

# Jemena Northern Gas Pipeline Pty Ltd

## Northern Gas Pipeline

### Draft Environmental Impact Statement

#### APPENDIX K – WATERCOURSE CROSSING SURVEY REPORT

Public

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**Jemena Northern Gas Pipeline Pty Ltd**

ABN 12 607 728 790

Level 16, 567 Collins Street

Melbourne VIC 3000

**Postal Address**

PO Box 16182

Melbourne VIC 3000

Ph: (03) 9713 7000

Fax: (03) 9173 7516

# Northern Gas Pipeline Watercourse Crossing Survey Report

Report for the Northern Gas Pipeline  
Environmental Impact Statement


Client: Jemena



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<b>Project Manager:</b>	Glen Ewers
<b>Author(s):</b>	Jay Shailes, Aiden Campbell
<b>Approved by:</b>	Helen Dwyer
	
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EcOz Pty Ltd.  
ABN: 81 143 989 039  
Winlow House, 3rd Floor  
75 Woods Street  
DARWIN NT 0800  
GPO Box 381, Darwin NT 0800

Telephone: +61 8 8981 1100  
Facsimile: +61 8 8981 1102  
Email: [ecoz@ecoz.com.au](mailto:ecoz@ecoz.com.au)  
Internet: [www.ecoz.com.au](http://www.ecoz.com.au)



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# Executive Summary

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The Northern Gas Pipeline (NGP) is a gas pipeline project which will involve the construction of 622 km of pipeline linking existing gas pipelines in the Northern Territory and Queensland. The pipeline will commence at Warrego, approximately 45 km north-west of Tennant Creek, and will terminate 5 km south of Mount Isa where it will connect to the existing Carpentaria Gas Pipeline.

The pipeline alignment crosses a number of watercourses, the majority of which are in the Georgina River Basin which spans the eastern portion of the Northern Territory and the western portion of Queensland. A survey of watercourse crossings was undertaken to assess the physical and hydrological features of the major watercourses that will be crossed during construction of the pipeline. The surveys were undertaken in May 2016.

The aim of the watercourse crossing survey was to fulfil the requirements of the Environmental Impact Statement (EIS) Terms of Reference for the NGP Project. The data also informed the risk assessment and management plans compiled for the EIS.

In summary, all of the rivers crossed by the NGP pipeline alignment were surveyed (six in total) and eight of the major creeks were also surveyed. The field data is presented in this report, including descriptions of the physical characteristics, bed and bank geometry, riparian vegetation and habitat assessments, and specific stream bed structural information. Presence of erosion, cattle and impacts from fauna were also recorded for stability information purposes. Ground and/or aerial photographs are presented for each site.

The information presented in this report is intended to inform the EIS process only, and further (pre-construction) surveys will be required to inform specific construction requirements and progressive erosion and sediment control plans.

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# 1 Introduction

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This Watercourse Crossing Survey Report documents the watercourse crossing survey data that informed the water risk assessment for the Environmental Impact Statement (EIS) for the Jemena Northern Gas Pipeline (NGP) project. It presents the preliminary field data collected on watercourses that will be crossed by the NGP construction Right of Way (ROW), a 30 m wide corridor within which the pipeline construction and installation activities will be undertaken.

## 1.1 Scope and objectives

The purpose of this document is to describe the major watercourses that intersect the construction ROW for the purposes of informing the EIS, specifically the water risk assessment, water management plan and erosion and sediment control plan

An entire route survey was not possible prior to submission of the EIS, therefore this survey prioritised watercourses mapped as stream order 3 and above (i.e. creeks and rivers). In some instances, proposed and existing access tracks intersect watercourses (generally stream order 3 and below). These crossings were not included in this survey as access tracks were not finalised at the time of the survey. Post-EIS, and prior to construction, the entire route and access tracks will be driven and any remaining watercourses will be surveyed as required.

## 1.2 NGP Project Overview

The NGP is a gas pipeline project which will involve the construction of 622 km of pipeline linking existing gas pipelines in the Northern Territory and Queensland. The pipeline will commence at Warrego, approximately 45 km north-west of Tennant Creek, and will terminate 5 km south of Mount Isa where it will connect to the existing Carpentaria Gas Pipeline.

The construction is scheduled to commence in early 2017 and be completed by early 2018 to allow the Construction Contractor to commission the pipeline with gas and commence commercial operation of the NGP pipeline in mid- 2018.

The NGP Project requires environmental assessment and approval pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth), *Environmental Assessment Act (Northern Territory)* and *Environment Protection Act 1994 (Queensland)*.

Within the Northern Territory, the approval for the NGP project is under an EIS. The Terms of Reference (TOR) for the EIS provide direction on the requirement for:

*Details of the locations of where the pipeline crosses watercourses (e.g. bed and bank profiles, riparian vegetation, bank and bed stability, the expected flow regime of the watercourse in the vicinity of the pipeline, in particular the timing of flows in relation to construction work, etc.)*

In QLD, the Environmental Authority (EA) identifies requirements to minimise risks relating to activities in watercourses. Conditions E2 – E6 provide specific guidance on watercourse construction, including:

- **E2** Any non-linear infrastructure activity requiring earthworks, vegetation clearing or other construction activities must not be undertaken within 200 m of a wetland, lake or spring, or 100 m of the outer bank of a watercourse.
- **E3** Linear infrastructure activities can be undertaken in watercourses but should be done when there is no water present, or in times of low flow, or in a manner which does not impede low flow.
- **E4** Activities must not result in an increase in turbidity of >10 % in high ecological value (HEVs) waters, excluding contained construction areas.

- **E5 and E6** Linear infrastructure activities in watercourses and wetlands must be designed and undertaken by a suitably qualified person, in accordance with the *Activities in a watercourse, lake or spring associated with a resource activity or mining operation guideline*.

Compliance with these requirements will be informed by the watercourse crossing survey data.

## 1.3 Definitions

Watercourses are defined as a body of water flowing in a particular direction (though not necessarily continuously), with a defined channel, bed and banks, including drainage lines, creeks and rivers.

Watercourses are categorised in the *NT Land Clearing Guidelines* (NRETAS 2010) accordingly:

- Stream order 1 – 2 are intermittent streams
- Stream order 3 – 4 are creeks
- Stream order 5+ are rivers.

These stream order categories are used throughout this report.



## 2 Methodology

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### 2.1 Desktop survey

Detailed existing environment as relevant to water is provided in Chapter 7 of the EIS, and summarised below.

The watercourse desktop survey determined the following:

- Major watercourses are only intersected between KP 380 and KP 622 (Figure 2-1).
  - In the Northern Territory, three rivers ranked as stream order 5+ intersect the construction ROW in the NT –Ranken River, James River and Georgina River. Literature notes the presence of permanent pools within these rivers, although the locations are unknown (Randal 1962). Further field survey work will be undertaken prior to construction to identify and map any permanent pools in proximity to the construction footprint.
  - Four creek crossings (stream order 3 or 4) intersect the construction ROW in the Northern Territory.
  - In Queensland, three rivers ranked as stream order 5+ intersect the construction ROW in Queensland – Mingerla Creek, Yaringa Creek and Templeton River.
  - Fourteen creek crossings (stream order 3 or 4) intersect the construction ROW in Queensland.
  - There are numerous other unnamed tributaries and minor drainage lines intersected by the construction ROW. These are ranked as stream order 1 or 2.
- Many of the creeks and rivers are braided and the pipeline alignment crosses the same watercourses a number of times.
- All watercourses are ephemeral and flow only after rainfall.

Rivers, creeks and tributaries intersected by the construction ROW are detailed in Table 2-1.

### 2.2 Field survey

All major watercourses that intersect with the construction ROW were surveyed using a helicopter for access. This involved all six rivers (stream order 5+) and eight creeks (stream order 3 or 4) (see Figure 2-1 and Figure 2-2).

Northern Territory surveys occurred from 2 to 9 May 2016 (most were on the 8 and 9 May as that was the Barkly Clay Plain region where all the larger watercourses are located). Queensland surveys occurred from 8 to 18 May 2016.

Each watercourse was described in terms of physical characteristics, and surveyed for bed and bank geometry. Riparian vegetation was described as part of the habitat assessment for the watercourses and specific stream bed structural information was recorded in addition to this (i.e. presence of vegetation root matter in banks). Presence of erosion, cattle and impacts from fauna were also recorded for stability information purposes. Ground and/or aerial photographs were taken of each site.

Where possible, upstream and downstream aerial surveys were also undertaken for 1 km either side of the ROW intersection to identify any presence or indication of permanent water, to inform threatened species surveys and watercourse barrier works requirements (for Queensland).

The identification of permanent pools was limited as a number of watercourse crossings were flowing at the time of the survey. Bureau of Meteorology climate data indicates that a number of weather stations in the region (e.g. Camooweal, Avon Downs, and Undilla Station) recorded above average rainfall in March 2016 (see BoM 2016). Most stations recorded in excess of 150 mm for the month of March, well in excess of the average monthly rainfall for the stations. Austral Downs, Avon Downs and Camooweal stations also recorded rainfall in early May, between 8 and 10 May. This rainfall is likely to have contributed to the conditions (i.e. flowing watercourses) observed at the time of the survey.

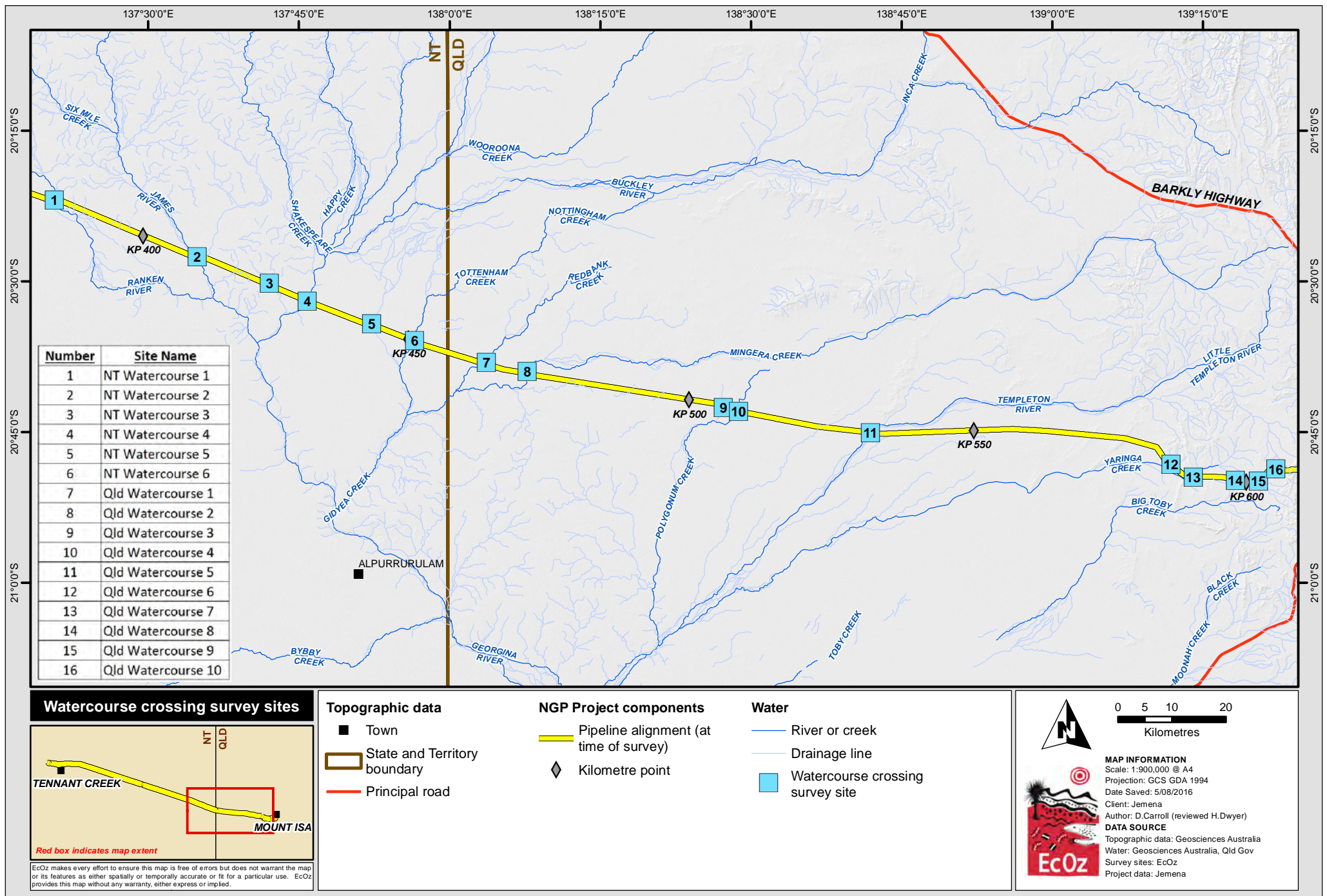
The location of permanent pools will be further investigated prior to construction, during the dry season (refer to Section 4).

Field data is presented in Section 3. Note that the watercourse crossing locations were based on the proposed pipeline alignment at the time of the survey, and are indicative. Any changes to the alignment which significantly move the location of watercourse crossings will require further assessment, which will be undertaken prior to construction.

**Table 2-1. Summary of watercourses traversed by the Construction ROW**

Name	Stream order*	Watercourse type	Basin	Approximate KP*	Number of crossings	Surveyed
Northern Territory						
Bishop Creek	2	Drainage line	Barkly	18	1 minor drainage	No
Gosse River	Not applicable	Flood-out		87	1	No
Ranken River	5+	River	Georgina River	383	1	Yes
	1	Drainage line		383-396	5	No
James River	5+	River		410	1	Yes
	1-2	Drainage line		408-420	5	No
Georgina River	5+	River		431	1	Yes
	1-2	Drainage line		422-424	2	No
Blue Bush Creek	4	Creek		443-451	2	Yes
	1	Drainage line		448-453	4	No
Two additional unnamed drainage lines are crossed in the Barkly Tablelands, all stream order 1-2.						
Queensland						
Redbank Creek	3-4	Creek	Georgina River	464-645	2	Yes
Mingera Creek	5+	River		472	1	Yes
	1-2	Drainage line		472-498	3	No
Polygonum Creek	1-2	Drainage line		505-515	5	Yes
One Mile Creek	1	Drainage line		531	1	No
Lily Hole Creek	3	Creek		537	1	No
Templeton River	5+	River		544	1	Yes
	1-2	Drainage line		544-609	11	No
Yaringa Creek	5+	River		590	1	Yes
	3-4	Creek		585-601	3	Yes
	1-2	Drainage line		584-604	14	No
Mica Creek	3-4	Creek	Leichhardt River	611-619	4	Yes
	1-2	Drainage line	609-621	9	Yes	
15 additional unnamed drainage lines are crossed; all stream order 1-2.						

