

**PHELPS/PANIZZA HOLDINGS
BLACKMORE RIVER (EAST) AQUACULTURE PROJECT
MIDDLE ARM, DARWIN HARBOUR, NORTHERN TERRITORY**

EXECUTIVE SUMMARY

INTRODUCTION

Phelps/Panizza Holdings proposes to construct an aquaculture development on the western side of Middle Arm, Darwin Harbour, adjacent to the Blackmore River. This document is a summary of the Public Environmental Report (PER) for the development. The PER has been submitted by Phelps/Panizza Holdings (Phelps/Panizza) to provide the Northern Territory Government and the public with concise and comprehensive information regarding the design, construction and operation of the proposed venture and associated facilities. It is designed to provide the information necessary to allow an informed appraisal of the environmental acceptability of the proposed development.

PROPONENT DETAILS

*Phelps/Panizza Holdings
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Phelps/Panizza Holdings, the lessee of this site, is a registered business in the Northern Territory, and is a Partnership of five individuals as listed:

<i>Helen Antoinette PANIZZA</i>	<i>15%</i>
<i>Albert John PANIZZA</i>	<i>15%</i>
<i>Benedict James PANIZZA</i>	<i>15%</i>
<i>Mark Joseph PANIZZA</i>	<i>15%</i>
<i>Gregory Vincent PHELPS</i>	<i>40%</i>

Phelps/Panizza Holdings is a land holding entity, which has been set up to purchase and develop aquaculture sites, for lease to our associated entity, Phelps/Panizza Partnership.

Phelps/Panizza Partnership (ABN# 43 190 784 216), also registered in the Northern Territory is a Partnership of two companies:

<i>Lombard Farms Pty Ltd</i>	<i>60%</i>
<i>Phelps Aquaculture Pty Ltd</i>	<i>40%</i>

EXPERIENCE OF PROPONENT AND KEY PERSONNEL

Proponents

Mr Greg Phelps is a Partner in Phelps/Panizza Holdings and a Director of Phelps Aquaculture Pty Ltd, which holds the management agreement to the aquaculture operations. Greg Phelps has a background of management in agricultural-based business, initially in irrigation design and construction, corporate cotton farming and, most recently, international cotton trading.

Mr Albert Panizza BE (Hons) MBA represents the Panizza family members of Phelps/Panizza Holdings and is the Managing Director of Lombard Farms Pty Ltd, a Brisbane based family company with various interests in primary production. The Panizza family holds extensive interest in property investments, civil construction, pre-casting and agriculture. Albert Panizza has acted as Chief Executive of the family's operations for the past ten years.

Phelps/Panizza has worked for five years towards developing a significant aquaculture venture, with the majority of this work focused on the Darwin region.

Key Personnel

A management structure is planned to allow smooth transition to the full-scale development over six years. Some key personnel have been selected and others will be appointed when the project is cleared through Native Title and environmental processes.

A General Manager will be appointed, with applicants expected to have a strong technical background in aquaculture or related disciplines. This position is planned to complement the more general management skills of Greg Phelps, who will act as Managing Director.

The structure will include a Manager of Project Assets (responsible for the construction, installation and maintenance of all buildings and machinery) and an Operations Manager (to run daily activities on the farm under instructions from the General Manager). Both these positions will report to the General Manager.

The Managing Director will be responsible for product marketing and the development of new markets off-shore.

In addition, it is expected that another six to nine permanent staff will be required during Stage 1.

PROOF OF LEASE PROJECT AREA

The development area is currently under offer of lease by the Minister for Lands, Planning & Environment to Helen Panizza, Albert Panizza, Benedict Panizza, Mark Panizza and Greg Phelps (Phelps/Panizza Holdings). Once the lease is established Phelps/Panizza Partnership will sublease from Phelps/Panizza Holdings.

