters were also captured (FRC Environmental 2004). A low diversity and abundance of aquatic invertebrates were collected from Bulimba Creek's brackish zone. Long-armed prawns and Gammaridean amphipods were common. Cirolanid isopods, which were also common, are parasites of larger crustaceans such as shrimp (Hawking & Smith 1997). Veliid and gerrid water striders were relatively abundant in the creek and its tributaries. The greasyback and red endeavour prawns *(Metapenaeus bennettae and M. ensis)* were also recorded.

The conservation, recreational and commercial significance of aquatic fauna is discussed in Appendix M2 and M3.

17.3.2 Potential Impacts

TOR Requirements:
This section is to define and describe the potential impacts of the project on aquatic flora and fauna (including aquatic invertebrates) and provide mitigation measures to minimise or avoid such impacts.

Detailed descriptions are required on the potential for the project to directly or indirectly impact the values of downstream aquatic environments, including the Moreton Bay Ramsar wetland.

This section of the EIS should also include discussion on the following:

- The potential impact on aquatic biology associated with any alterations to the local surface and ground water environment;
- The potential for, and mitigation measures to prevent, the creation of new mosquito breeding sites during construction and operation; and
- Potential impacts on fish movement and fish spawning or recruitment areas from any permanent or temporary structures or stream diversions.

17.3.3 Impacts of Design

The design of the proposed alignment shows the roadway running roughly parallel to, and 'upslope' of, the upper reaches of Bulimba Creek at Mansfield (CH5160 – 6200) presenting the opportunity for any contaminants associated with either construction or operation to be carried by stormwater to the creek. A tributary of the creek rises less than 300m west of the alignment at Carindale (CH8800); and the creek itself meanders to within 150m of the alignment at Belmont (CH11900).

The alignment crosses Bulimba Creek and its fringing riparian vegetation at Murarrie (CH14800), presenting the potential for impacts to both riparian habitat and water quality.

17.3.4 Impacts of Construction

Potential impacts of the GUP on the aquatic environment include:

- direct loss of, or damage to, riparian and in stream communities at the Bulimba Creek crossing and invasion of weed species;
- altered hydrology;
- creation of mosquito and midge breeding habitat; and
- degradation of water quality, from runoff and following erosion and / or the disturbance of sediments, and subsequent sedimentation.

Construction will not result in the blocking of any waterway, or in any feature that materially restricts flow or the passage of aquatic fauna.

Loss of Riparian and Aquatic Habitat (including Marine Plants)

At Murarrie, a second crossing of Bulimba Creek is to be constructed, with earthworks on the overbank. A relatively small area of riparian mangrove is likely to be lost under the footprint of supporting piers (approximately 1,200m^2) whilst mangroves under the bridge itself may require trimming, and adjoining vegetation may be disturbed by construction machinery. The placement of bridge pylons/ culvert supports may result in the loss of small areas of stream bank/bed.

Mangroves will also need to be cleared for embankment widening between CH14300 and 14470 (approximately 2,000m^2).

Riparian vegetation, including mangroves, stabilises riverbanks and reduces sedimentation downstream. Riparian vegetation also filters water entering rivers, thereby reducing the nutrient content. Removal or disturbance of riparian vegetation may destabilise river-banks, cause localised erosion, and sedimentation and increased turbidity downstream. Sediments that would otherwise be intercepted by vegetation may carry high nutrients into the water column. Mangroves have important ecological functions and are critical to sustained fisheries production

Where riparian and aquatic vegetation is removed, weed species may quickly colonise. The declared weed groundsel (*Baccharis halimifolia)* is common in the more disturbed saltmarsh and mangrove communities of the study area and is likely to spread quickly in areas of disturbed soil. Similarly, para grass (*Urochloa mutica*) is common adjacent to freshwater streams in the study area.

Bridge pylons and other supporting structures will provide new habitat for aquatic flora and fauna requiring a solid substrate (such as macroalgae and oysters); and provide shelter for fishes and mobile invertebrates (such as prawns).

Altered Hydrology

The construction of roadways, approaches (possibly including culverts) and crossings has the potential to alter both surface and groundwater hydrology. This potential is significantly lessened in this section of the GUP as the proposed alignment lies in close proximity to the existing arterial (as any such impacts are likely to have been effected by the existing roadway, approaches and crossings).

Short term changes to groundwater hydrology may occur where dewatering is required to construct foundations for bridge crossings. Any such short term changes are unlikely to impact on 'marine plant' communities.

Creation of Mosquito Breeding Habitat

The saltmarsh mosquito *Ochlerotatus vigilax* is likely to be the most common mosquito encountered within the Brisbane coastal region, breeding prolifically within pooled water of intertidal lands. *Culex sitiens* also breeds in temporary brackish pools and salt marshes filled by spring tides. *Ochlerotatus vigilax* is the most important vector of arboviruses in south east Queensland, also being a suspected carrier of Barmah Forest virus and dog heart-worm. During breeding, the eggs are laid by the female of each species, in mud or on vegetation associated with pooled water, and hatch when water levels rise (with the incidence of tidal inundation or heavy rainfall). Both these species and others mosquito species are likely to breed within any brackish or freshwater pools created by construction activities.

Impacts Associated with Runoff

Runoff from the road corridor is likely to flow into Bulimba Creek. During construction, the erosion of exposed ground and stockpiled material may result in the discharge of sediment-laden runoff. Eroded sediments may also carry with them adsorbed nutrients and any contaminants that may be associated with sediments.

Construction may expose acid sulfate soils or potential acid sulfate soils, potentially resulting in acidified leachate reaching adjacent waters and wetlands.

Spilt fuel, oil and other chemicals that may be used in construction may also be carried to Bulimba Creek by stormwater.

The introduction of contaminants to waterways and wetlands has the potential to significantly impact upon fish and other aquatic fauna, and aquatic flora such as phytoplankton and mangroves.

The potential impacts associated with runoff relate to:

- elevated turbidity and sediment deposition;
- elevated materials;
- petroleum hydrocarbons;
- heavy metals; and
- acid leachate.

A discussion on these potential impacts on aquatic biology is provided in Appendix M4.

17.3.5 Potential Impacts of Operation

Potential impacts associated with use of the GUP include:

- road runoff associated pollutants entering adjacent waters and wetlands;
- the creation of habitat suitable for mosquito breeding (for example through stormwater treatment ponds) (refer Section 17.3.3);
- shading of mangrove and saltmarsh communities by bridges and approach structures; and
- increased noise and light.

Operation will not result in the blocking of Bulimba Creek, or in any feature that materially restricts flow on the passage of aquatic fauna.

Altered Inflows to Waterways

The operational GUP also has the potential to impact Bulimba Creek through runoff carrying suspended solids, heavy metals and hydrocarbon residues. Where these contaminants are carried by stormwater to existing water bodies, they can impact the growth, morphology reproduction and development of aquatic flora and fauna (refer Appendix M4).

Litter discarded by motorists and items that fall off passing vehicles is likely to enter waterways adjacent to the roadway. Ingestion and entanglement of litter by seabirds, turtles and fish can be fatal in Australia (Wace 2000).

Shading of Mangroves

Shade is an important factor influencing both the growth and survival of established mangroves, and the regeneration of disturbed communities. Seedlings of different species have different preferences for shade in their early development. *Rhizophora* seedlings appear to be more tolerant of shade than *Avicennia* seedlings, and can establish under a dense *Avicennia* canopy and grow up and replace it (Bird & Barson 1982).

Decreasing the light available to seedlings is likely to reduce seedling survival and growth, which may have long term consequences on the community composition and morphology of the forest. It may also favour the establishment of species with more shade tolerant species (eg *Rhizophora*) over those with shade intolerant seedlings (eg *Avicennia*).

Despite wide geographic variations and variations with life stage, mangroves have been broadly divided into two groups:

- Those that are shade tolerant both as seedlings and adults (*Aegiceras, Ceriops, Bruguiera, Osbornia, Xylocarpus and Excoecaria*) and
- Those that are shade intolerant (*Acrostichum, Acanthus, Aegialitis, Rhizophora, Lumnitzera, Scyphiphora and Sonneratia*) (Hutchings & Saenger 1987).

Avicennia is shade intolerant as a seedling but shade tolerant as a tree (Hutchings & Saenger 1987). That is grey mangrove trees that are left undisturbed under bridge crossings are likely to survive; however grey mangrove seedlings that are heavily shaded may not grow to maturity. This may impact the long term density and survival of mangrove communities beneath the bridges. *Aegiceras* is tolerant of shading, and this species is likely to successfully recolonise habitats under bridges.

