AECOM Australia Pty Ltd
Level 8
540 Wickham Street
PO Box 1307
Fortitude Valley QLD 4006
Australia
www.aecom.com

+61 7 3553 2000 tel
+61 7 3553 2050 fax
ABN 20 093 846 925

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Greg Lee-Manwar
Arrow Energy Pty Ltd
GPO Box 5262
Brisbane QLD 4001

Dear Greg

Watercourse Crossing Information for Arrow Bowen Pipeline

AECOM Australia Pty Ltd (AECOM) was engaged by Arrow Energy Pty Ltd (Arrow) to conduct a flora and watercourse assessment for the proposed Arrow Bowen Pipeline (ABP), running from gas fields in the Moranbah region to the coast at Gladstone. The ABP is approximately 600 km in length, and includes several lateral and header sections. This letter report provides ecological information for water crossings along the proposed Revision D pipeline route.

Yours faithfully

Con Lokkers
Principal Professional Scientist
con.lokkers@aecom.com
Direct Fax: +(07) 3553 2050
Mobile: 0409 668 711
Direct Dial: +(07) 3553 3466

Martha Rees
Environmental Scientist
Martha.Rees@aecom.com
Direct Dial: +07 3553 4153

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1.0 Watercourse Information

This letter report describes major water crossings for the proposed ABP Revision D route that were inspected by AECOM during two surveys conducted 15 June to 4 July and 30 August to 10 September 2011. Water crossings for the main line are presented in **Table 1** and lateral and header crossings are presented in **Table 2**. The location of each watercourse is provided as a Kilometre Point (KP), which is the distance in kilometres from the upstream (northern / western) end of the pipeline. The following abbreviations are used for KPs to differentiate the mainline and laterals: Arrow Bowen Pipeline mainline (AB), Elphinstone Lateral (EL), Saraji Lateral (SL) and Dysart Lateral (DL).

Provided mitigation measures are put in place, most watercourses assessed in this report can be crossed using conventional open cut techniques without significant impacts on ecological values. At some crossings, an alternative nearby crossing point could be identified that reduced potential impacts (e.g. existing clearing, less steep banks, smaller channel, less permanent water, fewer large trees). In these instances, the crossing table provides details of the original crossing point and a proposed alternative crossing point. There are also some sites that are presented with more than one alternative crossing point.

Fitzroy River (AB 319.5) is a large watercourse which had a 50 m wide flowing channel in June 2011. While it is feasible to use open cut methods at the proposed crossing, Horizontal Directional Drilling (HDD) is recommended to minimise ecological impacts during construction and reduce rehabilitation requirements. Other significant crossings for which alternative techniques may be considered include crossings of the Isaac River (AB 234.4) and Raglan Creek (AB 446.6).

Several watercourse crossing sites contained black ironbox (*Eucalyptus raveretiana*), which is listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) and the Queensland *Nature Conservation Act* 1992 (NC Act). At the majority of these watercourses, including Two Mile Creek (AB 349.3), Louisa Creek (AB 358.3), Deep Creek (AB 373.4) and Lion Creek (AB 382.7), black ironbox can be avoided by utilising existing gaps at an alternative nearby crossing point. At Limestone Creek (AB 371.3), three alternative crossings (with gaps of 20 m or more) were identified at various distances to the south east of the original crossing point. The closest alternate (about 20 m south east) contained large blue gums, while the other alternates (about 450 and 550 m south east) had less mature vegetation with lower habitat values.

Marine vegetation was recorded at Inkerman Creek (AB 430.1) and Raglan Creek (AB 446.6). Further investigations may be considered to locate alternative upstream crossings without marine vegetation.

Waterholes were present at numerous watercourse crossings. Waterholes at Endrick Creek (AB 285.4), Black Gin Creek (AB 377.6), Larcom Creek (AB 476.2) and the Isaac River (SL 19.0), and wetlands on the Saraji lateral (SL 7.8, SL 11.1) are likely to be permanent or semi-permanent, based on the presence of aquatic flora and fauna and / or landholder knowledge. Alternative crossing points have been nominated for these watercourses.

Weeds are prevalent on many watercourse crossings. A weed management plan should be developed to address hygiene, control and monitoring of weed infestations along the pipeline route.

Evidence of erosion was observed at numerous watercourse crossings. A sediment and erosion control plan should be developed to minimise erosion and sediment loss during construction and promote rapid effective rehabilitation of watercourse crossings. Whenever possible, construction should be undertaken during the dry season. Streambank and gully erosion were particularly severe at the crossings of Eaglefield Creek (AB 28.3) and Carborough Creek (EL 28.3). Investigations into alternative crossing locations may be considered for these watercourses.

Table 1 **Descriptions of water crossings along the proposed main alignment (Note: Upstream/ downstream refers to direction of gas flow)**

Water course	Stream Order	KP (Rev D)	Crossing Method	Salinity	Seasonality	Stream Flow	Water Condition	In-stream Habitat	Bed Width (m)	EVNT*	Aquatic Vegetation	Aquatic Fauna / Habitat	Bank Type	Bank Slope	Bank Height (m)	Riparian Vegetation	Constraints / Why Alternate Preferred
Suttor Creek	5	12.3	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point. Avoid large trees bearing hollows and stags where possible.
				Fresh	Perennial / Seasonal	Pool	Clear	Shallows, Deep open water, Snags, Standing dead timber	25	Wetland Management Area			Earth	Gentle	2	11.3.25	
													Downstream bank				
													Earth	Gentle	2	11.3.25	
Eaglefield Creek	2	28.3	Open cut	**Original Crossing Point**									**Upstream bank**				Not a suitable crossing point due to steep eroding stream banks.
				Fresh	Intermittent	Dry			30		Emergent Woody, Fringing Woody		Sandy/ Rocky	Steep	12	11.9.9	
													Downstream bank				
													Sandy/ Rocky	Steep	12	11.9.9	
				Alternate Crossing Point									**Upstream bank**				Move line approximately 400 m west to a more suitable crossing point. Geotechnical investigations recommended.
				Fresh	Intermittent	Dry			50				Sandy/ Rocky	Moderate/ Gentle	12	11.9.9	
													Downstream bank				
													Sandy/ Rocky	Moderate/ Gentle	12	11.9.9	
Isaac River	5	50.2	Open cut	**Original Crossing Point**									**Upstream bank**				Large remnant *E. tereticornis* located to north-west.
				Fresh	Intermittent	Pool	Clear	Shallows, Snags, Standing dead timber	25	Wetland Management Area			Earth, Sandy	Gentle	3	11.3.25	
													Downstream bank				
													Earth, Sandy	Moderate	4	11.3.25	
				Alternate Crossing Point									**Upstream bank**				Move approximately 50 m east to avoid large remnant trees.
				Fresh	Intermittent	Pool	Clear	Shallows, Snags, Standing dead timber	25	Wetland Management Area			Earth, Sandy	Gentle	3	11.3.25	
													Downstream bank				
													Earth, Sandy	Moderate	4	11.3.25	
Twelve Mile Gully	3	59.1	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point.
				Fresh	Intermittent	Dry			5	Wetland			Sandy	Steep	1.5	11.3.25	