PROPOSAL BACKGROUND AND JUSTIFICATION

*Phelps/Panizza have extensively researched the aquaculture industry with study of various existing operations in Australia and abroad. Their research, including aerial surveys of the Darwin region, has led them to choose the Blackmore River site for the production of marine species, mainly the black tiger prawn (*Penaeus monodon*). Based on primary data, including climate and ocean statistics, Phelps/Panizza has concluded that the Darwin region offers conditions optimum for the success of their proposal.*

The commercial success of the project will be based on:

- *increasing world demand, especially in South East Asia, for seafood production conducive to maximum growth of warm water marine species;*
- *plateaued supply of seafood from the worlds natural fish stocks; and*
- *tightening legislation with respect to exploitation of natural fish stocks.*

The Northern Territory has been selected for establishment of the aquaculture development for the following reasons:

- *climate conducive to maximum growth of warm water marine species;*
- *availability of sufficient land and water resources at cost effective prices;*
- *location of Darwin on established trade and freight routes and proximity to South East Asian markets;*
- *readily available educated technical workforce; and*
- *supportive government policies.*

The Blackmore River Aquaculture Development site has been selected for the following reasons;

- *readily accessible seawater with minimal impact to mangroves;*
- *close proximity to Darwin;*
- *soil types and topography are satisfactory for construction requirements;*
- *suitable dam catchment area and construction site;*
- *adjacent electricity supply; and*
- *existence of potable groundwater.*

PROPOSAL OBJECTIVES

Phelps/Panizza are proposing to construct and operate an aquaculture farm at Blackmore River (East), Middle Arm, Darwin Harbour. The proposal is intended to be a long-term profitable investment with recognition that the following issues must be carefully managed to sustain the success of the project into the future:

- *preservation of the surrounding natural environment;*
- *formation of an effective workforce, offering job satisfaction and real long-term career prospects for employees;*
- *operational and cost efficiencies, achieved by well-researched design, professional management and application of modern technology; and*
- *the presentation for sale of a consistently high quality product in sufficient quantity to establish a brand of preference in target markets.*

DESCRIPTION OF PROPOSED DEVELOPMENT

The project is expected to be developed in two stages, over a five-year period.

Stage 1 of the project will involve the construction of 22 production ponds (total water area of approximately 27 ha), a saltwater pump jetty into the Blackmore River, a saltwater supply channel, a 20 ha exchange water treatment pond, a 20 ha freshwater dam, associated supply channels, access roads and buildings.

Stage 2 (full-scale development) will comprise a total of 93 production ponds (approximately 115 ha), a 186 ha freshwater dam (with a holding capacity of approximately 5,500 ML), four exchange water treatment ponds (80 ha in total) and a 26 ha pasture area. This infrastructure will be serviced by a network of saltwater supply channels, three saltwater intake pumps (installed on the original jetty), channeling and pipe work required for supply and drainage, three above ground fuel (diesel) storage tanks, power generators and supply lines. A packing/processing factory, hatchery, office building and managerial/staff housing will be built. Fencing, access roads and farm roads will also be constructed.

PHYSICAL ENVIRONMENT

Locality

The lease site occupies an area of approximately 796 ha on Middle Arm, Darwin Harbour, approximately 25 km south of Darwin. The site is bound to the south and west by mangrove margins of the Blackmore River, and generally consists of woodland areas between the 4 m and 24 m Australian Height Datum (AHD). The northern boundary of the site fronts the Middle Arm Boat Ramp Road and the eastern border parallels Finn Road.

Climate

The Darwin region has a tropical monsoon climate with two distinct seasons - the Wet Season from November to March and the Dry Season from May to September, with April and October being transitional months. Average annual rainfall is 1702 mm, most of which falls during the Wet Season when humidity averages 70-80%. In the Dry Season humidity is often below 40% and there is virtually no rainfall. Mean annual evaporation is 2661 mm.

Between November and April tropical depressions, which may develop into cyclones, pass through the Darwin region. Surface wind stress, lowered atmospheric pressure and wave set-up combine to elevate sea levels during the passage of a cyclone.

Oceanography

The lease area lies within Darwin Harbour. Tides are predominantly semidiurnal (two high waters and two low waters per day), with a slight inequality between tides during a single day. Tidal amplitudes are greatest during equinoctial tides in May and November/December, when the tidal range can reach 8.0 m.

Topography

The lease area encompasses:

- *Undulating rises and gentle slopes, present across the majority of the lease area.*
- *Gently undulating upland surfaces, in a thin strip at the north-east of the lease area.*
- *Gently undulating lower slopes (along minor streams).*
- *Alluvial plains and drainage lines/minor levees (along major streams).*

Geology and Soils

The Blackmore River is underlain by meta-sediments of the Early Proterozoic Finnis River Group, which generally consists of shale, siltstone, sandstone, greywacke, schist and gneiss. The Finnis River Group was deposited by turbidity currents in a submarine fan environment. The member of the Finnis River Group present beneath the site is the Burrell Creek Formation.

