Contents

1. Introduction

1.1 Background

Pacific Reef Fisheries propose to develop a prawn farm facility near Guthalungra, approximately 40km WNW of Bowen in North Queensland. The development will comprise growing ponds (approx. 295ha), water treatment ponds, seawater storage, processing and administrative structures situated on an approximately 800ha site close to the coast, adjacent to the Elliot River. The development also includes water supply and water disposal pipelines between the main development site and Abbot Bay.

An assessment of flora and fauna is required to inform the development application process for the proposal. The scope of works for the flora and fauna investigations was and supplied to Lambert and Rehbein, Brisbane.

Ecotone Environmental Services (EES) was contracted by Lambert and Rehbein, Brisbane (L&H) to undertake the necessary flora and fauna investigations for the EIS. This document presents the findings of the EES investigations.

1.2 Study Area

The study area for the investigation comprised:

- the main development area including Lot 8 SB294, Lot 370 K124843, and part of the adjoining Ridley property;
- the proposed pipeline route situated to the north of the main development area; and,
- adjacent lands and waterways, particularly the Elliot River and coastal wetlands situated to the north of the main development area.

The local setting of the study area is indicated in Figure 1.1.

The study area is situated within the Townsville Plains Province of the Brigalow Belt Bioregion (Sattler and Williams 1999). The Townsville Plains comprises predominantly quaternary alluvial plains associated with streams such as the Bohle, Ross, Haughton, Burdekin and Elliot Rivers. Soils are predominantly duplex soils and fine-grained alluvium including cracking clays. The dominant vegetation is open woodland particularly of poplar gum (*Eucalyptus platyphylla*), narrow-leaved ironbark (*Eucalyptus crebra*), Dallachy's (ghost) gum (*Corymbia dallachiana*), and paperbarks (*Melaleuca* spp.).

For the remainder of this report the following definitions apply:

study area

The areas required to be directly assessed as per the study brief, i.e. the main development area, the pipeline route and immediately adjacent areas.

study region

The more extensive area surrounding the study area, in particular the area of the Townsville Plains biogeographic province extending to the north and north-

west towards Ayr. For the purposes of the database searches, the study region comprised those lands contained within the following 1:100,000 map sheets: Bowling Green Bay, Ayr, Cape Upstart.

main development area

The area proposed to accommodate the ponds, water treatment and processing area, namely Lots 8 and 370, and the area of land to the north-west of Lot 8 known as Ridley's block. For the purposes of the ecological assessments in this report, the northeastern boundary of Lot 370 has been taken as the high bank of the Elliot River. The high bank appears to have migrated into Lot 370 as a result of natural bank erosion; however, only the area landward of the high bank is available for development and is regarded as part of the main development area.

pipeline route

The proposed route of the water supply pipeline that traverses the area to the north of the main development area and ends in Abbot Bay

1.3 Study Objectives

The terms of reference for the study were determined by the relevant Commonwealth and State regulatory bodies, and supplied to EES by Lambert & Rehbein (ref. B01388EF006). The objectives of the study were to:

- identify the likely presence of, and habitat suitable for, species that have local, state, national or international significance such as species listed under the Commonwealth *EPBC Act 1999* (Environment Protection and Biodiversity Conservation Act) and the Queensland *Nature Conservation (Wildlife) Regulations 1994* as rare, vulnerable or endangered (excluding cetaceans), on Lots 8 and 370 and adjacent lands and waterways;
- identify the likely presence of, and habitat suitable for, migratory species listed under the China-Australia Migratory Bird Agreement (CAMBA) and Japan-Australia Migratory Bird Agreement (JAMBA) on Lots 8 and 370 and adjacent lands and waterways;
- provide details of how the development may be affected by the *Vegetation Management Act 1999*;
- identify, map and describe vegetation communities on Lots 8 and 370 and adjacent lands;
- identify and map the regional ecosystems present on Lots 8 and 370 and identify their biodiversity status (see EPA website);
- identify areas of special ecological significance such as wildlife corridors and refuges on Lots 8 and 370 and adjacent lands and waterways; and,
- identify and describe important ecological interactions on and adjacent to the development site including those between inter-tidal areas and migratory birds.

For the remainder of this document, flora and fauna scheduled in State and Commonwealth legislation as rare, vulnerable, endangered or migratory is referred to as significant flora or fauna.

1.4 Seasonality

The EES field assessment was a single event survey. Field visits to survey flora and/or fauna have not been conducted at any other time of the year and, therefore, the data collected for this investigation are season specific. Temporal variation in flora and fauna communities (diversity, structure and taxon abundance) may be large during the course of each year and seasonal differences in the presence/absence and activity of taxa influence survey results. Published information and records from other sources such as the NSW Atlas of Wildlife, Queensland Museum and Queensland Herbarium are utilised, where available, to support discussions of the flora and fauna of the study area.

Seasonal variability in species presence/absence, species abundance and ecological processes are addressed in this document, where necessary, by inference only or based on expert knowledge/experience in similar habitats.

2. Study Methods

The study comprised a once-off site visit and review of available literature and databases concerning flora and fauna within and adjacent to the study area.

2.1 Literature and Data Review

The desktop review focussed on database records of flora and fauna for the study area and adjoining areas of the Townsville Plains Province, and on Regional Ecosystem mapping. Flora and Fauna database records were retrieved for the area lying between Latitude $19^0$00' and $20^0$00' and Longitude $147^0$00' and $148^0$00'. Regional Ecosystem mapping was supplied in a digital format by the Queensland Herbarium for the area comprising the following 1:100,000 map sheets:

- Townsville (8259)
- Mingela (8258)
- Bowling Green Bay (8359)
- Cape Upstart (8458)
- Ayr (8358).

The large search areas for the above data allowed the study area to be placed in context with the surrounding areas of the bioregion, and in particular, the adjacent areas of the Townsville Plains bioregion.

Reports of previous flora and fauna surveys conducted in the region were used to supplement database records for the study area. The area has not been subject to recent systematic floristic or fauna survey but a number of previous investigations provided valuable information including:

- Burdekin River Irrigation Area Flora and Fauna Survey (Thomas and Pearson 1993).
- Surveys of mammals and birds in the Lower Burdekin River District (Lavery and Johnson 1974, Lavery and Seton 1974, Ingram 1908).

- Rapid flora and fauna assessment for Alva Beach aquaculture farm upgrade, Pacific Reef Fisheries (Lokkers and Anderson 2001).

2.2 Field Survey

A four day site visit was undertaken between the 16th and 20th of March 2002. The survey included description of vegetation communities and habitats, identification of flora and fauna species and weeds, and targeted searches for rare, threatened, or migratory species potentially occurring in the area. Specific tasks undertaken during the site visit included the following.

- Extensive traverses of the main development site to:
  - identify the vegetation types present;
  - validate EPA Regional Ecosystem mapping of the area;
  - assess the presence or likely presence of significant flora species; and,
  - assess the presence or likely presence of significant fauna species or their preferred habitats.
- Morning bird observations within the main development area in habitats likely to be utilised by significant fauna, especially wading birds, comprising:
  - the freshwater wetlands located in the eastern part of the main development area;
  - the reach of the Elliot River adjacent to the main development area;
  - the mangrove lined tributary of the Elliot River located adjacent to the north-eastern section of the main development area;
  - the margin of the hypersaline flats located along the northern boundary of the main development area; and,
  - the area of shrubby open woodland vegetation located adjacent to the Elliot River.
- A traverse of the proposed pipeline route to:
  - identify the vegetation types present;
  - validate EPA Regional Ecosystem mapping of the area;
  - assess the presence or likely presence of significant flora species; and,
  - assess the presence or likely presence of significant fauna species or their preferred habitats.

2.3 Vegetation Mapping

Vegetation mapping was undertaken using Mapinfo 5.01 GIS software. Vegetation polygons were delineated by on-screen digitising obvious vegetation units appearing on a colour aerial image of the study area. Delineation of polygon boundaries incorporated observations of vegetation type and extent made during the ground traverses.

3. Vegetation

3.1 Description of the Vegetation

3.1.1 Main development area

The vegetation within the main development area is predominantly remnant eucalypt open woodland with large areas of cleared or modified vegetation also occurring. Clearing of original vegetation was apparently undertaken to facilitate cattle grazing which has been the main land use for many years. A number of tree stumps are evident throughout the area however; these are most likely to have resulted from post cutting rather than timber getting, as the mature trees on the property do not attain large girth sizes.

The open nature of the eucalypt communities is most likely similar to the natural density of the vegetation and reflects the difficult growing conditions of the site, particularly the heavy textured alluvium that occurs across most of the site, and pronounced seasonal fluctuation in rainfall and soil moisture. Overlaid on these natural conditions are the effects of sustained grazing pressure over many years, including suppression of recruitment of juvenile trees through trampling and grazing, and compaction and erosion of the ground surface leading to mortality of mature trees from root damage.

The ground cover vegetation is indicative of significant disturbance in terms of both structural and species composition. The two introduced grasses *Bothriochloa pertusa* (Indian bluegrass) and *Digitaria ciliaris* (summer grass) dominate the ground cover across the majority of the main development area with a small number of native grasses also present.

The woody weeds *Acacia nilotica* (prickly acacia) and *Zizyphus mauritianus* (chinee apple) are widespread in the otherwise treeless areas and within the eucalypt community occurring on lighter textured alluvium in the eastern part of the area.

3.1.2 Proposed pipeline route

The proposed pipeline route traverses inter-tidal and coastal areas supporting a wide range of vegetation types. Sparsely vegetated hypersaline flats are crossed to the north of the main development area before the route joins the weedy vegetation adjacent to Cape Upstart Road and then turns eastward towards the coastline of Abbot Bay. A large expanse of freshwater/brackish wetlands is traversed between this point and the beach dunes. It appears that these wetlands have been created as a result of significant changes to the local surface hydrology produced by bunds that have been constructed to the north and south. The natural vegetation of this area was most likely salt couch and samphire flats subject to occasional tidal inundation.

The vegetation of the coastal dunes is dominated by the typical sequence of eucalypt and *Melaleuca* woodlands associated with the ridge/swale sequence. A grassy ephemeral wetland is traversed before the foredune vegetation is reached. The vegetation of the dunes and beach is regarded as remnant and there has been little anthropogenic or grazing related disturbance of the ground surface or natural vegetation, although there are significant infestations of ground cover and woody weeds becoming established.

3.2 Vegetation mapping

A map of the vegetation types occurring on and immediately adjacent to the main development area and proposed pipeline route is provided in Figure 3.1. Descriptions of each of the vegetation map units delineated are provided below, and a summary of the vegetation map units and their relationship to regional ecosystems is provided in Table 3.1. Structural codes and descriptions follow Walker and Hopkins (1991).

Delineation of vegetation map units aimed to be compatible with the regional ecosystems described for the bioregion and most map units are directly attributable to a regional ecosystem. The nomenclature of vegetation mapping units is based on the Land Zone categories of the regional ecosystem description. For instance, map units 1*x* refer to Land Zone 1, and 2*x* to Land zone 2 etc.

All vegetation map units that have been attributed to a regional ecosystem are regarded as remnant vegetation. Map units that are indicated as modified in the regional ecosystem column in Table 3.1, are regarded as disturbed vegetation that does not satisfy the parameters for remnant vegetation under the VMA and is therefore not regarded as remnant vegetation.

VMA Status is the conservation status of the regional ecosystem under the *Vegetation Management Act*. This is the legal instrument for managing and protecting vegetation in Queensland. Under the VMA, conservation status is determined primarily according to the proportion of a regional ecosystem remaining compared to its original pre-clearing extent. There are three status categories:

endangered- less than 10% of the pre-clearing extent remains
of concern- less than 30% but more than 10% of the pre-clearing extent remains
not of concern- more than 30% of the pre-clearing extent remains

Biodiversity Status is the conservation status recognised by the Environmental Protection Agency. This status may differ from the VMA status as it incorporates additional parameters into the determination of status such as the existence and severity of on-going threatening processes. Biodiversity status is not a legally binding status. Issues regarding the proposed project and the VMA are dealt with in Section 4.

