Freshwater mussels (*Westralunio carteri*) in the catchments of Geographe Bay, south-western Australia

Prepared for the Water Corporation, Western Australia

Prepared by

A Lymbery, R Lymbery, D Morgan & S Beatty

FISH HEALTH UNIT

Freshwater Mussels (*Westralunio carteri*) in the catchments of Geographe Bay, south-western Australia

Prepared for the Water Corporation, Western Australia

Prepared by A Lymbery, R Lymbery, D Morgan & S Beatty, Fish Health Unit, Centre for Fish & Fisheries Research, Murdoch University, Western Australia

November 2008

Acknowledgements

Thanks to Ron McLean from McLean Consultants, John Moon from the Water Corporation and Shirley Slack-Smith from the Western Australian Museum for valuable assistance during the project.

Background

During planning for the proposed upgrading of the Vasse Diversion Drain, the water Corporation of Western Australia became aware of the possible presence of a species of freshwater mussel in the drain. The proposed Vasse Diversion Drain upgrade will affect any mussel populations downstream of Chapman Hill Road, as well as a small area in the vicinity of the Vasse River Diversion Pipe. The Western Australian Museum was contracted to survey mussels and other molluscs in the Drain in January, 2006. As a result of this survey, the presence of the freshwater mussel *Westralunio carteri* Iredale 1934 (Order Unionoida; Family Hyriidae) was established in the upper reaches of the Vasse Diversion Drain and recommendations were made to (1) conduct additional surveys of surrounding waterways and (2) establish whether regional representation of the mussel is such as to warrant relocation of mussel populations affected by the upgrade works (Slack-Smith 2006). The Fish Health Unit, Centre for Fish & Fisheries Research at Murdoch University was subsequently approached by McLean Consultants Pty Ltd on behalf of the Water Corporation of Western Australia to conduct these further studies.

Scope of works

- *Resample sites within the Vasse Diversion Drain that were found to contain mussel populations by Slack-Smith (2006) and provide a more accurate density estimation of the species within the drain.*
- *Conduct additional surveys to determine presence and establish population densities of the species in the Vasse River and its tributaries.*
- *Determine presence and establish population densities of the species in adjacent river systems.*
- *Where mussel populations are found, preserve mussel samples for genetic studies and record relevant environmental information.*
- *Provide recommendations for actions required to mitigate any impacts of upgrade works in the Vasse Diversion Drain upon existing mussel populations, and any further studies required to implement mitigation procedures.*

Methodology

A total of 28 sites in a number of catchments were surveyed for the presence of *W. carteri*. These included four sites in the Vasse Diversion Drain (corresponding to stations BDD02, BDD03, BDD05 and BDD11 of Slack-Smith 2006), as well as sites in all the major waterways in the surrounding Geographe Bay region; 10 in the Vasse River and New River Wetland, three in the Ludlow River, two in the Sabina River, two in the Abba River, one in the Buayanup River and one site in the Buayanup Drain. In addition, we surveyed the major rivers to the immediate north of the region; one site in the Collie River, one in the Preston River, one in the Capel River (Table 1, Figure 1). At each site we searched along a 50 m stretch of bank and, where water depth and visibility allowed, along a total of 10 bank to bank transects for living and dead mussels. At each site we recorded substrate type on the bed of the river (rock, gravel, sand, mud) and measured turbidity, salinity and water temperature.

When mussels were found, population density was estimated by counting all mussels in 10 x 1 m^2 randomly placed quadrats, as recommended by Downing and Downing (1992) and Christian and Harris (2005). The first 20 mussels captured at each site were measured using vernier callipers for shell length, height and width (see Gosling 2003) to the nearest 0.01 mm, and then preserved in 70% ethanol for future genetic studies.