The majority of the site is underlain by unconsolidated sand, ferruginous, clayey and gravelly soil, common limonite pisolites, or pisolitic and mottled laterites, ferricrete, in-situ and reworked remnants of standard laterite profile. The lower lying mangrove areas to the west of the lease area are underlain by mud, clay and intertidal marine alluvium and the watercourses that drain the upper catchment are underlain by sand, shelly sand, coralline sand and cheniers.

Numerous outcropping quartz dykes exist across the lease area. In addition, there are small occurrences of outcropping shale, siltstone and phyllite, in places colour-banded, fine to very coarse sandstone, quartzite, quartz pebble conglomerate, minor graphic phyllite, quartz-mica schist and gneiss.

Only a small portion of the development area (approximately 1 ha) is underlain by marine clays, which may contain acid sulfate soils (ASS). As there will be minimal disturbance to the underlying marine clays as a result of construction works, ASS are not considered a management issue for the Blackmore River (East) Aquaculture Development.

Groundwater and Surface Hydrology

The groundwater regime of the lease area comprises a near-surface seasonally affected groundwater table, and a deeper groundwater aquifer associated with the underlying Burrell Creek Formation.

The weathered soil profile at the site can generally be expected to have high permeability, which will readily facilitate recharge to a shallow watertable. Laterite profiles, which are typical of the area, include porous laterite that typically absorbs groundwater recharge during the Wet Season and then gradually releases the stored water during the Dry Season as the water table slowly drains.

The Burrell Creek Formation that underlies the site is relatively impermeable, holding limited quantities of water in fractures of defined spatial and vertical extent. Groundwater bores located on the site are expected to yield 0.5 L/s to 2.0 L/s.

BIOLOGICAL ENVIRONMENT

Vegetation

Vegetation within the lease area forms recurring spatial patterns that closely reflect the interplay of topography and soils and the influence of seasonal and temporal fluctuations of salt and fresh water supply. Of the total lease area, approximately 99% (794 ha) comprises upland woodland habitats lying above the 4 m AHD contour, which marks the upper limit of tidal inundation. A minor area of the proposed development (approximately 1 ha) occurs below the 4m contour and this mainly comprises saltflats and mangroves of the upper intertidal zone.

Key aspects of the vegetation in the lease area are:

- The terrestrial vegetation communities are typical of the woodlands of the Darwin region and are well represented in reserves elsewhere.
- The mangrove communities are broadly similar to assemblages elsewhere in Darwin Harbour and the region generally.
- No endangered plant species or plant communities of conservation significance have been recorded, but one species (*Grevillea longicuspis*) currently listed as rare, occurs within the lease area. This *Grevillea* is restricted in distribution but is locally common within its range and botanists from the Northern Territory Herbarium consider that this species no longer warrants rare status. It is anticipated that the aquaculture development will have a minor effect on the overall population of this species.
- While four introduced plant species have been recorded, three of which are declared Class B noxious weeds, the vegetation of the lease area is in relatively intact, natural condition and is free from widespread weed infestations.
- Frequent, extensive wildfires play a major role in determining overall vegetation types in the local area.

Terrestrial Fauna

Examination of international, national and state lists of threatened species indicate that there is little likelihood of any endangered species occurring in the project area and none of the "Specially Protected" species listed under the Territory Parks and Wildlife Conservation Act 1997 are expected in the project area. However, some species in the area are of some conservation significance.

One mammal and two bird species listed as 'low risk, near threatened' are known or expected to occur within the lease area. Five reptile species classified as "insufficiently known" are common or expected to occur in the Blackmore River area. However, other than the mangroves, the area does not support specialist or significant habitats such as monsoon forest, paperback swamp or wetlands and no significant breeding, roosting or feeding sites have been recorded.

The habitats occurring on the project area are in good condition, evidenced by the number and diversity of small mammals trapped in the limited time available. Feral animals, including pigs and cattle, are in low numbers. Feral cats in the area may be a threat to native small mammal populations.

Fisheries Resources

Barramundi is an important commercial and recreational species in the Northern Territory. Spawning occurs at river mouths and larval fish are carried by tides into supralittoral swamps at the interface of salt and freshwater, at or near the upper high tide level. These swamps are vegetated by seasonal plants, including saltwater grasses and various sedges, and can provide nursery habitat for the young fish. The swamps are very productive, providing barramundi with conditions for rapid growth and with shelter from predators. Towards the end of the Wet Season, before the swamps dry out, the fish move out into adjacent rivers or creeks and usually migrate upstream into permanent freshwaters.

