APPENDIX M

GROUNDWATER FAUNA SAMPLING IN THE KIMBERLEY

Groundwater fauna sampling in the Kimberley north of 16°S and east of 128°E.

A report for Kinhill Pty Ltd pertaining to Stage 2 (M2): Ord River Irrigation Area project

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Summary

The Museum of Natural Science has undertaken limited sampling of stygofauna in the area in 1994 and 1998. A significant stygofauna is associated with the karstic landforms in the Devonian Reef system comparable to that found in the west Kimberley. Interstitial stygofauna is found in the alluvial deposits of the established part of the Ord Irrigation area (Ivanhoe Plain), including two families of bathynellid Syncarida (Crustacea). Bathynellids are also found in the proposed Ord River expansion project area (Cave Spring Gap and Weaber Plain). Owing to the characteristics of the sampling points little confidence is placed that the samples to hand represent the diversity of the stygofauna of the area sampled. No sampling has been undertaken on the Keep River Plain or the Knox Creek Plain which together comprise a large majority of the project area.

Introduction

Kinhill Pty Ltd requested, at short notice, a report on the stygofauna (aquatic subterranean fauna) known in the region of Stage 2 (M2): Ord River Irrigation Area project and in the immediately surrounding area. This report provides the distribution of stygofauna sampling sites, the associated fauna to the level of identification currently available and a discussion of the limitations to the data.

Identification of stygofauna

While the nature of the fauna can be determined largely from the typical morphology often found in stygal species, the stygofauna of Western Australia is largely unknown and predominantly undescribed, being newly found species or higher order taxa. This is also the case with the fauna reported here. Few specialists are available to determine and describe the fauna and most material can only be identified and described by specialist taxonomists located interstate or overseas.

It is important to clarify taxonomic relationships to establish the significance of potential impacts. For example, if a taxon is represented by a single species throughout the aquifer then localised drawdown or elevation of the groundwater surface, or other effects, are less likely to have significant impact, but if different and localised species occur then the danger will increase that any impacts may result in the loss of biodiversity.

Significance of stygofauna

Stygofauna is significant for a number of reasons. It includes rare and relict taxa which comprise a significant component of biodiversity. It is of considerable value to studies in zoogeography and the evolution of the Australian biota and landscape. Stygofauna play an essential role in ecosystem processes, by breaking down nutrients and recycling them through the food web. They may also play an important role in maintaining water quality through bioturbation, in much the same manner as earthworms contribute to the health of the soil. Stygofauna may be valuable indicators of threats to the integrity and sustainability of the groundwater system.

Habitat patchiness

The dispersion of stygofauna within an alluvial aquifer, as opposed to a karstic or fissured aquifer, is likely to be widespread but with individual species having patchy distributions owing to local variations in groundwater characteristics. Typically, downwelling and upwelling areas have different characteristics and changes to the water level (e.g. during flooding) may have profound effects on the distribution of organisms within the aquifer. Hence, a broad range of fauna will most likely only be detect by sampling across a wide geographical area and range of habitats. In the absence of knowledge of the hydrology of the system there is perforce a degree of chance involved in sampling. Hence, repeated sampling of a number and types of bores may be required to be reasonably confident, for example, that an apparent absence is real.

In some localities elsewhere, however, stygofauna appears to be genuinely absent in apparently suitable habitats. In the Millstream aquifer, for instance, the distribution of the spelaeogriphacean *Mangkurtu mityula* Poore and Humphreys appears to be confined to a limited area of the calcrete aquifer, and absent from contiguous areas despite apparently similar hydrogeology, bore age and construction, and sampling effort. Thus stygofauna cannot be assumed to occur throughout the range of potential habitat (Poore and Humphreys 1998).

Bore Constructions

Detecting the presence of stygofauna may be dependant upon bore construction characteristics. Stygofauna is more likely to be detected in un-cased bores because the fauna is free to migrate directly into the bore cavity from the natural voids in the host rock or sediments. The efficacy of the case slotting in allowing fauna movement will likely depend, inter alia, on the slotting or screen size, its interval and depth, and whether or not the bore annulus is gravel packed. Slotting or gravel pack of small dimensions will inhibit or prevent the migration of stygofauna into the bore cavity, especially for macro-sized (> 1 mm) fauna. Fine sediments originating from the host rocks, or from the drilling process, may clog the slotting or interstitial spaces within the gravel pack and prevent the movement of fauna into the bore cavity. End caps on bore casings, or bentonite seals may also restrict the dispersal of fauna into the bore cavity.

The construction date of bores may also influence the ability to detect stygofauna. Newly constructed bores will contain unfavourable conditions for stygofauna due to retention of turbid or foreign waters, other fluids, or drilling clays, especially if they have not been developed. Older bores are more likely to harbour stygofauna as the water quality stabilises to that of the surrounding groundwater, and the fauna has been given time to disperse and colonise the bore cavity.

Lithology

The distribution of stygofauna is related, inter alia, to rock and sediment types, and the geologicial structure. Stygofauna habitat is best developed in karstic aquifers. Stygofaunal habitat may also occur in non-karstic rocks, or unconsolidated sediments, if suitable water-filled voids are present. In non-karstic rocks natural voids may be associated with structural features, such as fissures for example (fissured aquifer) (Gilbert et al. 1994). In unconsolidated sediments, the water-filled pores between grains of sediment, especially where these are sand-sized or larger, forms an extensive groundwater habitat (porous aquifer). Thus stygofauna may be present in gravels alongside and beneath water courses, as well as aquifers in alluvial or other sediments.

In Western Australia, stygofauna is frequently well developed where limestone and calcrete despots occur, although in some karst areas such as the Nullarbor Plain macro fauna is largely absent. Stygofauna is known to be present in consolidated sediments alongside the Robe and Fortescue Rivers (Humphreys 1999; W.F. Humphreys, unpublished data) and sandstone springs in the Kimberley (Humphreys 1994; Wilson and Keable 1999).

Sampling methods

Stygofauna was sampled by using standard techniques as used successfully elsewhere (e.g. Humphreys, 1994). Bores were sampled for fauna using a haul plankton net with a 250 or 350 µm mesh and of a diameter suitable for the bore – from 50 mm to 300 mm in diameter. Haul net samples were taken from the entire water column at each site. Samples were transported live to the laboratory and examined for fauna under a binocular dissecting microscope. Specimens were preserved in 70% ethanol and lodged with the Western Australian Museum of Natural Science.

Samples

Thirty-four sampling locations have been examined in the region in 1994 and 1998. Of these 11 sites contained undoubted stygofauna and another two sites contained fauna that is probably stygal (Tables 1 and 2). These sites range from the karstic limestone Devonian Reef system (Ningbing Range), to the alluvial aquifers associated with the former course of the Ord River through the Ivanhoe Plain, Cave Spring Gap and Weaber Plain. No samples are available from the extensive Keep River Plain or the Knox Creek Plain that together comprise the bulk of the project area.

Regional fauna

Aspects of the subterranean fauna of the west Kimberley was reported by Humphreys (1995, 1999). The Ningbing Range contains an undescribed family of flabelliferan isopods (Wilson and Ponder 1992) while the sandstone Durack Range to the west contains a phreatoicid isopod of a lineage that provides a link between those known from the fragments of Eastern Gondwana (Humphreys 1995; Wilson and Keable 1999), and thus contains information of great antiquity. To the east, the Gregory National Park in the Northern Territory contains protojanirid isopods (Asellota), a family newly found in Australia (G.D.F. Wilson, pers, comm, 1999) and elsewhere known from Sri Lanka and southern Africa.

Ord irrigation region

The Ivanhoe Plan alluvial aquifers contain undescribed species in two families of bathynellid syncarid Crustacea (Table 1) and a number of other probable stygofauna less widely collected (Table 2). The fauna on the Cave Spring Gap and the Weaber Plain has similar characteristics but the detailed identifications is unknown at this stage (Tables 1 and 2; Figure 1). It may be pertinent that there is a natural groundwater divide between the Ivanhoe Plain and the remainder of the Ord palaeodrainage channel that was sampled (R Puglisi, pers comm 1999). Such a groundwater divide separates quite distinct faunas in the Western Fortescue Plain (Poore and Humphreys 1998; Humphreys 1999; W.F. Humphreys unpublished). Furthermore, the groundwater salinity varies widely indifferent parts of the project area and this may have a major impact on the fauna it can support. While stygofauna is typically associated with freshwater (Gilbert et al 1994), it is found in salinity of seawater strength in both near coastal aquifers (Humphreys in press b) and in the Yilgarn (W.F. Humphreys and H.J. Hahn, unpublished 1999).

Syncarida

Of marine origin, syncarids are one of the oldest grounds of freshwater fauna and the two evoluntionary lines that independent invaded freshwater were the only ones to survive. The Bathynellacea probably occupied surface freshwater habitats in the Carboniferous and subsequently became restricted in living in the interstitial spaces in subterranean waters—95% of rent syncarids are strictly stygobionts (Schminke, 1986). They have limited dispersal ability and their occurrence in oligohaline and polyhaline waters is secondary (Schminke, 1981), hence their biogeography may provide useful information on past continental connections.

They became adapted to the interstitual stygofauna habitats by neoteny and the Bathynellacea now attain sexual maturity at a stage that corresponds to the zoea in the development of primitive Decapoda (Schminke, 1981).

