



Fortescue River Gas Pipeline

EP Act Referral Supporting Document

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Abbreviations

Abbreviation	Description
CS1	Compressor Station 1
DAA	Department of Aboriginal Affairs
DBNGP	Dampier to Bunbury Natural Gas Pipeline
DBP	DBP Development Group
DEC	Department of Environment and Conservation (now split into the DER and DPaW)
DER	Department of Environment Regulation (formerly DEC)
DMP	Department of Mines and Petroleum
DoE	Department of the Environment (formerly SEWPaC)
DoW	Department of Water
DPaW	Department of Parks and Wildlife (formerly DEC)
EPA	Environmental Protection Authority
EP Act	<i>Environmental Protection Act 1986</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FMG	Fortescue Metals Group
FRGP	Fortescue River Gas Pipeline
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometre
KP	Kilometre Point
MW	Mega Watt
NVCP	Native Vegetation Clearing Permit
P	Priority flora
PEC	Priority Ecological Community
SEWPaC	Department of Sustainability, Environment, Water, Populations and Communities (now DoE)
SRE	Short-range Endemic
TEC	Threatened Ecological Community
WA	Western Australia
WC Act	<i>Wildlife Conservation Act 1950</i>

1 Introduction

1.1 Proposal overview and background

The Fortescue River Gas Pipeline (FRGP) proposal (the Proposal) refers to the construction and operation of an approximate 266 km buried natural gas pipeline to transport natural gas from the Dampier to Bunbury Natural Gas Pipeline (DBNGP) to the Solomon Power Station (**Figure 1-1**). The Solomon Power Station is a 125 MW power station (owned and operated by TEC Pipe Pty Ltd, a subsidiary of TransAlta Corporation) which supplies power to Fortescue Metals Group's Iron Ore Mine (the Solomon Hub) in the Pilbara region of WA.

The FRGP connects to the DBNGP at Compressor Station 1 (CS1) via an Inlet Station and delivers gas to the Solomon Power Station through a Delivery Station.

The FRGP shall initially enable a shift from diesel to natural gas fired power generation at the Solomon Hub, with the potential to deliver similar benefits to a number of large resource projects in the area. Future expansion of the Pipeline has been allowed for potential supply of gas to Western Hub, North Star and Chichester Hub.

1.2 The proponent

The Fortescue River Gas Pipeline Joint Venture, an unincorporated joint venture between DDG FR Pty Ltd (DDG) (57%) and TEC Pilbara Pty Ltd (TECP) (43%) owns the FRGP (**Figure 1-2**).

DDG is the operator of the asset and the Proponent for the Proposal. DDG is solely owned by DUET, an ASX listed infrastructure fund.

DDG has contracted DDG Operations Pty Ltd (DDGO) to operate and maintain the FRGP. As part of this arrangement, both DDG and DDGO rely on the services of DBNGP (WA) Nominees Pty Ltd (DBP), the owner of the DBNGP, for the provision of labour and equipment to undertake their business. DDG adopt all DBP policies and procedures across the operation of its business.

All correspondence pertaining to the referral and this EP Act referral supporting document should be directed to the Proponent contact.

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1.3 Purpose and scope

This Environmental Review document provides supplementary information to support the referral of the Proposal under the *Environmental Protection Act 1986* (EP Act). This document provides:

- a description of the Proposal
- an overview of the environmental setting
- a preliminary evaluation of the potential environmental impacts of the Proposal
- an outline of how existing regulatory requirements, including under the *Petroleum Pipelines Act 1969* and Part V of the EP Act, provide comprehensive management controls (measures) to manage environmental impacts to prevent a significant impact to the environment as a result of the Proposal.

It should be noted that the management measures (Section 4) are aligned with that applied by the Environmental Protection Authority (EPA) for the DBNGP Stage 5A looping project - a similar project implemented on a much larger scale.

1.4 Legal framework and assessment process

The following legislation is relevant to the Proposal:

- *Environmental Protection (Clearing Of Native Vegetation) Regulations 2004*
- *Environmental Protection (Controlled Waste) Regulations 2004*
- *Environmental Protection (Noise) Regulations 1997*
- *Environmental Protection (Abrasive Blasting) Regulations 1998*
- *Environmental Protection Act 1986* (EP Act)
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Land Administration Act 1997*
- *Petroleum Pipelines Act 1969*
- *Rights in Water and Irrigation Act 1914* (RWI Act)
- *Rights in Water and Irrigation Regulations 2000* (RWI Regulations)
- *Wildlife Conservation Act 1950* (WC Act).

At the time of this application, DDG is applying for a 30 m wide *Petroleum Pipelines Act 1969* easement with an application for a pipeline licence to be made in the near future. A condition of this licence will require the preparation of a Construction Environmental Management Plan (CEMP) to be approved by the Department of Mines and Petroleum (DMP), prior to commencement of construction.

DDG will submit a Native Vegetation Clearing Permit application under Part V of the EP Act if the EPA determines that the Proposal is not required to be formally assessed under Part IV of the EP Act based on the information provided in the referral and this supporting document.

DDG will be referring the Proposal to the Federal Department of the Environment (DoE) for a determination of whether it constitutes a controlled action under the EPBC Act. A Threatened Species Management Plan will be developed to support this referral.

Section 4 of this Environmental Review document describes how regulatory requirements of relevant legislation, and associated management plans (Section 5.3) to be prepared, address the management of potential impacts of the Proposal (**Table 1**).

Table 1: Relevant legislation and associated approvals

Agency/Authority	Approval required	Application lodged Yes/No
Department of Environment Regulation (DER)	Native Vegetation Clearing Permit (NVCP) under Part V of the EP Act	No – pending the outcome of the EP Act Referral
Department of the Environment (DoE)	Referral under the EPBC Act. Anticipated to be "not-assessed, particular manner"	No – awaiting results of further biological surveys
Department of Water (DoW)	Licence(s) to take groundwater.	No – will be lodged once locations and potential resources are defined
	Bed and Banks Permit under the RWI Act	No – to be lodged for minor watercourse crossings within the Pilbara Surface Water Proclamation Area
Department of Mines and Petroleum (DMP)	Submission of environmental management plans to meet licence requirements under the <i>Petroleum Pipelines Act 1969</i>	No – will be lodged concurrent with the EPBC Act referral
Department of Aboriginal Affairs (DAA)	Application under s 18 of the AH Act for disturbance to Aboriginal heritage sites	No – will be lodged if and as required

