Chapter 4

FAUNA

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Abstract

The ERMP does not adequately address the EPA guidelines and makes inadequate commitments for fauna conservation and rehabilitation. The vertebrate survey was limited in terms of seasons when sampling took place and because of this the ERMP makes unsupportable statements concerning animals' association with or dependence on particular habitats as well as the seasonality of habitat use. No surveys of terrestrial invertebrates were conducted and the ERMP makes unjustified statements about the difficulty and usefulness of such work as well as making unsupported assumptions concerning the relationships of invertebrates with vegetation types. Surveys of aquatic fauna were conducted at inappropriate times of the year, and consequently the ERMP makes unwarranted statements about the composition of the aquatic fauna. The ERMP contains no assessment of the regional conservation status of the aquatic fauna of the area. No surveys were conducted of the aquatic fauna of Cockleshell Gully, the largest catchment in the proposed conservation reserve, even though this catchment will be affected by the project.

No surveys were made of the fauna of most of the proposed conservation reserve at Lesueur, nor of nearby conservation reserves and no attempt was made by the proponents to assess the conservation status of the Lesueur fauna, particularly those occurring in the area to be mined or otherwise disturbed, in nearby conservation reserves.

The ERMP fails to recognise the importance of the whole Lesueur - Coomallo region for the survival of Carnaby's Black-Cockatoo and that the Cockatoo is important because it is implicated in the survival of Banksia tricuspis, a Declared Rare Flora species. It does not mention the cockatoo's need for fresh water sources (which must have shady trees around them), nor the possible effects of mining and water extraction in this context, although the Hill River and the Hill River Spring are highlighted as areas most likely to suffer from water table drawdown.

4.1 A REVIEW OF THE INFORMATION IN THE ERMP

In the guidelines for the preparation of the ERMP, the EPA stated:

> "The critical issue for the coal mine is likely to be the subject of mining in a proposed nature reserve. It is critical therefore that the ERMP shows a detailed understanding of conservation values in the area, if they are represented elsewhere and their relationship to disturbances due to the proposal ..... the key issues should include: ... native fauna ... inter-relationships of the biota and environment (eg ....)" (ERMP Attachment 1, pp. 2, 3)

4.11 Terrestrial fauna

Consultants Martinick and Associates carried out for the proponents a survey of terrestrial vertebrates in an area confined to the immediate vicinity of the proposed mines and power station (Martinick and Associates 1989c). For mammals, reptiles and frogs, 32 sample sites were established - these were trapped with pit-fall traps and Elliott traps. There were two trapping sessions: 10 days in September/October 1988 and seven days in December 1988. Opportunistic observational data were also recorded, and searches for nocturnal vertebrates were conducted. No attempt was made to survey bats. Birds were counted at 20 of the 32 sites, with 30 minute counts on five consecutive days during the September/October 1988 session only. The daily order of the bird counts was rotated to reduce bias associated with time after dawn.

Although the number of trap-nights (= survey effort) appears relatively high, this was achieved by leaving the traps open, but in the same position, for much longer periods than is normal for broad vertebrate survey studies (10 and 7 days). Four or five nights per session is usual.

The surveys were restricted in terms of season - studies were only conducted in September - October and early December. As pointed out by Burbidge and Hopper (1990) such surveys should be conducted in several seasons (at least two non-adjacent ones, e.g. spring and autumn). Data from surveys of the Eastern Goldfields (McKenzie 1984) and the Fitzgerald River National Park (Newbey and Chapman 1987) clearly demonstrate this point.

Use of, or dependence on, particular habitats can also vary with season and population density (McKenzie 1984; Rosenzweig and Abramsky 1986; Wiens 1981). Thus the data presented in the ERMP are inadequate to make any statement concerning a lack of seasonality in habitat use. The statement in the ERMP "there is little evidence for strong seasonal differences in habitat use..." (ERMP p. 4-23) is not supported by the data because of inadequate survey design.

Returning to the key issues as identified by the EPA, it is clear that the consultants only tried to assess whether:

1. any species might be limited to the study site,

2. any endangered species were present, and

3. patterns in vertebrate occurrence matched broad vegetation categories. (This was done to assess whether the categories in the environs of the power station and mine sites had recognisably distinct vertebrate communities.

With respect to points 1 and 2, the following quotes are relevant.

> "The fauna survey described here was designed to cover the area likely to be impacted by the Hill River Project"
>
> "The fauna survey described here was not extended to cover all the proposed reserve because there will be no direct physical impact on the land to the west and some habitats present in the western side are different to those seen in the area of impact" (Martinick and Associates 1989c, p. 4).

