Striker
RESOURCES N.L.
A.B.N. 86 009 153 119

BARGE SITE, LAYDOWN AREA and ACCESS ROAD
GUMBOOT BAY, NORTH KIMBERLEY W.A.

PUBLIC ENVIRONMENTAL REVIEW

MAY 2002

INVITATION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

In accordance with the *Environmental Protection Act 1986* a Public Environmental Review has been prepared which describes the Striker Resources proposal to utilise a dry door barge site at Gumboot Bay, North Kimberley and develop a laydown area and access road to support their diamond exploration in the region. Gumboot Bay is located within Proposed National Park 215. The PER is available for a public review period of 4 weeks from Monday 13 May 2002 to 10 June 2002.

Comments from the public and government agencies will assist the EPA to prepare an assessment report in which it will make recommendations to the government.

Why Write a Submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action, including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless specifically marked confidential and may be quoted in full or in part in each report.

Why Not Join a Group?

If you prefer not to write your own comments, it may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a Submission

You may agree or disagree with, or comment on, the general issues discussed in the document or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more acceptable environmentally.

When making comments on specific proposals in the document:

- Clearly state your point of view;
- Indicate the source of your information or argument if this is applicable; and
- Suggest recommendations, safeguards or alternatives.

Points to Keep in Mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that the issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate sections, chapter or recommendation in the document;
- if you discuss sections of the document, keep them distinct and separate, so there is no confusion as to which section you are considering; and
- attach any factual information you wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address
- date; and
- whether you want your submission to be confidential.

The closing date for submission is: Monday, 13 June 2002. Submission should be addressed to:

The Chairman
Environmental Protection Authority
9th Floor, Westralia Square
141 St. George's Terrace
PERTH WA 6000

or

Environmental Protection Authority
PO Box K822
PERTH WA 6842

More information on how to make a submission can be obtained from the free pamphlet "*Environmental Impact Assessment – How to Make a Submission*" available from the Library of the Department of Environmental Protection. Tel: (08) 9222 7127.

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EXECUTIVE SUMMARY

Overview

Striker Resources NL (hereafter referred to as the Proponent), has been an active "junior" diamond explorer in the North Kimberley region of Western Australia since 1992.

The Proponent has been successful in discovering diamondiferous kimberlite pipes in the Ashmore area (see Figure 1) and is actively exploring and evaluating other prospects in the region. To determine the commercial viability of kimberlite pipes, advanced exploration programmes are implemented, including large diameter drilling, trial mining and bulk sampling of ore parcels up to several thousand tonnes from each kimberlitic occurrences. Testing of the bulk samples and drill cuttings is undertaken in a centrally located Washing and Heavy Medium Separation (WHMS) plant located at Ashmore.

On a wider front, diamond exploration activities, which include drilling, ground based geophysical and soil sampling programmes are undertaken in the adjacent Forrest River Aboriginal Reserve, Beta Creek, North King George and Casuarina Project areas. The ongoing implementation of these programmes requires a cost effective and reliable supply route.

In past years, supply of bulk diesel fuel, consumables and equipment for Ashmore and other project areas was achieved via the Kununurra - Gibb River and Kalumburu - Carson River Station road network - a distance of up to 700 km. The ford access across the Drysdale River and opening of the Gibb River Road varies from year to year depending upon the length of the wet season. Coupled with this can be the precursor showers to the wet season commencing in late October, which can make the Carson River road impassable due to extensive sections of "black soil" country. This can restrict secure access to just 4 months of the year.

More recently, fuel supplies, consumables and heavy equipment were barged to Longini Landing near Kalumburu and road transported across the Drysdale River and its numerous tributaries to the Ashmore site, a distance of 185 km. This route, while shorter, experiences the same problems outlined above.

Other mineral explorers operating in the region adapt their field programmes to suite climatic conditions. They bring in drummed fuel supplies and equipment either by road or in some circumstances by barge to the Faraway Bay Bush Camp. Neither of these options is appropriate for Striker's proposed testwork and exploration programmes. The level of mining and processing necessary, with their associated fuel volumes and equipment requirements, cannot be sustained either by road or by barge from Faraway Bay.

The current road routes, extended wet seasons, clay rich terrain units and extensive drainage systems combine to:

- potentially delay and shorten the mining and exploration season;
- increase costs associated with re-establishing and maintaining trafficable access across the major river systems; and
- increase the risk of environmental incidents such as fuel or chemical spills.

An associated issue is the annual re-opening of the Carson River road to the Gibb River road which allows uncontrolled access by tourists into the region against the wishes of the Pastoral Lease holders, the Balanggarra Aboriginal Community and the local tourist operator at the Faraway Bay Bush Camp.

To overcome these issues the Proponent has been investigating alternative means of access for some time. This proposal details the outcome of these investigations.

Assessment Process

The Environmental Protection Authority (EPA) originally set the level of assessment for this proposal at Informal Review with Public Advice on the basis of the limited extent of likely environmental impacts and the availability of provisions under the *Mining Act 1978* to manage potential impacts. Twenty-four appeals were lodged against the informal assessment decision by the EPA principally from the local tourist industry. The comments raised in the public submissions covered a range of topics that included:

- consideration of alternative sites;
- the level of public consultation with barge and charter boat operators in the area;
- consideration of potential impacts within a proposed national park;
- consideration of issues affecting the interests of the Bush Camp in Faraway Bay – a small tourist facility situated 1.5 km from the proposed barge site; and
- lack of comprehensive environmental, archaeological and cultural research undertaken in the area.

It was determined by the Minister for the Environment and Heritage, that to satisfy public interest and allow the re-examination of alternative locations, the proposal should be formally assessed as a Public Environmental Review (PER) with a four week public review period.

The Proposed Development

The Proponent proposes to establish a dry door barge access and laydown area in a coastal inlet 36 km south-east of Cape Londondery and 30 km north of the Ashmore Treatment Plant. The site, known locally as Gumboot Bay, is in the Ashmore Project Area within Unallocated Crown Land (see Figure 2) that has been proposed as part of the Cape Londonderry National Park (PNP/215). The site is within exploration tenement EL80/1840 held by the Proponent since 1994 (see Figure 2) and 1.5 km south east a small isolated tourist facility known as the Bush Camp. The facility would operate initially for eight months of the year. Use of the facility would provide security of supply for the Proponents ongoing mining and exploration activities. The laydown area would house above ground fuel transfer and storage facilities. The facility would be linked by a purpose built, unsealed Restricted Access Road (Figure 3) to the Proponent's Ashmore Plant.

The project has the following main components:

- drydoor barge access during high tides to a beach landing site. The access would be used up to 40 times during the field season. Seabed dredging would not be required;

- a 50 m long, 8m wide access road from the beach to a laydown area located above the 100 year storm surge level. Beach access to the laydown area would be controlled by a locked gate;

- a 50m x 50m laydown area that would contain unidirectional tower lighting, navigational aids, graded hardstand area and a bunded compound for 2 x 20,000 litre camouflaged diesel fuel storage tanks;

- a 15 metre wide perimeter fire buffer zone around the laydown area and a water storage tank;

- barge to shore fuel unloading infrastructure including fuel spillage containment; and

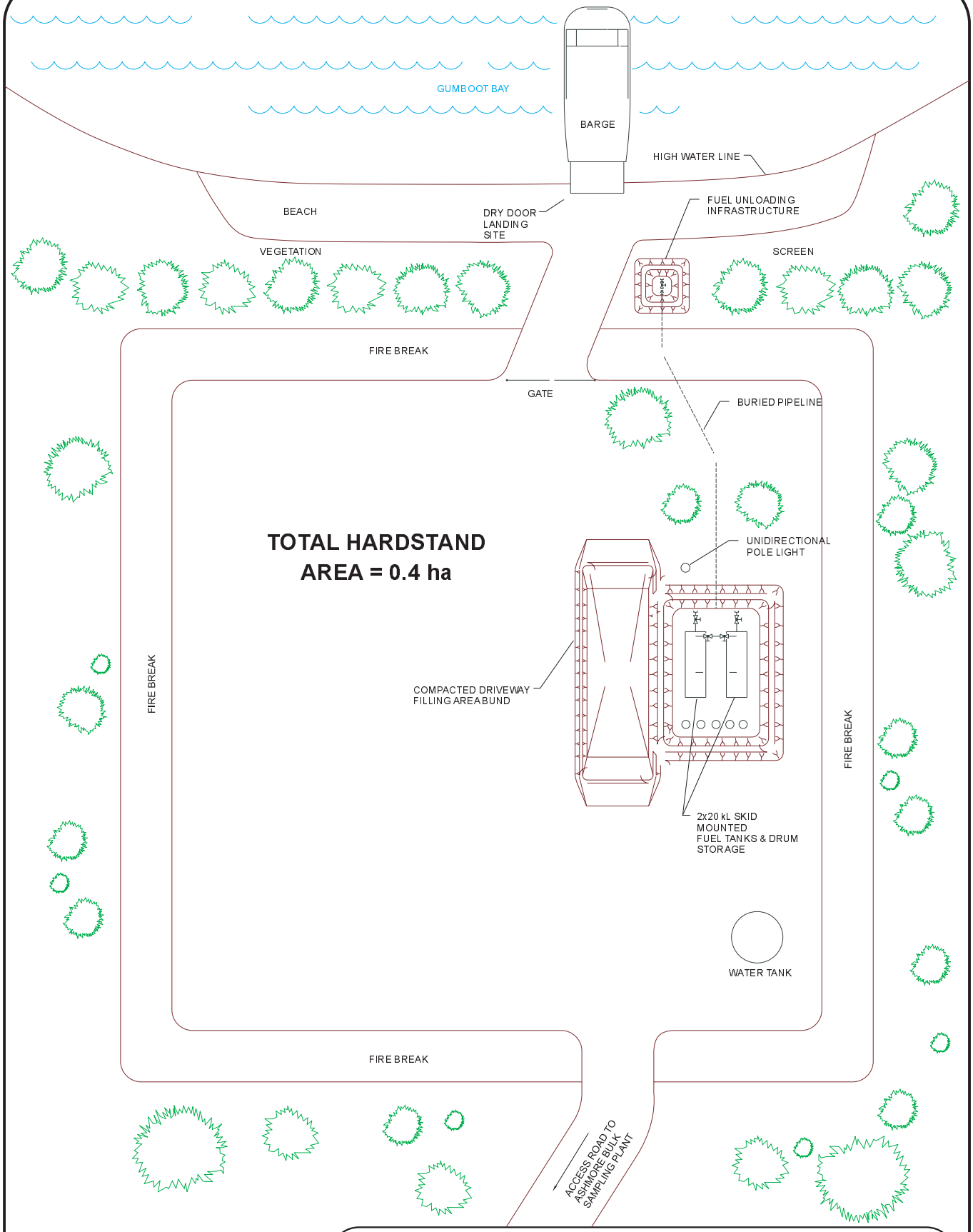

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Figure A-1

GUMBOOT BAY BARGE LANDING SITE SCHEMATIC LAYOUT

Author: K. Hart

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- a new unsealed, 3.6 km segregated Restricted Access Road within PNP/215. The road would link up with an approved road of similar design direct to the Ashmore Plant.

The area of clearing within PNP/215 would be approximately 4.0 ha.

The Proponent's road tanker would transport fuel, equipment and supplies to the Ashmore Project Area as required during daylight hours. Materials designated for return to Darwin such as empty fuel drums, waste oils, industrial scrap and samples would be backloaded to the barge.

The road corridor south of PNP/215, which completes the access through the centre of the Ashmore Project Area, has received construction approval from the Department of Mineral and Petroleum Resources (DMPR) and is covered by a separate Miscellaneous Licence. This road when completed will, in addition to providing road access to the barge site, support the ongoing exploration programmes on the Proponent's leases.

Timing

Subject to obtaining all of the necessary approvals and grant of Licence, construction of the facility in PNP/215 would commence in 2002. Road works would be completed in approximately two weeks. Key characteristics of the project are outlined in Table A.1. A schematic site plan of the barge site and laydown area is shown in Figure A.1 with the access corridor within PNP/215 superimposed on a low level aerial photograph (see Figure 3).

TABLE A.1: KEY CHARACTERISTICS OF THE PROPOSAL

Element	Description
Location	Proposed Barge Site is located in the informally named Gumboot Bay at Latitude 13°58'S and Longitude 127°12'E, 36km south-east of Cape Londonderry.
Construction Period	Approximately 2 weeks – works undertaken during daylight hours.
Equipment	Conventional earth moving equipment – bull-dozer, rock breaker, loader and trucks.
Infrastructure	Dry door beach landing site. This allows the barge door to open directly onto the beach. Construct an access up to laydown area (50m x 8m). Construct on laydown area (50m x 50m) above 100 years storm surge level. Clear a perimeter (15m) fire buffer zone around the laydown area and water storage tank. Construct a unsealed restricted use access road (3.6 km x 8m) within PNP/215. Install 2 x 20,000 litre camouflaged fuel tanks, unloading and transfer infrastructure with unidirectional tower lighting in bunded area. Source construction material from borrows located outside of PNP/215 on the Carson River Pastoral Lease. Establish barge site vegetation screens and erosion control structures as required.
Area of disturbance within PNP/215	Access Road - 3.6 ha Laydown area - 0.4 ha Borrow pits - External to PNP/215 on E80/1840 Total – approximately 4.0 ha
Facility Operation	Up to 40 barge movements per field season. Road transportation to Ashmore undertaken during daylight hours. No refuelling or permanent residential facility at barge site.
Workforce	Construction - up to 5 personnel. Accommodation – At Ashmore Exploration Camp.
Life of Project	For the period the Proponent holds leases in the region.

Evaluation of Alternatives

Barging of supplies, fuels and equipment is a long established method of supporting exploration activities and remote communities in the Kimberley's where road access is controlled by rugged terrain, dissected drainage landscapes and seasonal climatic conditions. Striker personnel have, in addition to undertaking aerial searches and vehicle traverses, sought information on potential barge sites, road construction methods and access routes from long term Kimberley residents, barge operators and pastoralists.

This information was used to identify fundamental site requirements and biophysical constraints which had to be satisfied if the project were to avoid potential environmental, engineering and economic penalties during construction and operation. Seven primary factors were identified as being necessary to satisfy environmental and operational requirements. These included:

- availability of a protected, dry door barge site within close sailing proximity to Darwin;
- access to a near-shore laydown area located above the 100 year storm surge level;
- close proximity to an access corridor that did not require the crossing of any major river system or extensive areas of basalt or siltstone derived clay soils;
- close proximity to, or located on, company held tenements for security of tenure;
- accessible for at least 8 months of the year;
- allowing the shortest practicable distance to the Ashmore Project Site to minimise road construction and maintenance expenditure; and
- located so as to minimise or avoid disturbance to environmentally sensitive habitat, areas of Aboriginal significance and the activities of other land users.

The second stage of the selection process identified regional dry door barge sites that allowed access up onto the escarpment without major materials movements and generally satisfied the other important constraint criteria in respect to corridor alignments.

This comparison and elimination process resulted in the selection of 5 of the 8 sites for assessment of potential environmental risks.

The environmental assessment of each potential site was completed by comparing the total environmental risk to each site. The environmental risk ranking (Tables 2.3 and 2.4) was determined by a combination of the expected frequency of the aspect occurring, the consequences of it's occurrence and public interest (Sandman 1993). The process provides a subjective assessment of the relative importance of the different factors considered and includes:

- impacts to current land use and visual amenity;
- impacts to drainage;
- impacts to vegetation communities and fauna habitats;
- impacts to the Conservation Estate, and
- barge site location and impacts to the marine environment.

The final stage of the selection process was the identification of impacts associated with the construction, engineering and economic considerations of the access road (Table 2.5) and the methods proposed to reduce any potentially adverse impacts. These aspects are incorporated into management actions in the Construction Management Plan (Appendix E) and outlined in the Proponents specific commitments (Table 7.1) for the development.

The Gumboot Bay site ranked as the most suitable, with the lowest potential to impact on the environment and satisfy operational requirements.

The Environment

The informally named Gumboot Bay is one of several coastal embayments located on the northern part of the Kimberley coastline between Cape Londonderry and Cape Ruhliers. The north Kimberley coastline is irregular and typical of a drowned coastline with beach and hinterland access limited, except in a few locations, by sea cliffs and plateau topography. It is bounded seaward by a broad continental shelf. The region is drained by two of the Kimberley's major rivers – the Drysdale to the west and the King George to the east. Neither will be impacted by the current proposal.

Gumboot Bay is one of two north-south oriented shallow embayments (Figure 3). The shoreline is predominantly basaltic cliffs and rocky points. There are small sandy beaches in the mid section reaches extending back to narrow fringing tidal flats supporting mangrove species - *Rhizophora stylosa* and *Bruguiera parviflora*. No extensive sea grass beds or coral communities have been identified within the upper reaches of Gumboot Bay. Dredging for barge access will not be required. No impacts to coastal processes are anticipated. Tides are semidiurnal with moderate spring ranges and low tidal velocities when compared with other Kimberley sites examined.

A total of 147 taxa, 107 genera and 54 families were recorded in the barge site corridor flora survey. Species representation was greatest amongst the families Poaceae, Papilionaceae, Cyperaceae, Proteaceae, Myrtaceae and Mimosaceae – a flora composition typical of the Gardner Botanical District. Six vegetation communities were recorded in PNP/215 and these appear to be parts of larger units well represented throughout the region and are not thought to be regionally or locally significant.

No plant taxa gazetted as Declared Rare Flora pursuant to subsection (2) of Section 23F of the *Wildlife Conservation Act (1950)* were located within the PNP/215 road corridor or laydown area (*Wildlife Conservation (Specially Protected Fauna) Notice 2001*. No plant taxa pursuant to Schedule 1, or threatened ecological communities pursuant to Schedule 2 of the *Environment Protection and Biodiversity Conservation Act (EPBC 1999)* were located.

Of the Schedule fauna which potentially occur within the area - one Schedule 1 (Red Goshawk) and a Schedule 4 (Peregrine Falcon) avian species may occur in the project area. Both are wide ranging and widely distributed and the proposed development is unlikely to effect them. One Schedule 1 Mammals - the Orange Leaf nosed-Bat and one Schedule 4 Reptile – the Saltwater Crocodile are recorded from habitats similar to those represented in the area. The Golden-backed Tree rat is nominated on the *EPBC(1999)* Vunerable Species Listing and may occur in the area. No species or habitats utilized by any of these species will be significantly impacted by the proposed development.

Land Use Considerations

Existing regional land uses include pastoral activities, mineral exploration, areas set aside for conservation parks, tourism and for the use and benefit of Aboriginal people. The entire Cape Londonderry area is currently subject to a Native Title Claim by the Balanggarra Aboriginal Traditional owners. The closest residential area to the proposed barge site is the Faraway Bay Bush Camp – a seasonal recreational fishing facility located 1.5 km north east of the barge site in an adjacent bay. Concerns raised by the Bush Camp Proprietors in regard to potential noise and landscape amenity impacts have been addressed in Management Plans and operational commitments. The Proponent believes the construction and operation of the facility will have minimal impact on the amenity of the Bush Camp.

The inlet is located on the eastern end of the Cape Londondery Proposed National Park and adjacent to the Forest River Aboriginal Reserve. The Conservation Through Reserve Committee (CTRC) recommended in the preamble to the System 7 - Recommendation 7.8 that the unallocated Crown Land at Cape Londonderry be reserved because of its geographical position, varied scenery, geology, flora, fauna and recreation depending on improvements to access.

The proposed laydown site and road is not inconsistent with the CTRC Recommendation 7.8.

Aboriginal Heritage

No sites will be impacted by the proposal. The Proponent works closely with local Aboriginal Communities and has well established site heritage clearance protocols in place. Heritage clearances for the barge site and access road have been completed.

Public Consultation

Throughout the initial development of the Environmental Management Plan and during the preparation of the PER, consultation was undertaken with a broad range of Decision Making Authorities, Aboriginal Groups and other commercial interests both in Perth and the region. Issues raised during the consultation process and measures developed to prevent or ameliorate potentially adverse impacts have been identified and incorporated into the planning of the facilities.

The proponent has made a commitment to continue consultation with all interested parties and to operate the facility site in a manner which avoids conflicts with other land users.