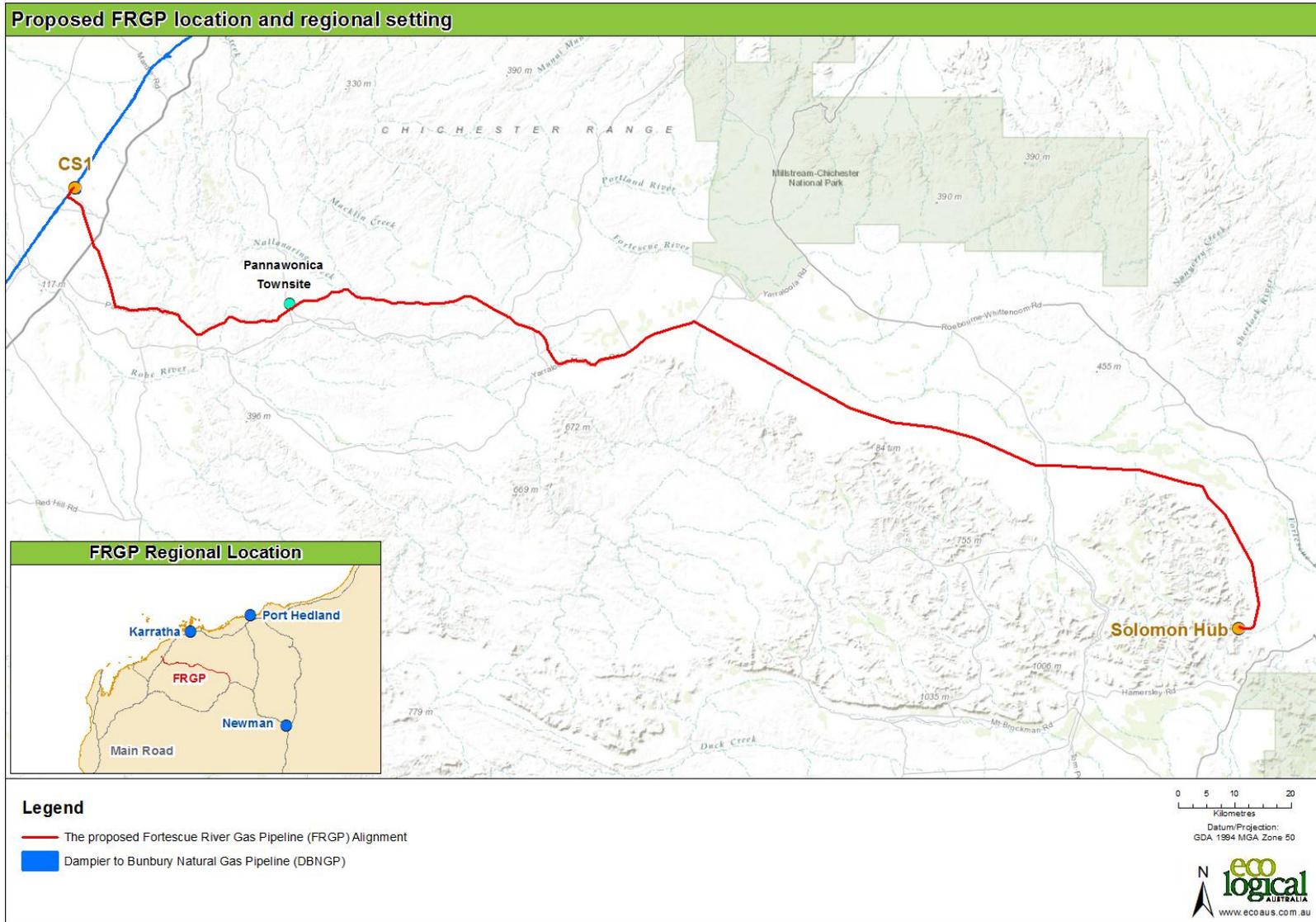


Figure 1-1: Proposed FRGP location and regional setting

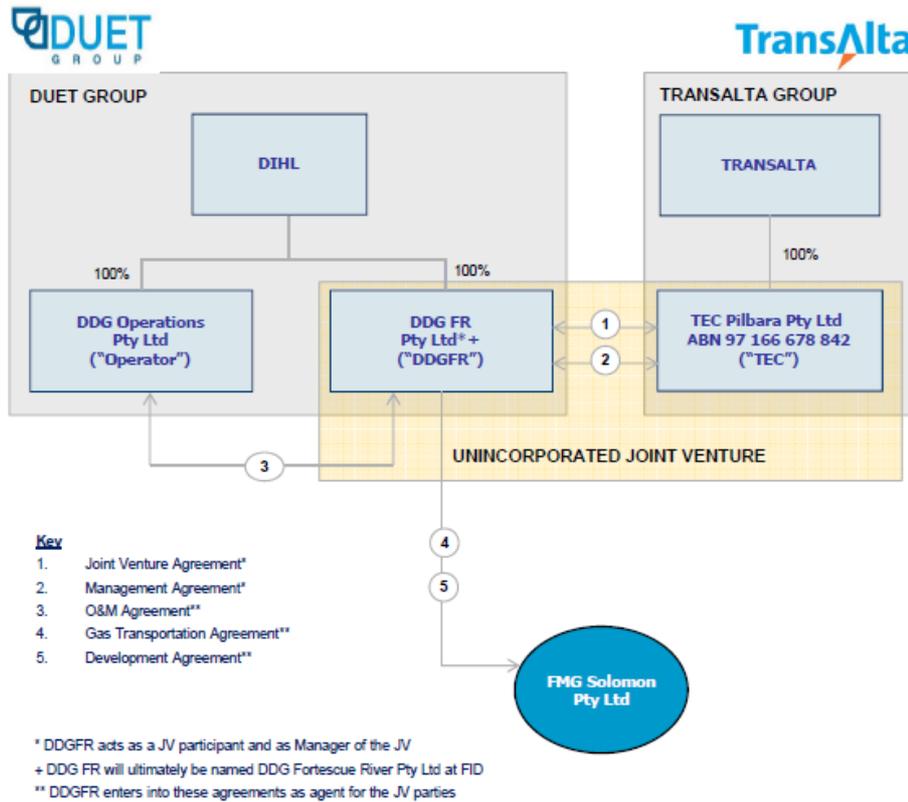


Figure 1-2: Fortescue River Gas Pipeline Joint Venture ownership Structure

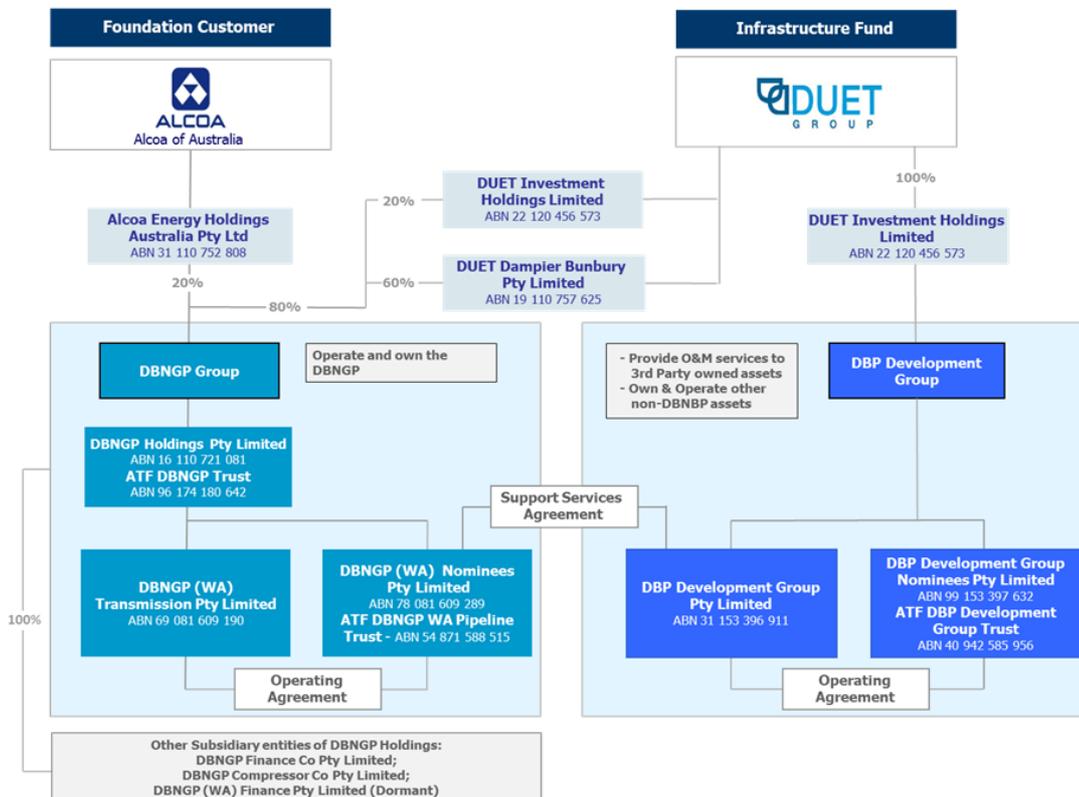


Figure 1-3: Corporate Structure (Combined DBP Groups)

2 Proposal description

The FRGP is located within the Pilbara region of WA within the Shire of Ashburton. The closest major town is Pannawonica which lies approximately 500 m north of the Project area (**Figure 1-1**).

2.1 Schedule

The Proposal is planned to commence in July 2014, with construction to be completed by December 2014 prior to the onset of heavy rains. Construction will be progressive, commencing at the western end of the corridor at kilometre point¹ (KP) zero and moving east to connect to the Solomon Hub at KP266.

2.2 Pipeline construction

The pipeline will be constructed and operated in accordance with the requirements of AS2885 Pipelines — Gas and Liquid Petroleum and the Australian Pipeline Industry Association (APIA) Code of Environmental Practice (1998).

Construction will typically be carried out within a 30 m wide corridor using a production line approach. In addition, there will be a number of turnaround points requiring a wider disturbance width every 5 km and four ‘turkey nest dams’ for storage of hydro-test water along the corridor.

Construction of the pipeline will be undertaken by a number of specialised teams that will fabricate and install the pipeline along the corridor. The construction corridor will be progressively rehabilitated as construction activity moves along the alignment, with the exception of a 5 m wide permanent access track.

Two construction camps will be established for the construction workforce in proximity to the corridor.

The total disturbance footprint of the Proposal will be 881 ha (including the construction corridor, other working areas and construction camps), of which 746 ha (85%) is temporary and will be progressively rehabilitated (**Table 2**). The remaining 133 ha is required for a permanent access track in the pipeline corridor and represents permanent disturbance (**Table 2**). This represents the maximum potential area for clearing/disturbance and does not take into account areas already degraded. Utilisation of areas that are already degraded may reduce the area of (new) clearing required.

Table 2: Disturbance footprint of the Proposal

Component	Disturbance (ha)
Proposal corridor (30 m width for approximately 266 km)	798 ha
Construction camp (including laydown area and vehicle compound)	20 ha
Temporary access tracks	~50 ha

¹ The kilometre point (KP) represents the length in kilometres along the FRGP alignment. Kilometre point zero (KP0) is the starting point of the FRGP alignment at DBNGP CS1, and KP266 is the end point at the Solomon Hub.

Component	Disturbance (ha)
Turnaround points (every 2 km)	10
Turkey nest dams (10 at 0.25 ha each)	3
TOTAL TEMPORARY DISTURBANCE	881
<i>Rehabilitation post-construction</i>	746
TOTAL PERMANENT DISTURBANCE	133

2.2.1 Access

Access during construction will be via existing roads and tracks to link into a new track to be established along the construction corridor. Additional access tracks may be required to link existing tracks to the pipeline corridor. The location of these is yet to be determined, but will be developed in consultation with affected pastoralists and will allow for flexibility to avoid significant environmental values. Clearing of up to 50 ha is estimated to be required for construction of these additional access tracks (**Table 2**).

Post construction, an approximately 5 m wide access track will be maintained from within the construction corridor for ongoing operational access.

2.2.2 Clear and grade

Graders and bulldozers will be used to remove vegetation and topsoil within a 30 m wide area to provide for construction activities. This corridor will be widened to approximately 50 m at watercourse crossings.

Vegetation will be pushed aside and residue vegetative material stockpiled in windrows for final respreading out over the reinstated ground following trench backfill.

Within the disturbance footprint, topsoil will be graded to a depth of 100 to 150 mm and stockpiled separately for return to the source area during rehabilitation and will be stockpiled separately to overburden.

2.2.3 Trenching and pipeline installation

As the corridor is progressively cleared, a trench will be dug by either a trenching machine or an excavator for installation of the pipeline in accordance with pre-defined depths of burial (the trench will typically be 1.2 m deep, but this is subject to detailed design). Trench spoil will be stockpiled in the construction corridor, usually on the non-working side, and will be stockpiled separately to topsoil. The length of open trench at any one time will be monitored daily for fauna entrapment. Fauna refuges (hessian bags or similar) will be placed in the trench to provide protection for fauna that temporarily occupy the trench. The trenches will be ramped at regular intervals to allow larger fauna to escape.

Steel pipe will be trucked to the construction site and sections laid end-to-end next to the trench as the excavation progresses from west to east. The sections will be placed on sandbags and raised on blocks of wood (timber skids) to protect the pipe from corrosion and coating damage.

Where required, pipe sections will be bent to match changes in either elevation or direction of the route. Pipe sections will then be welded together.

The pipe welds will be inspected using x-ray or ultrasonic equipment as per AS 2885.2. The area around the weld will be grit blasted and then coated with a protective coating to prevent corrosion.

Side booms or excavators will be used to lower the welded pipe into the trench. Trench spoil will be returned to the trench and material compacted to minimise the likelihood of subsidence of material over the pipe. Where required, padding machines will be used to sift the excavated subsoil to remove coarse materials to prevent damage to the pipe coating. The remaining fine material will be used to pad beneath and on top of the buried pipe. In some instances (e.g. rocky soils), imported sand or foam pillows will be used for padding.

The period of time that any part of the trench is left open will be minimised. Trenches will be stopped and started at regular intervals with “plugs” between these sections to allow for unimpeded movement of fauna that may temporarily occupy the trench. Where possible, trenching will be delayed until completion of welding and joint coating as part of ensuring that the trench will be open for the minimum amount of time necessary.

Open trench excavation will be used at gravel road crossings. Horizontal directional drilling (HDD) will be used at six bitumen road crossings including the North West Coastal Highway and Pannawonica Road.

2.2.4 Horizontal directional drilling (HDD)

At the six road crossing sites where HDD is required, a drill site area will be required to temporarily house the drill rig. The drill site area for the HDD will incorporate an area for the positioning of the drilling rig and an area for the management of the drilling mud (i.e. mud pits). No additional clearing will be required in association with HDD and there will be no clearing outside the 30 m corridor for HDD. The same topsoil removal and stockpiling methods used on the general construction corridor will be used when clearing the drill site areas.

The HDD drilling mud disposal requirements include the construction of evaporation dams at the HDD entry and exit locations where the mud will be stored until it is dry. At this point, the mud will then be loaded into tip trucks and disposed of at a suitable approved land fill/waste disposal site.

2.2.5 Watercourse crossings

The FRGP crosses a major tributary of the Fortescue River (Caliwinga Creek) in addition to a number of smaller drainage lines. Caliwinga Creek and the smaller drainage lines are ephemeral and will be dry during construction. Crossings will be constructed using standard open cut (trenching) methods. Erosion and sediment control measures will be implemented to ensure there are no significant impacts at these crossings.

Permits for interference with river/creek bed or banks will be obtained from the DoW for minor watercourse crossings within the Pilbara Surface Water Area.

2.2.6 Pressure testing

Pipeline integrity will be verified using hydrostatic testing in accordance with Australian Standard (AS) 2885.5 or the American Society of Mechanical Engineers (ASME) Code for Pressure Piping (B31.3) as required. During hydrostatic testing, the pipeline will be capped with test manifolds, filled with water and pressurised up to a minimum of 125% of design maximum operating pressure for a minimum of two hours. A minimum 24-hour duration leak test will then follow.

Providing it meets DoW water quality guidelines and has landholder approval, hydro-test water will be discharged to the surrounding environment. Hydro-test water will be sourced from a variety of sources, including public water supply system standpipes, dams, and local groundwater or stream flows, subject to licensing from the DoW. In general, it is expected that chemicals will not be added, as the pipeline is internally coated. However, in some locations, chemicals may need to be added if there is danger of corrosive water affecting the integrity of the internal coating. In these cases and where necessary, the water will be treated to neutralise alkaline elements to an appropriate standard before discharge to the environment. Discharge would be once-off during commissioning of the pipeline and will comply with DoW requirements as set out in Water Quality Protection Note 13 (DoW 2006).

2.2.7 Signage

Information signs on the presence of the buried pipeline will be erected in line of sight along the pipeline corridor as per AS 2885.1.

2.2.8 Rehabilitation

The construction corridor will be re-contoured to match the surrounding landforms, and erosion controls constructed where necessary. Separately stockpiled topsoil will then be respread evenly across the corridor and any stockpiled vegetation placed across the corridor to assist in soil retention, provision of seed stock and fauna shelter.

Active reseeding or revegetation of the corridor using appropriate species (i.e. crops/pasture or indigenous native species of the right provenance) will be undertaken to restore vegetation cover if and where areas do not respond to the initial rehabilitation treatment, as evaluated by monitoring.

2.3 Other infrastructure requirements

2.3.1 Construction camps

Accommodation of the construction workforce will utilise existing infrastructure at the western and eastern extents of the pipeline. One new temporary construction accommodation camp will be required in the central portion of the Proposal Corridor. A suitable site has been selected at approximately KP115 which utilises an existing cleared area (recently a water pipe lay down area). The camp will be approximately 20 ha in size and will be constructed of demountable buildings with individual sleeping quarters, toilet/showers, laundry, food mess, wet mess (bar) and recreation rooms. Although the camp will be located within an existing cleared area, it has been conservatively included within the overall disturbance footprint.

The camp has been located to minimise noise impacts on surrounding residences, and is not located close to any residences or sensitive receptors. The nearest sensitive receptor is the town of Pannawonica, which is located approximately 30 km to the west of the proposed construction camp.

2.3.2 Water supply

Water will be required for potable use (i.e. accommodation camps), dust suppression and hydro-testing as follows:

- Potable water: 7200kL (KP115 camp only)
- Process Water: 180,000kL (roads and hydro testing).