It is important to note shading is not as critical an issue when bridges area aligned north south as when bridges aligned east west, as a north-south alignment allows morning and afternoon sunlight to reach the trees. The crossing of Bulimba Creek at Murarrie is aligned northeast – southwest. There are currently mature grey mangroves, and river mangrove under the current bridges on Bulimba Creek at Murarrie. Increasing the width of the crossing may have a slight negative impact on the long term growth and density of the grey mangroves. However, river mangroves are not likely to be impacted.

Traffic Noise and Lights

Increased traffic volumes are likely to result in increased noise; and roadway-associated infrastructure is likely to result in an increase in the extent of illumination, particularly at the bridge crossing at Murarrie. Whilst many aquatic animals are able to detect 'sound', chronic (or background) roadway sound is unlikely to have any impact. Many species of fish and mobile invertebrates are attracted to light. Increased illumination at Bulimba Creek, may contribute to the concentration of some species of fishes and prawns at night, potentially making them more susceptible to capture. However, Bulimba Creek at the Murarrie crossing is already illuminated from the existing bridge and changes to faunal populations are therefore likely to be negligible.

17.3.6 Section Specific Mitigation Measures

Design Phase

The potential impacts of the design may be minimised or mitigated where:

- Design refinement minimises the physical disturbance of fringing riparian vegetation and waters, for example: where bridge buttresses are placed landward of the riparian zone at the Bulimba Creek crossing (CH14800); and where the number and size of piers are minimised, and their shape produces minimal hydraulic 'interference';
- The Bulimba Creek bridge is designed to ensure sufficient light penetration to support marine plants;
- Rehabilitation of marine plants occurs within the inter tidal areas adjacent to Bulimba Creek;
- Design elements should seek to maintain existing patterns of flow and bed levels at Bulimba Creek (CH14800);
- Provision is made for the collection and treatment of stormwater runoff; and
- Stormwater runoff collection is designed to minimised the breeding of mosquitoes.

Construction Phase

The potential impacts of construction may be minimised or mitigated where:

- Construction activities minimise the loss or disturbance of riparian flora (and in particular 'marine plants'), particularly at the Bulimba Creek crossing (CH14800);
- Rehabilitation of damaged vegetation communities (particularly 'marine plants') is undertaken (refer Section 17.3.7);
- Sediments, particularly fine sediments, are prevented from being transported from the construction corridor to adjacent Bulimba Creek. The minimisation of sediment disturbance and subsequent erosion, and the effective adoption of sediment management strategies are likely to be critical;
- Acidified waters are prevented from entering Bulimba Creek. Where acidified waters accidentally enter a water body, remedial action should be taken to prevent the receiving waters from falling more than two pH units below ambient;
- The spillage and subsequent transport of contaminants (including hydrocarbons, heavy metals) from the construction corridor to Bulimba Creek is prevented. Spill management plans should be developed for the construction phase;
- A mosquito management plan is implemented; and
- A comprehensive environmental monitoring program is developed and implemented. Baseline data should be gathered prior to any construction activity.

Operation Phase

The potential impacts of operation may be minimised or mitigated where:

- Sediments, particularly fine sediments, are prevented from being transported from the GUP to the creek;
- 'Best practice' surface water quality management is undertaken during operation; and
- Runoff from roadways (including bridges) is treated before release to natural waterways.

17.3.7 Rehabilitation of Riparian and Aquatic Habitat

Sediment type, compaction and elevation are the critical elements that will control the revegetation of the disturbed areas by mangroves or saltmarsh. 'Natural' recolonisation from the surrounding forests and marshes may take some years. While there is no plant cover over, the sediment it is more likely to be subject to erosion and reworking, potentially requiring ongoing maintenance. 'Natural' recolonisation may be supplemented by the active planting of mangrove and saltmarsh propagules of local provenance, to increase the rate of re-vegetation. This may be particularly appropriate if large areas are disturbed, as recolonisation can take disproportionately longer in large areas of unvegetated sediment. Where practical:

- Loss of riparian and aquatic habitat, including marine plants, will be minimised;
- Construction and use of access ways will be undertaken so as to minimise damage to the surrounding habitats;
- Existing cleared areas will be preferentially used where practical;
- Once construction of the road and bridges is complete, the temporary access ways will be returned to their original levels, and the type and compaction of the sediment will be rehabilitated so as to match surrounding areas; and
- Seeds and seedlings from the areas to be disturbed will be collected prior to construction and stored for replanting.

The issue of habitat rehabilitation will be addressed in further detail during the project's detail design phase.

17.3.8 Mitigation of Impacts on Water Quality

The majority of mitigation measures to address water quality impacts are contained in Section 12. However, the measure relevant to aquatic biology include:

- Sediments, particularly fine sediments, should be prevented from being transported from the construction corridor to Bulimba Creek;
- Construction activities in the vicinity of Bulimba Creek may be scheduled to avoid periods of high rainfall;
- Impacts on aquatic flora and fauna will be lessened if works are undertaken during periods of low runoff;
- 'Best practice' surface water quality management is required during both construction and operation to minimise adverse impacts on aquatic ecosystems;
- Spill management plans should be developed prior to construction; and
- Runoff from roadways (including bridges) should be treated before release to natural waterways.

17.3.9 Mosquito Management

Mosquito abundance is most effectively managed by restricting the availability of breeding habitat. Daily inspection of active construction sites will be used to identify newly created pools. Where practical, these pools will be filled in immediately. Pools required to manage stormwater will be monitored for larval abundance, and treated with appropriate larvicides to prevent the emergence of adults. Two larvicides are currently widely used within the region: *Bacillus thuringiensis israelensis* (Bti), a bacterial larvicide, and Altosid, an S-methoprene based hormone regulator, which prevents the development of larvae into adults.

17.4 Cleveland Branch Rail Line to Pinkenba Rail Line

17.4.1 Description of Existing Aquatic Biology

Water Quality of Brisbane River

Dissolved oxygen at the Brisbane River was low and did not meet the BCC Water Quality Objectives (BCC 2000) nor the ANZECC/ARMCANZ (2000) guidelines (refer Table 17.5). Turbidity in the Brisbane River was high and also exceeded BCC Water Quality Objectives (BCC 2000) and ANZECC/ARMCANZ (2000) guidelines. High turbidity is likely to be a common characteristic in the Brisbane River, and not solely associated with recent rainfall.

The Brisbane River at this reach is strongly tidal and well flushed.

Table 17.5 In situ Surface Water Quality Parameters of Brisbane River (March 2004)

Parameter	ANZECC/ ARMCANZ Trigger Level		BCC Water Quality Objectives	Brisbane River
Dissolved oxygen (%)	**mg/L**	6*	-	-
	% Sat.	80 – 110	80 – 100	77.0
ORP	-		-	367
pH	7 - 8.5		6.5 – 8.5	8.02
Temperature (°C)	**-**		**-**	26.03
Turbidity (NTU)	0.5 – 10		20	21.9
Sediments	-		-	Sandy silts
Date Sampled				22/3/04
Time Sampled				14:50

Table Notes:

1. The conductivity meter failed at the Brisbane River.
2. Shaded values exceed BCC (2000) water quality objectives and/or ANZECC/ARMCANZ (2000) trigger levels for estuarine waters.
3. ORP = Oxidation Reduction Potential

Aquatic Flora of Brisbane River

No species of aquatic flora listed as rare or threatened under either State or Commonwealth legislation were recorded, or are likely to be present.

The Brisbane River in the vicinity of the existing Gateway Bridge, and the GUP are essentially free of vegetation (refer Figure 17.4b). The southern bank is littered with rocky rubble and concrete, in patches of finer substrate (primarily coarse sand) occasional grey mangroves grow (refer Photo 17.5). Approximately 100m to the west of the bridge, there is a dense stand of grey mangroves up to 8m in height.