The most primitive Bathynellacea are found in southeast Asia and of the Parabathynellidae two lines extend from there, one through Europe, Africa and South America, and the other south via Australian also to South America—along both lines the genera become more and more apomorphic in their characters (Schminke, 1974). Syncarids are considered to be rare but this is probably due to

their escaping attention by being subterranean (Schminke, 1986); indeed, recent work in the Yilgarn has found both a high diversity and large populations of syncarids in calcrete aquifers (W.F. Humphreys and H.J. Hahn, unpublished 1999). The biology of syncarids is virtually unknown.

Two new species of syncarid Crustacea (H.K. Schminke, pers. comm.), belonging to two families (Bathynellidae and Parabathynellidae) were taken sympatrically in the groundwater of the Ord River Irrigation Area. One is a species of *Atopobathynella* (Parabathynellidae). he recent finding of the genus in the arid (Barrow Island; Humphreys in press a) and monsoonal tropics of Western Australia (Ord River Irrigation Area) suggests that syncarids of the genus *Atrpobathynella* may be expected throughout Australia, at least in areas not inundated by the sea during the Cretaceous (see figure in Humphreys 1999).

Ostracoda

These tiny bivalve-like Crustacea were collected from spring caves but can be expected to be more widespread. Williams (1979) reported on a collection of ostracods from 13 localities in northwestern Australia—of the 16 species collected all belonged to known genera but six were undescribed; three genera were recorded for the first time in Australia and the range of several species was extended from eastern Victoria. We can expect the subterranean fauna to be less well known (Danielopol et al. in press; P. Marmonier, pers. comm. 1999; K Wouters and K. Martens, pers. comms. 1999) as is the case for the copepods.

Copepods

These tiny Crustacea were collected from a number of piezometers and cave springs. They are being examined by Professor G.L. Pesce at Univesity di l'Aquila, Italy. Williams (1979) also collected calanoid copepods from northwestern Australia and recorded only four species; major range extensions were made for two species of *Diaptomus* and of *Boeckella triarticulata.* Such is the poor state of knowledge of the surface fauna, but the subterranean fauna is less well known (Pesce *et al.* 1996a, 1996b; Pesce and De Laurentiis 1996; De laurentiis *et al*. 1999; Jaume and Humphreys, in prep; D, Jaume, pers. comm. 1999).

Numbers

Of the most commonly sampled taxa, the bathynellids, mostly one or two individuals were taken except where one site was sampled repeatedly (Table 1). Hence, the intensity of sampling provides little scope for detecting diversity within the fauna at any site.

Conclusions

A significant, regionally variable, stygofauna is present in the eastern Kimberley and the neighbouring parts of the Northern Territory. A limited stygofauna inhabits both the current Ord Irrigation Area and the proposed State 2 extension. At this stage it is not known whether these fauna are the same, an uncertainty exacerbated by a natural groundwater divide between the two areas. These is a low level of confidence that the sampling has been adequate to characterise the stygofauna owing to the nature of the bores sampled, and because the bulk of the project area has not been sampled at all. The fissured and karstic aquifers adjacent to the Knox Creek Plain are potential sources of stygofauna and, as they lie outside any immediate impact of the project, could be potential buffer zones for subterranean fauna.

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Table 2: Other aquatic fauna taken from few groundwater sampling sites.

Sampling site	**Taxa**
PB1	Copepoda; vermes indet.
PB2	Nematoda; Protozoa
WP10	Oligochaeta
WBS 5062	Insect larva
KNI-19	*Tainisopus* sp. (Isopoda: Flabellifera); Copepoda; Ostracoda
Siggins Spring	[1]*Strandesia* sp. (Ostracoda: Cyprididae: Cypridopsini). Genus known from Cuba (K. Wouters)[probably epigean].
HI 3/78	Nematoda
PN5D	Harpacticoidea (Copepoda).

[1] det. Prof. K. Wouters, pers. comm.

Table 1: Groundwater sites sampled by Museum of Natural Science in Western Australia (north of 16° S and east of 128° E) and the stygofauna.

Area	Bore etc.	Latitude	Longitude	Higher taxon	Family[1]	N
Kununurra	Bore west of production bores	-15.78861	128.71861	•		
Kununurra	Golf Course Bore	-15.78806	128.71472	•		
Ivanhoe Plain	HI 3/78	-15.70111	128.68972	•		
Ivanhoe Plain	medium pipe capped #82	-15.67972	128.72694	•		
Ivanhoe Plain	#83	-15.67972	128.72972	•		
Ivanhoe Plain	#84a	-15.67889	128.72861	•		
Ivanhoe Plain	PB2 & PB2M1-1	-15.67806	128.72639	Syncarida: Bathynellacea	Bathynellidae	1m
Ivanhoe Plain	PN6D	-15.64250	128.74917	Syncarida: Bathynellacea	Parabathynellidae	2
Ivanhoe Plain	PB1M1-1	-15.63278	128.74556	•		
Ivanhoe Plain	PB1	-15.63222	128.74500	Syncarida: Bathynellacea	Bathynellidae species A	5m + 32[2]
Ivanhoe Plain	PN5S	-15.62667	128.72583	•		
Ivanhoe Plain	PN5D	-15.62667	128.72583	•		
Ivanhoe Plain	VEPL shallow	-15.62028	128.75694	•		
Ivanhoe Plain	VEPL deep	-15.62028	128.75694	•		
Ivanhoe Plain	Piezo No. 30	-15.61667	128.70000	•		
Ivanhoe Plain	Boschamber deep 102/1	-15.61222	128.74278	Syncarida: Bathynellacea	Parabathynellidae	1j
Ivanhoe Plain	Boschamber shallow102/2	-15.61222	128.74278	•		
Cave Spring Gap	CG2	-15.56667	128.76667	Syncarida: Bathynellacea		2
New piezometer		-15.54167	128.80583	•		
Cave Spring		-15.52917	128.83278	•		
Weaber Plains	WP1	-15.48861	128.82722	Syncarida: Bathynellacea		10
Weaber Plains	WP10	-15.46639	128.89111	Syncarida: Bathynellacea		2
Weaber Plains	WP6	-15.46472	128.83583	Syncarida: Bathynellacea		7
Weaber Plains	WP11	-15.45861	128.90222	Syncarida: Bathynellacea		1
Weaber Plains	WP9	-15.43917	128.91944	Syncarida: Bathynellacea		1
Ord	WBS 5062	-15.39556	128.95917	•		
Weaber Plains	WP19	-15.39417	128.95139	Syncarida: Bathynellacea		1
	Eight Mile Well	-15.31750	128.64167	•		
Ningbing Range cave	KNI-19	-15.30000	128.63000	•		
	Siggins Spring	-15.28333	128.65000	•		
	Tanmura Bore	-15.09528	128.63194	•		
	Number 8 Bore	-14.97056	128.59722	•		
	Brolga Spring Bore	-14.89750	128.56444	•		
	Limestone Well	-14.47722	128.73278	•		

[1] Determined by Prof. Dr H.K. Schminke, Universität Oldenburg, the authority on syncarids. [2] Based on repeated sampling over a number of days.

Sites sampled for stygofauna
Keep River
Western Australia
Northern Territory
Knox Creek Plain
Knox Creek
Weaber Plain
Cave Spring Gap
Ivanhoe plain
Kununurra
Ord River

APPENDIX N
CULTURAL HERITAGE PROTECTION PROCEDURES

CULTURAL HERITAGE PROTECTION PROCEDURES DURING THE FEASIBILITY STUDY OF THE ORD RIVER IRRIGATION AREA (M 2) PROJECT

Wesfarmers Limited **Marubeni Corporation**

and the

Water Corporation

17 SEPTEMBER 1998

INTRODUCTION

Wesfarmers Ltd. & Marubeni Corporation, in association with the Water Corporation (the Proponents), are undertaking a Feasibility Study to establish the viability of a raw sugar industry on the Ord River Irrigation M2 Area (the Project Area), near Kununurra in the East Kimberley Region of Western Australia and the Northern Territory.

The Feasibility Study is designed to determine whether the land in the M2 Area can be developed for the purposes of irrigated farmland, the operation of processing and storage facilities related to the agricultural output from the land and the development and operation of all necessary infrastructure. Infrastructure would include, but not be limited to, roads, bridges, power supply, communications facilities, and irrigation infrastructure, the latter including water supply channels (including the M2 supply channel), secondary channels and drains, balancing storages, pump stations, flood protection levees, hillside drains, and regional ground water control systems.

The Ord River region is an area of traditional significance, occupation and use by the Miriuwung and Gajerrong Aboriginal people. The Proponents are committed to recognising and respecting Aboriginal cultural values and rights to this land. This Project offers the opportunity for the development of a mutually beneficial relationship between Aboriginal and non-Aboriginal people alike.

The *Aboriginal Land Rights (Northern Territory) Act* 1976 and the *Native Title Act (1993)*, formally recognise land tenure rights of Aboriginal people in Australia. Along with this legislation, the Proponents are obliged to comply with State, Territory and Commonwealth legislation and procedures to ensure that Aboriginal cultural heritage values associated with the Project Area are adequately addressed.

This document outlines the procedures to be employed by the Proponents and observed by their employees, contractors and consultants during the Feasibility Study. Separate but complementary procedures will be established prior to the actual development of the Project.