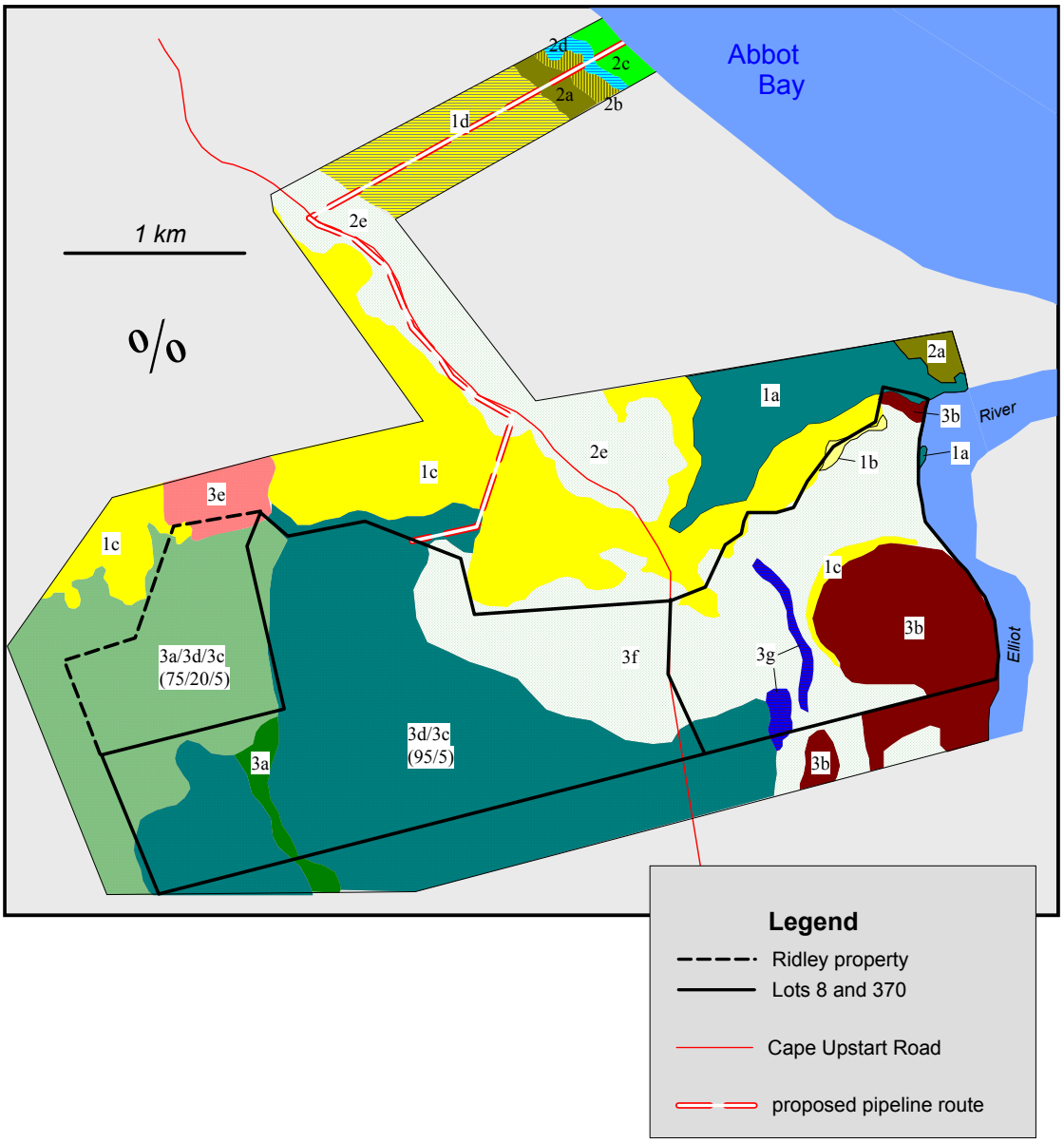
Table 3.1 Vegetation map units delineated for the main development area and pipeline route, and equivalent regional ecosystems.

	Vegetation map unit	Regional Ecosystem	VMA Status	Biodiversity Status	Occurrence: main development area	Occurrence: pipeline route	Occurrence: adjacent areas
	Land Zone 1- quaternary marine deposits						
1a	mangrove forest	11.1.4	not of concern	not of concern			✔
1b	*Sporobolus virginicus* grassland	11.1.1	not of concern	not of concern	✔		✔
1c	sparsely vegetated hypersaline flats	11.1.2	not of concern	not of concern	✔	✔	✔
1d	freshwater wetlands on modified tidal flats	modified	nil status	nil status		✔	✔
	Land Zone 2- quaternary coastal dunes and beaches						
2a	*Corymbia tessellaris* shrubby woodland on ridges	11.2.5	not of concern	not of concern		✔	✔
2b	*Melaleuca dealbata* woodland in swales	11.2.5	not of concern	not of concern		✔	✔
2c	*Casuarina equisetifolia/Spinifex sericeum* foredune vegetation	11.2.2	of concern	of concern		✔	✔
2d	grassy ephemeral wetland in swales	11.2.5	not of concern	not of concern		✔	✔
2e	weedy grassland/forbland with scattered shrubs	modified	nil status	nil status		✔	✔
	Land Zone 3- cainozoic alluvial plains						
3a	*Eucalyptus crebra* and/or *Corymbia dallachiana* open woodland/woodland	11.3.30	not of concern	not of concern^	✔		✔
3b	*Corymbia tessellaris* shrubby open woodland	11.3.7	not of concern	of concern*	✔		✔
3c	*Grevillea striata* open woodland	11.3.13	of concern	endangered#	✔		✔
3d	grassland with isolated *Eucalyptus platyphylla* and *Corymbia tessellaris*	11.3.35	not of concern	not of concern	✔		✔
3e	*Acacia tephrina* woodland	11.3.34	not of concern	of concern^	✔		✔
3f	weedy grassland/forbland with scattered shrubs	modified	nil status	nil status	✔		✔
3g	artificial freshwater lagoons	modified	nil status	nil status	✔		✔

^ under review
* of concern because of threatening processes in addition to clearing (under review)
# endangered because of threatening processes in addition to clearing (under review)

Figure 3.1 Vegetation within and adjacent to the main development area and proposed pipeline route.

Polygons are labelled with the Vegetation map unit code. Refer to Table 3.1 for a description of each unit and comparable regional ecosystem.
Numbers in brackets following multiple map unit labels indicate the proportion of each of the map units in the polygon.



Land Zone 1- Quaternary Marine Deposits

Map Unit 1a – *mangrove forest*
Description:
Narrow bands of low diversity *Avicennia marina* dominated communities with *Aegialitis annulata* along the seaward margin. One small patch occurs in the Elliot River adjacent to Lot 370, with a more extensive occurrence along the tributary to the north of Lot 370.

Vegetation Structure:
low, woodland-open forest
Structural code: T5M-S
Dominant species
Trees: *Avicennia marina* (grey mangrove), *Rhizophora stylosa* (red mangrove)
Shrubs: *Aegialitis annulata* (club mangrove)

Regional Ecosystem Type: 11.1.4. [not of concern]

Map Unit 1b - *Sporobolus virginicus* grassland
Description:
Typical salt couch grassland occurring in a narrow band between the terrestrial grassland community and saltflats in the north east of the main study area.

Vegetation Structure:
low, closed grassland
Structural code: G1D
Dominant species
Grasses: *Sporobolus virginicus* (salt couch)
Forbs: *Halosarcia halocnemoides* (samphire)

Regional Ecosystem Type: 11.1.1. [not of concern]

Map Unit 1c - sparsely vegetated hypersaline flats

Description:
Extensive areas of hypersaline flats largely devoid of vegetation but with isolated individuals or patches of samphire and salt couch.

Vegetation Structure:
low, closed grassland
Structural code: GF1IL
Dominant species
Grasses: *Sporobolus virginicus* (salt couch)
Forbs: *Halosarcia halocnemoides* (samphire)

Regional Ecosystem Type: 11.1.2. [not of concern]

Map Unit 1d - freshwater wetlands on modified tidal flats

Description:

A broad expanse of freshwater wetlands comprising seasonally inundated grassland and sedgeland, bare ground, and shallow lagoons associated with old channels and drainage lines. The freshwater wetlands appear to have been created due to disruption of the natural saline or brackish hydrology resulting from the construction of a powerline easement servicing Camp Island. The lagoons appear to be permanent and are fringed with *Schoenoplectus validus* but do not support floating macrophytes.

Vegetation Structure:

Tall grassland with *Diplachne* sp.; fringing tall sedgeland of *Schoenoplectus litoralis* and *Eleocharis equisetina*.

Structural code: G3M;V3M

Dominant species

Grasses: *Diplachne* sp. (a beetle grass)

Sedges: *Schoenoplectus litoralis* (clubrush); *Eleocharis equisetina* (spikerush)

Regional Ecosystem Type: modified ecosystem

Land Zone 2- Quaternary Coastal Dunes and Beaches

Map Unit 2a - *Corymbia tessellaris* shrubby woodland on ridges

Description:

A narrow band of shrubby woodland occurring along hind-dunes associated with Abbot Bay, and traversed by the pipeline route. The shrubby understorey contains a number of dry rainforest species. The ground cover is sparse given the sandy, unstable substrate.

Vegetation Structure:

Tall woodland of *Corymbia tessellaris* with a mid-dense understorey of low trees and tall shrubs, especially *Pleiogynium timorense*. Ground cover is very sparse and includes a number of exotic species.

Structural code: T6S/TS5M/FT2V

Dominant species

Trees: *Corymbia tessellaris* (Moreton Bay Ash)

Shrubs: *Pleiogynium timorense* (Burdekin Plum), *Alphitonia excelsa* (red ash), *Cupaniopsis anacardioides* (tuckeroo), *Pandanus tectorius* (coastal panadanus); *Planchonia careya* (cocky apple), *Carissa ovata* (conkerberry).

Grasses: *Aristida* sp. (wiregrass); *Cenchrus ciliaris* (buffel grass).

Forbs: *Crotalaria novae-hollandiae* (); *Achyranthes aspera* (chaffweed);

Vines: *Abrus precatorius* (giddee gidee); *Jasminum didymum* (native jasmine); Cassytha filiformis (dodder laurel).

Regional Ecosystem Type: 11.2.5. [not of concern]

Map Unit 2b - *Melaleuca dealbata* woodland in swales

Description:

A narrow band of *Melaleuca* woodland associated with the dune swale, and traversed by the pipeline route. The ground cover is sparse but includes sedges reflecting the moist topo-position and likely shallow seasonal inundation.

Vegetation Structure:

Mid-high woodland of *Melaleuca dealbata* with a low sparse understorey of *Melaleuca viridiflora*. Ground cover is sparse.

Structural code: T6S/TS5M/FT2V

Dominant species

Trees: *Melaleuca dealbata* (silver-leafed paperbark), *Melaleuca viridiflora* (broad-leaved paperbark).

Sedges:

Regional Ecosystem Type: 11.2.5. [not of concern]

Map Unit 2c - *Casuarina equisetifolia/Spinifex sericeum* foredune vegetation

Description:

Variable vegetation community associated with the fore-dune and traversed by the pipeline route. The ground cover includes creepers and spinifex grass typical of the fore-dune situation with isolated *Casuarina equisetifolia*. The vegetation has been adversely affected by dense infestations of *Cryptostegia grandiflora* and *Passiflora foetida*.

Vegetation Structure:

variable

Structural code: T6S/TS5M/FT2V

Dominant species

Trees: *Casuarina equisetifolia* (coast she-oak); *Zizyphus mauritianus** (chinee apple).

Shrubs: *Ficus opposita* (sandpaper fig)

Grasses: *Spinifex sericeus* (beach spinifex); *Cenchrus echinatus* (Mossman River grass).

Forbs: *Tridax procumbens* (tridax daisy).

Creepers: *Ipomoea pes-caprae* (beach morning glory); *Canavalia rosea* (beach bean);

Vines: *Cryptostegia grandiflora** (rubber vine) and *Passiflora foetida** (stinky passionfruit).

Regional Ecosystem Type: 11.2.2. [of concern]

Map Unit 2d - grassy ephemeral wetland in swales

Description:
A mid-high closed grassland of *Paspalum vaginatum* in a shallow swale behind the fore-dune. The community is apparently seasonally inundated.

Vegetation Structure:
mid-high closed grassland of *Paspalum vaginatum*
Structural code: T6S/TS5M/FT2V
Dominant species

Grasses: *Paspalum vaginatum* (freshwater couch).
Forbs: *Physalis minima** (wild gooseberry); *Stachytarpheta jamaicensis** (blue snakeweed).

Regional Ecosystem Type: 11.2.5. [not of concern]

Map Unit 2e - weedy grassland/forbland with scattered shrubs

Description:
A weedy area bordering the Cape Upstart access road with scattered native and exotic low trees and shrubs. The area may have been cleared some years ago and the current vegetation is regarded as regrowth.
Vegetation Structure:
A tall grassland/forbland with very sparse regrowth shrubs and trees.
Structural code: TS5V/FG3M
Dominant species

Trees: *Petalostigma pubescens* (quinine bush); *Alphitonia excelsa* (red ash); *Zizyphus mauritianus** (chinee apple); *Melaleuca viridiflora* (broad-leaved paperbark); *Pandanus tectorius* (coastal panadanus); *Planchonia careya* (cocky apple).
Shrubs: *Lantana camara* (lantana); *Acacia holosericea* (silver-leafed wattle)
Grasses: *Cenchrus ciliaris** (buffel grass); *Heteropogon contortus* (black spear grass); *Aristida* sp. (wiregrass);
Forbs: *Stachytarpheta jamaicensis** (blue snakeweed); *Hyptis suaveolens* (hyptis);
Vines: *Passiflora foetida** (stinky passionfruit); *Cryptostegia grandiflora** (rubber vine); *Cassytha filiformis* (dodder laurel); *Macroptilium atropurpureum** (siratro)

Regional Ecosystem Type: nil- highly modified vegetation/regrowth

Land Zone 3- Cainozoic alluvial plains

Map Unit 3a - *Eucalyptus crebra* and/or *Corymbia dallachiana* open woodland/woodland

Description:

Woodland comprising both species as co-dominants or either species (without the other) as a sole dominant. Shrubs are generally absent although scattered *Acacia salicina* occur. Ground cover is a low mid-dense grassland with native and exotic species and scattered forbs. The introduced grasses *Bothriochloa pertusa** and *Digitaria ciliaris* are the most abundant species. The occurrence of this community on the relict drainage line in the western portion of Lot 8 comprises a denser canopy and sparse mid-high understorey of native shrubs and low trees. Occurrence of the shrubs appears to be in response to the coarser textured alluvium that has infilled the drainage line.