Water course	Stream Order	KP (Rev D)	Crossing Method	Salinity	Seasonality	Stream Flow	Water Condition	In-stream Habitat	Bed Width (m)	EVNT*	Aquatic Vegetation	Aquatic Fauna / Habitat	Bank Type	Bank Slope	Bank Height (m)	Riparian Vegetation	Constraints / Why Alternate Preferred
										Management Area			**Downstream bank**				
													Earth, Sandy	Steep	1.5	11.3.25	
Hat Creek	4	68.2	Open cut	**Original Crossing Point**									**Upstream bank**				Steep eroded cliff on southern bank.
				Fresh	Intermittent	Pool	Clear	Shallows, Snags, Rocks	10				Earth/ Sandy	Gentle	3	11.3.25	
													Downstream bank				
													Earth	Cliff	8	11.5.3	
				Alternate Crossing Point (1)									**Upstream bank**				Move to old road crossing, 50 m west of alignment. 20 m gap in vegetation.
				Fresh	Intermittent	Pool	Clear	Shallows, Snags, Rocks	10				Earth/ Sandy	Gentle	4	11.3.25	
													Downstream bank				
													Earth	Gentle	4	11.5.3	
				Alternate Crossing Point (2)									**Upstream bank**				Alternate crossing 50 m to east of alignment. Possibly too close to haul road.
				Fresh	Intermittent	Pool	Clear	Shallows, Snags, Rocks	10				Sandy	Steep	4	Non-remnant	
													Downstream bank				
													Earth	Gentle	4	Non-remnant	
North Creek	4	105.2	Open cut	**Original Crossing Point**									**Upstream bank**				Large habitat trees.
				Fresh	Seasonal	Pool	Turbid	Shallows, Deep Open Water, Snags	7				Earth	Moderate	10	11.3.25	
													Downstream bank				
													Earth	Moderate	10	11.3.25	
				Alternate Crossing Point									**Upstream bank**				Move line 25 m east into existing gap.
				Fresh	Seasonal	Pool	Turbid	Shallows, Deep Open Water, Snags	7				Earth	Moderate	10	11.3.25	
													Downstream bank				
													Earth	Moderate	10	11.3.25	
North Creek (south crossing)	4	109.3	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point.
				Fresh	Seasonal	Run, Riffle	Clear	Shallows	12				Sandy	Moderate	4	11.3.25	
													Downstream bank				
													Sandy	Moderate	4	11.3.25	

Water course	Stream Order	KP (Rev D)	Crossing Method	Salinity	Seasonality	Stream Flow	Water Condition	In-stream Habitat	Bed Width (m)	EVNT*	Aquatic Vegetation	Aquatic Fauna / Habitat	Bank Type	Bank Slope	Bank Height (m)	Riparian Vegetation	Constraints / Why Alternate Preferred
North Creek Tributary	2	110.0	Open cut	**Original Crossing Point**									**Upstream bank**				Two channels approximately 15-20 m apart. Suitable crossing point. Avoid large trees where possible and utilise existing clearing / thin vegetation.
				Fresh	Intermittent	Dry			5				Earth	Steep	4	11.3.3	
													Downstream bank				
													Earth	Steep	4	11.3.3	
Isaac River Tributary	2	160.1	Open cut	**Original Crossing Point**									**Upstream bank**				Riparian vegetation. Large blue gums.
				Fresh	Intermittent	Dry			5		Emergent Woody		Earth	Gentle	0.5	11.3.25/ 11.3.4	
													Downstream bank				
													Earth	Gentle	0.5	11.3.25/ 11.3.4	
				Alternate Crossing Point									**Upstream bank**				Move line approximately 200 m west to avoid remnant vegetation.
				Fresh	Intermittent	Dry			5		Emergent Woody		Earth	Gentle	0.5	Non-remnant	
													Downstream bank				
													Earth	Gentle	0.5	Non-remnant	
Isaac River	6	164.7	Open cut	**Original Crossing Point**									**Upstream bank**				Large remnant trees.
				Fresh	Seasonal	Run	Clear	Shallows	30				Earth	Moderate	8	11.3.25	
													Downstream bank				
													Earth	Moderate	8	11.3.25	
				Alternate Crossing Point (1)									**Upstream bank**				Move line 40m east into existing clearing to avoid remnant trees.
				Fresh	Seasonal	Run	Clear	Shallows	30				Earth	Moderate	8	11.3.25	
													Downstream bank				
													Earth	Moderate	8	11.3.25	
				Alternate Crossing Point (2)									**Upstream bank**				Potential crossing point approximately 2.8 km north-east.
				Fresh	Seasonal	Run	Turbid	Shallows, Snags	50		Fringing Woody		Earth	Steep	6	11.3.25	
													Downstream bank				
													Earth	Steep	6	11.3.25	
				Alternate Crossing Point (3a)									**Upstream bank**				Potential crossing point at Fitzroy Development Road. Involves moving alignment 5.5 km to the north-east. Avoid large trees where possible.
				Fresh	Seasonal	Run	Turbid	Shallows, Deep Open Water, Snags	20				Earth	Steep	8	11.3.25	
													Downstream bank				
													Earth	Steep	8	11.3.25	