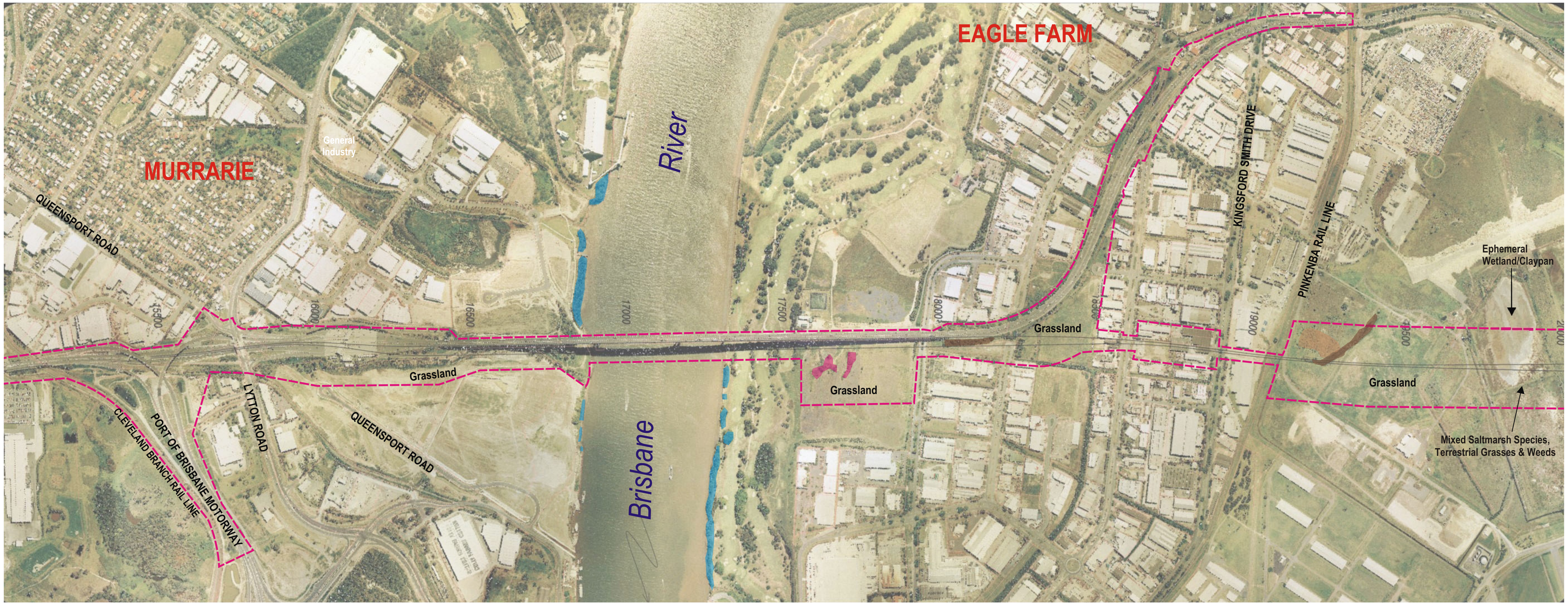
The northern bank of the Brisbane River at the Gateway Bridge is silty sand below a rock retaining wall (refer Photo 17.6). No aquatic plants grow immediately adjacent to the bridge, however approximately 60m east of the bridge grey and river mangroves grow above the rock wall. Occasional New Zealand spinach *(Tetragonia tetragonoides)* grows on the rock wall. There are also several small mangrove channels of local significance in the vicinity of the Gateway Bridge crossing.

Photo 17.5

The southern bank of the Brisbane River near the Gateway Bridge

Photo 17.6

The northern bank of the Brisbane River near the Gateway Bridge



KEY

Saltmarsh	Mangroves
Brackish Wetland	Exotic Vegetation
Coastal Vegetation	Freshwater Wetland and Sedge
Saltmarsh/Mudflats	
3	Terrestrial Ecology Survey Sites
RE 12.9/10.4	Regional Ecosystem Classification
--------	Project Corridor

Note: Amenity landscaping occurs within the GUP corridor at various locations. Vegetation community mapping outside GUP corrodor is based on limited field investigations.

0 250 500m
SCALE

Queensland Government Department of Main Roads

Australian Government Department of Transport and Regional Services

Connell Wagner

FIGURE 17.4b
Ecological Features
Cleveland Branch Rail Line to Pinkenba Rail Line

Q:\graphics\graphics\jobs579210NZ\Ecology Features 17-4b.cdr June 2004

Conservational significant wetlands are also found near the mouth of the Brisbane River at Fisherman's Island, Cooney Flats, West Crab Creek, Pelican Banks and Boggy Creek. The wetlands associated with Fisherman's Island are of 'state significance' (refer Figure 17.2). Wetlands of state significance have the highest level of conservation significance (in the Mclean et al. 2001 wetland conservation assessment). These wetlands should be, in general, managed for nature conservation and to maintain and enhance the natural values that contribute to conservation significance. They should be protected from development and disturbance of the physical and biological components of the ecosystem (Mclean et al. 2001). The wetlands of Boggy Creek are of regional significance. The wetlands of West Crab Creek, Cooney Flats and Pelican Banks are of local significance (refer Figure 17.2).

Aquatic Fauna of the Brisbane River

No species of aquatic flora listed as rare or threatened under either State or Commonwealth legislation were recorded during the survey, although several species of turtle and dolphin, and dugong (species more commonly found within adjoining Moreton Bay) may be found within the river's lower reaches from time to time.

The estuarine section of the Brisbane River supports a fish community of high species richness and diversity. The community is dominated by marine species with a tolerance for a broad range of salinities, such as the estuarine perchlet, blue catfish, estuarine anchovy, silverbiddy, garfish, mullet, striped butterfish, whiting, yellowfin bream, common toadfish and several species of goby. The River supports many fish species of importance to commercial and recreational fishers. These include flathead, threadfin, tailor, whiting, tarwhine, bream, flounder, longtom, trevally luderick, moses perch and greasy-back prawns. Several important bait species, such as Ogilby's hardyhead and southern herring were also recorded.

Several species of shore crab were collected from the riverbanks under the Gateway Bridge. Haswell's shore crab *(Helograpsus haswellianus)* was common. The broad fronted mangrove crab *(Metapograpsus frontalis)*, furry-clawed crab *(Australoplax tridentate)*, grey-clawed fiddler crab *(Uca longidigita)* and porcelain crabs from the family Porcellanidae were also present. Barnacles are also abundant on the bridge pylons. The riverbank adjacent to the Gateway Bridge supports large numbers of mangrove slug *(Onchidina australis)* and gold-mouthed periwinkle *(Bembicium auratum)*.

Fisheries of the Brisbane River

Beam trawlers have operated in the Brisbane River since the 1940s. Prior to 1983, there was no restriction on beam trawling in the Brisbane River. Vessels are limited to 9m in length and are generally operated by a single person, working in daylight hours, although some operators work at night (Quinn 1992). Maximum net length is restricted to 5m and a net minimum mesh size of 25mm. Their shallow draught allows them to operate in shallow waters, and often to within 10m of the seaward extent of mangroves. River beam trawl operators are licensed to operate from the mouth of the river upstream to the Victoria Bridge. The fishery is seasonal, with greasyback prawns being most abundant from September to April, whilst banana prawns are most abundant from April to July (MBTF 1997).

The beam trawl catch consists mainly of greasyback *(Metapenaeus bennettae)*, school prawns *(M. macleayi)* and banana prawns *(Penaeus merguiensis)*. Large, edible species (blue swimmer crabs, squid and whiting, etc.) taken as by-catch are also retained for sale. Each of these species are each widely distributed along the Queensland coast, although commercial catches of school and greasyback prawns are restricted to waters south of Bundaberg (TFMAC 1996).

17.4.2 Potential Impacts

Impacts of Design

There are some small, scattered mangroves on the southern bank of the Brisbane River (CH16900) adjacent to the existing Gateway Bridge that may be lost under the footprint of a new crossing.

The placement of bridge pylons will result in the loss of small areas of river bed.

Impacts of Construction

Potential impacts of the GUP on the aquatic environment of the Brisbane River include the:

- Direct loss of, or damage to, a small number of mangroves on the banks of the river and a potential invasion of weed species;
- Altered hydrology;
- Creation of mosquito breeding habitat (via the creation of ponded water during construction); and
- Degradation of water quality, from runoff and following erosion and / or the disturbance of sediments, and subsequent sedimentation.

Construction will not result in the blocking of the Brisbane River, or in any feature that materially restricts flow or the passage of aquatic fauna. A discussion of the above impacts is presented in Section 17.3.4.

Loss of Riparian and Aquatic Habitat (including Marine Plants)

There are some small, scattered mangroves on the southern bank of the Brisbane River adjacent to the existing Gateway Bridge that may be lost under the footprint of a new crossing.

The placement of bridge pylons will result in the loss of small areas of river bed. However, bridge pylons and other supporting structures will provide new habitat for aquatic flora and fauna requiring a solid substrate (such as macroalgae and oysters); and provide shelter for fishes and mobile invertebrates (such as prawns).