It is considered that the proposed aquaculture development has no potential to significantly impact upon the Darwin Harbour barramundi population. There is very little suitable nursery habitat within the harbour and no supralittoral swamps have been identified within the lease area. There will be minimal disturbance of the intertidal salt flats, over which barramundi may periodically feed. The proposed development will not prevent the migration of barramundi into the upper fresh water reaches of rivers upstream from the site.

Biting Insects

Mosquitoes and biting midges were recorded within the lease area and potential breeding habitats identified. The major source of mosquitoes in the lease area are: the upper tidal sections of creek lines near the mangrove margins, tidally filled depressions near the high tide mark, and disturbed area at the tidal limit. Farm design and management measures will be implemented to minimise the creation of new breeding grounds for biting insects and information with respect to mosquitoes/midges will be provided to all staff.

SOCIAL ENVIRONMENT

Recreational

The Blackmore River is a popular fishing area, however the development, other than the pump jetty will be screened from view from the river by mangroves. The lease area is used by the public for recreational purposes on an irregular basis. The main apparent use of the lease area, mainly around the mangrove fringe, is for off road motorcycle riding.

The lease area contains no permanent freshwater habitat, limiting the recreational use of the lease area for many activities.

Heritage Sites

A total of six archaeological sites, comprising three shell scatters and three stone artefact scatters, were identified across the study area. All sites consisted of small, low density, surface scatters of archaeological material, including shells and quartz flakes, retouched flakes and bifacial points.

In addition to the archaeological sites, a total of 60 isolated artefacts were recorded within the proposed lease area. These included flakes, retouched flakes, cores, unifacial and bifacial points made almost exclusively from quartz, which as noted above, crops out extensively across the area. A single chert flake was also identified as part of the background scatter. Isolated artefacts were generally found on the mangrove/hinterland boundary or along creek banks.

ENVIRONMENTAL EFFECTS

The environmental effects of the proposed development are summarised in the Environmental Effects and Management Register, presented later in the Executive Summary. This summary lists the:

- *existing environmental status of the lease area;*
- *potential or actual impacts of the development;*
- *environmental factors of concern;*
- *management tasks proposed to mitigate any adverse effects; and*
- *predicted outcomes of the management strategies.*

In summary, the predicted environmental effects associated with the development of the Blackmore River site from unimproved land to an intensive agriculture site will be:

- *loss of vegetation, including minor losses of mangrove habitat ;*
- *loss of habitat for fauna;*
- *alteration to surface and sub-surface drainage patterns;*
- *destruction of six archaeological sites;*
- *increased road traffic during the operation phase (mainly during Stage 2) and increased demand on infrastructure; and*
- *restricted public access to the site;*

Potential environmental effects that will require management relate to erosion, weeds, fire, biting insects and waste water discharge.

ENVIRONMENTAL MANAGEMENT AND MONITORING

The PER includes details of management strategies that will be adopted. The objectives of the management strategies are to establish procedures that ensure the actual and potential adverse impacts associated with the construction and operation of the development are minimised.

A summary of management commitments is presented in Environmental Effects and Management Register.

The aim of the environmental monitoring programs will be to test and validate the main predictions regarding the effects of the development which have the potential to adversely impact the environment. The monitoring will also ensure that potential environmental effects are minimised and that the development complies with any regulations governing particular activities.

Monitoring conducted during construction and operation of the Stage I project will be used to assist in the design of subsequent stages of the development as it progresses towards Stage 2. Monitoring will include:

- *water quality;*
- *mangroves;*
- *weeds, and*
- *biting insects.*

BENEFITS

The development will provide significant benefits to the local community and economy of the Darwin area. The farm will provide short-term employment during construction phases of Stages 1 and 2 and long-term employment during the operational phase of the development. Through the establishment of a viable local industry the development will also result in the diversification of the local economy base.