Water course	Stream Order	KP (Rev D)	Crossing Method	Salinity	Seasonality	Stream Flow	Water Condition	In-stream Habitat	Bed Width (m)	EVNT*	Aquatic Vegetation	Aquatic Fauna / Habitat	Bank Type	Bank Slope	Bank Height (m)	Riparian Vegetation	Constraints / Why Alternate Preferred
				Alternate Crossing Point (3b - braid)									**Upstream bank**				Potential crossing point (Isaac River Braid) at Fitzroy Development Road. Involves moving alignment 5.5 km to the north-east. Avoid large trees where possible.
				Fresh	Seasonal	Pool	Turbid	Snags	10		Emergent Woody		Sandy	Moderate	4	11.3.25d	
													Downstream bank				
													Sandy	Moderate	4	11.3.25d	
				Alternate Crossing Point (4a)									**Upstream bank**				Potential crossing point, east of the Fitzroy Development Road. Involves moving alignment 6.5 km to the north-east. Avoid large trees where possible.
				Fresh	Seasonal	Run	Turbid	Shallows, Deep Open Water, Snags	20				Earth	Steep	8	11.3.25	
													Downstream bank				
													Earth	Steep	8	11.3.25	
				Alternate Crossing Point (4b - braid)									**Upstream bank**				Potential crossing point (Isaac River Braid). Involves moving alignment 6.5 km to the north-east. Avoid large trees where possible.
				Fresh	Seasonal	Pool	Turbid	Island, Shallows, Deep Open Water, Snags, Standing Dead Timber	15		Emergent Woody		Sandy	Moderate	4	11.3.25d	
													Downstream bank				
													Sandy	Steep	4	11.3.25d	
Blackburn Creek	6	171.7	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point, within existing clearing. Ensure line is well north of EVNT.
				Fresh	Intermittent	Pool	Clear, Algae	Snags, Shallows	20	*Eucalyptus raveretiana* to south-east; Wetland Management Area			Earth	Steep	10	11.3.2	
													Downstream bank				
													Earth	Gentle	10	11.3.2	
Sandy Gully	2	197.8	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point.
				Fresh	Seasonal	Dry			12				Sandy	Gentle	0.2	HVR	
													Downstream bank				
													Sandy	Gentle	0.2	HVR	
Isaac River	8	North of 234 (on Rev C line)	Open cut or HDD	**REV C Original Crossing Point (REV D Crossing Point Not Surveyed)**									**Upstream bank**				Large remnant trees. Gully heading north-west.
				Fresh	Seasonal	Pool, Run	Clear	Islands, Shallows, Snags, Rocks	50	Wetland Management Area			Earth	Moderate	6.5	11.3.25	
													Downstream bank				
													Earth	Moderate	6.5	11.3.25	

Water course	Stream Order	KP (Rev D)	Crossing Method	Salinity	Seasonality	Stream Flow	Water Condition	In-stream Habitat	Bed Width (m)	EVNT*	Aquatic Vegetation	Aquatic Fauna / Habitat	Bank Type	Bank Slope	Bank Height (m)	Riparian Vegetation	Constraints / Why Alternate Preferred
				REV C Alternate Crossing Point (REV D Crossing Point Not Surveyed)									**Upstream bank**				Move 50 m south-east to avoid gully and large trees.
				Fresh	Seasonal	Pool, Run	Clear	Islands, Shallows, Snags, Rocks	50	Wetland Management Area			Earth	Moderate	6.5	11.3.25	
													Downstream bank				
													Earth	Moderate	6.5	11.3.25	
Clarke Creek	7	238.5	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point.
				Fresh	Intermittent	Dry, Pool	Clear	Island, Shallows, Snags	8		Fringing Woody		Earth	Gentle	6	11.3.3	
													Downstream bank				
													Earth	Gentle	6	11.3.3	
Bora Creek	4	245.1	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point. Avoid large remnant trees and stags.
				Fresh	Intermittent	Pool, Dry	Clear	Shallows, Snags, Standing dead timber	8	Wetland Management Area		Freshwater mussels	Earth	Steep	8	11.3.25	
													Downstream bank				
													Earth	Moderate	8	11.3.25	
Clive Creek	4	249	Open cut	**Original Crossing Point**									**Upstream bank**				Good crossing point as few large trees. Degraded creek, very weedy, dieback.
				Fresh	Seasonal	Pool	Clear	Shallows, Snags, Rocks	8	Wetland Management Area			Earth, Sandy	Cliff	9	11.3.25	
													Downstream bank				
													Earth, Sandy	Steep	9	11.3.25	
Mackenzie River Tributary	2	261.5	Open cut	**Original Crossing Point**									**Upstream bank**				Riparian vegetation, including vine thicket species.
				Fresh	Intermittent	Dry, Pool	Clear	Shallows, Snags, Rocks	5		Emergent Woody		Earth	Gentle	2	11.3.25	
													Downstream bank				
													Earth	Steep	3	11.3.25	
				Alternate Crossing Point									**Upstream bank**				Move line approximately 150 km north-east to a thinner band of vegetation.
				Fresh	Intermittent	Dry, Pool	Clear	Shallows, Snags, Rocks	5		Emergent Woody		Earth	Moderate	2	11.3.25	
													Downstream bank				
													Earth	Moderate	2	11.3.25	
Pluto Creek	3	275.6	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point.
				Fresh	Seasonal	Pool	Algae	Shallows	8			Fish	Earth			11.3.25	
													Downstream bank				
													Earth			11.3.25	