Proponents Commitments

The Proponent is committed to achieving a high standard of environmental management during the construction and operation of its proposed facilities and infrastructure. This commitment has resulted in the development of Management Sub-Plans and procedures covering Construction, Equipment Hygiene, Spill Response and Emergency Response. These are referenced in Appendices E to I.

The Proponents environmental performance and compliance with any Ministerial Conditions of Approval and the commitments made for the Project will be reported annually in the Site Annual Environmental Report (AER) to Regulatory Authorities.

The environmental and social factors associated with the proposal and their proposed management are summarised in Table A-2.

Table A.2: Summary of Factors and Proposed Management for the Project

Issue/Factor	EPA Objective	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
BIOPHYSICAL FACTORS					
Terrestrial Flora – Vegetation Communities	Maintain the ecological function, abundance, species diversity, geographic distribution and productivity of vegetation communities	The landforms and associated vegetation present in the project corridor (PNP/215) are common in the region. A flora and vegetation survey of the barge site and road corridor within PNP/215 and on the Pastoral Lease was completed in 2001. A baseline survey of the Ashmore Project area was completed in 1999. 147 taxa in 6 communities were identified within PNP/215. None are identified as Regionally or Locally significant. Communities with highest local conservation significant are: • Dunal (beach) complexes which contain mangroves; • Major riparian vegetation; One introduced weed taxa (*Acanth ospermum hispidum*) recorded in PNP/215. Its distribution is limited.	The establishment of the laydown area and access road will result in the clearing of approximately 4.0 ha covering 6 communities. These include • Community 1ca – 1.0 ha • Community 1cb – 0.5 ha • Community 1f – 0.3 ha • Community 2 – 0.8 ha • Community 3 – 1.3 ha • Community 4 – 0.04 ha Minor disturbance to surface runoff. No impact to mangroves from proposed development. No impacts to riparian vegetation Weed species introduced or spread during earthworks.	Specific measures outlined in Construction Management Plan (Appendix E). Minimize vegetation clearing. Progressive rehabilitation of any disturbed areas no longer required for project use. Slope drainage to be maintained through design. Avoidance measures to sensitive habitat implemented through site selection and design. Corridor sited to avoid crossing major drainage systems. Management procedures to minimise weed spread are outlined in Construction Management Plan (CMP)and Equipment Hygiene Procedure.	Six vegetation communities were recorded in PNP/215. No threatened ecological communities pursuant to Schedule 2 of the *EPBC Act (1999)* were located. No significant long-term impacts.

Table A.2: (Continued)

Issue/Factor	EPA Objective	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
Terrestrial Flora – Declared Rare and Priority Flora, Flora of Conservation Significance	Protect Declared Rare and Priority Flora consistent with the provisions of the *Wildlife Conservation Act (1950*). Protect flora listed on the relevant schedules of the *EPBC Act (1999*). Protect other flora species of conservation significance.	A flora and vegetation survey of proposed infrastructure corridor in PNP/215 completed in May (2001). No Declared Rare or Priority Species or Schedule 1 taxa were identified in PNP/215. No threatened Ecological Communities pursuant to Schedule 2 of the *EPBC Act* (*1999*) were located in PNP / 215.	Direct clearing impact on 4 ha of land. No DRF or Priority Species identified at barge site or in alignment corridor.	Minimise vegetation clearing. Progressive rehabilitation of disturbed areas (ie borrow pits). Workforce education includes conservation of habitat information. Avoidance of large trees or timber stands during road construction.	No significant long term impact.
Terrestrial Fauna – Specially Protected (threatened) fauna	Maintain the abundance, species diversity and geographic distribution of terrestrial fauna. Protect specially protected fauna consistent with the provisions of the *Wildlife Conservation Act (1950).* Protect fauna listed on the relevant schedule of the *EPBC Act (1999).*	Desktop study completed. 269 vertebrate species potentially expected to utilise similar habitats to those represented in PNP/215. No habitats of regional significance identified in infrastructure areas although locally significant habitats (ie. Mangroves) present in the wider Project Area. Desktop survey identified 5 Schedule listed fauna. • 2 Schedule 1 fauna (Orange Leaf nosed-Bat and Red Goshawk); • 3 Schedule 4 fauna (Peregrine Falcon, Freshwater and Saltwater Crocodile). • The Red Goshawk and Golden-backed Tree-rate are also listed as vulnerable under the *EPBC Act (1999*).	Main impact to fauna will be loss of 4 ha of habitat. Disturbance to rocky areas during construction. Minor impacts to clay rich soil areas, rocky zones and riparian zones associated with drainage. Fauna injury deaths arising from vehicle movements. Uncontrolled dry season burns. Impacts to threatened fauna: Peregrine Falcon, Orange Leaf-nosed Bat, Red Goshawk and Golden-backed Tree-rat unlikely to be impacted. Freshwater Crocodile habitat is not present in the development area. Saltwater Crocodile	Disturbed areas will be rehabilitated progressively to minimise loss of habitat. Avoidance of clay rich and riparian systems where possible. Tanker designed to travel at slow speeds. Fire management education in consultation with Pastoralist and CALM. Discussions with CALM on appropriate management actions as necessary. No impact No impacts to marine habitats or threatened fauna. Proposed development within PNP/215 does not cross permanent freshwater bodies.	Area of disturbance is small. No significant impact on fauna habitats or species of conservation significance as the latter all are wide ranging or widely distributed in the region.

Table A.2: (Continued)

Issue/Factor	EPA Objective	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
Landform, Drainage and Site Hydrology	Maintain the integrity, functions and environmental values of landforms and natural surface water drainage.	Minor ephemeral creeks in vicinity of laydown area/access road drain into sea. Plateau access to plant site is within drainage catchment of 2 major rivers – Drysdale and King George Rivers.	Laydown area and access road located on low rises. Minor drainage lines will be traversed by road. Slope erosion through concentration of flow on road. Release of sediments from disturbed areas.	Major ephemeral drainage lines avoided. Minor creek crossing forded to avoid flow barriers. Road to plateau sited to minimise vegetation clearing. Erosion and sediment control plan included in CMP. Access road sited on drainage divide to avoid major river crossings.	No significant impacts to drainage catchments or site hydrology from laydown or access road construction.
POLLUTION					
Noise	Ensure noise impacts emanating from the construction and operational activities comply with statutory requirements and acceptable and appropriate standards.	Noise levels in Gumboot Bay are at ambient levels. Area noise sources include passing marine craft, aircraft and limited vehicle traffic. The closest noise sensitive residence is the Bush Camp tourist facility located 1.5 km west of the laydown area and separated by a substantial basalt ridge.	Noise will be generated during the short construction phase by earth moving equipment and during barge and transport operations. Greatest potential for nuisance noise associated with barge night time unloading operations.	Construction of laydown area and access road to be undertaken during daylight hours. Road transport to be undertaken during daylight hours. Management of the Bush Camp to be advised of planned barge movements by fax, and Noise levels during night barge operations to be monitored and the findings integrated into noise reduction programmes.	Impacts associated with noise emissions from barge transport operations are likely to be negligible.
Light Spill	Protect the amenity of residents at the Faraway Bay Bush Camp from light impacts resulting from night time activities associated with the site.	No current impacts.	Some of the proposed 40 barge movements per season may, because of barge availability or suitable tides, occur at night and may require working lights.	Barge site is 1.5 km from Bush Camp and separated by 80m high vegetated basalt ridge. Infrequent use of unidirectional lighting.	Impacts associated with light emissions are likely to be negligible. Light overspill onto water will be limited due to >50m separation from beach on raised laydown area and vegetation screening.

Table A.2: (Continued)

Issue/Factor	EPA Objective	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
SOCIAL SURROUNDINGS					
Aboriginal Heritage and Culture	Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act (1972)*. Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations.	Site surveys are undertaken by the Traditional Owners in accordance with the existing Site Clearance Protocol signed between Proponent and the Balanggarra Aboriginal Corporation. No sites have been recorded at the Barge Site or within the proposed road alignment corridor within PNP/215.	No impacts.	Surveys of barge site and access road by the Traditional Owners completed in 2000 and 2001. Under the Site Clearance Protocol surveys are conducted prior to any ground disturbing works. Site avoidance is the preferred management approach.	The absence of recorded sites in the access corridor or barge site will result in no impacts to known cultural or heritage sites.
Visual/Landscape Amenity	Ensure visual amenity of the area is not unduly affected by the proposal.	A diverse range of landforms and vegetation types characterise the Londonderry area contributing to its scenic attributes. Gumboot Bay is one of several a shallow inlets rimmed by sea cliffs which merge with a sandstone plateaux attaining an elevation of over 120m within 1 km of the coast. The bay contains small irregular/rocky sandy beaches and narrow fringing mangrove stands between rocky points. The laydown site is separated from a nearby fishing base and tourist facility (The Bush Camp) in an adjoining bay by a substantial basalt ridge. A track used to transport tourists from the Bush Camp to the airstrip on the escarpment would cross the proposed road corridor.	The proposed laydown facility and road is potentially visible by clients from the Bush Camp during transit to the airstrip or while engaged in recreational fishing and viewing wildlife in Gumboot Bay. The barge site and road is potentially visible to passengers on off shore cruise vessels.	Minimisation of vegetation clearing and retention of mature fringing vegetation around laydown area. Planting of vegetation screens around storage infrastructure that is compatible with Fire Management Plan for site. Laydown area infrastructure designed to present low visible profile. Infrastructure to be painted in natural colours that blend with the local terrain and vegetation. Barge movements advised to Bush Camp Management 7 days prior to arrival. Facility to be constructed so as to blend in with surrounding landforms.	The visual impacts of the infrastructure is expected to be negligible. Proposed ongoing consultation arrangement with respect to barge movements will further assist in minimising any potential impacts to the Bush Camp operations. Laydown facilities and access road to escarpment unlikely to be visible from passing coastal marine traffic.

Table A.2: (Continued)

Issue/Factor	EPA Objective	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
Chemical/Hydrocarbon Spills	Maintain the quality of marine waters to ensure that existing and potential use, including ecosystem maintenance are protected. Minimise the impacts of hydrocarbon spillage during unloading operations.	No current impacts.	Spillage during unloading and handling operations.	Discharge vessels to demonstrate they have current Shipboard Oil Pollution Emergency Plan (SOPEP) and the capability to implement the plan. Develop and implementation of Spills Management Plan to statutory requirements.	No significant impacts to water quality. Risk of hydrocarbon spill not significantly increased.
Dust/Particulates	Ensure that the dust levels generated by the proposal do not adversely effect welfare and amenity of surrounding land users or cause health problems in accordance with EPA Guidance Statement No 18 – Preventing Air Quality Impacts from development.	Particulate emissions restricted to bush fire fallout. Soils are skeletal and prone to erosion.	Low level dusts potentially generated through vehicle movements on unsealed roads and during construction activities.	Minimise surface disturbance activities. Use water sprays as required on disturbed areas. Strip topsoils when soil moisture levels are highest. Adopt low speed limits for unsealed roads.	Minor dusting may occur during construction. These will be managed by water sprays and construction generated dusts will have negligible impact on environment.

1. INTRODUCTION

1.1 Overview

Striker Resources NL (the Proponent) has been successful in discovering diamondiferous kimberlite pipes on their North Kimberley leases. To determine the commercial viability of the projects, advanced exploration programmes will include the trial mining and bulk sampling of ore parcels up to several thousand tonnes from the kimberlitic occurrences.

Ore treatment is undertaken in a centrally located Washing and Heavy Medium Separation (WHMS) plant at Ashmore (Figure 1). The plant produces a small volume of mineral concentrate. The ore treatment process, although relatively simple metallurgically when compared to most mineral processing operations, will provide the necessary information on the commercial potential of the projects.

In past years, supply access for the Project was achieved via the Gibb River-Kununurra and Kalumburu - Carson River Station road network (see Figure 1), with transport distances up to 700 km. Fuel supplies, consumables and heavy equipment were barged to Longini Landing near Kalumburu in the past field season and road transported across the Drysdale River (Plate 4) and its numerous tributaries to the Ashmore plant site, a distance of 185 km.

Extended wet seasons, delays and increased costs associated with re-establishing and maintaining trafficable access across the Drysdale River catchment, severely curtails exploration and mining field time. The existing routes also increase the risks to riverine environments from spillages and threatens security of supply. Any proposed access road must be sited so as to avoid major river crossings and tributaries.

Other explorers operating in the region adapt their field programmes to suite climatic conditions and bring in drummed fuel supplies either by road or in some circumstances by barge to the Faraway Bay Bush Camp. Neither of these options is appropriate for Striker's proposed testwork and exploration programmes.

1.2 The Proposal

To reduce the costs associated with maintaining long sections of road with the attendant risks to the security of supply, (particularly for diesel fuel) and to extend the length of the field season, the Proponent, after consideration of several alternatives, plans to establish a dry door barge access in a small coastal inlet 36 km south east of Cape Londonderry in the north Ashmore Project Area. A dry door access is defined as a site where the barge door can be lowered directly onto the beach and equipment or stores can be unloaded without the requirement for fixed infrastructure such as ramps. The facility would be linked to the Ashmore plant via a new, unsealed rural road sited on the Drysdale-King George River drainage divide.

The barge site, known locally as Gumboot Bay, is within Unallocated Crown Land that is part of the proposed Cape Londonderry National Park (PNP/215) (Figure 2). The facility would operate intermittently for approximately eight months of the year and provide security of supply for the Proponents ongoing mining and exploration activities. The laydown area would house above ground fuel transfer and storage facilities (Figure A.1) and would be linked by a purpose built, unsealed Restricted Access Road (RAR) to the Ashmore plant site. Fuel dispensing would not be undertaken at the barge site. The development would consist of:

- drydoor barge access during high tides to a landing site. The access would be used up to 40 times during the field season. Seabed dredging would not be required;

- a 50 m long, 8m wide access road from the beach to a laydown area located above the 100 year storm surge level. Beach access to the laydown area would be controlled by a locked gate;

- a 50m x 50m laydown area that would contain unidirectional tower lighting, navigational aids, graded hardstand area and a bunded compound for 2 x 20,000 litre camouflaged diesel fuel storage tanks;

- a 15 metre wide perimeter fire buffer zone around the laydown area and a water storage tank;

- barge to shore fuel unloading infrastructure including fuel spillage containment; and

- a new unsealed, 3.6 km segregated Restricted Access Road within PNP/215. The road would link up with an approved road of similar design direct to the Ashmore Treatment Plant.

The area of clearing within PNP/215 would be approximately 4.0 ha. For the purpose of the PER, the barge site and proposed infrastructure are considered an extension of the Proponent's Ashmore Project Area.

The Proponent's road tanker would transport fuel, equipment and supplies to the Ashmore Plant site as required during daylight hours. Materials designated for return to Darwin such as empty fuel drums, waste oils, and industrial scrap would form the backload.

1.3 Timing

Construction of the facility would commence in 2002 following receipt of the necessary approvals and resolution of the current appeal in respect to the grant of Miscellaneous Licence 80/41 currently before the Mining Warden's Court.

1.4 Purpose of this Document

The aim of this document is to provide members of the local community, local stakeholders, the Government and the Striker workforce with details of the proposal. The main focus of the Public Environmental Review (PER) is the identification of the social, environmental aspects and impacts, risks and hazard associated with the construction and operation of the barge access, laydown facility and access road within PNP/215 and the proposed management plans designed to minimise any adverse social or environmental impacts. Particular attention has been paid to implementing operating strategies designed to minimise potential visual and amenity impacts to the landscape.

1.5 Document Structure

This PER presents the following information:

- background, description of the project; and ownership, land use and leasing information (Section 1);

- details on project justification and an evaluation of alternative sites undertaken by the Proponent before selecting the preferred route for the current proposal (Section 2);

- a description of the project covering the important engineering aspects (Section 3);
- a description of the existing environment; and an evaluation of the impacts that the project will impose on the existing environment during the construction and operation of the facility (Sections 3 and 4);
- details on Community and Government consultation (Section 6);
- a summary of the Proponent's management commitments (Section 7);
- lists of references and abbreviations cited in the PER or used in the preparation of the Management Plans (Sections 8 and 9 and a glossary in Section 10);
- EPA Guidelines, the Proponents Environmental Policy and Flora and Fauna species lists (Appendices A-D); and
- the proposed programme of environmental management actions and procedures that will be implemented through Management and Response Plans, Guidelines, Audit and Reporting processes (Appendices E-I.)

1.6 The Proponent

Striker Resources NL (ABN 86 009 153 119) is the Proponent for the proposed barge access, laydown and access road development at Gumboot Bay in the North Kimberley of Western Australia. Striker has been an active diamond explorer in the Kimberley region since 1992 and has extensive lease holdings of approximately 6,000 km^2 in the area.

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1.7 Tenure

All infrastructure associated with the barge site is located within Exploration Licence 80/1840 granted in July 19, 1994. The Licence is 100% owned by the Proponent. The underlying tenure is Unallocated Crown Land which has been included in the proposed Cape Londonderry National Park (PNP/215). The barge site is located within 600 m of the eastern boundary of the proposed park, which adjoins Aboriginal Reserve 13873. Existing access roads into the Project area are located on Carson River Pastoral Station (Crown Lease 3114/1056) owned by members of local Aboriginal communities.

Application has been made for a Miscellaneous Licence (80/41) covering the barge site and infrastructure within PNP/215 (Figure 3). This application is currently being addressed through the appeals process in the Mining Warden's Court. A separate Miscellaneous Licence (80/42) covering the

new alignment from the southern boundary of PNP/215 to the Ashmore Plant site has received regulatory approval.

1.8 Regulatory Framework and Procedures

This proposal is subject to a formal assessment at the level of a PER under Part IV of the *Environmental Protection Act 1986* (as amended).

The document has been prepared in accordance with the Guidelines issued by the Environmental Protection Authority (EPA). The Guidelines are referenced in Appendix A. A description of the generic stages of the assessment process are available on the DEP's website at www.environ.wa.gov.au.

If the project is approved, the Western Australian Minister for the Environment and Heritage will issue a statement under Section 45 of the Act listing the environmental protection conditions under which the project will be implemented. In addition to obtaining approval from the Minister for the Environment and Heritage the Proponent will also take into account the legislation, regulations, Australian Standards and Codes of Practice administered by a range of State and Federal Government agencies. Relevant Legislation, their application and responsible departments are listed in Table 1.1.

Table 1.1: Relevant Legislation, Standards and their Application

Acts/Standard	Application	Responsible Department
Aboriginal Heritage Act 1972-1980.	Controls Aboriginal sites, and disturbance to sites.	Dept. of Indigenous Affairs.
Agriculture and Related Resources Protection Act 1976.	Management of weeds and pests.	Agriculture Western Australia.
Bush Fires Act 1954.	Management of fire safety.	Bush Fires Board.
Conservation and Land Management Act 1984.	Management of flora and fauna and reserves.	Dept. of Conservation and Land Management.
Environmental Protection Act 1986 (Part V).	Works Approvals, Pollution Prevention Licences.	Dept. of Environmental Protection.
Environment Protection and Biodiversity Conservation Act 1999.	Establishes a Commonwealth Process for the assessment of actions on six matters of environmental significance.	Environment Australia.
Explosive and Dangerous Goods Act 1961.	Specifies storage, handling requirements for fuels.	Dept. of Mineral and Petroleum Resources.
Land Administration Act 1977.	Classification of land tenure other than Mining Tenements.	Dept. of Land Administration.
Mining Act 1978.	Licensing of extractive industries.	Dept. Mineral and Petroleum Resources.
Mine Safety and Inspection Act 1995.	Occupational health and safety issues.	Dept. Mineral and Petroleum Resources.
Native Title Act 1993.	Handles Aboriginal claims for land ownership.	Ministry for Premier and Cabinet.
Rights in Water and Irrigation Act 1914.	Licensing groundwater abstraction.	Water and Rivers Commission.
Soil and Land Conservation Act 1945.	Controls land degradation and clearing of land.	Agriculture Western Australia.
Wildlife Conservation Act 1950.	Rare flora and fauna protection.	Dept of Conservation and Land Management.

2. PROJECT JUSTIFICATION AND EVALUATION OF ALTERNATIVE

2.1 Overview

The Kimberley extends over 421,000 sq km or one sixth of Western Australia's land surface from its northern coastal extremities to approximately latitude 20° south.