PROTECTING CULTURAL HERITAGE

As a key component of the Feasibility Study, the Proponents will undertake a Work Programme Clearance of the land within the M2 Area to ensure that archaeological and ethnographic sites are avoided prior to any proposed ground disturbing activities. The First Stage Work Programme Clearance is scheduled to occur during September and October 1998. The Second Stage Work Programme Clearance is scheduled to occur in the 1999 dry season.

To facilitate the Work Programme Clearance, the Proponents have entered into arrangements with the Aboriginal Representative Bodies (the Kimberley Land Council, the Northern Land Council and the Aboriginal Legal Service of Western Australia) and via them the Miriuwung and Gajerrong people, to ensure that cultural heritage values and sites within the Project Area are avoided.

Aboriginal sites within the Project Area fall into two broad but not exclusive categories - archaeological sites and ethnographic sites. These are collectively known as Aboriginal sites and are protected by State, Territory and Commonwealth heritage legislation, which can impose severe penalties for knowingly or unknowingly disturbing and damaging Aboriginal sites.

CULTURAL HERITAGE VALUES

The Miriuwung and Gajerrong people have strong cultural heritage values associated with the Project Area. These values potentially include sites of mythological and ceremonial significance, occupation sites, burial sites, resource procurement sites as well as a general spiritual and emotional attachment the Miriuwung and Gajerrong people have to the land. The cultural heritage values that pertain to these Procedures apply to the following:

- All areas of land associated with the Feasibility Study of the Project Area;
- All surface archaeological and ethnographic sites, cultural materials and objects within the Project Area;
- All sub-surface archaeological materials, including human remains, which may be discovered during excavation or other earthworks during the Feasibility Study.

AVOIDANCE AND PROTECTION OF ABORIGINAL SITES

All interactions with the Miriuwung and Gajerrong people on cultural heritage issues are being managed by the Proponents Representatives. Briefings on respecting cultural heritage values will be held with the Proponent's employees, contractors and consultants prior to any ground disturbing activities in the Project Area.

All Aboriginal sites avoided as a consequence of the Work Programme Clearance, will be considered to be ‘prohibited areas’ in relation to any ground disturbing activities during the Feasibility Study. All known Aboriginal sites within the Project Area will be avoided at all times by the Proponent's employees, contractors and consultants. Interference with any known Aboriginal site, including visiting such sites or removing artefacts or objects, by the Proponent's employees, contractors and consultants will result in termination of their contract.

All ground disturbing activity shall be restricted to the First Stage Works, including the proposed 50 metre wide Infrastructure Corridor the subject of the Trace Survey. No access to the land within the Project Area external to the First Stage Works shall occur without the express permission of the Proponents Representatives.

All areas located during the Work Programme Clearance considered to be of Aboriginal significance as documented by a qualified archaeologist and/or an anthropologist, shall be delineated in the following manner:

- A map delineating the areas containing Aboriginal sites shall be provided to the Proponent's contractors to ensure that their work remains outside of those areas;

- Survey markers (star pickets and survey ribbon) shall be placed in close proximity to each area to ensure that contractors are aware of their locations and avoid them during ground disturbing activities as advised by the consultant archaeologist and/or anthropologist;

- A differential GPS survey of each area shall occur, in order to determine the dimensions of the area of land containing the Aboriginal site for current and future management.

Any additional areas of Aboriginal significance located within the Project Area shall be noted by the Proponents Representatives for future recording by a qualified archaeologist and/or anthropologist with the participation of the Aboriginal Representative Bodies.

PROCEDURE UPON THE ACCIDENTAL DISCOVERY OF CULTURAL HERITAGE MATERIALS DURING GROUND DISTURBING ACTIVITY

Habitation Sites

Should an archaeological site, or obvious cultural materials be located within the Project Area by the Proponent's employees, contractors and consultants or uncovered during any ground disturbing activities, the following steps shall be observed:

1. Any person making the discovery will cease the activity and notify the contractor/consultants Site Representative, who in turn shall immediately notify the Proponents Representatives;

2. The Proponents Representatives shall note the details and spatial extent of the archaeological site/cultural materials and shall advise the Site Representative accordingly. Ground disturbing activity may commence away from the archaeological site/cultural materials as advised by the Proponents Representatives;

3. The Proponents Representatives shall inform the Aboriginal Representative Bodies of the location of the archaeological site/cultural materials and shall arrange for a qualified archaeologist to record the site in detail;

4. Information on the significance of the archaeological site shall be provided to the Aboriginal Representative Bodies.

Human Remains

Should human skeletal remains be uncovered during any ground disturbing activities, then work shall immediately cease and the following action shall be taken:

1. The Proponents Representatives and the Site Representative will be notified immediately, who will in turn ensure that all access to the site is restricted. The Proponents Representatives shall immediately notify the local Police as well as the Aboriginal Representative Bodies;

2. If the remains are presumed to be human in origin, work should not continue less than 100 metres away from the remains, and only if the Proponents Representatives as well as representatives of the Aboriginal Representative Bodies are present to monitor this work;

3. The Proponents Representatives shall await advice from the Police and after consultation with the Aboriginal Representative Bodies, may arrange for a qualified archaeologist/physical anthropologist to visit the site in order to provide advice about the remains;

4. If the remains are determined as originating from a traditional burial, the Police will formally notify the Proponents Representatives. Assuming the Police agree, the site can therefore be considered to be a cultural heritage site and not a crime scene;

5. The Police will notify the appropriate State, Territory and Commonwealth agencies of the existence of the remains. The Proponents Representatives shall seek the advice of the Aboriginal Representative Bodies about what should be done with the remains. This could include leaving the remains in situ or excavation and re-burial at a location acceptable to the Aboriginal Representative Bodies.

Should the remains be in an area required for future development, the Proponents Representatives shall discuss the options for managing the remains in a manner acceptable to the Aboriginal Representative Bodies as well as the respective State, Territory and Commonwealth Government agencies.

CULTURAL PROTOCOLS

The Work Programme Clearance will involve Miriuwung and Gajerrong people, the Traditional Owners of the land within the Project Area. These Traditional Owners will be working with consultant archaeologists, anthropologists and other contractors and consultants during the Feasibility Study.

Cultural protocols need to be observed during all interactions with the Traditional Owners. While some of these protocols may not seem to be significant to non-Aboriginal people, observation of them will show respect for Aboriginal people and include:

- Not asking the names of Traditional Owners or their family members;
- Not asking about the cultural details of Aboriginal sites;
- Not taking photographs of Traditional Owners, their residences or cultural heritage sites without first asking permission;
- Not asking questions about deceased persons;
- Not insisting that male and female Traditional Owners travel together in the same vehicle; and
- Not requesting Traditional Owners to agree to or sign documents without recourse to proper advice.

Furthermore, there are general environmental protocols that also need to be observed to ensure 'best practice' and include:

- Limit vehicle use to existing roads and tracks;
- Minimise disturbance to vegetation;
- Backfill all test pits and plug all drill holes;
- Not leaving rubbish or waste behind;
- Keep all work sites clean and tidy;
- Not to use alcohol on site;
- Not to light camp fires unless absolutely necessary and not to leave fires unattended or properly extinguished;
- Leave gates and fences as they were found; and
- Avoid all stock watering points.

CONTACT DETAILS

Enquires regarding cultural heritage issues should be addressed to the Proponents Representatives:

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APPENDIX O

OUTLINE ENVIRONMENTAL MANAGEMENT PLAN

ORD IRRIGATION AREA
STAGE 2
PROPOSED DEVELOPMENT OF THE M2 AREA

OUTLINE ENVIRONMENTAL MANAGEMENT PLAN

Prepared for:

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December 1999

CONTENTS

1 Introduction

1.1 BACKGROUND

A joint venture between Wesfarmers Sugar Company Pty Ltd (Wesfarmers) and Marubeni Corporation (Marubeni) was awarded an exclusive mandate in April 1998 by the Western Australian and Northern Territory Governments to investigate the feasibility of development of a portion of Ord Stage 2 known as the M2 Development Area (the Project Area).

The proposal being considered by Wesfarmers and Marubeni involves the potential establishment of a raw-sugar industry. The industry may involve the development of farmland for the purposes of growing sugarcane, the development of a sugar mill, and the development of storage facilities at the port of Wyndham. In parallel with the feasibility study being conducted by Wesfarmers and Marubeni, the Water Corporation of Western Australia (Water Corporation) is investigating the feasibility of development of the irrigation infrastructure required to service the farmland.

Following development, the Project Area would include a raw sugar mill and approximately 32,000 hectares of land developed for farms, development of a further 3,000 hectares of land for infrastructure, and over 40,000 hectares of land managed for conservation. Farm areas would be developed on the heavy clay soils (black soils), while the land managed for conservation would include those areas that contain flora and fauna of conservation significance on the black-soil and other areas, including riparian and rocky areas, within and around the farmland.

Due to the interrelated nature of the core industry activities, Wesfarmers–Marubeni and the Water Corporation propose that an entity is established to shoulder the operational aspects of ongoing environmental management in relation to the proposed development on behalf of the industry participants. The proposed entity, or Environmental Management Entity (EME), would be owned by the industry participants, and would provide environmental management services to the owners. Key features of the proposed EME would be as follows:

- The EME would be wholly owned by the industry participants, including all three core industry participants.
- The key objective of the EME would be the management of environmental issues within the entire Project Area, on behalf of the industry participants.
- The EME would be responsible for aspects such as ongoing monitoring, analysis, and reporting on behalf of industry within the proposed development—but legal responsibility for environmental compliance would rest with the individual asset owners.