Water course	Stream Order	KP (Rev D)	Crossing Method	Salinity	Seasonality	Stream Flow	Water Condition	In-stream Habitat	Bed Width (m)	EVNT*	Aquatic Vegetation	Aquatic Fauna / Habitat	Bank Type	Bank Slope	Bank Height (m)	Riparian Vegetation	Constraints / Why Alternate Preferred
Apis Creek	5	284.2	Open cut	**Original Crossing Point**									**Upstream bank**				Good crossing point. Degraded creek, abundant weeds, evidence of flooding and erosion.
				Fresh	Seasonal	Pool	Clear	Shallows, Snags	10			Fish	Earth	Steep	5	11.3.3	
													Downstream bank				
													Earth	Gentle	6	Non-remnant	
Endrick Creek	4	285.4	Open cut	**Original Crossing Point**									**Upstream bank**				Natural waterhole.
				Fresh	Perennial	Pool	Clear	Deep open water, Snags	8		Submerged	Spangled perch	Earth	Moderate	3	11.3.25	
													Downstream bank				
													Earth	Steep	3	11.3.25	
				Alternate Crossing Point									**Upstream bank**				Move 90 m north to avoid natural waterhole.
				Fresh	Seasonal	Pool	Clear	Shallows	6				Earth	Steep	4	11.3.25	
													Downstream bank				
													Earth	Steep	3	11.3.25	
Endrick Creek Tributary (west)	3	286.4	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point.
				Fresh	Seasonal	Run	Clear, Algae	Shallows, Rocks	3		Emergent Woody		Earth, Rocky	Gentle	2	11.3.25	
													Downstream bank				
													Earth, Rocky	Gentle	2	11.3.25	
Endrick Creek Tributary (east)	3	289.1	Open cut	**Original Crossing Point**									**Upstream bank**				Remnant vegetation.
				Fresh	Intermittent	Run	Clear	Shallows, Snags, Standing dead timber	6				Earth	Steep	3	11.3.25	
													Downstream bank				
													Earth	Steep	4	11.3.25	
				Alternate Crossing Point									**Upstream bank**				Move 200 m west into clearing to avoid remnant vegetation.
				Fresh	Intermittent	Run	Clear	Shallows, Snags, Standing dead timber	6				Earth	Gentle	3	Non-remnant	
													Downstream bank				
													Earth	Gentle	3	Non-remnant	
Develin Creek	4	303.1	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point. Avoid vine thicket to south and pool to north.
				Fresh	Intermittent	Riffle	Clear	Shallows, Snags, Rocks	10				Earth	Steep	6	11.3.25	
													Downstream bank				
													Earth	Steep	9	11.3.25	

Water course	Stream Order	KP (Rev D)	Crossing Method	Salinity	Seasonality	Stream Flow	Water Condition	In-stream Habitat	Bed Width (m)	EVNT*	Aquatic Vegetation	Aquatic Fauna / Habitat	Bank Type	Bank Slope	Bank Height (m)	Riparian Vegetation	Constraints / Why Alternate Preferred
Fitzroy River	9	319.5	HDD	**Original Crossing Point**									**Upstream bank**				Suitable crossing point. Evidence of major flooding.
				Fresh	Perennial	Run	Turbid	Deep open water, Snags, Standing dead timber	100			Wood ducks	Sandy	Moderate	10	11.3.25	
													Downstream bank				
													Sandy	Moderate	20	HVR	
Ten Mile Creek	3	332.2	Open cut	**Original Crossing Point**									**Upstream bank**				High value regrowth (HVR) of endangered vegetation community.
				Fresh	Seasonal	Pool	Clear	Deep open water, Snags	10				Earth	Moderate	4	HVR 11.3.1	
													Downstream bank				
													Earth	Moderate	4	HVR 11.3.1	
				Alternate Crossing Point									**Upstream bank**				Move 200 m south-east to existing clearing to avoid HVR.
				Fresh	Seasonal	Pool	Clear	Deep open water, Snags	10		Floating		Earth	Steep	4	Non-remnant (cleared)	
													Downstream bank				
													Earth	Steep	4	Non-remnant (cleared)	
Eight Mile Creek Tributary	2	336.2	Open cut	**Original Crossing Point**									**Upstream bank**				Riparian vegetation, cell grazing paddock.
				Fresh	Intermittent	Pool	Turbid	Shallows, Snags	4		Emergent Woody		Earth	Steep	1	HVR	
													Downstream bank				
													Earth	Steep	1	HVR	
				Alternate Crossing Point									**Upstream bank**				Move line approximately 300 m north where there is less vegetation and to avoid cell grazing paddock.
				Fresh	Intermittent	Pool	Turbid	Shallows, Snags	4		Emergent Woody		Earth	Steep	1	Non-remnant	
													Downstream bank				
													Earth	Steep	1	Non-remnant	
Two Mile Creek	4	349.3	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point, but use existing 40 m gap to avoid EVNT.
				Fresh	Intermittent	Pool	Clear	Islands, Deep open water, Snags, Standing dead timber	4	Eucalyptus raveretiana; Wetland Management Area			Earth	Gentle	3	11.3.25	
													Downstream bank				
													Earth	Steep	5	11.3.25	
Louisa Creek	4	358.3	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point 20 m to east which avoids large *E. tereticornis* with hollows. Creek degraded, weedy and evidence of erosion and flooding. Avoid large trees.
				Fresh	Permanent	Pool	Clear	Deep open water, Standing dead timber	30	Wetland Management Area	Emergent Non-woody		Earth	Steep	5	Non-remnant (cleared)	
													Downstream bank				
													Earth	Steep	5	Non-remnant	