The source of the water supply for the Project is yet to be determined and DDG is currently looking into a combination of the following options:

- access to the new Bungaroo water pipeline for potable water
- established bores on pastoral properties or use of those that belong to the Shire of Ashburton and are used for road water
- the drilling of new bores in suitable locations.

If water resourcing requires groundwater abstraction, RWI Act licence(s) will be required and will be sought from DoW prior to commencement of construction in each area.

2.4 Modifications made to reduce impacts

The FRGP alignment has undergone several modifications to avoid or reduce potential environmental impacts. The original planned alignment of the western portion was further south and followed the Robe River, traversing the Robe River Valley then across to the Fortescue catchment. The current (proposed) alignment traverses significantly fewer watercourses than the original design, having been shifted further north, and more specifically no longer intersects major rivers such as the Robe River. In addition, the alignment has been redesigned to avoid watercourses such as Kumina Creek, which is a major tributary of the Robe River and provides important refuge for terrestrial fauna. These amendments have reduced the potential impacts of the FRGP in areas of environmental and cultural heritage value.

2.5 Stakeholder engagement

The Proponent has held discussions with the following key regulatory agencies and government organisations regarding the Proposal:

- Environmental Protection Authority (EPA)
- DER
- DoW.

The Proponent has also consulted with the Water Corporation and the relevant Native Title Claimant Groups: Kuruma Marthudunera and Yindjibarndi. Details of consultation and outcomes to date are outlined in **Table 3**.

Table 3: Stakeholder consultation for the Proposal

Consultation date	Stakeholder	Outcomes
November 2013	Environmental Protection Authority	A project briefing was provided by DDG. The EPA indicated that the level of significance of the Proposal was unlikely to warrant EPA assessment under Part IV of the EP Act.
August 2013	Kuruma Marthudunera	A project overview was provided. Initial support for the Proposal and associated schedule was indicated. Issues were raised with respect to Robe River crossings.
August 2013	Yindjibarndi	A project overview was provided. Initial support for project indicated. Issues were raised with respect to the schedule.
October 2013	Water Corporation	A project overview was provided. Initial support for the Proposal was indicated. Issues were raised with respect to a camp or hydrocarbon storage within a Public Drinking Water Source Area (PDWSA), Priority 1 (P1) zone (see Section 3.1.3).

Consultation date	Stakeholder	Outcomes
October 2013	Department of Water	A project overview was provided. Initial support for the Proposal was indicated. Issues were raised with respect to a camp or hydrocarbon storage within P1 area.
November 2013	Department of Environmental Regulation – Pilbara	A project briefing was provided by DDG and an offer was extended to meet in person if desired.

3 Environmental setting

3.1 Physical environment

3.1.1 Biogeographic and regional setting

A biogeographic regionalisation of Australia has been developed collaboratively in which bioregions (broad-scale regionalisations) are formally recognised and mapped: the Interim Biogeographic Regionalisation for Australia (IBRA), currently version 7 (DoE 2013). IBRA version 7 provides a landscape-based approach to the classification of the land surface of Australia, with bioregions being classified according to common climate, geology, landform, native vegetation and species information. Bioregions each reflect a unifying set of major environmental influences which shape the occurrence of flora and fauna and their interaction with the physical environment across Australia.

Subregions are more localised and homogeneous geomorphological units within each bioregion. The Pilbara bioregion comprises four subregions: Hamersley, Fortescue Plains, Chichester and Roebourne.

The Proposal area, in which the construction corridor and camps are proposed, lies within the Pilbara bioregion, predominantly within the Hamersley subregion and extending slightly into the subregions of Roebourne, Fortescue and Chichester (**Table 4**). Characteristic features of the Hamersley subregion include Proterozoic sedimentary ranges dominated by spinifex grasses dissected by gorges with low mulga woodlands on the valley floor. The deeply incised gorges of the Hamersley Ranges contain extensive permanent spring-fed streams and pools.

The climate is described as semi-desert tropical, with an annual average rainfall of 300 mm, which usually occurs in summer cyclonic or thunderstorm events. Winter rain is not uncommon with drainage into either the Fortescue to the north, the Ashburton to the south, or the Robe to the west of the Proposal area (DoW 2009).

The Hamersley subregion occupies an area of approximately 6.2 million ha, with the dominant land uses being grazing of native pastures, unallocated Crown land and Crown reserves, conservation, and mining (DEC 2003).

Table 4: Subregions of the Proposal area

Subregion	Code	Description
Hamersley	PIL3	Recognised as the southern section of the Pilbara Craton. The Hamersley subregion consists of mountainous areas of Proterozoic sedimentary ranges and plateaux, dissected with gorges (basalt, shale and dolerite) (Kendrick 2001).
Chichester	PIL1	Recognized as the northern section of the Pilbara Craton and consists of undulating Archaean granite and basalt plains, including significant areas of basaltic ranges (Kendrick 2001).
Roebourne	PIL4	Includes coastal areas is recognized as Quaternary alluvial and older colluvial coastal and sub-coastal plains (Kendrick 2001). Resistant linear ranges of basalts occur across the coastal plains, with minor exposures of granite (Kendrick 2001 and Stanley 2001).
Fortescue	PIL2	Consists of alluvial plains and river frontages (Kendrick 2001). There are calcrete aquifers and localized springs in sections of the Fortescue system.

3.1.2 Geology, Geomorphology and Land Systems

The Proposal area is situated within the Fortescue Province, which lies over the Pilbara Craton. The Hamersley Ranges, which extend from the north-west to the south-east across the southern region of the Pilbara Craton, were formed on the late Archaean-Palaeoproterozoic metamorphosed banded iron formation, shales, dolerite, carbonate, chert and rhyolite of the south Pilbara sub-basin.

The main characteristic of the soils in the Pilbara region is the predominant red colour with the most extensive soils being shallow, stony soils on hills and ranges and sands on sandplains (MWH 2009). Other soil types present in the region include red earths overlying hardpan, cracking and non-cracking clay soils and duplex soils.

The physical resources of the Pilbara region have been characterised and mapped into a number of land system units based on landforms, soils, vegetation and drainage patterns (Van Vreeswyk et al., 2004).

Twenty-two land systems as mapped by Van Vreeswyk et al. (2004) were identified as occurring within the Proposal area (Mattiske 2013). These land systems and their associated descriptions are presented in **Table 5** and **Figure 3-1**.

Table 5: Major land systems within the Proposal area

Land system	Code	Description
Boolgeeda	BGD	Stony lower slopes and plains below hill systems; not degraded or eroded
Brockman	BRO	Alluvial plains with cracking clay soils supporting tussock grasslands
Calcrete	CAL	Low calcrete platforms and plains supporting shrubby hard spinifex grasslands
Cane	CAN	Alluvial plains and flood plains supporting snakewood shrublands, soft and hard spinifex grasslands and tussock grasslands
Capricorn	CPN	Rugged hills and ridges on sedimentary rocks; poorly accessible, not degraded or eroded
Egerton	EGE	Highly dissected hardpan plains supporting mulga shrublands and hard spinifex hummock grasslands
Hooley	HOY	Alluvial clay plains supporting a mosaic of snakewood shrublands and tussock grasslands
Horseflat	HOF	Weakly gilgaied alluvial plains; some parts severely degraded and eroded
Jurrawarrina	JUR	Hardpan plains and alluvial tracts supporting mulga shrublands with tussock and spinifex grasses
Kanjenjie	KAN	Stony clay plains supporting snakewood shrublands with tussock grasses
Kumina	KUM	Duricrust plains and plateau remnants supporting hard spinifex grasslands
McKay	MCK	Hills, ridges, plateaux remnants and breakaways of metasedimentary and sedimentary rocks supporting hard spinifex grasslands
Nanutarra	NNT	Low mesas and hills of sedimentary rocks supporting soft and hard spinifex grasslands
Newman	NEW	Rugged ironstone ridges, plateaux and mountains; hard spinifex pastures in good to excellent condition; no erosion

Land system	Code	Description
Oakover	OAK	Breakaways, mesas, plateaux and stony plains of calcrete supporting hard spinifex grasslands
Paraburdoo	PAR	Basalt derived stony gilgai plains and stony plains supporting snakewood and mulga shrublands with spinifex, chenopods and tussock grasses
Peedamulla	PED	Gravelly plains supporting hard spinifex grasslands and minor snakewood shrublands
Robe	ROB	Low limonite mesas and buttes supporting soft spinifex (and occasionally hard spinifex) grasslands
Rocklea	ROC	Rugged basalt hills and dissected plateaux; poorly accessible, not degraded or eroded
Sherlock	SRK	Stony alluvial plains supporting snakewood shrublands with patchy tussock grasses and spinifex grasslands
Urandy	URY	Stony plains, alluvial plains and drainage lines supporting shrubby soft spinifex grasslands
Wona	WON	Basalt upland gilgai plains supporting tussock grasslands and minor hard spinifex grasslands

3.1.3 Hydrological processes

The Proposal area passes through the Lower Fortescue Basin catchment (MWH 2009) and lies within the RWI Act's Surface Water Proclamation Area of the Pilbara. The eastern section of the Proposal area passes through mainly valley systems associated with the Fortescue River whilst the western section runs north of Robe River prior to joining CS1 on the DBNGP alignment on the coastal plain area south of Dampier and Karratha (Mattiske 2013) (**Figure 3-2**).

The Proposal alignment has been carefully designed to avoid disturbance at the culturally and environmentally significant Fortescue and Robe Rivers.

The Proposal area does not traverse the Fortescue River itself, but does traverse several creeks associated with the river, namely Caliwinga Creek (a major tributary), Weelamurra Creek and Asbestos Creek (**Figure 3-2**). In addition, a number of associated minor drainage lines as well as valley systems associated with the river are traversed.

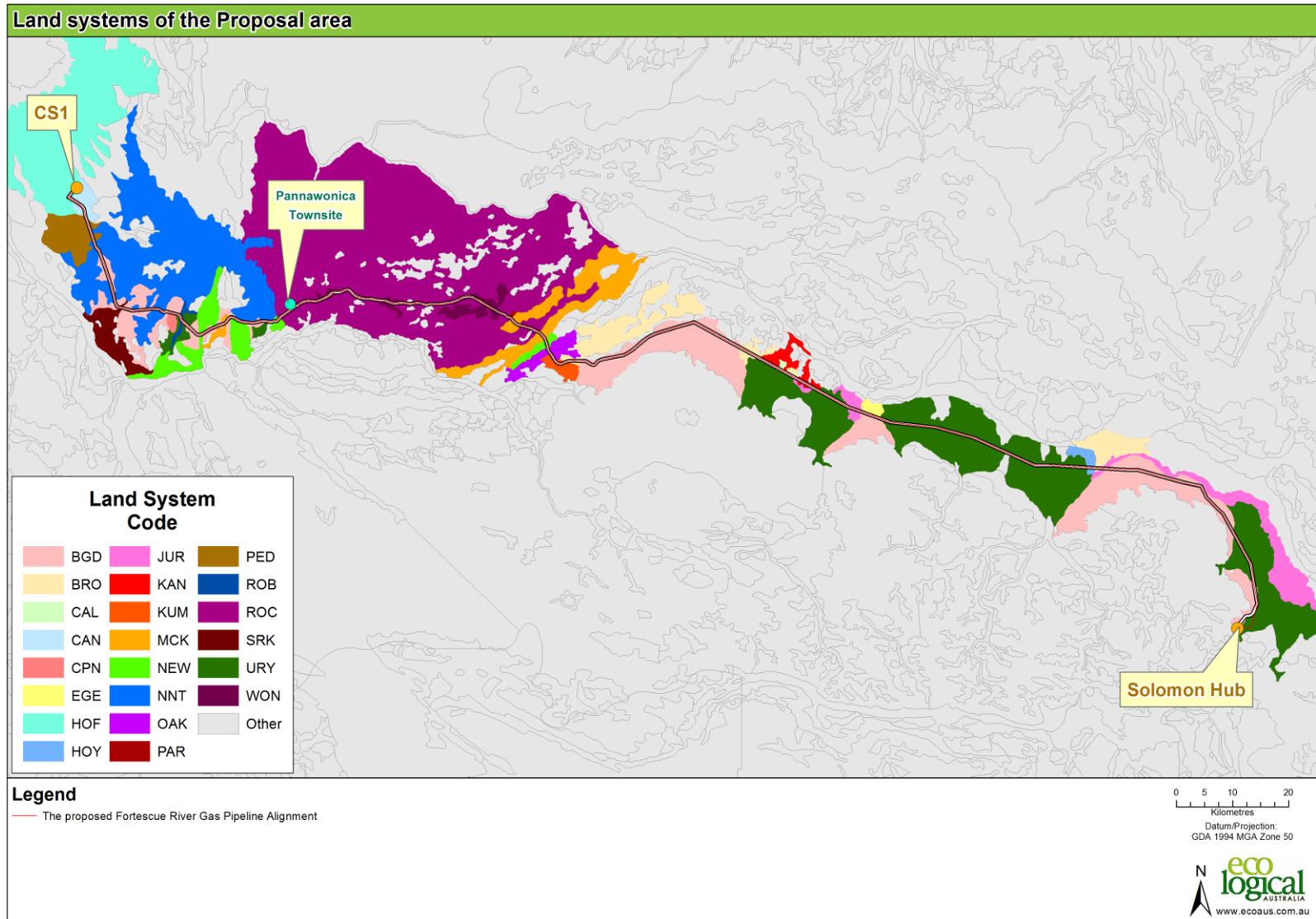
The Proposal area also traverses Peter Creek and a number of minor drainage lines associated with the Robe River but does not traverse the Robe River itself (**Figure 3-2**).

