Chapter 9
Summary of water resource management issues

9.1 Proserpine River

The Proserpine River catchment is a highly modified and regulated system, albeit one that retains high ecological value assets, and could be managed for improved ecological value outcomes. The basin's alluvial levees and plains have been extensively cleared for agricultural development and flood flows, largely captured for irrigation supplies and then released as regulated flows (not at flood flow levels) from Peter Faust Dam to the Proserpine River, Kelsey Creek, Lethe Brook and Six Mile Creek systems.

High ecological values within the catchment include the nationally recognised Goorganga Plain wetland aggregation, which includes lower Goorganga Creek, Lethe Brook and the Proserpine estuary and southern floodplain, and the associated coastal and marine ecosystem complex, which receives water, sediment and nutrient discharges from the basin. The values of the adjoining marine ecosystem are recognised through declared Fish habitat and Dugong Protection areas and inclusion in the Great Barrier Reef Marine Park. Other areas of high flow-dependent ecological value include perennial aquatic refugia and high conservation value stream reaches with good fish habitat values and/or diverse and complex riparian forest remnants on the lower Proserpine River, lower Myrtle Creek, Lethe Brook, Goorganga Creek and upper Thompson Creek. Perennial habitats created or partially sustained by flow regulation within the mid reaches of the Proserpine River and within Kelsey Creek, Lethe Brook and Lagoon Creek were also observed to have a range of ecological values worthy of management.

Although data were generally limited, evidence of ecological stress and condition impacts within the system included elevated nutrient levels, typically poor riparian vegetation condition, fish passage barriers and locations with extensive infestations of invasive exotic riparian and aquatic grasses.

The key water resource management issues for the Proserpine River basin are how to best manage the existing regulated system to deliver optimal ecological outcomes and whether further water resource development in unregulated areas could proceed without impacting the identified high ecological value assets. Issues that warrant full consideration in any future water resource management arrangements for the basin include:

- the implications of existing regulated flow regimes within the Proserpine River basin for in-stream ambient water quality and ecological values and the derivation of best management practices for flow regulation in the river channel based on an improved understanding of the interactions between regulated flow regimes, groundwater behaviour, aquatic macrophytes, nutrient availability and ambient water quality (particularly dissolved oxygen), and effects on aquatic biota (particularly fish populations), including the possible merits of regulated 'environmental flows'
- the geomorphological implications of existing flow regulation, modified riparian vegetation condition and riparian vegetation management practices for river

channel form, in-stream habitat values, flooding and downstream estuarine processes
- the impact of existing and future tributary and overland flow capture on downstream flow characteristics and the channel geomorphology of floodplain areas
- the interactions between surface water habitats and groundwater aquifers of floodplain areas and the implications for 'sustainable use'
- the existing impact of surface water use and tailwater discharge on floodplain water quality and ecological values, and the implications for potential further irrigated agriculture development on the upper catchment of the Goorganga Plain wetland
- the existing and future prospect of climate change, which delivers reduced and/or more variable rainfall patterns.

9.2 O'Connell and Andromache rivers

The O'Connell and Andromache river basin is a system under ecological stress. This stress is associated with a decade of below-average rainfall, the extent and intensity of catchment development and current levels of surface and groundwater use.

The intensity and extent of catchment development is exemplified by extensive clearing of almost all alluvial levees and plains within the catchment and of steep sided valleys in the uppermost catchment of the O'Connell and of sodic soil dominated subcatchments and drainage lines of tributary catchment streams. Past clearing has included riparian vegetation, bank erosion and collapse and loss of channel form, including the aggradation of stream beds, was noted particularly in the Andromache River. Stream channel form has been further impacted by widespread sand and gravel extraction activities and numerous vehicular access roads within and across the stream channel, particularly in the O'Connell River, some of the latter also forming apparent fish passage barriers under non-flood flow conditions. Almost all perennial freshwater holes in the system, particularly in the O'Connell River, are being utilised as surface water extraction points and there has been fairly widespread development of dams and overland flow capture on tributary streams.