Though the Kimberley is generally considered to be under-explored for minerals, the minerals industry is by far the biggest contributor to Gross Domestic Product from the region, with the total value of production in the vicinity of $891 million in 1999/2000 (KDC 2001). This represents approximately 4.1% of the State's minerals sector revenue for that year and was mainly drawn from the Argyle diamond production, and the Lennard Shelf zinc-lead mines.

The joint Department of Regional Development and Department of Minerals and Energy *Regional Mineral Prospectivity Study* undertaken in 1997, concluded that the Kimberley's large variety of geological settings potentially could contain a wide range of mineralisation styles and could host a range of significant mineral deposits. However, isolation, difficult access and the harsh working environment, combined with high exploration costs, resulted in large parts of the region being under-explored and its overall mineral potential not fully evaluated. The Commonwealth and State Governments recognised these issues and the Federal Government established a Regional Minerals Program to encourage a co-ordinated approach to minerals development.

In a local context, the Proponent is a significant financial contributor to the Kununurra/Wyndham community, which provides a range of valuable logistic services in support of exploration activities in the North Kimberley's. These services include:- employment, accommodation, fuel supply, stores, parts and freight and air services. The Proponent is also involved with the Balanggarra Aboriginal Corporation through the development of training and employment opportunities with Aboriginals from Kalumburu, Oombulgurri and Wyndham.

2.2 Need for the Barge Site

The Proponents exploration operations are located in the subtropical region of northwestern Australia where maximum daily rainfall during the wet season can exceed 200mm. Extended wet seasons and delays in re-establishing trafficable access across the regions river systems severely curtails the start of the exploration and mining season. In addition, early storm events in the Drysdale River and King George River catchments after September can strand equipment, resulting in high risks to mining and supply contractors and higher costs to the project.

Security of supply for bulk consumables and equipment for ongoing exploration and mining projects cannot be sustained using the existing road networks.

2.3 Benefits of the Project

Establishing the barge site will result in the following economic, environmental and social benefits.

- significantly extend the field operational time by allowing earlier startup and later departure of plant and equipment;
- ensure reliability and certainty of supply of bulk consumables, fuels and equipment;
- ensure certainty of completing exploration programmes;
- significantly reduce road transport costs and the associated risks of long haul fuel transport;

- significantly reduce current road construction and maintenance costs;

The siting of the barge site closer to the plant infrastructure and positioning the road in the catchment divide between the Drysdale and King George Catchments will result in:

- reduction in potential fauna injuries as a result of reduced truck movements and shorter haul distances;

- reductions in surface disturbance arising from the annual expansion of borrow pits to maintain roads in unsuitable terrain units such as the black soil and cracking clay units;

- reductions in greenhouse gas emissions through lower fuel usage for both barge and road transport;

- substantial reduction in the environmental risk arising from a tanker incident during a major river crossing

Rapidly growing and largely uncontrolled adventure tourism (Wunambal-Gaambera Aboriginal Corporation 2000) is an urgent issue for remote pastoral stations, Aboriginal Communities and tourist facilities that promote isolation as a drawcard. The establishment of the Gumboot Bay barge site will eliminate the need for the annual upgrading of the Kalumburu-Carson River Road. Without annual maintenance this road will again revert to a pastoral road standard. This will assist in controlling the level of tourist access particularly along the Kalumburu-Carson River Road in accordance with wishes of the Balanggarra Aboriginal Community and the tourism operator at the Faraway Bay Bush Camp.

The proposal by the Proponent forms a small but ongoing part of the development of the Kimberley Region. The North Kimberley's is under explored (DRD 2001) and secure and sustainable access is a critical part of increasing on ground expenditure in grass roots exploration and increasing the likelihood of a successful discovery. Such developments have the potential to be of significant benefit to the State and regional economies. Regional initiatives, increased investment, development of jobs and increased value for export products will have positive effects on the economy of the Kimberley.

2.4 Evaluation of Alternative Sites

The Proponents have actively explored in the north Kimberley since 1992 and their field personnel have a sound understanding of infrastructure constraints imposed by the interaction of climate, terrain and drainage.

Barging of supplies, fuels and equipment is a long established method of supporting exploration activities and Aboriginal communities in remote regions where road access is controlled by rugged terrain and dissected drainage landscapes. Striker personnel have, in addition to undertaking fixed wing and helicopter aerial searches and vehicle traverses, sought advice on potential barge sites, road construction methods and access routes from long term Kimberley residents, barge operators and pastoralists.

As part of the initial project review undertaken in 1999 the primary factors considered relevant to the establishment of a barging operation were identified. This information was used to identify primary site requirements and environmental constraints which had to be satisfied if the project were to avoid potential environmental, engineering and economic penalties during construction and operation. Five sites were initially examined although this was increased to eight following information from Bush Camp management on potential sites between Cape Bernier and the Berkeley River.

2.4.1 Primary Barge Site Requirements

To achieve the operational objectives outlined in Section 1.2, seven primary site requirements for the barge site and access corridor were identified. These included:

- availability of a protected dry door barge site within close sailing proximity to Darwin;
- access to a near-shore laydown area located above the 100 year storm surge level;
- located in close proximity to an access corridor that did not require the crossing of any major river system or extensive areas of basalt or siltstone derived clay soils;
- located on or in close proximity to company held tenements for security of tenure;
- accessible for at least 8 months of the year;
- allowing the shortest practicable distance to the Ashmore Project Site to minimise road construction and maintenance expenditure; and
- located so as to minimise or avoid disturbance to environmentally sensitive habitat, areas of Aboriginal significance and the activities of other land users.

2.4.2 Second Stage Evaluation Process

The second stage of the selection process identified regional dry door barge sites that had suitable hinterland topography and would allow routine access up onto the escarpment. Regional assessments were based on the stable attributes of the landscape-geology, relief of the terrain and drainage patterns. This information is presented on a computer generated relief map (Figure 5) and shows the complexity of the eastern escarpment units and the extent of potentially unsuitable terrain when compared with the northern route. These sites also had to satisfy the other important constraint criteria in respect to inland corridor alignments. The results of these assessments are shown in Table 2.1 to Table 2.5.

Table 2.1: Primary Barge Site Requirement Matrix

Barge Site								
Alternative Sites Considered	**Dry Door Access and Laydown**	**Protected Anchorage**	**Heritage Clearance**	**Presence of Sensitive Ecosystems**	**Company Tenured**	**Proximity to Darwin**	**Suitable Access to Hinterland**	**Site Suitability Ranking**
Kalumburu	YES	YES	YES	NO	NO	NO	YES	HIGH
Faraway Bay #1	NO	YES	NO	NO	YES	YES	YES	LOW
Gumboot Bay # 2	YES	YES	YES	NO	YES	YES	YES	HIGH
Whiskey Creek # 3	NO	NO	NO	NO	NO	YES	NO	LOW
Site # 4	NO	NO	NO	YES	NO	YES	NO	LOW
Site # 5	YES	NO	NO	NO	YES	YES	NO	LOW
Berkeley River #6	YES	NO	NO	YES	NO	YES	NO	LOW
Berkeley River # 7	NO	YES	NO	YES	YES	YES	NO	LOW

An important consideration in the evaluation process was whether the site was suitable for routine use. Commonly barge site landings to support exploration programmes are planned as one off events for a

specific site, and the site, for a range of reasons, may prove unsuitable for routine use over the entire field season.

Table 2.2: Primary Access Route Matrix

Access Road Route							
Alternative Sites Considered	**Presence of Major River Crossings**	**Presence of Unsuitable Terrain Units**	**Company Tenured**	**Heritage Considerations**	**Third Party Access**	**Road Length < 60 km**	**Site Suitability Ranking**
Kalumburu – Carson River Road – Ashmore	YES	YES	NO	NO	YES	NO	LOW
Faraway Bay #1 Ashmore	NO	NO	YES	NO	YES	YES	HIGH
Gumboot Bay #2 – Ashmore	NO	NO	YES	NO	YES	YES	HIGH
Whiskey Creek # 3 – Ashmore	YES	YES	YES	NI	NO	YES	LOW
Site # 4 – to Ashmore	YES	YES	NO	NI	NO	YES	LOW
Site # 5 – Ashmore	YES	YES	NO	NI	NO	YES	LOW
Berkeley River # 6 – Ashmore	YES	YES	NO	NI	NO	YES	LOW
Berkeley # 7 – Ashmore	YES	YES	NO	NI	NO	YES	LOW

NI – No Information

This comparison and elimination process resulted in the selection of 5 of the 8 sites for assessment of potential environmental risk from the proposed development.

The environmental assessment of each potential site was completed by comparing the total environmental risk to each site. The environmental risk ranking (Tables 2.3 and 2.4) was determined by a combination of the expected frequency of the aspect occurring, the consequences of it's occurrence and public interest (Sandman 1993) and included:

- potential impacts to drainage;
- potential impacts to vegetation communities and fauna habitats;
- impacts to the Conservation Estate; and
- barge site location and impacts to the marine environment.

The final stage of the selection process was the identification of impacts associated with the construction, engineering and economic considerations of the access road (Table 2.5) and the methods proposed to reduce any potentially adverse impacts. These aspects are incorporated into management actions in the Construction Management Plan (Appendix E) and outlined in the Proponents specific management commitments (Table 7.1) for the development.

2.4.3 Discussion of Regional Alternatives

Three coastal zones were initially targeted in the desktop survey that covered the area from Kalumburu to the Berkeley River (Figure 2). The three areas assessed were the Berkeley River, which had been used previously by other mineral explorers, Faraway Bay and surrounds, and the Kalumburu site on the mouth of the Prince Edward River. Additional sites south of Cape Bernier including the Whiskey Creek area was included following advice from the Bush Camp management that the sites possessed some of the required attributes for a barge site.

Site locations 1 to 7 are shown on Figure 5 and aerial photos of sites 1, 3, 4, 6 and 7 are shown on Plates 1, 5, 6, 7 and 8. The sites were initially assessed in a screening matrix that required a yes/no ranking against the seven primary selection criteria. The results of the screening tests are shown in Table 2.1.

Three of the sites - Whiskey Creek (Plate 5), Site 4 (Plate 6) and the Berkeley River (Site 7), while possessing several dry door barge sites do not have suitable laydown areas in close proximity to the barge site. The approach to Site 3 (Whiskey Creek) and Site 6 (Berkeley) is shoaled and exposed to the prevailing winds. The wide sandy beach at Site 3 is vegetated and would require stabilisation or capping for routine use. In addition, the only known access from the Whiskey Creek site onto the plateau is via a gorge containing sensitive habitat. Site 4 (Plate 6) and Site 5 are similarly constrained by steep access up onto the escarpment. Two major drawbacks for the east coast sites is the requirement to cross the King George River and the development costs and ongoing maintenance of a road formation constructed on clay rich (basalt and siltstone derived) substrates (Figure 5). An assessment of engineering and economic factors for the access road is shown in Table 2.5.

In the 2000 field season, the Proponent utilized the Kalumburu barge entry point and have undertaken considerable road maintenance works on the Kalumburu–Carson River Road to tanker in fuel supplies to maintain the Year 2001/02 operations. Road works would be required on an ongoing basis to maintain the road to the necessary standard for safe, regular tanker operation. In addition this route requires a natural ford crossing (Plate 4) of one of the largest rivers in the Kimberley's – the Drysdale River and its numerous creek crossings. In "normal" years, access across the Drysdale and the adjacent clay plains with bulk transport is restricted to the mid-July to September period.

The five east coast sites and Kalumburu were rejected following the followup helicopter survey as they failed to satisfy key elements of the primary screening test

Table 2.3: Assessment of Environmental Risk – Barge Sites

Potential Environmental Factors	BARGE SITES				
	Kalumburu	Faraway Bay	Gumboot Bay	Whiskey Creek	Berkeley River
Current Landuse	Aboriginal Reserve	Fishing/Tourism	Exploration/ Tourism	Aboriginal Reserve	Aboriginal Reserve/Tourism
Visual Amenity	High	High	High	High	High
Conservation Estate	No CE affected	UCL (PNP/215)	UCL (PNP/215)	No CE affected	No CE affected
Heritage	NR[2]	NR	Site Clearance Completed	NR	NR
Impacts to Drainage	Minor impacts	Minor impacts	Minor impacts	Major impacts	Major impacts
Impacts to Marine Environment	Low	Low	Low	Low	High
Erodability	Low	Low	Low	High	High
Vegetation Communities	No significant communities	No significant communities	No significant communities	Wide vegetated dune	No significant communities
Fauna Habitat	No significant habitat affected	No significant habitat affected	No significant habitat affected	No significant habitat affected	Passes through riparian habitats
Environmental Risk [1]	Low	Low	Low	High	High

[1] **Procedure for Environmental Risk Assessment**
[2] **Not Recorded**
[3] **Not Applicable**

Table 2.4: Assessment of Environmental Risk – Access Roads

	ACCESS ROADS				
	Kalumburu - Ashmore	**Faraway Bay - Ashmore**	**Gumboot Bay - Ashmore**	**Whiskey Creek - Ashmore**	**Berkeley River - Ashmore**
Current Landuse	Aboriginal Reserve/Pastoral	Exploration/ Tourism	Exploration/ Tourism	Aboriginal Reserve	Aboriginal Reserve
Visual Amenity	Moderate to Low	Low	Low	Moderate to Low	Moderate to Low
Conservation Estate	No CE affected	UCL (PNP/215)	UCL (PNP/215)	No CE affected	No CE affected
Heritage	NR	Yes	Yes	NR	NR
Impacts to Drainage	Major impacts	Moderate impacts	Minor impacts	Major impacts	Major impacts
Impacts to Marine Environment	NA[3]	NA	NA	NA	NA
Erodability	High	Low	Low	High	High
Vegetation Communities	NR	No significant communities	No significant communities	Passes through riparian zones	Passes through riparian zones
Fauna Habitat	Passes through numerous riparian habitats	No significant habitat affected	No significant habitat affected	Passes through riparian zones	Passes through riparian zones
Environmental Risk [1]	High	Low	Low	High	High

[1] **Procedure for Environmental Risk Assessment**
[2] **Not Recorded**
[3] **Not Applicable**

Table 2.5: Assessment of Engineering and Economic Factors

Potential Environmental Factors	ACCESS ROADS				
	Kalumburu - Ashmore	**Faraway Bay - Ashmore**	**Gumboot Bay - Ashmore**	**Whiskey Creek - Ashmore**	**Berkeley River - Ashmore**
Road Length (km)	185	33	40	45	55
Major River Crossings	Drysdale	No	No	King George	King George
Terrain Units Traversed	Crosses major and intermediate drainage systems and >10 km black clays	Crosses minor drainage and clay sections	Crosses minor drainage, minor clay sections	Crosses major and intermediate drainage and >10 km black clays sections	Crosses major and intermediate drainage and >10 km black clays sections
Maintenance Costs	High	Low	Low	High	High

[1.] **To top of Escarpment**
[2] **NA = Not Applicable**

2.4.4 Local Site Selection

Two sites, Faraway and Gumboot Bays, were selected for further consideration because they satisfied the key aspects of the selection criteria outlined in Section 2.4.1. An aerial plan of the area is shown on Figure 3.

Site 1 is a shallow entry, sand floored inlet on which the Faraway Bay Bush Camp is situated. The facility is operated under Special Lease 3116/11267 that covers a beach frontage, access road and airstrip. The Bush Camp normally operates during the dry season and although linked by an exploration

track to the Carson River and Kalumburu road systems – road visitor access is actively discouraged and guests are flown to a light plane airstrip on the plateau approximately 2.5 km south of the camp. A narrow, and in places extremely steep road, suitable only for light 4WD vehicle traffic winds its way up through the sandstone escarpment to the airstrip.

The second site – Gumboot Bay is a shallow entry, (rock bars are present) sand and rock floored inlet - located 1.5 km south east of the Bush Camp and separated from the tourist facility by a 80 m high vegetated ridge (Plate 3).

2.4.5 Preferred Site

Detailed assessments of the Faraway Bay and Gumboot Bay sites has concluded that although the issues associated with both sites are similar, the proposed barge site in Gumboot Bay is the favoured site in terms of dry door access, near shore laydown area availability, (Plates 1 & 3) improved anchorage protection, low impacts to coastline visual amenity and the likelihood of little or no disturbance to the rustic ambience of the Bush Camp. The physical separation of the inlets and the substantial landform separating the 2 sites will further minimise impacts even during transport operations and night barge deliveries. The site is situated so as to exploit the presence of the low relief landforms that provide access up onto the escarpment and onto the drainage divide between the Drysdale and King George River Systems. The proposed alignment has been sited so as to avoid the crossing of all primary and secondary drainage lines and unsuitable terrain units.

2.5 The "No Project Option"

The alternative of not proceeding with the barge site at the present time would give rise to the following consequences. The Proponent would continue to use the existing supply route options and the current transport arrangements. Expenditure on exploration would remain static with substantial funds being required for continual road maintenance rather than for exploration. This in turn increases discovery and evaluation lead times and economic opportunities, leading to increased wealth generation for the region and the State, would be lost.

3. PROJECT DESCRIPTION

This section presents a description of significant aspects of the project including information on the barge, site infrastructure, utilisation, site security and operational information including spill contingency planning.

3.1 Overview

The proposed dry door barge access and laydown area is located in a coastal inlet 36 km south east of Cape Londonderry and 1.5 km south east of the Faraway Bay Bush Camp. The facility would operate initially for eight months of the year and provide security of supply for the Proponents ongoing mining and exploration activities. The laydown area would house above ground fuel transfer and storage facilities and would be linked by a purpose built, unsealed Restricted Access Road (Figure 3) to the Proponent's Ashmore Project Area.

The main components of the project are shown in Table 3.1.

The Proponent's road tanker would transport fuel, equipment and supplies to the Ashmore Plant as required during daylight hours. Materials designated for return to Darwin, such as empty fuel drums and samples would form the backload.

The road corridor south of PNP/215, which completes the access to the Ashmore Project Area, has received construction approval from the Department of Mineral and Petroleum Resources (DMPR) and is covered by a separate Miscellaneous Licence. This road when completed will, in addition to providing road access to the barge site, support the ongoing exploration programmes on the Proponent's leases.

The proposed site layout is shown on Figure A-1 and the alignment in PNP/215 on Figure 3.

TABLE 3.1: KEY CHARACTERISTICS OF THE PROPOSAL

Element	Description
Location	Proposed Barge Site is located in the informally named Gumboot Bay at Latitude 13°58'S and Longitude 127°12'E.
Construction Period	Approximately 2 weeks – works undertaken during daylight hours.
Equipment	Conventional earth moving equipment – bull-dozer, rock breaker, loader and trucks.
Infrastructure	Dry door beach landing site. This allows the barge door to open directly onto the beach. Construct an access up to laydown area (50m x 8m). Construct a laydown area (50m x 50m) above 100 years storm surge level. Clear a perimeter (15m) fire buffer zone around the laydown area and water storage tank. Construct a unsealed restricted use access road (3.6 km x 8m) within PNP/215. Install 2 x 20,000 litre camouflaged fuel tanks, unloading and transfer infrastructure with unidirectional tower lighting in bunded area. Source construction material from borrows located outside of PNP/215 on the Carson River Pastoral Lease. Establish barge site vegetation screens and erosion control structures as required.

Table 3.1: Key Characteristics of the Proposal (Continued)

Element	Description
Area of disturbance within PNP/215	Access Road - 3.6 ha Laydown area - 0.4 ha Borrow pits - External to PNP/215 on E80/1840 Total – approximately 4.0 ha
Facility Operation	Up to 40 barge movements per field season. Road transportation to Ashmore undertaken during daylight hours. No refuelling or permanent residential facility at barge site.
Workforce	Construction - up to 5 personnel. Accommodation – At Ashmore Exploration Camp.
Life of Project	For the period the Proponent holds leases in the region.

3.2 Gumboot Bay

The coastline between Cape Londonderry and Cape Ruhliers is irregular and typical of a drowned coastline (Figure 1). Three large bays open northwards to the Timor Sea. The central bay contains smaller rocky embayments which includes the informally named Faraway and Gumboot Bays (Figure 3).