The sampled area was very small; no similar surveys were made of the remainder of the proposed conservation reserve at Lesueur, nor of nearby existing or proposed conservation reserves. Nor was any attempt made to compare the species present in the study area with those known to be present in the remainder of the proposed conservation reserve, or to other conservation reserves in the region. Instead, the consultants attempted to assess their own sampling "efficiency" (i.e. how exhaustive their sampling was) ... "by looking at the total range of species which might be expected to occur in the study area" (Martinick and Associates 1989c, p. 9). They listed species of mammals and reptiles previously recorded within 50 km of the proposed project and others that range through the area. (Incidentally, we can find no evidence that *Sminthopsis hirtipes* has been recorded south of Kalbarri; its inclusion in Table 9 in Martinick and Associates (1989c) mammal list is probably a mistake.)

The consultants state in the review of their efficiency that their sampling of some groups, reptiles in particular, was inadequate, but they did not attempt to locate species from these groups which might occur in the area, including the rare or endangered species identified during this review.

Although the consultants' lists of species "which could be expected to occur on the study site" (Tables 8 and 9), developed during their review of efficiency, include species recorded within 50 km of the study site, Table 9 omits the Dibbler *Parantechinus apicalis*, a declared endangered species, that is known from Boullanger and Whitlock Islands in Jurien Bay, 25 km from Lesueur (Fuller and Burbidge 1989). Although these are island populations:

a. Dibblers are difficult to trap and searches in the northern kwongan have not been sufficient to reasonably demonstrate that it does not occur in the district,

b. Dibblers occur in areas of similar rainfall, vegetation and substrate on the south coast, and

c. the proponents' consultants suspected that Dibblers were present: "During the pit trapping in September/October an unknown animal consumed part of a specimen of House Mouse and then escaped. From the way in which the mouse was eaten and the depth of the pit, it was possible that this animal was the Dibbler (Parantechinus apicalis). The surrounding area was trapped intensively with Elliott traps but no Dibblers were caught. This was at Trapline 26." (Martinick and Associates 1989c)

There is no mention of the possible Dibbler record in the ERMP (see p. 4-24).

With regard to point 3 (above), the consultants made no numerical analyses of their data. Instead, species in each class of vertebrates were grouped "by eye" according to broad substrate/vegetation categories. Only the pit trapping and bird counting data were used for this purpose. To assess the validity of the groups distinguished by the consultants (see Table 2 in Martinick and Associates 1989c), the reptile data set was analysed using the CSIRO numerical analysis package PATN (Belbin 1989). A standard classification pathway was used and default options were selected. Eight groups were selected to provide consistency. The results of this analysis are presented in Table 4.1; the groups distinguished by Martinick and Associates are superimposed for comparison. Very different groupings of trap lines (= reptile habitats) were found.

Examination of the reptile data revealed that genera such as *Lerista, Morethia* and *Cryptoblepharus* were inconsistently detected at traplines in apparently suitable habitat. It appears most likely that under-sampling is confounding the data; without more thorough, multi-seasonal data, no conclusion should be drawn on species usage of different substrate categories.

These considerations also bear on the thoroughness of the overall species lists of terrestrial vertebrates compiled by the consultants for the area. "The fauna described here is diverse. It includes a substantial part

of the typical south-western fauna, and must be regarded as in good condition because of the size and integrity of the area." (ERMP p.4-24).

Field work subsequent to both the consultants' 1988 studies, and to the compilation of data in mid-1989 by Burbidge and Fuller (1990), has been carried out by:

1 G. Connell and students from The University of Western Australia (Connell *et al.* 1990)

2. the Royal Australasian Ornithologists Union.

Though these additional surveys have been cursory, or are as yet uncompiled (Connell *et al.*), additional species have been recorded (cf. Burbidge and Fuller 1990), and are listed below.

Mammals

Dibbler, *Parantechinus apicalis* (possible record only, discussed above).

Birds

Eight additional species have been recorded. Two were added by Martinick and Associates (1989c), six by the Royal Australasian Ornithologists Union (Wilder 1990, personal communication[1]) and two by Craig (in Connell *et al.* 1990); one species was added by all three. Data presented below are in the same format as Table 6.2 in Burbidge and Fuller (1990).

Little Black Cormorant, *Phalacrocorax sulcirostris*, recorded by Martinick, but no abundance or habitat data provided.

Little Pied Cormorant, *Phalacrocorax melanoleucos*, single bird in flight, September 1989.

Straw-necked Ibis, *Threskiornis spinicollis*, small flock over woodland.

Square-tailed Kite, *Lophoictinia isura,* scarce, woodlands.

Painted Button-quail, *Turnix varia*, uncommon, woodland.

Fan-tailed Cuckoo, *Cuculus pyrrhophanus,* moderately common, kwongan and woodland.

White-naped Honeyeater, *Melithreptus lunatus*, uncommon, kwongan.