The hydrology of both river systems is typical of ephemeral rivers in the Pilbara bioregion, which experience periods of extremely high flood flows during cyclonic and significant rainfall events, followed, often closely, by long periods of low or no stream flow (MWH 2009).

There are several Public Drinking Water Source Areas (PDWSAs) in the Pilbara, mainly located in the west of the region. The Proposal area partially passes through the Millstream Water Reserve which is a Priority One PDWSA (DoW 2009). However, the Proposal area does not intersect the Wellhead Protection Zones nor the production bores of the Millstream Water Reserve (DoW 2010).

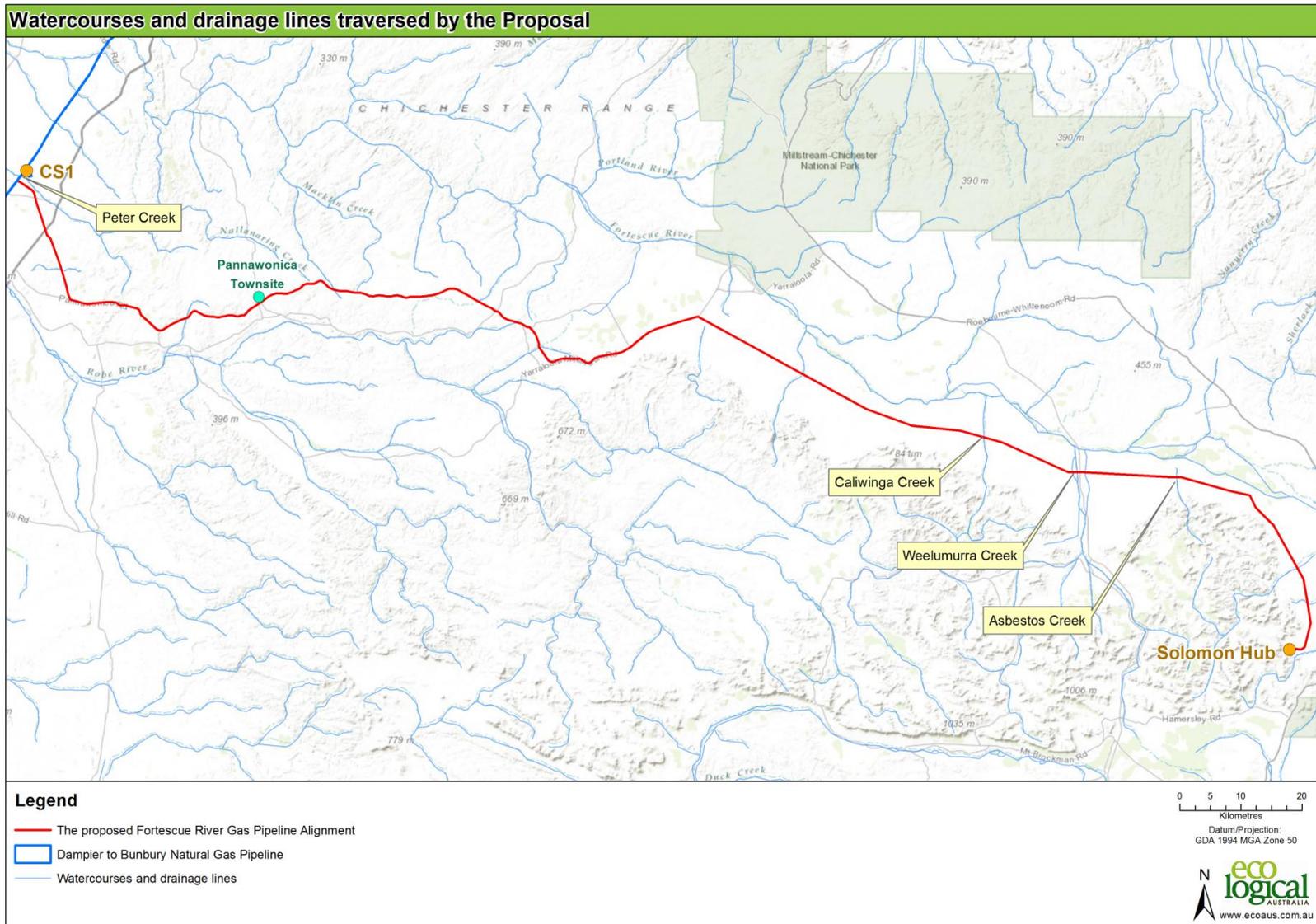
The hydrogeology along the western section of the Proposal area comprises surficial sediments and shallow aquifers, fractured and weathered rock aquifers and rocks of low permeability. The eastern

section of the Proposal area, in the Fortescue Valley, passes through differentiated, sedimentary rocks in fractured and weathered aquifers, and surficial sedimentary shallow aquifers. Localised connection between the aquifers may occur where conduits for water flow are formed due to faulting and fracturing (Kendrick 2001).



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Figure 3-1: Land systems of the Proposal Area



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Figure 3-2: Watercourses and drainage lines traversed by the Proposal

3.2 Biological environment

3.2.1 Flora and vegetation

A desktop assessment of the flora and vegetation values of the Proposal area was undertaken by Mattiske in July 2013 with a subsequent Level 1 flora and vegetation field survey undertaken in September 2013 (Mattiske 2013). The report is provided in full in Attachment 2 of the EP Act Referral Documentation and the key findings are summarised below.

Flora

A total of 353 vascular plant taxa representative of 135 plant genera and 43 plant families were recorded during the survey. The majority of the taxa recorded were representative of the Fabaceae (77 taxa), Poaceae (63 taxa) and Malvaceae (40 taxa) families. Of the 353 taxa recorded 69.4% were perennial, 17.8% were annual and 12.7% were both annual and perennial depending on local conditions.

Seven taxa recorded during the survey represented range extensions from current known locations. Of particular note were *Aristida anthoxanthoides*, **Jatropha gossypifolia*, *Notoleptopus decaisnei* var. *decaisnei* and *Sclerolaena limbata*.

Eleven introduced (exotic) taxa were recorded within the Proposal area. Of these, one taxon **Jatropha gossypifolia* is a Declared Pest pursuant to section 22 (s22) of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) with a Control Category of C3 for the whole of WA. In addition two species with high environmental weed ratings, **Cenchrus ciliaris* and to a lesser extent **Vachellia farnesiana*, were recorded in high densities in a small number of creeklines and flood-out zones.

Threatened and priority flora

No Declared Threatened flora species were recorded within the survey area. However, one species was identified as potentially occurring: *Lepidium catapycnon* which is listed as Vulnerable under both the EPBC Act and WC Act. *L. catapycnon* is a disturbance opportunistic that has been recorded previously in the eastern Pilbara near Wittenoom, south-eastwards towards Newman and eastwards towards Nullagine. This species is considered to have a high likelihood of occurrence in the Proposal area based on nearby records and the occurrence of landsystems within the area that are favoured by the species.

One Priority 3 (P3) flora species, *Astrebla lappacea*, was recorded in five locations during the field survey (**Figure 3-3**). A further 83 Priority flora species were identified as potentially occurring in the Proposal area of which six were considered as likely to occur:

Priority 3 flora species:

- *Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479)
- *Solanum albotellatum*
- *Swainsona thompsoniana*
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431).

Priority 4 flora species:

- *Goodenia nuda*
- *Rhynchosia bungarensis*.

None of the Priority flora considered as likely to occur were recorded during the survey (Mattske 2013).

Vegetation associations

Eleven broad vegetation associations occur within the Proposal area based on Beard (1975) (**Table 6** and **Figure 3-3**). The key vegetation values appear to relate to the diversity of species which are expected on the broad, less undulating slopes of the valley systems and the shift in communities through the different areas from the coastal systems on the Onslow Coastal Plain to the Fortescue Valley through the series of landforms and soils associated with the Stewart Hills, the Abydos Plain - Chichester, Hamersley groupings. The vegetation is dominated by different hummock grasslands, tussock grasslands, bunch grasslands, sedgeland and woodlands which support dominant genera such as *Triodia*, *Acacia*, *Eucalyptus* and *Corymbia* (Mattske 2013). These vegetation associations currently have between 99% and 100% of their pre-European extents remaining (Shepherd et al. 2002).

Table 6: Summary of Beard (1975) vegetation associations near the Proposal area*

Pre-European Vegetation Association	Mapping Code	Vegetation Description
Onslow Coastal Plain		
601	a ₁₁ Sb xGc/a ₂ Sr t ₁ Hi	Mosaic: Sedgeland; various sedges with very sparse snakewood/Hummock grasslands, shrub-steppe; kanji over soft spinifex
Stewart Hills		
603	a ₆ Sb t ₃ Hi	Hummock grasslands, sparse shrub steppe; <i>Acacia bivenosa</i> over hard spinifex
605	a ⁵ ₁₁ Sr t ₁ Hi	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> & waterwood over soft spinifex
Abydos Plain – Chichester		
173	a ₂ Sr t ¹ ₃ Hi	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>Triodia wiseana</i> on basalt
175	NA	Short bunch grassland – savanna/grass plain (Pilbara)
Hamersley		
82	e ₁₆ Lr t ₃ Hi	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>
175	xGc	Short bunch grassland – savanna/grass plain (Pilbara)
609	e ₂₄ Lr a ₂ Sp t ₁ Hi /e ₁₆ Lr t ₃ Hi	Mosaic: Hummock grasslands, open low tree steppe; bloodwood with sparse kanji shrubs over soft spinifex/Hummock grasslands, open low tree steppe; snappy gum over <i>Triodia wiseana</i> on a lateritic crust
644	a ¹ ₁₁ Lr t ² ₂ Hi	Hummock grasslands, open low tree steppe; mulga & snakewood over soft spinifex & <i>Triodia basedowii</i>
645	a ² ₁₁ Sr t ¹ ₃ Hi	Hummock grasslands, shrub steppe; kanji & snakewood over soft spinifex & <i>Triodia wiseana</i>
Fortescue Valley		

Pre-European Vegetation Association	Mapping Code	Vegetation Description
111	e ₂₅ Sr t ₂ Hi	Hummock grasslands, shrub steppe; <i>Eucalyptus gamophylla</i> over hard spinifex
175	xGc	Short bunch grassland – savanna/grass plain (Pilbara)
629	NA	Mosaic: Short bunch grassland - savanna/grass plain (Pilbara)/Hummock grasslands, grass steppe; hard spinifex, <i>Triodia wiseana</i>

* Source: Government of Western Australia 2011, based on Beard (1975)

Vegetation communities

During the survey, 30 vegetation communities were delineated and mapped across the Proposal area. A full description of each vegetation community is provided in **Appendix A**. Most of the Proposal area was found to comprise of a mosaic of sparse *Acacia* spp. shrubland and open *Triodia* spp. hummock grassland associations on flats to low natural relief, interspersed with creek and flow line associations of predominantly *Eucalyptus victrix/Eucalyptus camaldulensis* dominated macro-channels and *Corymbia hamersleyana/Acacia* spp. dominated micro-channels and flood-out zones. Mid slope and ridge associations, although comprising similar species to lower slope associations, generally contained common upland/breakaway species such as *Eucalyptus leucophloia* subsp. *leucophloia*, *Acacia inaequilatera*, *Acacia maitlandii* and *Grevillea pyramidalis*. Soft spinifex (e.g. *Triodia pungens*) and/or mixed tussock grasses were a common feature of vegetation on flats and lower slopes, with hard spinifex (e.g. *Triodia wiseana*) becoming more dominant higher in the landscape.