Gumboot Bay has a shallow entry and soundings show the floor is largely rock with thin layers of muddy sands. The inlet shallows east of the proposed barge site (Plate 1) where it supports mangles before terminating in low basalt cliffs that produce ephemeral waterfalls after rain. The barge beach consists of sand covered over pebbles (Plate 2) and backed by a 4 metre high basalt (scree) slope to a flat slope break (Plates 1 & 3) part of which will be formed into the laydown area. The low shore ridge extends to the sandstone jumpup where it meets the existing Faraway Bay track. West of the barge site a 80m high basalt ridge (Plate 3) separates the laydown facility from the Bush Camp in the adjacent Faraway Bay.

3.3 Moorings

The proposed barge site (Figure 3) is protected from the dominant dry season winds by easterly landmasses and supports dry door landings. Moorings or permanent beach infrastructure such as ramps will not be required.

3.4 Dredging

Seabed dredging will not be required and no impact on the marine environment is anticipated.

3.5 Barge Description

The barge *MV Brisk* is typical of the type of vessel proposed for the supply runs. It is a single hull/steel skin, shallow draught (1.5m) vessel operated by Gulf Freight Services Pty Ltd of Darwin (Plate 2). The vessel is routinely used for supplying fuel and supplies to isolated communities across the northern coastline of Australia. Gulf Freight Services Pty Ltd is a wholly owned subsidiary of Riverside Marine – a Brisbane based company that have extensive experience in ship to ship bunkering in one of Queenslands most sensitive marine conservation, recreational and shipping zones - Moreton Bay. Gulf Freight Services will be responsible for all aspects of fuel supply and delivery up to the

Laydown Bulk Storage. The *MV Brisk* is in current survey and carries an approved Shipboard Oil Pollution Emergency Plan (SOPEP) in accordance with Australian Marine Transport requirements.

3.6 Barge Movements

The presence of rock bars and the shallow nature of the entry to the barge site will result in access only being possible during high tides for durations of 3 to 4 hours or as tides permit. Barge landings will be achieved up to 40 times during the field season. Advice on barge movements will be faxed to the Faraway Bay Bush Camp 7 days prior to the planned arrival date. Third party use of the facility will be considered by the Proponent on a case by case basis.

While daytime barge access is preferred, supply requirements, suitable tides and barge availability may result in some night operations.

3.7 Laydown Area

The laydown area (Plate 1) will be located at the break in slope approximately 50m from the beach and above the 1 in a 100 year storm surge height. The area will be connected to the beach by an 8m wide access road. A gate will be installed at the crest of the road.

An area of approximately 0.25ha will be levelled, sheeted with locally sourced materials and contoured to promote drainage into silt traps to ensure sediment and other potential contaminants are caught before discharge to the environment. External stormwater runoff will be directed around the laydown into regrowth and screen planting areas.

Mature fringing vegetation (Plate 3) will be retained where feasible to provide visual amenity screens. Additional plantings will be undertaken once the site Fire Protection Plan has been established.

Site layout is shown on Figure A-1.

3.8 Hydrocarbon Storage Facilities.

Drummed product handling areas will be bunded or centrally graded to contain spills, stormwater or fire fighting residues. Discharges will be directed to a central grated sump to facilitate cleanup and treatment.

Skid based bulk fuel tanks will be placed within a low permeability bunded storage designed to allow recovery of any spillage. Storages will be lined with a H.D.P.E. liner system in accordance with AS1940-1993. All pipeworks will be constructed to recognised engineering standards and be wholly within the bund. The laydown facility will be surrounded by a cleared 15m wide fire break.

3.9 Road Construction

Road construction, to the Shire of Wyndam – East Kimberley Rural Standard E5, to produce a 3.6 km long running surface within PNP/215 suitable for tanker movements will entail:

- clearing vegetation 4m either side of the road centreline to produce an 8m wide right of way. Cleared vegetation will be stockpiled and track rolled for future rehabilitation use.

- stripping of topsoil where feasible and stockpiling in low piles in erosion free areas for further reuse.

- construction of an 8m wide unsealed pavement such that slope drainage is not significantly impeded and drainage shadows or ponding areas are not developed.

- importation of base layer where required, utilising mined materials from small borrows located outside the boundary of PNP/215 and in areas that will not result in significant visual impacts.

- construction would consist of spreading, trimming, profiling, water binding and traffic compacting to produce a suitable running surface.

- installation of a lockable gate and appropriate signage at site(s) to be determined in consultation with other land users.

- progressively rehabilitating disturbed areas (ie borrows, bypass tracks) no longer required for construction and,

- construction of graded floodways across ephemeral creeklines to minimise local drainage line impacts.

The barge site, laydown area and the road within PNP/215 have received heritage clearance from the Balanggarra Traditional Owners. No sites or alignment changes were recorded.

3.9.1 Timing

The construction of the facility and the access road within PNP/215 is expected to take approximately 2 weeks to complete and will require a workforce of 5. The proposed road corridor is shown on Figure 3. The road will link up with the new 36km road to the Ashmore Project site which received regulatory approval in 2001.

3.9.2 Road Maintenance

Road maintenance, erection of signage and dust suppression will be undertaken by the Proponent on the road extension to ensure a safe travel way is maintained at all times.

3.9.3 Resource Requirements

Road construction materials will be sourced from selected borrow sites away from the escarpment and outside the current proposed park boundary.

Fuel and equipment servicing requirements will be met from an existing site mobile service unit. Equipment servicing wastes will be incorporated into existing waste management programmes at the Ashmore minesite.

Water for road binding will be sourced from a standpipe to be erected at Sandy Creek (on Carson River Station) and other sources such as seawater may be utilised as required. Seawater would be used for emergency fire fighting activities.

4. EXISTING ENVIRONMENT

This section contains descriptions of the area's major biophysical elements with an emphasis on vegetation and terrestrial vertebrate fauna. Marine aspects are not considered as no part of the proposal impacts on the marine attributes of Gumboot Bay. The barge sit is dry door and does not require any modification to the seabed to allow the project to proceed. Narrow stands of mangroves (Mattiske 2001) occur to the west and east of the barge site (see Figure 3), however these will not be directly affected by the proposed development. Discussions in this chapter necessarily draws heavily on existing regional information and it is acknowledged that some aspects of the biological resources of the region require further study.

4.1 North Kimberley Bioregion

The project lies in the "North Kimberley" biogeographic region of the Interim Biogeographic Regionalisation for Australia (IBRA). This is a system of eighty bioregions covering the whole of Australia (Thackway & Cresswell, 1995) and is the result of collaboration between all State Conservation agencies with co-ordination by the Australian Nature Conservation Agency (ANCA).

The main use of the IBRA system is that it sets a nationally agreed boundary which can be used for the assessment of the conservation values of the area surveyed. The IBRA bioregions were specifically developed to assess the conservation value of areas for inclusion in a national reserves system.

The North Kimberley bioregion is bounded to:

- the north and northwest by the Timor Sea,
- the east by the Joseph Bonoparte Gulf,
- the south by the Central Kimberley,

While a small portion in the east abuts the Victoria-Bonaparte Bioregion.

The bioregion includes a significant diversity of landforms and vegetation types, summarised by Thackway and Cresswell (1995) as follows:

> "Dissected plateau of the Kimberley Basin. Savanna woodland of Woolybutt and Darwin Stringy bark over high Sorghum grasses and *Triodia schinzii* hummock grasses on shallow sandy soils on outcropping Proterozoic siliceous sandstone strata. Savanna woodlands of *Eucalyptus tectifica – E. grandiflora* alliance over high Sorghum grasses on red and yellow earths mantling basic Proterozoic volcanics. Riparian closed forests of paperbark trees and pandanus along drainage lines. Extensive mangal occurs in estuaries and sheltered embayments. Numerous small patches of monsoon rainforest are scattered through the district. Dry hot tropical sub-humid, summer rainfall."

With an area of 87,017 km^2 the North Kimberley bioregion is of moderate size, with other regions varying from 2,372 to 423,751 km^2 and most being between 14,000 and 200,000 km^2 in size. The area disturbed by this proposal occupies less than 0.00005% of the North Kimberley Bioregion and an even smaller area of PNP/215.

4.1.1 Regional Studies

Detailed regional flora survey work was not conducted until fairly recently with the publication of information on plant ecology (Perry, 1956), a survey of the Ord-Victoria area by Stewart et al (1970), the Keep River area (Henshall and Mitchell, 1979) and several recently published monographs on the flora of the Kimberley region (Petheram & Kok, 1991). Descriptions of plant life in areas of the north-east Kimberley include the monsoon forests of the Admiralty Gulf (Beard, 1976), the Bungle Bungle and Osmond Range (Forbes & Kenneally, 1986).

A series of biological surveys in the 1970's and early 1980's by the then Department of Fisheries and Wildlife in Western Australia included the Prince Regent River Nature Reserve (Miles & Burbidge, 1975), Drysdale River National Park (Kabay & Burbidge, 1977), the islands of the North-west Kimberley (Burbidge & McKenzie, 1978), the Edgar Ranges area (McKenzie, 1981), and the Dampier Peninsula (McKenzie, 1983). The Western Australian Museum completed a survey of the Mitchell Plateau and Admiralty Gulf in 1976 (Wilson et al, 1981).

More recent biological surveys in the region include a survey of Purnululu (Bungle Bungle) National Park (Woinarski, 1992), and a wide scale survey of Kimberley rainforest areas (McKenzie et al, 1991). During the development of the Argyle Diamond Project, Dames and Moore (1982) completed a biological survey of an area 35 km southwest of Lake Argyle, and within the Northern Territory there has been some work in the Keep River National Park (McKean, 1986). The Department of Agriculture has produced a reptile and amphibian list for the North-east Kimberley (Gowland & Sonnemann, 1980), and bird and mammal lists for the ORLA (Gowland & Brennan, 1980; Gowland, 1980). An unpublished ecological survey of Spirit Hills Station by Tidemann et al. (1987) focuses on upland sandstone areas. Research projects conducted by CALM and Parks and Wildlife Commission of the Northern Territory (PWCNT) staff, the Western Australian Museum (WAM) and opportunistic collecting by amateur naturalists have further supplemented this information. Ecologia Environmental Consultants have also documented a survey of the flora and fauna of the Stage 2 Development of the Ord River Irrigation Scheme in the northeast Kimberley, adjacent areas of the Northern Territory (ecologia, 1998) and the Ashmore Project area (ecologia, 1999).

4.1.2 Conservation Estate

The Biological Survey of the Drysdale River National Park (Kabay and Burbidge, 1977) provides substantial information on the biota of the Northern Kimberley. The boundary of the National Park is approximately 30 km to the south west of the Ashmore Project site and as such this survey provides the best indication of the biota of the project area and of the alignment to Gumboot Bay. The Drysdale survey identified 594 plant taxa, 28 species of native mammal, 10 species of frog, 60 species of reptile and 2415 species of insects, in an area of approximately 42,000 km^2, giving some insight into the diversity of fauna in this area. The biological significance of the area was recognised and gazetted as a "Class B" Reserve in 1974.

The geology of the Drysdale River National Park represents a cross section of the main geological formations of the Northern Kimberley (Kabay & Burbidge, 1977), a subset of which are contained within the Ashmore project area. Rainfall at Ashmore, located 36 km from the coast, is similar to the park.

In 1972 the EPA established the Conservation Through Reserves Committee (CTRC) to make recommendations with respect to National Parks and Native Reserves of the state. The Kimberley Region was identified as System 7 (EPA 1991) and Recommendation 7.8 proposed the establishment of a National Park in the Cape Londonderry area. The CTRC recommended the vacant Crown Land at

Cape Londonderry be reserved because of its geographical position, being the northern most point of the Western Australian and its varied scenery, geology, flora and fauna. The Committee also stated that the area, which covers 70,862 ha has the potential for recreation dependent upon improved access EPA (1991).

4.1.3 Project Studies

A baseline biological survey of the southern section of Ashmore Project Area was conducted by ecologia Environmental Consultants in May 1999. The objectives of the survey was to provide information on the flora and vertebrate fauna for inclusion in a Notice of Intent document. Specific objectives were directed at:

- an inventory of:

  Flora
  - vegetation associations; and
  - species list including declared rare and priority flora.

  Fauna
  - vertebrate species list including recent published and unpublished records;
  - significant fauna habitats and critical resources; and
  - records of species which might be expected to occur but whose presence is as yet unrecorded.

- a review of:

  Flora
  - biologically significant species including declared rare and priority flora; and
  - environmental impacts and recommendations for species and/or associations requiring special management.

  Fauna
  - biologically significant species including rare fauna;
  - introduced exotic or declared pest species and their impact; and
  - environmental impacts and recommendations for fauna management.

- an assessment of:

  - the regional and local conservational value of the flora and fauna of the intended development area.

Further baseline flora and vegetation studies were undertaken at the barge site and road alignment in PNP/215 and on the new road alignment corridor to the Ashmore plant site (Mattiske 2001). Specific objectives were to:

- collect and identify the vascular plant species present in the field survey area;

- search for any rare, endangered or significant flora species;

- review the conservation status of the vascular plant species by reference to current literature and current listings by the Department of Conservation and Land Management (Atkins 2001) and plant collections held at the State Herbarium and current listings associated with *the Environment Protection and Biodiversity Conservation Act (1999);*

- identify any weed species present, including those listed as noxious species;

- define and map the plant communities present; and
- review the local and regional significance of the plant communities recorded.

Other baseline studies conducted include climatic appraisals by the Bureau of Meteorology, (1995a, 1995b) and hydrogeological assessments (KH Morgan and Associates, 1995) of river catchments and water resources in the Ashmore area.

4.2 Climate

Climate in the Kimberley is influenced by proximity to the coast, topography and latitude. Extreme weather events are a component of the climate. Cyclonic occurrences and severe tropical storms associated with the NW Monsoons are common from October to April in most years.

The project area lies in a region of semi-arid monsoonal climates. The environment of the Northern Kimberley follows a similar pattern to the general Kimberley region, with two dominant seasons separated by short transitional periods. The wet (or monsoon) season usually occurs from November to April and the remainder of the year is commonly referred to as the dry season, having only light sporadic rainfall. During the monsoon, temperatures and humidity are high and there is a great deal of rain due to frequent thunderstorms formed in subtropical low pressure systems. In contrast, the dry season is characterised by cooler temperatures, little precipitation, and lower humidity (Bureau of Meteorology, 1995a). High pressure systems have a dominant influence from May to October resulting in a predominantly south-easterly - north-easterly airflow. This aspect was an important factor in the selection of protected sites for barge landings.

4.2.1 Rainfall

Kimberley rainfall is lowest in southern areas, increasing progressively north and northwest. Kalumburu on the coast has an average annual rainfall of 1180 mm, almost all of which occurs during the wet season primarily between January and March. Rainfall decreases to the east overland and thus the barge site would be expected to receive slightly less rainfall than Kalumburu, although the pattern of rainfall would be similar.

Bureau of Meteorology (1995a) analysis for the Ashmore area suggest the median annual rainfall for this location and region is 900 mm. This is based on data provided by the Wyndam Post Office and Kalumburu Mission. The 10 percentile value for the region is 650 mm and the 90 percentile is 1400 mm. Design rainfall estimates for the Beta Creek catchment – one of largest influencing the King George River (Figure 2) are shown in Table 4.1.

Table 4.1: Design Rainfall at Ashmore

Years	Duration (Hours)		
ARI	1	12	72
2	60 mm/hr	9 mm/hr	2.7 mm/hr
50	124 mm/hr	21 mm/hr	6.4 mm/hr

These figures can be interpreted as indicating a one hour rainfall of 60 mm is likely to occur every two years, while a 72 hour rainfall total of 460 mm should be expected once in 50 years. The high runoff coefficients and extreme rainfall during the wet season results in significant peak discharges of rivers

into the sea. Following cessation of rainfall, the major river systems continue to flow for several months after peak flood due to bank drainage.

4.2.2 Temperature

Between May and October mean temperatures range from a 15°C minimum to a 36.6°C maximum. Temperatures increase during "the wet" (Table 4.2), commonly reaching 38°C to 40°C with high humidity.

Table 4.2: Summary of Climatic Data for Kalumburu

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (°C)													
Daily max. – mean	34.1	33.5	34.2	34.4	33.2	31.8	32.0	33.4	35.3	36.6	37.0	35.9	34.3
Daily min. – mean	24.7	24.4	23.8	21.4	17.9	15.0	13.8	15.5	18.8	22.4	24.6	25.0	20.6
Rainfall (mm)													
Mean	800.1	293.6	208.6	58.2	17.9	5.6	7.8	0.5	4.3	25.9	82.5	175.9	1180.9
Mean # rain days	2.5	2.8	3.3	3.7	5.7	7.5	7.4	5.8	3.6	3.0	2.7	2.4	50.4

Evaporation rates, which depend on radiation, wind speed, air temperature, humidity, and the physical properties of the evaporating water surface are high, and during April to November generally exceed precipitation. Mean annual evaporation rates are derived from broadscale analysis of data across the region and commonly exceed 2600mm.

These extreme conditions can have a substantial influence on lifestyles and the economy of the region.

4.2.3 Cyclones

A tropical cyclone is defined (Bureau of Meteorology 1995-a), as a cyclonically rotating low pressure systems of tropical origin in which 10 minute mean winds, at 10 metres above the surface are at least gale force (> 33 knots).

Tropical cyclones develop from tropical depressions which are either located over warm tropical waters or move from land over tropical waters. Once a cyclone moves over land it rapidly loses intensity and cyclone characteristic. Studies undertaken by the Bureau of Meteorology (1995-a) for the Proponent, showed that for the period from mid 1959 to mid 1993, 60 systems passed within 300 nautical miles (nm) of the Ashmore site. Of these, three were rated as severe. Of equal importance from an operational perspective are continental monsoonal lows which cause significant flooding and commonly result in extended periods of isolation.

Under these types of conditions, operations must ensure that supply routes are established that provide a reasonable level of security and are sustainable in respect to maintenance.

4.2.4 Tides

Tides in Gumboot Bay, based on data from nearby Lesueur Island (Department of Transport 2001), are semidiurnal with a range between low and high tide of up to 2.0 m. Tidal velocities in the bay are low. This is in contrast to the tides south east of Cape Rulhieres in Joseph Bonaparte Gulf where spring ranges of several meters are experienced (Lees 1992).

The effect of semidiurnal tides with a low to moderate range in a drowned, protected inlet has resulted in the development of a narrow intertidal zone (Figure 3) relatively protected from wave action.

Exploration for marine diamonds undertaken in Gumboot Bay in the late eighties (Gates 1989) recorded that the bay was filled with fine sand and shell material without any apparent channels. East of the barge site, the inlet shallows rapidly with a increasing silt component over a cobble floor until it terminates against an ephemeral water fall.

4.3 Regional Geology

The geology of the Kimberley is relatively complex and is the principal determining factor for the range of landscape features observed today. Descriptions of the Kimberley Basin and the area encompassed by the Drysdale-Londonderry Sheet 1:250,000 Geological Survey Map are outlined in Gallatly and Sofoulis (1975).

The Kimberley region comprises a central sedimentary/volcanic basin (the Kimberley Basin) with two mobile zones bordering to the south and east – the King Leopold and Halls Creek Zones. In contrast to the mobile zones, the rocks of the Kimberley Basin exhibit gentle, almost flat dips.

Contemporaneously folding in 2 directions has produced interference patterns resulting in the development of basin and dome features. The other prominent geomorphic feature is the extensive development of a SE/SW jointing pattern in the Warton Sandstone. Commonly the joint trends are followed by incised drainages which form pronounced liniments on aerial photographs.

4.3.1 Landforms

The Drysdale-Londonderry area consists of 3 distinct physiographic elements;

- the Karunjie Plateau – underlain by various jointed sandstone lithologies and distinguished by numerous mesas and erosional escarpments or jump-ups. Relief ranges from 70m to 150m;

- the Gibb Hills – essentially basaltic hills often capped by lateritic mesas. Near the coast they form resistant cliffs particularly in the Cape Londonderry area. (Gellatly and Sofoulis 1975), and

- the Prince Regent Plateau - west of the Drysdale River the rocks are mostly flat lying and give rise to typical rocky butte topography.