New Holland Honeyeater, *Phylidonyris novaehollandiae*, uncommon, kwongan.

The White-naped Honeyeater is at the northern limit of its range.

Craig (in Connell *et al.* 1990) found some species to be more abundant or widespread than were indicated by earlier data. These include the Emu, Maned Duck, Scarlet Robin, Hooded Robin, Western Thornbill, Australian Magpie-lark and Australian Magpie. Bird counts he reports show very high densities of nectarivores; densities reported were higher than those in published records for other parts of south west Australia.

These data bring the total number of bird species known from the Lesueur area to 130 indigenous and two introduced species; more than are known from any other conservation reserve in the south west of Western Australia except the much larger Kalbarri, Fitzgerald River and Cape Arid National Parks, all of which include coastal habitats (Table 12.2 in Hopper and Burbidge 1990; Cape Arid National Park of 310 000 ha has a recorded bird fauna of about 170 species, Burbidge and Talbot 1990) and Yanchep National Park of 5 900 ha (including proposed additions), which has 130 native species; this reserve contains extensive wetland habitats.

Reptiles

Moloch horridus - photographed at Mt Peron by S. van Leeuwen.

Morelia stimsoni stimsoni - previously recorded in the Lesueur Area, but range extended by Connell *et al.* (1990).

The number of reptile species now known from the proposed conservation reserve is 49. It has more species than any conservation reserve in the south west, except the much larger Kalbarri National Park.

Frogs

No additional species has been recorded, but collections by Connell *et al.* (1990) show that the Banovich Uplands are the major breeding areas for some species in the area, e.g. *Neobatrachus pelobatoides.*

Terrestrial Invertebrates

The proponents commissioned no surveys of terrestrial invertebrates. The ERMP states that "such studies would be impossible without many years of work, and basically would achieve little because:

- findings in any invertebrate group would not necessarily reflect what is happening with any other group;

1 C. Wilder, RAOU (W.A. Group).

- there are no comparative data with which to correlate results; and
- the findings would have no real implications for management except in the most unusual circumstances." (ERMP p. 4-22)

We do not agree with these statements. Firstly, studies of some terrestrial invertebrate groups, e.g. molluscs, spiders and ants, are relatively easy and comparative data do exist that allow interpretation of data. Furthermore, invertebrates have been shown to be useful groups to monitor in assessments of rehabilitation success (see Majer 1989 for a review).

A brief survey of the area by Connell *et al.* (1990) in the winter of 1989 revealed a rich invertebrate fauna. They report on collections of spiders, pseudoscorpions, scorpions, opilones, mites, centipedes, ants and terrestrial molluscs. The spider collection, for example, comprised 87 species, a high number for a winter sample, and included 37 species (42%) that were either new species or were unknown to Dr B.Y. Main, Western Australia's leading spider specialist. The ant fauna was also rich, with about 80 species in the collection. The snail collection, which was identified by the Curator of Molluscs at the Western Australian Museum, comprised three species, including the geographically restricted northern kwongan endemic *Bothriembryon perobesus* (see Burbidge and Fuller 1990, p. 81) and two undescribed species of *Bothriembryon*, one of which is new to science and only known from the Lesueur area.

Further details of these collections are contained in a submission to the EPA from Connell and his colleagues. Their data indicate the importance of terrestrial invertebrate studies in assessing fauna conservation values, and the species diversity available for measuring change during disturbance and rehabilitation.

The ERMP also makes some assumptions about terrestrial invertebrates: "... richness in plant species in the area undoubtedly provides for a diversity of pollen and nectar feeding insects. However, the floristically-rich heath covers an area considerably greater than the Project area. Implications of clearing in the Project area on these species are not known, but could be expected to be small because there are unlikely to be any insects so restricted in distribution." (ERMP p. 4-22). This statement does not recognise the enormous diversity in the composition of the various 'heaths' in the Lesueur area (Griffin and Hopkins 1990) and is not supported by any data or references.

4.12 Aquatic fauna

Streamtec Ecological Consultants carried out a survey of the aquatic macro-invertebrates and vertebrates of the Gairdner Range creeks for the proponents in October 1988. This was assessed in Burbidge and Fuller (1990). Since EPA Bulletin 424 was written, an additional survey of aquatic fauna of the Hill River has been carried out.

4.121 Gairdner Range creeks survey

This work was conducted at an inappropriate time (October) when most creeks were drying. All creeks in the Cockleshell Gully Catchment were dry and therefore were not sampled. An August survey is required, as was recommended by the consultants (Streamtec 1988, p. 19).

The ERMP summarises the data in Streamtec's survey report but does not recognise its inadequacies. Thus the statement "Despite the extensive survey, no species of fish were found" (ERMP p. 4-25) over-emphasises the adequacy of the survey and does not acknowledge that the lack of fish in the samples could be a result of the time of sampling. Similarly, the statements about trophic groups reflect the time of sampling rather than the nature of the streams.

