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**Santos Ltd**

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**Ecological Survey  
of the Proposed Moon #1 to Kerna # 2A Flowline  
South West Queensland**

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**REFERENCES**

- 1. Vegetation Survey Report
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- Prepared by  
**Social and Ecological Assessment Pty Ltd**

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## 1. INTRODUCTION

Santos Ltd plans to link the Moon #1 gas well to Kerna # 2A via a 5.5 km buried pipeline. This report describes the ecology of the proposed route, identifies sensitive ecological features on or near the route and recommends measures that should be taken to mitigate potential ecological impacts during pipeline construction.

The pipeline survey was conducted on 13th June 2002.

## 2. OVERVIEW

The whole of the proposed Moon # 1 flowline traverses the Dunefield Land System. This system comprises red dunes 5-6 metres high with sandy-clay inter-dunes and occasional small claypans. The dunes are north-south trending. The proposed route follows an old seismic line for approximately 1km.

The dunes and sand plains are well vegetated with a diversity of shrubs and grasses. The vegetation is characterised by Lobed spinifex *Triodia basedowii* hummock grassland and Marpool *Acacia ligulata* and/or Narrow-leaved hopbush *Dodonaea viscosa ssp. angustissima* open shrubland. The inter-dune sandplains generally support Lobed spinifex and occasional Needlewood *Acacia leuoptera*. The western end of the route near Kerna traverses an extensive inter-dune claypan supporting occasional Coolibah *Eucalyptus coolabah* and Lignum *Muehlenbeckia florulenta*.

## 3. VEGETATION

The main vegetation types traversed by the proposed pipeline route are summarised in Table 1.

**Table 1: Vegetation types occurring along the proposed Moon #1 Flowline.**

Land system	Vegetation type	Dominant plant species
<i>Dunefield - dunes &amp; sandplains</i>	Lobed spinifex hummock grassland Marpool/Narrow-leaved hopbush open shrubland	Lobed spinifex <i>Triodia basedowii</i> Marpool or Sandhill wattle <i>Acacia ligulata</i> Narrow-leaved hopbush <i>Dodonaea viscosa ssp. angustissima</i> Dead finish <i>Acacia tetragonophylla</i> Emu bush <i>Eremophila longifolia</i> Honey suckle spider-flower <i>Grevillea juncifolia</i> Mulga <i>Acacia aneura</i> Needlewood <i>Hakea leuoptera</i> Sandhill spider-flower <i>Grevillea stenobotrya</i> Silver cassia <i>Senna artemisioides ssp. artemisioides</i> Whitewood <i>Atalaya hemiglauca</i>
-claypan	Lignum low open shrubland	Lignum <i>Muehlenbeckia florulenta</i> Coolibah <i>Eucalyptus coolabah</i>

The vegetation types traversed by the proposed pipeline are widespread at the local and regional scale, and their conservation status is listed as of "no concern at present" (Sattler and Williams 1999).

A total of 22 native plant species was recorded along the proposed route. A list of plant species recorded is presented in Appendix 3. None of these species are considered to have high conservation significance (Briggs & Leigh 1996). No introduced species were encountered.

Locally significant trees and shrubs occur at the following locations (Table 2).

**Table 2: Locations of significant small trees and shrubs.**

Ref.	Species	CP <sup>1</sup>	Location (Zone, Easting, Northing)		
V1	Dead finish	2	54	0500509	6877007
V2	3 Georgina gidgee	2	54	0500017	6876999
				0500024	6876988
				0500012	6876981
V3	Murray's wattle	2	54	0499557	6877026
V4	Whitewood	2	54	0499557	6877026
V5	Coolibah	1	54	0499035	6877074
V6	Coolibah	1	54	0498903	6877062
V7	Coolibah	1	54	0498796	6877068
V8	Coolibah	1	54	0498678	6877017

CP<sup>1</sup> = clearance priority (Santos 1997)

1 = do not clear

2 = avoid if possible

#### 4. HABITAT

None of the habitat traversed is of special conservation significance. The dunefield and sandplain, however, provide habitat for a diversity of fauna including lizards, snakes, small mammals and birds.

#### 5. SPECIES LISTED IN THE EPBC ACT, 1999

A list of flora and fauna identified in the Environment Protection and Biodiversity Conservation Act, 1999, and occurring in South West Queensland is given in Appendix 1(a). The species list was compiled using Badman (2000), LAMR (2000), Ford (2000) and SEA (2000). Species that may occur within the Dunefield Land System traversed by the proposed pipeline are shown in bold.