Supporting evidence for the ecological stress being experienced by the system includes water quality data that indicate elevated nutrient and salinity levels, visual observations of algal blooms associated with elevated nutrients and low flows, and anecdotal reports of fish kills in 'pumping pools', historically reduced base flows and pool persistence, and changes to the fish community (e.g., loss of jungle perch and reduced upstream recruitment of barramundi).

In spite of the ecological stresses confronting the system it retains high ecological values including groundwater associated perennial pools and aquatic refugia, high integrity freshwater fish populations, including large juvenile populations of recreationally important species (e.g., mangrove jack), a diverse macrophyte community with few exotics, high conservation value stream reaches with diverse and structurally complex riparian vegetation, a productive estuary with associated diverse mangrove forests and sediment, and freshwater discharges that maintain coastal ecosystems and coastline-forming processes.

A positive ecological trend noted was the relatively widespread recruitment of riparian forest pioneer species, which, if left to natural succession processes, would be likely to reinstate ecological values and stream channel form in a number of degraded reaches.

The key water resource management issue for the basin is limiting any further resource development in a system that appears to have reached or exceeded sustainable extraction levels. Issues that warrant full consideration in any future water resource management arrangements for the basin include:

- best management practice for surface water extraction from perennial pools that provide important aquatic refugia functions
- the impact of existing catchment development including vegetation clearing and tributary and overland flow capture on landscape water balance, flows, groundwater recharge and the development of salinity problems
- understanding of fractured rock, shallow aquifer and surface water interactions and yield in terms of both volume and quality characteristics and the management implications of such interactions for maintaining in-stream ecological values
- insufficiency of data to assess the diurnal and seasonal fluctuations of ambient water quality characteristics (e.g., nutrients, dissolved oxygen and temperature) and their response to flows and water extraction activities
- the existing and future prospect of climate change, which may result in reduced and/or more variable rainfall patterns.

9.3 Overland flow capture impacts

It was noted during the study flyover and field investigations that there has been considerable development of overland flow water infrastructure in the plan area, particularly the O'Connell and Thompson Creek catchments. This is of such an extent that it may be having significant (measurable) effects on rainfall-runoff patterns, thereby affecting flood flow hydrographs, and on fluvial and Tertiary terrace aquifer recharge, thereby affecting base flows. The extent of these impacts is not presently quantified.

9.4 Specific issues — groundwater

As previously mentioned, the existing groundwater data have not been fully interpreted or understood. The coverage of data is incomplete and only applicable to certain reaches of the Proserpine River. There has been a long history of individualistic water resource utilisation in areas not subject to licensing and regulation.

It should be noted that the rules applying to the recent alluvial aquifers of the Proserpine River may not apply to those of the O'Connell and Andromache rivers. In particular, the 100-metre or 200-metre zone for licensing may not be sufficient because there is likely to be a larger contribution of fractured bedrock flow closer to the river channels. The sustained yields from fractured rock and Tertiary terrace aquifers are likely to be small, and increased depletion may cause irreversible increases in salinity and decreases in baseline flows and groundwater window pool levels.

Further, the groundwater chemistry of Tertiary terrace aquifers is not fully understood. Altering the balance of recharge-depletion by increased extraction is likely to mobilise more saline water into the freshwater windows, with a possibly irreversible loss of ecological values. A better understanding of this issue may be gained by ensuring that the existing data are more completely assessed, particularly for the post-dam period for the Proserpine River.

Chapter 10 Conclusions

10.1 General conclusions for each chapter

Chapter 1: Introduction

Study introduction only

Chapter 2: Background information

- Peter Faust Dam in the Proserpine River catchment area has drastically altered the flow patterns of the Proserpine River.
- There are no major storages located in the O'Connell and Andromache river catchment, and water use from these rivers is primarily for irrigation purposes.
- A significant feature of the plan area is the Goorganga Plain wetland, which is of national significance.
- There are potentially problems of salinisation and of groundwater window loss as a consequence of over-utilisation of groundwater from the older fractured bedrock or Tertiary terrace aquifers in all parts of the plan area.
- There has been a run of dry years since approximately 1979.
- There is some debate in the available literature relating to whether the shoreline of Repulse Bay is eroding or prograding.