4.122 Hill River survey

The ERMP deals with the Streamtec (1989) report quite fairly. However, the major problem with the Hill River work (as acknowledged by Streamtec) was the date of sampling (May). Another survey should have been carried out in August/September when the river was flowing strongly.

4.2 ASSESSMENT OF ERMP CONCLUSIONS ON CONSERVATION STATUS

4.21 Terrestrial fauna

No attempt was made by the proponents to assess the conservation status of the Lesueur fauna in nearby conservation reserves. Table 4.2 provides available data on mammals, reptiles and frogs from the data-bases of the Western Australian Museum. It should be emphasised that no systematic surveys have been made of these national parks (although fairly intensive trapping for reptiles has been carried out at Badgingarra National Park, see Murray 1980). The EPA guidelines for the preparation of the ERMP (see 4.1 above) have not been fulfilled because of the lack of such surveys.

Conservation status is discussed mainly in terms of endangered vertebrate species: "Despite the diversity of species present, there are few of particular conservation interest either by being endangered or having restricted distributions" (ERMP p. 4-24). At least three issues needed to be considered with more care:

'Total fauna' versus 'vertebrate fauna'

Throughout the consultants' report on fauna surveys and in most of the ERMP the word 'fauna' is used synonymously with vertebrates. As discussed above, the section of the ERMP on terrestrial invertebrates (p. 4-22) is inadequate. For instance, the discussion under ERMP sub-heading "4.2.2.2 Faunal Communities" does not mention invertebrates. This confounds the reader by concealing the lack of data on terrestrial invertebrate groups. The proponents focus their arguments concerning fauna on local endemism yet, at the scale of the study area, only the invertebrates are likely to show the patterns of local endemism seen in the flora. In the ERMP's section on invertebrates (p. 4-22), the examples chosen are large, mobile species (cockroaches, jewel beetles) rather than spiders, snails, worms and litter arthropods. Both scientifically and in the Wildlife Conservation Act, the definition of 'fauna' includes invertebrates. Indeed, the vast majority of animals are invertebrates and it is recognised that vertebrates and other macro-organisms merely ride on the energy flow connections of small invertebrates and micro-organisms (Price 1988).

Species inter-relationships

The ERMP under-emphasises the inter-dependence between plant and animal species, especially terrestrial invertebrates (see below).

> "Faunal communities are usually tied, either directly or indirectly, to the vegetation and soil assemblages in their habitat" (ERMP p. 4-22).

Most ecologists would argue that this is a two-way interaction; for example soil invertebrates such as ants and termites have a profound affect on water infiltration, aeration and nutrient recycling in the soil (Anderson 1988; Lal 1988; Lee 1983; van Schagen 1986; Wood and Sands 1977; etc).

There should be a difference between a biological survey designed to select reserves that represent a region or district (e.g. McKenzie and Robinson 1988), one carried out as a precursor to *status quo* or restoration management of essentially natural ecosystems in a park (e.g. Newbey and Chapman 1987), and one undertaken to assess a location subject to an ERMP where areas will be effectively destroyed as fauna habitat and post-mining rehabilitation or restoration will be needed. A survey for an ERMP must focus on the sorts of organisms likely to be most affected by the disturbance, rather than only attempting to determine and monitor patterns in the biota (e.g. see Hobbs and Hopkins 1990). As well as species-habitat patterning and conservation status appraisals, a biological survey for an ERMP should include site-inventories of the sorts of organisms most likely to be affected by the disturbances that will be imposed. When these sets of quadrats are inventoried for subsequent monitoring, the "size and complexity of invertebrate groups" should not "preclude all but the most superficial study", as claimed in the ERMP (p. 4-22). Ants, for instance, have been monitored on mined sites elsewhere in Western Australia (van Schagen 1986; Majer 1989) and many other invertebrate groups have been monitored elsewhere (see Majer 1989 for a review).

Ecosystem conservation

The ERMP shows no understanding of the need for the conservation of communities and the need for the protection of areas of both typical and special habitat in conservation reserves to minimise the number of now common indigenous species entering the endangered category. As was pointed out earlier in this chapter, the ERMP made no similar surveys of the remainder of the proposed Lesueur conservation reserve or of nearby conservation reserves. Indeed, no attempt was made to compare the species present in the study area to those in the remainder of the proposed reserve, nor to other conservation reserves in the region.

4.22 Aquatic fauna

The ERMP contains no assessment of the conservation status of the aquatic fauna of ephemeral streams in the project area.