Assessment of the Project against the criteria within the EPBC Act, 1999 Guidelines is presented in Appendix 1(b). The assessment revealed that:

- no threatened (ie. endangered or vulnerable) ecological communities listed in the EPBC Act, 1999 occur in the area traversed by the pipeline; and
- threatened species that may occur in the Dunefield Land System are the Dusky Hopping Mouse and the Night Parrot.

## 6. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The pipeline route has been skillfully located to avoid areas of dense shrubs and trees. The impacts of the development will be reduced to some degree by the pipeline route following an old seismic line for approximately 1 km. The route finally deviates from the seismic line where the density of shrubs on the line becomes greater than the density on the adjacent terrain.

Potential impacts of the development and proposed mitigation measures are summarized in Table 3.

**Table 3: Summary of potential impacts and mitigation measures.**

Ref.	Potential impact	Proposed mitigation measure	Location (54)	
			Easting	Northing
V1	clearance of a Dead finish	leave on edge of R.O.W.	0500509	6877007
V2	clearance of 3 Georgina gidgee	narrow R.O.W. to 10m for 10-15m	0500017	6876999
			0500024	6876988
			0500012	6876981
V3	clearance of a Murray's wattle	leave on edge of R.O.W.	0499557	6877026
V4	clearance of a Whitewood	leave on edge of R.O.W.	0499557	6877026
V5	clearance of a Coolibah	leave on edge of R.O.W.	0499035	6877074
V6	clearance of a Coolibah	leave on edge of R.O.W.	0498903	6877062
V7	clearance of a Coolibah	leave on edge of R.O.W.	0498796	6877068
V8	clearance of 2 Coolibahs	narrow R.O.W. to 15m for 10m	0498678	6877017
F1	entrapment of small mammals, reptiles and emu chicks in open trench	<ul style="list-style-type: none"> <li>• leave trench open for as short a time as possible</li> <li>• leave escape ramps in trench as appropriate</li> <li>• check trench regularly and release trapped fauna</li> </ul>	at all locations along trench	

### 6.1 EPBC Act Species

Only two species listed in the EPBC Act, 1999 may occur in the Dunefield Land System traversed by the proposed development – the Dusky Hopping Mouse and the Night Parrot.

Since there is a vast amount of dunefield in the region, the temporary loss of some of this habitat during construction of the pipeline would in no way compromise the viability of populations of either species. The only possible impact upon either species may be Dusky Hopping Mice becoming entrapped in the open trench. Although the likelihood of this occurring is minimal, precautions will be taken to ensure that animals can escape from the trench (see Section 6.2).

The development will not:

- "lead to long-term decrease in the size of an important population of a vulnerable or endangered species;
- adversely affect habitat critical to the survival of a vulnerable or endangered species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; or
- result in invasive species that are harmful to a vulnerable or endangered species becoming established in the species' habitat".

## 6.2 Other Species

Clearance of the pipeline right-of-way will result in the loss of some dunefield vegetation, primarily Lobed spinifex and some shrubs. A few small Lignum may also be cleared near Kerna. The regional occurrence of the vegetation types that will be cleared is extensive and consequently the proposed development will have no affect on their conservation status. No locally significant trees or shrubs will be cleared.

Recovery of dunefield vegetation is generally rapid, although regrowth of Lobed spinifex and can be slow if root-stock is removed (SEA 1987). Consequently, care should be taken to ensure that spinifex is only skimmed off wherever possible, leaving some root-stock intact. Similarly, near Kerna care should be taken to skim off the few Lignum on the R.O.W.

The impact of the development on fauna through habitat loss will be negligible as the loss will comprise a minute proportion of the available habitat in the region, and the loss will be temporary. There is, however, potential for the death of small mammals, emu chicks and reptiles, which may be trapped in the open trench during pipeline construction. These impacts, however, will be minimised by keeping the trench open for as short a time as possible, including regular ramps in the trench to allow fauna to escape, and regularly inspecting the open trench for captive fauna and releasing captive fauna.

Disturbance to fauna by construction activities will be of short duration, and recovery is anticipated to be rapid once construction is complete.