Environmental Effects and Management Register

<i>Environmental Factor</i>	<i>Existing Environment</i>	<i>Potential Impact</i>	<i>Environmental Management</i>	<i>Predicted Outcome</i>
BIOLOGICAL				
<p>Vegetation clearing Refer Section 3.9 and 4.2</p>	<p><i>Extensive Eucalypt woodlands dominate the hinterland vegetation with open woodlands fringing a narrow riparian corridor along the seasonal drainage lines.</i></p> <p><i>Mangrove communities of the Blackmore River and its tributary creeks fringe the upland woodlands of the lease area.</i></p> <p><i>Narrow grasslands occur in the transitional area between the hinterland and the mangrove margin.</i></p> <p><i>No endangered plant species or special vegetation communities have been recorded in the lease area. However, several populations of <u>Grevillea longicuspis</u>, an endemic species of restricted distribution occurs in Open Woodland habitat within and adjacent to the lease area.</i></p> <p><i>The proposed production ponds will be located entirely within upland woodland habitat.</i></p>	<p><i>Loss during construction will result in clearing of:</i> ~200 ha during Stage 1 ~290 ha during Stage 2</p>	<p><i>Farm layout designed to minimise loss of vegetation.</i></p> <p><i>Construction adjacent to mangrove areas will aim to protect intertidal areas from negative impacts including siltation and changes in drainage.</i></p> <p><i>Clearing within the freshwater dam will be selective and limited to those communities that will be permanently flooded to a level considered lethal to the trees. Trees fringing the upper levels of the dam will be retained to reduce disturbance and loss of habitat.</i></p> <p><i>Restriction of construction activities to specified areas. Movement of construction vehicles will be managed to ensure that tree loss is minimised.</i></p> <p><i>Should areas of the development be decommissioned appropriate vegetation will be reestablished.</i></p>	<p><i>Total loss due to clearing through to Stage 2 development:</i></p> <p><i>~420 ha of eucalypt woodland;</i> <i>~61 ha of drainage line communities;</i> <i>~8 ha of grassland community; and</i> <i>~1 ha of mangroves.</i></p> <p><i>The communities to be cleared are well represented elsewhere within the lease area and surrounding region. No significant adverse ecological impacts are anticipated.</i></p>

Environmental Factor	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
<p>Inundation of vegetation</p> <p>Refer Section 3.9 and 4.2</p>	<p>The proposed production and exchange water treatment ponds will be located within upland vegetation communities.</p> <p>Stage 1 freshwater dam will inundate riverine open woodland and associated drainage line communities and some Eucalyptus woodlands.</p> <p>Stage 2 freshwater dam will inundate riverine open woodland and associated drainage line communities and some mixed species woodlands.</p> <p>The Stage 2 dam will inundate Eucalyptus dominated open woodland, including limited areas with <i>Grevillea longicuspis</i>, a Darwin region endemic currently listed as rare.</p> <p>Tracts of similar habitat are present outside the southern boundary of the lease area.</p>	<p>Approximately 200 ha of vegetation will be effected by dams. Some areas of woodland not cleared prior to dam construction may be permanently or seasonally inundated.</p>	<p>Clearing for freshwater dam construction will be kept to the minimum necessary and fringing vegetation in the upper levels of the proposed dam will be retained.</p> <p>Similarly, clearing along the dam spillway will be selective and minimised to prevent erosion and habitat loss.</p> <p>Regular surveys of freshwater dams will be undertaken to control the introduction and spread of aquatic weeds.</p> <p>The staged approach to the development will enable an assessment of Stage 1 of development to be conducted prior to clearing and inundation of the Stage 2 freshwater dam.</p>	<p>If the development proceeds to Stage 2 approximately 200 ha of vegetation will be effected by seasonal and permanent inundation to 14 m AHD.</p> <p>Increased diversity of aquatic, semi-aquatic and fringing wetland plant species, including <i>Melaleuca</i> spp. and <i>Lophostemon</i> spp.</p>
<p>Indirect vegetation changes</p> <p>Refer Section 3.9 and 4.2</p>	<p>Mangrove communities fringe the estuarine creeks adjoining the lease area.</p>	<p>Changes to the pattern of drainage, seepage and sedimentation may lead to the loss of some trees within the mangrove fringe in the vicinity of the exchange water treatment dams and saltwater supply channel. Gradual shifts in species composition may also occur over time.</p>	<p>The saltwater supply channel and the wall of the exchange water treatment dams are designed to minimise impacts on natural hydrological and sedimentary regimes, especially within adjacent mangroves.</p>	<p>The transitional grassland communities will be most affected (8 ha cleared).</p> <p>The hinterland margin of the mangroves may be effected by changes in drainage, but this community is well represented elsewhere within the surrounding region. No significant ecological impacts are anticipated.</p>