Water course	Stream Order	KP (Rev D)	Crossing Method	Salinity	Seasonality	Stream Flow	Water Condition	In-stream Habitat	Bed Width (m)	EVNT*	Aquatic Vegetation	Aquatic Fauna / Habitat	Bank Type	Bank Slope	Bank Height (m)	Riparian Vegetation	Constraints / Why Alternate Preferred
																(cleared)	
Limestone Creek (Original crossing not described as on Rev C line)	5	371.3	Open cut	**Alternate Crossing Point (1)**									**Upstream bank**				Potential crossing point 20 m to south-west. 20 m gap between *Euc. raveretiana* trees. Large blue gums present.
				Fresh	Seasonal	Run, Rifle	Turbid	Island, Shallows, Snags, Rocks	15	*Eucalyptus raveretiana*			Earth	Moderate	6	11.3.25	
													Downstream bank				
													Earth	Moderate	6	11.3.25	
				Alternate Crossing Point (2)									**Upstream bank**				Potential crossing point 450 m south-west into a 25 m gap.
				Fresh	Seasonal	Run, Rifle	Turbid	Island, Shallows, Snags, Rocks	15	*Eucalyptus raveretiana*			Earth	Moderate	6	11.3.25	
													Downstream bank				
													Earth	Steep	6	11.3.25	
				Alternate Crossing Point (3)									**Upstream bank**				Potential crossing point 550 m south-west to a 20 m gap. This option would avoid low-lying country with seeps.
				Fresh	Seasonal	Run, Rifle	Turbid	Island, Shallows, Snags, Rocks	15	*Eucalyptus raveretiana*			Earth	Moderate	6	11.3.25	
													Downstream bank				
													Earth	Moderate	6	11.3.25	
Deep Creek	3	373.4	Open cut	**Original Crossing Point**									**Upstream bank**				EVNT.
				Fresh	Intermittent	Run	Clear	Islands, Shallows, Snags, Rocks, Standing dead timber	5	*Eucalyptus raveretiana*			Earth	Steep	3.5	11.3.25	
													Downstream bank				
													Earth	Moderate	2.5	11.3.25	
				Alternate Crossing Point									**Upstream bank**				Move 50 m east into 18 m existing clearing to avoid EVNT.
				Fresh	Intermittent	Run	Clear	Shallows, Snags	5	*Eucalyptus raveretiana*			Earth	Moderate	3	11.3.25	
													Downstream bank				
													Earth	Steep	4	11.3.25	
Black Gin Creek	3	377.6	Open cut	**Original Crossing Point**									**Upstream bank**				Natural waterhole.
				Fresh	Seasonal	Pool	Algae	Deep open water, Snags	10				Earth	Steep	6	11.3.25	
													Downstream bank				
													Earth	Moderate	6	11.3.25	
				Alternate Crossing Point									**Upstream bank**				Move 150 m east (downstream) to avoid natural waterhole.
				Fresh	Seasonal	Riffle	Clear	Islands, Shallows, Snags, Rocks	10				Earth	Steep	6	HVR (11.3.25)	
													Downstream bank				
													Earth	Steep	6	HVR (11.3.25)	

Water course	Stream Order	KP (Rev D)	Crossing Method	Salinity	Seasonality	Stream Flow	Water Condition	In-stream Habitat	Bed Width (m)	EVNT*	Aquatic Vegetation	Aquatic Fauna / Habitat	Bank Type	Bank Slope	Bank Height (m)	Riparian Vegetation	Constraints / Why Alternate Preferred
Lion Creek	4	382.7	Open cut	**Original Crossing Point**									**Upstream bank**				EVNT.
				Fresh	Intermittent	Pool	Algae	Islands, Shallows, Standing dead timber	8	Eucalyptus raveretiana; Wetland Management Area			Earth	Steep	8	11.3.25	
													Downstream bank				
													Earth	Moderate	6	11.3.25	
				Alternate Crossing Point									**Upstream bank**				Move 80 m north-east into existing 12 m clearing to avoid EVNT.
				Fresh	Intermittent	Dry			8	Eucalyptus raveretiana; Wetland Management Area			Earth	Steep	4	11.3.25	
													Downstream bank				
													Earth	Steep	6	11.3.25	
Scrubby Creek	5	391.3	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point.
				Fresh	Perennial	Pool	Clear	Deep open water, Snags	20				Earth	Steep	6	Non-remnant	
													Downstream bank				
													Earth	Steep	4	Non-remnant	
Teatree Creek Tributary	1	399.1	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point.
				Fresh	Intermittent	Run	Clear	Shallows, Snags, Standing dead timber	4				Earth	Gentle	0.5	11.3.25d	
													Downstream bank				
													Earth	Gentle	0.5	11.3.25d	
Four Mile Creek	4	402.7	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point.
				Fresh	Intermittent	Run	Pool	Shallows, Snags, Rocks	2-6				Earth, Rocky	Moderate	0.5	11.3.25	
													Downstream bank				
													Earth, Rocky	Moderate	0.5	11.3.25	
Gavial Creek	3	406.3	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point. Avoid large remnant trees where possible.
				Fresh	Intermittent	Pool, Run, Riffle, Cascade	Clear	Shallows, Snags, Rocks	5				Earth	Moderate	4	11.3.25	
													Downstream bank				
													Earth	Moderate	4	11.3.25	
Midgee Creek	2	410.4	Open cut	**Original Crossing Point**									**Upstream bank**				Large habitat trees and native vegetation.
				Fresh	Perennial	Pool	Turbid, Clear	Shallows, Deep Open Water, Snags, Rocks	7		Submerged, Emergent Woody, Emergent		Earth	Gentle	0.5	HVR	
													Downstream bank				
													Earth	Gentle	0.5	HVR	