Vegetation Structure:

Mid-high to tall woodland/open woodland with isolated low shrubs over low grassland.

Structural code: T6-7S/S5I/G1M

Dominant species

Trees:	***Eucalyptus crebra*** **(**narrow-leafed ironbark); ***Corymbia dallachiana*** (Dallachy's gum)
Shrubs:	*Acacia salicina* (sally wattle)
Grasses:	*Bothriochloa pertusa** (Indian bluegrass); *Digitaria ciliaris** (summer grass); *Iseilema vaginiflorum* (red Flinders grass); *Dicanthium sericeum* (bluegrass).
Forbs:	*Sida spinosa* (spiny sida); *Euphorbia hirta* (asthma plant).

Regional Ecosystem Type: 11.3.30 [not of concern]

Map Unit 3b - *Corymbia tessellaris* shrubby open woodland

Description:

An open woodland dominated by *Corymbia tessellaris* with a relatively diverse understorey of native tall shrubs and low trees, occurring on sandy textured alluvium adjacent to the Elliot River. Ground cover is highly variable, dominated by grasses or forbs, and weeds are abundant. The area is composed of more recent alluvium than the heavy textured plains that occur across most of the main

development site, and contains numerous relict and active channels and drainage depressions associated with the Elliot River. The density of *Corymbia tessellaris* is greatest where they fringe these channels, and is accompanied by *Eucalyptus tereticornis* and *Melaleuca dealbata*.

Vegetation Structure:

Tall open woodland-isolated trees over low open-sparse shrubland with variable forb and grass dominated ground cover.

Structural code: T7V-I/S5S-V

Dominant species

Trees: *Corymbia tessellaris* (Moreton Bay Ash); *Eucalyptus tereticornis* (blue gum); *Melaleuca dealbata* (silver-leafed paperbark).

Shrubs: *Alphitonia excelsa* (red ash); *Pleiogynium timorense* (Burdekin plum); *Chionanthus ramiflora* (native olive); *Zizyphus mauritiana** (chinee apple); *Planchonia careya* (cocky apple) *Acacia nilotica** (prickly acacia) *Petalostigma pubescens* (quinine tree); *Diospyros* sp. (native olive); *Acacia holosericea* (silver-leafed wattle);

Grasses: *Perotis rara* (comet grass); *Eragrostis* sp. (a love grass), *Chloris inflata** (purpletop chloris); *Chloris virgata* * (feathertop Rhodes grass); *Cenchrus ciliaris** (buffel grass).

Forbs: *Hyptis suaveolens* (hyptis); *Sida spinosa* (spiny sida); *Stachytarpheta jamaicensis** (blue snakeweed); *Jatropha gossypiifolia** (bellyache bush); *Acanthospermum hispidum** (starburr); *Cleome viscosa* (tickweed).

vines: *Passiflora foetida** (stinky passionfruit); *Cryptostegia grandiflora** (rubber vine); *Jasminum didymum* (native jasmine)

Regional Ecosystem Type: 11.3.7 [not of concern]

Map Unit 3c - *Grevillea striata* open woodland

Description:

An open woodland of *Grevillea striata* occurring as small to moderately large patches within map units 3a and 3d. In most instances *Grevillea striata* is the only tree species present; however, additional trees and shrubs may also be present. The grassy ground cover is similar to that occurring in map units 3a and 3d.

Vegetation Structure:

Low to mid-high open woodland over low grassland.

Structural code: T5-6V/G1M

Dominant species

Trees: *Grevillea striata* (beefwood); following occasionally present- *Corymbia tessellaris* (Moreton Bay Ash); *Eucalyptus platyphylla* (polar gum).

Shrubs: *Acacia salicina* (sally wattle); Atalaya hemiglauca (whitewood).

Grasses: *Bothriochloa pertusa** (Indian bluegrass); *Digitaria ciliaris** (summer grass); *Iseilema vaginiflorum* (red Flinders grass); *Dactyloctenium radulans* (button grass).

Regional Ecosystem Type: 11.3.13 [of concern]

Map Unit 3d - grassland with isolated *Eucalyptus platyphylla* and *Corymbia tessellaris*

Description:

Low grassland dominated by exotic species with isolated trees and shrubs to 15m. The grassland is similar in composition to the other vegetation types occurring on the heavy textured plains of Lot 370 and Lot 8 (ie. map units 3a, 3c and 3e)

Vegetation Structure:

Low grassland with isolated mid-high to tall trees and shrubs.

Structural code: T6-7I/G1M

Dominant species

Trees: *Corymbia tessellaris* (Moreton Bay Ash); *Eucalyptus platyphylla* (polar gum); *Corymbia dallachiana* (Dallachy's gum).

Shrubs: *Acacia salicina* (sally wattle); *Atalaya hemiglauca* (whitewood); *Melaleuca viridiflora* (broad-leafed paprbark).

Grasses: *Bothriochloa pertusa** (Indian bluegrass); *Digitaria ciliaris** (summer grass); *Iseilema vaginiflorum* (red Flinders grass); *Dactyloctenium radulans* (button grass); *Ophiuros exaltata* .

Regional Ecosystem Type: Difficult to attribute to current RE'S but most likely a form of 11.3.35 [not of concern]

Map Unit 3e – *Acacia tephrina* woodland

Description:

A woodland of *Acacia tephrina* with no other trees or shrubs present. The ground surface below the canopy is largely devoid of other plants.

Vegetation Structure:

Low woodland.

Structural code: T5S

Dominant species

Trees: *Acacia tephrina*

Grasses: *Dactyloctenium radulans* (button grass).

Regional Ecosystem Type: 11.3.34 [not of concern]

Map Unit 3f - weedy grassland/forbland with scattered shrubs

Description:

Low grassland dominated by exotic species with isolated woody weed shrubs to 4m. The grassland is similar in composition to the other vegetation types occurring on the heavy textured plains of Lot 370 and Lot 8 (ie. map units 3a, 3c and 3e). This vegetation appears to have been cleared in the past or is a highly modified native grassland.

Vegetation Structure:

Low grassland with isolated tall shrubs.

Structural code: S4I-7I/G1M

Dominant species

Shrubs: *Zizyphus mauritiana** (chinee apple); *Acacia nilotica** (prickly acacia)

Grasses: *Bothriochloa pertusa** (Indian bluegrass); *Digitaria ciliaris** (summer grass); *Iseilema vaginiflorum* (red Flinders grass); *Dactyloctenium radulans* (button grass); *Dichanthium sericeum* (bluegrass).

Regional Ecosystem Type: nil- highly modified vegetation/regrowth

Map Unit 3g - artificial freshwater lagoons

Description:

These largely permanent lagoons have been created by damming natural ephemeral drainage lines. Emergent and floating macrophytes are present, and the lagoons are fringed in part by *Corymbia tessellaris*.

Vegetation Structure:

Tall woodland to isolated trees fringing grassy wetland vegetation.

Structural code: not applicable

Dominant species

Trees: *Corymbia tessellaris* (Moreton Bay Ash)

Shrubs: *Zizyphus mauritiana** (chinee apple); *Acacia salicina* (sally wattle)

Grasses: *Pseudoraphis spinescens* (spiny mudgrass); *Echinochloa colona** (barnyard grass); *Brachiaria mutica** (para grass); *Digitaria ciliaris** (summer grass).

Forbs: *Ludwigia octovalvis* (willow primrose); *Persicaria orientalis* (prince's feather); *Philydrum lanuginosum* (frogsmouth).

Sedges: *Eleocharis equisetina* (spikerush); *Eleocharis philippinensis* (spikerush) *Typha domingensis* (cumbungi); *Cyperus iria* (variable sedge).
Aquatics: *Monochoria cyanea* (monochoria); *Nymphoides indica* (water snowflake); *Azolla pinnata* (ferny azolla)

Regional Ecosystem Type: nil- highly modified vegetation/regrowth

3.3 Weeds and Exotic Species

Four declared plant species were detected during the survey, and it is likely that additional species (e.g. noogora burr) would be detected during surveys at other times of the year. A large number of other exotic species were present including weeds and pasture species. The most widespread and abundant were the introduced grasses *Bothriochloa pertusa* (Indian bluegrass) and *Digitaria ciliaris* (summer grass).

3.3.1 Declared plants

The *Rural Lands Protection Act* provides for the control of declared noxious plants in Queensland and requires landholders to manage declared plant populations according to specified management intents.

Ziziphus mauritiana (chinee apple) and *Acacia nilotica* (prickly acacia) were the most widespread declared species and were abundant on Lot 370, particularly within the weedy grassland/forbland with scattered shrubs (map unit 3e) and *Corymbia tessellaris* shrubby open woodland (map unit 3b) vegetation types.

Cryptostegia grandiflora (rubber vine) was largely confined to the *Corymbia tessellaris* shrubby open woodland in the east of Lot 370 where it occurred as scattered shrubs and vine towers on native trees. It is likely that rubber vine will continue to spread and increase in abundance in this area and produce on-going deterioration of the native vegetation present. Rubber vine was also encountered within the dunal vegetation (map units 2a, 2b, 2d) along the pipeline route as scattered shrubs and vine towers.

Parkinsonia aculeata (parkinsonia) occurred only on Lot 370 on the northern margin of the *Corymbia tessellaris* shrubby open woodland, adjacent to the large drainage line.

Table 3.2 Declared plants detected in the study area.

Weed species	Common name	main development area	pipeline route	adjacent areas
P2- species to be destroyed				
Cryptostegia grandiflora	rubber vine	✔	✔	✔
Parkinsonia aculeata	parkinsonia	✔		✔
P3- species to be reduced				
Acacia nilotica	prickly acacia	✔		✔
Ziziphus mauritiana	chinee apple	✔	✔	✔

4. Wetlands

Figure 4.1 maps the distribution of wetland habitats in the study area using the classification scheme of Blackman *et. al* (1992). Wetlands from three ecological systems are present; namely, marine, estuarine and palustrine. A small area of lacustrine habitat also occurs within a farm dam on Lot 370, but is mapped as a mosaic with more extensive palustrine habitats.

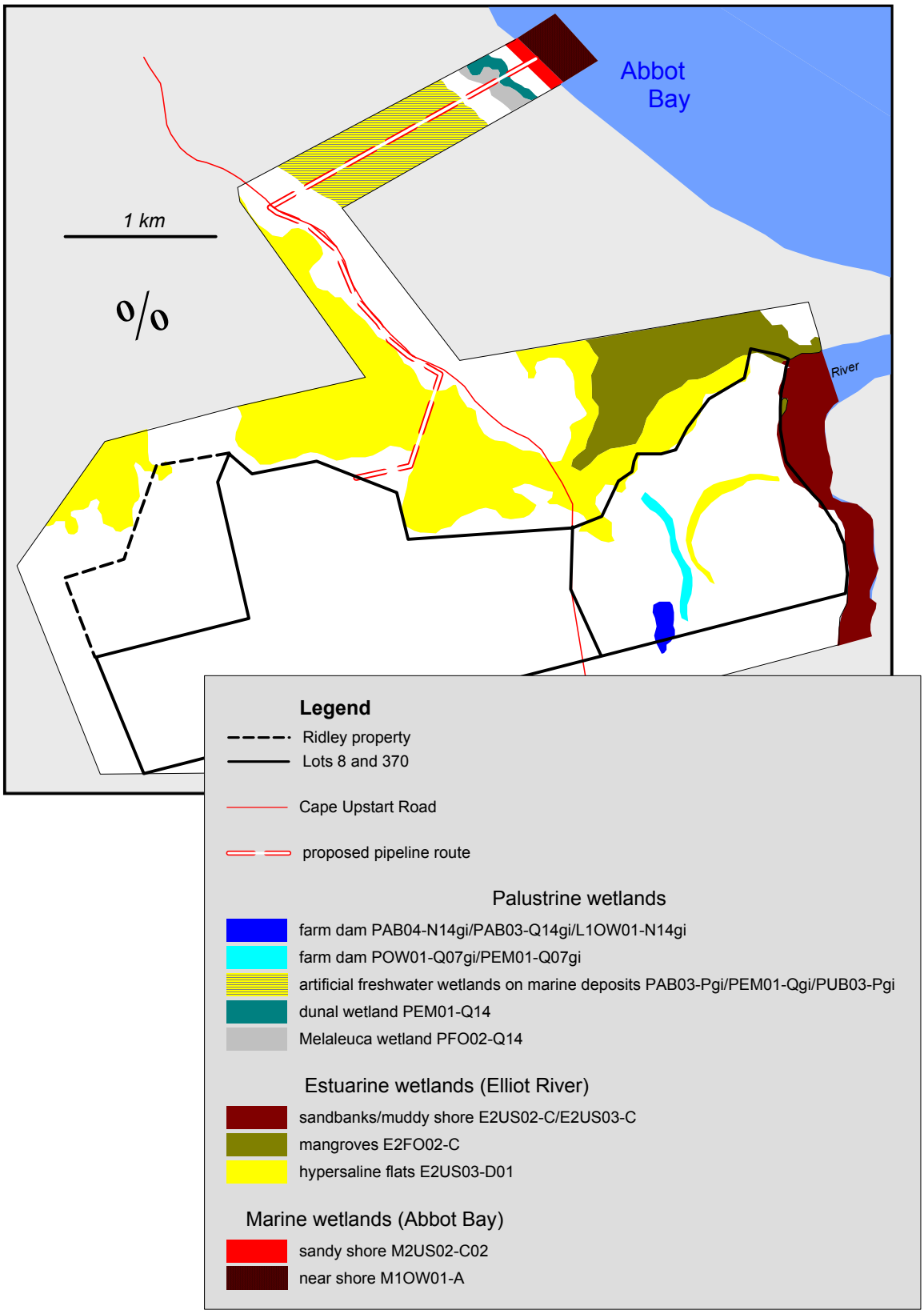
Only a small area of wetland habitat occurs within the main development area comprising artificial wetland created by dams and hypersaline flats.