The North Kimberley coastline is rocky and sea cliffs are common between Cape Londonderry and Cape Rulhieres. The shoreline is dominated by large bays and shallow inlets often fringed by narrow sandy beaches and mangles. Rock and sand bars are common and restrict navigation to all but shallow draught vessels. Major seaward draining rivers such as the King George and Berkerley enter the sea via ephemeral waterfalls into tidal gorges some kilometres from the sea. Under certain climatic conditions rivers such as the Berkerley can be seasonally shoaled at their mouth, making navigation hazardous.

4.3.2 Corridor Geology

The project area occurs on the northern edge Karunjie Plateau, which is distinguished by numerous mesas and erosional escarpments (Figure 5). Bedrock is predominantly resistant Proterozoic sandstone (Warton Sandstone) alternating with beds of easily eroded sandstone or locally with siltstone or shale. Relief is variable over the plateau. The Carson Escarpment, which forms the western boundary and trends northwards across the area has a relief of 60 – 120m, however the relief of other escarpments is

seldom more than 75m. In the northern portion of the Plateau near Gumboot Bay, the escarpments are less prominent but the same geomorphic features of a plateau and steep jumpup with a basal scree slope are present. Structurally the area is defined by strong NW-SE, NE-SW and N-S jointed land surface (Figure 3).

The Warton Sandstone crops out in a north-north easterly belt in the centre and east of the region. The lower beds form the cliffs of the Carson Escarpment, and the upper beds form a gentle dip-slope represented by sand covered plains. The formation consists predominantly of white, cream, and pale purple-grey coarse to medium grained, blocky to massive, well sorted quartz sandstone. Minor feldspathic sandstone is present at the base and near the top of the formation.

The Elgee Siltstone consists of soft red-brown rocks – siltstone, mudstone and shale – with interbeds of find grained well sorted buff to pale red-brown quartz sandstone and feldspathic sandstone. The siltstones weather to a fine powder like material and have poor engineering properties. The sandstone units conformably overlie the Carson River Volcanics which are characterised by subdued rounded landform development near the coast and extensive areas of grey clay soil plains east of the King George River. The latter soils are unsuitable for road building.

Locally overlying the sandstones and basalts in lenses of varying thicknesses are Tertiary to present day lateritic materials ranging from permeable pisoliths to hard compacting clay materials. The proposed barge site, laydown area and lower parts of the access road within PNP/215 are located on basaltic terrain rising up through the sandstone jumpup onto the flat lying escarpment. Cainozoic soil development over the Warton Sandstone is extensive with thickest accumulations in gentle sloped drainage depressions. At the base of the escarpments, colluvium consisting of sandy soils and sandstone clasts form well developed scree slopes.

4.4 Regional Drainage

Four major north flowing river systems dominate the North Kimberley region:

- the Carson River in the west;
- the Drysdale and King George Rivers in the central zone, and
- the Berkeley in the east (Figure 2).

The Drysdale and the Berkeley have estuarine shoal conditions in the lower reaches. The King George River terminates in a waterfall within a deep tidal gorge.

The Ashmore project area lies on a catchment divide approximately in the centre between the Drysdale and the King George Rivers in what is defined as a downstream valley regime.

Both rivers exhibit incised, superimposed features that can become a string of deep pools during the dry season and subject to high level flooding during the wet. Following the wet season, river crossing access can be restricted for several months. The Carson River Road – Drysdale Crossing (Plate 4) was 400 meters wide and 3 metres deep in June 2000 and road access was not possible until two months later.

A more significant impediment to access can occur during flooding associated with late dry season thunderstorm activity. Flow concentrations can develop from several tributaries as a result of aerially isolated, high intensity storm events on any one tributary catchment. Although limited data is available for the major rivers, flood level estimates for these storm events undertaken for Beta Creek (Morgan, 1995), which included observations of channel profiles, flood height estimates from debris and erosion

scours, showed that with high runoff coefficients from the Warton Sandstone, peak river levels can develop rapidly posing a risk of temporary entrapment for road travellers in isolated sections of the catchment.

A primary objective in determining alignment selection criteria for the barge site was to ensure that any proposed road access was not required to cross a major river, and where possible, was routed on the catchment divide.

4.4.1 Barge Site Drainage

Several short ephemeral creeks and one permanent creek enter the sea in the general area of Gumboot and Faraway Bay. Creeks are incised, structurally controlled and have the larger part of their catchments on the Carson River Pastoral Station, outside of PNP/215.

The permanent creek west of the barge site is utilised as the water supply for the Faraway Bay Bush Camp and is spring fed. No part of the proposed development within PNP/215 will impact on perennial drainage lines.

4.5 Vegetation and Flora

The Ashmore Project area is located within the Karunjie Plateau sub-district of the Gardner Botanical District of the North Kimberley Region, in the state's Northern Province (Beard, 1990). Dominant plant families include Poaceae (grasses) and Myrtaceae (myrtles) and is characterised by tropical high grass savanna with a tree layer forming a savanna woodland.

Beard (1979 and 1990) found that the plant communities of the Karunjie Plateau sub-district reflect the underlying geology and soils. The Karunjie Plateau is underlain in the most part by sandstone, with the "*Eucalyptus tetrodonta-E. miniata* alliance, with the *E. dichromophloia* sub-alliance on the rugged country and the *E. tetrodonia* sub-alliance on the deeper soils" (Beard 1990).

The Gardner Botanical District has been found to contain nine dominant upper storey species, all of which are Eucalypts, except the species *Callitris intratropica.* A range of smaller trees has been identified and found to be relatively scattered. Shrub species common scattered within the district include *Acacia spp,* Mytraceae species including *Calytrix sp.* and *Verticordia sp.*, Proteaceae species including *Grevillea agrifolia* and Papilionaceae species including *Bossiaea bossiaeoides*, *Jacksonia argentea* and *Jacksonia thesioides.* The grass layer is considered to be relatively poorly developed and to consist predominantly of the annual species *Sorghum stipoideum* and *Sorghum timorense* (Beard 1990).

4.5.1 Baseline Survey

A baseline vegetation and flora survey of the barge site and access road within PNP/215 was undertaken in June 2001 (Mattiske 2001). The survey also covered the access road alignment south to the Ashmore Project Area which linked up with the survey area of ecologia (1999). The area covered by the two surveys is, for reporting purposes, designated The Ashmore Project Area.

4.5.2 Methodology

The vegetation of the Project Area, which included the barge site and access road within PNP/215, was surveyed by traversing areas on foot, by vehicle and in some parts by aerial survey via a helicopter. Detailed recordings were undertaken in the alignment where plant communities occurred, recognised on the basis of the local variation in vegetation structure and floristic composition (e*cologia* 1999,

Mattiske 2001). Landsat imagery was also used to aid the extrapolation of the distribution of the vegetation.

A database search was undertaken of records held by the Department of Conservation and Land Management for Declared Rare and Priority Flora species likely to occur in the vicinity of the project area. Relevant species were examined at the Western Australian State Herbarium prior to the field survey being undertaken. Nomenclature of the species recorded follows the Western Australian Herbarium (2000) database. Selective opportunistic collecting was also undertaken at additional sites in plant communities of like structure and floristic composition.

4.5.3 Vegetation Communities in the Alignment Corridor

A total of 13 vegetation communities were recorded by Mattiske (2001) in the entire alignment corridor which included the barge site and the 37 km road alignment south to Ashmore. The communities recorded for the alignment have been grouped into 5 structural groups and are shown in Table 4.3 and their distribution mapped onto a series of strip maps covering the alignment corridor. Vegetation communities covering the proposed facilities in PNP/215 are shown on Figure 4.1. Species lists are referenced in Appendix C.

Table 4.3: Vegetation Communities in the Alignment Corridor

Group	Total Communities
Eucalyptus Woodlands	9
Mixed Species Woodland	1
Terminalia Shrubland	1
Dunal Complex	1
Creekline Community	1
Total	**13**

4.5.4 Vegetation Communities in PNP/215

Six communities (1ca, 1cb, 1f, 2, 3 and 4) were mapped at the barge site and in the alignment corridor in PNP/215 and comprise:

Community 1ca: Low Woodland of *Eucalyptus tetrodonta*, *Corymbia opaca* and *Eucalyptus* ?*miniata* over *Buchanania obovata*, *Terminalia canescens*, *Grevillea agrifolia*, *Grevillea cunninghamii*, *Bossiaea bossiaeoides* and *Calytrix* spp. over *Sorghum* sp., *Schizachyrium fragile*, *Schizachyrium crinizonatum* and *Eriachne sulcata*.

Community 1cb: Low Woodland of *Eucalyptus tetrodonta* and *Corymbia opaca* over *Acacia monticola*, *Acacia plectocarpa* and *Grevillea heliosperma* over *Cyperus microcephalus* subsp. *saxicola*, *Eriachne glauca* var. *glauca*, *Panicum decompositum*, *Xenostegia tridentata*, *Chrysopogon fallax* and *Thaumastochloa major*.

Community 1f: Low Woodland of *Corymbia* ?*opaca* over *Tephrosia* ?*phaeosperma*, *Ptilotus corymbosus* and *Pterocaulon verbascifolium* over *Chrysopogon fallax* and *Fimbristylis leucocolea* with occasional emergent *Eucalyptus* ?*bigalerita*.

Community 2: Low Open Woodland of *Bauhinia cunninghamii* over *Hakea arborescens*, *Terminalia canescens*, *Exocarpos latifolius* and *Grevillea pyramidalis* subsp. *pyramidalis* over *Sorghum* sp., *Cajanus lanceolatus* and *Xerochloa laniflora*.

Community 3: Low Shrubland of *Terminalia canescens* over *Sorghum* sp. over *Heteropogon contortus*, *Eriachne* ?*avenacea*, *Panicum decompositum*, *Triodia* sp. and *Fimbristylis* ?sp. F (A.S. George 13789) with occasionally emergent *Corymbia* ?*opaca*.

Community 4: Dunal complex of (a) *Terminalia platyphylla*, *Mimusops elengi* and *Cochlospermum fraseri* over *Dodonaea platyptera*, *Glochidion disparipes*, *Abutilon* ?*otocarpum* and *Crotalaria montana* over *Sarcostemma viminale* subsp. *australe* and *Jasminum didymum* subsp. *lineare*, (b) *Spinifex longifolius* and *Sorghum* sp. and (c) mangrove species *Rhizophora stylosa* and *Bruguiera parviflora*.

4.5.5 Status of Vegetation Communities

The six communities defined and mapped within PNP/215 appear to be parts of larger units well represented throughout the region and are therefore not thought to be Regionally or Locally Significant. None of the communities in PNP/215 contain Priority flora.

The mangroves community incorporated into the Dunal Complex (Community 4) is not expected to be significantly affected by the proposed barge site, and is therefore not considered to be locally significant. The condition of the vegetation throughout the entire survey area was very good. Evidence of disturbance, while minimal, was largely associated with tracks and occasional 'borrow pits', pastoral activities and feral animals.

4.5.6 Vascular Flora

A total of 243 taxa (including subspecies and varieties), 156 genera and 65 families were recorded for the Ashmore Plant to the Barge Site Corridor.

One hundred and forty seven taxa, 107 genera and 54 families, were recorded within the PNP/215 survey area. Species representation was greatest amongst families *Poaceae*, *Papilionaceae, Cyperaceae, Proteaceae, Myrtaceae* and *Mimosaceae,* a flora composition typical of the Gardner Botanical District. Within these families, the genera *Eucalyptus*, *Sorghum* and *Eriachne* are predominant in the majority of communities.

The relatively high number of taxa recorded during the survey in PNP/215 reflects the length of the corridor surveyed and the range of communities encountered. The major families recorded reflect the predominant types of vegetation communities recorded. In view of seasonal conditions, it is predicted that additional species would be recorded if further survey work was undertaken in alternative seasons. Although the proposal will result in the clearing of approximately 4 ha in PNP/215, the diversity of vascular flora species in the wider area will not be adversely affected.

4.5.7 Conservation Status of the Flora

No plant taxa gazetted as Declared Rare Flora pursuant to subsection (2) of Section 23F of the *Wildlife Conservation Act (1950)* nor any plant taxa pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act (1999)* were located in the alignment survey within PNP/215. No Priority Flora (Atkins 2000) were located in the PNP/215 alignment survey. No threatened ecological communities pursuant to Schedule 2 of the *Environment Protection and Biodiversity Conservation Act (1999)* were located. The development has no significance at a State level in the context of flora conservation and protection.

Within the project area, threats to flora conservation currently include the introduction of exotic plant species (weeds), limited grazing by domestic stock, uncontrolled dry season burns and feral animals.

Management of these issues has been addressed in Section 5 and the Construction Management Plan (Appendix E) and Equipment Hygiene Procedures (Appendix H).

4.5.8 Introduced Species

One introduced species (*Acanthospermum hispidum*) was observed within the alignment in PNP/215. Although this species is not a declared noxious weed under the *Agriculture and Related Resources Protection Act (1976)*, and the occurrence is restricted, measures to limit the spread of weeds will be implemented.

4.6 Fauna

The Ashmore project area lies within the central part of the Northern Kimberley Bioregion (Thackway and Cresswell, 1995). This region is characterised by dissected plateaus supporting various woodland associations. Sorghum grasses and *Triodia schinzii* hummock grasses dominate the majority of the understorey. Riparian closed forests of paperbark trees and *Pandanus* occur along the drainage lines.

The Ashmore Project area, based on detailed survey results from the Drysdale River National Park is expected to support a broad vertebrate community as its composite fauna habitats are diverse. Of the 488 species recorded in the region, approximately 269 would be expected to utilise habitats similar to those represented in the Ashmore area and Barge site. However, it is unlikely that a full complement of species would occur in such a small area. A survey of the nearby Drysdale River National Park in 1975 (Kabay & Burbidge 1977) yielded 221 species, including 131 bird species, 28 native and two introduced mammal species, 13 amphibian species and 47 reptile species.

4.6.1 Approach to Survey

The approach taken by ecologia (1999) for the fauna assessment component of the Ashmore Project area study involved an extensive literature search for all published information available for the region surrounding the Ashmore Project area and consultation with relevant authorities to obtain access to unpublished information and databases.

In the absence of a fauna field survey, areas recognized as having potential ecological significance, were duly noted during the botanical survey, and advice on avoiding these areas forwarded to corridor planners.

The following organizations were consulted for access to unpublished datasets and reports containing relevant fauna data for the project area and general bioregion.

- Conservation and Land Management (C.A.L.M),
- Western Australian Museum (W.A.M), and
- Kimberley Land Council (KLC)

The current information is based upon datasets generated from the literature review, opportunistic sightings during road and helicopter traverses and consultation with the above organizations. However, it should be noted that no specific field information exists on the faunal communities for the PNP/215 area other than some sporadic records in the Western Australian Museum.

4.6.2 Limitations of Fauna Assessment

The current fauna and fauna habitat assessment is based solely upon a review of relevant literature, including both published and unpublished data. Assessment of vertebrate faunal habitats within the

project area was based upon ground and aerial photography and a brief site visit conducted by a field botanist, with relevant faunal experience, to confirm fauna habitat types.

The assessment of terrestrial vertebrate fauna species potentially occurring in the Ashmore project area (see Appendix D) was based upon the known preferred habitat and distribution records for all species as determined from the literature review. While the study encompassed an extensive review of the literature, no detailed trapping survey work was undertaken within the alignment corridor or the laydown area within PNP/215 due to the extremely small area (4 ha) involved. This lack of site specific field surveys limits to some extent the confidence of predictions made for the composition of faunal communities and species present in the project area.

The primary limitations of the study lie with the lack of predictability concerning;

- undocumented species range extensions;
- the undocumented local presence of fauna of conservation significance, and
- the potential presence of new undescribed species or poorly known species.

The taxonomy used in this assessment is based on the following references:

Mammals	….	Strahan (1995)	Skinks	….	Storr *et al.* (1981)
Birds	….	Slater *et al.* (1991)	Monitors	….	Store *et al.* (1983)
	….	Simpson and Day (1996)	Snakes	….	Storr *et al.* (1986)
Geckos	….	Storr *et al.* (1990)	Reptiles	….	Cogger (1994)
Pygopods	…	Storr *et al.* (1990)	Amphibians	….	Tyler *et al.* (1994)

4.6.3 Fauna Habitat

While three of the four fauna habitats identified within the Ashmore Project area (ecologia 1999) are repeated to varying degrees north along the road alignment to Gumboot Bay. Only two habitat types, Eucalyptus Woodland (EW) and Exfoliated Rock (ER) occupy a significant area in PNP/215.

A fifth habitat, identified as the Dune Complex (Community 4) by Mattiske (2001) occupies a small area at the barge site, at the interface of the marine environment and the Exfoliated Rock (ER) habitat.

These five habitat types are:

Dune Complex (DC)	Sparse overstory which includes broad leaf *Terminalia* over low shrubs, spinifex and narrow mangrove fringes.
Riparian Closed Forest (RF)	Closed forest of *Melaleuca dealbata* with some eucalypts, bordering a dense fringe of *Livistona* at the margin of permanent waterways such as Beta Creek and King George River.
Eucalyptus Woodland (EW)	Moderately dense eucalypt woodland over *Sorghum plumosum.* A diverse ground cover of small grasses and shrubs. This habitat also includes areas that have been regularly burnt but maintains a similar structure from a fauna perspective.
Seasonally Damp Woodland (DN)	Very sparse overstorey of various eucalypt species with a complicated ground storey of savannah low grasses and herbs including *Stylidium* (triggerplants) and *Drosera* (sundews).

Exfoliated Rock (ER)	Vegetation typical of tropical dry savannah woodland with irregular patches of exfoliating rock outcrops.

4.6.4 Results and Discussion

- Riparian Closed Forest

The riparian closed forest habitat is expected to support the greatest diversity of fauna with 208 species expected, including 60 reptiles, 15 frogs, 95 birds and 38 mammals (four of which are introduced). This habitat is represented on major permanent drainage systems such as along Beta Creek and the King George River. The relatively dense stands of *Melaleuca dealbata* trees provide arboreal habitat for several mammal and avian species. The area of pooled water provide spawning and food resources for amphibians. This habitat is not present in the alignment corridor in PNP/215.

- Eucalypt Woodland

The eucalypt woodland habitat is expected to support 170 fauna species, including 51 reptiles, 10 amphibians, 67 birds and 42 mammals (four of which are introduced). The stands of *Excoecaria ovalifolia* may support a variety of tree frogs (Family: Hylidae). This habitat covers extensive areas of the plateaux and also occurs within PNP/215.

- Seasonally Damp Woodland

Damp woodland is expected to support the lowest diversity of fauna with 139 species expected, including 21 reptiles, 12 amphibians, 69 birds and 37 mammals (four of which are introduced). The lack of fauna species is a reflection of the lack of structural diversity within the habitat. The thick understorey provides habitat for several small mammals and some herpetofauna, however the sparsity of tree cover limits the habitat available to avian and some mammal species. This habitat does not occur within the proposed infrastructure alignment in PNP/215.

- Exfoliated Rock

The exfoliated rock habitat is expected to support 163 species, including 44 reptiles, 11 amphibians, 60 birds and 38 mammals (four of which are introduced). High species richness is due to both rocky outcrop and woodland dependent species occurring sympatrically. Common in PNP/215 and elsewhere where it forms the sandstone escarpments and basalt cliffs.

- Dunal Complex

The dunal complex is expected to support 79 species, including 35 birds, 26 mammals (2 of which are introduced) and 18 reptiles. Use of the site by migratory waders with the absence of mud flats is not known, but is considered low. Approximately 100m^2 of the beach habitat will be utilised intermittently at the barge site. No mangroves will be impacted by the development.

Table 4.4 shows the potential composition of fauna types in each of the three habitats occurring at the barge site in the alignment corridor within PNP/215.

Table 4.4: Potential Composition of Fauna in PNP/215 Alignment Habitats

Habitat Type within PNP/215	No of Species Potentially Present				
	Mammals	Birds	Reptiles	Amphibians	Total Species
Eucalypt Woodland	44	67	51	10	170
Exfoliated Rock	38	60	44	11	153
Dunal Complex	26	35	18	0	79

4.6.5 Mammals

Forty-three native mammals from 14 families and four introduced species are expected to occur within the habitats of the Ashmore Project Area Vertebrate fauna lists are referenced in Appendix D. This includes 21 bats, 12 marsupials, one monotreme, eight murids and one canine the Dingo (*Canis familiaris dingo*).