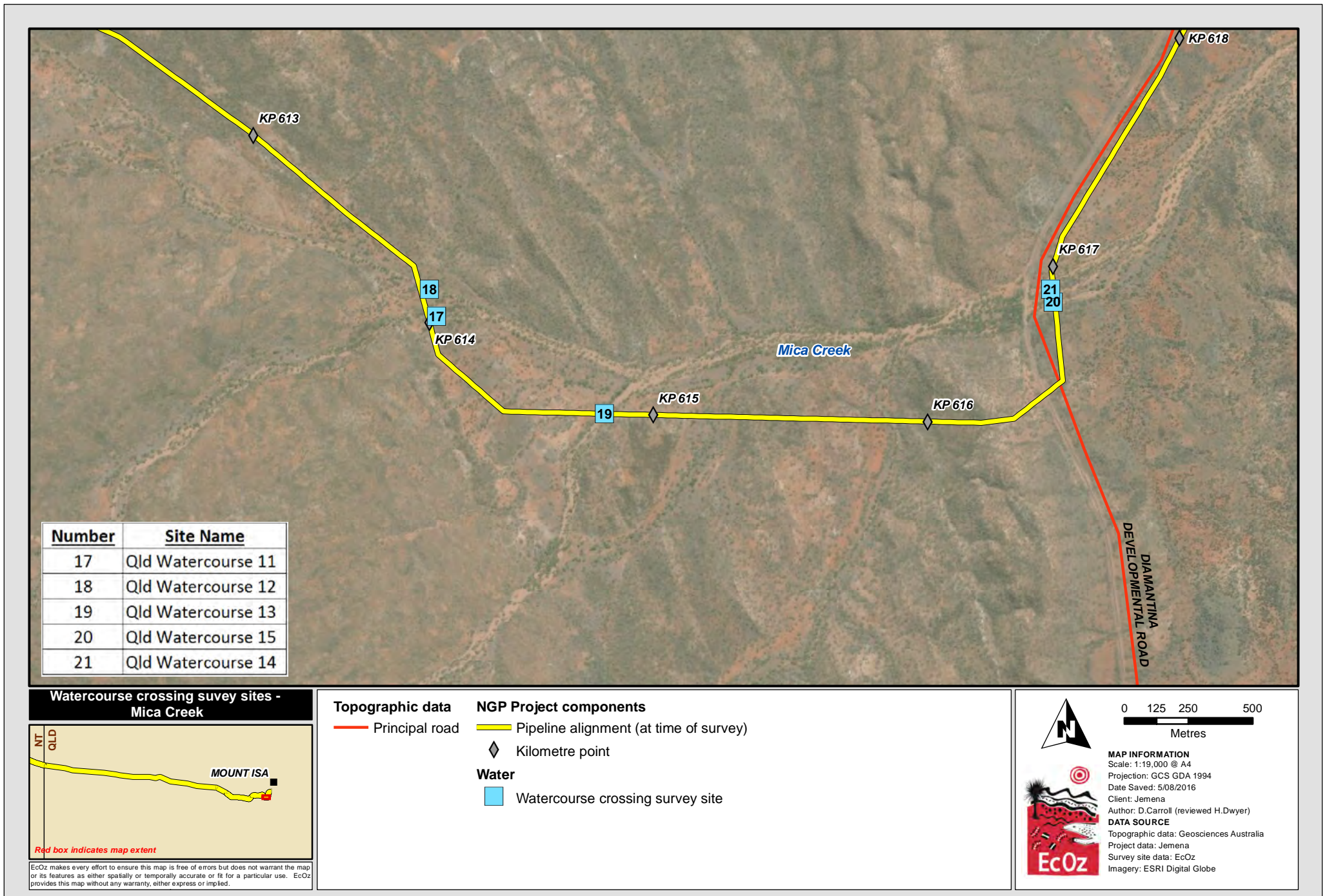
\*At point where Construction ROW crosses watercourse



Path: Z:\01 EcOz Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch7-EMP\Water\Figure 3-1. Map of watercourse crossing assessment sites.mxd

**Figure 2-1. Map of watercourse crossing assesement sites**





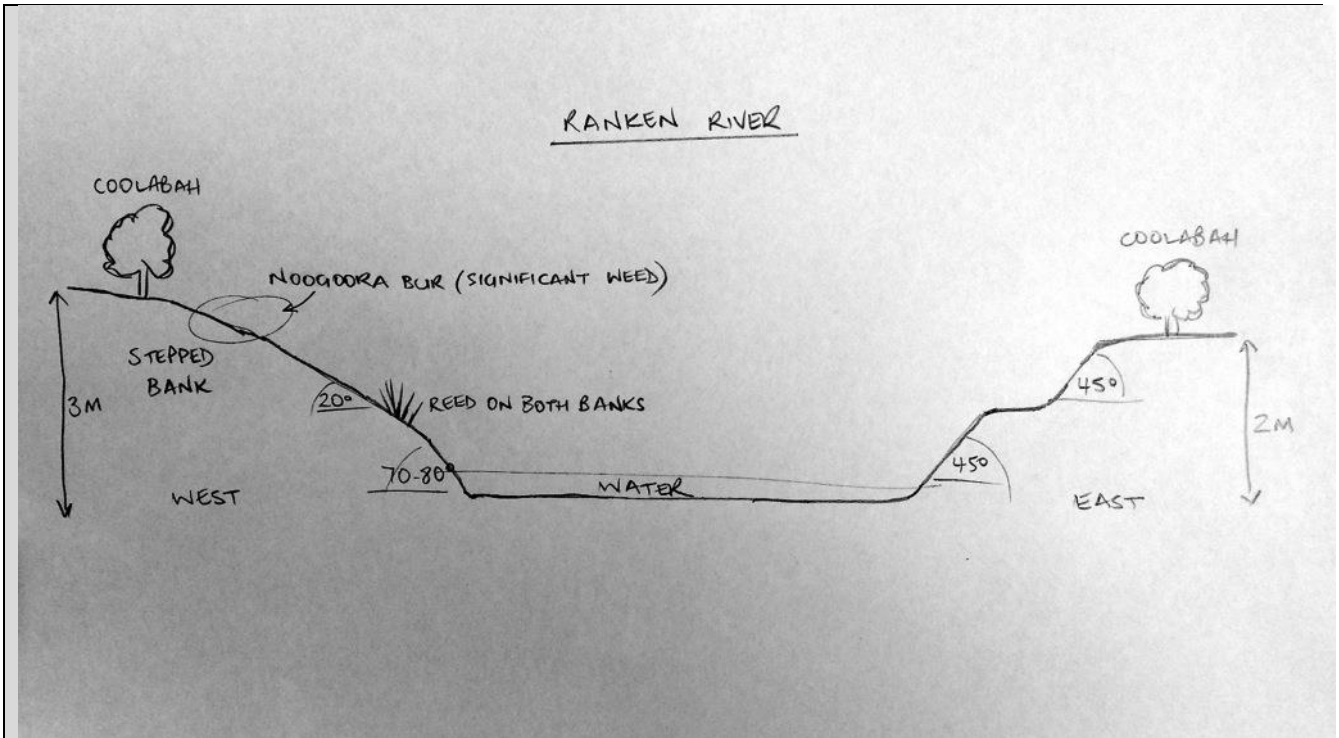
**Figure 2-2. Inset map of Mica Creek watercourse crossing assessment sites**

## 3 Results

### 3.1 Northern Territory

<b>Location</b>							
<b>Site name</b>	NT Watercourse 1			<b>Location (KP)</b>		383	
<b>Watercourse name</b>	Ranken River (main channel)			<b>GPS points GDA 1994, Zone 53</b>		E 744704 N 7746343	
<b>General</b>							
<b>Stream order</b>	5+	<b>Channel type</b>	Braided & meandering	<b>No. of channels</b>	1 main 1 smaller	<b>Surrounding landform</b>	Clay plains
<b>Geometry</b>							
<b>Bank height (m)</b>	2 - 3	<b>Channel width (m)</b>	35 - 40	<b>Bank slope (%)</b>	See sketch	<b>Bank type</b>	Stepped Clay with gravel
<b>Bed width (m)</b>	25 - 30	<b>Bed slope (%)</b>	2 - 3 south aspect	<b>Bed type</b>	Unknown (under water)	<b>Presence of root matter in bank or aquatic vegetation</b>	No
<b>Stability</b>							
<b>Erosion presence</b>	Yes	<b>Location</b>	Banks			<b>Type</b>	Cutting
<b>Possible contributing factors</b>			Cattle			<b>Severity</b>	Significant
<b>Habitat</b>							
<b>Riparian vegetation</b>	Coolabah trees, reeds, Noogoora Burr, Mitchell Grass, various herbs						
<b>In-stream habitat</b>	Some grass – no lily pad, murky water					<b>Presence of water or signs of wetted embankment</b>	Yes
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	Not identified- water flowing at the time of survey				<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>
<b>Water description</b>					<b>Bank height (m)</b>		<b>Bank width (m)</b>
<b>Bank slope</b>		<b>Bank composition</b>					<b>Vegetation presence</b>
<b>General notes</b>							
Depth of water unknown Significant cattle impact Dry section 80 m north of ROW crossing (better option) E744728 N7746494							
<b>Sketch of cross sectional profile</b>							





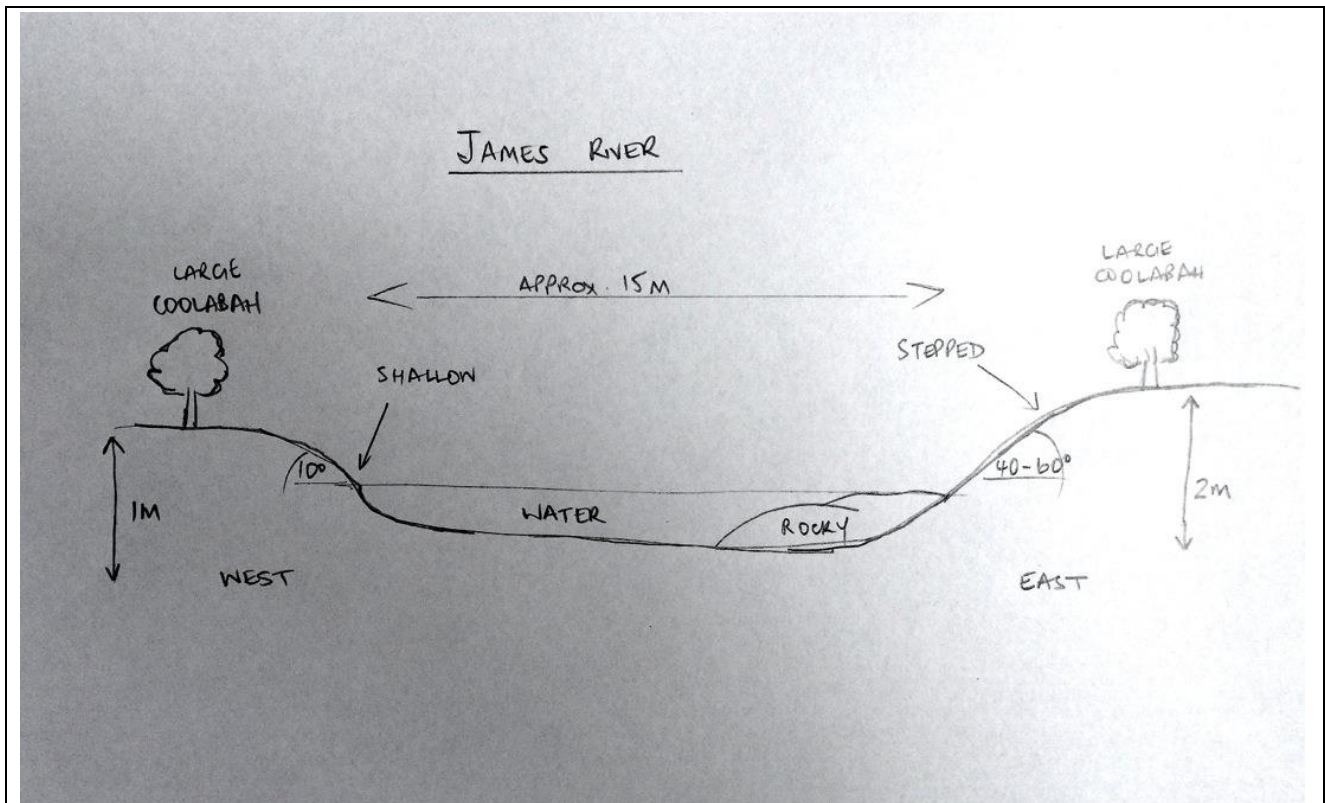
## Photos







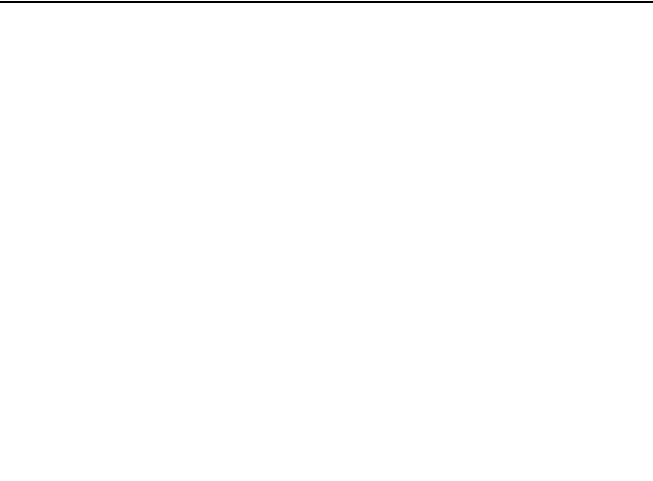
<b>Location</b>							
<b>Site name</b>	NT Watercourse 2			<b>Location (KP)</b>	410		
<b>Watercourse name</b>	James River			<b>GPS points GDA 1994, Zone 53</b>	E 769233 N 7735528		
<b>General</b>							
<b>Stream order</b>	5+	<b>Channel type</b>	Straight	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Clay plain
<b>Geometry</b>							
<b>Bank height (m)</b>	1 (west) 2 (east)	<b>Channel width (m)</b>	15	<b>Bank slope (%)</b>	See sketch	<b>Bank type</b>	Clay
<b>Bed width (m)</b>	10	<b>Bed slope (%)</b>	3	<b>Bed type</b>	Clay & mud	<b>Presence of root matter in bank or aquatic vegetation</b>	Yes Tree roots only
<b>Stability</b>							
<b>Erosion presence</b>	Yes	<b>Location</b>	Bank			<b>Type</b>	Gully
<b>Possible contributing factors</b>			Cattle			<b>Severity</b>	Moderate to high
<b>Habitat</b>							
<b>Riparian vegetation</b>	Coolabah, Sedges, Sporobolus sp., reeds						
<b>In-stream habitat</b>	Murky water, no aquatic vegetation					<b>Presence of water or signs of wetted embankment</b>	Yes
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	Not identified- water flowing at the time of survey			<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>				<b>Bank height (m)</b>		<b>Bank width (m)</b>	
<b>Bank slope</b>		<b>Bank composition</b>				<b>Vegetation presence</b>	
<b>Sketch of cross sectional profile</b>							



## Photos

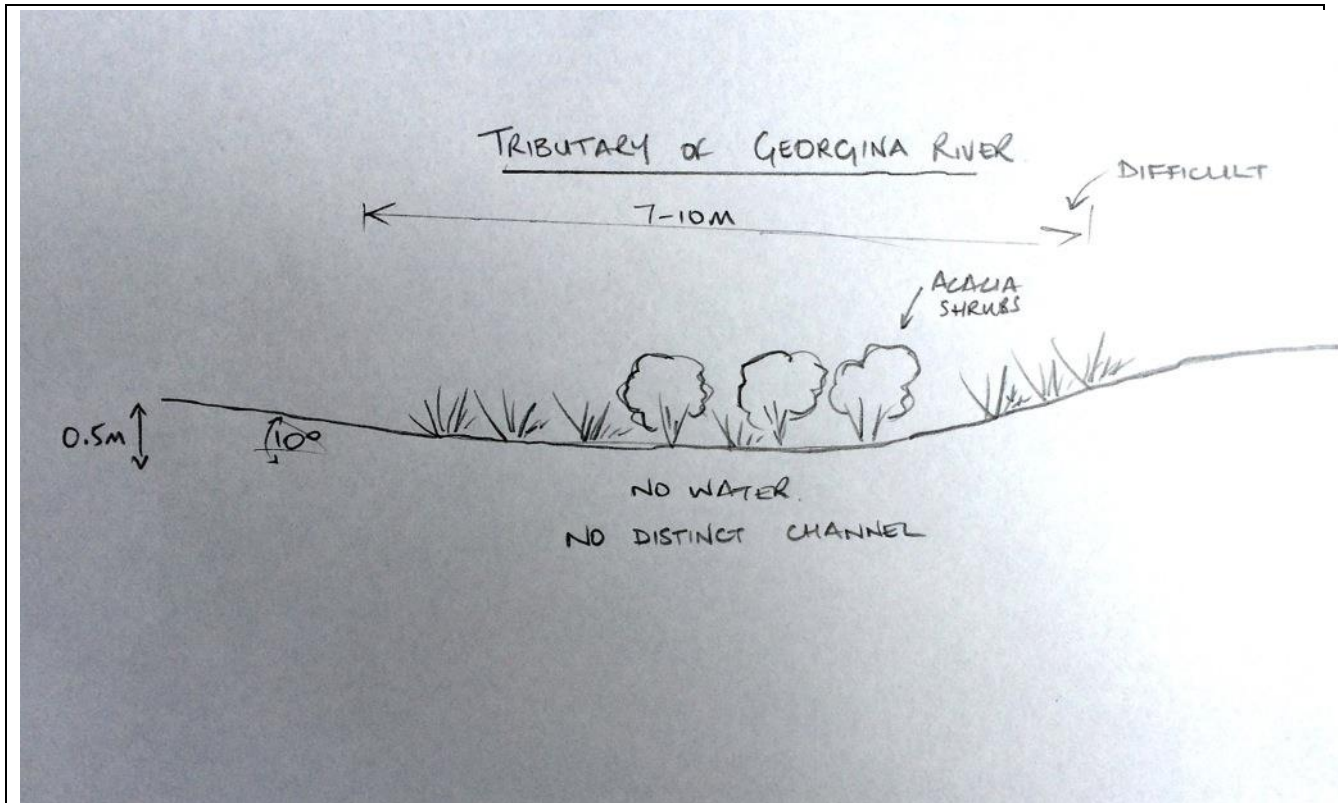






<b>Location</b>							
<b>Site name</b>	NT Watercourse 3			<b>Location (KP)</b>		KP 424	
<b>Watercourse name</b>	Tributary of Georgina River			<b>GPS points GDA 1994, Zone 53</b>		E 781700 N 7730490	
<b>General</b>							
<b>Stream order</b>	3	<b>Channel type</b>	Straight	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Clay plains
<b>Geometry</b>							
<b>Bank height (m)</b>	0.5	<b>Channel width (m)</b>	7 no distinct channel	<b>Bank slope (%)</b>	10	<b>Bank type</b>	Clay, gravel Not distinct
<b>Bed width (m)</b>	3 - 5	<b>Bed slope (%)</b>	2	<b>Bed type</b>	Clay	<b>Presence of root matter in bank or aquatic vegetation</b>	
<b>Stability</b>							
<b>Erosion presence</b>	No	<b>Location</b>	N/A		<b>Type</b>	N/A	
<b>Possible contributing factors</b>			N/A			<b>Severity</b>	N/A
<b>Habitat</b>							
<b>Riparian vegetation</b>	No riparian vegetation, tussock grass & Mesquite ( <i>Prosopis pallida</i> ) shrubs (significant weed)						
<b>In-stream habitat</b>	N/A tussock grass					<b>Presence of water or signs of wetted embankment</b>	No
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	No	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>				<b>Bank height (m)</b>		<b>Bank width (m)</b>	
<b>Bank slope</b>		<b>Bank composition</b>				<b>Vegetation presence</b>	
<b>Sketch of cross sectional profile</b>							