Environmental Factor	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
<p>Colonising native vegetation</p> <p>Refer Section 3.9 and 4.2</p>	<p>Mangrove communities occur between the Blackmore River and the hinterland along the alignment of the saltwater supply channel.</p>	<p>Mangrove seedlings can be expected to colonise the bund walls and mangrove growth may be encouraged downstream of the dam spillway.</p> <p>Increased waterlogging and possibly raised groundwater levels in the vicinity of the freshwater dams may encourage the expansion of paperbark and Lophostemon communities in this area.</p> <p>Native reeds such as Eleocharis spp. may proliferate in the swampy areas created along the margins of the freshwater dams.</p>	<p>Growth of native species will be encouraged, except where this may exacerbate biting insect problems.</p>	<p>Minor, regionally insignificant, colonisation of parts of the lease area by native vegetation can be expected.</p>
<p>Weeds</p> <p>Refer Section 3.9 and 4.2</p>	<p>The lease area is free from large weed infestations. Four introduced species recorded, three of which are declared noxious weeds (Class B).</p>	<p>Clearing of native vegetation and terrain disturbance may create conditions favourable for the proliferation of weed species.</p> <p>The new and extensive freshwater aquatic habitats created by the freshwater dams may provide conditions suitable for the proliferation of aquatic and semi-aquatic weed species.</p>	<p>Weed management and prevention measures will include:</p> <ul style="list-style-type: none"> • earthmoving equipment washed-down prior to entering the lease area during construction works to prevent spread of seeds; • rapid draw-down of water in the freshwater dam early in the Dry Season to discourage formation of semi-aquatic reed swamps along the dam margin; • selection of native species for the pasture production area and for landscaping around farm buildings; • weed removal from areas around farm buildings; • during the operational phase, off site vehicles will not be permitted to enter the site other than to park at designated parking bays outside the prawn farm; • slashing of fire breaks; and • annual weed surveys. 	<p>Management of weed issues will result in low risk of occurrence spread of weeds.</p>

Environmental Factor	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
<p>Fire regime</p> <p>Refer Section 3.9.5 and 4.9</p>	<p>Frequent, extensive burning of lease area and surrounds.</p>	<p>Reduction in frequency, timing and spread of fires.</p>	<p>A fire management plan will be developed, which will include:</p> <ul style="list-style-type: none"> • fire break alignment and construction; • reduction of flammable fuel loads around farm infrastructure; • protection of fire-sensitive species and communities; and • promotion of habitat heterogeneity. 	<p>A shift in vegetation species composition may occur towards a more dense mid-stratum layer, possibly including fire-sensitive monsoon forest species.</p> <p>Frequency, timing and spread of fires will be reduced due to site access restrictions and construction of fire breaks. Habitat heterogeneity may increase due to protection of fire-sensitive vegetation.</p>
<p>Terrestrial fauna</p> <p>Refer Section 3.10 and 4.3</p>	<p>One mammal and two bird species listed as 'low risk, near threatened' and five reptile species classified as 'insufficiently known' were identified within the lease area. However, the lease area is not considered to contain significant sites for these species. No significant breeding, roosting or feeding sites have been recorded.</p> <p>Feral animals are present in low number in the lease area.</p>	<p>Removal of terrestrial fauna habitat.</p>	<p>Feral animals will be managed on an 'as required' basis.</p> <p>Bird nets will be installed on the production ponds if water birds cause significant stock losses.</p>	<p>Vegetation clearing will reduce available terrestrial fauna habitats within the lease area.</p> <p>The freshwater dam may increase the extent of habitats favoured by fauna such as wading birds and frogs.</p> <p>Increased habitat heterogeneity through improved fire management practices may improve wildlife habitat quality.</p> <p>Loss of ~1 ha of mangrove habitat is likely to be insignificant to mangrove fauna, given the extensive area of similar habitat in the immediate vicinity.</p>
<p>Fisheries resources</p> <p>Refer Section 3.11 and 4.3</p>	<p>No supralittoral swamps (potential barramundi nursery habitat) have been identified within the lease area.</p>	<p>Minor disturbance to intertidal salt flats and mangrove creek banks during construction of the saltwater supply channel and exchange water discharge channel.</p> <p>Low potential for increases in nutrient levels or depletion in dissolved oxygen levels in Middle Creek due to exchange water discharge.</p> <p>Low potential for infection of wild prawn stocks by disease outbreaks.</p>	<p>Restriction of construction activities to the minimum required for construction of the channels.</p> <p>Treatment of exchange water to minimise nutrient loads and to return dissolved oxygen to background levels prior to discharge.</p> <p>Disease control management measures will be implemented to minimise the potential for significant impacts upon stocks of wild prawns and mud crabs.</p>	<p>No significant adverse impacts to fisheries resources are anticipated.</p>