Of the mammals species occurring in the area, 48% have greater than 75% of their distribution occurring within the boundaries of the Torresion Zoogeographic Region. The Lesser Wart-nosed Horseshoe-bat, *(Hipposideros stenotis)* was the only Torresion endemic species. Other species such as the Long-tailed Planigale, *(Planigale ingrami)* and the Eastern Broad-nosed Bat, *(Scotorepens orion)* occupy distributions that extend only marginally into the Eyrean Zoogeographic Region. A Significant number of species (16%) show distributions with greater than 70% occurring in the Eyrean Zoogeographic Region. All of these species were bats of the families *Emballonuridae* and *Vespertilionidae*. The distribution of bat species is closely aligned with suitable roosting sites and vegetation strata that accommodates a variety of foraging strategies. Bats readily radiate into areas supporting appropriate resources and therefore generally have wide distributions. Tree hollows of the woodlands and escarpment covers the area providing roosting opportunities while the open water allows optimal foraging opportunities with its attraction of insects.

The project area would accommodate species such as the Northern Nailtail Wallaby, *(Onycheogalea unguifera),* which prefers lightly wooded flood plains land, the Agile Wallaby *(Macropus agilis),* a species that prefers habitats along rivers and streams, open forest and adjacent grasslands. Within the project area these species are expected to be widespread although not present in large numbers.

The Long-tailed Planigale, (*Planigale ingrami)* is expected to occur within the cracks of the seasonally dry flooded woodlands. With the onset of the wet season this species will migrate to higher ground. However, in the dry it will move amongst the grasslands taking the small insects and lizards that comprise its diet. Of the other Dasyurids, the Bush-tailed Phascogale, (*Phascogale tapoatafa)* is also expected to utilise the areas of open woodland.

4.6.6 Birds

Up to two hundred and eleven bird species are expected to occur in the region surrounding the Ashmore Project Area and the alignment corridor to Gumboot Bay. Of these, only 128 are expected to utilise the habitats type identified in this survey. The species expected are comprised of 70 non-passerines and 58 passerines (Appendix D). The project area is unlikely to support the full complement of species at any one time since many species, particularly aerial species such as the raptors, are transitory visitors. Migratory waders are recorded from the mud flats at the mouth of the Drysdale River however the level of use of mud flat poor environments such as Gumboot Bay is not expected to be significant.

The high proportion (27%) of expected species that are wide ranging in distribution clearly demonstrates the mobility of Australian bird species. Seasonal climate variation results in few resources

being present all year round. The high bird species richness translates to high resource competition and as a result birds often move regularly when the resources are depleted. Many species may return to the same breeding or foraging areas each year resulting in massive variations in the number of avifauna present at any one time. The Red-tailed Black-Cockatoo, *Calyptorhynchus magnificus* is known to inhabit Eucalypts along water courses, however this species is also described as being nomadic with a seasons element, its movement governed by the regular fruiting of particular plants. At any given time this and many other species may be abundant or absent in the project area.

4.6.7 Reptiles and Amphibians

Ninety-four herptile species are expected to potentially occur within habitat in the Ashmore Project area, including the barge site in PNP/215. These include 18 frogs, 2 crocodiles, six dragons, nine geckos, four pygopodids, twenty-one skinks, nine varanids, 22 snakes and three turtles (Appendix D).

The proximity of the project area to the northern coastline dictates the origin of the species present in this region. Sixty species expected to occur are endemic to the Torresion Zoogeographic region. These species are of 'New World' origin. 'New world' herptiles species originate in Asia and are recent immigrants, in geological time, to Australia. They have migrated during glacial period, where lower sea levels created land bridges from Asia and Papua New Guinea that allowed cross-continental migration. The Chameleon Dragon, (*Chelosonia brunnea)* is one example. Some of the frog species of Asian origin, such as *Litoria rothii* have conspecifics in Southern New Guinea (Tyler and Davies, 1986). Distribution of species such as those of the family Coloubridae are restricted by the boundaries of the high rainfall tropical regions. These species are unable to persist below the Kimberley region and are a unique facet of the Torresion biota. Other species that demonstrate Torresion distributions that are not 'New World' species, such as the Blue-tonged Skink, *Tiliiqua scincoids*, have radiated across the north of Australia from the eastern coast of Australia.

Eighteen of the 94 herptile species are predominantly Eyrean distributed. These arid adapted reptiles persist into the savanna woodlands of the tropics, making efficient use of the habitats during the dry season, retiring to higher ground in the wet. The small fossorial Three Striped Fire-tail skink, (*Morethia ruficauda)*, and the Ridge-tailed Monitor, (*Varanus acanthurus)* are two such examples. Many of the arid adapted reptiles are of Gondwanna origin.

The microhabitat variation that occurs between the wet and dry seasons results in the evolution of several adaptations amongst the frog species that enable them to cope with the seasonally dry environment. Species such as the Bilingual Toadlet, (*Crinia bilingua*) select to remain near permanent water, while the Woodworker Frog, (*Megistolotis* lignarius) retires under large rock piles and into caves with the onset of the dry season. The Green Tree-frog, (*Litoria caerulea)* is able to remain exposed on the limbs of savannah woodland trees during the dry season by adopting a water conserving posture and secreting a waxing cuticle over it's entire dorsal surface.

4.7 Rare and Specially Protected Fauna

Fauna species which have been formally recognised as rare, threatened with extinction or as having high conservation value are protected by law under the Western Australian *Wildlife Conservation Act (1950)*, the China & Australia Migratory Bird Agreement (CAMBA), the *Commonwealth Environment Protection and Biodiversity Act* (*EPBC Act 1999*). The Japan & Australia Migratory Bird Agreement (JAMBA) has now been incorporated into the *Wildlife Conservation Act*. In addition fauna are covered under the April (1991) Australian & New Zealand Environment & Conservation Council (ANZECC) convention and are listed as referral triggers under the *EPBC Act (1999).* Classification of rare and

endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice (2001)* recognises four distinct Schedules such that:

- Schedule 1 - fauna are rare or likely to become extinct, and are declared to be fauna in need of special protection;
- Schedule 2 - fauna are presumed to be extinct, and are declared to be fauna that are in need of special protection;
- Schedule 3 - fauna are birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, and are declared to be fauna that are in need of special protection; and
- Schedule 4 - fauna are in need of special protection, otherwise than for the reasons mentioned above.

In addition to the scheduled classification provided for under Western Australian legislation, conservation of fauna is also recognised via a non statutory – four Priority level system.

Priority 1 – taxa with few, poorly known populations on threatened lands;

Priority 2 – taxa with few, poorly known populations on conservation lands or taxa with several poorly known populations not on conservation lands;

Priority 3 – taxa with several poorly known populations, some on conservation lands; and

Priority 4 – taxa in need of monitoring.

The desktop study (ecologia 1999) found that five Scheduled fauna and five Priority species (*Wildlife Conservation – Specially Protected Fauna Notice 2001*) potentially occur in the Ashmore Project Area and by extension in the two common habitats that occur in PNP/215. These are documented in Table 4.5.

Table 4.5: Significant Fauna Species Known or Likely to Occur in PNP/215

Species	Common Name	Classification	Comment
Rhinonicteris aurantius	Orange Leaf-nosed Bat	Schedule 1	Reliant on woodland habitats for food resources and nests in hollows. Recent studies suggest it is a poor thermal regulator and must roost deep within warm humid caves to sustain body temperatures. The species may forage within the barge site environs, however its residence in the area of impact is limited by lack of roosting caves. The project is therefore unlikely to impact on this species.
Erythrotriorchis radiatus	Red Goshawk	Schedule 1	Utilises eucalyptus woodlands along water courses and adjacent grasslands. Regarded as sedentary. The alignment in PNP/215 while traversing open woodland does not cross permanent water courses. Direct and indirect impacts on this species is considered negligible.

Species	Common Name	Classification	Comment
Falco peregrinus	Peregrine Falcon	Schedule 4	An occasional visitor to open woodlands and along water courses. Has a cosmopolitan distribution across Australia although not observed during biological surveys in PNP/215. Its sedentary nature means large scale disturbance may impact on resident individuals. Proposed development in PNP/215 will cause a small degree (4 ha) of isolated disturbance and impacts on the species are considered negligible.
Crocodylus porosus	Salt-water crocodile	Schedule 4	This species occurs in Gumboot Bay and is common elsewhere along the Kimberley Coast. The direct and indirect impacts to this species are considered negligible.
Crocodylus johnstoni	Freshwater crocodile	Schedule 4	Species occurs in most river systems in region. Barge site and alignment in PNP/215 do not impact on any permanent streams. Impact to the species is negligible.
Phascogale tapoatafa	Brush-tailed phascogale	Priority 3	Widespread distribution in Kimberley's. Preferred habitat is open dry sclerophyll woodlands with little ground cover. Largely arboreal. The loss of habitat has potential to disrupt local residents in the jump-ups, however the effect is not considered significant at a regional scale given the limited number of individuals likely to be effected.
Petropseudes dahli	Rock ringtail possum	Priority 3	Lives exclusively in rock outcrops and large boulder piles. Common within its preferred range but very secretive. Loss of habitat in PNP/215 has potential to disrupt local residents, however effect is not considered significant at local or regional scale given the limited number of individuals affected.
Macroderma gigas	Ghost bat	Priority 4	Patchy and widely distributed across Northern Australia. Expected to forage opportunistically over the project area. Roosts in rock scree and fissures. Proposed development will avoid preferred roosting habitats. Limited impact.
Hydromys chrysogaster	Water rat	Priority 4	Preferred habitat fresh or brackish water bodies occasionally found on marine beaches. Barge site activities has potential to temporarily disrupt local residents however effect is not considered significant at regional scale given the limited number of barge visits per season and the small number of individuals likely to be impacted.
Mesembionys macrurus	Golden-backed Tree-rat	Priority 4	Occurs in near coastal woodlands, sandstone screes and beaches. Exhibits nocturnal arboreal habits but also forages on the ground. Believed reasonably common in coastal areas in Kimberley's. This species is listed as vulnerable under *EPBC (1999) Act.* Development in PNP/215 has potential to disrupt some individuals but not considered significant at regional scale.

- Other Protected Species

Only one bird species of those expected to occur in the Project Area, is protected under international agreements (ie JAMBA & CAMBA). The Great Egret is protected under both international agreements. This species utilises watercourses in the region and is unlikely to be impacted by the barge site proposal.

4.8 Conservation Status of Fauna

The conservation values in PNP/215 arise, because of the area's relatively undisturbed state, the diversity of its landforms, geology, flora, fauna and landscape visual amenity.

The significance of the biota of the barge site, laydown and access road was assessed in three contexts; state, regional and local.

4.8.1 State and Regional Significance

The proposed facilities in PNP/215 area encompasses habitat and vegetation associations which are relatively widespread in the Northern Kimberley bioregion. There is no habitat of regional significance and no threatened or priority fauna (see Table 4.5) that will be significantly impacted by this development.

4.8.2 Local Significance

Areas of local ecological significance were identified by applying the following criteria;

- habitats, landforms or vegetation associations poorly represented in the project area;
- habitats, landforms, vegetation associations or locations supporting features or species of conservation or ecological significance;
- habitats, landforms, vegetation associations or locations with the capacity to support site-specific elements; and
- habitats, landforms or vegetation associations in better condition than other similar locations.

Gumboot Bay supports fringing mangals of the proposed dry door barge site. These will not be impacted by the operation of the barge site. The project is unlikely to result in the loss of any of the vertebrate fauna species or populations inhabiting the terrestrial or marine environments of Gumboot Bay.

4.9 Social Environment

4.9.1 General

The Kimberley Region extends over 423,000 square kilometres, or one sixth of Western Australia's land surface and is the northern most non-metropolitan region. It includes four local government areas.

- Shire of Broome
- Shire of Derby – West Kimberley
- Shire of Halls Creek, and
- Shire of Wyndham – East Kimberley.

4.9.2 Demography

The Australian Bureau of Statistics (ABS) estimated a resident Kimberley Population of 24,968 as at June 30, 1995 (KDC 1997) although current estimates (KDC 2001) put the population at 31,300. The region has a demographic structure unique in Australia with approximately 46% of the population being Aboriginal people.

4.9.3 Economic Profile

The Kimberley region is economically dependent on six industries (KDC 1997):

- Mining and Exploration – mining production was valued at $551 million in 1995. This had risen to $891 million in 1999/00 (KDC 2001) largely as a result of production increases from the Argyle Diamond Mine and Western Metal's Lennard Shelf Mines.
- Pearling and fishing - the cultured pearl industry in the region produced approximately $60 million worth of pearl product in 1998/1999 (ER – TRMS 2001) with Kimberley fishing valued at $12 million (KDC 1997).
- Tourism - consisting of recreation, eco and adventure tourism was valued at $208 million in 1999/00 with major growth prospects for the region.
- Agriculture and Horticulture - annual production associated with the Ord River Irrigation Area was valued at $67.4 million in 1999.
- Pastoral Industry - cattle sales to Asia and the Middle East were estimated at $61 million in 1999, and
- Community Services - Community Services, Public Administration and Defence provide a large financial injection into the region.

The Kimberley economy is small relative to the Western Australian economy with short to medium economic growth likely to be generated from expansion of Government Services, pearling and aquaculture, irrigated agriculture and tourism.

Mining, which currently underpins the economy faces long term decline unless exploration efforts are expanded and new mines are developed and bought into production (DRD 2001).

4.9.4 Shire of Wyndham – East Kimberley

The Proponents exploration programmes and the proposed barge site are located in the Shire of Wyndham – East Kimberley (SWEK). The Shire has an area of 121,189 square kilometres and a population of 6,275 (KDC 1997).

Kununurra, with a population of 5,500 is the major urban centre within the Shire, which also includes the historic port of Wyndham (population 800), pastoral stations, several other small Aboriginal communities such as Kalumburu and Oombulgurri and a residential tourism venture at Faraway Bay.

Established in 1960 as the Administrative Centre for the Ord River Irrigation Scheme (ORIS), the township of Kununurra provides retail and wholesale business opportunities, medical and education facilities, Government Services, road transport and air links with Darwin and Perth. The town is an important light aircraft support centre providing for tourists visiting the many regional attractions, mineral explorers and the agribusiness.

While the mining industry is a major factor in the regions economy, greater emphasis is being placed by local government on developing a wider economic base to support, a more stable social environment. To this extent the contribution of other sectors of the economy such as agriculture, cattle raising and tourism are being actively promoted at several levels to maximise employment and growth opportunities.

4.9.5 Land Use

Regional landuse includes pastoralism, mineral exploration, conservation, tourism and recreation and areas set aside for the use and benefit of Aboriginal people (Figure 2).

The region is sparsely populated and the closest residential area to the proposed barge site is the Faraway Bay Bush Camp - a seasonal recreational fishing facility (Benrama Pty Ltd 1992).

The coastal region is also serviced by a variety of tourist cruise ships operating between March and September from Broome to Wyndham. Special attractions include the spectacular rocky coastline and gorges and waterfalls of the King George and Berkerley Rivers.

The Carson River Pastoral Station, owned and operated by local aboriginal group, was established prior to the Second World War. The homestead is located 55 km south west of Ashmore and 70 km from the barge site.

Diamond exploration has been undertaken in the area since the early 1970's and several companies remain active, with most of the North Kimberley under lease.

The Project area and a significant portion of the road alignment are located on the Carson River Pastoral Station.

4.9.6 Tourism

According to the Kimberley Development Commission (1997) the north Kimberley has a unique and spectacular environment which is attracting increasing numbers of tourists to the region.

A diverse range of land forms fauna and vegetation types characterise the coast from Broome to Wyndham. For example, the steep cliffs of the Cape Londonderry landforms with their many colours and small hidden sandy beaches give way to large bays and minor and major estuaries. Some have seasonal waterfalls, others extensive and important mangrove development. While relatively unattractive at ground level due to their inaccessibility, many of these areas have aesthetic appeal when seen from the air or from the sea.

4.9.7 Access

Access into the region is possible by road, air and water with seasonal constraints imposed by climatic conditions. No major all weather road systems service the north Kimberley and road access can be restricted to four months of the year. Adventure tourism (4WD) is a rapidly expanding industry sector although largely uncontrolled. Regional towns such as Broome and Kununurra have well developed air links and provide a range of domestic and charter services.

Marine access is serviced by recreational and commercial cruisers offering a range of services largely during the dry season. Some operators have on board helicopters or link with regional charter operators to provide clients with opportunities to view the landscape or fish in little visited waters.

4.9.8 Faraway Bay

Facilities such as the Faraway Bay Bush Camp, originally developed as a small fishing base in 1992, (Benrama Pty Ltd 1992) have gradually shifted into providing nature based tourism product that includes fishing, bush walks and site seeing. Some of these activities are undertaken in Gumboot Bay and concerns have been expressed by the Proprietors of Faraway Bay that the proposed barge site and operations will have direct and indirect impacts on the tourism product they provide.

The Proponents have maintained an open dialogue with the Proprietors of the Bush Camp, and while they do not accept the contention that the barge operations will impact on the Bush Camps operations, continue to search for ways of protecting the facilities sought after isolation while engaging in their own exploration programmes.

4.9.9 European Heritage

A search of the Heritage Council of Western Australia Database for sites that may have cultural heritage significance found there were no Heritage Agreements in place and no Conservation Orders have been issued for the area surrounding the barge site or access corridor.

A search of the Register of the National Estate (Commonwealth) website database returned no records for the place names in the immediate region.

4.9.10 Aboriginal Heritage

Aboriginal people with traditional ties to the proposed barge site are located in communities at Kalumburu, located 70 km south west of the barge site, or Oombulgurri 150 km to the south east.

The Proponent has a well established Mining and Exploration agreement with the Balanggarra Aboriginal Corporation since 1997 which covers exploration and mining activities. This agreement, which covers the land and waters of the Native Title Claims (under the *Native Title Act 1993*), requires the Proponents to undertake heritage clearances of proposed development areas by a nominated survey team before any ground disturbance takes place.

A survey team, consisting of the Traditional Owners (the registered Native Title Parties), for the proposed development area, their Heritage Advisors and Striker staff, have completed heritage surveys of the road alignment, barge site and laydown area by helicopter and on foot in 2000 and 2001. All heritage clearances for the proposed barge site development and access road were received following surveys of fine road alignment changes in August 2001. No sites of significance or importance to Aboriginal people were recorded in any of the proposed development areas.

5. ENVIRONMENTAL IMPACTS AND MANAGEMENT

5.1 Overview

This section of the document reviews the potential environmental impacts arising from the establishment and operation of a dry door barge site, a 0.25 ha laydown area and a 3.6 km access road in Proposed National Park PNP/215 in the remote North Kimberley's.

The review assesses the significance of these impacts and describes the precautions and management procedures proposed to minimise potential impacts. Key environmental aspects of the project were identified in the EPA Guidelines (Appendix A), from comments during consultation with Decision Making authorities or from public submissions arising from appeals on the level of assessment. These included:

- topography, landform and visual amenity
- drainage alteration
- surface water quality
- vegetation and flora
- fauna
- aboriginal heritage
- social economic aspects
- operational impacts
- environmental management plans

5.2 Topography and Landform

Two physiographic units are present in the vicinity of the barge site and access corridor. These are:

- subdued basalt ridges rising from sea to a height of approximately 80 meters and merging with

- prominent sandstones cliffs to a height of 120m that form the escarpment of the extensive Karanjui Plateau.

The rugged coastline is relatively inaccessible by land and has high scenic value.

5.2.1 Potential Impacts

The construction of the laydown area and access road up the escarpment will require only minor disturbance of a non permanent nature to the existing topography. The total area required for the facility within PNP/215 is approximately 4 ha. Borrow materials for construction will be sourced outside PNP/215.

5.2.2 Mitigation Measures

The Proponent has promoted a policy of minimising land disturbance in the 12 years of exploring in the Kimberley's and this practice will continue to be applied to all construction activities associated with the barge site development.