Chapter 3: Approach and methods

- The reach breakdown adopted for this study is shown in
- Figure 3-1 and presented in Appendix 2.

Chapter 4: Condition of Proserpine, O'Connell and Andromache river catchments

Hydrology, hydrogeology, geomorphology

- Base flows are more persistent in the Andromache and O'Connell rivers than the Proserpine River (pre-dam).
- Interactions between surface and groundwater for the plan area are generally poorly understood, but higher base-flow rates for the O'Connell and Andromache river system probably result from greater hydraulic connectivity between the aquifer systems and the surface drainage network.
- Peter Faust Dam has had a major effect on the flow characteristics of most of the length of the Proserpine River and the current flow regime bears little resemblance to the natural flow regime, evidenced by:
  - significant reduction in the duration of zero flows
  - truncation of flows significant for sediment transport and channel maintenance (nominally specified at > 100 m^3s^{-1})
  - reduction in flow variability
  - significant change in seasonality of flows
  - increased duration of low to medium flows.
- A large number of farm dams and overland-flow storages were noted during the catchment flyover, particularly in the O'Connell catchment.
- In the O'Connell and Andromache rivers summer and autumn were the most important times of the year for sediment transport, flushing and filling of waterholes, wetting of benches and terraces and floodplain recharge events, and the number of zero flow days was much higher for the spring– summer period than autumn–winter. The rate of zero-flow days was low for the Andromache River. This analysis highlighted the importance of zero flow events to the flow regime and the dramatically altered frequency of these events for the Proserpine River.
- Releases to the Proserpine River have maintained a balance between extraction and recharge from the recent alluvium aquifers.

- Potential salinisation due to irrigation-induced groundwater rise has been recognised in the Kelsey Creek and Lethe Brook area and this may be related to an ancient seawater intrusion into this area.
- There is direct communication between surface water and groundwater of the Proserpine River channel and recent alluvium, extending to about 200 metres away from the channel banks.
- In the O'Connell and Andromache subcatchments, groundwater resources are restricted by the limited Tertiary terrace cover over the older bedrock. However, little is known about the yield and quality of these groundwaters because existing development is unregulated and the interactions between groundwater and surface waters have not been systematically studied.
- In the Proserpine River below Peter Faust Dam there has been channel contraction, the formation of in-channel benches and vegetation encroachment across the flood channel due to the truncation of larger flows.
- The volumes of sand in the Andromache and O'Connell rivers are elevated compared with natural conditions. Further, the transport rate of the sand load would have been relatively low during the low flow years of the last two decades. However, it is also likely that the rate of land erosion has also been low.
- The dominant discharge flow band was ~ 250 to 600 m^3s^1 for the O'Connell River and ~ 100 to 400 m^3s^1 for the Proserpine River (pre-dam). These values correspond to approximately the two-year to five-year ARI flow events in each case.

Water quality

- The available water quality data are patchily distributed both geographically and temporally. In particular, sites are lacking for some key tributaries, such as Thompson Creek and Goorganga Creek, and very limited in extent in most catchments, particularly the Andromache.
- The surface water quality of the Proserpine River catchment is impacted by nutrient loadings from the Proserpine STP, by below-thermocline waters from Peter Faust Dam and by more diffuse nutrient and salinity inputs into Kelsey Creek and Lethe Brook, with at times high nutrient loading in Myrtle Creek.
- As most stream surface waters are shallow, elevated nutrient concentrations have not led to general dissolved oxygen suppression, except in lower Lethe Brook and Myrtle Creek, but the data available are limited and may have missed reaches and/or times with suppressed oxygen.
- Water quality for the O'Connell River subcatchment sites was generally within the ANZECC/ARMCANZ (2000) trigger values, but the water quality in the Andromache and O'Connell catchment was characterised by common occurrence of high nitrogen concentrations, and increasing conductivity in Boundary Creek at least between 2000 and 2002.