- The EME would be the focal point for community input in relation to environmental issues in relation to the proposed development.
- The EME would be resourced by the industry participants within the proposed development.

This document is the outline of the Environmental Management Plan (EMP) for the proposed development and operation of the Project Area. The EMP outline has been prepared to support the Environmental Review and Management Programme/draft Environmental Impact Statement (ERMP/draft EIS) for the Project. Finalisation of the EMP would require incorporation of any environmental conditions, operating licences for the Project, and the development of detailed monitoring and management schedules.

This document presents an indicative set of objectives and strategies that would comprise the EMP. When complete, the EMP would comprise a set of sub-plans that are described in the later chapters.

1.2 ENVIRONMENTAL MANAGEMENT COMMITMENTS

This section would consolidate the environmental management commitments made in the ERMP/draft EIS for the Project (Chapter 17 of the ERMP/draft EIS refers) and any requirements under environmental conditions, legislation or operating licences required by the Project.

1.3 MANAGEMENT STRUCTURE, GENERAL OBJECTIVES AND RESPONSIBILITIES OF THE EME

This section would outline the management structure, general objectives and responsibilities of the EME that would be established in conjunction with the Project. A description of the EME is provided in Chapter 16 of the ERMP/draft EIS.

1.4 INFORMATION SOURCES

This section would describe the information sources of reference to environmental management of the Project.

An Appendix would contain a reference list of the legislation and policy references relevant to the Project.

1.5 DUE DILIGENCE AND ENVIRONMENTAL MANAGEMENT SYSTEMS

The broad concept of due diligence is to foster (in individuals and organisations) compliance with environmental laws and to prevent environmental harm. In general, to demonstrate that "due diligence" has occurred, it would be necessary to show that a proper environmental management or control system had been implemented (to provide for compliance with environmental legislation) and that adequate supervision had been provided to ensure that the system was complied with, implemented and monitored.

Environmental due diligence requires the application of Best Practice Environmental Management (BPEM), which includes the preparation, implementation and monitoring of documents (such as an EMP), for example, through an environmental management system (EMS).

An EMS is an ideal way to demonstrate environmental due diligence and BPEM.

The concept and major components of the EMS that would be adopted for the Project are set out in the Australian/New Zealand Standard AS/NZ ISO 14000 series. The EMS therefore would have the following key components:

- organisational commitment;
- environmental policy;
- environmental aspects and impacts register;
- regulatory and legal compliance register;
- objectives and performance indicators;
- environmental management program documentation (ie. EMP);
- operational and emergency procedures;
- responsibility and reporting structure;
- training and awareness program;
- environmental performance reviews, audits, monitoring and measurement.

2 Environmental education and information management

2.1 ENVIRONMENTAL EDUCATION AND TRAINING MANAGEMENT PLAN

2.1.1 Background

It is mandatory that the EMP for the Project be followed by all personnel from the corporate and independent farms, the sugar mill and the water and drainage service provider, as well as contractors working in the Project Area.

This plan would address the environmental protection training requirements identified in the sub-plans of the EMP and the environmental induction and awareness requirements for all people involved in the Project. The plan requires the adoption of an Environmental Code of Practice (ECP) for the Project Area.

2.1.2 Risk assessment

Without adequate, up-to-date information and training, use and management of the Project Area will not achieve due diligence objectives, nor will it be cost effective.

2.1.3 Objectives

The objectives of the environmental education and training program are:

- to prevent adverse environmental impacts from construction and operations;
- to ensure all staff have relevant knowledge of environmental management, know their own (and others) environmental responsibilities and carry out their duties in order to protect the environment.

2.1.4 Management actions

The EME would:

- prepare environmental education training materials;
- prepare an ECP for construction and maintenance of the Project and obtain endorsement for the ECP from all asset owners;
- audit compliance with the ECP;

- develop and maintain an informal environmental group consisting of pro-environmental personnel (as cultural change agents) for the Project Area. The purpose of this group is to monitor and discuss environmental issues, facilitate communication of relevant environmental information, encourage environmental awareness, promote environmentally sustainable work practices, and strengthen interaction with the community;
- encourage operations and management personnel to provide suggestions for improvement in site environmental management practices;
- brief all new workers and personnel regularly deployed to the Project Area about the environmental responsibilities of the EME;
- organise and conduct regular environmental awareness-raising activities including on-site inspections/assessments, training activities, briefing sessions and preparation of information bulletins.

2.2 LEGISLATION, POLICY AND STANDARDS MANAGEMENT PLAN

2.2.1 Background

It is mandatory that all activities conducted in the Project Area comply with relevant State, Territory and Commonwealth Laws.

2.2.2 Risk assessment

If the EME does not identify all relevant legislation, policies and standards then Project related activities may not be compliant with these and legal proceedings may result.

2.2.3 Objectives

The objective of legislation and standards management will be to comply with all relevant government legislative requirements and Australian/International Standards.

2.2.4 Management actions

The EME would:

- consult adequately with all relevant levels of government in order to obtain all legislative and policy decisions relevant to the Project;
- obtain a copy of all relevant legislation and develop and update a legislative/policy register by placing a request, as a standing order notification, for copies of all new legislation and policies;
- obtain copies of all relevant Australian standards.

2.3 RECORDS AND INFORMATION MANAGEMENT PLAN

2.3.1 Background

Acquisition of information through monitoring, review and research will be an ongoing process, and an accurate, diverse and relevant information base will be essential for understanding and managing the environment. Reporting the results of monitoring and performance reviews and recording the changes in environmental conditions are particularly important if the EMP is to be useful, and provide a due diligence role. Records and information must be readily accessible and interpreted to assist planning of site activities, construction, and maintenance programs and to enable cost-effective, informed environmental management practices to be undertaken.

2.3.2 Risk assessment

Without appropriate records, performance reviews and assessments, it will not be able to demonstrate to outside agencies an adequate base for decision making and environmental due diligence.

2.3.3 Objectives

The objectives of records and information management will be to:

- obtain and maintain information pertinent to operation, construction and environmental management of the Project Area;
- use records and information to facilitate safe and sustainable development and environmental management in the Project Area;
- initiate and maintain a land use database and information for operations in the Project Area.

2.3.4 Management actions

The EME would:

- develop an appropriate filing or reference system for all information, databases, records, and references about all issues relevant to work activities and management of the Project Area;
- prepare an index of this material, update it annually and distribute it to relevant authorities;
- progressively incorporate baseline information and monitoring data into a computerised environmental management system;
- report the results and interpretation of the monitoring process on an annual basis on behalf of the industry participants. The annual report would detail actual environmental performance against the environmental performance targets detailed in the EMP, and would be made readily available to the industry participants. The

annual report would also be made available to relevant agencies and possibly other organisations and community interest groups.

3 Aboriginal Issues

3.1 NATIVE TITLE

3.1.1 Background

The land encompassing the Ord and Keep rivers, including the Project Area, is of traditional and current significance to the Miriuwung and Gajerrong people.

The early development of the ORIA Scheme occurred at a time when Aboriginal people were not consulted. In recent years, Aboriginal people have actively sought to have their traditional rights recognised, and to participate and share in the benefits of economic development.

The Miriuwung and Gajerrong people lodged three Native title claims under the *Native Title Act 1994*, over a significant portion of the East Kimberley in Western Australia and the Northern Territory in 1994 and 1995. These claims cover the entire Project Area.

In 1997, the Northern Land Council also lodged a land rights claim under the *Aboriginal Land Rights (Northern Territory) Act 1976* over the portion of the Project Area located within the Spirit Hills pastoral lease.

In 1998, the Federal Court of Australia determined that Miriuwung and Gajerrong people hold native title rights to an area of land the subject of the first of the three native title claims. This determination covers approximately 7,900 square kilometres and includes the Ord River, Lake Argyle and approximately 100 square kilometres of the Project Area.

For land that is the subject of a native title determination and land that is the subject of a native title claim, the native title holders and claimants may voluntarily surrender their native title rights and interests by way of a negotiated settlement. Such a negotiated settlement is known as an Indigenous Land Use Agreement (ILUA). Mutually agreed benefits packages for the native title holders and claimants are a key element of any ILUA, in return for the voluntary surrender of native title rights and interests over the land, enabling the development to proceed.

Wesfarmers-Marubeni and the Water Corporation intend to negotiate the terms of an ILUA with the Miriuwung and Gajerrong people prior to the start of Project construction.

3.1.2 Risk Assessment

If the EME does not support those elements of the ILUA directly relevant to the environmental management of the Project Area, then the good faith established with the Miriuwung and Gajerrong people may be compromised.

3.1.3 Objectives

The objective of supporting the terms of the ILUA would be to ensure that the good relationship with the Miriuwung and Gajerrong people is maintained for the life of the Project, benefiting the corporate farmers and independent farmers alike.

This objective would be met by ensuring that ongoing strategies for the delivery of the commitments made in the ILUA including farm and enterprise management support and opportunities, suitable employment opportunities including environmental monitoring, and access to the conservation area occur.

3.1.4 Management Actions

The EME would undertake the following actions with the Miriuwung and Gajerrong native title holders and claimants with regard to the Project Area:

- have ongoing transparent interaction with the native title holders/claimants as defined in the Community Consultative Plan (see Community Issues);
- establish an ILUA Implementation Plan to ensure that any outstanding commitments that are attributable to the EME are honored;
- ensure that native title holders/claimants have uninterrupted access to the conservation area to enable them to observe their native title rights and interests.