Wetlands are the predominant habitat along the proposed pipeline route, including natural and modified types. Hypersaline flats are the most common wetland type with a large palustrine wetland situated to the east of the Cape Upstart Road. This apparently freshwater wetland area has formed on previously hyper-saline flats due to alteration to the natural drainage patterns following the construction of a bund to the south. The far eastern portion of the pipeline route traverse dunal and beach wetlands typical of the region.

The estuarine habitats of the Elliot River and the marine habitats of Abbot Bay, dominate the habitat landscape to the east and north of the main development area. Farm dam wetlands occur on adjoining pastoral properties to the west and south of the main development area.

Figure 4.1 identifies wetland types according to the coded classification system of Blackman *et. al* (1992). Descriptions of most of these wetlands can be found under the appropriate vegetation mapping unit in the preceding section.

Figure 4.1 Wetland habitats occurring within the study area, identified according to the coded classification of Blackman *et. al.* (1992).



5. Vegetation Management Act

This section provides an assessment of the way in which the proposal relates to the *Vegetation Management Act 1999*. The Act provides for protection and management of native vegetation particularly with respect to *endangered* and *of concern* Regional Ecosystems.

In order to ensure the accuracy of this VMA assessment, the EPA regional ecosystem mapping for the study area was acquired from the EPA and ground-truthed during the EES survey. As a result of inconsistencies between the EPA mapping and observed vegetation types and boundaries, a number of modifications were made to the regional ecosystem mapping. The EPA regional ecosystem map for the study area is presented in Figure 5.1. The modified regional ecosystem map for the study area is presented in Figure 5.2. [NB: due to the format of the aerial photo used to develop the EES vegetation map, Figure 5.2 has a different orientation to Figure 5.1 which is a reproduction of EPA mapping data.]

No *endangered* Regional Ecosystems have been mapped for the study area or adjacent areas, and none were encountered during the EES survey. Two *of concern* Regional Ecosystems occur within the study area.

- RE 11.3.13 [*Grevillea striata* open woodland] is mapped for the main development area and adjacent areas, and the EES survey confirmed the presence of this RE although it is not as widely distributed as suggested by the EPA RE mapping.
- RE 11.2.2 [*Ipomoea pes-caprae* and *Spinifex sericeus* grassland ± *Casuarina equisetifolia*] occurs at the seaward extent of the proposed pipeline route where the pipeline enters Abbot Bay.

Another *of concern* Regional Ecosystem, 11.2.3 [low microphyll rainforest] is mapped by the EPA for the pipeline route; however, the EES survey suggests that this vegetation has been incorrectly mapped and is more closely attributable to RE 11.2.5 [*Corymbia tessellaris* on beach ridges]. This Regional Ecosystem is *not of concern*.

Figure 5.3 details the extent and VMA status of regional ecosystems within and immediately adjacent to the study area. Table 5.1 summarises the pre-clear and remnant area information (Accad *et al.* 2001) for the two *of concern* regional ecosystems occurring within the study area.

Figure 5.1 Regional Ecosystems within the main development area and along the proposed pipeline as mapped by the EPA.

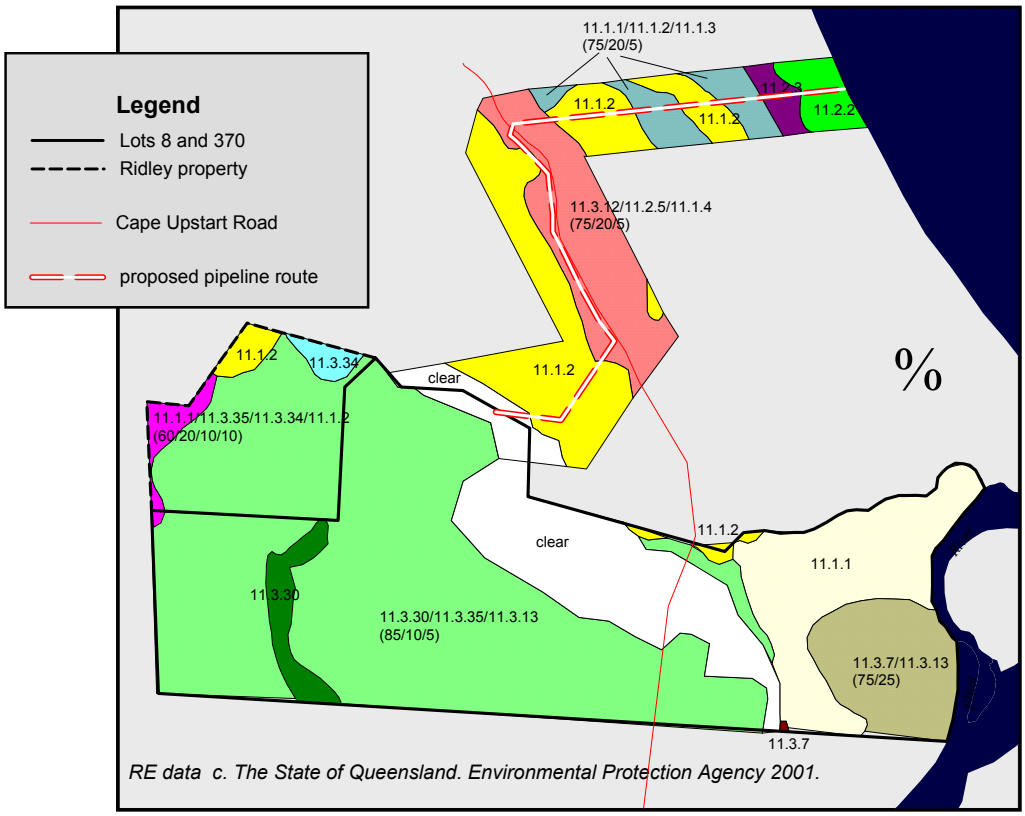


Figure 5.2 Modified map of Regional Ecosystems within the main development area and along the proposed pipeline.

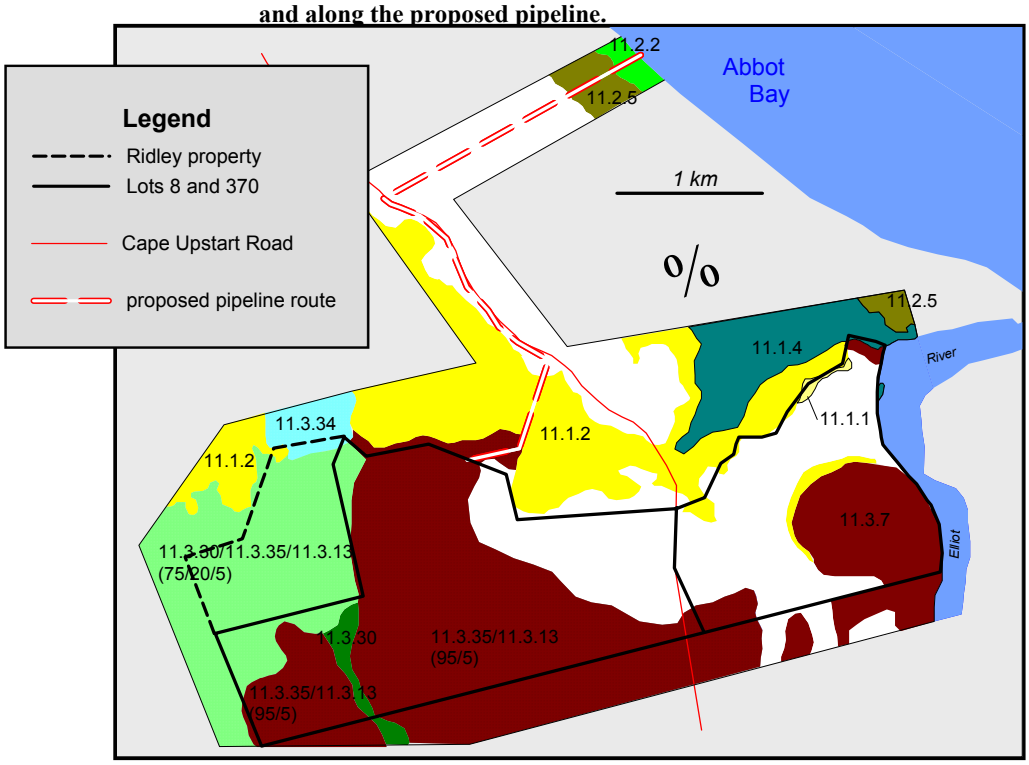


Figure 5.3 VMA status of Regional Ecosystems within and adjacent to the main development area and proposed pipeline.

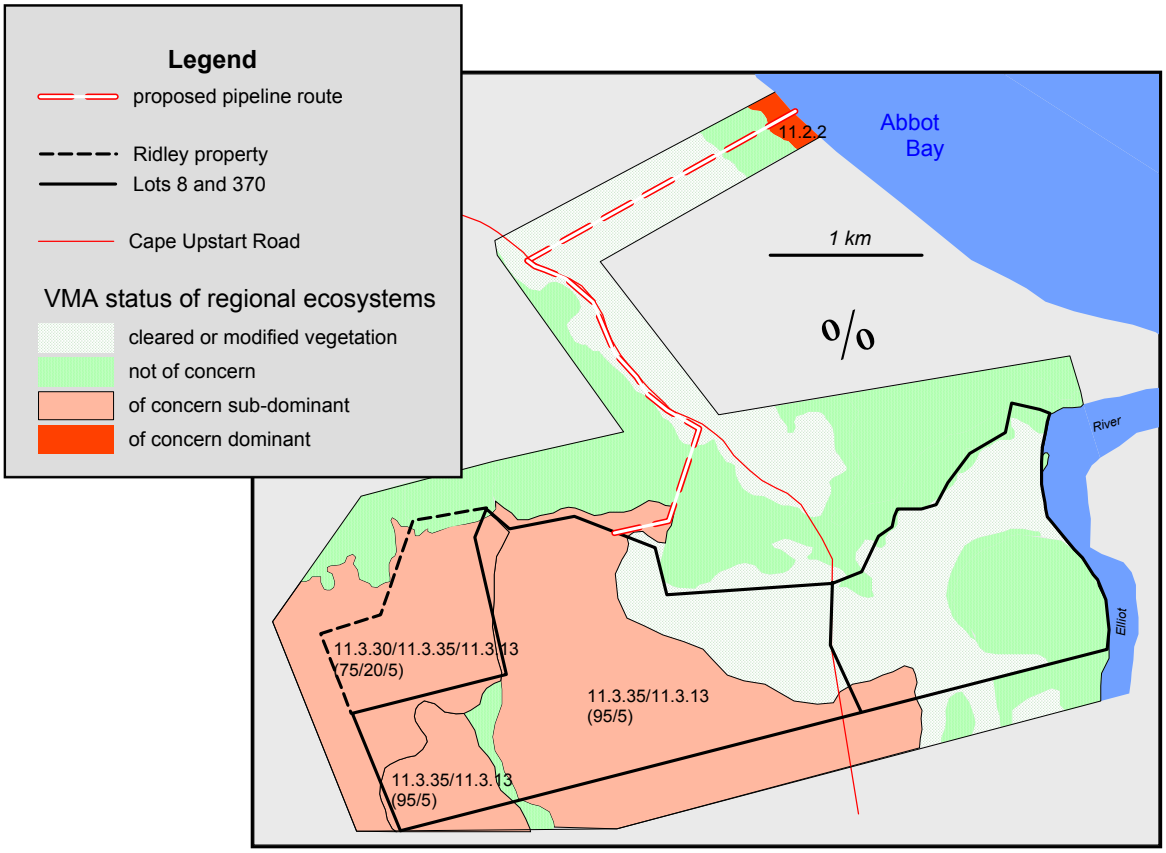


Table 5.1 Pre-clear and remnant areas within the Townsville Plains Province of the two *of concern* Regional Ecosystems occurring within the study area. Data sourced from Accad *et al.* (2001).