Aquatic biota

- Overall the macroinvertebrate sampling results indicated generally healthy assemblages in the upper reaches of the Proserpine River and Saltwater Creek, moderate to good health in middle Lethe Brook and the Proserpine River below Peter Faust Dam, but poor health in lower Lethe Brook and the Proserpine River below Proserpine. The overall pattern of taxonomic richness and SIGNAL scores were consistent with nutrient impacts below Proserpine and in lower Lethe Brook.
- The macroinvertebrate sampling results for the Andromache and O'Connell catchment were indicative of generally adequate health, but there were signs of impact, probably from agriculture, in the O'Connell, particularly for the lower reaches, and generally harsh conditions or agricultural impacts at the two Andromache River sites
- A feature of the aquatic macrophyte assemblages of the Proserpine catchment was that generally there was a low incidence of weed species except for aquatic grasses. There existed a good diversity of native macrophyte species in the catchment and the assemblage structure was generally healthy.
- Overgrowth of aquatic vegetation, particularly exotic grasses, was found in

some sections of the Proserpine River, and was probably associated with managed stable flows, the absence of flushing flows, elevated nutrient concentrations and the absence of riparian shading of the stream.

- In the Andromache and O'Connell catchment there was also good diversity of native macrophytes, low abundance of exotic species and generally good assemblage health. These features suggest that the aquatic flora of the catchment has substantial environmental values.
- The only exotic fish species found in the plan area were the guppy and gambusia, found in the Proserpine River and Lethe Brook catchments. Despite more detailed sampling in the Andromache and O'Connell by QDPI, as well as TAP visual observations across that catchment, these exotic species were not located.
- Two translocated species also occur in the Proserpine River catchment, sooty grunter and sleepy cod.
- Several migratory fish species are known to occur in the area, and at least two such species were observed just below Peter Faust Dam.
- The barramundi population in the Goorganga Creek wetlands is abundant and dominated by first-year class juveniles, indicating its importance as a nursery and early stage refuge for this species.
- A number of fish passage barriers were observed in the catchment and, although small, with the largely artificial flow regime now imposed in this catchment, the impacts of such barriers are exacerbated.
- The recorded distributions of the migratory fish species appear correlated with their ability to surmount passage barriers, with the more agile species being recorded further upstream than the less agile species.

Flow-linked regional ecosystems

- The flow-linked regional ecosystems found in the plan area are diverse (8.1.1; 8.1.2; 8.1.3; 8.1.4; 8.1.5; 8.3.1; 8.3.1a; 8.3.2; 8.3.3; 8.3.3a; 8.3.5; 8.3.6; 8.3.6a; 8.3.11; 8.3.12; 8.3.13a; 8.3.13b; 8.3.13c; and 8.3.13d).
- The majority of REs persist along the coast and on the ranges along the western rim of the study catchment. This reflects the pattern of historic vegetation clearing for agriculture. In the O'Connell and Andromache catchment REs also persist on a tongue of dissected lowlands that extends from the south-western ranges north-east towards the confluence of the Andromache and O'Connell rivers.
- Atypically, the very upper catchment of the O'Connell River has also been extensively cleared for pastoral development.
- The Proserpine catchment riparian zone has been estimated at 23 142 hectares of which 60 per cent currently retains natural vegetation (although not necessarily remnant vegetation).
- Aerial imagery and RE mapping clearly indicate a denuded riparian strip along the mid to lower Proserpine River. With directed management a more diverse riparian vegetation community representative of the original gallery forest could be re-established in the longer term.
- The Goorganga Plain wetlands are recognised to have values of national significance and are listed in the *Directory of Important Wetlands in Australia*. However, extensive areas of the Goorganga Plain, particularly east of the highway, is now dominated by introduced pasture species.
- Riparian vegetation along the mid and upper reaches of Lethe Brook and Kelsey, Goorganga and Albert creeks (i.e., LE-1, LE-2 and G-1) has fared better than mid reaches of the Proserpine, with a more or less continuous narrow corridor persisting.
- Fauna usage of riparian communities in some areas is limited by:
  - the relative isolation of the riparian corridor from other natural habitats as a result of extensive clearing of adjacent alluvial and non-alluvial plains
  - poor condition of riparian areas due to invasion of the ground stratum by weeds such as guinea grass and elephant grass, and the water margins by para grass
  - poor condition of ground habitat due to the effects of cattle activity