## 7. CONCLUSIONS

The development will result in relatively minor impacts upon local ecological communities. The mitigation measures proposed in Table 3 will ensure that impacts are minimized and rehabilitation is rapid. These measures are to:

- avoid clearance of isolated trees on the R.O.W.; and
- minimise impacts upon fauna by leaving the trench open for as short a time as possible, leaving escape ramps in the trench, and regularly inspecting the trench for trapped fauna.

The proposed development will not result in:

- the clearance of any threatened (ie. rare or endangered) flora or threatened ecological communities; or
- adverse effects upon any species of flora or fauna or ecological communities listed as "of conservation significance" in the EPBC Act, 1999.

In conclusion, the development will have no discernable effect upon the diversity, abundance or distribution of flora or fauna inhabiting the region. Rehabilitation of the R.O.W. is likely to be rapid if the proposed mitigation measures are followed.

8. REFERENCES

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**Appendix 1(a): Flora and fauna species listed in the EPBC Act, 1999, and occurring in NE South Australia and/or SW Queensland (species in bold may occur within the land systems traversed by the proposed flowline).**

Common name	Scientific name	EPBC Act	CAMBA	JAMBA	CMS	Status	Habitat
<b>MAMMALS</b>							
Kowari	<i>Dasyercus byrnei</i>	V				Rare	mi, cl
Dusky Hopping-mouse	<i>Notomys fuscus</i>	V				Rare	d
Plains Mouse	<i>Pseudomys australis</i>	V				Rare	mi, cl, lw
Greater Bilby	<i>Macrotis lagotis</i>	V				?extinct	mi, gm
Greater Stick-nest Rat	<i>Leporillus conditor</i>	V				?extinct	gh
Ghost Bat	<i>Macroderma gigas</i>	V				?extinct	gh
<b>BIRDS</b>							
Northern Shoveler	<i>Anas clypeata</i>		x	x	x	vagrant	cw, lw
Great Egret <sup>1</sup>	<i>Egretta alba</i>		x	x		common, b	cw, lw
Cattle Egret	<i>Egretta ibis</i>		x	x		vagrant	cw, lw
Glossy Ibis <sup>2</sup>	<i>Plegadis falcinellus</i>		x		x	uncommon, b	cw, lw
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>		x			rare, b	cw
Plains-wanderer	<i>Pedionomus torquatus</i>	V				?rare	mi, cl
Latham's Snipe	<i>Gallinago lathamii</i>		x	x	x	rare, nb	lw
Pacific Golden Plover	<i>Pluvialis fulva</i>		x	x	x	rare, nb	cw, lw
Lesser Sand Plover	<i>Charadrius mongolus</i>		x	x	x	rare, nb	cw, lw
Oriental Plover	<i>Charadrius asiaticus</i>			x	x	rare, nb	cl
Oriental Pratincole	<i>Glareola maldivarum</i>		x	x		rare, nb	cl
Whimbrel	<i>Numenius phaeopus</i>		x	x	x	rare, nb	lw
Little Curlew	<i>Numenius minutus</i>		x	x	x	vagrant	lw
Black-tailed Godwit	<i>Limosa limosa</i>		x	x	x	rare, nb	cw, lw
Bar-tailed Godwit	<i>Limosa lapponica</i>		x	x	x	rare, nb	cw, lw
Marsh Sandpiper	<i>Tringa stagnatilis</i>		x	x	x	uncommon, nb	cw, lw
Common Greenshank	<i>Tringa nebularia</i>		x	x	x	uncommon, nb	cw, lw
Wood Sandpiper	<i>Tringa glareola</i>		x	x	x	uncommon, nb	cw, lw
Common Sandpiper	<i>Tringa hypoleucos</i>		x	x	x	rare, nb	cw, lw
Ruddy Turnstone	<i>Arenaria interpres</i>		x	x	x	rare, nb	cw, lw
Red-necked Stint	<i>Calidris ruficollis</i>		x	x	x	uncommon, nb	cw, lw
Long-toed Stint	<i>Calidris subminuta</i>		x	x	x	rare, nb	cw, lw
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>		x	x	x	uncommon, nb	cw, lw
Pectoral Sandpiper	<i>Calidris melanotos</i>			x	x	rare, nb	cw, lw
Curlew Sandpiper	<i>Callidris ferruginea</i>		x	x	x	rare, nb	cw, lw
Painted Snipe	<i>Rostratula benghalensis</i>		x			rare, ?b	cw, lw
White-winged Black Tern	<i>Chlidonias leucoptera</i>		x	x		rare, nb	cw, lw
Caspian Tern	<i>Hydropogone caspia</i>		x			uncommon	cw, lw
Fork-tailed Swift	<i>Apus pacificus</i>		x	x		uncommon, nb	aerial
Night Parrot	<i>Pezoporus occidentalis</i>	E				?extinct	d, mi, lw
Thick-billed Grasswren	<i>Amytornis textilis modestus</i>	V				?rare, ?b	gh
<b>PLANTS</b>							
Sea-heath	<i>Frankenia plicata</i>	E				?	cl