Retention of vegetation for habitat, visual amenity and conservation of a limited soil supply will be managed through the implementation of clearing control and workforce education. The barge site

infrastructure and access corridors has been sited to avoid substantial trees or areas considered to have high conservation value.

Prior to final closure of the facility a detailed rehabilitation plan would be prepared by the Proponent for DMA assessment.

5.3 Drainage Alteration

5.3.1 Potential Impact

The surface drainage in the project area (Figure 3) is a function of the strong joint overprint and underlying geology. Earthworks even at small scales can alter surface drainage patterns, which can indirectly effect vegetation distribution growth patterns and vigour. While drainage lines in the Project area are low order and ephemeral, some drainage alteration will occur.

5.3.2 Mitigation Measures

In respect to the road, the final formation will be completed and maintained so as not to present a barrier to sheet flow. The barge site and corridor has been sited to avoid the crossing of any significant streams or major catchment. Appropriate erosion control structures will be installed to minimise sediment losses during the wet season.

5.4 Surface Water Quality

5.4.1 Potential Impact

Surface water runoff from disturbed areas including the access road and laydown area flow directly into Gumboot Bay and could potentially contain spilt fuels, hydraulic fluids, packaging materials and sediments. Stream flow in the area surrounding the alignment is ephemeral except for the water supply for the Bush Camp which is fed by groundwater discharge. This supply is in a separate catchment to the access road and barge site and will not be affected by the development. During the wet season increased turbidity in coastal waters is observed as a result of natural erosive processes and rapid runoff.

5.4.2 Mitigation Measures

To prevent potentially contaminated runoff from affecting surface or marine waters in Gumboot Bay, storm water runoff systems will be separated from laydown area waste capture systems. This will require:

- diverting rainwater around potentially contaminated areas such as the laydown area into natural flow paths.
- passing waters from potentially contaminated areas through sediment and oil traps prior to discharge or reuse for dust suppression.
- maintenance of site housekeeping standards in accordance with EMP Sub-Plan – Spill Response Plan (Appendix G).

Implementation of these measures will result in only minor localised impacts on surface water flow around the laydown area and no loss of discharge water quality.

5.5 Aboriginal Heritage

5.5.1 Potential Impacts

The entire Cape Londonderry area is subject to a Native Title Claim by the Balanggarra Aboriginal Corporation. The barge site and access corridor has been surveyed by Traditional Owners on two separate occasions in 2000 and 2001 (BAC 2000, 2001). The surveys located no sites of significance within the corridors.

5.5.2 Mitigation Measures

The Proponent works closely with local Aboriginal Communities and have well established Heritage Clearance Protocols in place. No sites will be impacted by the proposal.

5.6 Terrestrial Flora – Vegetation Communities

The main determinants of vegetation pattern within the infrastructure corridor are rainfall, soil fertility, fire and drainage.

Of the six communities mapped within PNP/215 (Section 4.5.3) all appear to be parts of larger units well represented throughout the region and are not thought to be regionally or locally significant.

5.6.1 Potential Impacts

The principal impacts from the construction of the proposed laydown area and access rod in PNP/215 will be the loss of vegetation through clearing activities or indirectly impacted by alteration to drainage. The area loss (4 ha) from the development is insignificant in comparison to the ecological landform units represented.

5.6.2 Mitigation Measures

Clearing of infrastructure areas will be restricted to that which is absolutely necessary. Topsoil from the laydown and access track will be stripped if sufficient thickness are present and stockpiled for future rehabilitation. Clearing of vegetation will be closely managed to minimise disturbance to mature vegetation. Disturbance areas and exploration tracks no longer required for access will be bunded at the intersection with the Restricted Access Road. Erosion control structures will be designed so as to regularly direct and spread surface waters back into flow zones.

5.6.3 Terrestrial Flora – Declared Rare and Priority Flora

One hundred and forty seven taxa, 107 genera and 54 families were recorded in the PNP/215 corridor.

5.6.4 Potential Impacts

Threats to flora conservation in the Project area include the introduction of exotic plant species, and feral animals (ie donkeys), mining and tourist activities and the decline in the traditional practices of aboriginal people. No plant taxa of conservation significance were located in the corridor within PNP/215.

5.6.5 Mitigation Measures

Grazing

Grazing pressures by introduced animals (cattle and donkeys) is evident in the region particularly around permanent waters. Little evidence is present of grazing impacts in proposed corridor within PNP/215 due to the absence of waters.

Fire

Frequent fires have the effect of reducing the nutrients levels within the ecosystem by the destruction of both plants and plant debris which would otherwise be recycled. Although much of the native flora is both adapted and indeed dependent upon "cool" fires to catalyse seeding, high frequency fires can prevent some species maturing to a reproductive state, resulting in a gradual change in the structure of vegetation as these species are replaced by species with rapid maturation. Thus as the frequency of burns increase there is a reduction in floristic diversity particularly of the understorey species (Craig 1997).

The region of seasonal burning will be confined in frequency and intensity to that which is necessary to control more severe bushfires.

Weeds

The introduction of weeds to native bushland usually accompanies development. Weeds may be introduced on personnel, vehicles (ie tourists 4WD and cattle trucks) or equipment and through the movement of soils materials. The Proponent has developed and implemented our Equipment Hygiene Procedure (Appendix H) to restrict the introduction of exotic fauna and flora through the barge site.

Measures to combat weed spread are outlined in Section 5.14.

5.7 Terrestrial Fauna

Three of the five habitat types identified in the project area (see Section 4.6.3) are present to varying degrees in PNP/215.

5.7.1 Specially Protected Fauna

Two Schedule 1 and three Schedule 4 species may potentially occur in the project area (See Table 4.5). The Red Goshawk, (*Erythrotriorchis radiatus)* and the Peregrine Falcon *(Falco peregrinus)* are wide ranging and widely distributed. The small impact of the proposed development poses little threat to either of these species. Similarly the impact to the foraging opportunities of the Schedule 1 Orange Leaf-nosed Bat, (*Rhinonicteris aurantius)* is insignificant as the habitats in the project area are well represented within the region. The small scale and type of disturbance and the siting of the facilities away from watercourses will result in minimal disturbance to the species. Furthermore bat roosting habitats are not present in the alignment corridor.

Two crocodile species the Freshwater crocodile *(Crocodylus johnstoni)* and the Saltwater Crocodile (*Crocodylus porosus)* are present in the region. The former occur in most permanent river habitats not impacted by the development. Saltwater crocodiles are present in Gumboot Bay and most other inlets in the region. The operation of the barge site is unlikely to effect resident populations.

5.7.2 Potential Impacts

Initial impact to local fauna population will be mortality caused by destruction of habitat and the relocation of mobile species into adjacent areas.

Secondary impacts include road deaths from increased traffic, increased noise and vibration and trapping in uncovered pits. Alteration of surrounding habitat may also be caused by dust, altered hydrology, increased fire and weed invasion.

5.7.3 Mitigation Measures

The Orange Leaf-nosed-Bat requires deep humid caves for roosting. No habitat of this type are present in the vicinity of the corridor or barge site and no impacts to this species are anticipated. The saltwater crocodile (Crocodylus porosus) is present in Gumboot Bay although no impacts to the marine environment will arise as a result of this proposal.

In general impacts to small terrestrial fauna will be minimised by staging clearing, limiting area disturbance to that which is absolutely essential, and limiting off road and track development. Movement of vehicles at dusk and early evening should occur at lower speeds to reduce the potential of road deaths to the nocturnal species.

5.8 Social and Economic Aspects

The Proponent has been successful in discovering diamondiferous kimberlite pipes in the remote North Kimberley Region of Western Australia. To determine the commercial viability of the discovery and support an ongoing exploration programme, a secure sustainable transport link is critical, barging equipment and supplies to Gumboot Bay and then a 35 km road link. The Ashmore plant site satisfies the projects short and longer term transport needs.

The town of Kununurra (population 5000) is located 220 km south east of the site and provides administrative transport and commercial services for the region.

The regions economy and growth is based on mining, tourism, cattle production, aquaculture (pearls) and agriculture (KDC 2001). The mining industry was valued at $891 million and the tourism industry $208 million in 1999/2000.

For the purpose of the study the local community is considered to be those people living in the Wyndham-East Kimberley Shire. The nearest community to the site are Kununurra (220 km), Wyndham (200 km), Kalumburu (70 km), Oombulgurri (150 km), Ashmore Camp (35 km) and the small Bush Camp (1.5 km) in Faraway Bay.

5.9 Visual Amenity, Recreation and Safety

5.9.1 Potential Impacts

The barge laydown area will be located on a flat area approximately 50m inland from the beach and above the 1m in a 100 year storm surge height (Plate 1).

An area of approximately 0.25 ha will be levelled, sheeted with local materials and contoured to promote drainage into silt traps to ensure sediment and other contaminants are caught before discharge to the environment.

Mature fringing vegetation will be retained where feasible to provide visual amenity screens. Additional screen plantings will be undertaken once the site Fire Protection Plan has been established.

Gumboot Bay and adjoining areas are utilised by the operators of the Bush Camp for boat-based guest sight-seeing and recreational fishing. The site would also be visited by Striker personnel during rostered days off. Swimming is prohibited due to the presence of estuarine crocodiles, sharks and other stringing marine organisms.

The road up onto the escarpment is located below the ridge crest and climbs up onto the escarpment in a timbered jumpup. The Restricted Access Road intersects the Bush Camp airstrip road at nearly right angles in two locations. Normal intersection signs will be displayed at the intersections.

5.9.2 Mitigation Measures

The road will be constructed of natural local materials and has been sited to minimise impacts to vegetation stands where possible. Opportunities to see the laydown area or road from charter vessels traversing the coast are limited in most situations by topography and distance.

The proposed laydown infrastructure within PNP/215 will occupy an area of 0.25 ha. The tank facilities will be no higher than 4m and will be painted natural colours that blend in with the local terrain and vegetation. Facility lighting will be confined to the laydown area although solar power security cameras and telemetry may be installed on poles. Existing upper story vegetation will be retained for screens whenever possible.

The laydown facility when viewed in context with the surrounding landscape will present a low visual profile that will be further reduced over time following the proposed vegetation screen planting.

5.9.3 Site Security and Safety

Access to the site is currently possible by 4WD vehicle on pastoral roads and exploration tracks. Annual upgrading of the Kalumburu-Carson River road system to supply mining and exploration activities has inadvertently increased the opportunities for third party adventure visitors to travel to Faraway Bay.

Resources to assist under-equipped or stranded travellers in the area are limited. In addition, other land users such as the Bush Camp, actively market the site's isolation and are required, as a condition of their licence to operate, to access the site only by air or sea.

Standard cautionary signage advising of the presence of crocodiles will be erected at the entrance to the barge site and information on living with crocodiles, developed by the Department of Conservation and Land Management will be included in Site Induction Programmes. Contingency planning in the event of a medical emergency associated with biting or stinging fauna is included in the site Emergency Response Plan (Appendix I).

Ongoing discussions will be held with other land users in the region to determine sensible methods of limiting unauthorised or unwanted access.

5.10 Noise

5.10.1 Potential Impacts

Noise from the barge site will originate from two sources.

- moderate but continuous noise for approximately two weeks during daylight hours associated with construction activities.

- moderate, short term occasional noise associated with barge and transport activities.

The barge will dock up to 40 times per season at high tide for approximately four hours to unload fuel and stores. Some landings will be at night to accommodate tides and barge availability.

The nearest residential area to the barge site is the Bush Camp located 1.5 km north west of the barge site in an adjoining bay. The barge site is separated from the Bush Camp by an 80m high vegetated basalt ridge (see Figure 3). The greatest potential impact of noise from a facility such as the barge site is the nuisance disturbance to neighbours particularly at night. Concern has been raised by the Proprietor of the Bush Camp in regard to this issue.

5.10.2 Mitigation Measures

Noise control is achieved through

- noise reduction at the source, and
- noise attenuation along the transmission path by a number of factors.

Noise reduction at the barge site will be achieved by:

- limiting all construction activities and related vehicle movements within a 5km radius of the Bush Camp to day light hours, and

- noise attenuation along the transmission path will be assisted by a separation distance of 1.5 km, meteorological conditions and elevated terrain (Plate 3).

Noise levels at the barge site during night unloading activities will be monitored and remedial actions implemented as required.

5.11 Particulate Emissions

5.11.1 Potential Impacts

Particulate emissions, notably dust will be generated by equipment movements during the short construction period, materials transport and tipping of borrow materials during road forming activities. Dust generation is unlikely to be of a scale that would impact on residents at the Bush Camp or on surrounding vegetation.

5.11.2 Mitigation Measures

Dust generation will be managed through the use of water sprays and the scheduling of construction works in early autumn when soil moisture levels are highest.

Significant wheel generated dusts during tanker transport are unlikely due to the proposed low travel speeds of the equipment.

5.12 Light Spill

5.12.1 Potential Impacts

Low tower lighting would be installed in the vicinity of the fuel storage bunded area. The lighting would be directional, located approximately 50 meters from the shoreline and used only when night barge visits were planned. Some wildlife such as bats may opportunistically forage around the lights.

5.12.2 Mitigation Measures

Although little information is available on the impacts of lights on wildlife, the infrequent use of the facility over the season is unlikely to result in permanent changes to foraging behaviour.

Light spill is unlikely to impact on the ambiance of the Bush Camp due to the infrequent use of the facility and the screening effect provided by terrain.

5.13 Hydrocarbon Handling and Spill Response

Hazardous materials, predominantly oils and diesel fuel will be transferred from the barge and stored in bunded containment in accordance with relevant legislation, Australian and International Standards (ISO/TR-13739) and Industry Codes of Practice. Planned diesel storage is 40,000 litres in two skid mounted removable bullet tanks. The tanks will be emptied, decoupled and stored inland during the cyclone season.

Hydrocarbon Management Guidelines for the facility have been prepared based on the following principles:

- prevention of all product leaks and spills;
- inspection and testing of tanks and containment prior to fuel delivery;
- operation, inspection and maintenance of drainage sumps, valves and oily water separators;
- appropriate containment and spill recovery facilities available on site, and
- monitoring and controlled disposal of oily waste products.

5.13.1 Potential Impacts

The main potential sources of spillage at the site are:

- loss of product from the barge into water during fuel transfer operations;
- loss of product at the transfer control site on land;
- loss of product within the bunded area arising from tank overfill;
- fork stick damage to containers during unloading, and
- minor spillage associated with road tanker filling.

5.13.2 Mitigation Measures

- Emergency Procedures and Contingency Planning

Emergency procedures, training and guidelines covering a range of spillage scenarios associated with fuel unloading, fuel handling and storage are described in the following section and referenced in various sections of the Management Sub Plans in Appendices F, G and I.

- Hydrocarbon Spill Response

Oil spill response management in Western Australian waters is covered by the Western Australian Department of Primary Industry – Oil Spill Contingency Plan, (OSCP). A further plan the, West Plan Marine Oil Pollution (West Plan – MOP) has been developed as a reference guide for those responsible for developing and managing oil spill response capability in Western Australia.

Under the plan Western Australia has been divided into eight oil spill response districts with a "first response" role for the North Kimberley delegated to the Broome Port Authority. Contact details for spill reporting are listed in the Proponent's Emergency Response Plan (Appendix I) and in the *MV Brisk* Shipboard Oil Pollution Emergency Plan (Appendix F).

- Oil Spill Contingency Plan

The vessel *MV Brisk* is in current survey and carries an approved Shipboard Oil Pollution Emergency Plan (SOPEP) in accordance with the requirements of Regulation 26 of Annex 1 of the International Convention for the Prevention of Pollution from Ships (1973) as modified by the protocol of 1978 (MARPOL) and Australian maritime transport requirements. Spillages while unloading and on shore are covered by a Spill Response Plan (SRP).

Gulf Freight Services has a Safety Management System (SMS) in conformance with the International Safety Management Code. The SOPEP and the SRP are covered under a Company Standard Work Instruction and are controlled documents within the SMS. Copies of the Plans have been customised for the Gumboot Bay site and form part of the Environmental Management Plan referenced in Appendixes E-I of this document.

The company conducts regular communications tests between ship and shore using various means of communications. In addition, each vessel routinely conducts training and contingency exercises in spillage control and emergency response. Copies of the *MV Brisk* SOPEP and the SRP are referenced in Appendices F and G.

An Oil Spill Contingency Plan specifically for the Gumboot Bay site is being modified to comply with DPI requirements. The Plan will be audited annually by the Proponent using the OSCP Audit Checklist and the outcomes reported to Regulatory Authorities in the Annual Environmental Report. A copy of the OSCP Audit Checklist is referenced in Appendix F.

- Spill Containment During Unloading Operations

Following discussions with the DPI Marine Environment Protection Unit, it is proposed that a floating containment boom will be placed around the barge during hydrocarbon transfer operations.

In addition to the Spill Kit permanently based on the *MV Brisk,* additional spill equipment will be stored permanently at the laydown area.

In the unlikely event of a diesel spill during unloading operations the *MV Brisk* has cargo fuel capacity, and should it be available, this can be used for spill recovery purposes.

- Spill Management on Shore

Spills will be cleaned up on discovery, with waste materials removed from site for appropriate disposal. Tanks will be located within the laydown bunded area taking into account the need for safety, product security, access for deliveries and annual tank removal. Fuel transfer to the tanker will take place over a bunded compacted driveway.

Fuel dispensing facilities will not be installed at the barge site. The provision of tank overfill warning devices is under consideration. The tanks will be emptied and removed at the end of the field season and stored at the Ashmore site.

- Oiled Fauna Management

The management of fauna (and flora) that has been exposed to hydrocarbon oiling is a specialised field. In Western Australia this activity is coordinated by the Department of Conservation and Land Management. Points of contact to obtain Departmental assistance are listed in the Shipboard Oil Pollution Emergency Plan referenced in Appendix F.

- Transport

Diesel fuel and other bulk requirements will be transported to the site by a modified prime mover and 20,000 litre tanker unit, on the proposed segregated Restricted Access Road.

A tanker loading facility will be provided adjacent to the storage tanks with drainage sumps to capture spillage. Accidental spillage will be treated immediately in line with guidelines referenced in Appendix G.

- Environmental Inspections

Environmental inspections will be conducted to ensure that site activities are undertaken in a manner consistent with Licensing, Legislative and Code requirements. Hydrocarbon Facility Audit Checklists and Guidelines have been prepared to assist site personnel undertake daily and monthly facility inspections. These Guidelines are adapted from Best Practice Industry Guidelines prepared by Mobil Oil Australia. Checklist Report Sheets are forwarded to the Project Manager who is responsible for the implementation of environmental management programmes, training and compliance reporting.

Marine pollution events associated with fuel transfer are uncommon in Australian ports due largely to stringent safeguards adopted. Careful management of this operation will ensure that the transfer, handling and storage of hydrocarbons will have a negligible effect on the environment.

5.14 Weeds

5.14.1 Potential Impacts

Two introduced weed species (*Acanthospermum hispidum* and *Passiflora foetida*) were recorded by Mattiske (2001) during the PNP/215 and Ashmore corridor survey and one species (*Emilia sonchifolia*) in the Ashmore plant area. None of these species are declared noxious weeds and all three were in low densities with restricted distribution.

5.14.2 Mitigation Measures

Weed infestations can be difficult and expensive to control and therefore the primary thrust is directed towards prevention rather than cure. To control the introduction of exotic plants (and fauna) into the region the Proponent has developed and implemented an Equipment Hygiene Procedure (Appendix H) to cover the importation of new and used mining equipment consigned to the Gumboot Bay site. The process requires a physical inspection and Certificate Signoff by the barge operator prior to departure from Darwin. Measures to control weed spread during road construction include:

Construction personnel shall be made aware of weed issues during site induction.

- existing infestations on the proposed alignment will be brought to the attention of the earthworks supervisor and remediation actions implemented, and
- borrow materials will not be removed from sites where weed infestations are evident.

5.15 Rehabilitation and Decommissioning

5.15.1 Potential Impacts

The proposed barge site development will result in surface disturbance of 4 ha within PNP/215 and, depending on the depth of material available, up to 1 ha for borrow sites on the Carson River Pastoral Lease.