Vegetation condition

The vegetation condition of the Proposal area ranges from cleared to pristine, with the majority of the Proposal area being in Very Good to Pristine condition. Large cleared areas are evident around CS1 and the Pannawonica Town site, and around the Pannawonica-Millstream Road at KP 120 to KP 140. Drainage lines between KP 50 and KP 59 were generally in degraded condition as a result of weed infestations, whereas creeks and drainage lines between KP 81 and KP 89 were generally in good condition despite evidence of livestock movement. Structurally vegetation communities rarely showed visible signs of disturbance affecting individual species and weed densities were mostly low. The exception being a small number of minor creeklines and flood-out zones where weed species, particularly *Cenchrus ciliaris* and *Vachellia farnesiana*, were recorded in relatively high densities.

Priority and Threatened Ecological Communities

Three Priority Ecological Communities (PECs) and one Threatened Ecological Community (TEC) occur in proximity to the Proposal area (**Table 7**). None of the PECs or TECs occur within the Proposal area. However, the Wona Land System PEC buffer is traversed by the proposal (**Figure 3-4**). In addition, aspects of the Wona Land System PEC were inferred to occur within the Proposal area, namely the P3 Mitchell grass plains (*Astrebla* spp.) on gilgai (part of the 'Four plant assemblages of the Wona Land System') (**Table 7**). Floristic aspects of this PEC were inferred to occur within the approximately 362 hectares of the FL15 community, between KP 148 and KP 162 (**Figure 3-4**). This community was recorded in excellent to pristine condition and contained intact tussock grasslands dominated by *Astrebla lappacea*.

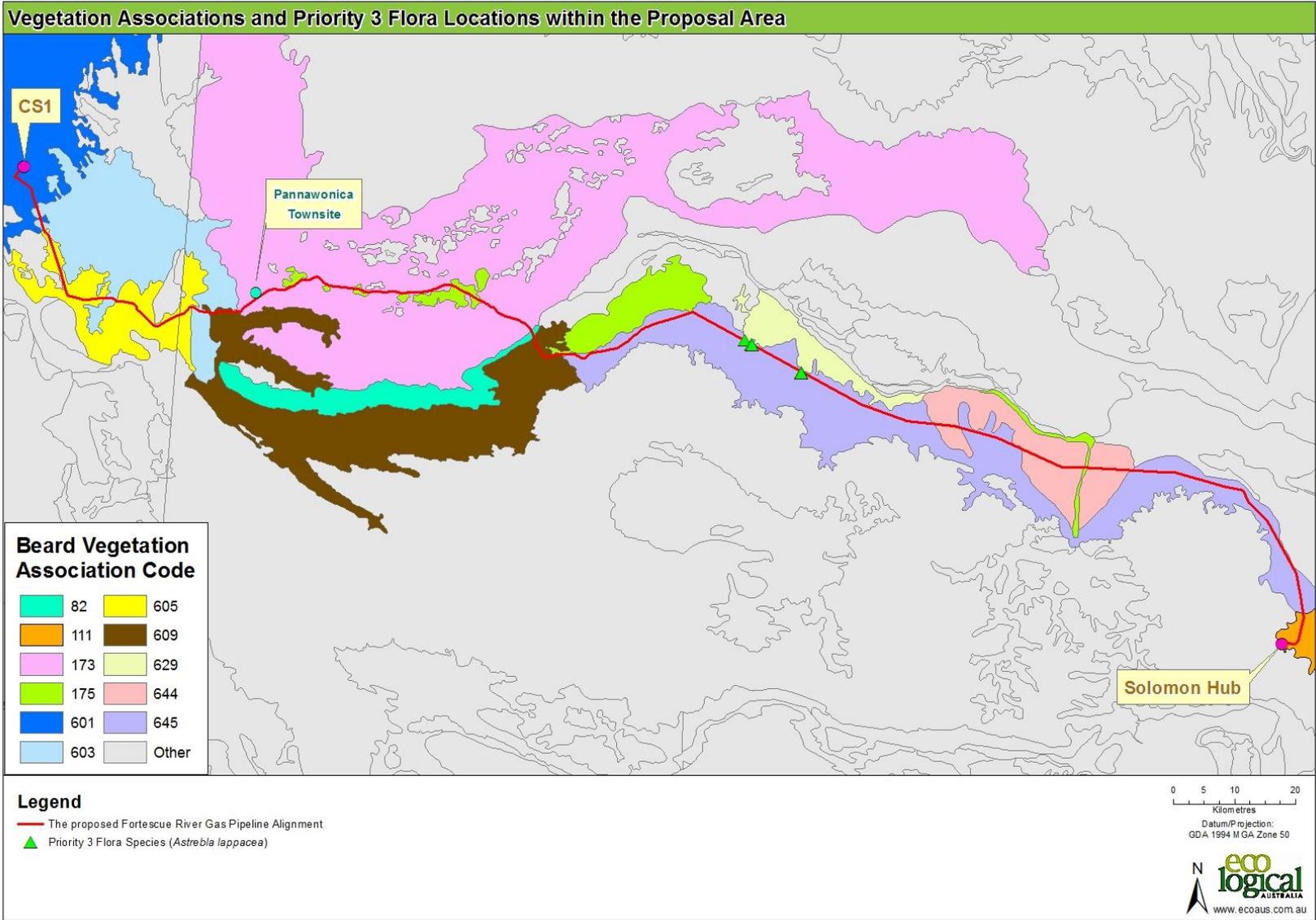
Conservation Areas

Approximately 3.8 km of the proposal Corridor traverses the north-eastern corner of the proposed West Hamersley Range Conservation Park (**Figure 3-4**) (Mattiske 2013). This portion of the Proposal Corridor follows Pannawonica Rd which also intersects the proposed Conservation Park. This overlap will necessitate discussions with State and Regional offices of DPaW to enable a review of the current status of, and intentions for, this area. The total disturbance from the construction corridor in the proposed conservation park is estimated to be 8.3 ha.

Table 7: Summary of Threatened and Priority Ecological Communities adjacent to or near the Proposal area*

Community ID	Community Description	Conservation Status
Robe Valley Mesas (PEC)	<p>Subterranean invertebrate communities of mesas in the Robe Valley region.</p> <p>A series of isolated mesas occur in the Robe Valley in the State's Pilbara bioregion. The mesas are remnants of old valley infill deposits of the palaeo Robe River. The troglobitic faunal communities occur in an extremely specialised habitat and appear to require the particular structure and hydrogeology associated with mesas to provide a suitable humid habitat. Short range endemism is common in the fauna. The habitat is the humidified pisolitic strata.</p> <p>Threats: Mining</p>	Priority 1
Millstream (PEC)	<p>Stygofaunal communities of the Western Fortescue Plains freshwater aquifer. (Previously named: Stygofaunal communities of the Millstream freshwater aquifer)</p> <p>A unique assemblage of subterranean invertebrate fauna.</p> <p>Threats: Groundwater drawdown and salinisation.</p>	Priority 4
Wona Land System (PEC)	<p>Four plant assemblages of the Wona Land System. (Previously named: Cracking clays of the Chichester and Mungaroona Range)</p> <p>A system of basalt upland gilgai plains with tussock grasslands occurs throughout the Chichester Range in the Chichester-Millstream National Park, Mungaroona Range Nature Reserve and on adjacent pastoral leases. There are a series of community types identified within the Wona Land system and gilgai plains that are considered susceptible to known threats such as grazing or have constituent rare/restricted species, as follows:</p> <ul style="list-style-type: none"> • Cracking clays of the Chichester and Mungaroona Range. This grassless plain of stony gibber community occurs on the tablelands with very little vegetative cover during the dry season, however during the wet a suite of ephemerals/annuals and short-lived perennials emerge, many of which are poorly known and range-end taxa. • Annual Sorghum grasslands on self mulching clays. This community appears very rare and restricted to the Pannawonica-Robe valley end of Chichester Range. • Mitchell grass plains (<i>Astrebela</i> spp.) on gilgai. • Mitchell grass and Roebourne Plain grass (<i>Eragrostis xerophila</i>) plain on gilgai (typical type, heavily grazed). 	Priority 1 Priority 1 Priority 3 Priority 3
Themeda Grasslands (TEC)	<p>Themeda grasslands on cracking clays (Hamersley Station, Pilbara)</p> <p>Grassland plains dominated by the perennial <i>Themeda</i> (kangaroo grass) and many annual herbs and grasses.</p>	Vulnerable

* Table modified from Matiske (2013)



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Figure 3-3: Vegetation associations (Beard) and Priority 3 flora locations within the Proposal Area

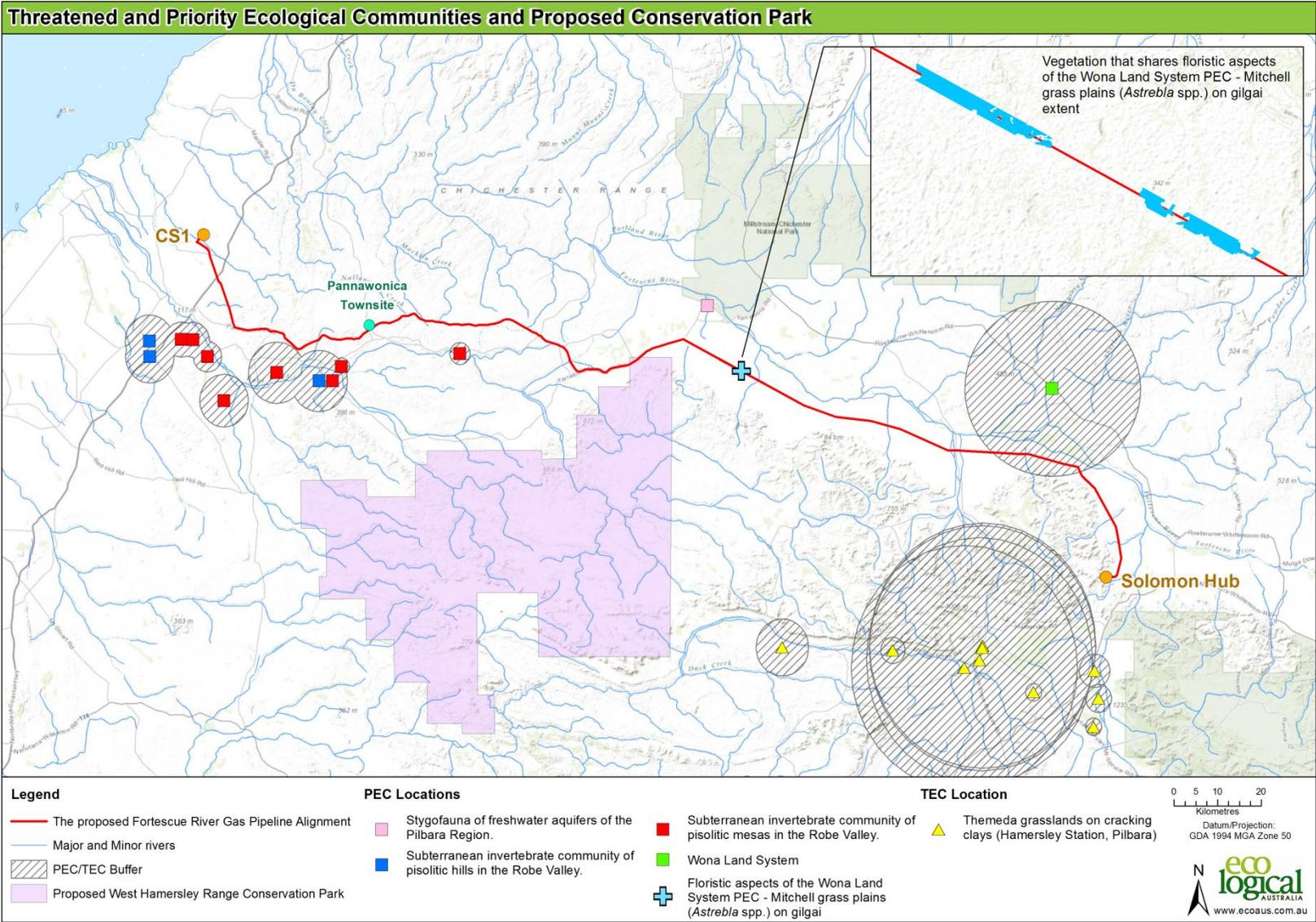


Figure 3-4: Threatened and Priority Ecological Communities and the Proposed Conservation Park

3.2.2 Terrestrial fauna

A Level 1 vertebrate fauna study of the Proposal area was undertaken by Ninox Wildlife Consulting (Ninox) which included a detailed desktop assessment and subsequent ground-truthing survey undertaken in October 2013 (Ninox 2013). The report is provided in full in Attachment 2 of the EP Act Referral Documentation and the key findings are summarised below.