Altered Hydrology

The construction of roadways, approaches (possibly including culverts) and crossings has the potential to alter both surface and groundwater hydrology. However groundwater has likely been altered by the existing Gateway Motorway and bridge.

Short term changes to groundwater hydrology may occur where dewatering is required to construct foundations for bridge crossings. Any such short term changes are unlikely to impact on ‘marine plant’ communities.

Impacts Associated with Runoff

Runoff from the road corridor is likely to flow into the Brisbane River. Construction related runoff and its potential impacts are discussed further in Section 17.3.4 and Appendix M4, respectively.

17.4.3 Potential Impacts of Operation

Potential impacts associated with use of the GUP include:

- Road runoff associated pollutants entering the Brisbane River;
- Shading of mangroves by bridges and approach structures; and
- Increased noise and light.

Bridge pylons will not block passage of the Brisbane River, or restrict flow or the passage of aquatic fauna. Mosquito breeding in the area will not increase during the operation phase if ponded water created by construction is appropriately managed.

Altered Inflows to Waterways

The inputs of runoff on waterways are discussed in Section 17.3.5. The Brisbane River is presently subject to pollutant inflow from a range of sources (including the Gateway Bridge). Inflow of pollutants from the GUP is likely to be negligible in comparison to catchment inputs.

Shading of Mangroves

The approximate north-south orientation of the bridge, along with the distance between many of the mangrove stands and the bridge, will minimise the effects of shading. The *Avicennia* trees present are unlikely to be shaded for most of the day and will therefore experience only minimal impacts on growth (if at all).

Traffic Noise and Lights

Increased illumination at the Brisbane River may contribute to the concentration of some species of fishes and prawns at night, potentially making them more susceptible to capture. However, due to illumination and noise from the existing Gateway Bridge, these animals are likely to be attracted to the area already, and increases in population numbers are likely to be negligible.

17.4.4 Section Specific Mitigation Measures

Design

The potential impacts of the design may be minimised or mitigated where:

- Design refinement minimises the physical disturbance of fringing riparian vegetation and waters;
- The number and size of piers are minimised, and their shape produces minimal hydraulic ‘interference’;
- Provision is made for the collection and treatment of stormwater runoff; and
- Stormwater runoff collection and treatment ‘ponds’ are designed to minimised the breeding of mosquitoes.

Construction Phase

The potential impacts of construction may be minimised or mitigated where:

- Construction activities minimise the loss or disturbance of riparian flora along the Brisbane River (CH16900);
- Rehabilitation of damaged vegetation communities (particularly ‘marine plants’) is undertaken (see Section 17.3.7);

- Sediments, particularly fine sediments, are prevented from being transported from the construction corridor to the Brisbane River;
- Acidified waters are prevented from entering the Brisbane River (although the saline waters are likely to have a buffering capacity). Where acidified waters accidentally enter a water body, monitoring should occur and remedial action should be taken to prevent the receiving waters from falling more than two pH units below ambient if necessary;
- The spillage and subsequent transport of contaminants (including hydrocarbons, heavy metals) from the construction corridor to adjacent waterways and wetlands is prevented; Spill management plans should be developed for the construction phase;
- A mosquito management plan is implemented; and
- A comprehensive environmental monitoring program is developed and implemented. Baseline data should be gathered prior to any construction activity.

Operation Phase

The potential impacts of operation may be minimised or mitigated where:

- Sediments, particularly fine sediments, are prevented from being transported from the GUP to the river;
- 'Best practice' surface water quality management is undertaken during operation; and
- Runoff from roadways (including the bridge) should be treated before release to natural waterways.

17.5 Pinkenba Rail Line to Nudgee Road

17.5.1 Water Quality

Dissolved oxygen levels were low and were below guideline values at all of the sites sampled. In contrast to the other waterways sampled during the study, turbidity levels within this section of the GUP were within recommended guideline values.

Table 17.6 In situ Surface Water Quality Parameters of Sampling Sites (March 2004)

Parameter	ANZECC/ ARMCANZ Trigger Level		BCC Water Quality Objectives	Lomandra Drive	Schultz Canal	Kedron Brook Floodway	Kedron Brook Trib.
Dissolved oxygen (%)	**mg/L**	6*					
	% Sat.	80 – 110	80 – 100	50.4	42.0	76.7	66.4
ORP	-		-	433	347	365	322
pH	7 - 8.5		6.5 – 8.5	6.68	7.43	8.00	7.53
Temperature (°C)	-		-	22.79	24.08	24.24	25.05
Turbidity (NTU)	0.5 – 10 (E)		20 (E)	3.2	3.8	9.0	4.2
Sediments	-		-	Anoxic silt	Silty	Sandy silt	Silty
Date Sampled				22/3/04	23/3/04	23/3/04	22/3/04
Time Sampled				10:10	13:10	11:05	12:30

Table Notes:
1. The conductivity meter failed at all sites above.
2. ORP = Oxidation Reduction Potential
3. Trigger levels and BCC Water Quality Objectives are for estuarine waters

17.5.2 Aquatic Flora

Brisbane Airport

The Brisbane Airport supports a variety of wetland communities in the vicinity of the GUP (refer Figure 17.4). At the old airport site, there is a network of small mangrove and/or Casuarina-lined channels that grade into brackish sedgelands, such as those sampled at Lomandra Drive. These channels are typically narrow (up to 2m wide and 1m deep), and poorly flushed. Grey mangroves (*Avicennia marina)* line the estuarine sections; whilst mixed marine and terrestrial communities, including bulrush (*Typha* spp.), common reed (*Phragmites australis*), Casuarinas, occasional grey mangrove trees and sedges line the brackish/freshwater sections (refer Figure 17.4c).

There are also wetland plants growing atop the dredge spoil piles on the old airport site. Here, areas of bare claypan or ponded water are fringed by a mosaic of sea purslane *(Sesuvium portulacastrum*), marine couch (*Sporobolus virginicus*), seablite *(Suaeda australis)*, and ruby saltbush *(Enchylaena tomentosa)*, along with some terrestrial grasses and weeds. Patches of common reed (*Phragmites australis*) also occur in places. High ridges, colonised by terrestrial grasses, trees (such as Acacias) and weeds (eg grounsel), surround each dredge spoil area. These dredge spoil areas are at least 1-2m above surrounding drainage channels and are not tidally inundated, with high soil salinity the likely explanation for the presence of marine plants. However, under the *Fisheries Act 1994*, a marine plant permit from DPI Fisheries will never the less be required to disturb these plants.

North of Airport Drive, the alignment crosses Casuarina plantations, some of which have a marine couch *(Sporobolus virginicus)* understorey. It also crosses small patches of saltmarsh (dominated by marine couch), before skirting a narrow mangrove channel (approximately 2m wide) that supports *Avicennia marina*, river mangrove *(Aegiceras corniculatum)* and milky mangrove *(Excoecaria agallocha)* that are up to 3m high (refer Photo 17.7).

Photo 17.7

The alignment skirts a narrow mangrove channel and associated marine couch meadows in the southern part of the Brisbane Airport

Further north, the alignment transects Schultz Canal. At this point the canal is approximately 5m wide, and lined with grey mangroves up to 7m. Lower on the bank there are river mangroves *(Aegiceras corniculatum)* to 3m (refer Photo 17.8). Schulz Canal is relatively well flushed in the downstream sections, however upstream of the proposed alignment, a service road without culverts crosses the road and blocks water passage.

Before crossing Kedron Brook Floodway, the GUP alignment crosses grey mangrove forests, Casuarina forests (both with terrestrial, weed dominated understoreys and with marine couch understoreys) and saltmarsh areas (refer Figure 17.4c).