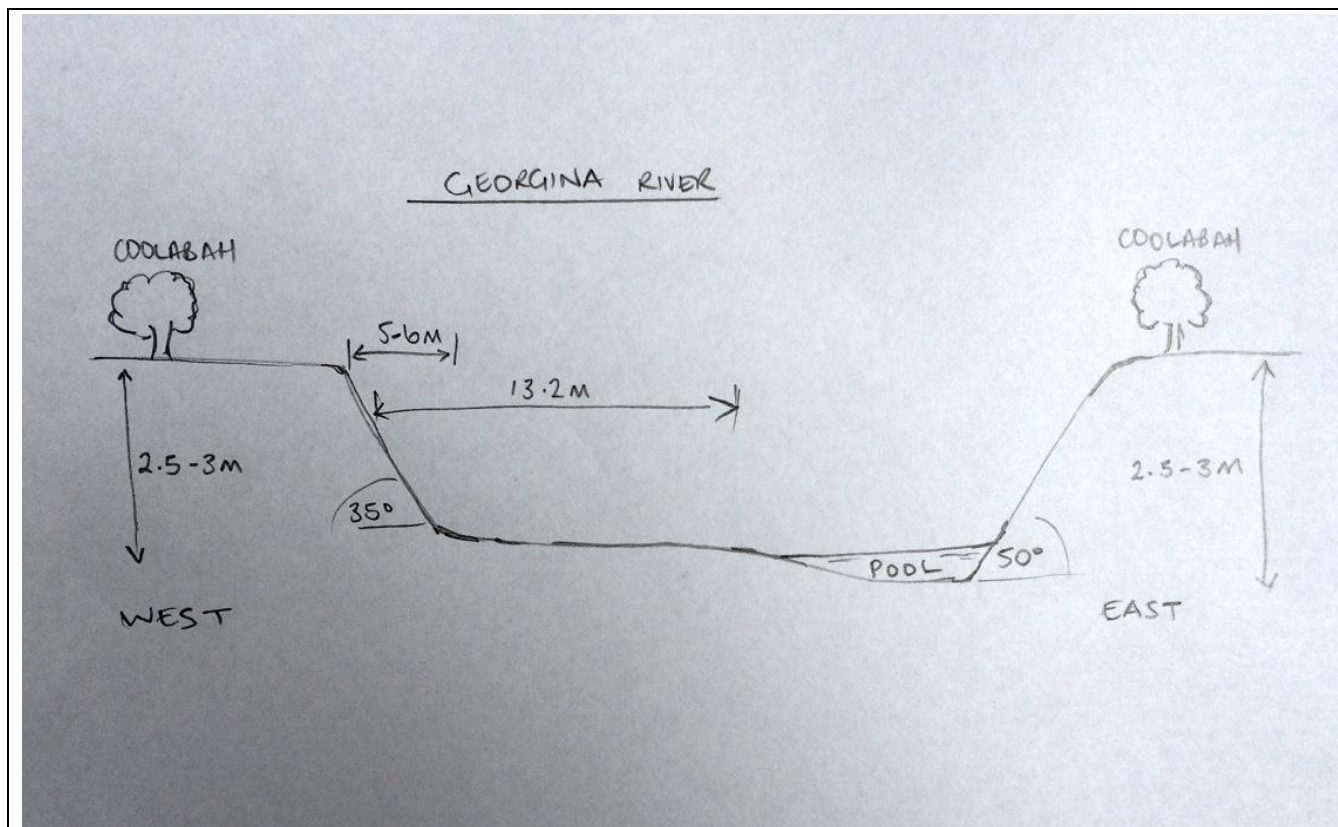


#### Photos



<b>Location</b>							
<b>Site name</b>	NT Watercourse 4			<b>Location (KP)</b>		431	
<b>Watercourse name</b>	Georgina River			<b>GPS points GDA 1994, Zone 53</b>		E 788219 N 7727078	
<b>General</b>							
<b>Stream order</b>	5+	<b>Channel type</b>	Meandering river	<b>No. of channels</b>	1 (three minor/small tributaries)	<b>Surrounding landform</b>	Clay plains
<b>Geometry</b>							
<b>Bank height (m)</b>	2.5 - 3	<b>Channel width (m)</b>	26	<b>Bank slope (%)</b>	See sketch	<b>Bank type</b>	Clay mud
<b>Bed width (m)</b>	16	<b>Bed slope (%)</b>	2 south aspect	<b>Bed type</b>	Fine sand clays	<b>Presence of root matter in bank or aquatic vegetation</b>	No
<b>Stability</b>							
<b>Erosion presence</b>	Yes	<b>Location</b>	Banks			<b>Type</b>	Gully
<b>Possible contributing factors</b>			Cattle			<b>Severity</b>	Moderate to high
<b>Habitat</b>							
<b>Riparian vegetation</b>	Coolabah lined banks, Mitchell Grass ( <i>Astrebla</i> sp.), <i>Sporobolus</i> sp., Pigface, Couch Grass (weed)						
<b>In-stream habitat</b>	Some small outcrop, murky water (light yellow-brown), fallen logs					<b>Presence of water or signs of wetted embankment</b>	Yes
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	Not identified- water flowing at the time of survey				<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>
<b>Water description</b>					<b>Bank height (m)</b>		<b>Bank width (m)</b>
<b>Bank slope</b>		<b>Bank composition</b>					<b>Vegetation presence</b>
<b>General notes</b>							
Impact by cattle significant							
<b>Sketch of cross sectional profile</b>							





## Photos





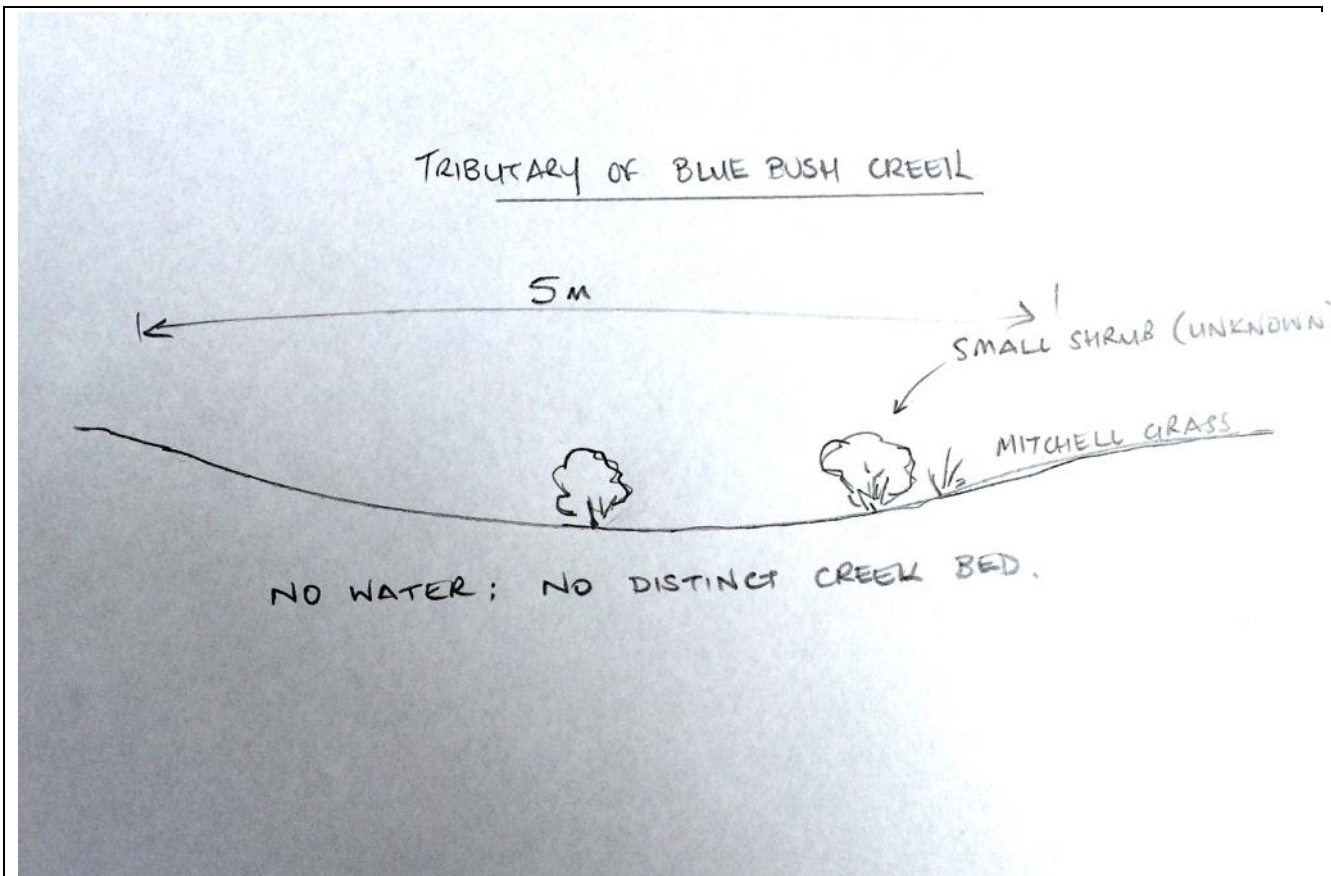






<b>Location</b>							
<b>Site name</b>	NT Watercourse 5			<b>Location (KP)</b>		443	
<b>Watercourse name</b>	Tributary of Blue Bush Creek			<b>GPS points GDA 1994, Zone 53</b>		E 799311 N 7722783	
<b>General</b>							
<b>Stream order</b>	3	<b>Channel type</b>	Straight	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Clay plain
<b>Geometry</b>							
<b>Bank height (m)</b>	0.5	<b>Channel width (m)</b>	5	<b>Bank slope (%)</b>	5	<b>Bank type</b>	Clay
<b>Bed width (m)</b>	1	<b>Bed slope (%)</b>	1	<b>Bed type</b>	Clay	<b>Presence of root matter in bank or aquatic vegetation</b>	No
<b>Stability</b>							
<b>Erosion presence</b>	No	<b>Location</b>	N/A		<b>Type</b>	N/A	
<b>Possible contributing factors</b>			N/A			<b>Severity</b>	N/A
<b>Habitat</b>							
<b>Riparian vegetation</b>	Lined with Lignum ( <i>Muehlenbeckia florulenta</i> ) (noted as unknown shrub in cross-section sketch)						
<b>In-stream habitat</b>	No				<b>Presence of water or signs of wetted embankment</b>		No
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	No	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>				<b>Bank height (m)</b>		<b>Bank width (m)</b>	
<b>Bank slope</b>		<b>Bank composition</b>				<b>Vegetation presence</b>	
<b>Sketch of cross sectional profile</b>							



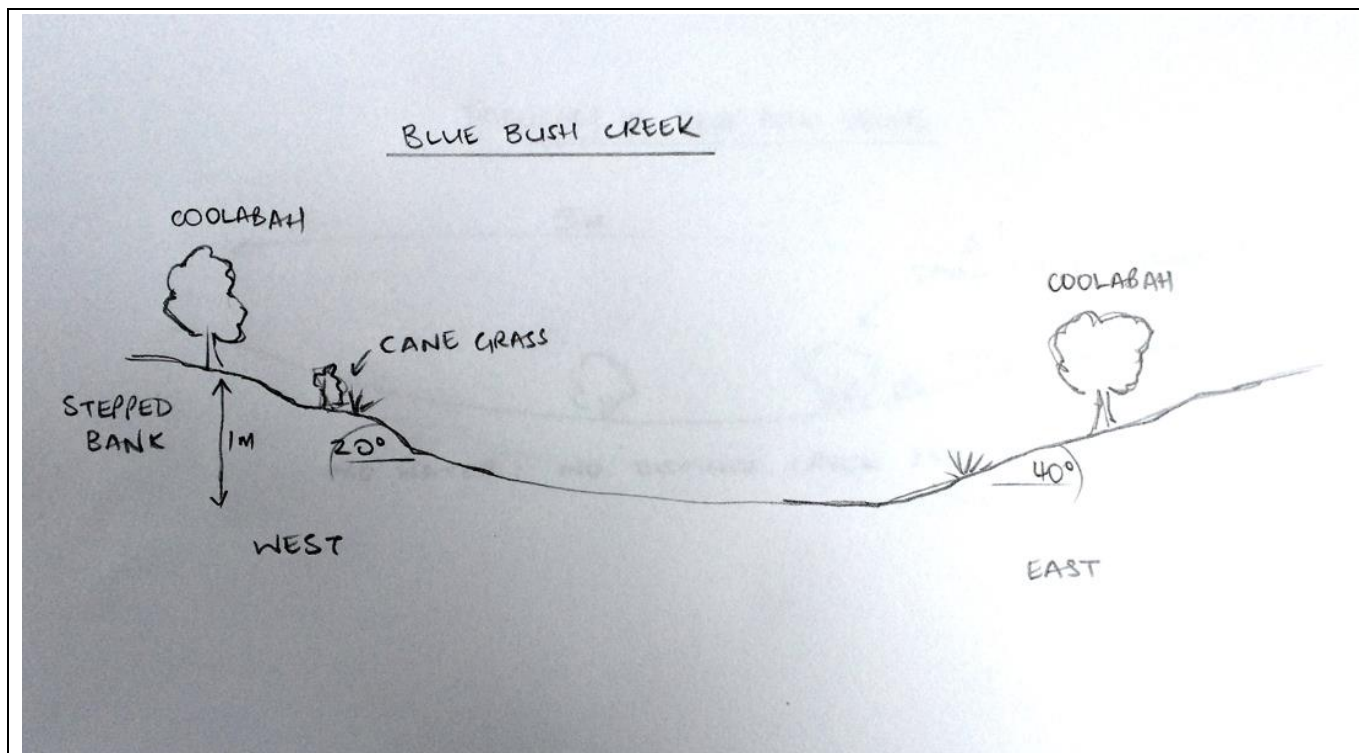


#### Photos





<b>Location</b>							
<b>Site name</b>	NT Watercourse 6				<b>Location (KP)</b>		451
<b>Watercourse name</b>	Blue Bush Creek				<b>GPS points GDA 1994, Zone 53</b>		E 806655 N 7719505
<b>General</b>							
<b>Stream order</b>	4	<b>Channel type</b>	Meandering	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Clay plains
<b>Geometry</b>							
<b>Bank height (m)</b>		<b>Channel width (m)</b>	20	<b>Bank slope (%)</b>	20 west 40 east	<b>Bank type</b>	Clay stepped
<b>Bed width (m)</b>	8	<b>Bed slope (%)</b>	2	<b>Bed type</b>	Sand & clay (patchy)	<b>Presence of root matter in bank or aquatic vegetation</b>	Grass
<b>Stability</b>							
<b>Erosion presence</b>	No	<b>Location</b>	N/A			<b>Type</b>	N/A
<b>Possible contributing factors</b>			N/A			<b>Severity</b>	N/A
<b>Habitat</b>							
<b>Riparian vegetation</b>	Coolabah, Bluebush ( <i>Chenopodium auricomum</i> )						
<b>In-stream habitat</b>	No water at crossing. Freshwater crab, muscle, snail					<b>Presence of water or signs of wetted embankment</b>	Yes
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	Yes	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>				<b>Bank height (m)</b>		<b>Bank width (m)</b>	
<b>Bank slope</b>		<b>Bank composition</b>					<b>Vegetation presence</b>
<b>Sketch of cross sectional profile</b>							