With regard to the Hill River, the perennial watercourse into which Munbinea Creek and Coomallo Creek flow, it could be argued that the occurrence of the dragonflies *Hesperocordulia berthoudi* (from the south west) and *Crocothermis nigrifrons* (from north Australia), together with three undescribed species of chironomid in the Gairdner Range creeks, shows that the area has special biogeographic importance. It may be a zone where elements of the northern and south-western aquatic faunas meet.

4.3 THE ERMP ASSESSMENT OF THE IMPACT OF THE PROPOSED PROJECT ON FAUNA

4.31 Terrestrial fauna

In the context of the area's fauna, the ERMP does not assess the direct and indirect effects of:

1. Long-term fallout or air pollution from the power station.
2. Changes to substrate (compaction, moisture availability) in or adjacent to pits, ponds, roads, overburden dumps, buildings, etc.

This is understandable, since their consultants did not collect or compile data on terrestrial invertebrates, and the vertebrate faunal survey

concentrated on species' presence or absence. The survey appears to have been too superficial to allow any quantitative appraisal of responses by vertebrate species to attributes of substrate or vegetation. No literature is cited to suggest the proponents reviewed relevant knowledge on the affects on fauna of coal mines/power stations elsewhere in Australia or the world.

The narrow scope and brevity of the fauna sampling do not justify the ERMP conclusion: "while some individuals will be affected by the project, the impacts will be such that no known species will be significantly affected." (ERMP p. 6-6). That such data did not provide "... any evidence that there were restricted habitats or any faunal species which could be endangered by the project" (ERMP p. 6-7), does not allow their conclusion: "... that the project will not have major detrimental impacts on the fauna." (ERMP p. 6-7).

Only for the vertebrate terrestrial fauna is there an undertaking to:

1. Improve the data-base prior to construction.

2. Monitor the affect of the project on fauna (ERMP p. 6-7).

The proponents aim only at vertebrate fauna rehabilitation, whereas air pollution from the stack, changes to soil water flow and the probable introduction of dieback disease are likely to disturb parts of the adjacent proposed Lesueur conservation reserve. For nature conservation purposes, total restoration of all the indigenous fauna would be required in a conservation reserve.

The ERMP briefly discusses the possible effects of the project on Carnaby's Black-Cockatoo *Calyptorhynchus latirostris*. It discusses two concerns:

1. that it will be disadvantaged by the removal of one its food plants, *Banksia tricuspis,* and

2. that it requires the interface between woodland and heath, using the woodland as a breeding location and the heath to forage.

The ERMP states "... the birds consume a wide variety of seeds and (that) Carnabys Cockatoo is not dependent on Banksia tricuspis. ... the Cockatoo is not dependent on the Hill River habitats for its survival, as it has a wide range of movement and several breeding locations" (ERMP pp 6-6, 6-7).

The inter-relationships between Carnaby's Black-Cockatoo and its environment were discussed by van Leeuwen *et al.* (1990). They showed that the presence of Carnaby's Black-Cockatoos was very important for the long-term survival of *Banksia tricuspis* rather than the reverse as implied in the ERMP. They concluded that "Management of B. tricuspis should ensure that all organisms involved in its inter-relationships are catered for. In the Cockatoos' case this is extremely important and will require protection of wandoo woodlands, kwongan and fresh water sources throughout the Lesueur - Coomallo region."

As well as failing to recognise that the Cockatoo is important, not only for its own sake, but also because it is implicated in the survival of a Declared Rare Flora species, the ERMP also does not discuss the need for fresh water sources (which must have shady trees around them), nor the possible effects of mining and water extraction in this context, although the Hill River Spring is highlighted as the area most likely to suffer from water table drawdown (ERMP p. 8-21). The Hill River is also predicted to change from a permanent watercourse to a temporary one. In this context, it is important to note that the Hill River Nature Reserve (Class A Reserve no. 36093, 882 ha) was declared to protect vital summer-feeding habitat of Carnaby's Black-Cockatoos along the Hill River. Here there is a combination of fresh water surrounded by shady trees, plus Marri (*Eucalyptus calophylla*) for food. The Hill River Spring is immediately adjacent to this nature reserve, within the proposed Coomallo National Park.

In addition, the ERMP fails to recognise the importance of the whole Lesueur - Coomallo region for the survival of Carnaby's Black-Cockatoo (Hopkins and Saunders 1987). This aspect is covered in a submission from Dr D.A. Saunders, CSIRO Division of Wildlife and Ecology, who is the expert on this species, and is not discussed further here.

4.32 Aquatic fauna

The richness of the aquatic fauna of the Gairdner Range creeks, as demonstrated by Streamtec (1988), has been discussed by Burbidge and Fuller (1990). The possible impact of the project on this fauna has not been discussed in the ERMP. Surface water flows from the mines will be sent along natural drainage lines after treatment, but nowhere in the ERMP was the effect on invertebrates of these changed flow regimes considered, nor were water quality criteria set. There is insufficient information in the ERMP about water management for us to assess what is likely to happen.