Fauna habitats

Eleven fauna habitat types were defined within the Proposal area based on vegetation community mapping by Mattiske (Ninox 2013) (**Table 8; Figure 3-5; Figure 3-6**). These range from open woodlands over spinifex *Acacia* shrublands over spinifex on flats, slopes and ridges, to open grassy plains, and major and minor gullies.

Table 8: Fauna habitats within the Proposal area

Fauna habitat type	Description
Habitat 1	Spinifex with Bloodwoods
Habitat 2	Spinifex grasslands with <i>Acacia xiphophylla</i>
Habitat 3	<i>Acacia</i> shrublands over spinifex on flats
Habitat 4	<i>Acacia</i> shrublands over spinifex on slopes with rocky outcropping
Habitat 5	Spinifex grassland
Habitat 6	<i>Acacia</i> shrublands with occasional <i>Eucalyptus</i> species over spinifex on upper slopes & ridges
Habitat 7	<i>Acacia</i> shrublands or <i>Eucalyptus</i> woodlands dominated by <i>Acacias</i> over spinifex on flowlines & small gullies
Habitat 8	Major drainage lines with large <i>Eucalyptus</i> species
Habitat 9	Floodplains
Habitat 10	Cracking clay grasslands
Habitat 11	Open plains

Three fauna habitat types of potential significance (due to likelihood of supporting conservation significant species) have been identified to date within the Proposal area (Ninox 2013). These are:

- Cracking clay grasslands – habitat type 10
- Rocky habitats (including Yandagee Gorge) – a combination of features associated with habitat types 4, 6 and 7
- Riparian habitat– habitat type 8.

The cracking clay grasslands support a number of species that are unlikely to be found elsewhere within the Proposal area including Priority (P) species such as *Leggadina lakedownensis* (Lakeland Downs Mouse; P4) and/or *Sminthopsis longicaudata* (Long-tailed Dunnart; P4). These cracking clay communities are similar to the grasslands located south of the Solomon Hub area on the Hamersley Station which comprises largely of small mammals (Ninox 2013).

While it is unlikely that the proposed pipeline route will coincide with the crests, plateaux and upper slopes of the ranges, it is possible that the route will cross some of the rocky gullies and small gorges where some of the more specialised vertebrate fauna species may potentially occur including species of conservation significance such as the *Dasyurus hallucatus* (Northern Quoll) and/or *Liasis olivaceus barroni* (Pilbara Olive Python). These species are known to occur in rocky gullies and gorges, particularly in proximity to water (Ninox 2013).

The western portion of the Proposal area traverses Yandagee Gorge which may also represent important habitat for Northern Quoll and/or Pilbara Olive Python. Pannawonica Road also passes between two hills within the gorge, and as such the Proposal area will be located as close to as possible to the road to enable as much separation from the gorge as practicable.

While no major rivers will be intersected by the Proposal area, minor creeks supporting riparian vegetation (i.e. dense vegetation and/or eucalypts) will be intersected by the Proposal area. Riparian habitats have been identified only within the western section of the Proposal area, where they provide refuge for a wide range of species, particularly birds, and small terrestrial species which shelter in the leaf litter (Ninox 2013). Larger eucalypts such as *Eucalyptus camaldulensis* and *Eucalyptus victrix* within some of these creek systems usually contain hollows suitable for nesting and/or roosting by a range of species. These linear habitats of dense vegetation also act as corridors through the more arid and sparsely vegetated country adjacent to them. As such, these corridors may provide safe access from rocky hills and slopes for species such as the Northern Quoll, which generally dens in the rocky habitat and forages through a wider range of habitats for food. This may also be the case for the Pilbara Olive Python.

Terrestrial fauna

The data and literature review identified 358 vertebrate fauna that have previously been recorded or potentially occur within, or in close proximity to, the Proposal area including 27 species of conservation significance (i.e. listed under the WC Act and/or listed as Priority species by the DPaW and/or listed under the EPBC Act). Each species of conservation significance was assessed for its likelihood of occurrence in the Proposal area based on previous records, habitat preferences and known distribution (**Table 9**).

Previous fauna surveys within the vicinity of the Proposal area have recorded fauna of conservation significance: from the Solomon Project area located at the south-eastern end of the Proposal area, and Brockman Syncline located 80 km south of the Proposal area. Species recorded include the *Apus pacificus* (Fork-tailed Swift), *Ardeotis australis* (Australian Bustard), *Macroderma gigas* (Ghost Bat), *Dasyurus hallucatus* (Northern Quoll), *Pseudomys chapmani* (Western Pebble-mound Mouse), *Notoscincus butleri* (a skink), *Ramphotyphlops ganei* (a blind snake), and *Liasis olivaceus barroni* (Pilbara Olive Python).

Table 9: Conservation significant fauna species potentially occurring in the Proposal area

Species	WC ACT or DPaW Priority list	EPBC Act	Likelihood of Occurrence
Rainbow Bee-eater (<i>Merops ornatus</i>)	Schedule 3 (Migratory)	Migratory	Recorded
Northern Quoll (<i>Dasyurus hallucatus</i>)	Schedule 1 (Endangered)	Vulnerable	High

Species	WC ACT or DPaW Priority list	EPBC Act	Likelihood of Occurrence
Pilbara Olive Python (<i>Liasis olivaceus barroni</i>)	Schedule 1 (Endangered)	Vulnerable	High
Eastern Great Egret (<i>Ardea modesta alba</i>)	Schedule 3 (Migratory)	Migratory	High
Peregrine Falcon (<i>Falco peregrinus</i>)	Schedule 4	-	High
A blind snake (<i>Ramphotyphlops ganei</i>)	Priority 1	-	High
A skink (<i>Ctenotus uber johnstonei</i>)	Priority 2	-	High
Australian Bustard (<i>Ardeotis australis</i>)	Priority 4	-	High
Bush Stone-curlew (<i>Burhinus grallarius</i>)	Priority 4	-	High
Long-tailed Dunnart (<i>Sminthopsis longicaudata</i>)	Priority 4	-	High
Ghost Bat (<i>Macroderma gigas</i>)	Priority 4	-	High
Western Pebble-mound Mouse (<i>Pseudomys chapmani</i>)	Priority 4	-	High
A skink (<i>Notoscinus butlerii</i>)	Priority 4	-	High
Fork-tailed Swift (<i>Apus pacificus</i>)	Schedule 3 (Migratory)	Migratory	Seasonally High
Lakeland Downs Mouse (<i>Leggadina lakedownensis</i>)	Priority 4	-	Moderate to high
Oriental Pratincole (<i>Glareola maldivarum</i>)	Schedule 3 (Migratory)	Migratory	Moderate
Flock Bronzewing (<i>Phaps histrionica</i>)	Priority 4	-	Moderate
Woma (<i>Aspidites ramsayi</i>)	Schedule 4	-	Low to Moderate
Marsupial Mole (<i>Notoryctes carinus</i>)	Schedule 1 (Vulnerable)	Endangered	Unlikely to Low
Greater Bilby (<i>Macrotis lagotis</i>)	Schedule 1 (Vulnerable)	Vulnerable	Unlikely to Low
Pilbara Leaf-nosed Bat (<i>Rhinonicteris aurantia</i>)	Schedule 1 (Vulnerable)	Vulnerable	Unlikely to Low
Barn Swallow (<i>Hirundo rustica</i>)	Schedule 3 (Migratory)	Migratory	Unlikely to Low
Oriental Plover (Dotterel) (<i>Charadrius veredus</i>)	Schedule 3 (Migratory)	Migratory	Unlikely to Low
Cattle Egret (<i>Ardea ibis</i>)	Schedule 3 (Migratory)	Migratory	Unlikely to Low
White-bellied Sea-eagle (<i>Haliaeetus leucogaster</i>)	Schedule 3 (Migratory)	Migratory	Unlikely to Low

Species	WC ACT or DPaW Priority list	EPBC Act	Likelihood of Occurrence
Eastern Osprey (<i>Pandion haliaetus</i>)	-	Marine Migratory	Unlikely
Australian Painted Snipe (<i>Rostratula australis</i>)	Endangered	Endangered Migratory	Unlikely

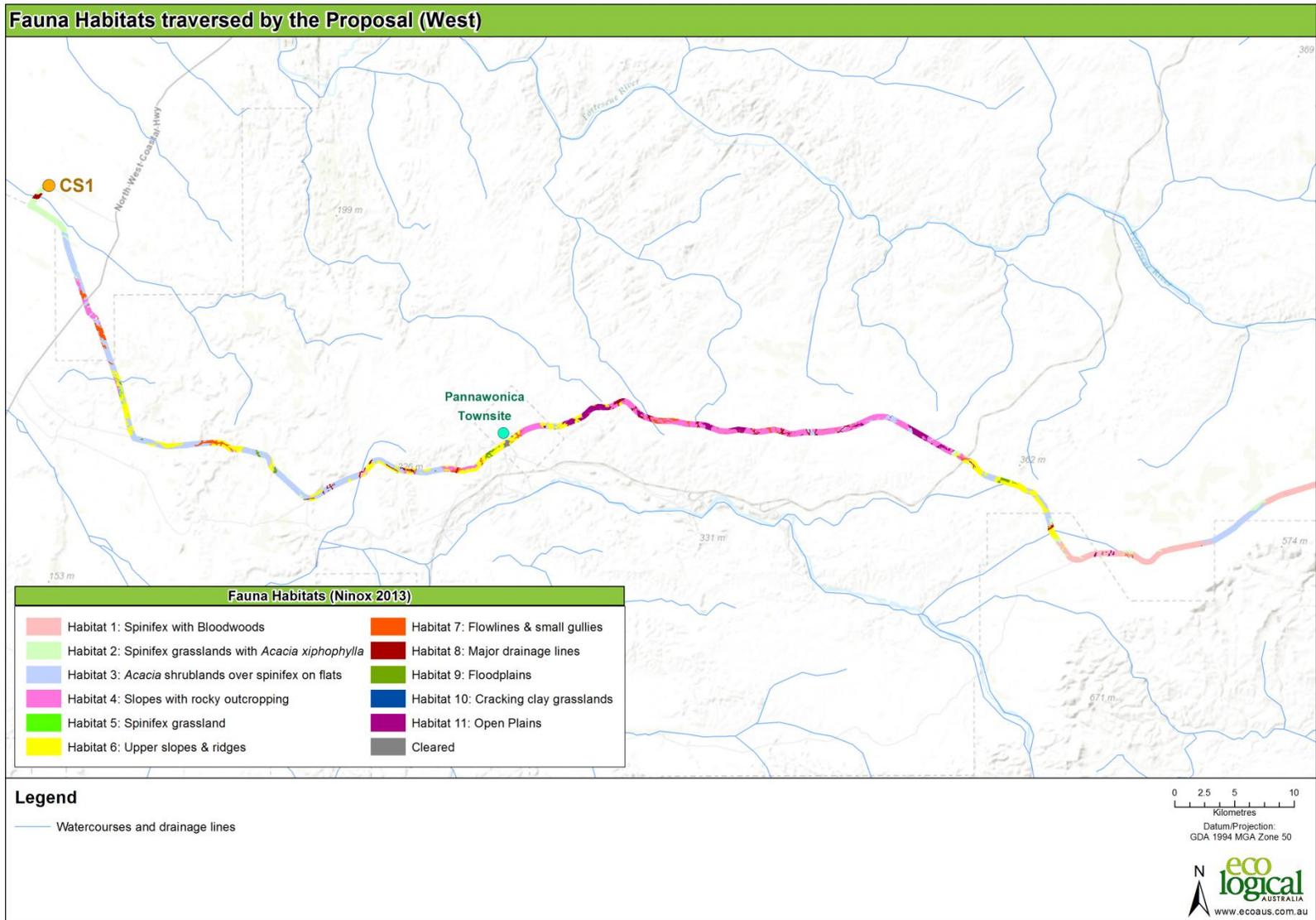
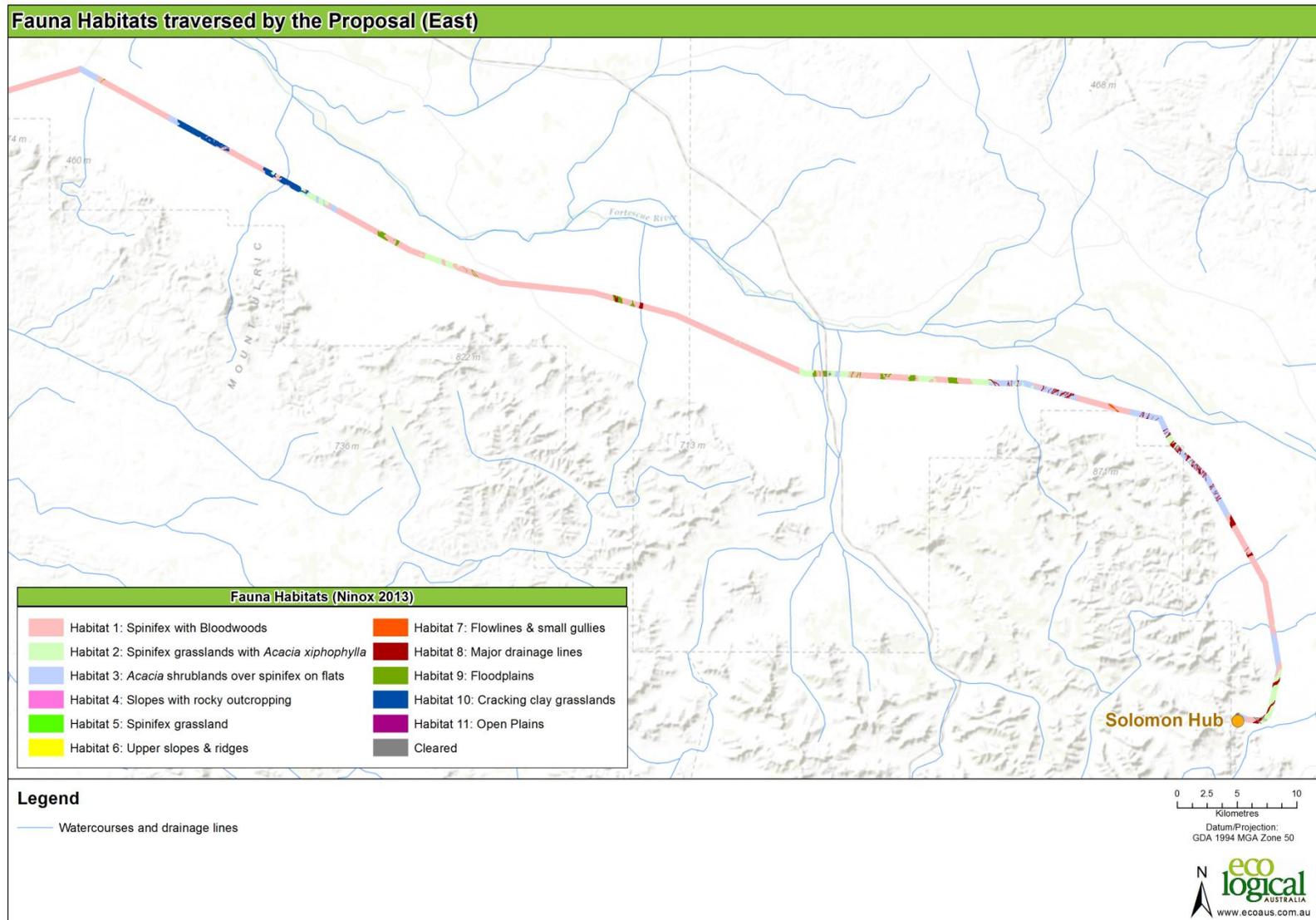