#### Photos







## 3.2 Queensland

<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 1				<b>Location (KP)</b>	465	
<b>Watercourse name</b>	Redbank Creek				<b>GPS points GDA 1994, Zone 54</b>	E 0193728 N 7715565	
<b>General</b>							
<b>Stream order</b>	4	<b>Channel type</b>	Defined	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Rocky plains
<b>Geometry – N/A aerial survey only</b>							
<b>Bank height (m)</b>		<b>Channel width (m)</b>		<b>Bank slope (%)</b>		<b>Bank type</b>	
<b>Bed width (m)</b>		<b>Bed slope (%)</b>		<b>Bed type</b>		<b>Presence of root matter in bank or aquatic vegetation</b>	
<b>Stability – N/A aerial survey only</b>							
<b>Erosion presence</b>	No	<b>Location</b>				<b>Type</b>	
<b>Possible contributing factors</b>						<b>Severity</b>	
<b>Habitat – N/A aerial survey only</b>							
<b>Riparian vegetation</b>							
<b>In-stream habitat</b>						<b>Presence of water or signs of wetted embankment</b>	
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	Yes	<b>Proximity to ROW crossing (m)</b>	400		<b>Width of pool (m)</b>	10	<b>Depth of pool (m)</b>
<b>Location</b>					<b>Location description</b>	North of ROW	
<b>Water description</b>	Brown				<b>Bank height (m)</b>		<b>Bank width (m)</b>
<b>Bank slope</b>		<b>Bank composition</b>	Mud			<b>Vegetation presence</b>	Yes
<b>General notes</b>							
Swamp >1 km north of ROW – dry. Area was checked for fringing reeds which could indicate suitable Yellow Chat habitat. None were found. 10 x 40 m pool in water course. Cattle tracks to water Eucalypts / Tussock Grass							
<b>Sketch of cross sectional profile</b>							
No sketch							
<b>Photos</b>							

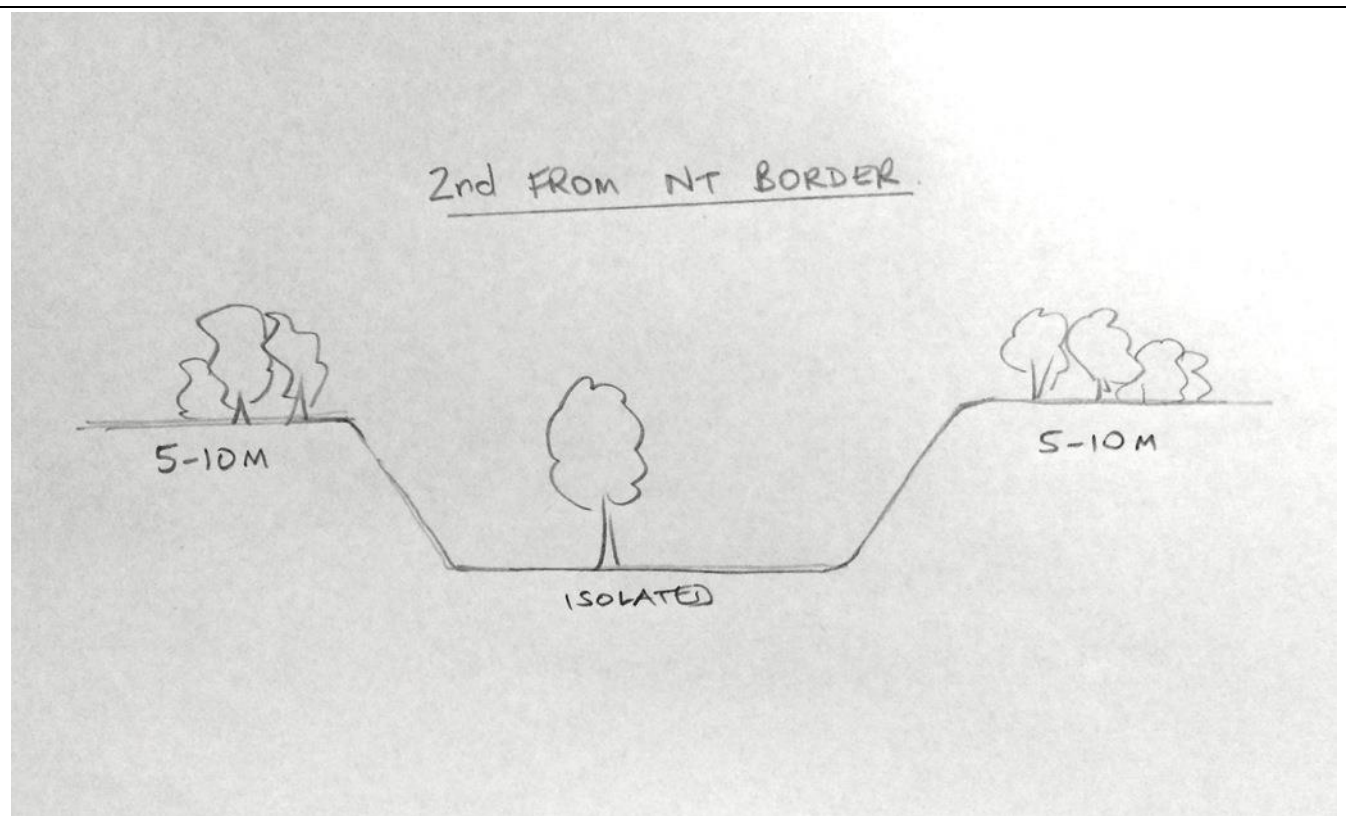








<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 2 (2 <sup>nd</sup> from NT border)				<b>Location (KP)</b>	472	
<b>Watercourse name</b>	Mingera Creek				<b>GPS points GDA 1994, Zone 54</b>	E 0200854 N 7714034	
<b>General</b>							
<b>Stream order</b>	5+	<b>Channel type</b>	Single	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Grassland
<b>Geometry</b>							
<b>Bank height (m)</b>	~ 2	<b>Channel width (m)</b>		<b>Bank slope (%)</b>	~ 60	<b>Bank type</b>	Mud / earth
<b>Bed width (m)</b>	18	<b>Bed slope (%)</b>	-	<b>Bed type</b>	Mud / gravel	<b>Presence of root matter in bank or aquatic vegetation</b>	
<b>Stability</b>							
<b>Erosion presence</b>	Yes	<b>Location</b>	All			<b>Type</b>	
<b>Possible contributing factors</b>			Cattle			<b>Severity</b>	Medium
<b>Habitat</b>							
<b>Riparian vegetation</b>	River Red Gum, Gidgee, Castor Oil Plant (weed), Buffel Grass (weed)						
<b>In-stream habitat</b>	Roots					<b>Presence of water or signs of wetted embankment</b>	Yes
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	No	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>					<b>Bank height (m)</b>		<b>Bank width (m)</b>
<b>Bank slope</b>		<b>Bank composition</b>					<b>Vegetation presence</b>
<b>General notes</b>							
Cracking clay surrounding. Cattle impact widespread. Standing water from recent rain – no permanent waterbody 2 <sup>nd</sup> small channel to east.							
<b>Sketch of cross sectional profile</b>							



#### Photos













<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 3			<b>Location (KP)</b>	506		
<b>Watercourse name</b>	Unnamed – tributary of Polygonum Creek			<b>GPS points GDA 1994, Zone 54</b>	E 0234887 N 7707907		
<b>General</b>							
<b>Stream order</b>	1	<b>Channel type</b>	Single	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Rocky plain
<b>Geometry– N/A aerial survey only</b>							
<b>Bank height (m)</b>		<b>Channel width (m)</b>		<b>Bank slope (%)</b>		<b>Bank type</b>	
<b>Bed width (m)</b>		<b>Bed slope (%)</b>		<b>Bed type</b>		<b>Presence of root matter in bank or aquatic vegetation</b>	
<b>Stability– N/A aerial survey only</b>							
<b>Erosion presence</b>		<b>Location</b>				<b>Type</b>	
<b>Possible contributing factors</b>						<b>Severity</b>	
<b>Habitat– N/A aerial survey only</b>							
<b>Riparian vegetation</b>							
<b>In-stream habitat</b>						<b>Presence of water or signs of wetted embankment</b>	
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	Yes	<b>Proximity to ROW crossing (m)</b>	~ 50 m		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>
<b>Water description</b>	Artificial dam				<b>Bank height (m)</b>		<b>Bank width (m)</b>
<b>Bank slope</b>		<b>Bank composition</b>					<b>Vegetation presence</b>
<b>General notes</b>							
<p><i>Parkinsonia aculeata.</i></p> <p>Some remnant pools in watercourse – unlikely to remain throughout dry season.</p> <p>Man-made dam close to ROW.</p>							
<b>Sketch of cross sectional profile</b>							
No sketch							
<b>Photos</b>							





<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 4			<b>Location (KP)</b>	509		
<b>Watercourse name</b>	Polygonum Creek			<b>GPS points GDA 1994, Zone 54</b>	E 0237521 N 7707285		
<b>General</b>							
<b>Stream order</b>	3	<b>Channel type</b>	Single	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Clay / rock
<b>Geometry– N/A aerial survey only</b>							
<b>Bank height (m)</b>		<b>Channel width (m)</b>		<b>Bank slope (%)</b>	> 60	<b>Bank type</b>	Sand / rock
<b>Bed width (m)</b>		<b>Bed slope (%)</b>		<b>Bed type</b>	Earth	<b>Presence of root matter in bank or aquatic vegetation</b>	
<b>Stability– N/A aerial survey only</b>							
<b>Erosion presence</b>	No	<b>Location</b>				<b>Type</b>	
<b>Possible contributing factors</b>						<b>Severity</b>	
<b>Habitat</b>							
<b>Riparian vegetation</b>	<i>Eucalyptus camaldulensis</i> , Spinifex.						
<b>In-stream habitat</b>	Yes, debris, root					<b>Presence of water or signs of wetted embankment</b>	
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>		<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>				<b>Bank height (m)</b>		<b>Bank width (m)</b>	
<b>Bank slope</b>		<b>Bank composition</b>					<b>Vegetation presence</b>
<b>General notes</b>							
Water present at a number of places, unlikely to persist during the dry season. Rocky surrounds							
<b>Sketch of cross sectional profile</b>							
No sketch							
<b>Photos</b>							



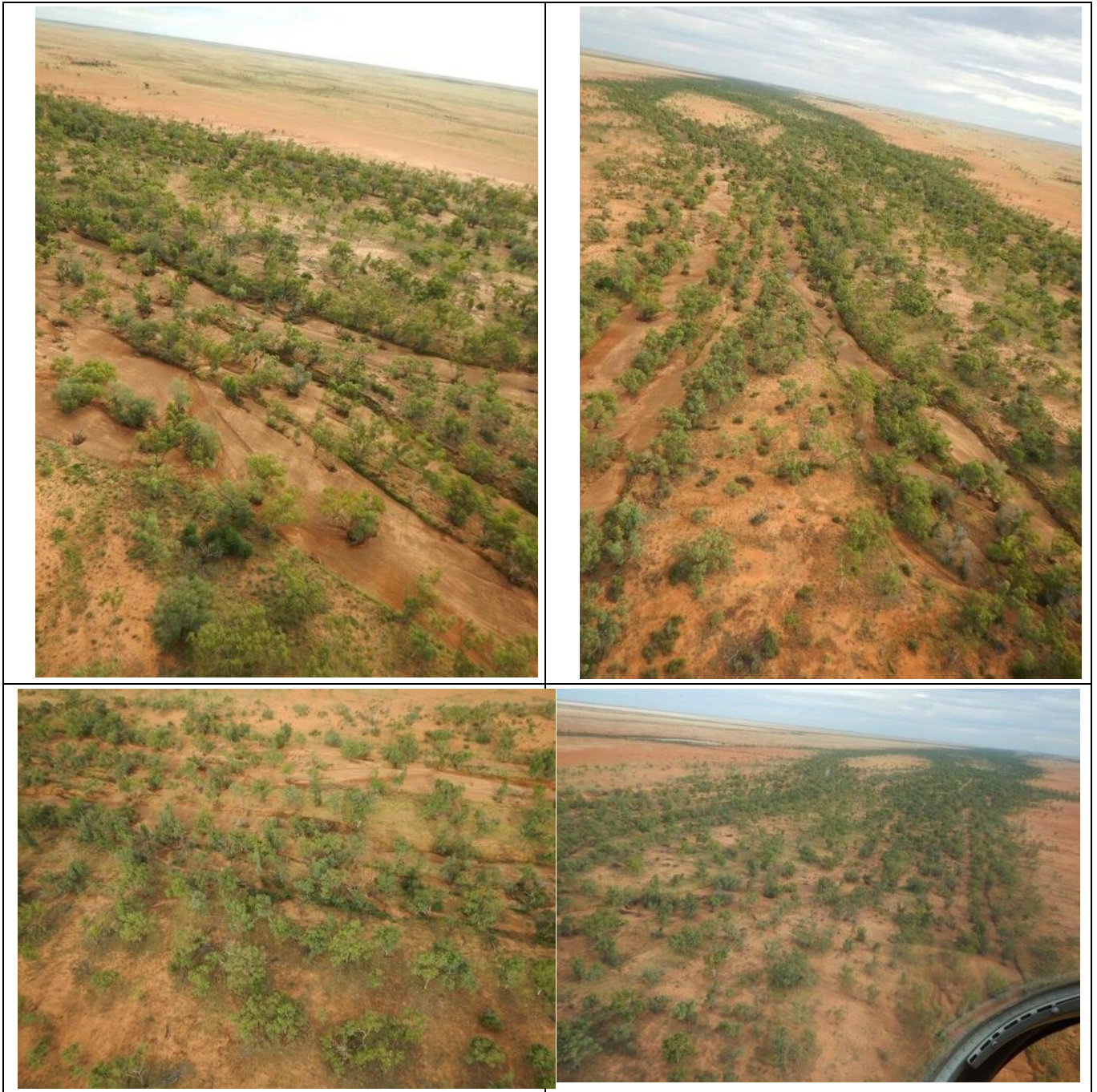






<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 5			<b>Location (KP)</b>		532	
<b>Watercourse name</b>	Templeton River			<b>GPS points GDA 1994, Zone 54</b>		E 0260411 N 7703687	
<b>General</b>							
<b>Stream order</b>	5+	<b>Channel type</b>	Braid	<b>No. of channels</b>		<b>Surrounding landform</b>	Rocky plains
<b>Geometry– N/A aerial survey only</b>							
<b>Bank height (m)</b>		<b>Channel width (m)</b>		<b>Bank slope (%)</b>	See sketch	<b>Bank type</b>	
<b>Bed width (m)</b>		<b>Bed slope (%)</b>		<b>Bed type</b>		<b>Presence of root matter in bank or aquatic vegetation</b>	
<b>Stability– N/A aerial survey only</b>							
<b>Erosion presence</b>		<b>Location</b>				<b>Type</b>	
<b>Possible contributing factors</b>						<b>Severity</b>	
<b>Habitat – N/A aerial survey only</b>							
<b>Riparian vegetation</b>							
<b>In-stream habitat</b>						<b>Presence of water or signs of wetted embankment</b>	
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	Yes*	<b>Proximity to ROW crossing (m)</b>	100	<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>				<b>Bank height (m)</b>		<b>Bank width (m)</b>	
<b>Bank slope</b>		<b>Bank composition</b>				<b>Vegetation presence</b>	
<b>General notes</b>							
*Man-made dam. Site was checked for presence of fringing reeds which could indicate suitable habitat for Yellow Chat. None was found.							
<b>Sketch of cross sectional profile</b>							
No sketch							
<b>Photos</b>							