3.2 CULTURAL HERITAGE

3.2.1 Background

There are a number of significant cultural heritage sites within and in close proximity to the Project Area. These cultural heritage sites are protected by State, Territory and Commonwealth heritage legislation. Many of these sites are of cultural significance to the Miriuwung and Gajerrong people. One such site was listed on the Register of the National Estate in 1980 because of its significant cultural heritage values and is known as the Weaber Range Sites Complex.

The Miriuwung and Gajerrong people have participated in a cultural heritage assessment of the Keep River Plain and the Northern Territory portion of the Knox Creek Plain. The locations of cultural heritage sites have been documented accordingly. A limited cultural heritage assessment of the Weaber Plain and the Western Australian portion of the Knox Creek Plain has occurred to date.

The sites that may occur in the region include places of mythological and ceremonial significance, middens, fish traps, stone arrangements, rock-shelters, hearths, grinding hollows, paintings, engravings, burials, isolated artefacts, artefact scatters, stone

quarries, ochre quarries and scarred trees. The Project Area has no known places of non-Aboriginal historic heritage value.

Most of the proposed development of the Project Area is restricted to the black soil plains. However, it may be necessary to source road pavement material sites off the black soil. The topography of the area has played a role in protecting sensitive natural areas and cultural heritage sites. A large number of cultural heritage sites, in particular rock art sites and rock-shelters occur within the adjacent ranges, and within valleys where they are sheltered from direct impacts. Most cultural heritage sites will escape direct impact from the proposed development, however, secondary impacts from visitation may occur.

Major gaps in information relating to cultural heritage sites within the Project Area relate to the:

- lack of available information from Government agencies;
- inaccuracy of information, particularly location and spatial information;
- lack of significance information;
- sensitivity mapping;
- cultural landscapes.

A predictive model developed for the likely distribution of archaeological sites within the black soil plains has been tested during recent archaeological assessments. However, a further archaeological assessment of the black soil plains, particularly the portion of the Weaber Plain that is located in the Western Australian portion of the Project Area remains to be undertaken. This information is considered important for the long-term integrated management of the Project Area and to assist the EME setting management objectives and actions for the documentation and protection of cultural heritage sites within the conservation area.

Expectations of the EME regarding management of the cultural heritage values of the Project Area should be consistent with what is expected of other agencies with similar responsibilities.

There are no historic heritage sites of non-Aboriginal value known for the Project Area, hence no management plan is required. However, if any area or object potentially of significance is located, the EME would contact the relevant Government agency.

3.2.2 Risk Assessment

If a cultural heritage site is degraded by the development of the Project Area or subsequent operations, legal proceedings may result.

3.2.3 Objectives

EME objectives would be to:

- establish a Cultural Heritage Management Plan co-operatively and jointly with the Miriuwung and Gajerrong people;

- comply with State, Territory and Commonwealth cultural heritage legislation for the protection of the cultural heritage values of the land within the Project Area;
- comply with Miriuwung and Gajerrong aspirations for the protection of cultural heritage values of significance to them;
- prohibit/minimise the effects of construction, maintenance and farming activities on cultural heritage sites;
- raise awareness among employees, contractors and future landowners and operators on the importance of the cultural heritage values of the Project Area.

3.2.4 Management Actions

The EME would:

- establish a working relationship with the Miriuwung and Gajerrong people and have consistent, open and honest consultation;
- hold regular meetings with the Miriuwung and Gajerrong people about any proposals that may impact the cultural heritage values of the Project Area, prior to any action being undertaken;
- comply with relevant cultural heritage legislation;
- implement the Cultural Heritage Protection Procedures during the construction and operation phase of the Project;
- undertake detailed recording of cultural heritage sites within the Project Area;
- provide appropriate information to the appropriate Government agency on the location and significance of cultural heritage sites;
- compile, manage and update the cultural heritage data base for the Project Area on a regular basis;
- undertake management activities on cultural heritage sites (signage, fencing) as required.

3.3 SOCIAL IMPACT

3.3.1 Background

In 1978, the Commonwealth and Western Australian Governments jointly undertook a review of the ORIA Stage 1, and examined the impact of the development on Aboriginal people. The review noted that the development had *'contributed to the dislocation of the life and religion of Aboriginal people living in the area by destroying land of sacred and traditional value'*.

The review found that Aboriginal people residing in Kununurra were experiencing acute social problems, some of which stemmed from the development of ORIA Stage 1. These social problems included the lifestyle changes that occurred as a result of the flooding of Lake Argyle, the displacement of Aboriginal people from the

pastoral stations, the loss of access to country and loss of sacred sites caused by the inundation of Lake Argyle and the development of ORIA Stage 1.

Wesfarmers–Marubeni and the Water Corporation intend to negotiate the terms of an ILUA with the Miriuwung and Gajerrong people. The ILUA would offset any potential negative social impacts on Aboriginal people, which would be identified during the proposed Aboriginal Socio-Economic Impact Assessment (ASEIA).

An Aboriginal Employment Skills Audit would be established to specifically target the Aboriginal community in order to ensure that there is an understanding of the employment skills within Kununurra and Wyndham prior to project construction.

3.3.2 Risk Assessment

If the EME does not establish mechanisms for ensuring that potentially negative social impacts on Aboriginal people (particularly Miriuwung and Gajerrong) are addressed during the construction and operation of the Project, then it is possible that the EME will not be supported by the Aboriginal community, resulting in opposition to the Project.

3.3.3 Objectives

EME objectives will be to:

- minimise any negative socio-economic impacts and maximise any positive impacts of the proposed development on the Miriuwung and Gajerrong people;
- ensure that there is ongoing consultation;
- ensure that there are ongoing meaningful employment opportunities;
- provide the opportunity for construction/operational personnel to be made aware of cross cultural issues.

3.3.4 Management Actions

The EME would:

- ensure that any commitments identified and agreed during the ASEIA are fulfilled;
- explore the opportunity for representation from the Miriuwung and Gajerrong community on the EME;
- ensure the Community Consultative Plan includes mechanisms for active consultation with the Miriuwung and Gajerrong community;
- ensure that the Aboriginal Employment Skills Audit is updated on a regular basis, and ensure that there are identified ongoing opportunities for the meaningful employment of Aboriginal people;
- establish and enforce a compulsory cross cultural awareness course for all construction/operational personnel to be facilitated by the Miriuwung and Gajerrong people.

4 Community Issues

4.1 COMMUNITY ISSUES MANAGEMENT PLAN

4.1.1 Background

The nearest population centres to the Project Area are the towns of Kununurra and Wyndham. Both towns are in the Shire of Wyndham-East Kimberley. Aboriginal people comprise about 34% of the total population of the Shire.

The pastoral industry and irrigated agricultural operations are the two major activities contributing to agricultural production in the region. Tourism has become a major industry generally in the Kimberley.

The estimated direct workforce required for the development of the Project Area would be approximately 550 full-time equivalent positions. This estimate includes employment on the corporate and independent farms, in the sugar mill, in harvest and transport operations, in water supply operations, in environmental management, and in general management and administration.

The estimated indirect workforce would be seventy-five people and an induced workforce of 200. Indirect employment refers to jobs in businesses supplying goods and services to the agricultural sector. Induced employment refers to jobs created by the personal consumption and associated activities of people employed directly and indirectly in the agricultural sector.

It is anticipated that the numbers of construction personnel would range from 250-650 per annum over a three-year period. Whilst many construction workers would be sourced locally, it is anticipated that the majority would originate from outside the Kimberley region, and would be accommodated in a self-contained construction camp in the Project Area. The construction camp would initially accommodate approximately 650 construction workers. At the completion of construction, the camp may be reconfigured as 200 single accommodation units to house seasonal workers. The social impact of the construction workforce on the people and facilities of Kununurra and Wyndham is expected to be minimal.

The estimates of net population increase in Kununurra range from 1,397 persons to 1,954 persons. The Ministry for Planning is in the final stages of the preparation of the Kununurra-Wyndham Area Development Strategy (KWADS). This strategy is intended to provide direction for the long-term use and management of land in the area, as well as promoting the coordination of activities and initiatives of the community, private enterprise and Government. The KWADS should provide a sound

basis for Government to plan the long-term provision of services in the area, including any significant expansion of Kununurra.

There may be a need for between 500 and 700 new dwellings to be constructed in Kununurra as a result of the proposed development. Plans to increase the number of beds in the Kununurra Hospital to accommodate any increase in demands for hospital services from anticipated growth have been factored in.

Kununurra has two schools: Kununurra District High School and St. Joseph's Catholic School. Currently there is no senior high school in either Kununurra or Wyndham. The anticipated population growth and projected increase in enrolments may necessitate development of another combined pre-school and primary school, and may precipitate an upgrade of the Kununurra District High School to a senior high school.

The maintenance of access to local waterways for both recreational and lifestyle purposes is an important issue for the local community. The Project has been designed in such a way that access to the Keep River would be maintained.

Significant community consultation has been undertaken in relation to the proposed development throughout 1998-99. These consultation activities have included the use of a range of media outlets, brochures, public displays and meetings, and direct consultations.

4.1.2 Risk Assessment

If the EME does not establish mechanisms for ongoing and transparent community interaction with the Kununurra and Wyndham community, then the integrity of the EME from the perspective of the local community may decline and may lead to a negative community perception of the Project.