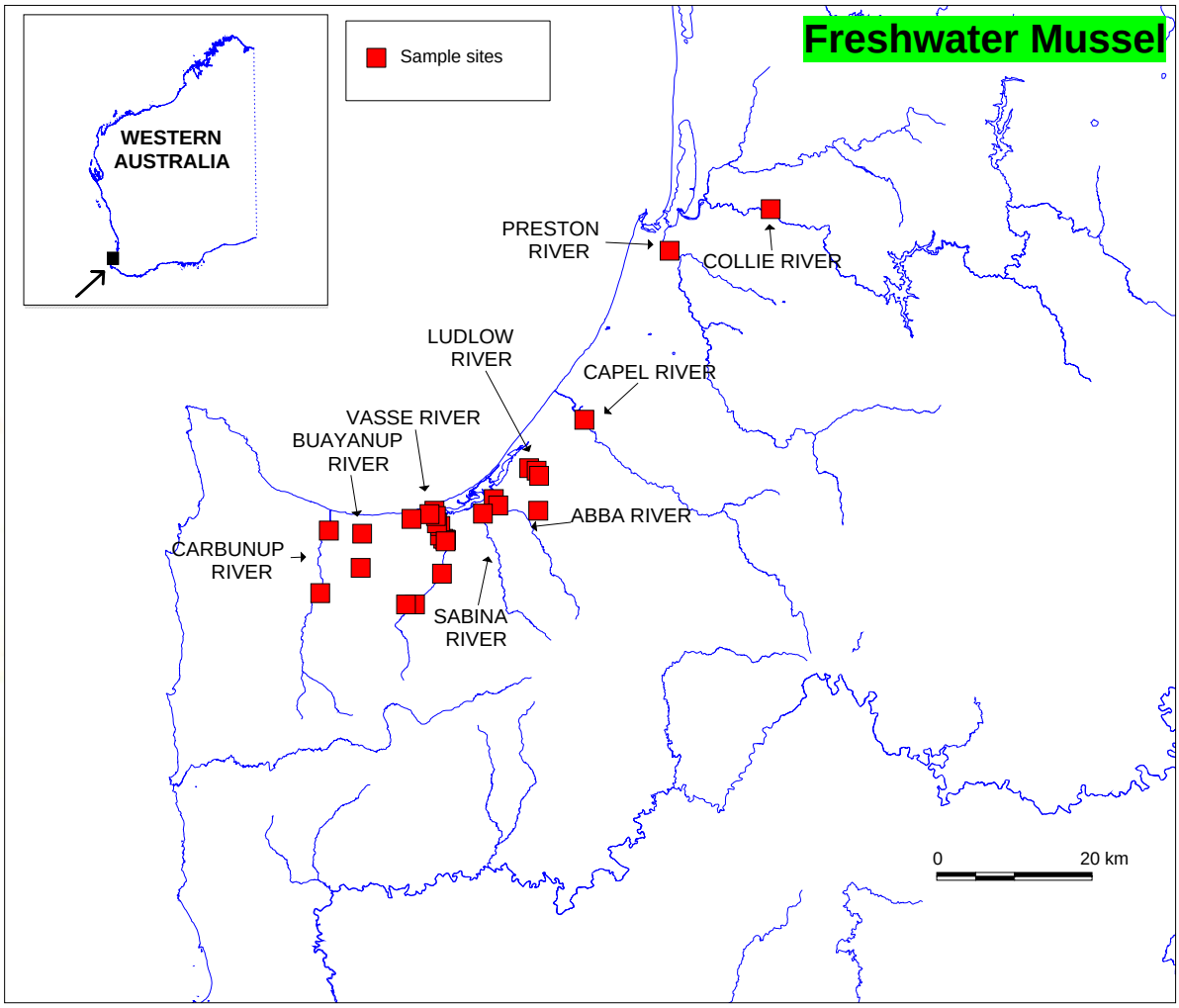

Figure 1 Sites sampled in the catchments of Geographe Bay and surrounding areas for the presence of freshwater mussels (*Westralunio carteri*).

Table 1. Location of sites sampled in the catchments of Geographe Bay and surrounding areas for the presence of freshwater mussels (*Westralunio carteri*). * Numbers in parentheses are the closest corresponding survey stations in the study by Slack-Smith (2006).