		Area (ha)		
RE	**Tenure**	**Pre-clear**	**Remnant 1997**	**Remnant 1999**
11.2.2	freehold	693	597	596
	leasehold	648	526	526
	National Park	696	583	583
	Reserves (other)	263	195	195
	Total ha	**2300**	**1901**	**1900**
	% of pre-clear	**100%**	**82.7%**	**82.6%**
11.3.13	freehold	2201	399	339
	leasehold	694	344	341
	National Park	4	4	4
	Reserves (other)	437	368	368
	Total ha	**3336**	**1115**	**1052**
	% of pre-clear	**100%**	**33.4%**	**31.5%**

Table 5.2 summarises the estimated effect that the development is likely to have on the remnant extent of the *of concern* RE's, based on Remnant 1999 data. The area of each RE to be directly disturbed by the proposal has been estimated as follows:

> ***RE 11.2.2***- If an above ground installation method (such as trenching) were to be used for this section of the pipeline, it is estimated that a 10m wide access corridor would be required. The length of pipeline corridor traversing RE 11.2.2 is in the order of 100m. Estimated area of RE 11.2.2 to be disturbed would be approximately 0.1 ha. [NB: It will be a recommendation of this report that disturbance of the vegetation in the beach/dune area traversed by the proposed pipeline be avoided by using directional boring rather than trenching]
>
> ***RE 11.3.13***- This RE occurs as small patches within eucalypt woodland vegetation on Lots 8 and 370. The EES survey and EPA RE mapping suggest that RE 11.3.13 occupies an estimated 5% of three polygons covering approximately 586 ha of the main development area. Estimated area of RE 11.313 to be disturbed is 5% of 586, which equals 29ha.

Table 5.2 Estimated areas of disturbance of the two *of concern* RE's due to the proposed development, and resulting overall remnant areas for each RE within the Townsville Plains Province

Regional Ecosystem	Pre-clear area (ha)	Estimated area to be disturbed		Resulting remnant area *	
		ha	% of pre-clear	ha	% of pre-clear
11.2.2	2300	0.1[#]	<0.5	1899	82.5%
11.3.13	3336	29	0.9	1023	30.6%

* based on Remnant 1999 data
[#] assuming surface installation method for pipeline such as trenching

Disturbance of RE 11.2.2 [*Ipomoea pes-caprae* and *Spinifex sericeus* grassland ± *Casuarina equisetifolia*] resulting from the proposed development will reduce the overall remnant area of the RE from 82.6% to 82.5% of the pre-clear area. This reduction represents a small proportion of the pre-clear area of the RE, and will not significantly reduce the remnant area of the Regional Ecosystem.

Disturbance of RE 11.3.13 [*Grevillea striata* open woodland] resulting from the proposed development will reduce the remnant area of the RE from 31.5% to 30.6% of the pre-clear area. This is a relatively small reduction that will not significantly progress the remnant area of the RE towards the 10% threshold of an *endangered* Regional Ecosystem.

6. Significant Species, Populations or Ecological Communities

6.1 Rare or Threatened Flora

Table 6.1 lists the rare or threatened flora species scheduled under Commonwealth and Queensland legislation that are known to occur within the study region. This list is based upon species identified in the database searches, the results of previous surveys, and data from previous reports.

The table includes a brief description of the known occurrences or preferred habitat for each species and, based on an assessment of the availability of these habitat features within the study area, makes an assessment as to whether each species is likely to occur in the study area. This assessment is based on available information regarding the habitats of each species, and on the author's knowledge of the flora and fauna of the Townsville Plains Province.

6.2 Rare or Threatened Fauna

Table 6.2 lists the rare or threatened fauna species scheduled under Commonwealth and Queensland legislation that are known to occur or potentially occur within the study region. This list is based upon species identified in the database searches, the results of previous surveys, and data from previous reports.

The table includes a brief description of the known preferred habitat and key resources for each species and, based on an assessment of the availability of these habitat features within the study area, makes an assessment as to whether each species is likely to occur in the study area.

This assessment is based on published information regarding the habitats of each species, and on the author's knowledge of the flora and fauna of the Townsville Plains Province. Literature used to determine the habitat information for these species included Debus 1998, Garnet 1993, Cogger 1992, Lee 1995, Churchill 1998.

Table 6.1 Threatened flora known from the study region and assessment of likely occurrence within the study area.

Species	EPBC Status	Qld Status	Record	Growth Form	Habitat	Likelihood of occurrence		
						Main site	***Pipeline***	***Adjacent areas***
Babingtonia papillosa [Myrtaceae]		E	QH	shrub	steep, rocky granite habitats and mountain tops	***low***; no suitable habitat present	***low***; no suitable habitat present	***low***; no suitable habitat present
Aponogeton queenslandicus [Aponogetonaceae]		V	QH	waterplant	ephemeral freshwater pools with clay bottoms	***Moderate,*** shallow ephemeral wetland habitats present on clay substrate; specimen known from Guthalungra area	***moderate,*** shallow ephemeral wetland habitats present on clay substrate; specimen known from Guthalungra area	***moderate,*** shallow ephemeral wetland habitats present on clay substrate; specimen known from Guthalungra area
Cassia sp. (Paluma Range G.Sankowsky+450) [Caesalpiniaceae]		R	QH	shrub	rainforest	***low***; no suitable habitat present	***low***; no suitable habitat present	***low***; no suitable habitat present
Croton magneticus [Euphorbiaceae]	V	V	EPBC	shrub	vine thicket in boulder strewn coastal areas	***low***; no suitable habitat present	***low***; no suitable habitat present	***low***; no suitable habitat present
Actephila sessilifolia [Euphorbiaceae]		R	QH		rainforest, vine forest, dry scrub	***low***; no suitable habitat present	***low***; no suitable habitat present	***low***; no suitable habitat present
Bonamia dietrichiana [Convolvulaceae]		R	QH	vine	rainforest, vine forest, dry scrub	***low***; no suitable habitat present	***low***; no suitable habitat present	***low***; no suitable habitat present
Hydrocharis dubia [Hydrocharitaceae]	V	V	QH, EPBC	waterplant	shallow freshwater wetlands and streams	***moderate,*** suitable wetland habitat present; known from Ayr	***moderate,*** suitable wetland habitat present; known from Ayr	***moderate,*** suitable wetland habitat present; known from Ayr
Marsdenia brevifolia [Asclepiadaceae]	V	V	EPBC	vine	in North Qld. occurs on acid granite derived soils	***low***; no suitable habitat present	***low***; no suitable habitat present	***low***; no suitable habitat present
Tylophora williamsi [Asclepiadaceae]	V	V	EPBC	vine	deciduous vine thickets, dry rainforest	***low***; no suitable habitat present	***low***; no suitable habitat present	***low***; no suitable habitat present
Corchorus hygrophilus [Tiliaceae]		R	QH	shrub	rainforest, fringing rainforest	***low***; no suitable habitat present	***low***; no suitable habitat present	***low***; no suitable habitat present
Grewia graniticola [Tiliaceae]		R	LA	shrub	woodland on hill slopes or coastal dunes	***Low***, no suitable habitat present	***Moderate***, small area of dunal woodland traversed	***Moderate***, dunal woodland present adjacent to pipeline
Livistona drudei [Arecaceae]		V	QH	palmtree	moist coastal habitats	***low***; specimens from study region may be misidentified *L. decipiens*; generally regarded to occur north of Townsville	***low***; specimens from study region may be misidentified *L. decipiens*; generally regarded to occur north	***low***; specimens from study region may be misidentified *L. decipiens*; generally regarded to occur north

Species	EPBC Status	Qld Status	Record	Growth Form	Habitat	Likelihood of occurrence		
						Main site	***Pipeline***	***Adjacent areas***
							of Townsville	of Townsville
Eucalyptus raveretiana [Myrtaceae]	V	V	QH, EPBC	tree	riparian and fringing woodland/forest	***low,*** suitable habitat present but a distinctive species that was not observed during the EES traverses of the site	***low,*** suitable habitat present but a distinctive species that was not observed during the EES traverses of the site	***low,*** suitable habitat present but a distinctive species that was not observed during the EES survey
Ozothamnus eriocephalus [Asteraceae]	V	V	EPBC	shrub	rocky ridges, rocky soils, most records from Eungella area	***low***; no suitable habitat present, no local records	***low***; no suitable habitat present, no local records	***low***; no suitable habitat present, no local records

Key to Records:

QH	records of specimens held by the Queensland Herbarium for the study region
EPBC	EPBC database search records for the study region
LA	occurrence in the study region cited by Lokkers and Anderson (2001)

Table 6.2 Rare or threatened fauna known to occur or potentially occurring in the study region and assessment of likely occurrence within the study area.
NB: species are listed according to their highest conservation status

Species	Common Name	EPBC Status	Qld Status	Record	Key resources	Habitat	Likelihood of occurrence		
							Main site	***Pipeline***	***Adjacent areas***
Endangered birds									
Erythrotriorchis radiatus	Red goshawk	V	E	EPBC	trees > 20m for nesting within 1km of a watercourse or wetland abundance of passerine prey	coastal and sub-coastal forests and riparian forests	***Low***, lack of suitable foraging and nesting habitat	***Low***, lack of suitable foraging and nesting habitat	***Low***, lack of suitable foraging and nesting habitat
Neochmia ruficauda ruficauda	Starfinch	V	E	EPBC	rank grassland and reedbeds near freshwater	grassy woodland and rank grassland near permanent freshwater	***Low***, limited areas of suitable habitat; very few records in NQ in recent years	***Low***, limited areas of suitable habitat; very few records in NQ in recent years	***Low***, limited areas of suitable habitat; very few records in NQ in recent years
Sterna albifrons (Australian breeding individuals)	Little tern		E	B	undisturbed unvegetated sites near estuaries and lakes and on coral quays	feeds in inshore waters	***Low***; only small artificial wetlands for foraging present, no breeding habitat	***Moderate***; wetlands for foraging present, but no breeding habitat	***Moderate***; wetlands for foraging present, but no breeding habitat
Vulnerable birds									
Esacus neglectus	Beach Stone-curlew		V	EES	nesting areas at the back of the beach free from feral predators	beaches of all types, particularly near estuaries and mangroves	***Low***; suitable habitat not present	***High***; suitable beach habitat present	***Present*** along the Elliot River sandflats and mangrove channel adjacent to the north-east periphery of the main site

Species	Common Name	EPBC Status	Qld Status	Record	Key resources	Habitat	Likelihood of occurrence		
							Main site	***Pipeline***	***Adjacent areas***
Geophaps scripta scripta	Squatter pigeon	V	V	EPBC, ACTFR	grassland near fresh water	eucalypt woodland with a grassy understorey in close proximity to fresh water	***Moderate***; grazing over the majority of the site maintains a low grass cover and there are few water sources within woodland areas, but the eastern portion of Lot 370 may provide suitable habitat conditions. The Burdekin Valley is a stronghold for the species.	***Low***; suitable grassland habitats are not present	***Moderate***; grazing maintains a low grass cover within the adjacent woodland areas so sub-optimal habitat present.
Poephila cincta cincta	Black-throated finch	V	V	EPBC, ACTFR	access to seeding grasses and fresh water	grassy woodland dominated by eucalypts, Melaleucas or acacias	***Moderate***; grazing over the majority of the site maintains a low grass cover, but the eastern portion of Lot 370 may provide suitable habitat conditions.	***Low***; grassy woodland areas are absent	***Moderate***; grazing maintains a low grass cover within the adjacent woodland areas so sub-optimal habitat present.
mammals									
Dasyurus maculatus maculatus	Spotted tailed quoll	V	V	EPBC, B	caves, rock outcrops, logs, tree hollows	rainforest, wet and dry sclerophyll forest, woodland	***Low***; key habitat resources not present; likely to be a paucity of prey given the adverse effects of grazing on ground habitats	***Low***; key habitat resources and preferred habitat types not present	***Low***; key habitat resources not present; likely to be a paucity of prey given the adverse effects of grazing on ground habitats
Xeromys myoides	False water rat	V	V	EPBC	inter-tidal areas with abundant crustaceans and other prey items	coastal wetlands and mangrove areas particularly within the inter-tidal zone	***Low***; only small mangrove areas present with short (relatively steep) inter-tidal zones	***Low***; no mangroves or inter-tidal wetlands present	***Low***; only small mangrove areas present with short (relatively steep) inter-tidal zones