4.1.3 Objectives

The objective of community interaction management will be to minimise deleterious socio-economic impacts on the surrounding area, including all neighbouring landholders, and encourage effective and positive communication and community liaison between the EME, project asset owners and external groups and agencies.

These objectives will be met by the establishment of four sub-Plans which are as follows:

- the Code of Conduct Plan. The objective of the Plan is to establish a code of conduct for employees of the construction contractors, with respect to their interaction with the Kununurra and Wyndham communities. This Plan would be enforceable through construction contracts;
- the Community Consultative Plan. The objective of the Plan is to establish meaningful and transparent consultative mechanisms with the Kununurra and Wyndham community;
- the Recreation and Tourism Management Plan. The objective of the Plan is to minimise disruptions to traffic, recreation and tourism and, where practicable, to allow for enhanced recreation and tourism (as supplementary land use) of the Project Area;

- the Security Management Plan. The objective of the Plan will be to prohibit unauthorised access to the Project Area facilities and to control access to the conservation area.

4.1.4 Management Actions

The EME would:

- have ongoing transparent interaction with the community in the form of meetings, visits to the Project Area and the production of a regular newsletter;
- establish a Code of Conduct Plan;
- establish a Community Consultative Plan;
- establish a Recreation and Tourism Management Plan;
- establish a Security Management Plan;
- establish a Visitors Centre at the Sugar Mill to inform the community about Project activities, and to act as the focal point for the operations of the EME;
- establish and maintain recreation areas within the Conservation Reserve associated with the Lower Keep River;
- erect suitable information signs;
- accommodate and contribute to community requests and activities on an as needs basis.

5 Physical environment

5.1 SOIL CONSERVATION, REPAIR AND RESTORATION MANAGEMENT PLAN

5.1.1 Background

Soil erosion, especially accelerated erosion, may be a significant management issue in the Project Area. The soils of the Project Area are generally moderately erodible and may be become highly erodible when disturbed. Likely causes of accelerated erosion are:

- vehicular movement;
- indiscriminate crossing of watercourses;
- frequent burning of the vegetation;
- construction activities;
- old quarries.

Repair, restoration and rehabilitation may be required following any construction activities that have removed vegetation cover and exposed the soil. These measures will also be required to effect stabilisation and recovery of eroded areas currently present. Passive and active (assisted) rehabilitation strategies would be required. Repair of damage would be a particularly important factor in reducing land degradation, minimising soil erosion, allowing regeneration of vegetative cover and retaining the long-term viability of irrigated agriculture in the Project Area.

5.1.2 Risk assessment

If Project activities are to avoid environmental degradation and reclamation activities and comply with legislative requirements, then appropriate soil conservation controls would have to be established and implemented.

5.1.3 Objectives

The objectives of soil erosion management would be to:

- minimise disturbance and impacts to soils outside of farm areas;
- stabilise disturbed areas against the erosive force of water;
- restore, as nearly as practicable, the original productivity of eroded areas.

5.1.4 Management actions

Wesfarmers–Marubeni, the Water Corporation and independent farmers, under the auspices of the EME, would ensure soil erosion in the Project Area would be controlled by a combination of the following management strategies:

- controlling drainage by providing levee banks to prevent floodwaters entering the developed area;
- grading land on farms to gentle slopes to minimise stormwater runoff velocities;
- sizing and designing receiving drains to accommodate anticipated flow regimes;
- providing buffer zones on both sides of watercourses to allow riparian vegetation to continue to stabilise soils in these areas;
- rehabilitating disturbed areas as soon as possible following disturbance during construction;
- formulating and implementing appropriate rehabilitation plans and programmes including topsoil stripping and stockpiling, land preparation, and reseeding to facilitate regeneration of disturbed areas;
- managing crops in such a way that crop cover of the soil is maximised, particularly during the wet season when erosive rainfall events may occur.

Drainage waters leaving farms would first pass through farm drains and tailwater return systems that would settle and collect larger soil particles, such as coarse silts and sands. Farm maintenance would include regular desilting of these drains.

Management of sediment during construction would involve a combination of the following measures:

- wherever practicable, restricting ground-disturbing operations to the dry season;
- restricting ground-disturbing operations to the minimum area required to facilitate construction;
- collecting and storing for future use any topsoil from areas to be disturbed;
- installing and maintaining temporary sediment traps downstream of any areas to be disturbed;
- progressive clearing, developing and rehabilitating, wherever possible using locally won topsoil, of any areas that are no longer going to be disturbed.

Localised areas of high water velocity may occur at structures constructed across natural watercourses, such as the siphon and bridge crossings of Knox Creek and the Keep River. Appropriate erosion protection measures such as stone pitching and bridge abutments would be developed for these areas as part of the detailed design of the Project.

The EME would:

- monitor erosion along all water courses within and downstream of the Project Area, including constructed drains at the completion of each wet season and undertake the erosion protection measures on an as-needed basis;

- brief all contractors involved in construction activities on the precautions and measures necessary to avoid significant erosion impacts. All contractors would be required to formally acknowledge having received and understood the briefing, and agree to abide by the requirements by signing the Environmental Code of Practice;
- assess all construction activities using photographs, maps, ground truthing and reporting;
- audit construction activities to ensure that vegetation clearing is minimised and is at a level consistent with:
  - design needs for operations, construction and maintenance requirements;
  - requirements for bushfire control (e.g. required fire breaks);
  - preservation of conservation zones (No Go areas);
  - the maintenance of areas containing significant conservation values.
- ensure that areas being rehabilitated and revegetated are fenced or similarly protected to minimise disturbance and that the locations of such areas are shown on maps;
- develop a revegetation monitoring program to assess the success and progress of restoration procedures. This program should allow for at least one visit every three months. Monitoring procedures to be adopted will include fixed photopoints, with photographs to be taken before commencement of the revegetation program and biannually.

5.2 SOIL CHEMICAL STATUS

5.2.1 Background

The application of water and fertiliser may impact on the natural physical and chemical status of the soil. Such impacts may include:

- increased levels of salt and sodium ions (sodicity) specifically associated with irrigation;
- an increase in soil-available-nutrient status resulting from the application of fertiliser and from natural nitrogen fixation from leguminous crops;
- long-term changes in the overall balance of macro- and micronutrients in the soil reflecting the cropping and fertiliser regimes.

A review carried out in ORIA Stage One by Lavelle (1983) concluded that salinity and sodicity were not a problem at that time. However, Lavalle noted a high relative bicarbonate concentration (110 mg/L) in the irrigation water and preferential precipitation of calcium on to the soil and release of sodium. This created a potential hazard to irrigation, particularly for the cracking clays, which have a high susceptibility to sodium damage.

5.2.2 Risk assessment

Without monitoring of changes in soil chemical status, and changes in management practices as necessary, soils within the Project Area have the potential to suffer from sodium damage or salinity. As such the sustainability of irrigated agriculture may be affected or remedial measures required.

5.2.3 Objectives

The objective for managing soil chemical status would be to ensure long term sustainability of irrigated agriculture by avoiding subsoil salinity and sodium damage.

5.2.4 Management activities

The EME would:

- conduct long term monitoring of soil chemical status in the Project Area, including:
  - sodium adsorption ratio;
  - exchangeable sodium percentage (ESP);
  - electrical conductivity;
  - salinity;
  - macro-and micronutrient status;
  - organic matter content;
  - pH;
- maintain records of the monitoring results so that long term trends can be assessed;
- undertake research into the relationship between farm management practices and soil chemical status;
- provide advice to farmers on measures to manage soil chemical status, based upon the results of monitoring and research.

5.3 SURFACE WATER RESOURCES

5.3.1 Background

As with ORIA Stage One, releases of water from Lake Argyle, flowing via Lake Kununurra would be the source of irrigation water for the Project. The distribution of water from Lake Kununurra to the Project Area would be via the purpose-built M2 Channel.

The Keep River, located between the Ord and Victoria river catchments, is the most significant watercourse draining the Project Area. In addition to the Keep River, Sandy Creek drains the easternmost fringes of the Keep River Plain. The entire Project Area would be contained within the lower reaches of the Keep River and Sandy Creek catchments. Both the Keep River and Sandy Creek discharge into Joseph Bonaparte Gulf.

Nearly all rivers and streams in the region flow only in the wet season. Permanent water is therefore restricted to sheltered pools and billabongs that retain water during the dry season, and the tidal reaches near the river mouths. Pools and springs are important refuge areas for fauna in an otherwise seasonally dry environment.

5.3.2 Risk assessment

There is the potential for increased sedimentation and contamination of water resources downstream of the Project Area. Wesfarmers–Marubeni, the Water Corporation and independent farmers, under the auspices of the EME, would have a responsibility to ensure that water quality target levels, such as the ANZECC Guidelines, are not exceeded. In order to provide for due diligence information about the effects of Project activities, a monitoring program would be necessary. Organisations and/or individuals would be liable for prosecution if statutory guidelines for water quality were exceeded due to Project activities.

5.3.3 Objectives

The objectives for managing surface water resources would be to:

- conserve water resources consistent with best practice construction and farming requirements;
- ensure that water quality is not diminished as a result of activities;
- conserve natural water supplies, particularly biological water flows and dry-season water sources, that are of significance to biological communities.