The lack of any survey of the aquatic fauna of Cockleshell Gully is disturbing, given that the ERMP states that the area will be affected by mining operations, with streams having an increased sediment load (ERMP Section 6.5.2). Although it appears efforts will be made to minimize the impact of mining, given that much of the proposed conservation reserve is downstream from the mine, more data about the fauna and stream types are required.

In relation to the Hill River, the statement in the ERMP that "There is no evidence that there are any restricted

habitats or faunal species that could be endangered by the project" (ERMP p. viii) is incorrect. The Hill River is a very restricted habitat for aquatic fauna and is threatened by the borefield (and possibly by mine waste water and run-off).

Steamtec (1989) stresses the importance of the Hill River as a permanent stream because permanent streams possess a distinct community (the occurrence of distinct communities in temporary and permanent streams in Australia is well documented, (e.g. Storey *et al.* (1990) for Jarrah forest streams and Boulton (1989) for Victorian streams) and because "permanent water ... may serve as a refugia (sic) of permanent water species which may re-invade other systems in wetter years" (Streamtec 1989, p. 13). The section in the ERMP on the impacts of the borefield on aquatic fauna (Section 8.3.3) states that "The greatest effects of the functioning of the aquatic ecosystem as a result of a lowering of the water table is expected to be due to the change from permanent to temporary flow in the affected streams, although the degree to which the stream will be made temporary is unknown..." (ERMP p. 8-23). The degree to which the Hill River will be made temporary is not stated. Our reading of the ERMP suggests that the River will change from permanent (i.e. free water or groundwater immediately under the streambed) to temporary (i.e. dry, including the soil of the streambed) and impact should have been assessed on that basis. We can find no mention of aquatic fauna under "Impacts and Management" (ERMP Section 6.0). A consultant's report (Australian Groundwater Consultants 1989) states "... correlating these model-predicted water table drawdowns with the surface topography reveals that the 'potentially gaining reach' of the Hill River lies outside the main drawdown area but is expected to suffer some water table lowering. This may be such as to remove the hydraulic gradient which is contributing seepage from below up to the river bed." (p. 21). This supports our contention that the Hill River may change to a temporary watercourse.

The ERMP states that "Regular monitoring will identify any adverse trend before unacceptable impact on vegetation or fauna occurs, and will allow sufficient time to implement an alternative water supply source or effect other remedial measures" (ERMP p. 8-22). We believe monitoring is unlikely to allow adverse impacts on the vegetation and aquatic fauna to be halted before they become unacceptable because of the long lead time required to develop other water sources. Also, there are insufficient base line data, particularly for aquatic invertebrates.

4.4 COMMITMENTS BY THE COMPANIES

Commitments in relation to fauna are given on p. 6-7 and summarised in Section 10.8. These are stated to be:

"8a. Native fauna will be protected by the following actions:

- minimisation of vegetation disturbance;
- prohibition of firearms and pets from site; and
- bunding of large excavations

8b. Faunal surveys and monitoring programmes will continue and will be reported to the appropriate authorities"

These commitments reflect the ERMP's mis-understanding of fauna conservation principles. Two of the commitments, while necessary for any such project, relate only to marginal issues in fauna conservation - hunting is not a serious concern in the conservation of any species that occur at Lesueur, nor is the occasional deaths that may occur if animals fell into pits.

Simply reporting the results of surveys (for which there is no commitment regarding detail or adequacy) is of little value if there is no commitment to standards or criteria relating to impact and rehabilitation.

This leaves the commitment to minimise vegetation disturbance. Again no standards are provided, nor is it explained how this will reduce impact to acceptable levels.

Table 4.1
Numerical classification of reptile data

Trap lines (numbers read vertically)	123111 1320405	2 89	112 24873	331 216	222 7084	121 361629	21 79	2 2 551
Aclys concinna	* *							
Notechis curtus	*							
Delma fraseri	**				*			
Pygopus lepidopodus	*	**		*		*		
Lerista distinguenda			***			*		
Diplodactylus granariensis			*		*	*		***
Diplodactylus spinigerus	* *	*		**		** **	*	*
Tiliqua rugosa	**					*****	*	
Ctenotus fallens	******		** **	***	****	******		
Morethia obscura	*		*****		* *	** *		
Ctenotus pantherinus	** **	*	** *			*		*
Pogona minor	*******	**	*****		*	*** **		*
Menetia greyii	******	*	*	* *	**	*	*	*
Crenodactylus ocellatus	*			*	*			*
Phyllurus milii	*				*	*	**	
Pletholax gracilis				*	*	*		
Lerista christinae				*				
Morethia lineoocellata		*			** *			
Ramphotyphlops australis			*		****	*		
Varanus tristis			*		*			
Ctenotus lesueuri	*							
Varanus gouldii	**					*		
Lialis burtonis	*		*		*	* *		
Cryptoblepharus plagiocephalus	*		*				*	
Diplodactylus polyopthalmus								*
Tympanocryptus adelaidensis	* *				*			*
Delma grayii						*		*
Rhinoplocephalus gouldii						*		
Martinick's Groups*	1145735	56	12444	126	1581	126337	48	688