Photo 17.8

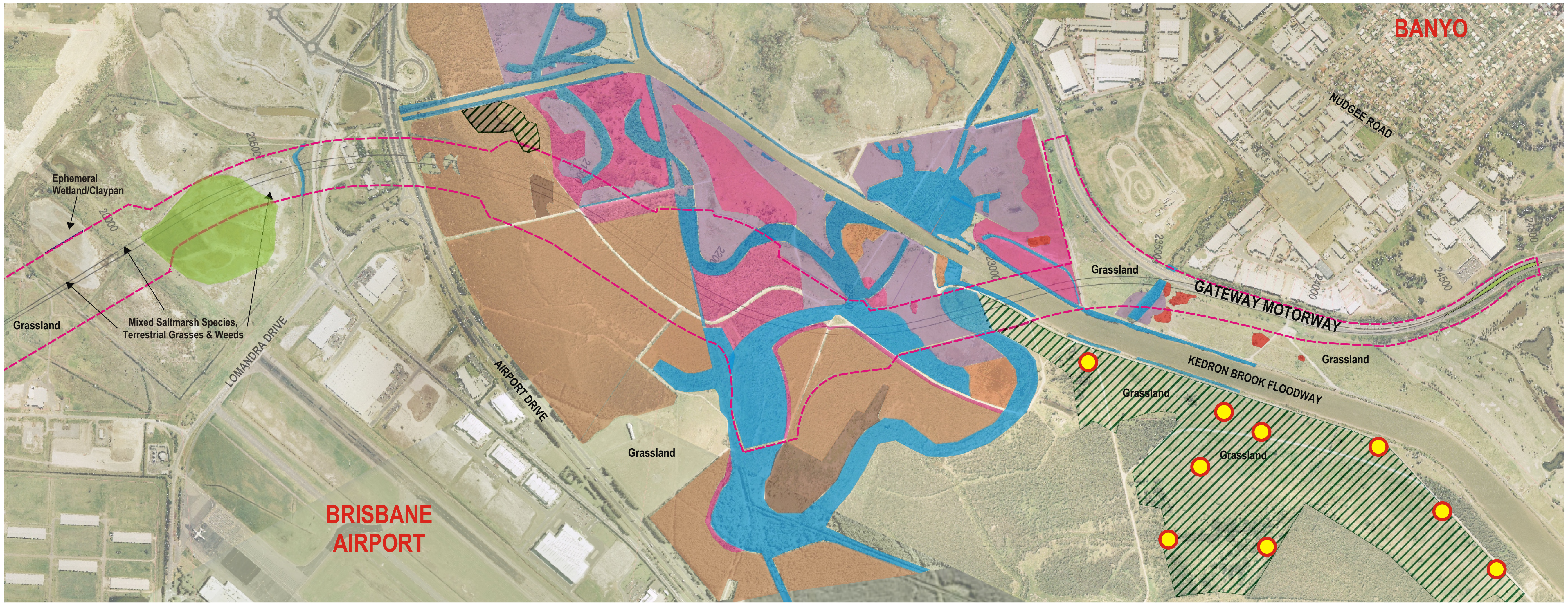
Schultz Canal is approximately 5m wide at the alignment

The saltmarsh areas within the airport precinct are dominated by marine couch, although seablite *(Suaeda australis)*, berry saltbush *(Einadia hastata)*, ruby saltbush *(Enchylaena tomentosa)*, samphire *(Sarcocornia quinqueflora)* and sea purslane *(Sesuvium portulacastrum)* are also present.

The mangrove wetlands of the airport precinct near Kedron Brook Floodway are commonly shallow (less than 0.5m), and poorly flushed (refer Figure 17.5 and Photo 17.9). Sediments are dark and anoxic. In some areas, ponded water and anoxic sediments have seemingly caused mangrove dieback. Grey mangroves are the dominant species, although occasional milky and river mangroves grow within these wetlands. Mangrove stands are typically bordered by marine couch, although the other saltmarsh species recorded in the area also occasionally grow in association with mangrove communities.

Photo 17.9

There are poorly flushed grey mangrove wetlands between Schultz Canal and Kedron Brook Floodway



KEY

Casuarina Plantation	Mangroves	Saltmarsh/Mudflats	Known or probable Lewin's Rail Habitat (Lambert & Rehbein 2004)
Coastal Vegetation	Saltmarsh	Mixed Grassland, Mudflats and Freshwater Wetland	Locations where Lewin's Rail recorded (Lambert & Rehbein 2004)
Freshwater Wetland and Sedge	Mangroves and Saltmarsh	Mixed Terrestrial and Marine Community	Project Corridor

Note: Vegetation community mapping outside the GUP corridor is based on The Brisbane Airport Vegetation Condition Assessment (ERM 2002) for BAC land and limited field investigations in other areas

0 250 500m
SCALE

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FIGURE 17.4c
Ecological Features
Airport Drive to Nudgee Road

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Photo 17.10

Wetlands of the airport are typically shallow (less than 0.5m) and bordered by marine couch

The phytoplankton sample collected from the Schultz Canal site at Brisbane Airport yielded the highest cell counts compared with other sites in this survey. The sample comprised a diverse phytoplankton dominated by two dinoflagellate genera, a tiny naked dinoflagellate resembling *Gymnodinium pumilum* and the much larger armoured dinoflagellate *Ceratium furca*. Other dinoflagellates recorded included *Noctiluca scintillans*, *Prorocentrum micans*, *Prorocentrum minimum*, *Protoperidinium cf depressum*, *Protoperidinium* spp., *Katodinium* sp. and other Gymnodinium species, all of which are common estuarine species.

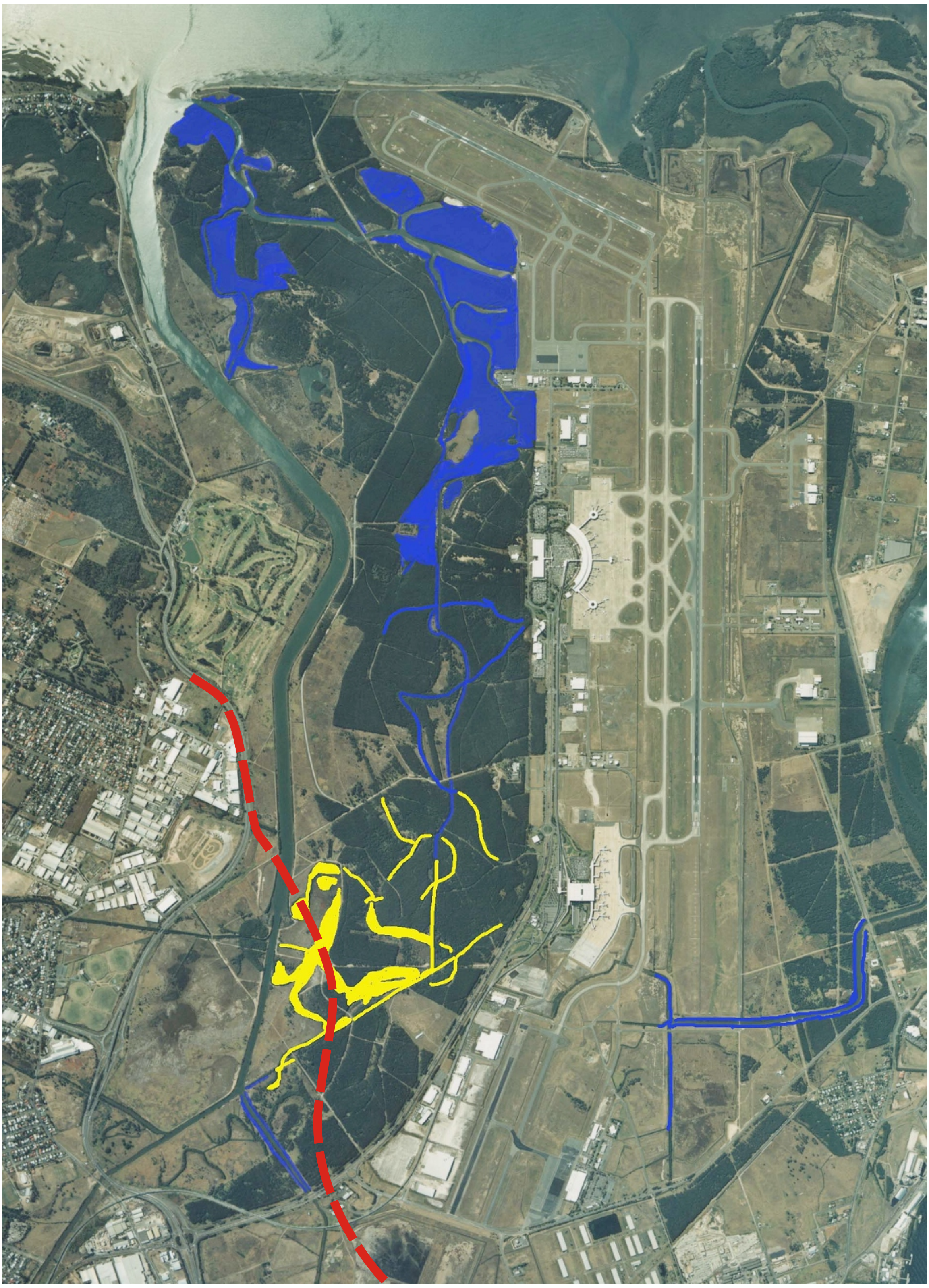
The remaining plankton included centric diatoms (*Leptocylindrus danicans*, *Rhizosolenia, cf Pseudonitzschia, Melosira, Chaetoceros*), crypotphytes *(Cryptomonas)*, euglenophytes *(Eutreptiella)*, zooplankton (mainly tintinnids) and other ciliates.