Water course	Stream Order	KP (Rev D)	Crossing Method	Salinity	Seasonality	Stream Flow	Water Condition	In-stream Habitat	Bed Width (m)	EVNT*	Aquatic Vegetation	Aquatic Fauna / Habitat	Bank Type	Bank Slope	Bank Height (m)	Riparian Vegetation	Constraints / Why Alternate Preferred
											Non-woody						
				Alternate Crossing Point (limited survey due to access restrictions)									**Upstream bank**				Potential crossing point 800 m south-west adjacent to existing cleared gas pipeline alignment. Suggested by landholder. Further survey required.
																HVR	
													Downstream bank				
																HVR	
Bob's Creek	4	413.6	Open cut										**Upstream bank**				Suitable crossing point. Avoid large remnant trees where possible.
				Fresh	Intermittent	Pool, Run, Cascade	Clear	Shallows, Rocks, Standing dead timber	7		Submerged		Earth	Steep	8	11.3.25	
													Downstream bank				
													Earth	Moderate	8	11.3.25	
Oakey Creek	4	419.7	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point.
				Fresh	Intermittent	Run, Riffle	Clear, Algae	Shallows	3		Submerged	Rainbow Fish and Spangled Perch	Earth	Moderate	4	11.3.25	
													Downstream bank				
													Earth	Moderate	3	11.3.25	
Inkerman Creek	5	430.1	Open cut	**Original Crossing Point**									**Upstream bank**				Tidal, mangroves. Possibly avoid marine vegetation by moving alignment 2.5 km to west, but requires further survey.
				Saline	Perennial	Run	Turbid	Mud flats, Shallows, Snags, Rocks, Standing dead timber	20	Wetland Management Area	Emergent Woody, Emergent Non-woody	Some fish (mullet?), waterbirds, oysters, crab holes, mudskippers	Earth	Gentle	3	11.1.4	
													Downstream bank				
													Earth	Steep	3	11.1.4	
Twelve Mile Creek	4	438.8	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point, but deep open water present.
				Fresh	Perennial / Seasonal	Pool	Clear	Deep open water, Shallows	15		Floating, Submerged, Emergent Non-woody	Fish	Earth	Gentle	1.5	HVR-OC	
													Downstream bank				
													Earth	Gentle	0.5	HVR-OC	
Horrigan Creek	4	445.5	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point, although ensure line crosses at right angle. Evidence of erosion and flooding.
				Fresh	Perennial / Seasonal	Pool	Clear, Algae	Shallows	20-25		Floating, Emergent Woody, Emergent Non-woody	Fish	Earth	Gentle	0.5	HVR	
													Downstream bank				
													Earth	Gentle	0.5	HVR	

Water course	Stream Order	KP (Rev D)	Crossing Method	Salinity	Seasonality	Stream Flow	Water Condition	In-stream Habitat	Bed Width (m)	EVNT*	Aquatic Vegetation	Aquatic Fauna / Habitat	Bank Type	Bank Slope	Bank Height (m)	Riparian Vegetation	Constraints / Why Alternate Preferred
Raglan Creek	6	446.6	Open cut or HDD	**Original Crossing Point**									**Upstream bank**				Mangroves east of creek. Saltwater couch / saltmarsh to west of creek.
				Brackish	Perennial	Run	Turbid		35-75	Wetland Management Area	Emergent Woody		Earth	Gentle	1.5	HVR	
													Downstream bank				
													Earth	Gentle	0.5	11.1.4	
				Alternate Crossing Point (1)									**Upstream bank**				Potential crossing point 40 m north into existing clearing. Further studies are required to minimise impacts to WMA.
				Brackish	Perennial	Run	Turbid		35-75	Wetland Management Area	Emergent Woody		Earth	Gentle	1.5	Non-remnant (cleared)	
													Downstream bank				
													Earth	Gentle	0.5	11.1.4	
				Alternate Crossing Point (2)									**Upstream bank**				Potential crossing point 250 m south to reduce area of marine vegetation along line. Further studies are required to minimise impacts to WMA.
				Brackish	Perennial	Run	Turbid		35-75	Wetland Management Area	Emergent Woody		Earth	Gentle	1.5	Non-remnant (cleared)	
													Downstream bank				
													Earth	Gentle	0.5	11.1.4	
Larcom Creek	3	476.2	Open cut	**Original Crossing Point**									**Upstream bank**				Large permanent waterhole.
				Fresh	Perennial	Pool	Clear	Shallows, Deep Open Water, Snags	30		Floating, Emergent Woody, Emergent Non-woody		Earth	Moderate	5	HVR	
													Downstream bank				
													Earth	Gentle	4	HVR	
				Alternate Crossing Point (1)									**Upstream bank**				Potential crossing point 100 m to north (just upstream of permanent waterhole).
				Fresh	Seasonal	Run	Clear	Shallows, Snags	4		Fringing Woody, Emergent Woody		Earth	Gentle	4	HVR	
													Downstream bank				
													Earth	Gentle	4	HVR	
				Alternate Crossing Point (2)									**Upstream bank**				Potential crossing point 300 m to north (well upstream of permanent waterhole).
				Fresh	Intermittent	Run	Clear	Shallows, Snags	4		Fringing Woody, Emergent Woody		Earth	Gentle	4	HVR	
													Downstream bank				
													Earth	Gentle	4	HVR	

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HVR: High Value Regrowth (as mapped by DERM). WPA: Wetland Protection Area. WMA: Wetland Management Area.

Table 2 **Descriptions of water crossings along the proposed lateral and header lines (Note: Upstream / downstream refers to direction of gas flow)**

Water course	Stream order	KP (Rev D)	Crossing method	Salinity	Seasonality	Stream Flow	Water Condition	Instream Habitat	Bed width (m)	EVNT*	Aquatic vegetation	Aquatic fauna/ habitat	Bank type	Bank slope	Bank height (m)	Riparian vegetation	Constraints / why alternate preferred
Elphinstone Lateral																	
Walker Creek	3	EL 8.3	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point. Stay south of large *E. tereticornis* habitat trees, as well as gully of tributary stream to the north-east.
				Fresh	Seasonal	Dry			8	Wetland Management Area			Sandy	Moderate	4	11.3.25	
													Downstream bank				
													Sandy	Moderate	4	11.3.25	
Walker Creek	3	EL 11.8	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point. Severe bank erosion.
				Fresh	Seasonal	Dry, Pool	Clear	Snags	10	Wetland Management Area			Sandy	Moderate	4	11.3.25	
													Downstream bank				
													Sandy	Moderate	4	11.3.25	
Carborough Creek	4	EL 28.3	Open cut	**Original Crossing Point**									**Upstream bank**				Crossing near sharp bend and small sandstone cliff. Extensive gully erosion around creek. Further geotechnical and ecological investigation recommended.
				Fresh	Intermittent	Pool	Clear	Shallows, Snags, Rocks	20		Fringing		Earth, Sandy, Rocky	Steep, Cliff	8	11.3.25	
													Downstream bank				
													Earth, Sandy	Gentle	5	11.3.25	
Spring Creek	2	EL 34.7	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point. Use existing cleared area and avoid large trees.
				Fresh	Intermittent	Dry			10				Sandy	Gentle	0.015	11.3.25	
													Downstream bank				
													Sandy	Gentle	0.5	11.3.25	
Thirty Mile Creek	2	EL 37.1	Open cut	**Original Crossing Point**									**Upstream bank**				Large remnant trees.
				Fresh	Intermittent	Dry			15				Sandy	Gentle	0.3	11.3.25b	
													Downstream bank				
													Sandy	Gentle	0.3	11.3.25b	
				Alternate Crossing Point									**Upstream bank**				Move 70 m west to avoid remnant vegetation.
													Sandy	Gentle	0.3	Non-remnant (cleared)	
				Fresh	Intermittent	Dry			15				**Downstream bank**				
													Sandy	Gentle	0.3	Non-remnant (cleared)	