* 1 = deep sands, 2 = sandy drainage lines, 3 = low lying sands, 4 = sandstone soils, 5 = gravels, 6 = laterite, 7 = low lying clays, 8 = wandoo clay

Table 4.2

Vertebrates known to occur within the Lesueur area and which are not known to occur in nearby existing and proposed conservation reserves (data from W.A. Museum).

A. MAMMALS

Badgingarra National Park

Echidna	*Tachyglossus aculeatus*
White-bellied Dunnart	*Sminthopsis dolichura*
Fat-tailed Dunnart	*Sminthopsis crassicaudata*
Euro	*Macropus robustus*
Gould's Wattled Bat	*Chalinolobus gouldii*
Chocolate Bat	*Chalinolobus morio*
King River Eptesicus	*Eptesicus regulus*
Lesser Long-eared Bat	*Nyctophilus geoffroyi*
Southern Bush Rat	*Rattus fuscipes*

Alexander Morrison National Park

Echidna	*Tachyglossus aculeatus*
Grey-bellied Dunnart	*Sminthopsis griseoventer*
White-bellied Dunnart	*Sminthopsis dolichura*
Fat-tailed Dunnart	*Sminthopsis crassicaudata*
White-tailed Dunnart	*Sminthopsis granulipes*
Honey Possum	*Tarsipes rostratus*
Brush Wallaby	*Macropus irma*
Euro	*Macropus robustus*
Gould's Wattled Bat	*Chalinolobus gouldii*
Chocolate Bat	*Chalinolobus morio*
King River Eptesicus	*Eptesicus regulus*
Lesser Long-eared Bat	*Nyctophilus geoffroyi*
Ash-grey Mouse	*Pseudomys albocinereus*
Southern Bush Rat	*Rattus fuscipes*

Drovers Cave National Park

Echidna	*Tachyglossus aculeatus*
Grey-bellied Dunnart	*Sminthopsis griseoventer*
White-bellied Dunnart	*Sminthopsis dolichura*
Fat-tailed Dunnart	*Sminthopsis crassicaudata*
White-tailed Dunnart	*Sminthopsis granulipes*
Honey Possum	*Tarsipes rostratus*
Brush Wallaby	*Macropus irma*
Euro	*Macropus robustus*
King River Eptesicus	*Eptesicus regulus*
Lesser Long-eared Bat	*Nyctophilus geoffroyi*

Nambung National Park

Echidna	*Tachyglossus aculeatus*
Grey-bellied Dunnart	*Sminthopsis griseoventer*
White-bellied Dunnart	*Sminthopsis dolichura*
Fat-tailed Dunnart	*Sminthopsis crassicaudata*
White-tailed Dunnart	*Sminthopsis granulipes*
Brush Wallaby	*Macropus irma*
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Gould's Wattled Bat	*Chalinolobus gouldii*
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King River Eptesicus	*Eptesicus regulus*
Lesser Long-eared Bat	*Nyctophilus geoffroyi*

Proposed Coomallo National Park

Echidna	*Tachyglossus aculeatus*
Grey-bellied Dunnart	*Sminthopsis griseoventer*
White-bellied Dunnart	*Sminthopsis dolichura*
Fat-tailed Dunnart	*Sminthopsis crassicaudata*
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Lesser Long-eared Bat	*Nyctophilus geoffroyi*
Ash-grey Mouse	*Pseudomys albocinereus*
Southern Bush Rat	*Rattus fuscipes*

B. REPTILES

Badgingarra National Park

Ctenophorus maculatus maculatus
Crenadactylus ocellatus ocellatus
Diplodactylus alboguttatus
Diplodactylus granariensis granariensis
Diplodactylus polyopthalmus
Gehyra variegata
Phyllodactylus marmoratus marmoratus
Underwoodisaurus millii
Delma fraseri
Delma grayii
Pletholax gracilis
Cryptoblepharus plagiocephalus
Egernia kingii
Egernia multiscutata bos
Lerista distinguenda
Lerista elegans
Lerista planiventralis decora
Lerista praepedita

Omolepida branchialis
Varanus gouldii
Varanus tristis tristis
Morelia stimsoni stimsoni
Demansia psammophis reticulata
Notechis curtus
Pseudonaja nuchalis
Pseudechis australis
Vermicella littoralis