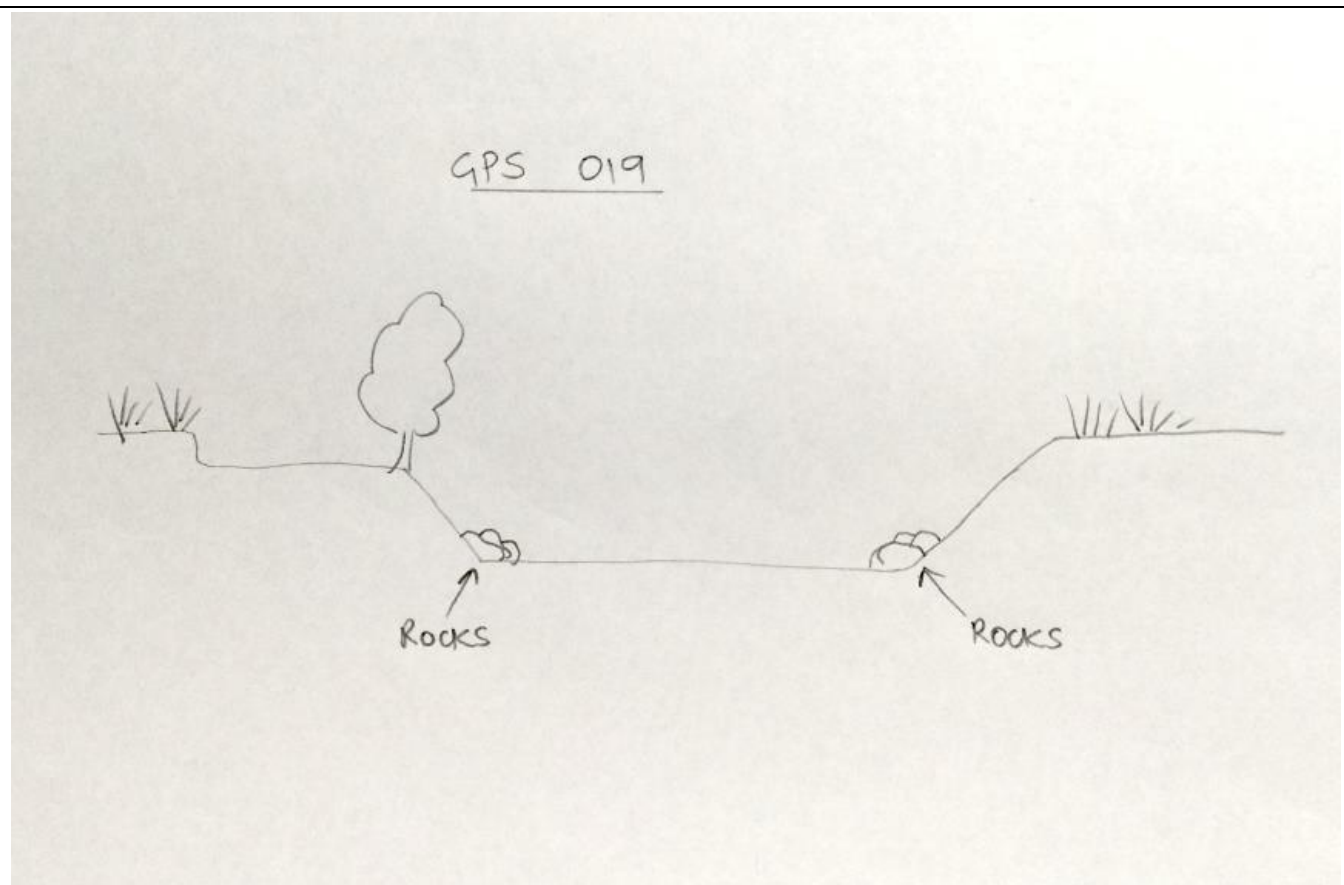






<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 6 (GPS019)			<b>Location (KP)</b>	586		
<b>Watercourse name</b>	Yaringa Creek			<b>GPS points GDA 1994, Zone 54</b>	E 0312403 N 7698545		
<b>General</b>							
<b>Stream order</b>	3	<b>Channel type</b>	Single	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Grassland
<b>Geometry</b>							
<b>Bank height (m)</b>	0.6 – 0.8	<b>Channel width (m)</b>	5	<b>Bank slope (%)</b>	> 45	<b>Bank type</b>	Rock / earth
<b>Bed width (m)</b>	5	<b>Bed slope (%)</b>	Flat	<b>Bed type</b>	Sand	<b>Presence of root matter in bank or aquatic vegetation</b>	Yes
<b>Stability</b>							
<b>Erosion presence</b>	Yes	<b>Location</b>	Bank		<b>Type</b>		
<b>Possible contributing factors</b>			Undercutting		<b>Severity</b>	Mild	
<b>Habitat</b>							
<b>Riparian vegetation</b>	River Red Gum						
<b>In-stream habitat</b>	Roots, rocks				<b>Presence of water or signs of wetted embankment</b>	No	
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	No	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>				<b>Bank height (m)</b>		<b>Bank width (m)</b>	
<b>Bank slope</b>		<b>Bank composition</b>				<b>Vegetation presence</b>	
<b>Sketch of cross sectional profile</b>							





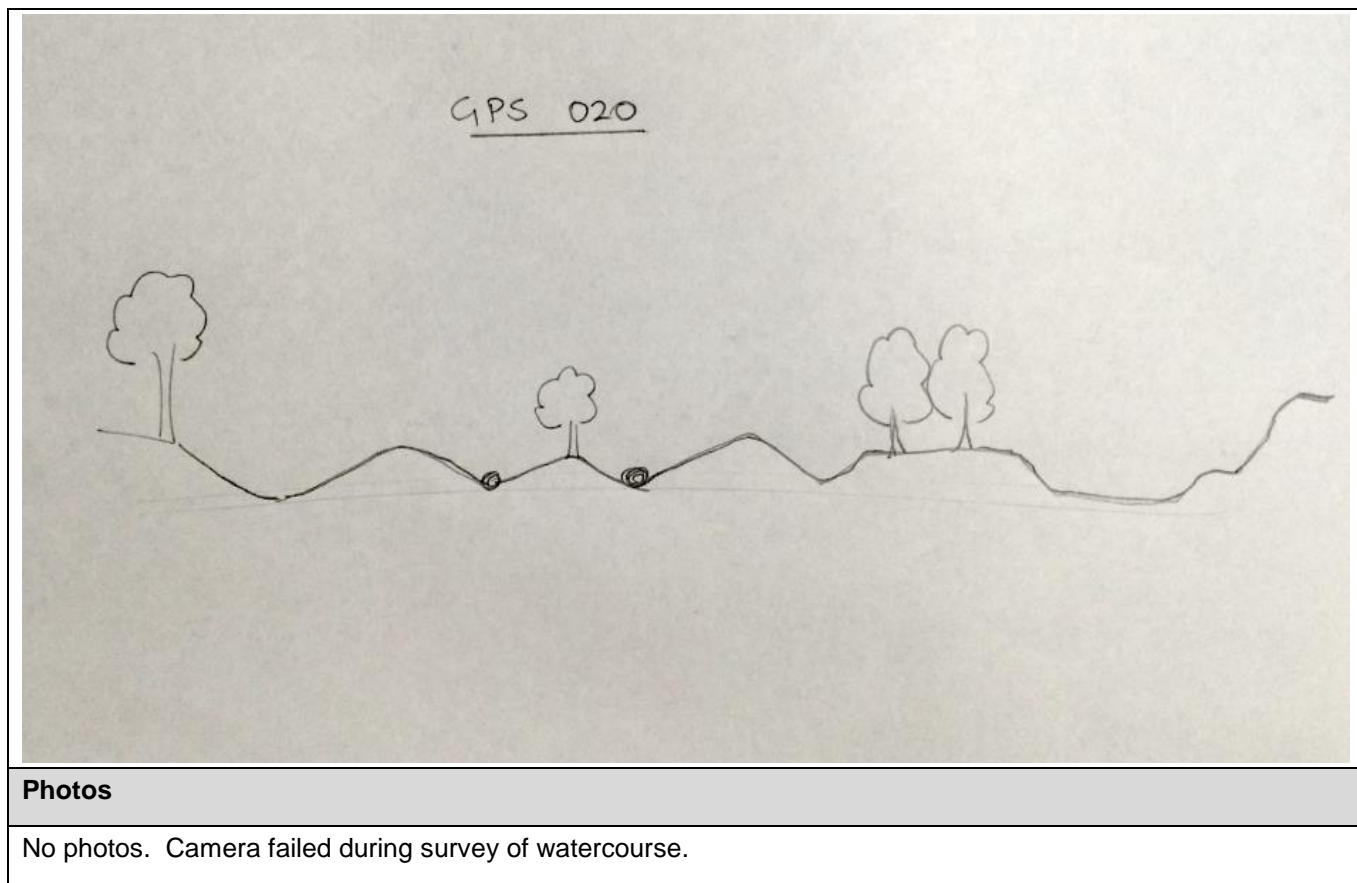
#### Photos





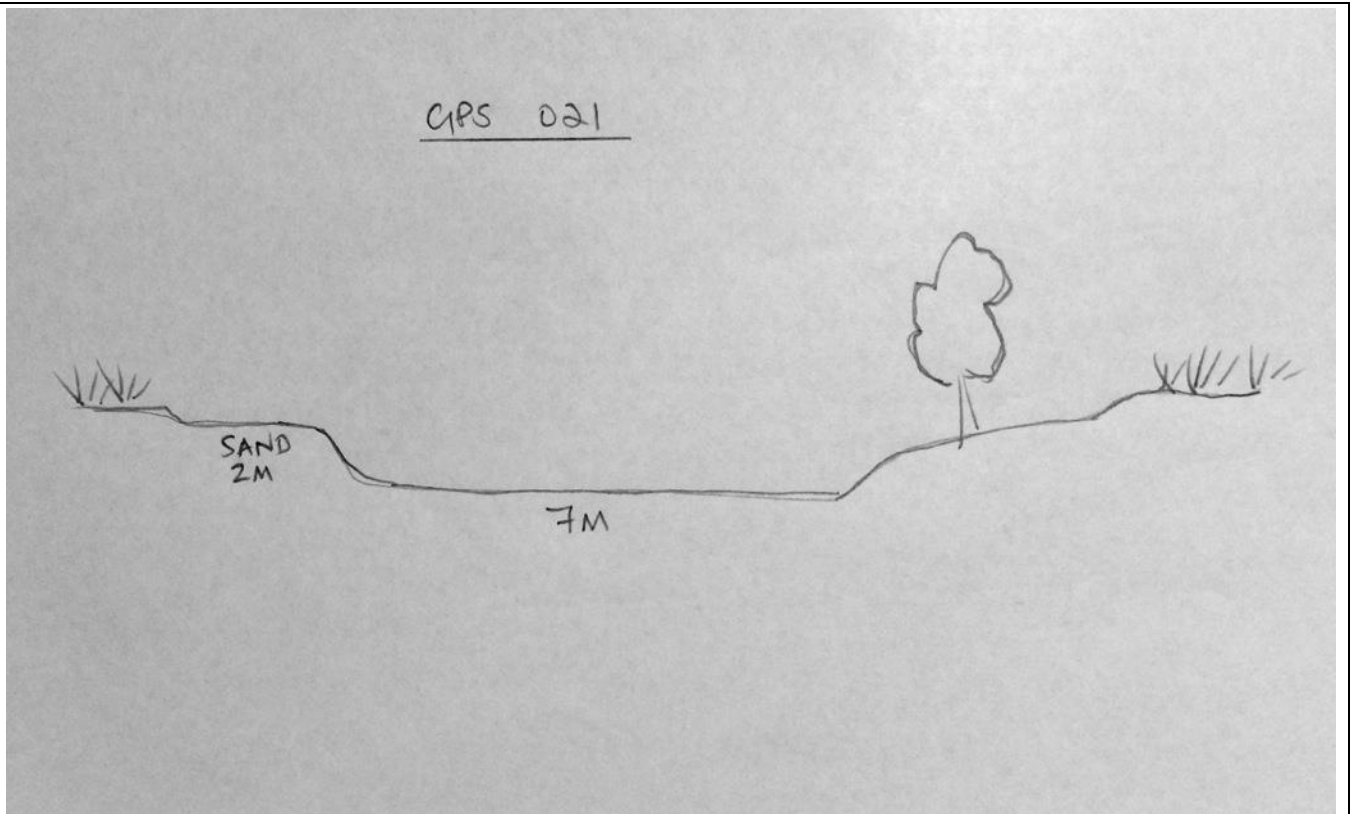


<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 7 (GPS020)				<b>Location (KP)</b>	591	
<b>Watercourse name</b>	Yaringa Creek				<b>GPS points GDA 1994, Zone 54</b>	E 0316311 N 7696264	
<b>General</b>							
<b>Stream order</b>	5+	<b>Channel type</b>	Braided	<b>No. of channels</b>	> 5	<b>Surrounding landform</b>	Rocky plains
<b>Geometry</b>							
<b>Bank height (m)</b>	0.6 – 0.8	<b>Channel width (m)</b>	~ 50	<b>Bank slope (%)</b>	80	<b>Bank type</b>	Earth / sand
<b>Bed width (m)</b>	30	<b>Bed slope (%)</b>	Flat	<b>Bed type</b>	Sand	<b>Presence of root matter in bank or aquatic vegetation</b>	Yes
<b>Stability</b>							
<b>Erosion presence</b>	Yes	<b>Location</b>	Bank			<b>Type</b>	Gully
<b>Possible contributing factors</b>			Cattle			<b>Severity</b>	Minor
<b>Habitat</b>							
<b>Riparian vegetation</b>	E. camaldulensis, C. terminalis						
<b>In-stream habitat</b>	Roots, debris, veg					<b>Presence of water or signs of wetted embankment</b>	No
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	No	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>					<b>Bank height (m)</b>		<b>Bank width (m)</b>
<b>Bank slope</b>		<b>Bank composition</b>					<b>Vegetation presence</b>
<b>Sketch of cross sectional profile</b>							



<b>Location</b>									
<b>Site name</b>	Queensland Watercourse 8 (GPS021)				<b>Location (KP)</b>		598		
<b>Watercourse name</b>	Yaringa Creek				<b>GPS points GDA 1994, Zone 54</b>		E 0323574 N 7695744		
<b>General</b>									
<b>Stream order</b>	-	<b>Channel type</b>	Single	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Rocky plain		
<b>Geometry</b>									
<b>Bank height (m)</b>	0.5	<b>Channel width (m)</b>	9	<b>Bank slope (%)</b>	~ 45	<b>Bank type</b>	Earth / sand		
<b>Bed width (m)</b>	7	<b>Bed slope (%)</b>	Flat	<b>Bed type</b>	Sand / gravel	<b>Presence of root matter in bank or aquatic vegetation</b>			Yes
<b>Stability</b>									
<b>Erosion presence</b>	Yes	<b>Location</b>	Bank - undercut			<b>Type</b>			
<b>Possible contributing factors</b>						<b>Severity</b>	Mild		
<b>Habitat</b>									
<b>Riparian vegetation</b>	<i>E. camaldulensis</i> , Buffel Grass, Black Spear Grass, <i>Themeda</i> sp.								
<b>In-stream habitat</b>	Yes – roots, debris, rock					<b>Presence of water or signs of wetted embankment</b>		No	
<b>Permanent water (within 1km of ROW)</b>									
<b>Presence of pool</b>	No	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>			
<b>Water description</b>					<b>Bank height (m)</b>		<b>Bank width (m)</b>		
<b>Bank slope</b>		<b>Bank composition</b>					<b>Vegetation presence</b>		
<b>Sketch of cross sectional profile</b>									