Water course	Stream order	KP (Rev D)	Crossing method	Salinity	Seasonality	Stream Flow	Water Condition	Instream Habitat	Bed width (m)	EVNT*	Aquatic vegetation	Aquatic fauna/ habitat	Bank type	Bank slope	Bank height (m)	Riparian vegetation	Constraints / why alternate preferred
Saraji Lateral																	
Ripstone Creek	3	SL 6.5	Open cut	**Original Crossing Point**									**Upstream bank**				Suitable crossing point. Avoid large trees with hollows.
				Fresh	Intermittent	Pool	Clear	Shallows, Snags	7				Earth, Sandy	Steep	5	11.3.25	
													Downstream bank				
													Earth, Sandy	Steep	5	11.3.25	
Unnamed Wetland, near Ripstone Creek	N/ A	SL 7.8	N/ A	**Original Crossing Point**									**Upstream bank**				Natural deep waterhole.
				Fresh	Perennial	Pool	Clear	Deep open water, Snags, Standing dead timber	100	Cotton pygmy goose (*Nettapus coromandelianus*); Wetland Management Area	Submerged, Floating, Emergent Woody, Emergent Non-woody	Flock of cotton pygmy geese, abundant other birdlife, freshwater turtles	Earth	Gentle	1	11.3.27b / 11.3.25	
													Downstream bank				
													Earth	Gentle	1	11.3.27b	
				Alternate Crossing Point									**Upstream bank**				Move 350 m north to avoid natural waterhole and remnant vegetation.
				Woodland									Non-remnant (cleared)				
													Downstream bank				
													Non-remnant (cleared)				
Unnamed Wetland, near Ripstone Creek	N/ A	SL 11.1	N/ A	**Original Crossing Point**									**Upstream bank**				Wooded Swamp.
				Fresh	Seasonal	Pool	Clear	Shallows, Snags		Wetland Protection Area	Emergent Woody, Emergent Non-Woody	Abundant birdlife	N/ A			11.3.27b	
													Downstream bank				
													N/ A			11.3.27b	
				Alternate Crossing Point									**Upstream bank**				Move 800 m north to avoid swamp and wetland vegetation.
				Woodland									11.5.3				
													Downstream bank				
													11.5.3				
Isaac River	6	SL 19.0	Open cut	**Original Crossing Point**									**Upstream bank**				Natural waterhole. Large trees and stags
				Fresh	Seasonal	Pool	Clear	Shallows, Snags	70	Wetland Management Area			Earth, Sandy	Moderate	6	11.3.25	
													Downstream bank				
													Earth, Sandy	Moderate	8	11.3.25	

Water course	Stream order	KP (Rev D)	Crossing method	Salinity	Seasonality	Stream Flow	Water Condition	Instream Habitat	Bed width (m)	EVNT*	Aquatic vegetation	Aquatic fauna/ habitat	Bank type	Bank slope	Bank height (m)	Riparian vegetation	Constraints / why alternate preferred
				Alternate Crossing Point (1)									**Upstream bank**				Move 130 m south-east (downstream) to avoid natural waterhole. Fewer large trees. Avoid large trees and stags
				Fresh	Intermittent	Pool	Clear	Shallows, Snags	5	Wetland Management Area			Earth	Moderate	6	11.3.25	
													Downstream bank				
													Earth, Sandy	Moderate	8	11.3.25	
				Alternate Crossing Point (2)									**Upstream bank**				Move crossing approximately 5.5 km north-west to allow Suraji lateral to be shifted north and avoid impacts on remnant vegetation and wetlands from SL 0 to SL 19. Avoid large trees and stags, including very large *E. tereticornis* on southwest bank.
				Fresh	Seasonal	Pool	Turbid	Snags	60	Wetland Protection Area			Earth	Moderate	10	11.3.25/ 11.3.4	
													Downstream bank				
													Earth	Steep	10	11.3.25/ 11.3.1	
Dysart Lateral																	
				Original Crossing Point									**Upstream bank**				Suitable crossing point. Disturbed creek, weedy, evidence of flooding. Road parallel and to the north. Avoid large trees if possible.
Blackburn Creek	6	DL 18.3	Open cut	Fresh	Seasonal	Pool	Clear	Shallows, Snags		Wetland Management Area			Earth	Steep	10	11.3.25	
													Downstream bank				
													Earth	Steep	10	11.3.25	

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HVR: High Value Regrowth (as mapped by DERM). WPA: Wetland Protection Area. WMA: Wetland Management Area.

2.0 Watercourse Photographs

Photographs of crossing points on the main alignment are presented in Plates 1 to 66, while Plates 67 to 81 illustrate lateral and header crossings.