5.15.2 Mitigation Measures

Rehabilitation management objectives are directed towards:

- minimising disturbance during the construction phase;
- returning disturbed areas to condition that will support activities consistent with multiple land uses and tenure;
- re-establishing stable topographic conditions that will support a self sustaining indigenous vegetation community consistent with the nominated land use objectives;
- minimising off-site impacts by controlling infiltration, erosion, deflation, sedimentation and the degradation of drainage and ground water resources, and
- employing rehabilitation methods that are technically effective and cost efficient, rely on proven engineering practice and do not require ongoing maintenance.

Disturbed area rehabilitation will be inspected annually using ecosystem function analysis methods to monitor rehabilitation success and erosion control structures.

General Techniques

During the life of the project it is intended to commence progressive rehabilitation of any areas that are no longer required for access. Rehabilitation work will consist of:

- profiling finished surface so that they are free of large depressions, windrows or ridges and are free draining at low gradients;
- all surface will be left rough and timber/rock mulched (track rolled) where materials are available;
- seeding of local sourced shrubland perennial species compatible with surrounding vegetation communities, and
- installation of appropriate erosion control structures to minimise sediment loss.

Borrow Pits

The project will utilise existing and new borrow locations, located on the Carson River Pastoral lease. Rehabilitation of borrow excavations will include:

- grading the borrow floor and sides to give a contoured finish consistent with adjacent landforms;
- stockpiled overburden habitat creation material and topsoil will be returned to the borrow and evenly spread;
- drainage diversion structures will be installed as required to divert runoff away from the borrow;
- the floor and sides will be ripped on the contour to a depth of 40 cm;
- access tracks to completed borrows to be bunded and ripped and erosion control structure installed if required, and
- disturbed areas to be seeded with species compatible with surrounding vegetation communities.

Decommissioning

Current exploration programmes are scheduled to run for several years. Prefeasibility studies are currently being undertaken on several potential developments and the area is considered to have high exploration prospectivity.

Road closure and laydown rehabilitation requirements will be developed in consultation with DMPR, CALM, the Shire and the Pastoral lease holder and other decision making authorities approximately two years prior to planned closure of the facility. Rehabilitation requirements will then be included on the Site Closure Plan.

5.16 Environmental Management

The identification of potential environmental impacts and their management is of high importance to the Proponent.

This PER has been prepared and structured so that each aspect identified as requiring management focus is covered by a series of draft management Sub-plans, guidelines, procedures and audit checklists. These primary Plans address most significant issues identified in baseline studies and from discussions with DMA's and local stakeholders and cover the following activities.

- Construction Management Plan;
- Shipboard Oil Pollution Emergency Plan;

- Spill Response Plan;
- Equipment Hygiene Procedure, and
- Emergency Response Plan.

These sub-Plans form the basis of the Site Environmental Management Plan and will be updated to incorporate monitoring requirements or issues raised during the assessment process.

5.16.1 Reporting

It is proposed that the Proponents environmental performance and their compliance with Tenement conditions, environmental management commitments and any further conditions imposed as a result of the Environmental Protection Authority (EPA) assessment of this proposal be reported each year in an Annual Environmental report submitted to Regulatory Authorities.

6. PUBLIC AND COMMUNITY CONSULTATION

6.1 Background

The proposed barge site is located in one of the most remote and sparsely populated parts of Western Australia. The closest communities to the site are located at Kalumburu, 80 km to the west, the Faraway Bush Camp a small tourist facility 1.5 km to the west in an adjoining bay and Oombulgurri, 150 km to the south east. Both Kalumburu and Oombulgurri are Aboriginal communities located on Reserve Land. The nearest regional centres – Kununurra and Wyndham are located approximately 200 km to the south east on the eastern side of Cambridge Gulf.

The waters off the north Kimberley coast are traversed by a range of commercial vessels, tourist cruisers, recreational sailors and trawlers. The principal land uses in the immediate region are pastoralism, tourism and recreational fishing, nature conservation and mineral exploration. The opinions gathered represent those of the groups, agencies and individuals most closely affected by and involved in the region.

6.2 Public Consultation

Striker Resources NL has continually endeavoured to maintain a policy of open and transparent communication and consultation with government, regional communities and local stakeholders.

Prior to and during the preparation of the original EMP, the Proponents consulted and communicated, either by personal contact or formal correspondence with representatives of State and Local Government Departments, Government Ministers, Aboriginal groups, local stakeholders, Tourist Associations and operators, mining companies and other regional commercial interests.

The following organizations or persons have received information or have been consulted/briefed in Perth or in the Kimberley's in respect to the relevant aspects of the project:

- *Department of Minerals and Energy* [1,2]
- *Department of Environmental Protection* [1,2]
- *Environmental Protection Authority* [1,2,3]
- *Water and Rivers Commission* [2,3]
- *WA Transport – Marine Pollution Unit* [3]
- *Department of Conservation and Land Management* [1,2]
- *Shire of Wyndham – East Kimberley's* [1,2]
- *Aboriginal Housing Commission* [4]
- *Balanggarra Aboriginal Corporation* [1,2,3]
- *Kimberley Land Council* [2,3]
- *Agriculture Protection Board* [4]
- *Bush Camp – Faraway Bay* [1,2, 3]
- *Gulf Freight Services* [2]
- *Rio Tinto Exploration Pty Ltd* [4]
- *De Beers Australia Exploration Ltd* [4]
- *Diamond Rose NL* [4]
- *Dioro Exploration NL* [4]
- *Australian Kimberley Diamonds* [4]
- *Kimberley Development Commission* [1,3]
- *Carson River Pastoral Company* [4]

- *Kimberley Echo Newspaper* [4]
- *WA Tourism Commission* [2,3]
- *Tourism Council of WA Ltd* [3]
- *Agriculture WA* [4]
- *Conservation Council of WA* [2,3]
- *WA Chamber of Minerals and Energy* [2,3]
- *Association of Mining and Exploration Companies* [2,3]
- *Department of Resource Development* [2,3]
- *Fire Control Officers – Northern Kimberley Region* [4]
- *Hon Clive Brown MLA* [4]
- *Hon Dr Judy Edwards MLA* [4]
- *Hon Tom Stephens MLC* [3]
- *Hon Carol Martin MLA* [3]
- *Hon Robin Chapple MLC* [3]
- *North Star Charters* [4]
- *Wyndham Barge Operations* [4]

[1] *Received a copy of the draft EMP for Comment in September 2000*
[2] *Received a copy of the Final EMP in January 2001*
[3] *Received a briefing*
[4] *Received correspondence or telephone conversation*

The proposal has undergone two distinct phases of consultation. The first phase involved discussions with key government departments and agencies and local Stakeholders – The bush Camp, Barge operators and local Aboriginal communities as part of the preparation of the draft EMP.

While Aboriginal communities supported the proposal, detailed discussions with the management of the Bush Camp over a twelve month period leading up to the submission of the EMP had not reached agreement on several issues.

The second phase, leading up to and during the public review for the EMP included radio interviews (Kimberley ABC), Newspaper articles (Kimberley Echo) and meetings with regional agencies. This proactive stance was undertaken to try and stem the level of misinformation that is invariably generated in small communities. A summary of public input is outlined in Section 7.3.

6.3 Summary of Public Input

The EPA set the level of assessment for the Environmental Management Plan at Informal Review with Public Advice on the basis of the limited extent of likely environmental impacts and the availability of provisions under the Mines Act (1978) to manage potential impacts.

Twenty four appeals were lodged against the informal assessment decision by the EPA principally from associates of the local tourist industry.

The comments raised in the public submissions covered a range of topics that included:

- consideration of alternative sites away from the Faraway Bay – Bush Camp Facility;
- the level of public consultation with barge and charter boat operators in the region;
- consideration of potential impacts within a proposed national park;

- consideration of operational issues (ie noise, visual amenity) potentially affecting the interests of the Bush Camp Faraway Bay – a tourist facility situated 1.5 km from the proposed barge site in an adjoining bay;

- perceived lack of comprehensive environmental, archaeological and cultural research undertaken in the area; and

- inconsistency of EPA in setting the level of assessment.

The Minister for Environment and Heritage upheld public appeals on the level of assessment for the barge proposal and directed the EPA to undertake a formal environmental assessment at the level of PER with a four week review period.

6.4 Comments on Public Submissions

6.4.1 Insufficient Consideration of Alternative Sites

A number of public comments referred to the presence of alternative barge sites on the Diamond Coast, from south of Cape Bernier to the Berkeley River. Although this coastline had been closely examined in previous surveys, following advice from the Management of Faraway Bay on alternative sites all previously identified sites (Figure 3) were re-examined by helicopter in July 2000. While the Proponents acknowledge that numerous dry door barge sites exist on the east coast, none were located in close proximity to an access corridor that did not require the crossing of any major river systems or extensive areas of basalt or siltstone derived soils.

The major river systems of the North Kimberley – the Drysdale, King George and Berkerley Rivers are in a relatively natural state. The Proponent has, through the application of catchment management principles, in the design and location of the barge site and access road endeavoured to protect and conserve these river values.

6.4.2 Insufficient Public Consultation

Public comments was received concerning the level of public consultation undertaken with barge and charter boat operators in the area resulting in the potential overlooking of possible barge sites. The Proponent did consult with a range of people with operating experience in the North Kimberley including barge operators.

While most had knowledge of other barge sites, few were able to advise on hinterland access or terrain. This was best done from a helicopter.

Some charter boat operators also raised concerns about potential impacts to landscape amenity from the proposed facilities.

The small scale nature of the proposed facilities and land disturbance (4.0 ha) in PNP/215, the retention of vegetation to form screens and the terrain shielded location within Gumboot Bay (see Figure 3) will minimise the impacts to the landscape vista.

Further discussions were held with a local barge operator from Wyndham with extensive experience in the region. No further information on potential barge sites that satisfied the criteria outlined in Section 2.3.2 was received.

7. SUMMARY OF MANAGEMENT COMMITMENTS

In addition to the preparation of the Environmental Management Sub-Plans, Guidelines and Procedures, the Proponent has prepared a summary of environmental commitments specific to issues raised in consultation with Decision Making Authorities, the public and other interested parties. These commitments are outlined in Table 7.1.

Table 7.1: Summary of Environmental Management Commitments

No.	Topic	Commitment/ Action	Objective	Timing	Whose Advice
1	EMP	Prepare a detailed EMP which addresses: 1. construction management; 2. dust; 3. light spill; 4. weed management; 5. hygiene procedures; 6. spill contingency planning, including oil and fuel spills, and 7. rehabilitation and decommissioning.	Monitor the implementation of the proposal described in the PER and Approved by the Minister. Monitor the management of potential environmental impacts associated with the implementation of the proposal. Meet EPA objectives.	Prior to construction of the laydown facility and access road, whatever is the sooner.	DMPR, CALM, DPI.
2	EMP	Implement the EMP referred to in Commitment 1.	Achieve the objectives of Commitment 1.	Throughout life of project	DMPR, CALM, DPI, SWEK.
3	Construction Noise	The Proponent will limit all construction activities and related vehicle movements within a 5 km radius of the Bush Camp to daylight hours during the construction period.	To ensure that noise impacts emanating from the site comply with statutory requirements specified in Environmental Protection (Noise) Regulations (1997). Protect the amenity of the residents at the Faraway Bay Bush Camp.	During the construction of the laydown and access road within PNP / 215.	SWEK.

No.	Topic	Commitment/ Action	Objective	Timing	Whose Advice
4	Barge Movements	The Proponent will limit barge movements to no more than 40 per field season with management of the Bush Camp advised of planned barge movements by facsimile 7 days prior to barge arrival.	To minimise any potential disturbance to the amenity and activities of the Faraway Bay Bush Camp.	During operational life of project.	
5	Aboriginal Heritage	The Proponent will continue to consult with the area Traditional Owners in accordance with the current agreements with the Balanggarra Aboriginal Corporation.	To avoid disturbance of Aboriginal sites and comply with provisions of the *Aboriginal Heritage Act (1972)* and amendments.	During construction and post construction of the project.	Balanggarra Aboriginal Corporation.
6	Visual/ Landscape Amenity	The Proponent will implement measures to minimise the visibility of the fuel storage facility from vessels traversing Gumboot Bay or from the air. Measures will include: 1. retention of mature vegetation around laydown infrastructure where possible. 2. planting of local indigenous vegetation screens around storage infrastructure that is compatible with the site Fire Management Plan. 3. laydown area infrastructure designed to present low visual profile. 4. disturbed areas to be rehabilitated progressively within the same year.	To minimise impacts on the visual amenity of the coastal landscape.	During construction and operation of the facility.	DMPR, CALM, SWEK
7	Wet Season Facility Management	The Proponent will remove fuel tanks, and secure site at close of the field season.	To minimise the risk of damage to fuel storage/infrastructure from cyclones.	At close of each field season.	DMPR

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9. ABREVIATIONS

AHD	Australian Height Datum
ASF	Alluvial storage facility
ANCA	Australian Nature Conservation Agency
ANZECC	Australian and New Zealand Conservation Council
AQIS	Australian Quarantine and Inspection Service
CAMBA	China and Australia Migratory Bird Agreement (1992)
°C	Degrees Celsius
CALM	Department of Conservation and Land Management
CE	Conservation Estate
CMP	Construction Management Plan
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTRC	Conservation Through Reserves Committee
DEP	Department of Environmental Protection
DMA	Decision Making Authority
DMPR	Department of Mineral and Petroleum Resources
DOT	Department of Transport
DPI	
DRD	Department of Resource Development
DRF	Declared Rare Flora
E18/1840	Exploration Licence 18/1840
EHP	Equipment Hygiene Procedure
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
EPBC	Environment Protection and Biodiversity Conservation Act
ERP	Emergency Response Plan
GSWA	Geological Survey of WA
ha	Hectares
H.D.P.E.	High Density Polyethylene
HMP	Hydrocarbon Management Plan
JAMBA	Japan and Australia Migratory Bird Agreement (1992)
IBRA	Interim Biogeographic Regionalisation for Australia
Km	kilometre
km/hr	kilometres per hour
L	litre
l/sec	litres per second
LWRRDC	Land and Water Resources Research and Development Corporation
MARPOL	International Convention for the Prevention of Pollution from Ships
M	Metre
m AHD	Meters above Australian Height Datum
M^3	cubic metres
m/d	Metres per day
m^2/d	Square metres per day
mg/L	Milligrams per litre
Mm	Millimetre
Mt	Million tonnes
OSCP	Oil Spill Contingency Plan
ORIS	Ord River Irrigation Scheme
PER	Public Environmental Review
PNP/215	Proposed National Park 215
SOPEP	Shipboard Oil Pollution Emergency Plan
SRP	Spill Response Plan
SWEK	Shire of Wyndham – East Kimberley
TDS	Total dissolved solids
$\mu g/m^3$	Micrograms per cubic metre
WA	Western Australia
WAM	Western Australian Museum
WHMS	Washing and Heavy Media Separation Plant
WRC	Water and Rivers Commission

10. GLOSSARY

Ambient
The background environmental condition.

Amenity value
The capacity of a site to provide aesthetic experiences of the type preferred by the majority of visitors.

Association
A group of plants with a characteristic form, structure and dominant species.

Average recurrence interval
The expected value or average value of the periods between exceedances of a given event magnitude.

Basalt
A fine-grained, dark-coloured volcanic rock that has crystallised from lavas on the Earth's surface and is composed mainly of the minerals plagioclase, olivine and pyroxene.

Basement
Crustal layer of rock beneath the sedimentary strata.

Baseline Data
A body of information collected over time to define specific characteristics of an area (eg. species occurrence or noise levels) prior to the commencement of an activity (eg. a mining operation).

Beach sediments
Sandy sediments deposited by the action of waves and wind on the inland side of a beach.

Biota
The totality of plants and animals of a specified area.

Biological diversity
The diversity of different species of plants, animals and micro-organisms, including the genes they contain, in the ecosystem of which they are a part.

Black Soil
Black or grey clay usually derived from basaslts on dark coloured sediments. Retains water and cracks and swells depending on moisture content. Generally unsuitable for construction.

Botanical District
A natural grouping of vegetation types based on climate and soil conditions.

Bund
An earth, rock or concrete wall or mound constructed to restrict the inflow or outflow of liquids or noise.

CAMBA
China-Australia Migratory Bird Agreement.

Catchment
An intake area and all parts of the drainage basin which drain into it.

Clay
A fine-grain sediment composed primarily of clay sized particles (2 microns) characterised by high plasticity.

Constraints
Existing natural or social features which represent impediments to project construction and operation.

Contour
A line connecting points of equal value on a map.

Decommissioning
Removal or reuse of infrastructure.

Dominant species
The most abundant species in the tallest or most important stratum of a plant association.

Drainage pattern
The pattern formed by drainage lines, gullies, streams and rivers.

Drydoor Site
A site where the barge can unload its cargo directly onto the beach.

Ecology
Study of the relations of animals and plants, particularly of animal and plant communities, to their surroundings.

Ecosystem
A community of organisms, interacting with one another, plus the environment which they live and with which they also interact.

Emission
A discharge of a substance (eg. dust) into the environment

Ephermeral Stream
A stream that flows briefly only in direct response to precipitation in the immediate locality and whose channel is at all times above the water table.-

Escarpment
The broken land at the border of an unpland. May be of cliffs or bouldery slopes.

Estuarine sediments
Sediments, usually fine grained, which are deposited in estuaries and other coastal areas affected by tides.

Exotic species
Not native, usually implying an unacclimatised introduction by human agency.

Fauna
The species of animals present within a community of a geographic area.

Habitat
A place where species or populations of plants and animals live. A habitat contains a system of components which satisfies the requirements of the organism and includes both living and non-living features

Infrastructure
The supporting installations and services that supply the needs of the project.

Intertidal
The area along the coast below high tide and above low tide.

Jamba
Japan-Australia Migratory Bird Agreement.

Kimberlite
Common host rock for diamonds.

Laterite

Red-brown iron-rich material formed at or near the land surface as a result of weathering and leaching of iron from the rocks and soils below.

Laydown Area
A slat storage area.

Mangrove
Trees which inhabit the intertidal zone on sheltered coastlines. Their lower trunk and roots are periodically flooded with the tides.

Noxious plants
Plants that are considered or declared a pest in a Shire or region.

Passerine
Relating to birds that perch.

Process Plant
The place where the extraction of the product from the mined material occurs.

RAMSAR
Convention on Wetlands of International Importance especially as Waterfowl Habitat.

Rehabilitation
Those activities which seek to upgrade damaged land to some pre-determined stable surface form and level of productivity in which the biological potential is restored.

Restricted Access Road
A road designated for a particular use (ie. ore haulage). Unauthorised access is not permitted.

Riparian
Pertaining to permanent waterways and their bank ecosystems.

Sandstone
A medium grained sedimentary rock which is consolidated equivalent of sands. Composed mainly of grains between the sizes of 60 microns and 2mm which usually consist of quartz.

Scree
The accumulation formed by fragments resulting from mechanical weathering of rocks.

Sheetwash
Shallow water flows over extensive areas of land, during floods or following heavy storm events.

Siltstone

An indurated silt having a texture and composition of shale but lacking its line laminations. A rock whose texture is intermediate between those of sandstone and shale and of which two-thirds of the material is silt-sized.

Skeletal soil
A thin veneer of soil overlying bedrock. Often comprised of rock fragments rather than truly weathered soil.

Species diversity
A number which relates the density of organisms of each species present in a habitat.

Species richness
A botanical term indicating a measure of the number of species of plants occurring in a given area.

Taxa
General taxonomical term for a sub-group of organisms (eg. species, genus, family etc.)

Tonnes
(t) unit of weight measure equalling 1000 kg

Topography
The physical features of a region (land or sea) such as are represented on maps, taken collectively; especially relief and contour.

Topsoil
The general term applied to the surface portion of the soil or the A-horizon where this is deeper.

Toxicant
A substance that can harm living organisms.

Treatment Plant
See Process Plant.

Turbidity
The condition resulting from the presence of suspended particles in the water column which restricts light.

Understorey
That vegetation less than 1m tall.

Upperstorey
The domnant tall strata (also usually the species by which the community is named).

Vertebrates
Animals with backbones.

Vulnerable species
Species that are believed likely to move into the 'endangered' category.

Weathered
Changed by long exposure to atmospheric conditions.

Wetlands
Lakes, pools rivers, streams and swamps and their associated, moist margins.