Gymnodinioid dinoflagellates are frequently associated with polluted brackish environments and can form large blooms or "Red Tides" in polluted estuaries. *Ceratium furca* is also a red tide dinoflagellate and was moderately abundant at this site, but not in bloom proportions.

Other organisms identified at this site which can also form red tides, (some potentailly harmful) and which are also common in polluted estuaries include *Prorocentrum micans*, *Prorocentrum minimum* and the very large and distinctive dinoflagellate *Notiluca scintillans*. Whilst these organisms were present at this site their numbers were low.

Prorocentrum micans and *Prorocentrum minimum* are non-toxic species, but if blooms were to occur in the Schultz Canal, they could be harmful to other organisms due to oxygen depletion during bloom decay.

Noctiluca scintillans is also a non toxic species and again was recorded in low numbers. However, extensive blooms of *N. scintillans* have resulted in massive fish and marine invertebrate kills worldwide being associated with increasing eutrophication in coastal embayments and coastal areas. Although this species does not produce a toxin, it has been found to accumulate toxic levels of ammonia, which is then excreted into the surrounding waters possibly acting as the killing agent. Blooms of *Noctiluca scintilans* are very distinctive, resembling tomato juice at the peak of the bloom moving to yellow brown to greyish white in the decay period.



KEY

- Well tidally connected mangroves
- Poorly tidally connected mangroves
- GUP Corridor

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FIGURE 17.5
Preliminary Characterisation of Mangrove Habitats at Brisbane Airport

Kedron Brook Floodway and Tributaries

The Kedron Brook Floodway is an engineered waterway that carries runoff from the Kedron Brook catchment into Moreton Bay immediately north of the Brisbane Airport.

The floodway is approximately 30m wide and 4m deep. It is well flushed, and strongly tidal. The banks are degraded in sections, with an erosion scarp up to 1.5m along parts of the eastern bank, and invasion of terrestrial weeds that grow on the upper bank (refer Photo 17.11 and 17.12). Along most of the east and west bank, there are grey mangrove to 5m and river mangrove to 2m (refer Photo 17.13). Sea blite and sea purslane grow in the understorey, whilst marine couch grows on the upper bank (often along the edge of the erosion scarp). Terrestrial grasses and weeds grow landward of the marine couch (refer Figure 17.4c).

Photo 17.11

Terrestrial grasses grow on the upper bank of the Kedron Brook Floodway

Photo 17.12

Some sections of the Kedron Brook Floodway's eastern bank are highly eroded

Photo 17.13

Mangrove communities of river and grey mangrove line much of the bank

A diverse population of zooplankton with many different species of Tintinnids dominated the water sample collected at the Kedron Brook Floodway site. The phytoplankton component comprised a mixed population of dinoflagellates (*Ceratium furca, Gymnodinium* spp., *cf. Alexandrium, Prorocentrum micans, Protoperidinium cf. pellucidum, Protoperidinium nudum, Peridinium* sp.) and centric diatoms (*Coscinodisus, Thalassiosira, Skeletonema costatum, Leptocylindrus danicans*), pennate diatoms (*Nitzschia longisima, Nitzschia cf obtusa, Pleurosigma, Pseudonitzschia*) and other undifferentiated small and medium sized pennate diatoms.

The water sample collected at this site yielded a diverse and healthy population of estuarine zooplankton (tintinnids) and a mixed estuarine phytoplankton comprising diatoms and dinoflagellates. Whilst some bloom forming species were recorded in the sample on the date surveyed, their numbers were low.

The tributary of Kedron Brook Floodway on the GUP is a channel approximately 6m in width, and up to 1m in depth (refer Photo 17.14). Dense grey mangroves to 7m in height line the channel; seedlings and smaller grey mangroves grow along the landward edge of the mangroves. Dense marine couch meadows grow landward of the tributary within 50m of the floodway (refer Photo 17.15), sea blite and sea purslane grows in association with the marine couch (refer Photo 17.16).

Photo 17.14

The tributary of Kedron Brook Floodway that is crossed by the Gateway Upgrade alignment

Photo 17.15

Extensive marine couch meadows grow between the Kedron Brook Floodway and the southern part of the tributary

Photo 17.16

Sea purslane (*Sesuvium portulacastrum)* grows amongst marine couch (*Sporobolus virginicus)* adjacent to the Kedron Brook Floodway tributary

Kedron Brook Wetlands

Scattered saltmarsh, mangrove channels and freshwater sedgelands grow adjacent to the existing Gateway Motorway at the proposed overpass/on-ramp that meets the Gateway Upgrade alignment. Marine couch grows in association with the tributary of Kedron Brook Floodway (refer Photo 17.15 and 17.16 and Figure 17.4c). Paperbark *(Melaleuca quinquenervia)* to approx. 12m grows in two stands – one north of the tributary, the other south (refer Photo 17.17). Common reed *(Phragmites australis)* grows landward of the southern bank of the creek (refer Photo 17.18).

Photo 17.17

Paperbark stands grow north and south of the tributary of Kedron Brook Floodway

Photo 17.18

Common reed grows south of the tributary creek

Rank grasses and bushland weeds grow in a dense thicket to 50m south of the Gateway Motorway. Occasional small mangrove channels grow further south, with marine couch, sea blite and sea purslane (refer Photo 17.19). There are also patches of bare claypan. Sedges *(Schoenoplectus sp.* and *Schoenoplectus validus)* grow in waterlogged sections with marine couch (refer Photo 17.20).

Photo 17.19

There are small mangrove channels approximately 80m south of the Gateway Motorway

Photo 17.20

***Schoenoplectus* sedges and marine couch grow in low lying lands south of the Gateway Motorway, north of Kedron Brook Floodway**

The mangrove *(Avicennia marina)* and marine couch *(Sporobolus virginicus)* communities of the Brisbane Airport adjoining Kedron Brook Floodway are classified as 'of local significance' (Mclean et al. 2001). There are also locally significant wetlands adjacent to Kedron Brook Floodway immediately downstream of Cannery Creek (refer Figure 17.2).

17.5.3 Aquatic Fauna

No species of fish or invertebrate recorded either from the EIS studies or from previous studies, is listed under either State or Commonwealth legislation as being rare or threatened. However, a number of listed species may potentially use aquatic habitats in the vicinity of the GUP; these species are discussed below and listed in Appendix M8.

The platypus, false water rat, or any freshwater turtles listed under the *Nature Conservation Act 1994* or EPBC Act are unlikely to inhabit the study area.

Lomandra Drive

The brackish channels adjacent to Lomandra Drive typically support a fish fauna of low diversity, dominated by Gambusia. The introduced platy and native empire gudgeon *(Hypseleotris compressa)* were also recorded. The small channels in this area are not adequately connected nor flushed to support fish communities other than those tolerant of degraded waters.

Brisbane Airport

Extensive surveys were undertaken within the Brisbane Airport precinct in 2002 and 2003 (FRC Environmental 2003). The large channels of the airport commonly support schools of tiger mullet *(Valamugil georgii)*, sea mullet *(Mugil cephalus)*, southern herring *(Herklotsichthys castelnaui)* and estuary perchlet. Yellowfin bream, common and banded toadfish *(Tetractenos hamiltoni* and *Marilyna pleurosticta)* and blue catfish are also common. The northern dusky flathead, silverbiddy *(Gerres ovatus)*, sole *(Synaptura nigra)*, snub-nosed gar *(Arramphus sclerolepis)*, tailor *(Pomatomus saltator)*, threadfin *(Polynemus heptadactylus)* and trumpeter *(Pelates quadrilineatus)* are also recorded from these waters.

Gobies, such as *Arenigobius frenatus*, *Gobiopterus semivestita*, *Istigobius nigroocellatus*, *Mugilogobius stigmaticus* and *Pseudogobius* sp.; and Pacific blue eye are very common amongst mangroves and within small tidal channels. Gambusia are common in wetlands with lesser tidal flushing. Long-armed prawns and Australian paste shrimp are common throughout the Brisbane Airport precinct. Greasy-back prawns, red endeavour prawns, sand crabs *(Portunus pelagicus)* and mud crabs *(Scylla serrata)* are recorded in low numbers. Sites with low tidal flushing and those that dried at low tide have both lower abundances and diversity than well flushed and permanently inundated sites.