Alexander Morrison National Park

Ctenophorus maculatus maculatus
Pogona minor minor
Tympanocryptis adelaidensis adelaidensis
Crenadactylus ocellatus ocellatus
Diplodactylus alboguttatus
Diplodactylus granariensis granariensis
Diplodactylus ornatus
Diplodactylus polyopthalmus
Diplodactylus spinigerus spinigerus
Gehyra variegata
Phyllodactylus marmoratus marmoratus
Underwoodisaurus millii
Aclys concinna concinna
Delma fraseri
Delma grayii
Lialis burtonis
Pletholax gracilis
Pygopus lepidopodus lepidopodus
Cryptoblepharus plagiocephalus
Ctenotus fallens
Ctenotus impar
Ctenotus lesueurii
Ctenotus pantherinus pantherinus
Egernia kingii
Egernia multiscutata bos
Egernia napoleonis
Lerista christinae
Lerista distinguenda
Lerista elegans
Lerista planiventralis decora
Lerista praepedita
Menetia greyii
Morethia lineoocellata
Morethia obscura
Omolepida branchialis
Tiliqua occipitalis
Tiliqua rugosa rugosa
Varanus gouldii
Varanus tristis tristis
Morelia stimsoni stimsoni
Demansia psammophis reticulata
Notechis curtus
Pseudonaja nuchalis
Pseudechis australis
Rhinoplocephalus gouldii
Vermicella littoralis
Vermicella bimaculatus
Ramphotyphlops australis

Drovers Cave National Park

Ctenophorus maculatus maculatus
Crenadactylus ocellatus ocellatus
Diplodactylus granariensis granariensis
Diplodactylus polyopthalmus
Gehyra variegata
Phyllodactylus marmoratus marmoratus
Aclys concinna concinna
Delma fraseri
Delma grayii
Lialis burtonis
Pletholax gracilis
Cryptoblepharus plagiocephalus
Ctenotus impar
Ctenotus pantherinus pantherinus
Egernia kingii
Egernia multiscutata bos
Lerista christinae
Lerista distinguenda
Lerista elegans
Lerista planiventralis decora
Menetia greyii
Morethia lineoocellata
Tiliqua rugosa rugosa
Varanus gouldii
Varanus tristis tristis
Morelia stimsoni stimsoni
Demansia psammophis reticulata
Notechis curtus
Pseudonaja nuchalis
Pseudechis australis
Rhinoplocephalus gouldii
Vermicella littoralis
Vermicella bimaculatus

Nambung National Park

Ctenophorus maculatus maculatus
Pogona minor minor
Tympanocryptis adelaidensis adelaidensis
Crenadactylus ocellatus ocellatus

Diplodactylus alboguttatus
Diplodactylus granariensis granariensis
Diplodactylus ornatus
Diplodactylus polyopthalmus
Diplodactylus spinigerus spinigerus
Gehyra variegata
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Ctenotus pantherinus pantherinus
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Lerista planiventralis decora
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Proposed Coomallo National Park

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Pogona minor minor
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Egernia kingii
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Lerista christinae
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Menetia greyii
Morethia lineoocellata
Morethia obscura
Omolepida branchialis
Tiliqua occipitalis
Tiliqua rugosa rugosa
Varanus gouldii
Varanus tristis tristis
Morelia stimsoni stimsoni
Demansia psammophis reticulata
Notechis curtus
Pseudonaja nuchalis
Pseudechis australis
Rhinoplocephalus gouldii
Vermicella littoralis
Vermicella bimaculatus
Ramphotyphlops australis

C. FROGS

Badgingarra National Park

Litoria moorei
Ranidella pseudinsignifera
Heleioporus psammophilus
Neobatrachus pelobatoides

Alexander Morrison National Park

Litoria moorei
Myobatrachus gouldii

Ranidella pseudinsignifera
Heleioporus albopunctatus
Heleioporus eyrei
Heleioporus psammophilus
Limnodynastes dorsalis
Neobatrachus pelobatoides
Pseudophryne guentheri

Drovers Cave National Park

Litoria moorei
Myobatrachus gouldii
Ranidella pseudinsignifera
Heleioporus albopunctatus
Heleioporus psammophilus
Limnodynastes dorsalis
Neobatrachus pelobatoides

Nambung National Park

Litoria moorei
Myobatrachus gouldii
Ranidella pseudinsignifera
Heleioporus albopunctatus
Heleioporus eyrei
Heleioporus psammophilus
Limnodynastes dorsalis
Neobatrachus pelobatoides
Pseudophryne guentheri

Proposed Coomallo National Park

Litoria moorei
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Ranidella pseudinsignifera
Heleioporus albopunctatus
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Heleioporus psammophilus
Limnodynastes dorsalis
Neobatrachus pelobatoides
Pseudophryne guentheri