5.3.4 Management actions

Wesfarmers–Marubeni and independent farmers will:

- develop all farms in the Project Area with irrigation tailwater management systems. Each tailwater management system would consist of the following elements:
  - tailwater ditches that collect tailwater from the furrows and deliver it to a tailwater dam;
  - tailwater dams. The volume of these dams would be optimised during detail design with the objective being to virtually eliminate discharges of irrigation tailwater during the dry season. As a minimum, the volume of the tailwater dam would be sufficient to provide the specified first-flush stormwater retention capacity for the Project—12 mm of rainfall runoff for sugarcane farms and 25 mm of rainfall runoff for all farms using endosulfan or any other chemicals perceived to be of high risk to the aquatic environment;
  - tailwater return pumps and pipelines that would return irrigation tailwater to the farm head ditch or to other intermediate points in the farm irrigation system for application to the crop. The tailwater return pumps would be set to operate at partial filling of the dam, thereby reducing the volume of tailwater requiring storage;
- adopt measures to minimise the effects of chemical spray drift, including:

  - adoption, where appropriate, of the integrated pest management strategy developed by AGWEST for ORIA Stage One to minimise the amount of pesticides used;
  - strict control on the use of pesticides, including mandatory adoption by all farmers of the spray calendar developed annually for ORIA Stage One;
  - minimisation of the use of aerial spraying, by using tractor-based spraying to the maximum extent possible;
  - avoidance of unsuitable weather conditions such as surface temperature inversions and unstable conditions during aerial spraying whenever possible;
  - utilisation of a large droplet size during aerial spraying;
  - a requirement that all commercial spray operators be accredited to a national registration programme;
  - management measures be adopted for the Project to minimise the effects of airborne dust;
  - provision of dedicated on-farm access tracks that would not have agricultural chemicals applied to them;
  - wherever possible, adoption of 'minimum tillage' farming practices.
- obtain approval from the EME for all intended applications of endosulfan;
- maintain the capacity of the first-flush basins through regular inspection and removal of silt;
- only apply fertilisers or chemicals to crops when the first-flush basin capacity is available;
- maintain registers of all chemicals and fertilisers used on the farms with the minimum data to include:
  - trade name and active constituents;
  - timing of application (dates);
  - mode of application;
  - area of application (farm blocks);
  - application rate;
  - meteorological conditions at time of application.
- provide the completed registers of chemical and fertiliser use to the EME on an annual basis.

The Water Corporation would:

- control aquatic weeds in the irrigation channels and balancing storage dams by a combination of mechanical weed removal and/or periodic dosing with a chemical such as acrolein. Chemical dosing would be in accordance with best-practice procedures as follows:

  - emptying the channel, locking offtakes, erecting warning signage and notifying farmers prior to injection of the chemical;
  - releasing a known flow of water to obtain a water depth of approximately 0.5 m into the channel and releasing the chemical from a controllable release point to maintain an initial concentration of 15 ppm (in the case of acrolein);
  - releasing a marker dye to denote the chemical front;
  - shutting flow to the channel and holding the chemical in the channel for a minimum of forty-eight hours before diluting by release of additional water and use of the water for irrigation.
- maintain a register of chemical use in the Project Area, with the minimum data to include:
  - trade name and active constituent;
  - timing of application (dates);
  - mode of application;
  - location of application;
  - application rate;
  - meteorological conditions of time of application.
- provide the completed register of chemical use to the EME on an annual basis.

The EME would:

- initiate and undertake regular monitoring of water quality at strategic locations upsteam, within and downstream of the Project Area. The monitoring programme would concentrate on establishing a baseline by collecting data on specific parameters associated with activities in the Project Area. The sampling regime would include:
  - monthly samples of irrigation water;
  - annual samples of soil from representative farm blocks;
  - annual samples (water and sediment) from all tailwater return systems;
  - monthly samples from all drains;
  - monthly samples for all receiving waters, including locations upstream of the Project Area;
  - monthly samples of groundwater discharges.
- have all samples analysed by NATA registered laboratories, utilising standard methods of analysis;
- establish and maintain a database of water quality monitoring data and relevant ANZECC criteria;
- provide advice to Wesfarmers–Marubeni, the Water Corporation and independent farmers on management practices to minimise impacts of Project activities on surface water resources.

5.4 GROUNDWATER RESOURCES

5.4.1 Background

Development of the Project Area for broad-acre flood irrigation is expected to result in an increased rate of water infiltration (known as accessions) to underlying aquifers and a consequential rise in groundwater levels.

The rate of groundwater rise and the need for groundwater management measures would be influenced by a number of factors, including the magnitude of the accessions to groundwater, the initial depth of groundwater from the surface, and local hydrogeological features. Agricultural activities are generally not affected unless groundwater levels are within approximately 2 m of the surface, a condition referred to as waterlogging. However, management measures are generally required for groundwater within 5 m of the surface, particularly if the groundwater is saline or the rate of groundwater rise has the potential to cause waterlogging in a short timeframe.

5.4.2 Risk assessment

Without proactive management, groundwater levels in some locations within the Project Area would rise to an extent that irrigated agriculture may be adversely affected.

5.4.3 Objectives

The objectives of managing groundwater resources would be to:

- ensure groundwater quality is not unnecessarily diminished as a result of farming activities;
- conserve groundwater resources that are of significance to biological communities;
- protect off-farm areas from groundwater impacts.

5.4.4 Management activities

Wesfarmers–Marubeni and the Water Corporation under the auspices of the EME would:

- undertake drilling across the interpreted position of the paleochannel aquifers in order to define their actual position beneath the irrigation area;
- install an extensive network of groundwater monitoring bores within and adjacent to the irrigation area prior to the commencement of irrigation. This network would include bore transects aligned perpendicular to the Keep River and Sandy Creek to acquire additional data for the better understanding of the river–groundwater interactions, and the establishment of monitoring bores adjacent to Milligan Lagoon;
- analyse samples of groundwater, collected during the above drilling, to quantify the vertical and horizontal water quality distribution;

- install test dewatering bores and test them to confirm aquifer yields and response of the aquifers to pumping;
- update the existing groundwater model for the Project Area, based upon data collected from the drilling programmes, and make the model available to the EME.

The Water Corporation would:

- adopt engineering design standards that comply with current best practice for all irrigation channels and regulating storages intended to convey or store water for prolonged periods. These design standards would specify the minimum thickness and compaction levels of the clay lining systems provided to minimise accessions to groundwater;
- site regulating storages in areas that naturally contain greater surface thickness of the less permeable Aquitaine clays;
- design drains for stormwater runoff with broad channel inverts to minimise excavation, thereby containing the channel inverts where possible in the naturally occurring less permeable surface soils;
- adopt comprehensive supervision and quality assurance procedures to ensure that the design intent is fulfilled during construction;
- develop and maintain a register of irrigation water supplied to each farm unit and make this register available to the EME on an annual basis.

Wesfarmers–Marubeni and independent farmers would:

- develop precision farm water management techniques, based upon the measurement of actual crop water use in the soil profile;
- use the above techniques to determine the timing and magnitude of irrigation applications.

The EME would:

- undertake annual monitoring of groundwater levels from all monitoring bores in the Project Area;
- undertake annual collection of groundwater samples and have these analysed at a NATA registered laboratory, using standard methods of analysis, for:
  - salinity (TDS);
  - nutrients;
  - insecticides and herbicides used in the Project Area.
- establish and maintain a data base of groundwater levels and groundwater quality analyses;
- regularly update the groundwater model;
- initiate and manage the timely installation of groundwater recovery bores, sub-soil drains and collector pipelines in the Project Area.

5.5 FIRE MANAGEMENT

5.5.1 Background

Typically, much of northern Australia has and continues to be burnt during the dry season, resulting in changes to the structure and composition of indigenous vegetation communities and an increased incidence of weeds.

5.5.2 Risk assessment

Inappropriate fire management can lead to the loss of life and property as well as reduce the conservation values of conservation areas.

5.5.3 Objectives

Objectives of fire management would be to:

- conform to all statutory requirements;
- prevent damage to human life and property;
- reduce the frequency, extent and intensity of wildfires;
- minimise the risk of fires entering or spreading beyond the Project Area or into the Project Area;
- protect any species and habitats sensitive to fire or inappropriate fire regimes, especially monsoon forest areas;
- maintain existing plant and animal communities.

5.5.4 Management activities

The EME would:

- prepare a Fire Management Plan for the Project Area following the receival of advice from CALM and the Parks and Wildlife Commission;
- apply for membership of the Bushfires Council (Northern Territory);
- co-ordinate and provide training in the operation of the Fire Management Plan.

6 Biological Environment

This chapter provides the EMP sub-plans for each of the following topics:

- native vegetation and fauna conservation;
- revegetation;
- weeds, plant pathogens and pest animals;
- biodiversity and nature conservation.

The sub-plains would form an integrated management strategy for the biological environment of the Project Area.

6.1 NATIVE VEGETATION AND FAUNA CONSERVATION MANAGEMENT PLAN

6.1.1 Background

The issues considered in this sub-plan are plant and animal species, communities, habitats and therefore, some aspects of biodiversity. An important feature of the Native Flora and Fauna Management Plan would be to manage and conserve listed ecologically significant communities and the majority of all vegetation communities.

Wesfarmers–Marubeni and the Water Corporation are committed to preserving the ecological and biodiversity values of the Project Area consistent with the proposed construction, farming and maintenance activities. Disturbance to the indigenous plant communities surrounding the farm areas would be minimised during construction and after development. Preventing the introduction and spread of declared and environmental weeds, pest animal species and plant pathogens is of importance to this plan.