Empire gudgeon *(Hypseleotris compressa)*, Pacific blue eye, platy, and Gambusia are the only fish species recorded in the freshwater/brackish channels and wetlands of the Brisbane Airport. The firetail gudgeon *(Hypseleotris galii)*, a tolerant and ubiquitous species, often found in association with empire gudgeons, has surprisingly not been recorded. Estuarine shrimp *(Palaemon sp.)* are also abundant in these channels.

Kedron Brook Floodway

Common toadfish are abundant in Kedron Brook Floodway and tributaries. Yellowfin bream, banded toado and several marine gobies are recorded in lesser numbers. Australian paste shrimp are abundant throughout the floodway. Long-armed prawn and estuarine shrimp are common in the tributaries, and brown-tiger prawns *(Penaeus esculentus)* are also recorded.

The Kedron Brook Floodway is the main point of entry to the Brisbane Airport precinct for marine species and many of the species recorded from tributaries in the vicinity of the Brisbane airport would occur with the Kedron Brook floodplain at different stages of the tide.

Fisheries of Kedron Brook Floodway

Kedron Brook floodplain is part of a total commercial fishing closure area (refer Figure 17.6), which extends to low water mark along the foreshore. Otter trawlers operate offshore, targeting banana *(Penaeus merguiensis)* and greasy back prawns *(Metapenaeus bennettae)*. Recreational fishing in the Kedron Brook Floodway/Shultz Canal target species such as flathead, garfish, tailor, tarwhine, whiting and sand crabs.

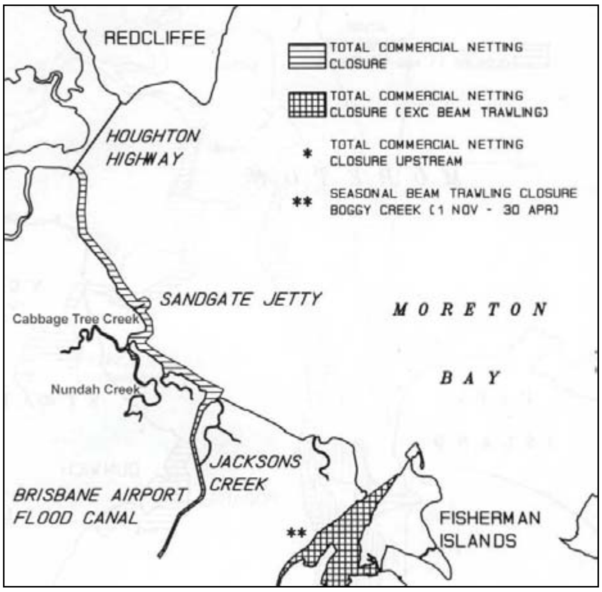

Figure 17.6 Netting Closure Areas in the Vicinity of Brisbane Airport and Kedron Brook Floodway (Quinn 1992)

Habitat associations of the fish most valuable in terms of recreational significance from Kedron Brook Floodway and Shultz Canal are presented in Appendix M3.

17.5.4 Potential Impacts

Impacts of Design

At the TCC site (old airport site), the alignment will span marine plant communities atop dredge spoil areas, along with drainage channels colonised by a mixed floral community of marine and terrestrial species. The proposed bridges in this area will reduce disturbance of marine plants, however the placement of supports and construction activity may result in the loss of some marine plants.

Within the Brisbane Airport precinct, the alignment crosses Schultz Canal at CH21900. Culverts that will maintain the existing hydraulic capacity of the canal will be installed along the existing line of the canal. Some loss of existing riparian flora (a mixed mangrove community) will occur. However upstream productivity, and connectivity of upstream and downstream reaches will be maintained.

A bridge will span the natural channel at approximately CH22100.

Bridges will also span the Kedron Brook floodplain (CH23000) and the minor western tributary (CH23500) that flows under the existing Gateway Arterial. Small areas of mangrove and saltmarsh communities may be lost to the placement of supports, and larger areas may be disturbed by construction activity.

Impacts of Construction

Potential impacts of the GUP on the aquatic environment include:

- The direct loss of, or damage to, riparian, wetland and in stream communities, particularly mangrove and saltmarsh areas, and invasion of weed species;
- Altered hydrology; and
- Degradation of water quality, from runoff and following erosion and/or the disturbance of sediments, and subsequent sedimentation.

Construction will not result in the blocking of any waterway, or in any feature that materially restricts flow or the passage of aquatic fauna. It is unlikely to increase mosquito breeding in the area if appropriate mosquito management measures are followed during construction.

Loss of Riparian and Aquatic Habitat (including Marine Plants)

Within the area of the second access to the airport mangroves and saltmarsh communities will be cleared. Based on the concept design, the loss of marine plants is likely to be approximately 2.7ha (mangroves) and 0.6ha (saltmarsh). Some of these mangroves and saltmarsh communities will regenerate along the GUP drainage lines.

Bridges will span the Kedron Brook floodplain (CH 23000) and the minor western tributary (CH23500) that flows under the existing Gateway Motorway. Small areas of mangrove and saltmarsh communities may be lost to the placement of supports. Additionally, construction of the GUP is likely to require temporary access for heavy equipment and machinery. In some cases, vegetation is likely to be removed completely to allow construction. Losses of habitat due to construction are likely to cause local impacts on aquatic faunal communities. Marine plants, such as saltmarsh and mangroves have important ecological functions and are critical to sustained fisheries production.

Some loss of saltmarsh plants will occur on the old airport site. However, these communities are not tidally inundated and therefore present little value to fisheries.

Altered Hydrology

The construction of roadways within the airport precinct, approaches to (including culverts) and crossings of the Kedron Brook floodplain has the potential to alter both surface and groundwater hydrology. This potential is significantly increased compared to other sections of the GUP because the area has not been affected by existing roadways to any large extent.

Short term changes to groundwater hydrology may occur where dewatering is required to construct foundations for bridge crossings. Any such short term changes are unlikely to impact on ‘marine plant’ communities.

Degradation of Water Quality and Impacts Associated with Runoff

Runoff of contaminants and fine sediments during construction may adversely impact aquatic floral and faunal communities. Refer to Section 17.3.4 and Appendix M4.

17.5.5 Potential Impacts of Operation

Potential impacts associated with use of the constructed roadway include:

- Road runoff associated pollutants entering adjacent waters and wetlands;
- Shading of mangrove and saltmarsh communities by bridges and approach structures; and
- Increased noise and light.

Altered Inflows to Waterways

Refer to section 17.3.5.

Shading of Mangroves

As the proposed crossing over Kedron Brook Floodway is north-south, grey mangroves are likely to survive in the long term under this crossing. Some saltmarsh species in the vicinity of the proposed bridges are likely to be affected by shading; those directly under the bridge may perish.

Traffic Noise and Lights

Fish and invertebrates within the airport precinct wetlands (CH21500 – 22950) may be attracted to the illumination of the GUP. Changes to population numbers here may be more noticeable than at other sections of the GUP, as the faunal populations of the airport precinct are not currently exposed to artificial light. The faunal populations of the Kedron Brook Floodway and its tributaries may also be attracted to the illumination of the GUP, however these populations are already subject to illumination from the existing Gateway Motorway.

17.5.6 Section Specific Mitigation Measures

Design Phase

The potential impacts of the design may be minimised or mitigated where:

- Design refinement minimises the physical disturbance of fringing riparian vegetation and waters, for example where bridge buttresses are placed landward of the riparian zone at Kedron Brook floodplain (CH21900 – 22100);
- Where the number and size of piers are minimised, and their shape produces minimal hydraulic 'interference'; and where wetlands are bridged, rather than spanned by raised earth (particularly within the north of the airport precinct (CH21900 – 22100);
- Bridges are designed to ensure sufficient light penetration to support marine plants ;
- Rehabilitation of marine plants occurs within the intertidal areas along and/or adjacent to the Kedron Brook floodplain;
- Design elements should seek to maintain existing patterns of flow and bed levels within the airport precinct (CH21900 – 22100);
- Provision is made for the collection and treatment of stormwater runoff;
- Stormwater runoff collection and treatment 'ponds' are designed to minimise the breeding of mosquitoes.