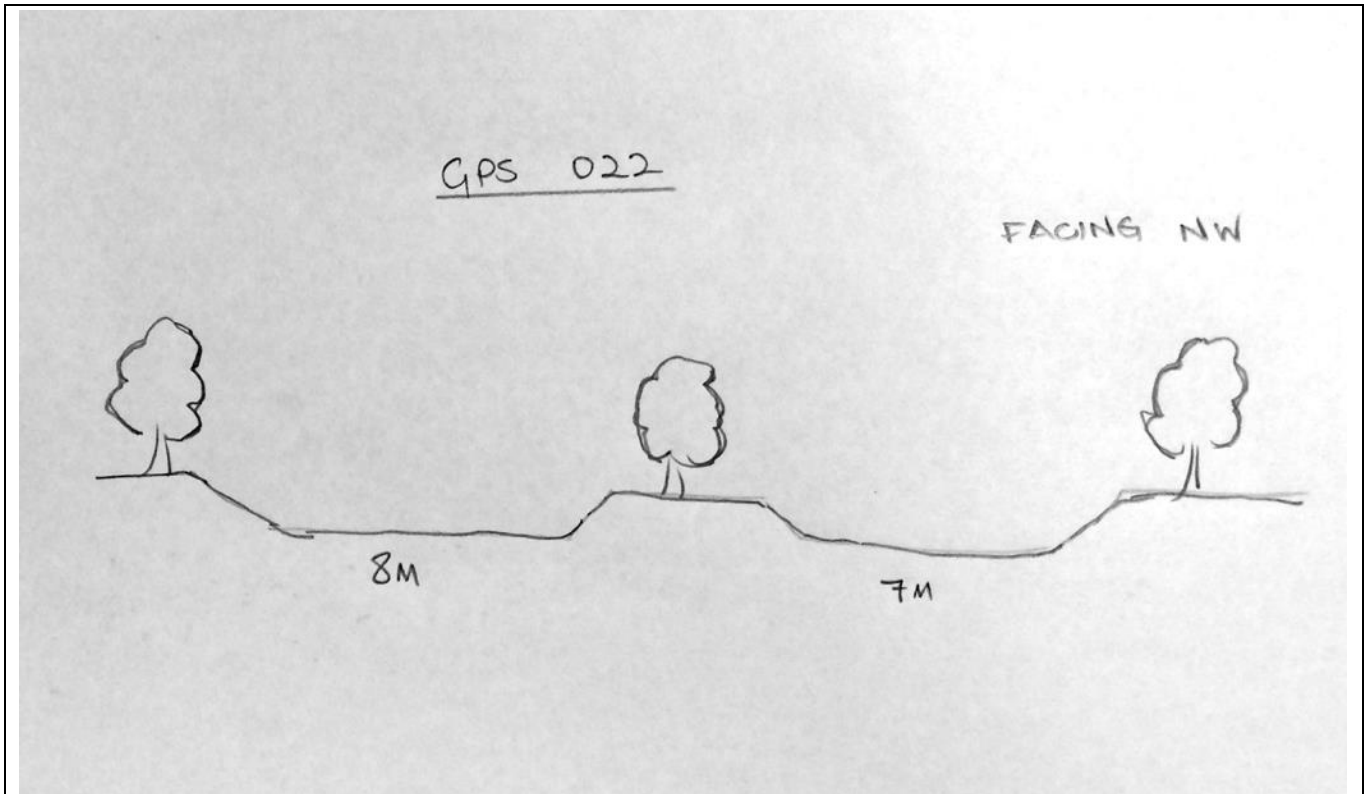
#### Photos





<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 9 (GPS022)			<b>Location (KP)</b>	602		
<b>Watercourse name</b>	Yaringa Creek			<b>GPS points GDA 1994, Zone 54</b>	E 0327567 N 7695639		
<b>General</b>							
<b>Stream order</b>		<b>Channel type</b>	Braided	<b>No. of channels</b>		<b>Surrounding landform</b>	Rocky / sandy plain
<b>Geometry</b>							
<b>Bank height (m)</b>	0.8 - 1	<b>Channel width (m)</b>	8, 7	<b>Bank slope (%)</b>	60	<b>Bank type</b>	Earth
<b>Bed width (m)</b>		<b>Bed slope (%)</b>		<b>Bed type</b>	Sand / gravel	<b>Presence of root matter in bank or aquatic vegetation</b>	Yes
<b>Stability</b>							
<b>Erosion presence</b>	No	<b>Location</b>			<b>Type</b>		
<b>Possible contributing factors</b>					<b>Severity</b>		
<b>Habitat</b>							
<b>Riparian vegetation</b>	River Red Gum, Buffel Grass, Black Spear Grass						
<b>In-stream habitat</b>	Veg, branches, roots, debris				<b>Presence of water or signs of wetted embankment</b>	Yes	
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	No	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>				<b>Bank height (m)</b>		<b>Bank width (m)</b>	
<b>Bank slope</b>		<b>Bank composition</b>				<b>Vegetation presence</b>	
<b>General notes</b>							
No permanent water – water within creek bed from rain. Multiple >10, all < 10 cm deep at crossing point.							
<b>Sketch of cross sectional profile</b>							





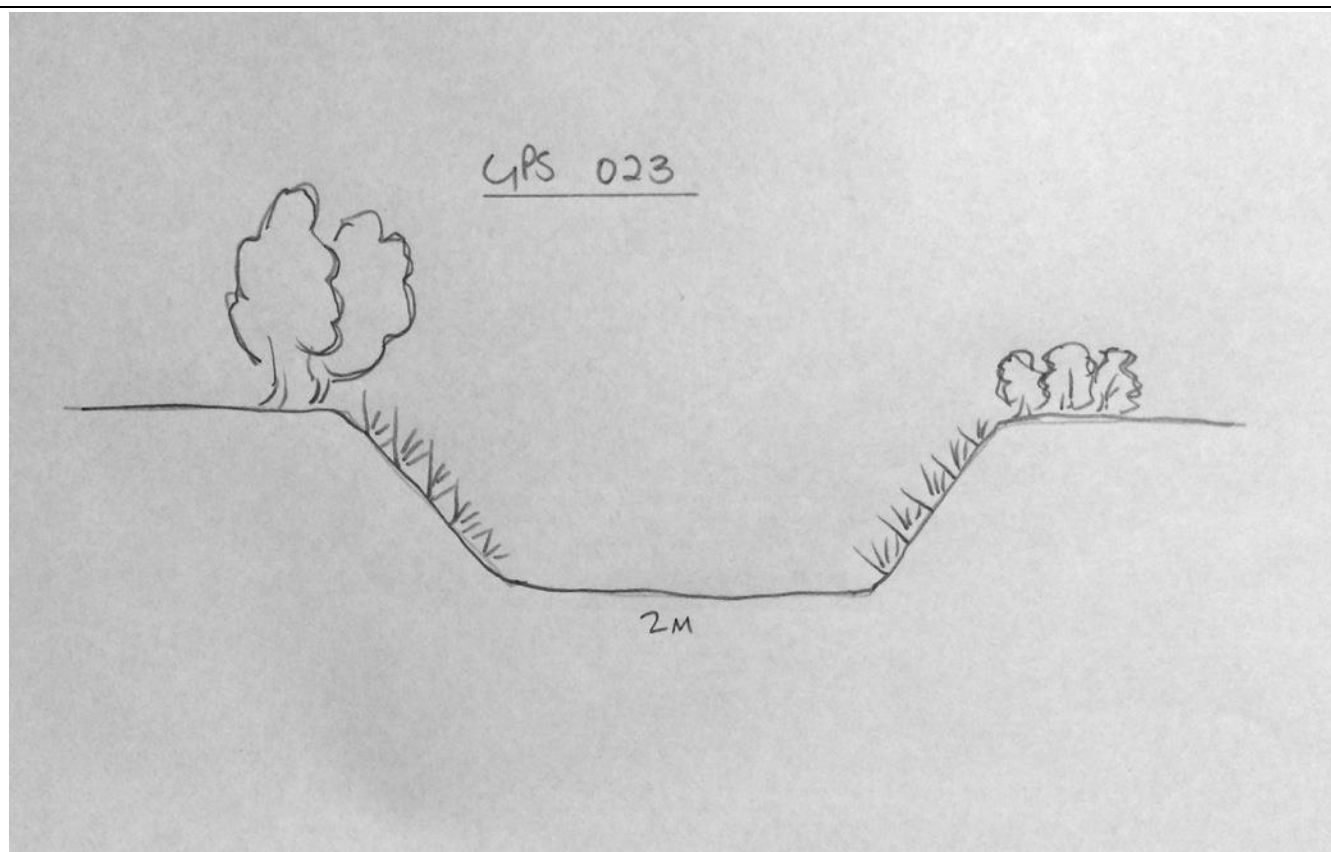
#### Photos





<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 10 (GPS023)			<b>Location (KP)</b>	607		
<b>Watercourse name</b>	Unnamed, tributary of the Templeton River			<b>GPS points GDA 1994, Zone 54</b>	E 0330539 N 7697820		
<b>General</b>							
<b>Stream order</b>	1-2	<b>Channel type</b>	Single	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Rocky plains
<b>Geometry</b>							
<b>Bank height (m)</b>	0.6. – 0.8	<b>Channel width (m)</b>	2	<b>Bank slope (%)</b>	60	<b>Bank type</b>	Earth / rock
<b>Bed width (m)</b>	2	<b>Bed slope (%)</b>	-	<b>Bed type</b>	Sand	<b>Presence of root matter in bank or aquatic vegetation</b>	Yes
<b>Stability</b>							
<b>Erosion presence</b>	No	<b>Location</b>				<b>Type</b>	
<b>Possible contributing factors</b>						<b>Severity</b>	
<b>Habitat</b>							
<b>Riparian vegetation</b>	<i>E. leucophylla</i> , Buffel Grass, <i>Themeda</i> sp.						
<b>In-stream habitat</b>	No					<b>Presence of water or signs of wetted embankment</b>	No
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	No	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>				<b>Bank height (m)</b>		<b>Bank width (m)</b>	
<b>Bank slope</b>		<b>Bank composition</b>					<b>Vegetation presence</b>
<b>Sketch of cross sectional profile</b>							





#### Photos

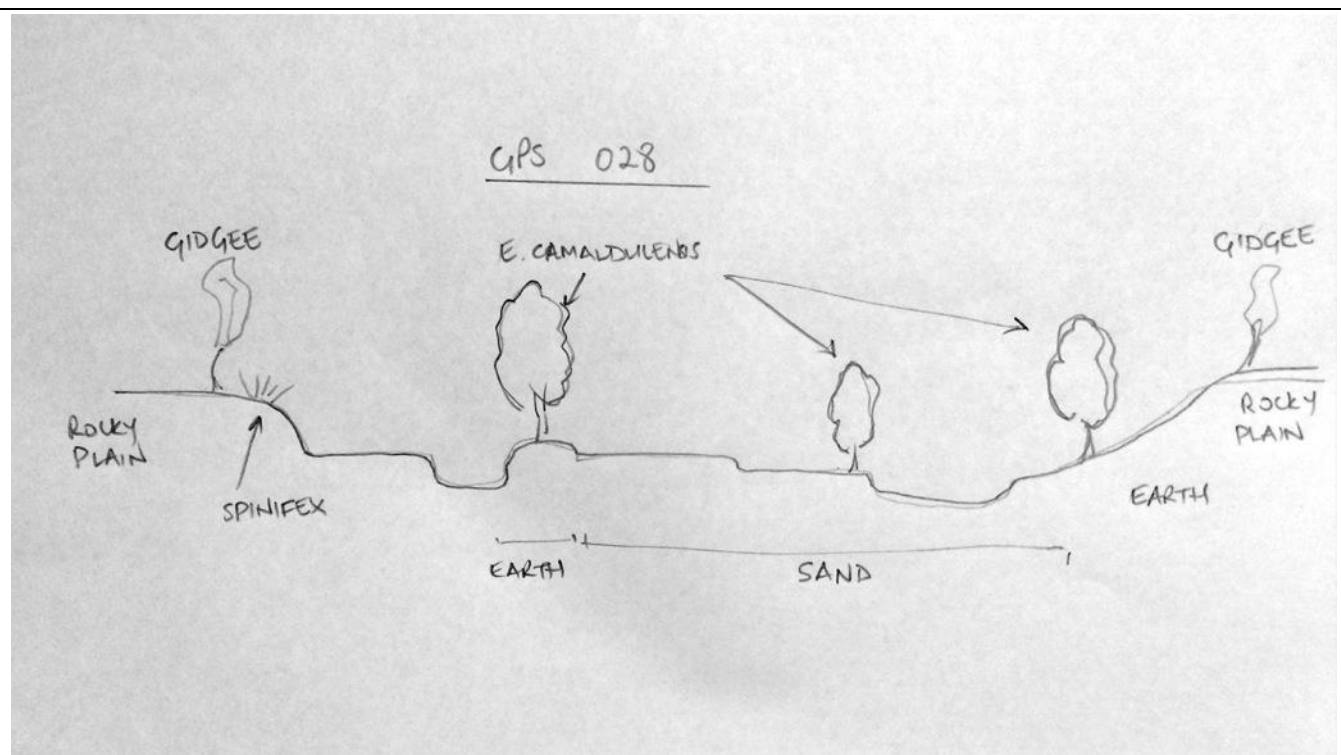






<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 11 (GPS028)			<b>Location (KP)</b>	614		
<b>Watercourse name</b>	Mica Creek			<b>GPS points GDA 1994, Zone 54</b>	E 0337679 N 7696802		
<b>General</b>							
<b>Stream order</b>	2	<b>Channel type</b>	Single	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Rocky plains
<b>Geometry</b>							
<b>Bank height (m)</b>	1	<b>Channel width (m)</b>	11	<b>Bank slope (%)</b>	50	<b>Bank type</b>	Gravel / sand
<b>Bed width (m)</b>	18	<b>Bed slope (%)</b>	< 5	<b>Bed type</b>	Sand gravel	<b>Presence of root matter in bank or aquatic vegetation</b>	Yes
<b>Stability</b>							
<b>Erosion presence</b>	Yes	<b>Location</b>	Bank / gully near crossing			<b>Type</b>	Gully Undercut
<b>Possible contributing factors</b>			Cattle, vehicles, runoff from side streams			<b>Severity</b>	Medium
<b>Habitat</b>							
<b>Riparian vegetation</b>	<i>Eucalyptus camaldulensis</i> , gidgee, Buffel Grass (grazed), some Mistletoe (scattered), <i>E. leucophylla</i> (back from bank)						
<b>In-stream habitat</b>	Roots, debris, stones (to 30 cm), fallen logs					<b>Presence of water or signs of wetted embankment</b>	Yes
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	No	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>				<b>Bank height (m)</b>		<b>Bank width (m)</b>	
<b>Bank slope</b>		<b>Bank composition</b>				<b>Vegetation presence</b>	
<b>General notes</b>							
Would likely form more channels in wet season, running water just upstream at time of survey							
<b>Sketch of cross sectional profile</b>							