Figure 3-5: Fauna habitats traversed by the Proposal (west)



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Figure 3-6: Fauna habitats traversed by the Proposal (east)

3.3 Social environment

Heritage

The Proposal area crosses two Native Title areas: the Kuruma Marthudunera and the Yindjibarndi, and crosses a number of known Aboriginal heritage sites. The Proponent is aware of its obligations under the *Aboriginal Heritage Act 1972* and surveys are currently underway in order to further refine the location, extent and significance of Aboriginal heritage sites that will or may be potentially impacted by the Proposal. The surveys will involve walking and assessing the land for places of importance and significance as defined under section 5 of the *Aboriginal Heritage Act 1972*. Any sites identified will be recorded to a standard that will allow the Aboriginal Cultural Materials Committee to assess their significance and offer advice to the Minister for Aboriginal Affairs regarding their ongoing management under Section 18 of the same act.

Population centres

The FRGP alignment passes in close proximity to Pannawonica Townsite: approximately 200 m at the closest point. The town has a population of 686, but also accommodates over 1000 people: Rio Tinto Iron Ore employee families, staff on fly-in fly-out ('FIFO') roster from Perth, and those involved in support services (49% residential, 51% FIFO). It is accessible by road, rail and light aircraft.

Tenure

The pipeline corridor traverses a number of pastoral leases with numerous exploration and mining leases overlapping.

4 Potential environmental impacts and management

4.1 Flora and vegetation

A description of the flora and vegetation values of the Proposal area and surrounds is provided in Section 3.2.1.

4.1.1 Assessment of potential impacts

The Proposal has the potential to impact flora and vegetation through:

- Clearing of vegetation for the construction of the pipeline trench, access road and other infrastructure, which will result in the disturbance and/or removal of flora and vegetation
- Ignition sources such as machinery and generators, which may increase fire risk
- Vehicle movement and earthworks, which may increase the spread of weeds in the area as well as generate dust which may be deposited on native vegetation.

4.1.2 Regulatory control measures to manage impacts

Clearing of vegetation can be adequately managed through the conditions set in a Native Vegetation Clearing Permit (NVCP) for the Proposal under Part V of the EP Act. These would typically require:

- Demarcating clearing boundaries prior to ground disturbance activities
- No clearing to occur outside the areas demarcated
- Avoidance of areas with potentially higher biodiversity values (e.g. riparian habitat)
- Rehabilitating/revegetating areas progressively
- Monitoring and auditing to ensure compliance with conditions
- Record keeping and compliance reporting.

Impacts from earthworks, potential ignition sources and vehicle movements will be comprehensively addressed in the CEMP required under the Petroleum Pipelines Act. The proposed controls shall also align with those set out by the EPA under Ministerial Statement 735 (MS735) for Dampier to Bunbury Natural Gas Pipeline Stage 5 Expansion Looping Project (DBNGP Stage 5), a pipeline construction project of similar nature but of a larger scale (EPA 2006). Management measures to be implemented under the CEMP will include (but not be limited to):

- Preferentially utilising areas devoid of vegetation or already degraded
- Liaising with the DPaW regarding the management of conservation significant flora
- Demarcating no-entry sites for protection of conservation significant flora
- Implementing clearance controls concerning topsoil and vegetation removal and stockpiling such as:
 - topsoil and vegetative material within identified weed high risk areas will be stockpiled within the high risk areas and kept separate from weed free material
 - stockpiles of weed and weed-free material shall only be re-spread back to their point of origin.
- Implementing hygiene measures for all vehicles, machinery and personnel entering the construction corridor
- Restricting vehicles and machinery access to designated tracks/roads

- Providing training and tools to personnel to assist in general awareness of conservation significant flora and to aid in minimising vegetation clearing and disturbance
- Minimising exposed surfaces by progressively rehabilitating disturbed areas no longer in use:
 - topsoil will be replaced immediately following completion of construction works to ensure the biotic viability of the soil is maximised.
 - stockpiled vegetative material removed from the construction corridor at clearing will be re-spread to aid in sediment and erosion control, moisture retention and to aid in the establishment of seeds/seedlings and revegetation of the construction corridor.

Active rehabilitation (seeding) will only be conducted on areas that do not respond to the initial rehabilitation treatment, as indicated by monitoring.

4.1.3 Environmental outcome

The Proposal is not anticipated to have any significant impacts on flora and vegetation values as:

- The vegetation associations identified in the Proposal area extend beyond the boundaries of, and are not restricted to, the Proposal area.
- Conservation significant flora that may potentially occur within the Proposal area are known from areas outside that to be disturbed, and currently only one Priority 3 species is known to be present.
- The regulatory controls shall be aligned with those of previous EPA recommendations (MS735) in addition to the conditions set under the NVCP and the controls described within the CEMP therefore providing more notable measures to reduce impacts to flora and vegetation.

4.2 Terrestrial fauna

A description of the terrestrial fauna values of the Proposal area and surrounds is provided in Section 3.2.2.

4.2.1 Assessment of potential impacts

The aspects of the Proposal that may affect fauna include:

- Clearing of vegetation, which will remove fauna habitat
- Open stretches of pipeline trench, which can potentially trap terrestrial fauna resulting in individual loss
- Blasting activities will remove fauna habitat and cause indirect impacts associated with noise and vibration
- Vehicle strikes which can result in loss of individuals.

4.2.2 Regulatory control measures to manage impacts

Removal of fauna habitat through vegetation clearing can be adequately managed through the conditions set in a Native Vegetation Clearing Permit (NVCP) for the Proposal under Part V of the EP Act. These would typically require:

- Avoiding conservation significant fauna habitat such as Yandagee Gorge
- Minimising impacts to areas with potentially higher biodiversity values (e.g. rocky gullies and gorges, riparian habitat) through:
 - demarcating clearing boundaries
 - restricting clearing to that which is necessary

- avoiding removal of large trees
- Implementing appropriate weed hygiene measures
- Rehabilitating/revegetating areas progressively
- Record keeping and submitting reports
- Monitoring and auditing to ensure compliance.

The management of clearing, trench management, blasting and vehicle movements will be comprehensively addressed in the CEMP required under the Petroleum Pipelines Act. The management measures prescribed by the CEMP will align with those set out by the EPA for DBNGP Stage 5 (MS735) (EPA 2006). These measures will include (but not be limited to):

- Prohibiting clearing outside authorised clearing areas
- Minimising disturbance (e.g. avoidance or reduction in working widths) through areas of potentially relatively higher conservation significance (e.g. Yandagee Gorge, cracking clay habitat, vegetation associated with watercourses)
- Implementing fauna encounter and clearing procedures consistent with conditions relating to fauna management in MS735 for DBNGP Stage 5 including (but not limited to):
 - fauna clearing personnel to operate in teams of two to the requirements of DPaW
 - trenches to be inspected and cleared by fauna handling teams daily and within three hours of sunlight
 - pipeline sections to be inspected for fauna immediately prior to welding to prevent fauna entrapment.
 - designing the pipeline trench (e.g. installing fauna shelters/refuges, fauna exit ramps) to prevent fauna entrapment or allow escape.
- Implementing blasting procedures such as undertaking several small blasts as opposed to single blasts, to minimising vibration emissions
- Limiting vehicle speeds to 40 km/hour or less within the Proposal area.

4.2.3 Environmental outcome

The Proposal is not anticipated to have any significant impacts on terrestrial fauna as:

- The fauna habitats identified in the Proposal area extend beyond the boundaries, and are not restricted to, the Proposal area.
- Conservation significant fauna habitats identified within the Proposal area will be largely avoided by construction activities. Where avoidance is not possible, the pipeline will utilise existing infrastructure or degraded areas as far as practicable.
- Due to the narrow width of the Proposal area (30 m), only a small subset of potentially-occurring fauna species are expected to actually occur in the Proposal area, and then only on a transitory basis.
- The DMP regulated CEMP will require implementation of adequate management measures to minimise the risk of trench entrapment or vehicle strike which may result in the loss of individuals.
- The management measures to be implemented by the conditions set under a NVCP and the management measures prescribed within the DMP required CEMP will be aligned with those of previous EPA recommendations for pipeline construction of a similar nature (MS735).

4.3 Hydrological processes and inland waters environmental quality

The hydrological values of the Proposal area are described in Section 3.1.3.

4.3.1 Assessment of potential impacts

The aspects of the Proposal that may affect hydrological processes and/or inland waters environmental quality are:

- Physical disturbance of watercourses from disturbance of creek beds, banks or riparian vegetation
- Alteration to surface water flow regimes associated with trenching
- Deterioration in surface water and groundwater quality
- Groundwater drawdown.

4.3.2 Regulatory control measures to manage impacts

Removal of vegetation associated with watercourses including riparian habitat can be adequately managed through the conditions set in a Native Vegetation Clearing Permit (NVCP) for the Proposal under Part V of the EP Act. These would typically require:

- Consolidating watercourse crossings with other infrastructure where practicable (in accordance with DoW 2012)
- Demarcating clearing boundaries within riparian vegetation along watercourses which will be disturbed
- Undertaking construction at watercourse crossings during the dry season
- Avoiding the removal of large, stabilising trees present on watercourse banks where practicable.