Construction Phase

The potential impacts of construction may be minimised or mitigated where:

- Construction activities minimise the loss or disturbance of riparian flora (and in particular 'marine plants') within the airport precinct (CH21900 – 22100) and the Kedron Brook floodplain (CH23100 – 23150);
- Rehabilitation of damaged vegetation communities (particularly 'marine plants') is undertaken (refer Section 17.3.7);
- Sediments, particularly fine sediments, are prevented from being transported from the construction corridor to adjacent waterways and wetlands;
- Acidified waters are prevented from entering any waterway or wetland. Where acidified waters accidentally enter a water body, remedial action should be taken to prevent the receiving waters from falling more than 2 pH units below ambient;
- The spillage and subsequent transport of contaminants (including hydrocarbons, heavy metals) from the construction corridor to adjacent waterways and wetlands is prevented. Spill management plans should be developed for the construction phase;
- A mosquito management plan is implemented; and
- A comprehensive environmental monitoring program is developed and implemented. Baseline data should be gathered prior to any construction activity.

17.6 Aquatic Ecological Values of Western Moreton Bay

Moreton Bay is the ultimate receiving environment for the waters likely to be affected by the GUP. Bulimba Creek flows to the Brisbane River, which flows to western Moreton Bay. The wetlands of the southern Brisbane Airport flow to the Kedron Brook floodplain complex, which flows to western Moreton Bay.

Moreton Bay is bordered by Moreton Island and North and South Stradbroke Islands to the east; Caloundra to the north; and the highly developed coastline including Brisbane and the northern Gold Coast to the west. The southern border of Moreton Bay is the Gold Coast Seaway.

The northern section of the Bay is open and largely oceanic, whilst the southern section is primarily estuarine, consisting of a network of islands and channels. Western and southern Moreton Bay is influenced by the nearby residential and urban development and catchment inputs from estuaries such as the Brisbane, Logan and Pine Rivers. The eastern part of the Bay is relatively pristine and unaffected by development.

Moreton Bay is of both local and regional ecological and conservational significance. In particular Moreton Bay:

- Contains flora and fauna of both tropical and temperate environments;
- Contains wetlands of international and national importance;
- Provides valuable habitat for rare and threatened species such as dugong and turtles;
- Is an important feeding and roosting area for migratory birds, many of which are listed under international treaties; and
- Supports diverse and productive fisheries.

The conservation significance of Moreton Bay has been recognised through:

- The creation of the Moreton Bay Marine Park;
- Listing as a Ramsar site; and
- Listing as a 'wetland of national importance'.

Moreton Bay Marine Park extends from Caloundra in the north to the southern tip of south Stradbroke Island. This park was declared in 1993, and serves to allow the wise use, enjoyment and appreciation of Moreton Bay (QPWS 2001).

Moreton Bay was added to the Ramsar Convention on Wetlands of International Importance in 1996. This convention aims to conserve one of the most threatened habitats – wetlands. Moreton Bay was added to this list primarily for its importance for many species of birds, but also for its importance to fisheries, dugong and turtle. Waterways that are directly threatened by the GUP lie between 4.74 and 26.5km upstream of the boundary of the Moreton Bay Ramsar site. Ramsar wetlands of western Moreton Bay are shown Figure 17.7.

17.7 Conclusions

Construction of the GUP is likely to result in the loss of relatively small areas of marine plants in the vicinity of Bulimba Creek at Murarrie, the Brisbane River, the Kedron Brook floodplain, and within the airport precinct. The areas to be lost are small in comparison with the extent of similar marine plant communities associated with each of these waterways, and present within the region. Species and communities to be impacted are both widely distributed and common within the region.

The design of bridges and culverts will seek to retain existing hydraulic capacity, bed levels and stream velocities. No waterway will have its 'connectivity' to upstream or downstream reaches adversely impacted; and structures will not impede the movement of fishes and other aquatic fauna.

Environmentally sensitive management of construction will seek to minimise construction-related disturbance to adjoining habitat. Disturbed habitat will be rehabilitated.

Both construction activity and stormwater management will be sensitive of the need to minimise contaminated runoff from the construction corridor, and later from the operational roadway.

Impacts (if any) to groundwater will be temporary and unlikely to impact on 'marine plant' communities.

Shading created by bridges over Bulimba Creek at Murarrie, within the airport precinct and over Kedron Brook floodplain may have a very localised impact on retained and regenerating mangrove communities.

Increases in noise and light are unlikely to have ecologically significant impacts for aquatic fauna.

In summary, the impacts of both construction and operational use, whilst significant in potential scope and scale, are largely manageable. Effective environmental management will result in minimised and mitigated impacts having a cumulative minor negative impact on the aquatic environment. Relatively minor habitat loss is likely to be the only enduring impact.

The cumulative impacts of the proposed construction and operation of the GUP on aquatic flora and fauna, when considered in the local and regional context, is considered minimal. The cumulative impacts do not significantly contribute to habitat loss or degradation.

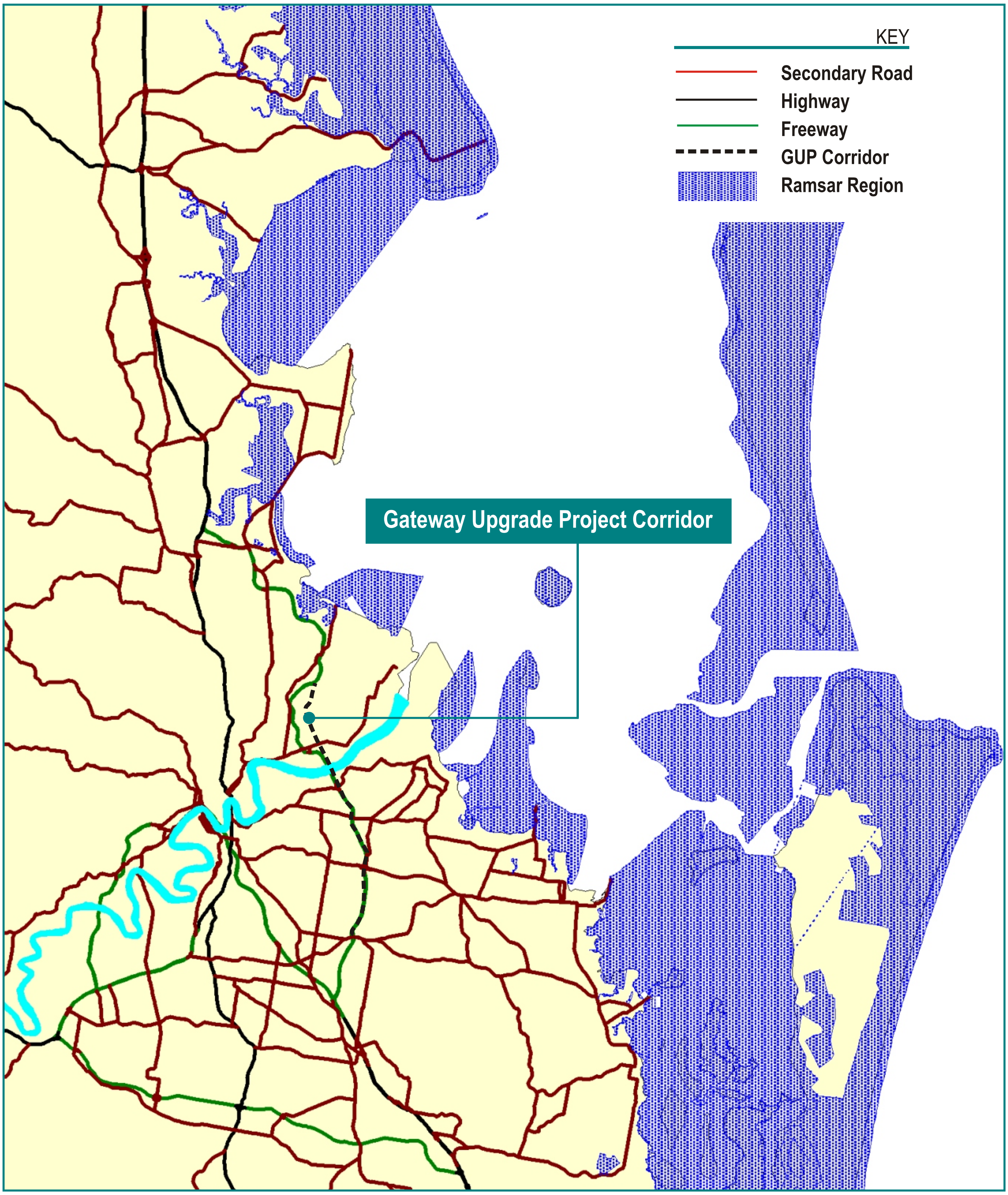

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FIGURE 17.7
Moreton Bay Ramsar Wetlands