Site number	Locality	Latitude	Longitude
DD01 (BDD02)*	Diversion Drain	33°41.174'	115°21.840'
DD02 (BDD03)*	Diversion Drain	33°41.116'	115°21.661'
DD03 (BDD05)*	Diversion Drain	33°40.893'	115°21.387'
DD04 (BDD11)*	Diversion Drain	33°40.223'	115°21.422'
VR01	Vasse River	33°41.214'	115°21.893'
VR02	Vasse River	33°40.037'	115°21.139'
VR03	Vasse River	33°43.552'	115°21.564'
VR04	Vasse River	33°45.693'	115°19.293'
VR05	Vasse River	33°45.693'	115°18.540'
VR06	Vasse River	33°41.304'	115°21.868'
VR07	Vasse River	33°39.159'	115°20.923'
VR08	Vasse River	33°39.531'	115°21.058'
NR01	New River	33°39.397'	115°20.511'
NR02	New River	33°39.732'	115°19.004'
BD01	Buayanup Drain	33°40.764'	115°14.874'
BR01	Buayanup River	33°43.143'	115°14.746'
CAR01	Carbunup River	33°44.902'	115°11.358'
CAR02	Carbunup River	33°40.554'	115°12.077'
AR01	Abba River	33°38.357'	115°25.893'
AR02	Abba River	33°38.789'	115°26.272'
SR01	Sabina River	33°39.164'	115°29.623'
SR02	Sabina River	33°39.367'	115°24.990'
LR01	Ludlow River	33°36.199'	115°28.866'
LR02	Ludlow River	33°36.368'	115°29.492'
LR03	Ludlow River	33°36.732'	115°29.702'
CP01	Capel River	33°32.828'	115°33.482'
PR01	Preston River	33°21.039'	115°40.631'
CR01	Collie River	33°18.136'	115°49.106'

Results & Discussion

Distribution of freshwater mussels

Westralunio carteri was recorded at 17 of the 28 sites surveyed (Figure 2). The species was widespread throughout the study area and live specimens were recorded in the Collie, Preston, Capel, Ludlow, Abba, Vasse and Carbunup Rivers. It was not found in the New River Wetlands, Sabina River, Buayanup River or Buayanup Drain. Sites containing mussels all had a substrate at least partly composed of sand, and ranged in salinity from 1,000 – 5,000 mg/L and in turbidity from 7.3-18.0 NTU.

Within the Vasse Diversion Drain, live mussels were found at two sites (DD01 and DD02), while shells, but no live specimens, were recorded on the bank at DD03 (Figure 3). Slack-Smith (2006) found live mussels at all of these sites. There was no sign of any mussels at site DD04 and Slack-Smith (2006) found no live mussels at this site or further downstream.

In the Vasse River, live mussels were found from the vicinity of the golf course and downstream of the junction with the Vasse Diversion Drain, all the way into the Busselton township. No signs of mussels were found in any sites surveyed upstream of the golf course or in the New River wetlands.