<b>EPBC Act:</b>	Schedules of Environment Protection and Biodiversity Conservation Act, 1999 E=Endangered; V=Vulnerable
<b>JAMBA:</b>	x=Listed in Japan – Australia Migratory Birds Agreement
<b>CAMBA:</b>	x=Listed in China – Australia Migratory Birds Agreement
<b>CMS:</b>	x=Listed in Convention on the Conservation of Migratory Species of wild animals (Bonn Convention).
<b>Status:</b>	Probable status of listed species within the subject land ?extinct = probably extinct; vagrant=odd individuals recorded well outside of normal range; rare=sparsely distributed; uncommon=present in small numbers; nb=non-breeding visitor from outside of Australia; common=present in reasonable numbers, b=likely to breed in area (birds only)
<b>Habitat:</b>	mi=mittell grass stony downs; gh=gidgee – mulga low woodland on dissected residuals; gm=gidgee mulga low open woodland on stony downs; cl=sparsely vegetated claypans; lw=lignum – Qld bluebush shrubland on floodplains; cw=coolabah woodlands on floodplain (includes waterholes); d=dunefields

<sup>1</sup> known to breed 30-40 km to the SE of Okotoko at the Wilson – Cooper junction (Roger Jaensch, Wetlands International, pers. comm.)

<sup>2</sup> recently observed 30-50 km south of Okotoko in the Cooper bend wetlands (Roger Jaensch, Wetlands International, pers. comm.)

**Appendix 1(b): Assessment of the Project against criteria from the EPBC Act, 1999 Guidelines.**

	CRITERIA	Yes	? <sup>1</sup>	No	COMMENTS
1.	<b>WETLANDS OF INTERNATIONAL IMPORTANCE</b>				
1.1	Does the development occur in or near a declared Ramsar wetland?			✓	The nearest Ramsar wetland is about 100 km to the northwest in SA.
1.2	Is the development likely to result in: areas of wetland being destroyed, or substantially modified; or			n.a. <sup>2</sup>	
1.3	a substantial and measurable change in the hydrological regime of the wetland eg. a substantial change in the volume, timing, duration and frequency of ground and surface water flows to and within the wetland; or			n.a.	
1.4	the habitat and or lifecycle of native species dependant upon the wetland being seriously affected; or			n.a.	
1.5	a substantial and measurable change in the physico-chemical status of the water – eg. a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity and ecological integrity, social amenity or human health; or			n.a.	
1.6	an invasive species that is harmful to the ecological character of the wetland becoming established in the wetland?			n.a.	
2.	<b>LISTED THREATENED SPECIES &amp; ECOLOGICAL COMMUNITIES</b>				
2.1	<b>EXTINCT IN THE WILD SPECIES</b>				
2.1.1	Is there a captive or propagated population, or one recently introduced/reintroduced to the wild, in the area of the development?			✓	The Eastern Pygmy Perch population is being reintroduced.
2.1.2	Is it likely that the development will: adversely affect such a population; or			n.a.	

CRITERIA		Yes	? <sup>1</sup>	No	COMMENTS
2.1.3	interfere with the recovery of the species or its reintroduction into the wild?			n.a.	
2.2	<b>CRITICALLY ENDANGERED AND ENDANGERED SPECIES</b>				
2.2.1	Are any critically endangered or endangered species likely to inhabit the area where the development will occur?	✓			The Night Parrot may occur in the dunefield habitat.
2.2.2	Is it likely that the development will: lead to long-term decrease in the size of a population; or			✓	
2.2.3	reduce the area of occupancy of the species;			✓	
2.2.4	fragment an existing population into two or more populations; or			✓	
2.2.5	adversely affect habitat critical to the survival of a species; or			✓	
2.2.6	disrupt the breeding cycle of a population; or			✓	
2.2.7	modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; or			✓	
2.2.8	result in invasive species that are harmful to a critically endangered or endangered species becoming established in the species habitat; or			✓	
2.2.9	interfere with the recovery of the species?			✓	
2.3	<b>VULNERABLE SPECIES</b>				
2.3.1	Are any vulnerable species likely to inhabit the area where the development will occur?	✓			The Dusky Hopping Mouse may occur in the dunefield habitat.
2.3.2	Is it likely that the development will: lead to a long-term decrease in the size of an important population of a species; or			✓	