Environmental Factor	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
<p>Biting insects</p> <p>Refer Section 3.12, 4.10 and 5.4.4</p>	<p>Significant numbers of mosquitoes and biting midges have been recorded.</p> <p>Areas where mangroves border brackish supralittoral swamps can become major mosquito breeding habitats during the late Dry and early Wet Seasons.</p>	<p>Mosquito breeding habitat may: increase along the shallow margins of the freshwater dam if growth of aquatic vegetation is enhanced; and/or decrease on the tidal flats to the west and south-west of the dam wall due to reduced seasonal fresh water flow</p> <p>The production ponds and exchange water treatment ponds are unlikely to provide suitable breeding habitats for biting insects.</p>	<p>Management of biting insect problems will include:</p> <ul style="list-style-type: none"> • drainage designed to prevent ponding of water in low-lying areas; • native fish populations will be maintained in the freshwater dams to assist in control of larval mosquito numbers; • farm buildings positioned away from low-lying areas; • regular clearing of vegetation in vicinity of buildings; • clothing, repellants and antiseptic creams will be available to all personnel on site; • screening of staff facilities; and • staff induction. 	<p>Staff will receive adequate protection against biting insects.</p>
PHYSICAL				
<p>Soil erosion</p> <p>Refer Section 4.8.2</p>	<p>The existing hydrology of the site includes ongoing natural erosion and deposition processes.</p>	<p>Increased erosion associated with altering natural hydrological patterns.</p>	<p>The following measures will be adopted to minimise erosion:</p> <ul style="list-style-type: none"> • all development will be undertaken in the Dry Season; • minor access roads will be formed so as not to impede or divert sheet flow drainage or channel drainage; • roads will be drained with side gutters and runoff drains; • embankments will be compacted and have a cover of lateritic gravel; and • channels will be lined with rock rip-rap. 	<p>Erosion will be minimised by the implementation of management measures. Some localised erosion may be expected as the natural hydrological patterns are reestablished. Current dynamic erosion patterns will continue.</p>

Environmental Factor	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
<p>Hydrological regime</p> <p>Refer Section 3.7 and 4.5</p>	<p>The existing hydrology of the site includes ongoing natural erosion and deposition processes.</p>	<p>Increased erosion associated with altering natural hydrological patterns</p>	<p>The following measures will be adopted to minimise hydrological changes:</p> <ul style="list-style-type: none"> • scouring will be prevented through implementation of erosion control measures; • farm alignment/design will avoid interruption to tidal movement; • drainage channels will be constructed around buildings and stormwater will be directed towards natural drainage lines; • overflow from the freshwater dam spillway will be directed back into the natural channel; and • main farm infrastructure will be constructed above the 1 in 100 year peak combined sea level prediction for the area. 	<p>The freshwater dams will significantly alter the natural hydrological processes.</p> <p>There will be a limited impact on the natural hydrological processes by the construction of the remaining structures.</p>
POLLUTION MANAGEMENT				
<p>Dust generation</p> <p>Refer Section 4.8.4</p>	<p>The existing Middle Arm Boat Ramp Road generates significant dust during the Dry Season.</p>	<p>Farm traffic will increase dust generation along the Middle creek Boat Ramp Road and the site access roads.</p>	<p>Management procedures will be put in place to minimise the volumes of traffic generated from the aquaculture farm.</p>	<p>Minimal increase in dust generation from Stage 1 development.</p> <p>Moderate increase in dust generation from Stage 2 development.</p>
<p>Discharge water quality</p> <p>Refer Section 3.8, 4.6 and 5.4.1</p>	<p>No discharge waters are currently released into the environment at the site.</p>	<p>Water quality (nutrients, recreational)</p>	<p>Management procedures will be put in place to minimise the nutrient load of waste discharge water. Discharge water will be passively treated in pond(s) prior to release. Active treatment of discharge water will, if required, be implemented.</p> <p>Discharge water will be released on outgoing tides to maximise dilution.</p> <p>Stocking levels, water exchange, feed and aeration times will be determined with reference to water quality parameters.</p> <p>Accidental or unauthorised release of discharge water will be prevented by use of valve locks.</p> <p>Water quality monitoring of discharge water will be regularly undertaken.</p>	<p>Minimal impact on water quality of the Blackmore River system.</p>