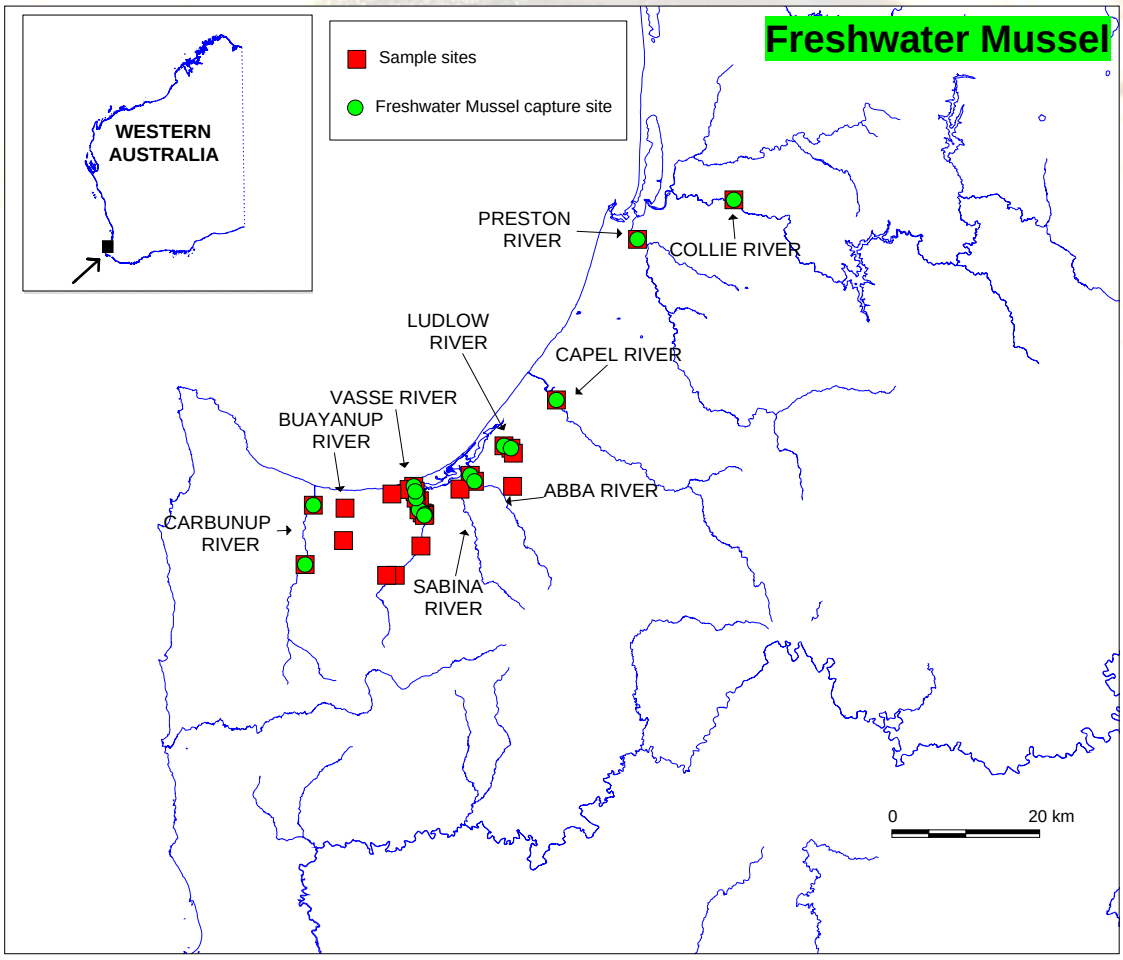

Figure 2 Capture sites for freshwater mussels (*Westralunio carteri*) in the catchments of Geographe Bay.