Species	Common Name	EPBC Status	Qld Status	Record	Key resources	Habitat	Likelihood of occurrence		
							Main site	***Pipeline***	***Adjacent areas***
reptiles									
Crocodylus porosus	Estuarine crocodile		V	EPBC	in estuarine areas, availability of tidal flats for basking	coastal wetlands, inland reaches of major rivers, and estuaries	***Low***; suitable habitats do not occur within the boundary of the main site	***Low***; only shallow wetlands present with limited vegetation	***High***; estuarine habitats of the Elliot River and small mangrove lined tributary adjacent to Lot 370 provide suitable foraging habitat but breeding unlikely
Delma labialis	Striped-tailed Delma	V	V	LA	poorly known	poorly known but may be present in dune vine thickets	***Low***; suitable habitat not present	***Low***; suitable habitat not present	***Low***; suitable habitat not present
Rare									
birds									
Accipiter novaehollandiae	Grey goshawk		R	B	dense forest types	wet forests and riverine forest among woodland	***Low***; suitable forest habitats not present	***Low***; suitable forest habitats not present	***Low***; suitable forest habitats not present
Ephippiorhynchus asiaticus	Black-necked stork		R	EES, ACTFR, B	aquatic habitats	river pools, wetlands, tidal flats	***High***; likely to utilise artificial and seasonal wetlands on Lot 370	***High***; suitable wetland habitats present	***Present***; observed feeding on Elliot River tidal flats
Melithreptus gularis	Black-chinned honeyeater		R	ACTFR, B	flowering trees and shrubs	woodlands, riparian forests and woodlands	***High***; suitable woodland habitat present	***Moderate***; small area of woodland habitat present along the eastern section of the route	***High***; suitable woodland habitat present
Nettapus coromandelianus	Cotton pygmy-goose		R	QM, EPBC, ACTFR, B	deep water with vegetation	deep lagoons, wetlands and dams with floating marcophytes	***Moderate***; dam adjacent to the main track in Lot 370 provides limited suitable habitat	***Moderate***; shallow wetlands with little floating macrophytes present	***Moderate***; farm dams on adjacent properties provide limited suitable habitat

Species	Common Name	EPBC Status	Qld Status	Record	Key resources	Habitat	Likelihood of occurrence		
							Main site	***Pipeline***	***Adjacent areas***
Numenius madagascariensis	Eastern curlew		R	EES,B	inter-tidal areas for feeding	estuaries, mudflats, mangroves, sandspits	***Low***; inter-tidal areas not present	***Low***; inter-tidal areas not present	***Present*** along the Elliot River sandflats and mangrove channel adjacent to the north-east periphery of the main site
Rallus pectoralis	Lewin's Rail		R	LA	availability of habitats	saltmarsh areas with thick vegetation	***Low***; suitable marsh habitat not present	***Moderate,*** suitable marsh habitat present	***Moderate,*** suitable marsh habitat present adjacent to pipeline
Rostratula benghalensis	Painted snipe	w m	R	EPBC	marsh habitat	marshes with moderate vegetation cover	***Low***; suitable marsh habitat not present	***Moderate***; limited marsh areas with vegetation cover present	***Low***; suitable marsh habitat not present
Tadorna rajah	Radjah shelduck	w	R	QM, EPBC ACTFR	aquatic habitats	coastal wetlands and rivers, mudflats, saltmarsh, mangroves, paperbark swamps	***Low***; limited wetland areas present and few records for the Ayr-Bowen area	***Low***; wetland areas present but few records for the Ayr-Bowen area	***Low***; wetland areas present but few records for the Ayr-Bowen area
mammals									
Saccolaimus saccolaimus	Bare-rumped sheathtail bat		R	QM	small hollow branches, especially in poplar gum	tropical woodland and tall open forest especially woodland dominated by poplar gum (*Eucalyptus platyphylla*)	***High***; poplar gum woodland containing potential roost hollows present	***Low***; only small area of woodland present without poplar gum	***High***; poplar gum woodland containing potential roost hollows present

Species	Common Name	EPBC Status	Qld Status	Record	Key resources	Habitat	Likelihood of occurrence		
							Main site	***Pipeline***	***Adjacent areas***
reptiles									
Varanus semiremex	Rusty monitor		R	LA	availability of habitats	mangrove forests and adjoining vine thicket	***Low***; suitable mangrove habitats not present	***Low***; suitable mangrove habitats not present	***Low***; only small areas of mangrove habitats present

Key to Records:

EES	observed during the March 2002 EES survey of the study area
QM	records of specimens held by the Queensland Museum for the study region
EPBC	EPBC database search records for the study region
LA	occurrence in the study region cited by Lokkers and Anderson (2001)
ACTFR	recorded during the 1991/1993 Burdekin River Irrigation Area Flora and Fauna Survey (Thomas and Pearson 1994)
B	records of surveys undertaken 1969-1973 in the Lower Burdekin Area including a site at Inkerman approx. 25km to the northwest of the study area (Lavery and Johnson 1974, Lavery and Seton 1974)

Key to Status:

E	endangered
V	vulnerable
R	rare

6.3 Fauna Species Covered by Migratory, Wetland and Marine Provisions of the EPBC Act

Table 6.3 lists the migratory and marine fauna species scheduled under the EPBC Act that are known to occur or potentially occur within the study region. This list is based upon species identified in the EPBC database search, the results of previous surveys, and data from previous reports.

The table includes a brief description of the known preferred habitat and key resources for each species and, based on an assessment of the availability of these habitat features within the study area, makes an assessment as to whether each species is likely to occur in the study area. This assessment is based on published information regarding the habitats of each species, and on the author's knowledge of the flora and fauna of the Townsville Plains Province.

Since this report deals with terrestrial fauna, fully marine species such as fish, dugong, sea turtles and sea snakes have been omitted. Migratory and wetland species that are also scheduled as rare or threatened under State and/or Commonwealth legislation are included in Table 6.2.

6.4 Significant Populations

No significant populations of rare, threatened or migratory fauna are listed under legislation for the study area, and none are known or anticipated to occur within or adjacent to the study area.

6.5 Significant Ecological Communities

The EPBC database search indicated one threatened ecological community as likely to occur in the study area. The community comprises Semi-evergreen vine thickets of the Brigalow Belt (north and south) and Nandewar Bioregions, and is listed as endangered. The EES field survey confirmed that the community does not occur within or adjacent to the study area.

Table 6.3 Migratory and wetland fauna known to occur or potentially occurring in the study region and assessment of likely occurrence within the study area.

Species	Common Name	EPBC Status	Record	Key resources	Habitat	Likelihood of occurrence		
						Main site	***Pipeline***	***Adjacent areas***
Migratory and wetland species listed under the EPBC Act								
birds								
Actitis hypoleucos	Common sandpiper	m	B, LA		banks, rocks, sandy beaches near water	***Low***; suitable habitats not present	***Low***; suitable mangrove habitats not present	***High;*** suitable habitats present along the Elliot River and to the north of the main site
Ardea alba	Great egret	m	LA	availability of habitats	floodwaters, rivers, wetlands, inter-tidal habitats	***High***, suitable natural and artificial wetland habitats present	***High***, suitable wetland habitats present	***High***, suitable natural and artificial wetland habitats present
Ardea ibis	Cattle egret	m	LA	availability of habitats	pasture especially among cattle, occasionally wetlands	***High***, suitable pasture and wetland habitats present	***Low***, pasture habitats absent	***High***, suitable pasture and wetland habitats present
Calidris acuminata	Sharp-tailed sandpiper	m	EES, LA		coastal and interior wetlands	***Low;*** only limited wetlands of low suitability present	***Present*** along the eastern section	***High;*** estuarine, and freshwater shores occur to the north and east of the main site
Calidris ferruginea	Curlew sandpiper	m	LA		coastal and inland shores	***Low;*** suitable habitats not present	***Moderate;*** wetland and saltflat habitats present along much of the pipeline	***Moderate;*** estuarine, mudflat and saltflat habitats occur to the north and east of the main site

Species	Common Name	EPBC Status	Record	Key resources	Habitat	Likelihood of occurrence		
						Main site	***Pipeline***	***Adjacent areas***
Calidris ruficollis	Red-necked stint	m	B, LA		coastal and inland shores	***Low;*** suitable habitats not present	***High;*** wetland and saltflat habitats present along much of the pipeline	***High;*** estuarine, mudflat and saltflat habitats occur to the north and east of the main site
Calidris melanotus	Pectoral sandpiper	m	LA		grassy coastal and inland swamps	***Low;*** suitable habitats not present	***Moderate;*** grassy wetlands present along eastern section	***Low;*** suitable habitats not present
Charadrius mongolus	Lesser sand plover	w	EPBC, B	availability of habitats	coastal wetland, estuarine, mudflats and saltflat habitats	***Moderate***; some saltflat habitat occurs along the northern periphery of the main site	***High;*** wetland and saltflat habitats present along much of the pipeline	***High;*** estuarine, mudflat and saltflat habitats occur to the north and east of the main site
Charadrius veredus	Oriental plover	m	LA		dry plains, occasionally coastal	***Low;*** suitable habitats not present	***Moderate;*** may utilise wetland habitats	***Moderate;*** may utilise wetland habitats associated with the Elliot River
Chlidonias hybridus	Whiskered tern	m	ACTFR, B, LA		lakes, swamps, saltmarsh, estuaries	***Moderate;*** likely to utilise dam on Lot 370	***High;*** freshwater wetlands along eastern section	***High;*** estuarine habitats of the Elliot River
Chlidonias leucopterus	White-winged black tern		B, LA		lakes, estuaries, coastal seas	***Moderate;*** likely to utilise dam on Lot 370	***High;*** freshwater wetlands along eastern section	***High;*** estuarine habitats of the Elliot River
Gallinago hardwickii	Latham's snipe	w m	EPBC, ACTFR, B	availability of habitats	wetland grasses, open, wooded swamps, ephemerally inundated grasslands	***Moderate;*** ephemerally inundated grasslands likely during wet season	***High;*** grassy wetland habitats present along the eastern section	***Moderate;*** ephemerally inundated grasslands likely during wet season

Species	Common Name	EPBC Status	Record	Key resources	Habitat	Likelihood of occurrence		
						Main site	***Pipeline***	***Adjacent areas***
Glareola maldivarum	Oriental pratincole	m	B, LA		open plains, bare ground around swamps, claypans	***Moderate;*** suitable habitat available	***Moderate;*** suitable habitat available	***Moderate;*** suitable habitat available
Grus antigone	Sarus crane	w	EPBC	availability of habitats	wetland habitats, grassy open woodland	***Low;*** outside main distribution in North Qld, no local records	***Low;*** outside main distribution in North Qld, no local records	***Low;*** outside main distribution in North Qld, no local records
Haliaeetus leucogaster	White-bellied sea eagle	t m	EPBC, ACTFR, B	availability of prey and nesting sites	large rivers, fresh and saline lakes, coastal seas and shoreline, islands	***High;*** likely to utilise perches adjacent to the Elliot River and mangrove tributary, but no nests observed	***High;*** likely to utilise wetland, dune woodland and beach habitats, but no nests observed	***High;*** likely to forage along the Elliot River and tributaries
Hirundapus caudacutus	White-throated needletail	t m	EPBC, B	availability of high-flying insect swarms	aerial over coastal habitats and mountain ranges	***Moderate;*** may occasionally utilise airspace above site	***Moderate;*** may occasionally utilise airspace above pipeline	***Moderate;*** may occasionally utilise airspace above adjacent areas
Hirundo rustica	Barn swallow	t m	EPBC	availability of habitat	open country, cultivated lands, urban areas	***Moderate;*** may occasionally utilise available habitats	***Moderate;*** may occasionally utilise available habitats	***Moderate;*** may occasionally utilise available habitats
Limosa limosa	Black-tailed godwit	w	EPBC	tidal flats with adequate prey populations	tidal flats, inland wetlands	***Low;*** suitable habitats not present	***Moderate;*** wetland habitat present	***Moderate;*** likely to utilise tidal flat areas of the Elliot River
Limosa lapponica	Bar-tailed godwit	m	LA		tidal flats	***Low;*** suitable habitats not present	***Low;*** suitable habitats not present	***Moderate;*** likely to utilise tidal flat areas of the Elliot River

Species	Common Name	EPBC Status	Record	Key resources	Habitat	Likelihood of occurrence		
						Main site	***Pipeline***	***Adjacent areas***
Monarcha melanopsis	Black-faced monarch	t m	EPBC, ACTFR, B	availability of forest habitat	forest habitats including riparian forest	***Moderate;*** may utilise the woodland areas on the eastern section of Lot 370	***Moderate;*** may utilise the small area of dunal woodland traversed by the pipeline	***Moderate;*** may utilise riparian woodland/forest along the Elliot River
Monarcha trivirgatus	Spectacled monarch	m	EPBC, ACTFR, B	availability of forest habitat	rainforest, riparian forest, mangroves	***High;*** likely to utilise the woodland areas on the eastern section of Lot 370	***Moderate;*** may utilise the small area of dunal woodland traversed by the pipeline	***Moderate;*** may utilise riparian woodland/forest along the Elliot River
Myiagra cyanoleuca	Satin flycatcher	t m	EPBC, ACTFR	availability of habitat	forests, riparian forest, woodland	***High;*** likely to utilise the woodland areas on the eastern section of Lot 370	***Moderate;*** may utilise the small area of dunal woodland traversed by the pipeline	***Moderate;*** may utilise riparian woodland/forest along the Elliot River
Numenius minutus	Little curlew	w m	EPBC, EES, B	inter-tidal areas for feeding	open plains, grassland, parkland, mudflats	***Moderate***; grassy plains present but with high grazing pressure	***Moderate;*** saltflats, grassy ephemeral wetlands and freshwater wetlands likely to be utilised	***High***; Inter-tidal areas of the Elliot River and saltmarsh areas to the north of the main site (i.e. within the NP) provide suitable habitat
Numenius phaeopus	Whimbrel	m	LA	inter-tidal areas for feeding	estuaries, mudflats, mangroves, sandspits	***Low***; inter-tidal areas not present	***Low***; inter-tidal areas not present	***Present*** along the Elliot River sandflats and mangrove channel adjacent to the north-east periphery of the main site
Plegadus falcinellus	Glossy ibis	m	LA	availability of habitat	freshwater wetlands and pasture	***Moderate***, suitable habitats present	***Moderate***, suitable habitats present	***Moderate***, suitable habitats present