#### Photos





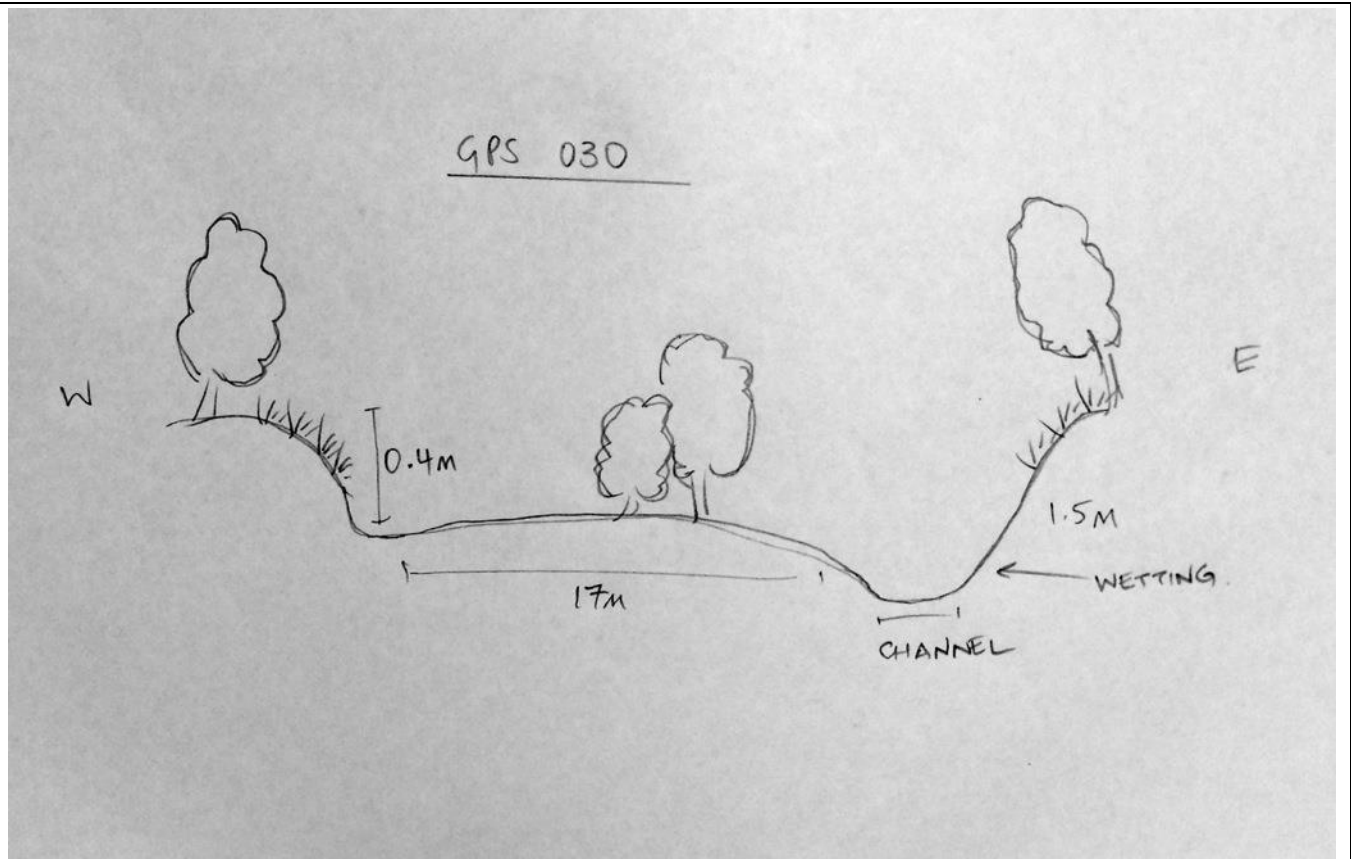








<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 12 (GPS030)			<b>Location (KP)</b>	614		
<b>Watercourse name</b>	Mica Creek			<b>GPS points GDA 1994, Zone 54</b>	E 0337652 N 7696906		
<b>General</b>							
<b>Stream order</b>	3	<b>Channel type</b>	Single	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Rocky plains
<b>Geometry</b>							
<b>Bank height (m)</b>	W - 0.4 E - 1.5	<b>Channel width (m)</b>	2	<b>Bank slope (%)</b>	W - 45 E - 60	<b>Bank type</b>	Sand / earth
<b>Bed width (m)</b>	~17	<b>Bed slope (%)</b>	Flat	<b>Bed type</b>	Gravel with large rocks	<b>Presence of root matter in bank or aquatic vegetation</b>	Yes
<b>Stability</b>							
<b>Erosion presence</b>	Yes	<b>Location</b>	Bank		<b>Type</b>		
<b>Possible contributing factors</b>			Cattle		<b>Severity</b>	Moderate	
<b>Habitat</b>							
<b>Riparian vegetation</b>	<i>Eucalyptus camaldulensis</i> , <i>E. leucophylla</i> , Buffel Grass, spinifex, large patches of gidgee						
<b>In-stream habitat</b>	Roots, debris				<b>Presence of water or signs of wetted embankment</b>	Yes	
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>		<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>				<b>Bank height (m)</b>		<b>Bank width (m)</b>	
<b>Bank slope</b>		<b>Bank composition</b>				<b>Vegetation presence</b>	
<b>Sketch of cross sectional profile</b>							



## Photos



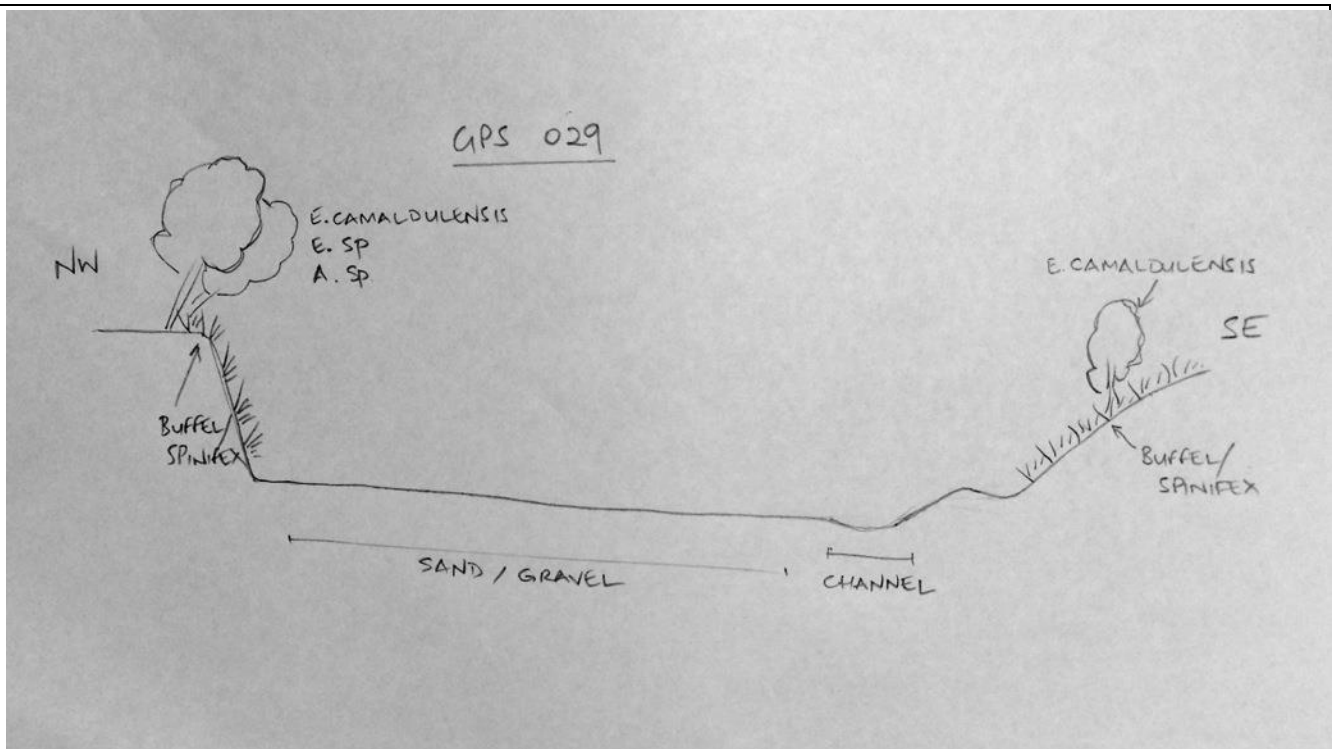








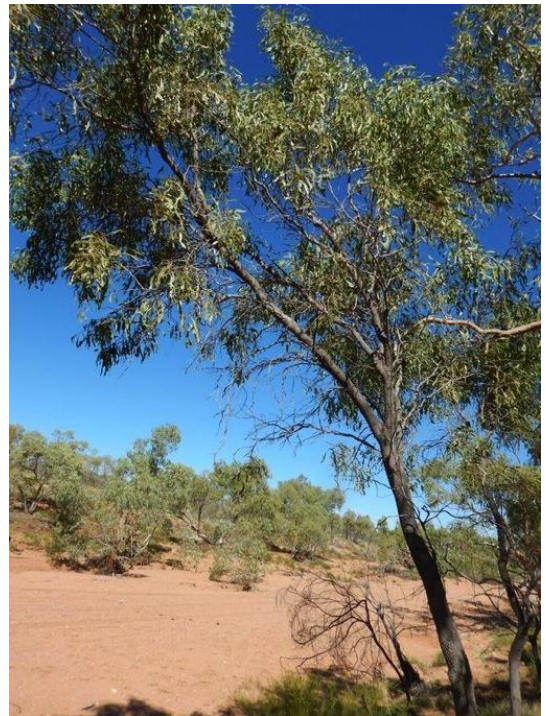
<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 13 (GPS029)				<b>Location (KP)</b>	615	
<b>Watercourse name</b>	Mica Creek				<b>GPS points GDA 1994, Zone 54</b>	E0338295 N7696431	
<b>General</b>							
<b>Stream order</b>	3	<b>Channel type</b>	Single	<b>No. of channels</b>	1	<b>Surrounding landform</b>	Rocky plains
<b>Geometry</b>							
<b>Bank height (m)</b>	1.2	<b>Channel width (m)</b>	1.5	<b>Bank slope (%)</b>	NW 80 SE 45	<b>Bank type</b>	Sand
<b>Bed width (m)</b>	23	<b>Bed slope (%)</b>	Flat	<b>Bed type</b>	Sand / gravel	<b>Presence of root matter in bank or aquatic vegetation</b>	Yes bank
<b>Stability</b>							
<b>Erosion presence</b>	Yes	<b>Location</b>	Bank			<b>Type</b>	
<b>Possible contributing factors</b>			Cattle (cattle tracks), vehicles (tyre marks in bed)			<b>Severity</b>	Minor
<b>Habitat</b>							
<b>Riparian vegetation</b>	<i>Eucalyptus camaldulensis</i> , <i>Corymbia terminalis</i> , Buffel Grass (eaten), spinifex, <i>E. leucophloia</i> , <i>E. leucophylla</i> , <i>Acacia</i> spp, <i>Acacia chisholmii</i> , Spear grass.						
<b>In-stream habitat</b>	Minimal, some debris near trees at bank, scattered					<b>Presence of water or signs of wetted embankment</b>	
<b>Permanent water (within 1km of ROW)</b>							
<b>Presence of pool</b>	No	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>	
<b>Water description</b>					<b>Bank height (m)</b>		<b>Bank width (m)</b>
<b>Bank slope</b>		<b>Bank composition</b>					<b>Vegetation presence</b>
<b>General notes</b>							
Would braid during wet season Spinifex down to bank							
<b>Sketch of cross sectional profile</b>							



## Photos





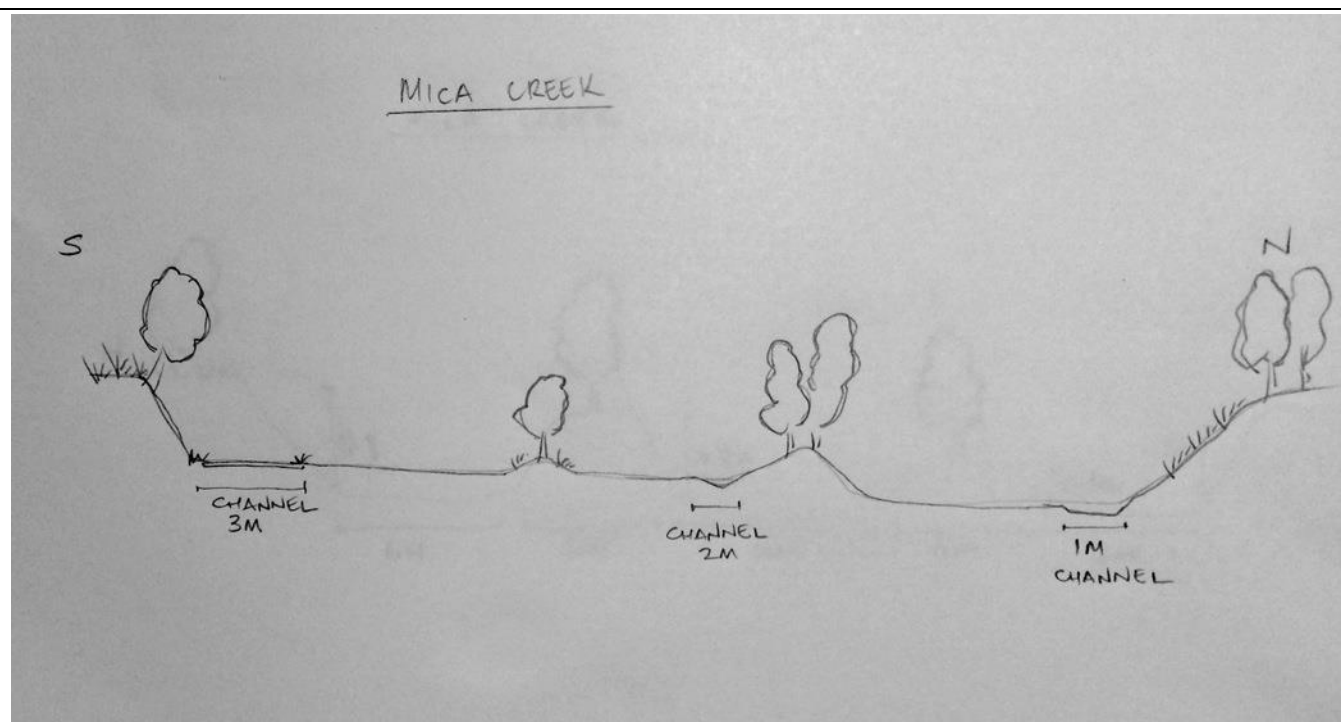






<b>Location</b>							
<b>Site name</b>	Queensland Watercourse 15 (Mica Creek)			<b>Location (KP)</b>	617		
<b>Watercourse name</b>	Mica Creek			<b>GPS points GDA 1994, Zone 54</b>	E0339926 N7696881		
<b>General</b>							
<b>Stream order</b>	4	<b>Channel type</b>	Braided	<b>No. of channels</b>	3	<b>Surrounding landform</b>	Rocky / sandy plains near rocky hills
<b>Geometry</b>							
<b>Bank height (m)</b>	~ 1.5	<b>Channel width (m)</b>	3, 2, 1	<b>Bank slope (%)</b>	N – 45 S – 60	<b>Bank type</b>	Sand
<b>Bed width (m)</b>	~ 42	<b>Bed slope (%)</b>	Flat	<b>Bed type</b>	Sand / gravel	<b>Presence of root matter in bank or aquatic vegetation</b>	Yes
<b>Stability</b>							
<b>Erosion presence</b>	Yes	<b>Location</b>	Bank (both sides)			<b>Type</b>	Gully
<b>Possible contributing factors</b>			Runoff from surrounding lands and cattle			<b>Severity</b>	Moderate
<b>Habitat</b>							
<b>Riparian vegetation</b>	<i>Eucalyptus camaldulensis</i> to <i>E. leucophylla</i> behind, Buffel Grass underneath, isolated native grasses						
<b>In-stream habitat</b>	Debris, roots, rocks to 50 cm					<b>Presence of water or signs of wetted embankment</b>	Yes
<b>Presence of water</b>							
<b>Flowing</b>	No flowing water						
<b>Presence of pool</b>	Yes	<b>Proximity to ROW crossing (m)</b>	20	<b>Width of pool (m)</b>	5 x 2	<b>Depth of pool (m)</b>	0.20
<b>Water description</b>	Dark / tannins			<b>Bank height (m)</b>	-	<b>Bank width (m)</b>	-
<b>Bank slope</b>	-	<b>Bank composition</b>	Sand			<b>Vegetation presence</b>	-
<b>General notes</b>							
Pool was small and unlikely to remain throughout dry season – not a permanent pool. Pool was near Mica Creek road crossing, and contained numerous fish.							
<b>Sketch of cross sectional profile</b>							