Environmental Factor	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
<p>Waste disposal</p> <p>Refer Section 4.7</p>	<p>No waste is presently generated at the site.</p>	<p>The following general wastes will be produced on site:</p> <ul style="list-style-type: none"> • sludge from the production ponds; • vehicle washdown water; • disinfectants and detergents from cooking and packing factory; • domestic sewage effluent; • diseased prawns; • used parts, sump oil, etc from farm machinery; and • domestic waste; <p>Potential impacts include localised on-site contamination.</p>	<p>Sewage and domestic discharge water will be treated by septic systems designed in accordance with Territory Health guidelines.</p> <p>General waste material will be either buried onsite or disposed off-site.</p> <p>Sludge will not be transferred from the desalination bays to the pasture area until in-situ conductivity measurements indicate a sufficient reduction in salinity levels. A bund wall will be constructed to contain runoff from the pasture area. Tail water drains will be constructed to collect excess stormwater from the pasture area for diversion into the exchange water treatment ponds.</p> <p>A TIT will be installed to remove potentially oily discharge water from vehicle/plant wash-down</p> <p>Waste oil will be disposed off-site by a licenced waste management contractor.</p>	<p>No reduction in water quality from the domestic sewage effluent disposal systems.</p> <p>Minimal adverse effects on the ecosystem from the on-site operations and waste disposal.</p>

Environmental Factor	Existing Environment	Potential Impact	Environmental Management	Predicted Outcome
<p><i>Disease control and quarantine</i></p> <p>Refer Section 4.4</p>	<p><i>Present level of prawn related disease within wild stocks unknown.</i></p>	<p><i>Introduced diseases could cause total loss of crop.</i></p> <p><i>Movement of introduced diseases could damage wild prawn stocks.</i></p>	<p><i>Quarantine facilities will be utilised for new stock.</i></p> <p><i>Broodstock will be certified as 'disease-free' prior to transfer to growing ponds.</i></p> <p><i>Dead and diseased stock will be collected and buried with a heavy application of lime to increase decomposition.</i></p> <p><i>Stock escape will be prevented by pond design measures.</i></p>	<p><i>No adverse impact to wild stocks is anticipated.</i></p>
SOCIAL ENVIRONMENT				
<p><i>Sacred sites</i></p> <p>Refer Section 3.13 and 4.12</p>	<p><i>There are no identified sacred sites within the lease boundaries.</i></p>	<p><i>No impact.</i></p>	<p><i>No management required.</i></p>	<p><i>No adverse outcome</i></p>
<p><i>Heritage sites</i></p> <p>Refer Section 3.13 and 4.12</p>	<p><i>There are 6 archaeological sites that have been identified at the site.</i></p> <p><i>Sixty isolate artefacts were identified on the lease area.</i></p>	<p><i>All 6 archaeological sites will be destroyed as a result of the development, either through physical destruction or inundation.</i></p> <p><i>Isolated artefacts are likely to be destroyed/inundated.</i></p>	<p><i>Ministerial consent to destroy the 6 archaeological sites will be sought prior to construction activities. No management measures required.</i></p>	<p><i>Destruction of the 6 archaeological sites on the lease area. Each of the sites is considered to be of low archaeological significance.</i></p>
<p><i>Public access</i></p> <p>Refer Section 3.14 and 4.13</p>	<p><i>The lease area is currently accessed on an occasional basis by off-road motorcycle riders.</i></p>	<p><i>Loss of access</i></p>	<p><i>Boundary fencing will prevent public access to the lease area for recreational purposes.</i></p>	<p><i>Public access to the site for off-road motorcycle riding will be prevented. Areas adjacent to the property will remain available to motorcycle riders. The impact of access restrictions to recreational users is limited.</i></p> <p><i>The development will have no effect on access to the adjacent waterways by recreational fishers.</i></p>

<i>Environmental Factor</i>	<i>Existing Environment</i>	<i>Potential Impact</i>	<i>Environmental Management</i>	<i>Predicted Outcome</i>
DECOMMISSIONING				
Site rehabilitation Refer Section 4.15	The site is currently relatively undisturbed.	The site is abandoned or partly decommissioned and not subsequently rehabilitated.	The rehabilitation program will include: <ul style="list-style-type: none"> • leveling of earthen structures; • removal of miscellaneous construction items; • revegetation of cleared areas, where practical; • feasibility study on potential to convert freshwater dam into a conservation area; • removal of buildings; and • regeneration of access roads. 	If the site is abandoned or partly decommissioned project infrastructure will be cleared and disturbed areas revegetated.