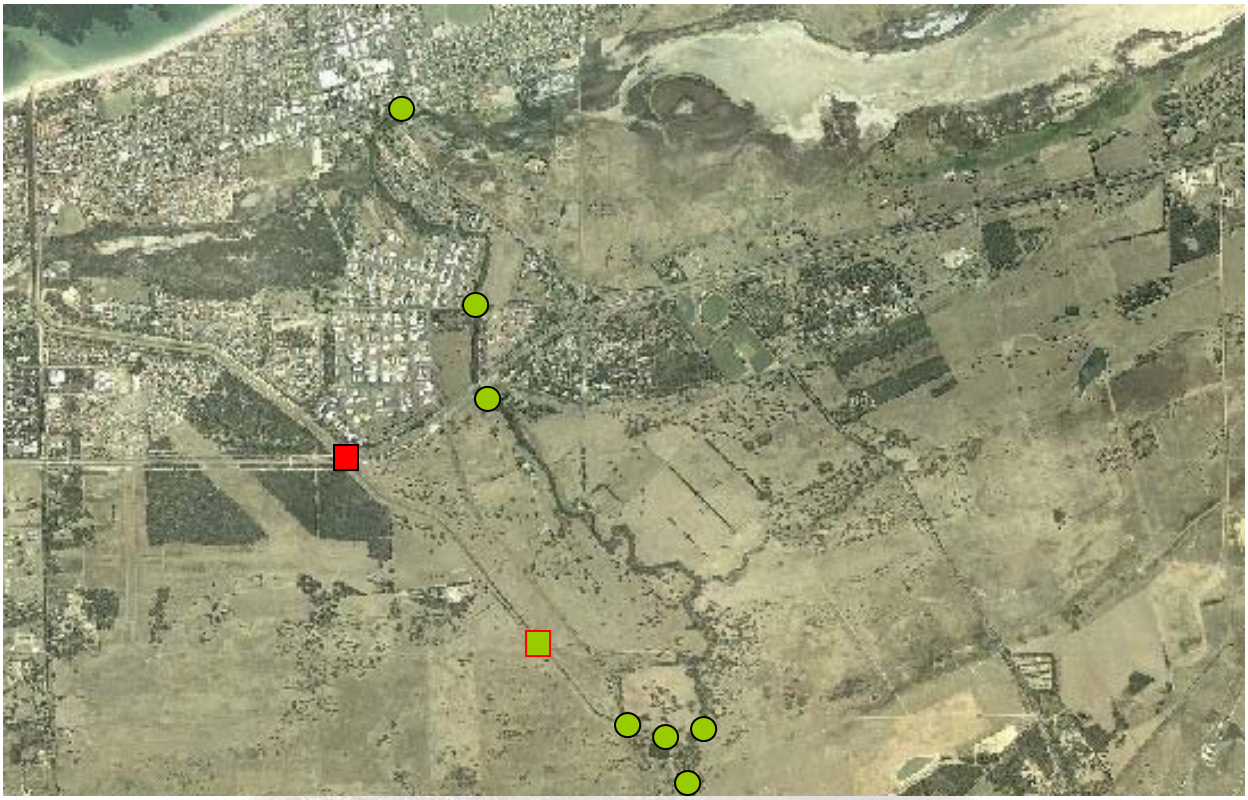

Figure 3 Capture sites for freshwater mussels (*Westralunio carteri*) in the Vasse Diversion Drain and the Vasse River, downstream of the Diversion Drain.
Live mussels Shells only No mussels

Population structure of freshwater mussels in the Vasse Diversion Drain and surrounding areas

Population densities were calculated at sites containing mussels in the Vasse Diversion Drain Vasse River, Abba River, Ludlow River and Carbanup River (Table 2). Over all natural river sites (i.e. excluding the Diversion Drain) the mean density was 4.4 mussels/m^2, which is similar to densities recorded for other species of hyriid mussels in Australia and New Zealand (Walker *et al.* 2001). The greatest density of 14.5 mussels/m^2 was found in the Vasse River, immediately downstream of the junction with the Diversion Drain (Figure 4a). Within in the Diversion Drain itself, reasonable numbers of mussels were found only at site DD01, immediately downstream of the junction with the Vasse River (Figure 4b). Only one live mussel was found at site DD02 and no live mussels at any further downstream sites in the Diversion Drain.

Table 2 Mean density (± standard error) of freshwater mussels (*Westralunio carteri*) at nine localities in the Vasse Diversion Drain and surrounding rivers.

Site number	Locality	Density (number/m^2)
DD01	Diversion Drain	1.6 ± 0.6
DD02	Diversion Drain	0.1 ± 0.1
VR01	Vasse River	14.5 ± 5.6
VR02	Vasse River	0.7 ± 0.2
VR06	Vasse River	1.4 ± 0.6
VR08	Vasse River	0.5 ± 0.2
CAR01	Carbanup River	6.4 ± 2.0
AR01	Abba River	2.5 ± 1.4
LR01	Ludlow River	5.1 ± 2.1

Figure 4 Adjacent sites containing mussels at the junction of the Vasse River and Vasse Diversion Drain: (a) Vasse River, VR01; (b) Vasse Diversion Drain (DD01).

Within the Vasse River Diversion Drain sites, individual *W. carteri* were dominated by those in the 50-60 mm shell length range (Figure 5). This contrasts with mussel populations recorded in the Vasse, Abba, Carbanup and Ludlow Rivers, which consisted of individuals from a much wider size range (Figure 5). The contrasting demographics of mussel populations in the Diversion Drain compared to those in the Vasse River and surrounding rivers may be the result of one or both of the following: (1) the absence of small individuals in the Drain indicates that recruitment is low or that survival of offspring is low; (2) the absence of larger individuals in the Drain suggests that longevity is reduced compared to more natural river sites.