#### Photos





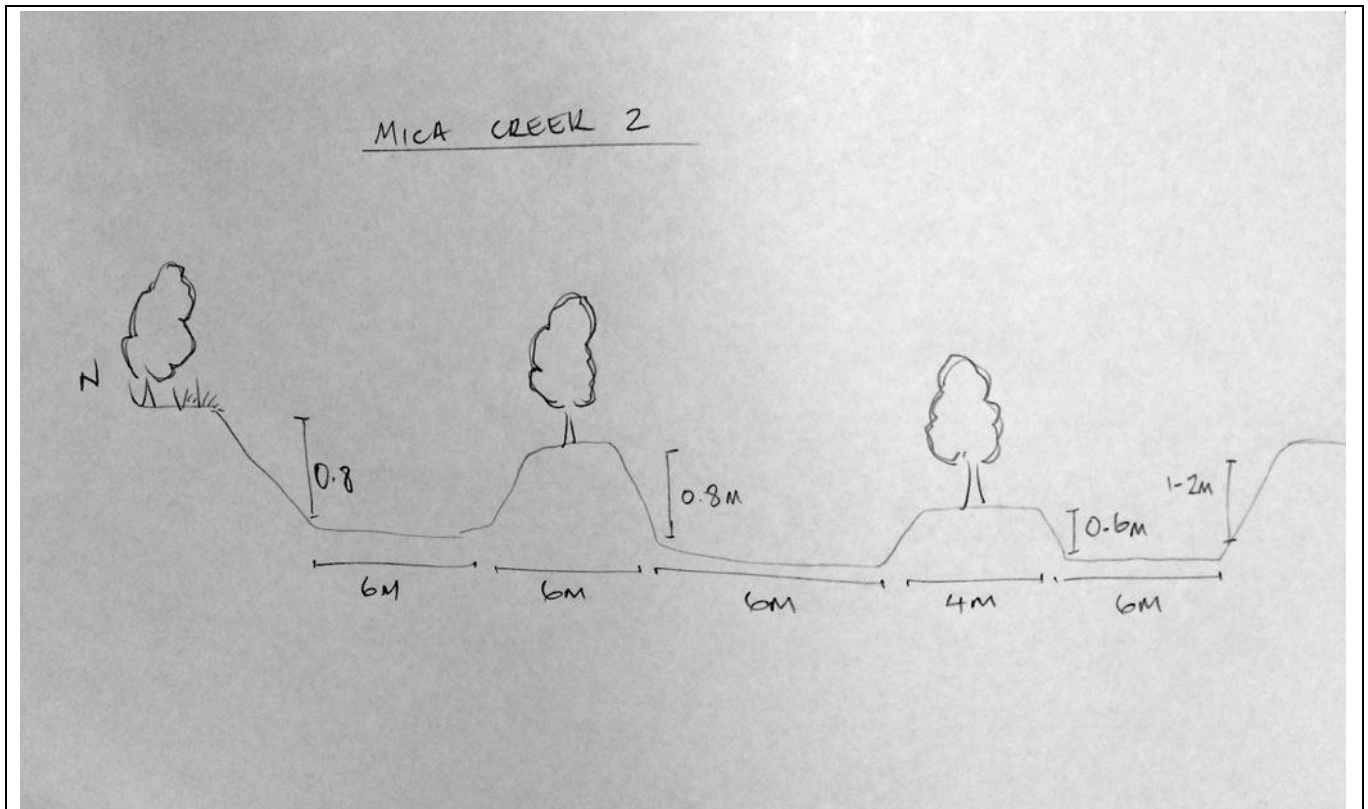








<b>Location</b>									
<b>Site name</b>	Queensland Watercourse 14 (Mica Creek 2)				<b>Location (KP)</b>		617		
<b>Watercourse name</b>	Mica Creek				<b>GPS points GDA 1994, Zone 53 or 54</b>		E 0339916 N 7696929		
<b>General</b>									
<b>Stream order</b>	4	<b>Channel type</b>	Braided	<b>No. of channels</b>	3	<b>Surrounding landform</b>	Sandy/rocky plains		
<b>Geometry</b>									
<b>Bank height (m)</b>	0.8 – 1.2	<b>Channel width (m)</b>	6, 6, 6	<b>Bank slope (%)</b>	60	<b>Bank type</b>	Sand / gravel		
<b>Bed width (m)</b>	~ 27	<b>Bed slope (%)</b>	Flat	<b>Bed type</b>	Sand / gravel	<b>Presence of root matter in bank or aquatic vegetation</b>			Yes
<b>Stability</b>									
<b>Erosion presence</b>	Yes	<b>Location</b>	North bank			<b>Type</b>	Gully		
<b>Possible contributing factors</b>			Cattle tracks on bank and in stream bed			<b>Severity</b>	Moderate		
<b>Habitat</b>									
<b>Riparian vegetation</b>	<i>Eucalyptus camaldulensis</i> , with <i>E. leucophylla</i> and gidgee back from bank <i>Acacia chisholmii</i> and predominantly Buffel Grass, spinifex away from river								
<b>In-stream habitat</b>	Debris, roots, rocks					<b>Presence of water or signs of wetted embankment</b>		Yes	
<b>Permanent water (within 1km of ROW)</b>									
<b>Presence of pool</b>	No	<b>Proximity to ROW crossing (m)</b>		<b>Width of pool (m)</b>		<b>Depth of pool (m)</b>			
<b>Water description</b>					<b>Bank height (m)</b>		<b>Bank width (m)</b>		
<b>Bank slope</b>		<b>Bank composition</b>					<b>Vegetation presence</b>		
<b>Sketch of cross sectional profile</b>									



## Photos







## 4 Further work

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Prior to construction the entire pipeline alignment route and access tracks will be driven, and any remaining watercourses will be surveyed as required. This will inform the development of a Progressive Erosion and Sediment Control Plan for watercourse crossings, which will detail:

- Watercourse crossing characteristics
- Specific designs for the construction ROW approach to watercourse crossings
- Construction requirements, including the methods for vegetation clearing, excavation and the handling of soils
- Reinstatement requirements to return watercourse crossing to as close to pre-disturbed condition as possible.

As a minimum, the Progressive ESCP will require that each watercourse crossing is surveyed prior to disturbance to determine the levels of the bed and bank. Once construction is complete within the watercourse, reinstated levels will be taken and compared to pre-disturbance levels to ensure that the watercourse crossing has been reinstated to a condition comparable with pre-disturbance profiles.

Also prior to construction, a dry season survey will be undertaken to identify and map the location of permanent pools of water in the James, Ranken and Georgina Rivers. The survey will focus on the reaches of these rivers for 1 km upstream and downstream of the proposed watercourse crossing location, and describe any permanent pools that are identified. This will inform the location of potential Groundwater Dependent Ecosystems or areas of groundwater-surface water interaction, and also potentially important aquatic habitat and wildlife refuges. The findings of the survey will inform the watercourse crossing designs and construction methodologies such that impacts to permanent pools are minimised.

In Queensland, all watercourse crossings are self-assessable under the *Code for Self-assessable Development Temporary Waterway Barrier Works* (DAF 2013). A requirement of the Code is to submit pre-work and post-work notifications to the Queensland Department of Fisheries which must include:

- A map of the location of works
- Site photographs for each crossing (upstream, downstream and across the crossing)

This will provide evidence that the code is complied with, specifically that the profiles or the bed and banks are reinstated to the natural stream profile (within five business days of completion of works), that the watercourse bed is retained with natural substrate (or comparable), and vegetation and cover is rapidly re-established.



## 5 Acronyms, Glossary & References

### 5.1 Acronyms

<b>BOM</b>	Bureau of Meteorology
<b>DAF</b>	Department of Agriculture and Fisheries (Queensland)
<b>E</b>	East or easting (GPS coordinate)
<b>EA</b>	Environmental Authority
<b>EIS</b>	Environmental Impact Statement
<b>ESCP</b>	Erosion and Sediment Control Plan
<b>GDA</b>	Geocentric datum of Australia
<b>GPS</b>	Global positional system
<b>KP</b>	Kilometre point
<b>m</b>	Metre
<b>N</b>	North or northing (GPS coordinate)
<b>N/A</b>	Not applicable
<b>NGP</b>	Northern Gas Pipeline
<b>NW</b>	North-west
<b>ROW</b>	Right Of Way
<b>S</b>	South
<b>SE</b>	South-east
<b>SW</b>	South-west
<b>TOR</b>	Terms of Reference
<b>W</b>	West

### 5.2 Glossary

Term	Meaning
<b>Anabran</b>	A stream that branches from a main river then reunites with it.
<b>Aquifer</b>	Rock or sediment in a formation, group of formations or part of a formation that is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.
<b>Aquitard</b>	A body of rock or stratum of sediment of low permeability that retards, but does not prevent, the flow of groundwater between aquifers.
<b>Catchment</b>	A water intake area or all parts of a drainage basin.
<b>Construction footprint</b>	Area encompassing all construction activities conducted as part of the NGP project. Includes the construction ROW within which the pipeline will be installed, compressor station sites, pipeline facilities sites, transport routes, access tracks, laydown areas, turn-around areas, construction camps and water storage.
<b>Construction ROW</b>	30m wide corridor in which construction activities required for installation of the pipeline will be undertaken.
<b>Declared fish habitat areas (DFHA)</b>	Coastal fish habitats; none exist within or near the Project area (as defined in the EPP Water; Qld Government 2014)

Term	Meaning
<b>Drainage pattern</b>	The pattern formed by drainage lines, gullies, streams and rivers.
<b>Ephemeral</b>	Watercourses or wetlands which are dry for the most of the year and flow, or fill, only immediately following rainfall.
<b>Floodout</b>	An area where a drainage channel becomes subdivided, indistinct or disappears completely and water is dispersed across a plain (as defined by Duguid et al. 2005)
<b>Floodplain</b>	An area of low-lying ground adjacent to a river, formed mainly of river sediments and subject to flooding.
<b>Ground-truth</b>	The collection of ground-truth data enables calibration of remote-sensing data, and aids in the interpretation and analysis of what is being sensed.
<b>Groundwater Dependent Ecosystems</b>	Groundwater-dependent ecosystems (GDEs) are a vital yet poorly understood component of the natural environment. An ecosystem is when living organisms benefit from one another via symbiotic relationships. A groundwater-dependent ecosystem is when its nourishment relies on groundwater input.
<b>Highly disturbed waters</b>	Waters where 'the biological integrity of an aquatic ecosystem is measurably degraded and of lower ecological value than waters' defined above (as defined in the EPP (Water); Qld Government 2014)
<b>High ecological value water</b>	Waters where 'the biological integrity of an aquatic ecosystem is effectively unmodified or highly valued' (as defined in the EPP (Water); Qld Government 2014)
<b>Intermittent (as in watercourse)</b>	Watercourses or wetlands which are alternatively wet and dry. They usually flow annually but cease to flow for weeks or months of each year. Intermittent streams can contain permanent pools of water which sustain life during dry periods.
<b>Maximum Allowable Operating Pressure</b>	Refers to the wall strength of a pressurised cylinder such as a pipeline or storage tank and how much pressure the walls may safely hold in normal operation.
<b>Moderately disturbed water</b>	Are waters where 'the biological integrity of an aquatic ecosystem is adversely affected by human activity to a relatively small but measurable degree' (as defined in the EPP (Water); Qld Government 2014)
<b>New access tracks</b>	Tracks which will be constructed and used to access the pipeline construction ROW. Tracks will be reinstated and rehabilitated on completion of construction, excepting those that access pipeline facilities and/or requested for retention by the landholder.
<b>Palustrine (as in wetlands)</b>	Primarily vegetated non-channel environments of < 8 ha in size. They include billabongs, swamps, bogs, springs and soaks (DEHP 2016)
<b>Perched water table</b>	Water table that is positioned above the normal water table for an area because of the presence of an impermeable rock layer.
<b>Perennial</b>	Lasting for an indefinite amount of time. In relation to watercourses; permanently flowing water courses, or those that flow for the majority of the time except in extremely dry years. In relation to wetlands; perennial refers to those that hold permanent water, although water levels may fluctuate depending on the season.
<b>Pipeline</b>	The buried steel gas transmission pipeline will be up to 42 inch (DN1050) in nominal diameter.
<b>Pipeline route</b>	The location of the pipeline alignment from the tie-in point on the Amadeus Gas Pipeline at Warrego, to the tie-in point on the Carpentaria Gas Pipeline at Mount Isa.
<b>Probable Maximum Flood</b>	The flood resulting from probable maximum precipitation and, where applicable, snowmelt, coupled with the worst flood-producing catchment



Term	Meaning
	conditions that can be realistically expected in the prevailing meteorological conditions.
<b>The Project</b>	The Northern Gas Pipeline Project encompasses all activities that will occur in association with planning, constructing, operating and decommissioning the Northern Gas Pipeline.
<b>Project footprint</b>	The area that may be impacted on directly or indirectly by the Project during the planning, construction, operations and decommissioning phases.
<b>Ramsar</b>	An international treaty for the conservation and sustainable use of wetlands. The treaty was adopted in the Iranian city of Ramsar in 1971.
<b>Recharge</b>	Water flowing into an aquifer.
<b>Recharge Area</b>	An area in which there are downward components of hydraulic head in the aquifer. Infiltration moves downward into the deeper parts of an aquifer in a recharge area.
<b>Right Of Way (ROW)</b>	The area cleared for the construction of the pipeline. The NGP ROW will be reinstated and rehabilitated following completion of construction – no permanent access is required along the pipeline route.
<b>Riparian</b>	Pertaining to, or situated on the bank of, a body of water, especially a watercourse such as a river.
<b>Riparian vegetation</b>	Riparian vegetation occurs along freshwater watercourses. It is defined as a distinct, closed forest community that creates suitable conditions for a range of aquatic species by providing dense shade that regulates water temperatures, maintains dissolved oxygen concentrations and reduces algal bloom
<b>Riverine (as in wetlands)</b>	All wetlands and deep water habitats within a channel which may periodically or continuously contain moving water (DEHP 2016).
<b>Sedimentation</b>	The tendency for particles in suspension to settle out of the fluid in which they are entrained and come to rest against a barrier. This is due to their motion through the fluid in response to the forces acting on them: these forces can be due to gravity, centrifugal acceleration, or electromagnetism.
<b>Sensitive vegetation types</b>	Those considered significant under the <i>Northern Territory Vegetation Clearing Guidelines</i> . These vegetation types are either unique to the region and/or have high biodiversity values.
<b>Sites of Conservation Significance (SOCS)</b>	Areas of important or unique habitat, or areas with significant biodiversity values
<b>Slightly disturbed waters</b>	Waters where 'the biological integrity of an aquatic ecosystem has effectively unmodified biological indicators, but slightly modified physical, chemical or other indicators' (as defined in the EPP (Water); Qld Government 2014)
<b>Stream order</b>	The hierarchy of streams based on their location in the catchment, and used to describe the relative size and frequency of defined watercourses. Strahler's stream order is used here as defined in the NT Land Clearing Guidelines (NRETAS 2010).
<b>Stringing</b>	Laying the pipe adjacent to the pipeline trench
<b>Sub-catchment</b>	An area within a catchment drained by one or more tributaries of the main water body.
<b>Substrate</b>	The underlying base to something, e.g. the streambed.
<b>Subterranean (as in Groundwater Dependent Ecosystems)</b>	Underground caves containing water. Includes karst (carbonate) landscapes which often contain sinkholes and springs (DEHP 2016).
<b>Topography</b>	The study of the Earth's surface, relief, shape and features.
<b>Trenching</b>	A narrow excavation made below the surface of the ground, to a depth of

Term	Meaning
	typically 1,800 mm.
<b>Water Table</b>	Level below which the ground is saturated with water.
<b>Watercourse</b>	<p>As defined by the <i>Water Act (NT)</i>, watercourse means a river, creek or other natural watercourse (whether modified or not) in which water is contained or flows (whether permanently or from time to time). Includes:</p> <ul style="list-style-type: none"> <li>• a dam or reservoir that collects water flowing in a watercourse</li> <li>• a lake or wetland through which water flows</li> <li>• a channel into which the water of a watercourse has been diverted</li> <li>• part of a watercourse</li> <li>• an estuary through which water flows.</li> </ul>
<b>Waterway</b>	<p>As defined by the <i>Fisheries Act 1994 (Qld)</i>, waterway includes a river, creek, stream, watercourse or inlet of the sea.</p> <p>This definition includes freshwater and tidal waters and both permanent and ephemeral flowing waterways. It does not include isolated water bodies (some lagoons or wetlands), although it does include channels along which fish would be expected to move, if they connect water bodies to waterways during times of flow.</p>
<b>Wetland</b>	<p>Areas of permanent or temporary surface water or waterlogged soil including floodplains, lakes, billabongs and swamps. They may be dry for extended periods but waterlogging or inundation reoccurs for a sufficient duration that they provide aquatic habitat (as defined by Duguid et al. 2005). They support distinct vegetation communities that rely on either permanent or seasonal surface water supply. These areas often support a shallow water-table.</p>

## 5.3 References

- Bureau of Meteorology (BoM) 2016, *Climate Data online*, online data resource, Australian Government, Canberra, viewed 24/06/2016, <http://www.bom.gov.au/climate/data/>.
- Department of Agriculture, Fisheries and Forestry (DAF) 2013, *Code for Self-assessable Development Temporary Watercourse Barrier Works*, State of Queensland, Brisbane.
- Department of Natural Resources, Environment, the Arts and Sport (NRETAS) 2010, *Land Clearing Guidelines*, Northern Territory Government, Darwin.
- Randal, M 1962, *The Hydrology of the Eastern Barkly Tableland*, Department of National Development, Bureau of Mineral Resources Geology and Geophysics, Commonwealth of Australia, Canberra.