Plate 1: Suttor Creek – Original Crossing (AB 12.3)

Plate 2:Eaglefield Creek – Original Crossing (AB 28.3)

Plate 3: Eaglefield Creek – Alternate Crossing (west of AB 28.3)

Plate 4: Isaac River – Original Crossing (AB 50.2)

Plate 5: Twelve Mile Gully – Original Crossing (AB 59.1)

Plate 6: Hat Creek – Original Crossing (AB 68.2)

Plate 7: Hat Creek – Alternate Crossing (1) (west of AB 68.2)

Plate 8: Hat Creek – Alternate Crossing (2) (east of AB 68.2)

Plate 9: North Creek – Original Crossing (AB 105.2)

Plate 10: North Creek – Alternate Crossing (east of AB 105.2)

Plate 11 – North Creek (south crossing) – Original Crossing (AB 109.3)

Plate 12: North Creek Tributary – Original Crossing (AB 110)

Plate 13: Isaac River Tributary – Original Crossing (AB 160.1)

Plate 14 – Isaac River – Original Crossing (AB 164.7)

Plate 15 – Isaac River – Alternate Crossing (2) (north-east of AB 164.7)

Plate 16 – Isaac River – Alternate Crossing (3a) (north-east of AB 164.7)

Plate 17 – Isaac River – Alternate Crossing (3b) (north-east of AB 164.7)

Plate 18 – Isaac River – Alternate Crossing (4a) (north-east of AB 164.7)

Plate 19 – Isaac River – Alternate Crossing (4b) (north-east of AB 164.7)

Plate 20: Blackburn Creek – Original Crossing (AB 171.7)

Plate 21: Sandy Gully – Original Crossing (AB 197.8)

Plate 22: Isaac River – Original Rev C Crossing (Rev D crossing not surveyed)

Plate 23: Clarke Creek – Original Crossing (AB 238.5)

Plate 24: Bora Creek – Original Crossing (AB 245.1)

Plate 25: Clive Creek – Original Crossing (AB 249.0)

Plate 26: Mackenzie River Tributary – Original Crossing (AB 261.5)

Plate 27: Mackenzie River Tributary – Alternate Crossing (north-east of AB 261.5)

Plate 28: Pluto Creek – Original Crossing (AB 275.6)

Plate 29: Apis Creek – Original Crossing (AB 284.2)

Plate 30: Endrick Creek – Original Crossing (AB 285.4)

Plate 31: Endrick Creek – Alternate Crossing (north of AB 285.4)

Plate 32: Endrick Creek tributary (west) – Original Crossing (AB 286.4)

Plate 33: Endrick Creek tributary(east) – Original Crossing (AB 289.1)

Plate 34: Endrick Creek tributary (east) – Alternate Crossing (AB 289.1)

Plate 35: Develin Creek – Original Crossing (AB 303.1)

Plate 36: Fitzroy River – Original Crossing (AB 319.5)

Plate 37: Ten Mile Creek – Original Crossing (AB 332.2)

Plate 38: Ten Mile Creek – Alternate Crossing (AB 332.2)

Plate 39: Eight Mile Creek Tributary – Original Crossing (AB 336.2)

Plate 40: Eight Mile Creek Tributary – Alternate Crossing (north of AB 336.2)

Plate 41: Two Mile Creek – Original Crossing (AB 349.3)

Plate 42: Louisa Creek – Original Crossing (AB 358.3)

Plate 43: Limestone Creek – Alternate Crossing (1) (AB 371.3)

Plate 44: Limestone Creek – Alternate Crossing (2) (AB 371.3)

Plate 45: Limestone Creek – Alternate Crossing (3) (AB 371.3)

Plate 46: Deep Creek – Original Crossing (AB 373.4)

Plate 47: Deep Creek – Alternate Crossing (AB 373.4)

Plate 48: Black Gin Creek – Original Crossing (AB 377.6)

Plate 49: Black Gin Creek – Alternate Crossing (AB 377.6)

Plate 50: Lion Creek – Original Crossing (AB 382.7)

Plate 51: Lion Creek – Alternate Crossing (AB 382.7)

Plate 52: Scrubby Creek – Original Crossing (AB 391.3)

Plate 53: Teatree Creek Tributary – Original Crossing (AB 399.1)

Plate 54: Four Mile Creek – Original Crossing (AB 402.7)

Plate 55: Gavial Creek – Original Crossing (AB 406.3)

Plate 56: Midgee Creek – Original Crossing (AB 410.4)

Plate 57: Bob's Creek – Original Crossing (AB 413.6)

Plate 58: Oakey Creek – Original Crossing (AB 419.7)

Plate 59: Inkerman Creek – Original Crossing (AB 430.1)

Plate 60: Twelve Mile Creek – Original Crossing (AB 438.8)

Plate 61: Horrigan Creek – Original Crossing (AB 445.5)

Plate 62: Raglan Creek – Original Crossing (AB 446.6)

Plate 63: Raglan Creek – Alternate Crossing (1) (north of AB 446.6)

Plate 64: Raglan Creek – Alternate Crossing (2) (south of AB 446.6)

Plate 65: Larcom Creek – Original Crossing (AB 476.2)

Plate 66: Larcom Creek – Alternate Crossing (2) (north of AB 476.2)

Plate 67: Walker Creek – Original Crossing (EL 8.3)

Plate 68: Walker Creek – Original Crossing (EL 11.8)

Plate 69: Carborough Creek – Original Crossing (EL 28.3)

Plate 70: Spring Creek – Original Crossing (EL 34.7)

Plate 71: Thirty Mile Creek – Original Crossing (EL 37.1)

Plate 72: Thirty Mile Creek – Alternate Crossing (west of EL 37.1)

Plate 73: Ripstone Creek – Original Crossing (SL 6.5)

Plate 74: Unnamed wetland, near Ripstone Creek (Vermont Park) – Original Crossing (SL 7.8)

Plate 75: Unnamed wetland, near Ripstone Creek (Vermont Park) – Alternate Crossing (north of SL 7.8)

Plate 76: Unnamed wetland, near Ripstone Creek (Vermont Park) – Original Crossing (SL 11.1)

Plate 77: Woodland near Ripstone Creek(Vermont Park) – Alternate Crossing (north of SL 11.1)

Plate 78: Isaac River – Original Crossing (SL19.0)

Plate 79: Isaac River – Alternate Crossing 1 (south-east of SL19.0)

Plate 80: Isaac River – Alternate Crossing 2 (north-east of SL 19)

Plate 81: Blackburn Creek – Original Crossing (DL18.3)