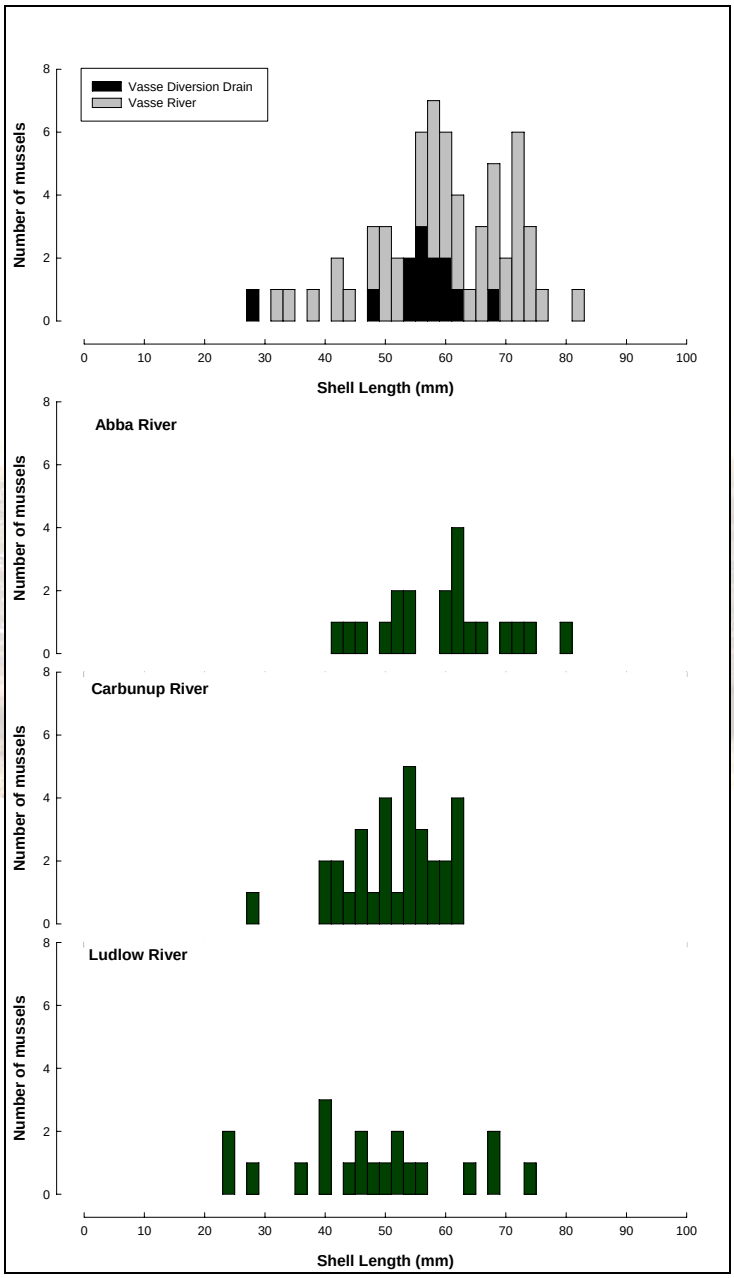

Figure 5 Length-frequency histograms of freshwater mussels (*Westralunio carteri*) in the Vasse River and Vasse River Diversion Drain, as well as in the Abba, Carbunup and Ludlow Rivers.

Importance of freshwater mussels

Westralunio carteri is endemic the south west of Western Australia. The distribution of the species is not precisely known, but it is believed to extend from the Moore to the Kalgan Rivers (Kendrick 1976). The species is classed as vulnerable (IUCN category 2.3) on the 2006 IUCN red list of threatened species and according to Slack-Smith (2006) it is listed by the Western Australian Department of Environment and Conservation as a Priority 4 species, meaning that it is not regarded as currently under threat, but requires monitoring. One of the major threats to the species is likely to be the increasing salinisation of rivers in the south west of Western Australia. Although the salinity tolerances of adult and juvenile *W. carteri* have not been determined, other Australian hyriid species are restricted to salinities less than 3000 mg/L (Walker 2001) and Kendrick (1976) reported a contraction of the distribution of the species in the Blackwood River, which he ascribed to increasing salinisation of the upper reaches. The Geographe Bay region is therefore likely to be an area of increasing importance in the future conservation of *W. carteri*, because it is one of the few areas in the South West Coast Drainage Division which does not have an increasing trend of stream salinities (Mayer *et al.* 2005).

Mussels are important components of freshwater ecosystems for a variety of reasons. First, they may improve water quality by filtering out large quantities of algae, diatoms, bacteria and other organic particles (Pusch *et al.* 2001; Bogan 2008). Second, they provide a source of food for freshwater crayfish, fishes, turtles, birds and water rats (Walker *et al.* 2001). Third, they may act as sensitive biomonitors of environmental quality because of their propensity to concentrate and store toxicants such as heavy metals and pesticides (Storey and Edward 1989; Walker *et al.* 2001). All of these functions are likely to be important in the Geographe Bay region, where the major river systems are increasingly affected by agricultural, horticultural, industrial and urban effluent.