Species	Common Name	EPBC Status	Record	Key resources	Habitat	Likelihood of occurrence		
						Main site	***Pipeline***	***Adjacent areas***
Pluvialis fulva	Pacific golden plover	m	EES, B, LA		beaches, mudflats, shallow wetlands	***Low;*** suitable habitats not present	***Present*** along the eastern section	***High;*** likely to utilise estuarine, and freshwater habitats to the north and east of the main site
Sterna caspia	Caspian tern	m	EES, ACTFR, LA		coastal and inland watercourses and lakes	***Moderate;*** likely to utilise dam on Lot 370	***Present*** over freshwater wetlands along eastern section	***Present*** over the estuarine habitats of the Elliot River
Tringa nebularia	Common greenshank	m	EES, B, LA	wetland habitat	coastal and inland lakes and wetlands	***Moderate;*** limited wetland areas present but likely to utilise large dam on Lot 370	***High;*** suitable freshwater and saline wetlands available along eastern section	***Present*** along Elliot River, also likely to the north of the main site
Tringa stagnatilis	Marsh sandpiper	w m	EPBC, B	availability of suitable wetland habitat	fresh or slatwater wetland habitats	***Moderate;*** small areas of freshwater wetland available on Lot 370	***High;*** suitable freshwater wetlands available along eastern section	***High;*** suitable habitat along the Elliot River and tributaries adjacent to the north-east periphery of the main site

Key to Records:

EES	observed during the March 2002 EES survey of the study area
QM	records of specimens held by the Queensland Museum for the study region
EPBC	EPBC database search records for the study region
LA	occurrence in the study region cited by Lokkers and Anderson (2001)
ACTFR	recorded during the 1991/1993 Burdekin River Irrigation Area Flora and Fauna Survey (Thomas and Pearson 1994)
B	records of surveys undertaken 1969-1973 in the Lower Burdekin Area including a site at Inkerman approx. 25km to the northwest of the study area (Lavery and Johnson 1974, Lavery and Seton 1974)

Key to Status:

w	listed under wetland provisions of EPBC comprising species listed under CAMBA and/or JAMBA
m	listed under migratory provisions of EPBC
t	listed under terrestrial provisions of EPBC

7. Areas of Ecological Significance and Important Ecological Interactions

7.1 Main Development Area

None of the terrestrial habitat areas occurring within the main development area are of particular ecological significance given their disturbed condition and abundance elsewhere in the study region. The wetlands occurring within the main development area (farm dams, hypersaline flats) are of limited spatial extent and are not expected to be of particular ecological significance, particularly given their abundance elsewhere in the study region.

An active nest of the osprey (*Pandion haliaetus*) was located in the northeastern corner of Lot 370 in a dead eucalypt adjacent to the Elliot River. Although not a significant species under legislation, the osprey is restricted to seashore habitats and may be susceptible to disturbance of nesting habitat. Nests are re-used each breeding season. The osprey nest is regarded as a significant ecological feature.

7.2 Proposed Pipeline Route

Two ecologically significant areas occur along the eastern section of the pipeline route.

The freshwater wetlands established on marine deposits (vegetation map unit 1d) are not remnant habitat features but provide extensive foraging habitat for migratory waders. These wetlands extend for some 7km to the north where they merge with tidal wetlands adjacent to the Cape Upstart National Park, and also link up with the mangrove habitats of the Elliot River 2.5 km to the south. This area of wetland is likely to support important ecological interactions with wetland birds including migratory waders.

The band of habitat types occurring on the dune complex fringing Abbot Bay provide a diversity of habitat opportunities for fauna including shrubby woodland, *Melaleuca* wetland, grassy ephemeral wetland, and foredune vegetation. While these vegetation types are not uncommon in the study region, the tract traversed by the pipeline route extends for a considerable distance northwards to Cape Upstart with little disturbance, and is of considerable extent. This corridor of dunal habitats also links the terrestrial habitats of Cape Upstart with the riparian vegetation of the Elliot River, and the small National Park patch located to the north of Lot 370. These habitats are of local significance.

7.3 Adjacent Areas

The main estuarine reach of the Elliot River is situated adjacent to, and downstream of the eastern boundary of the main development area and is regarded as a significant area supporting interactions with wading and fishing birds including migratory and rare species. The estuary is likely to provide significant

feeding resources for these types of fauna, as evidenced by the presence of the Osprey nest on Lot 370.

8. Potential Impacts on Significant Flora and Fauna

The following tables summarise the potential impacts on rare or threatened flora and rare, threatened or migratory fauna that may occur within the study area. While there may be some repetition of potential impact entries in the tables, this tabular approach provides concise, accessible information on individual species or groups of similar species.

8.1 Rare or Threatened Flora

Assessment of the potential impacts on significant flora resulting from the development is provided in Table 8.1. No rare or threatened flora are definitely known to occur in the study area; however, three species are at least moderately likely to occur. No rare or threatened flora are anticipated to be significantly effected by the proposal. This is because only very small areas of potential habitat for the species will be disturbed by the development, and extensive areas of similar habitat occur locally and regionally.

8.2 Rare or Threatened Fauna

Assessment of the potential impacts on rare or threatened fauna resulting from the development is provided in Table 8.2. A total of two (2) rare and one (1) threatened fauna species are known to utilise the study area. An additional nine (9) species were assessed in Section 6 as at least moderately likely to occur in the study area. None of these species are anticipated to be significantly effected by the proposal since:

- for the majority of the species, potential habitat immediately adjacent to the main development area and proposed pipeline will not be effected; and,
- in instances where potential habitat will be disturbed, only relatively small areas of habitat will be disturbed by the development, and extensive areas of similar habitat occur locally and regionally.

The local impact on the Bare-rumped sheath-tail bat (*Saccolaimus saccolaimus*) (if present) may be significant, as a result of the removal of scattered poplar gums (*Eucalyptus platyphylla*) that occur over the majority of Lot 8. This tree is favoured as a roosting site by the species. However, the EPA RE mapping shows that RE's containing poplar gum (11.3.9 and 11.3.35) are widely distributed in the surrounding area and the viability of the regional population of the species is unlikely to be significantly effected.

Table 8.1 Potential impacts on threatened flora with a moderate or high likelihood of occurrence within the study area.

Species	Potential Impact		
	Main site	***Pipeline***	***Adjacent areas***
***Aponogeton queenslandicus* V** and ***Hydrocharis dubia* V**	The main potential ephemeral wetland habitats for this species occur on the central section of Lot 370. Based on Concept Farm Layout 2 (SKM) these potential habitat areas will not be affected by the development. Should the farm layout change to include these areas, they represent only a small area of potential habitat and it is unlikely that the regional or local population (if any) will be significantly affected.	The large ephemeral wetland traversed by the pipeline route represents potential habitat for the species; however, only a very small area of this habitat will be disturbed during construction. Provided that appropriate measures are taken to control erosion and sedimentation during construction, significant impacts on the species (if present) are not anticipated.	The development is unlikely to have any adverse effects on potential habitat areas on adjacent areas.
***Grewia graniticola* R**	unlikely to be present	A narrow corridor (approximately 10m wide) of potential dunal woodland habitat is traversed by the pipeline route. Any plants present within this corridor will be disturbed during construction; however, the dunal woodland habitat extends for 7km to the north and 2km south. [NB: due to the sensitivity of this dunal vegetation this report will recommend that directional boring is used if possible to install the pipeline and greatly reduce impacts on these habitats]	Directional boring of the pipeline is recommended to reduce disturbance of the sensitive dune vegetation within the pipeline corridor. Potential impacts on the species in adjacent areas (if present) will be negligible if boring is adopted. Above ground installation methods may create significant water and wind erosion impacts adjacent to the pipeline in which case a small area of potential habitat may be disturbed. However, impacts on the local population of the species (if present) are anticipated to be minimal.

Table 8.2 Potential impacts on rare or threatened fauna with a moderate or high likelihood of occurrence within the study area.

NB: species are listed according to their highest conservation status

		Potential Impact	
Common Name	***Main site***	***Pipeline***	***Adjacent areas***
Endangered			
birds			
Little tern	unlikely to be present	Some short-term impacts on wetland habitat quality within the pipeline corridor may occur during construction but a significant effect on this species is not anticipated.	Some short-term impacts on wetland habitat quality adjacent the pipeline corridor may occur during construction but no significant effect on this species is anticipated
Vulnerable			
birds			
Beach Stone-curlew	unlikely to be present	Installation of the pipeline across the beach habitat of this species is unlikely to significantly effect foraging or movement of the species If pipeline construction occurs during the July-February breeding season of the species, a pre-construction survey is recommended to ensure that nest sites will not be affected. Significant impacts are not anticipated.	The Elliot River estuarine habitats will not be directly disturbed by the project so direct impacts on the species are not anticipated. Inappropriate effluent disposal to estuarine habitats has the potential to affect food resources of the species; however, provided that effluent discharge complies with EPA standards significant effects on the species are not anticipated.
Squatter pigeon and **Black-throated finch**	The eastern portion of Lot 370 may provide suitable habitat conditions for these species; however, similar habitats are widespread locally and regionally, and the main development area is not anticipated to represent an especially significant area for the species. Current farm layouts suggest that this potential habitat area will not be disturbed.	unlikely to be present	Potential habitat in adjacent areas will not be affected by the project.
reptiles			
Estuarine crocodile	unlikely to be present	unlikely to be present	The Elliot River estuarine habitats will not be directly disturbed by the project so direct impacts on the species are not anticipated. Inappropriate effluent disposal to estuarine habitats has the potential to affect food resources of the species; however, provided that effluent discharge complies with EPA standards significant effects on the species are not anticipated.

	Potential Impact		
Common Name	***Main site***	***Pipeline***	***Adjacent areas***
Rare birds			
Black-necked stork	Some of the artificial and seasonal wetlands on Lot 370 may be disturbed during construction. Loss of these small areas of habitat is not anticipated to significantly affect the species, and some of the sedimentation and water storage ponds to be constructed may provide foraging habitat.	Some short-term impacts on wetland habitat quality within the pipeline corridor may occur during construction but a significant effect on this species is not anticipated.	Some short-term impacts on wetland habitat quality adjacent the pipeline corridor may occur during construction but no significant effect on this species is anticipated The Elliot River estuarine habitats will not be directly disturbed by the project so direct impacts on the species are not anticipated. Inappropriate effluent disposal to estuarine habitats has the potential to affect food resources of the species; however, provided that effluent discharge complies with EPA standards significant effects on the species are not anticipated
Black-chinned honeyeater	The woodland habitats on Lot 8 will be removed during construction. The more diverse woodland habitats on the eastern section of Lot 370 are unlikely to be disturbed and provide better habitat opportunities. Some reduction in woodland habitat will occur but it is not anticipated to significantly effect the species.	A narrow corridor (approximately 10m wide) of potential dunal woodland habitat is traversed by the pipeline route. This habitat is unlikely to be disturbed if directional boring is used to install the pipeline. If more disruptive installation methods are used, significant impacts on the species are not anticipated since extensive areas of similar habitat exist to the north and south.	Potential habitat in adjacent areas will not be affected by the project.
Cotton pygmy-goose	The dam adjacent to the main track in Lot 370 provides limited suitable habitat for the species. Removal of the dam during construction may be necessary but is not anticipated to produce significant effects on the species.	Some short-term impacts on wetland habitat quality within the pipeline corridor may occur during construction but a significant effect on this species is not anticipated.	Some short-term impacts on wetland habitat quality adjacent to the pipeline corridor may occur during construction but a significant effect on this species is not anticipated. Potential farm dam habitat in adjacent areas will not be affected by the project.
Eastern curlew	unlikely to be present	unlikely to be present	The Elliot River estuarine habitats will not be directly disturbed by the project so direct impacts on the species are not anticipated. Inappropriate effluent disposal to estuarine habitats has the potential to affect food resources of the species; however, provided that effluent discharge complies with EPA standards significant effects on the species are not anticipated.

		Potential Impact	
Common Name	***Main site***	***Pipeline***	***Adjacent areas***
Lewin's Rail and **Painted snipe**	unlikely to be present	Some short-term impacts on marsh habitat quality within the pipeline corridor may occur during construction but a significant effect on this species is not anticipated.	Some short-term impacts on marsh habitat quality adjacent to the pipeline corridor may occur during construction but a significant effect on this species is not anticipated.
mammals			
Bare-rumped sheathtail bat	Poplar gum woodland is a key habitat of this species. While true poplar gum woodland does not occur in the main development area, poplar gums are widely scattered across approximately 70% of Lot 8 as co-dominant trees. Loss of these trees will comprise loss of habitat for the species; however, the EPA RE mapping shows that RE's containing poplar gum (11.3.9 and 11.3.35) are widely distributed in the surrounding area. Removal of these trees may have an impact on the local population of the species, but the viability of the regional population of the species is unlikely to be significantly effected.	unlikely to be present	Potential habitat in adjacent areas will not be affected by the project.