CRITERIA		Yes	? <sup>1</sup>	No	COMMENTS
2.3.3	adversely affect habitat critical to the survival of a species; or			✓	
2.3.4	disrupt the breeding cycle of an important population; or			✓	
2.3.5	modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; or			✓	
2.3.6	result in invasive species that are harmful to a vulnerable species becoming established in the species' habitat; or			✓	
2.3.7	interfere substantially with the recovery of the species?			n.a.	
2.4	<b>CRITICALLY ENDANGERED AND ENDANGERED ECOLOGICAL COMMUNITIES</b>				
2.4.1	Are there any critically endangered or endangered ecological communities in the area where the development will occur?			✓	
2.4.2	Is it likely that the development will: lead to a long-term adverse affect on the ecological community; or			n.a.	
2.4.3	fragment an occurrence of the community; or			n.a.	
2.4.4	adversely affect habitat critical to the survival of the ecological community; or			n.a.	
2.4.5	modify or destroy abiotic (non-living) factors (such as water, nutrients, or soils) necessary for the community's survival; or			n.a.	
2.4.6	result in invasive species that are harmful to the critically endangered or endangered community becoming established in an occurrence of the community; or			n.a.	

CRITERIA		Yes	? <sup>1</sup>	No	COMMENTS
2.4.7	interfere with the recovery of the ecological community?			n.a.	
3.	<b>LISTED MIGRATORY SPECIES</b>				
3.1	Are any listed migratory species likely to inhabit the area where the development will occur?			✓	
3.2	Is it likely that the development will: substantially modify (including by fragmentation, altering fire regimes, altering breeding cycles, or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species; or			✓	
3.3	result in invasive species that are harmful to the migratory species becoming established in an area of important habitat of the migratory species; or			✓	
3.4	seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species?			✓	

<sup>1</sup> ? = assessment is uncertain

<sup>2</sup> n.a. = not applicable

**Appendix 2: Photographs of typical terrain traversed by the pipeline route.**



**Plate 1: Typical dunefield vegetation with dense Lobed spinifex on the dune flank.**



**Plate 2: The pipeline route follows an old seismic line for about 1 km.**

## Appendix 3: Plant species recorded along the proposed Moon #1 flowline.

Scientific name	Common name	Dune	Inter-dune
<i>Acacia aneura</i>	mulga		X
<i>Acacia georginae</i>	Georgina gidgee	X	
<i>Acacia ligulata</i>	marpoo, sandhill wattle	X	X
<i>Acacia murrayana</i>	Murray's wattle	X	
<i>Acacia tetragonophylla</i>	dead finish		X
<i>Aristida contorta</i>	mulga grass, curly wire-grass		X
<i>Aristida holathera</i> var. <i>holathera</i>	tall kerosene grass		X
<i>Atalaya hemiglauca</i>	whitewood	X	
<i>Atriplex vesicaria</i>	bladder saltbush		X
<i>Crotalaria cunninghamii</i>	parrot pea	X	
<i>Crotalaria eremaea</i>	blue-bush pea	X	
<i>Dodonaea viscosa</i> ssp. <i>angustissima</i>	narrow-leaf hop-bush	X	
<i>Enchylaena tomentosa</i>	ruby saltbush	X	
<i>Eremophila longifolia</i>	emu bush		X
<i>Grevillea juncifolia</i>	honeysuckle spider-flower		X
<i>Grevillea stenobotrya</i>	sandhill spider-flower	X	
<i>Hakea leucoptera</i> ssp. <i>leucoptera</i>	needle bush		X
<i>Muehlenbeckia florulenta</i>	lignum		X
<i>Rhagodia spinescens</i>	spiny saltbush		X
<i>Scaevola depauperata</i>	skeleton fan-flower	X	
<i>Senna artemisioides</i> nothosp. <i>artemisioides</i>	silver senna		X
<i>Triodia basedowii</i>	lobed spinifex	X	X