6.1.2 Risk assessment

Land management and operations in the Project area should not be allowed to jeopardise vegetation and fauna values in the conservation areas. In particular, degradation of vegetation in the conservation areas would result in public embarrassment if these areas are no longer suitable for their intended purpose and therefore require restoration and/or rehabilitation by the EME; and pressure for the conservation area to be managed by government agencies.

6.1.3 Objectives

Objectives for the management of native flora and fauna would be to:

- identify, protect and maintain flora and fauna species, vegetation communities and habitats;
- maintain and not degrade the ecological integrity and biodiversity of the conservation areas;
- rehabilitate areas disturbed during construction, enhance native flora, vegetation communities and habitats.

6.1.4 Management actions

Wesfarmers–Marubeni and the Water Corporation would:

- undertake a detailed biological survey of the conservation area;
- preserve vegetation communities consistent with construction, farming and maintenance requirements by establishing dedicated conservation area as described in the ERMP/DRAFT EIS;
- ensure if there is any loss in the use of flora and fauna and other resources by the Miriuwung and Gajerrong people that it would be addressed in an Indigenous Land Agreement between the co-proponents and the Miriuwung Gajerrong people;
- protect the conservation area from construction impacts by clearly marking its location on maps and on the ground;
- minimise the possibility of weed invasion and the risk of introduction and establishment of new weed species and plant pathogens during construction by requiring construction contracts to include provisions outlined in the Weed Management Plan (Section 6.3).

The EME would:

- protect areas containing plant species of particular conservation significance by controlling access through signage, fencing and the development of walk trails;
- undertake rehabilitation of borrow pits and other sites not intended for farms using flora species endemic to that area and the most appropriate methods (e.g. topsoil and vegetation spreading, direct seeding and seedlings);
- establish, maintain and upgrade maps, diagrams, plans and photographs to indicate ecologically significant areas;
- take photographic records of each of the flora and fauna monitoring sites to illustrate any long term changes in the vegetation;
- establish permanent monitoring sites for flora in the conservation area along selected corridors. In the conservation area at least three, 20m x 20 m permanent quadrats would be established in each of the different vegetation associations;
- establish transects to monitor condition where the vegetation varies rapidly as on the river and creek banks and wetlands;
- develop terrestrial fauna assessment sites for frog call census; pitfall lines and elliott traps; spotlighting transects; bat trapping; timed counts; records of nesting and box trap;

- develop aquatic fauna assessment sites for sampling by gill nets, fine mesh seine, scoop nets and beam trawl nets in the estuarine portions of the Keep River and Sandy Creek.

6.2 REVEGETATION AND MANAGEMENT PLAN

6.2.1 Background

This section covers the requirements for rehabilitation of areas, especially along drainage channels.

The key management issues are:

- restoration of areas damaged during construction;
- fire management, particularly the intensity, optimal season, length between fires and percentage of area burned;
- weed control, including along water courses, roads, boundaries with farms;
- use of seed from native plant species collected before the vegetation is cleared for revegetation;
- protection of threatened flora and fauna;
- ongoing surveying to monitor the success of the different rehabilitation methods and seed mixes used.

6.2.2 Risk Assessment

Wesfarmers–Marubeni and the Water Corporation are committed to undertake appropriate rehabilitation of areas degraded as a result of development. If Project activities are to avoid environmental degradation and expensive rehabilitation activities, and comply with legislature requirements, the appropriate revegetation of disturbed areas must be implemented.

6.2.3 Objectives

The objectives of rehabilitation management are to:

- protect and enhance indigenous species and communities;
- initiate a revegetation program based on locally sourced propagating material representative of indigenous species and vegetation communities present.

6.2.4 Management Actions

Wesfarmers–Marubeni would:

- fence the perimeter of the Project Area to exclude stock. Fencing, will not be provided to natural barriers, such as the tidal sections of the Keep River and the Weaber Range escarpment;
- arrange for pastoralists to remove stock from the Project Area.

The EME would:

- develop and implement a Fire Management Plan (Section 5.5);
- regularly monitor the conservation area for stock and arrange for their removal if any are detected;
- develop and implement a Weeds, Plant Pathogens and Pest Animals Management Plan (Section 6.3);
- obtain the necessary permits for the collection of seeds from native species;
- undertake rehabilitation of disturbed areas utilising locally sourced topsoil and seeds from native species;
- provide temporary fencing and signage to any revegetated areas;
- monitor the success of revegetation methods and modify as necessary.

6.3 WEEDS, PLANT PATHOGENS AND PEST ANIMALS MANAGEMENT PLAN

6.3.1 Background

The most effective and environmentally acceptable method of controlling new weed species and animal pests is to prevent their introduction. All staff and contractors should be made aware of the need to prevent the introduction of new weed species and animal pests into the Project Area. Weeds along the rivers and creeks should be targeted in particular wild passionfruit and caltope which exist in the Project Area prior to development.

Feral animals recorded from the Project Area include cats, rats and mice.

6.3.2 Risk Assessment

The EME is obliged to manage pest species on the farm land and in the conservation areas in order to ensure minimal land degradation. Failure to do so could result in prosecution from the State and Territory authorities and deleterious changes to the ecology of the Project Area.

6.3.3 Objectives

The objectives for controlling weeds and pest animals and for dealing with plant and animals diseases are to:

- prevent the introduction of weed species and plant and animal diseases;
- control the introduction and spread of feral animals and vermin;
- eliminate declared and environmental weeds;
- minimise the spread of existing weed species;
- control pest animals in the conservation areas.

6.3.4 Management actions

Wesfarmers–Marubeni and the Water Corporation would:

- ensure clearance and disturbance of native vegetation during construction is minimised and vegetation rehabilitation accomplished quickly, thereby avoiding the creation of suitable areas for weed and plant pathogen invasion;
- ensure mandatory interstate quarantine are maintained during construction to control weeds from other areas;
- require construction contractors to carry out cleaning, where appropriate, of all vehicles and maintenance materials of soil and organic debris prior to arriving at the site;
- ensure site vehicles are restricted as much as possible to within the Project Area;
- require construction contractors to source borrow from weed free sites.

The EME would:

- regularly (annual) monitor and prepare a summary of the main areas of weed infestations within the conservation area;
- notify the Weed Science Section of AGWEST or the Department of Primary Industries and Fisheries (Northern Territory) of any declared weeds observed in the Project Area, and consult with the agencies to ensure compliance with relevant legislation and to ensure the implementation of appropriate control measures;
- develop methods for weed control where possible, ensuring acceptable controls are used when removing weeds near water courses;
- ensure constant monitoring of problem weed species is carried out and that effective control methods are undertaken before the populations are deemed a problem;
- take adequate measures to prevent the introduction and spread of new weed species and plant pathogens by:
  - undertaking equipment, plant and vehicle cleaning as necessary;
  - requiring all soil materials delivered to the site is certified weed and disease free;
  - ensure that quarantine inspection and clearance certificates are available for all interstate equipment and vehicles;
- ensure that species used in revegetation are suitable plants indigenous to and collected from the area;
- investigate immediately any area of vegetation which was apparently healthy and which, for no obvious reason, wilt and/or die to determine the presence of plant pathogens, changes in water levels or quality;
- control or eradicate feral fauna ensuring that no native fauna species are jeopardised;
- prohibit all unauthorised animals from the Project Area (eg. no cats and dogs);

- seek advice and expertise from authorities on all topics of this sub-plan as necessary.

6.4 BIODIVERSITY AND NATURE CONSERVATION MANAGEMENT PLAN

6.4.1 Background

Protection of the natural environment is a high priority. Conservation areas have been selected to conserve the natural assets of the Project Area, as consistent with the proposed development, and to implement ecologically sustainable management.

6.4.2 Risk Assessment

The proposed conservation area includes several priority flora and fauna species, vegetation communities and habitats. The farm development must not have a negative impact on the biodiversity of the conservation area. If it does, the Project may suffer a poor public image and the integrity of the EME may decline.

6.4.3 Objectives

The objective is to protect the conservation area during the development of the Project Area and during ongoing operations.

6.4.4 Management Actions

During construction, Wesfarmers–Marubeni and the Water Corporation would:

- ensure conservation of all important existing habitats by the conservation of representative vegetation communities;
- ensure areas designated for construction works are clearly marked on development maps and on the ground prior to commencement of work;
- require progressive rehabilitation of sites disturbed during development by construction contractors, especially drainage channels;
- require environmental and cultural heritage induction programs for all contractors and consultants working in the Project Area.

During operations, the EME would:

- maintain firebreaks and access tracks in the conservation areas;
- monitor and remove noxious and environmental weeds and pest animals;
- review maintenance proposals to ensure the extent of vegetation clearing for every maintenance activity is consistent with:
  - needs for the specific task;
  - requirements for bushfire control (access tracks);
  - priority conservation of significant areas of vegetation, wildlife habitats, corridors and other areas of significance;

  - the maintenance of areas containing significant plant communities, species and animal habitats.

- develop and maintain public access points to the Keep River;
- monitor the use of the conservation area to ensure there is no deliterious use that could lead to degradation;
- brief all contractors and establish construction site guidelines as per the EMP;
- establish liaison with all regional and surrounding landholders who are involved with the active land management of properties;
- develop education material on nature conservation and implement as part of the environmental education and training program.