8.3 Migratory and Wetland Fauna Listed Under the EPBC

Assessment of the potential impacts on migratory and wetland fauna resulting from the development is provided in Table 8.3. A total of five (5) migratory, wetland or marine terrestrial fauna species listed under the EPBC Act species are known to utilise the study area. An additional twenty-three (23) species were assessed in Section 6 as at least moderately likely to occur in the study area. None of these species are anticipated to be significantly effected by the proposal since:

- for the majority of the species, potential habitat immediately adjacent to the main development area and proposed pipeline will not be effected; and,
- in instances where potential habitat will be disturbed, only relatively small areas of habitat will be disturbed by the development, and extensive areas of similar habitat occur locally and regionally.

Table 8.3 Potential impacts on migratory and wetland fauna with a moderate or high likelihood of occurrence within the study area.

Common Name	Potential Impact		
	Main site	***Pipeline***	***Adjacent areas***
birds			
Common sandpiper **Bar-tailed godwit** **Whimbrel**	unlikely to be present	unlikely to be present	The Elliot River estuarine habitats will not be directly disturbed by the project so direct impacts on the species are not anticipated. Inappropriate effluent disposal to estuarine habitats has the potential to affect food resources of the species; however, provided that effluent discharge complies with EPA standards significant effects on the species are not anticipated.
Cattle egret	Grassy plain habitats will be lost but these habitats are extensively available in adjacent areas locally and regionally. Significant effects on this species are not anticipated.	unlikely to be present	Potential habitat in adjacent areas will not be affected by the project.
Pectoral sandpiper	unlikely to be present	Some short-term impacts on wetland habitat quality within the pipeline corridor may occur during construction but a significant effect on this species is not anticipated.	unlikely to be present

Common Name	Potential Impact		
	Main site	***Pipeline***	***Adjacent areas***
Lesser sand plover	Only a very small area of saltflat habitat occurs along the northern periphery of the main site. Loss of this habitat is not anticipated to significantly effect the species.	Some short-term impacts on wetland and saltflat habitat quality within the pipeline corridor may occur during construction but this is not anticipated to significantly effect the species.	Some short-term impacts on small areas of wetland and saltflat habitat quality adjacent the pipeline corridor may occur during construction but a significant effect on this species is not anticipated The Elliot River estuarine habitats will not be directly disturbed by the project so direct impacts on the species are not anticipated. Inappropriate effluent disposal to estuarine habitats has the potential to affect food resources of the species; however, provided that effluent discharge complies with EPA standards significant effects on the species are not anticipated
Oriental plover **Black-tailed godwit** **Pacific golden plover** **Red-necked stint** **Curlew sandpiper** **Sharp-tailed sandpiper**	unlikely to be present	Some short-term impacts on wetland habitat quality within the pipeline corridor may occur during construction but a significant effect on these species is not anticipated.	Some short-term impacts on wetland habitat quality adjacent the pipeline corridor may occur during construction but no significant effect on this species is anticipated The Elliot River estuarine habitats will not be directly disturbed by the project so direct impacts on the species are not anticipated. Inappropriate effluent disposal to estuarine habitats has the potential to affect food resources of the species; however, provided that effluent discharge complies with EPA standards significant effects on the species are not anticipated
White-bellied sea eagle	Likely to utilise perches adjacent to the Elliot River. Fringing vegetation will be retained in these areas so significant impacts are not anticipated.	Only small areas of wetland, dune woodland and beach habitats, will be disturbed by the development. Given the abundance of these habitat s adjacent to the pipeline, significant impacts are not anticipated.	Some short-term impacts on wetland habitat quality adjacent the pipeline corridor may occur during construction but no significant effect on this species is anticipated The Elliot River estuarine habitats will not be directly disturbed by the project so direct impacts on the species are not anticipated. Inappropriate effluent disposal to estuarine habitats has the potential to affect food resources of the species; however, provided that effluent discharge complies with EPA standards significant effects on the species are not anticipated
White-throated needletail	This species forages high above the ground surface. The anticipated levels of disturbance to ground habitats is not anticipated to significantly effect the species ability to forage above the study area.	This species forages high above the ground surface. The anticipated levels of disturbance to ground habitats is not anticipated to significantly effect the species ability to forage above the study area.	This species forages high above the ground surface. The anticipated levels of disturbance to ground habitats is not anticipated to significantly effect the species ability to forage above the study area.

Common Name	Potential Impact		
	Main site	***Pipeline***	***Adjacent areas***
Barn swallow	The terrestrial habitats of the area are unlikely to be of special significance for this species and extensive potential habitat occurs locally and regionally. Significant effects on this species are not anticipated.	The terrestrial habitats of the area are unlikely to be of special significance for this species and extensive potential habitat occurs locally and regionally. Significant effects on this species are not anticipated.	Potential habitat in adjacent areas will not be affected by the project.
Black-faced monarch **Spectacled monarch** **Satin flycatcher**	These species may utilise the woodland areas on the eastern section of Lot 370. These areas are unlikely to be disturbed by the development; however if they are disturbed, extensive areas of similar habitat occur locally and regionally, and significant impacts are not anticipated.	A narrow corridor (approximately 10m wide) of potential dunal woodland habitat is traversed by the pipeline route. This habitat is unlikely to be disturbed if directional boring is used to install the pipeline. If more disruptive installation methods are used, significant impacts on the species are not anticipated since extensive areas of similar habitat exist to the north and south.	Potential habitat in adjacent areas will not be affected by the project.
Little curlew **Glossy ibis** **Oriental pratincole** **Latham's snipe**	Grassy plain habitats will be lost but these habitats are extensively available in adjacent areas locally and regionally. Significant effects on these species are not anticipated.	Some short-term impacts on marsh and wetland habitat quality within the pipeline corridor may occur during construction but a significant effect on these species is not anticipated.	Some short-term impacts on marsh and wetland habitat quality adjacent to the pipeline corridor may occur during construction but no significant effects on these species are anticipated The Elliot River estuarine habitats will not be directly disturbed by the project so direct impacts are not anticipated. Inappropriate effluent disposal to estuarine habitats has the potential to affect food resources of the species; however, provided that effluent discharge complies with EPA standards significant effects on the species are not anticipated
Common greenshank **Marsh sandpiper** **Caspian tern** **White-winged black tern** **Whiskered tern** **Great egret**	Species likely to utilise large dam on Lot 370. Loss of this artificial habitat area is not anticipated to have a significamt effect on the species	Some short-term impacts on wetland habitat quality within the pipeline corridor may occur during construction but a significant effect on this species is not anticipated.	Some short-term impacts on wetland habitat quality adjacent the pipeline corridor may occur during construction but no significant effect on this species is anticipated The Elliot River estuarine habitats will not be directly disturbed by the project so direct impacts on the species are not anticipated. Inappropriate effluent disposal to estuarine habitats has the potential to affect food resources of the species; however, provided that effluent discharge complies with EPA standards significant effects on the species are not anticipated

9. Summary of Potential Impacts and Areas of Ecological Significance

This section summarises the conclusions regarding potential impacts on flora and fauna, and areas of ecological significance that have been made within the report.

9.1 Potential Impacts

- Two Regional Ecosystems listed as *of concern* under the *Vegetation Management Act 1999* will be disturbed as a result of the development.
    - Disturbance of RE 11.2.2 [*Ipomoea pes-caprae* and *Spinifex sericeus* grassland ± *Casuarina equisetifolia*] resulting from the proposed development will reduce the overall remnant area of the RE from 82.6% to 82.5% of the pre-clear area. This reduction represents a small proportion of the pre-clear area of the RE, and will not significantly reduce the remnant area of the Regional Ecosystem.
    - Disturbance of RE 11.3.13 [*Grevillea striata* open woodland] resulting from the proposed development will reduce the remnant area of the RE from 31.5% to 30.6% of the pre-clear area. This is a relatively small reduction that will not significantly progress the remnant area of the RE towards the 10% threshold of an *endangered* Regional Ecosystem.
- No endangered Regional Ecosystems (VMA status) will be effected by the development
- Use of above ground installation methods such as trenching to install the pipeline in the coastal dune area at the easternmost extent of the pipeline could lead to significant water and/or wind erosion of the dune structure, and establishment of a weed pathway that would disturb adjacent vegetation.
- No rare or threatened flora are anticipated to be significantly effected by the proposal. This is because only very small areas of potential habitat for the species will be disturbed by the development, and extensive areas of similar habitat occur locally and regionally.
- None of the rare or threatened fauna species known or likely to occur in the study area are anticipated to be significantly effected by the proposal since:
    - for the majority of the species, potential habitat immediately adjacent to the main development area and proposed pipeline will not be effected; and,
    - in instances where potential habitat will be disturbed, only relatively small areas of habitat will be involved, and extensive areas of similar habitat occur locally and regionally.
- Within the main development area, impact on the Bare-rumped sheath-tail bat (*Saccolaimus saccolaimus*) (if present) may be significant, however, favoured roost trees are widely distributed in the surrounding local area and the viability of the regional population of the species is unlikely to be significantly effected.
- None of the EPBC listed fauna species known or likely to occur in the study area are anticipated to be significantly effected by the proposal since:
    - for the majority of the species, potential habitat immediately adjacent to the main development area and proposed pipeline will not be effected; and,

- in instances where potential habitat will be disturbed, only relatively small areas of habitat will be disturbed by the development, and extensive areas of similar habitat occur locally and regionally.

9.2 Areas of Ecological Significance

- An active nest of the osprey (*Pandion haliaetus*) was located in the north eastern corner of Lot 370 in a dead eucalypt adjacent to the Elliot River. Although not a significant species under legislation, the osprey is restricted to seashore habitats where it occurs in low densities, and may be susceptible to disturbance of nesting habitat.
- Two ecologically significant areas are traversed by the eastern section of the pipeline route.
    - The freshwater wetlands established on marine deposits (vegetation map unit 1d) provide extensive foraging habitat for migratory waders. These wetlands extend for some 7km to the north where they merge with tidal wetlands adjacent to the Cape Upstart National Park, and also link up with the mangrove habitats of the Elliot River 2.5 km to the south.
    - The band of habitat types occurring on the dune complex fringing Abbot Bay provide a diversity of habitat opportunities for fauna including shrubby woodland, *Melaleuca* wetland, grassy ephemeral wetland, and foredune vegetation. While these vegetation types are not uncommon in the study region, the tract traversed by the pipeline route extends for a considerable distance northwards to Cape Upstart with little disturbance, and is of considerable extent. This corridor of dunal habitats links the terrestrial habitats of Cape Upstart with the riparian vegetation of the Elliot River, and the small National Park patch located to the north of Lot 370. These habitats are of local significance.
- The main estuarine reach of the Elliot River is situated adjacent to, and downstream of the eastern boundary of the main development area and is regarded as a significant area supporting interactions with wading and fishing birds including migratory and rare species.

10. Recommendations for Mitigation of Impacts

A number of measures are recommended in order to mitigate the potential impacts of the Guthalungra Prawn Farm development on flora and fauna.

We recommend that:

- The easternmost section of the proposed pipeline that traverses the coastal dune system be installed using directional boring in order to:
    - minimise the disturbance to the ground surface;
    - minimise impacts on significant flora and fauna;
    - reduce the disturbance of the *of concern* Regional Ecosystem 11.2.2;
    - minimise the risk of providing a major weed pathway; and,

    - reduce the potential barrier effect of a wide disturbance corridor within an ecologically significant area.
- The pipeline is designed and constructed so that it does not interfere with the current surface hydrology regime, especially in the freshwater wetland areas which provide habitat for migratory waders.
- Sensitive construction methods and practices are utilised along the pipeline that reduce the disturbance to natural vegetation and the ground surface, and minimise the risks of contamination of freshwater and marine wetlands. In particular,
    - construction vehicles should be restricted to the pipeline corridor and vehicle movements across other areas (e.g. shortcuts) should be avoided;
    - the number of vehicle movements along the pipeline corridor should be minimised;
    - previously disturbed areas such as adjacent to the Cape Upstart Road should be used for stockpiles and vehicle and machinery parking if required; and
    - any maintenance or refuelling of machinery is to be undertaken away from the saltpan, freshwater wetland and dune areas.
- Appropriate measures are adopted during the construction and operational phases of the project to ensure that water quality and/or ecological processes in the Elliot River (and subsequently the fauna that utilises these habitats) is not affected by surface run-off and/or discharge of process water from the development.
- All natural fringing vegetation is retained adjacent to the Elliot River and along the small tributary located adjacent to the north east section of Lot 370.
- The small stand of native trees and shrubs that surrounds the osprey nest is retained in its entirety and visitation to this area is limited during the March-December breeding season.

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