Conclusions & Recommendations

The freshwater mussel, *Westralunio carteri*, is reasonably widespread and locally abundant in the natural river systems of Geographe Bay. It appears, however, to be confined to only a small section of the Vasse Diversion Drain, between the junction of the Drain with the Vasse River and the crossing at Chapman Hill Road. Within this area the species is found in moderate densities, but with a truncated size distribution indicative of a non-sustaining population. The simplest explanation of the data from our survey and that of Slack-Smith (2006) is that mussels disperse into the Vasse Diversion Drain from the adjacent Vasse River during periods of increased water flow, but then suffer high mortality over summer and are unable to recruit locally. The substrate of the Drain, being mostly hardpan rock, may be unable to support aestivating mussels over the dry season and the Drain may not have suitable fish populations to act as a host for the parasitic larval stage of the mussel's life cycle.

In light of these findings, we make the following recommendations:

1) The proposed upgrade of the Vasse Diversion Drain downstream of Chapman Hill Road will not affect mussel populations and no removal or translocation of mussels is required from this area.

2) The mussel population in the Diversion Drain upstream of Chapman Hill Road and concentrated in the vicinity of the Vasse River Diversion pipe is likely to be composed of non-reproducing migrants from the Vasse River, but the area may be an important buffer for the Vasse River population and any future work in this area which may impact upon the mussels should consider relocating them into the Vasse River.

3) Although it is not within the scope of the proposed work on the Vasse Diversion Drain, we would urge support for continued monitoring of the mussel populations in the Geographe Bay region because of their likely importance in maintaining water quality and ecological function in freshwater ecosystems.

References

Bauer, G. and Wächtler, K. (2001) Environmental relationships of naiads: threats, impact on the ecosystem, indicator function. In: Bauer, G. and Wächtler, K. (Eds) *Ecology and Evolution of the Freshwater Mussels Unionoida.* Springer-Verlag, Berlin, pp. 311-314.

Bogan, A.E. (2008) Global diversity of freshwater mussels (Mollusca, Bivalvia) in freshwater. *Hydrobiologia* **595**: 139-147.

Christian, A.D. and Harris, J.L. (2005) Development and assessment of a sampling design for mussel assemblages in large streams. *American Midland Naturalist* **153**: 284.

Downing, J.A. and Downing, W.L. (1992) Spatial aggregation, precision, and power in surveys of freshwater mussel populations. *Canadian Journal of Fisheries and Aquatic Science* **49**: 985-991.

Gosling, E. (2003) *Bivalve Molluscs.* Fishing News Books, Oxford.

Kendrick, G.W. (1976) The Avon: faunal and other notes on a dying river in south-western Australia. *Western Australian Naturalist* **13**: 97-114.

Mayer, X.M., Ruprecht, J.K. and Bari, M.A. (2005) *Stream salinity status and trends in south-west Western Australia.* Department of Environment, Salinity and Land Use Impacts Series, Report No. SLUI 38.

Pusch, M, Siefert, J. and Walz, N. (2001) Filtration and respiration rates of two unionid species and their impact on the water quality of a lowland river. In: Bauer, G. and Wächtler, K. (Eds) *Ecology and Evolution of the Freshwater Mussels Unionoida.* Springer-Verlag, Berlin, pp. 318-326.

Slack-Smith, S.M. (2006) *Report on a survey of the non-marine molluscan fauna of the Vasse Diversion Drain, Busselton, Western Australia*. Western Australian Museum, Perth.

Storey, A.W. and Edward, D.H.D. (1989) The freshwater mussel, *Westralunio carteri* Iredale, as a biological monitor of organochlorine pesticides. *Australian Journal of Marine and Freshwater Research* **40**: 587-593.

Walker, K.F., Byrne, M., Hickey, C.W. and Roper, D.S. (2001) Freshwater mussels (Hyriidae) of Australasia. In: Bauer, G. and Wächtler, K. (Eds) *Ecology and Evolution of the Freshwater Mussels Unionoida.* Springer-Verlag, Berlin, pp. 5-31.