All of the proposed watercourse crossings lie within the Pilbara Surface Water Area as proclaimed by the RWI Act and as such s11 permits to interfere with bed and banks will be required under the RWI Act. The bed and banks permits will be applied for following the outcome of this EP Act referral.

In regards to groundwater, the use of groundwater for construction purposes and potable water supply would be subject to the conditions of permits to take water under the RWI Act.

Disturbances to watercourses and alterations or deterioration in surface and ground water quality are also addressed in the CEMP required under the Petroleum Pipelines Act.

At this stage, no substantial dewatering for pipeline construction is anticipated due to the nature of the landforms traversed. Similarly, it is considered that there is a low probability of encountering potential or actual acid sulphate soils due to the general lack of low lying areas where groundwater is close to the surface and the relative shallow depth of pipeline excavation. Geotechnical investigation is still to take place along the pipeline corridor prior to construction, which will clarify any dewatering requirements (if any). Should dewatering be required, it would be subject to dewatering permit requirements of the DoW and specific requirements for acid sulphate soil management in the CEMP. These measures would include (but not be limited to):

- Undertaking dewatering during summer and autumn months when water table levels are annually low
- Limiting dewatering rates such that the drawdown cone will not affect surrounding water bodies, and groundwater dependent ecosystems (if present) (i.e. no significant drawdown at surface water bodies)
- Treating dewatering product in potential acid sulphate soil risk areas identified by geotechnical investigations in accordance with specific requirements set out in the CEMP

- Disposing of dewatering products through use for dust suppression in the first instance, and by transport to a turkey nest dam for re-infiltration in the second instance.

4.3.3 Environmental outcome

The Proposal is not anticipated to have any significant impacts on hydrological processes or inland waters environmental quality as:

- Major watercourses have been avoided through pipeline design
- Construction at minor watercourses will be undertaken during the dry season when watercourses run dry
- Substantial dewatering for pipeline construction is unlikely to be required
- Requirements of existing regulatory controls for surface and groundwater management shall be aligned with or exceed those of EPA requirements for DBNGP Stage 5 (MS735) to minimise the potential for impacts to hydrological processes and inland waters environmental quality.

4.4 Aboriginal heritage

The Aboriginal heritage values of the Proposal area are described in Section 3.3.

4.4.1 Assessment of potential impacts

Potential impacts that may result from Proposal activities include:

- Damage to significant natural features of ethnographic significance (trees, watercourses and landscape)
- Disturbance to shallow artefacts and subsurface material.

4.4.2 Regulatory control measures to manage impacts

A Section 18 approval will be applied for under the WA Aboriginal Heritage Act 1972 before undertaking works requiring disturbance to any Aboriginal site.

Disturbances to aboriginal heritage would be adequately addressed in the CEMP required under the Petroleum Pipelines Act. Management measures will include, but not be limited to:

- Heritage monitors will be engaged to inspect grounds prior to any disturbance
- All staff will be inducted on their requirement to stop work within 50 m of any area where archaeological material is uncovered.

4.4.3 Environmental outcome

The Proposal is not anticipated to have any significant impacts on aboriginal heritage as:

- Pre-construction aboriginal heritage surveys will be completed to identify areas of Aboriginal heritage value
- Disturbance to areas of Aboriginal heritage value will be avoided where practicable
- Where Aboriginal heritage sites cannot be avoided, a Section 18 approval licence will be applied for and controls will be applied in accordance with the Section 18 approval and the CEMP.

4.5 Noise and vibration

Pipeline construction activity will result in a temporary increase in noise levels within the immediate vicinity of the corridor, associated with the operation of vehicles and equipment. Vibration may result from blasting, which may be required to enable excavation of the trench, compaction following backfilling the trench and the operation of heavy vehicles.

The majority of the Proposal area passes through remote areas, with no residences. However, the western section of the corridor traverses within 200 m of the Pannawonica Town site and the eastern end terminates at the FMG Solomon Hub, where there is an accommodation camp.

4.5.1 Assessment of potential impacts

Potential impacts that may result from Proposal activities include:

- Disturbances to the amenity of nearby residences (noise and vibration)
- Damage to property (vibration)
- Interruption of fauna behaviour and movement.

4.5.2 Regulatory control measures to manage impacts

Impacts from noise and/or vibration will be addressed in the CEMP required under the Petroleum Pipelines Act. Requirements of the CEMP will include (but not be limited to):

- Where construction is required out of hours or on Sundays and/or public holidays, noise emissions will comply with the assigned levels provided in Regulation 7 of the *Environmental Protection (Noise) Regulations 1997*
- Where blasting is required, several small blasts will be undertaken, as opposed to single blasts, to minimise vibration emissions.

4.5.3 Environmental outcome

The Proposal is not anticipated to have any significant impacts on nearby residences or fauna from noise and/or vibration as:

- Any potential impacts from noise will be short in duration
- Noise emissions will comply with the assigned levels provided in Regulation 7 of the Environmental Protection (Noise) Regulations
- Management measures to minimise impacts from noise and vibration in the CEMP.

4.6 Dust

Construction activities such as clearing and grading, trenching, backfill, rehabilitation, and general vehicle movement are likely to increase the risk of atmospheric dust emissions which may be deposited on vegetation adjacent to the construction areas.

4.6.1 Assessment of potential impacts

Potential impacts that may result from dust emissions include:

- Smothering of flora and fauna
- Contamination of watercourses
- Effects on human health or the amenity of nearby residences.

4.6.2 Regulatory control measures to manage impacts

Dust emissions will be managed in accordance with the CEMP required under the Petroleum Pipelines Act. Management measures will include (but not be limited to):

- Complying with the Department of Environmental Protection's (DEP) *Guidelines for the Prevention of Dust and Smoke Pollution from Land Development Sites* (DEP 1996). For example:
 - scheduling work to be carried out at the time of the year which reduces the potential impacts of dust to a practical minimum
 - all possible alternatives to burning of cleared vegetation will be considered before the decision to burn is made
 - retaining as much vegetation as possible.
- Limiting vehicle speeds to 40 km/hour or less within the Proposal area
- Limiting soil stockpile heights to minimise wind erosion
- Managing blasting to comply with the *Environmental Protection (Abrasive Blasting) Regulations 1998*.

4.6.3 Environmental outcome

The Proposal is not anticipated to have any significant impacts from dust as:

- Emissions are expected to be of short duration and intensity
- Dust emissions will be managed in accordance with the CEMP.

4.7 Waste

Solid waste such as pipe off-cuts will be produced during construction along with domestic waste generated from the camp. No significant quantities of hazardous waste are expected to be generated during construction.

4.7.1 Assessment of potential impacts

Potential impacts that may result from waste include:

- Damage to environmental values
- Contamination of watercourses
- Effect on the amenity of nearby residences.

4.7.2 Regulatory control measures to manage impacts

Regulatory controls for waste will be addressed within the CEMP required under the Petroleum Pipelines Act and will typically include (but not be limited to):

- Treating waste from ablution associated with camps prior to disposal and in areas remote of watercourses
- Collecting all waste in appropriately labelled and lidded containers for off-site disposal by a licenced contractor.

Hazardous waste will also be effectively regulated under the requirements of the Environmental Protection (Controlled Waste) Regulations.

4.7.3 Environmental outcome

The Proposal is not anticipated to have any significant impacts from waste as:

- No significant quantities of hazardous waste will be generated during construction
- Waste will be managed in accordance with the CEMP.

5 Environmental management

5.1 Environmental management framework

DDG relies on the services of DBNGP (WA) Nominees Pty Ltd (DBP), the owner of the DBNGP, for the provision of labour and equipment to enable DDG to undertake its business. All DBP policies and procedures are wholly adopted by DDG for implementation across its business.

DDG operates in accordance with the DBP Environmental Management System (EMS) that includes the DBP Health, Safety and Environment Policy, the relevant DMP approved Environment Plan (EP), and other subsidiary environmental documentation including DBP environmental procedures. The purpose of the EMS is to ensure proactive planning, sustainable development and continuous environmental improvement.

The key elements of the EMS include:

- A corporate environmental policy
- Assessing environmental risk and identification of legal requirements
- Developing objectives and targets for improvement
- Training, operational control, communication, emergency response, corrective and preventative actions audits and review.

The Proponent is committed to responsible environmental management of the Proposal and believes that all potential adverse environmental effects can be effectively managed in accordance with the EMS. All planning, construction and operation activities shall be conducted in accordance with the DBP Health, Safety and Environment Policy, which outlines a commitment to sound management of environmental aspects of the Proposal.

5.2 Principles of environmental protection

In 2003, the EP Act was amended to include the following five core environmental principles which guide the EPA in carrying out its role and responsibilities:

- Precautionary principle
- Principle of intergenerational equity
- Principle of the conservation of biological diversity and ecological integrity
- Principles relating to improved valuation, pricing and incentive mechanisms
- Principle of waste minimisation.

These principles were considered in the development of impact mitigation and management measures for the Proposal as set out in this document. Further consideration will be given to these principles in the development of the Proposal.

5.3 Environmental management plans

A number of management plans relevant to environmental management for the Proposal, and relevant to the management of conservation significant species will be developed and implemented for the Proposal. These will include the CEMP required under the Petroleum Pipelines Act (Section 5.3.1) and a Threatened Species Management Plan to be prepared as part of the referral of the project under the EPBC Act (Section 5.3.2).

5.3.1 Construction Environmental Management Plan

Under the Petroleum Pipelines Act, DDG is required to submit a CEMP to DMP for approval prior to the commencement of construction. The CEMP will address potential environmental impacts that may be encountered during construction of the pipeline.

The following key aspects will be addressed within the CEMP:

- Environmental Incident Response
- Weed Management
- Dewatering and Water Disposal Management
- Fauna Interaction
- Watercourse Crossing Management
- Fire Management
- Dust Management
- Noise and Vibration Management
- Fuel and Chemical Storage, Spill and Emergency Response
- Waste Management
- Soil Management
- Aboriginal Heritage Site Management
- Rehabilitation.

5.3.2 Threatened Species Management Plan

A Threatened Species Management Plan will be developed and implemented for the Proposal as part of the EPBC Act referral (Section 1.4). The objective of this plan will be to maintain the abundance, diversity, geographic distribution and productivity of Threatened species, at both the species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. As well as specific measures for each key Threatened species of concern, the Plan also captures the proposed fauna management measures from the CEMP to minimise the impacts to Threatened species from habitat removal, mortality of individuals from capture in trench or vehicle strike, habitat degradation, weeds, fire, dust, hydrocarbon and chemical spills and waste.

5.4 Compliance and reporting

Assessment of the level of compliance with the CEMP will be undertaken through a number of methods and at different timeframes throughout the life of the Proposal. Compliance checking against the CEMP will include:

- Weekly inspections of construction areas and review of relevant documentation
- Monitoring in accordance with each management plan
- Implementation of an audit program comprising:
 - regular internal audits by the Proponent to assess compliance and performance against objectives detailed within the CEMP to ensure readiness for auditing by DMP
 - annual reporting to DMP to document the findings, issues and proposed actions resulting from regular audits described above.
- Auditing of compliance with all aspects of the CEMP by DMP during construction.

Internal CEMP audits will be undertaken by suitably qualified environmental personnel employed by the Proponent to ensure contractors are fulfilling environmental obligations.

The Proponent will maintain an appropriate and auditable record system in accordance with the EMS, and conduct environmental reporting in accordance with the conditions of all approval instruments.

Environmental incidents (including identified instances of non-compliance with the CEMP and/or the Threatened Species Management Plan or any approval condition) will be recorded and managed via the DBP incident management system In Control. This includes identification and implementation of necessary corrective actions, all of which will be tracked through the implementation of the HSE Hazard/Event Reporting and Investigation Hse-Pro-014-08 protocol.

Revision of the CEMP may be required to ensure that the proposed management actions are current and effective in achieving the management objectives. Any required changes to the CEMP will be conducted in consultation with key regulatory agencies and stakeholders.

6 Conclusion

The completed referral form, together with this Environmental Review document have been prepared to provide sufficient information to allow the EPA make a decision on whether to formally assess the Proposal under Part IV of the EP Act, and an assessment of whether the Proposal is likely to have a significant effect on the environment as per Section 7 of the EIA (Part IV Divisions 1 and 2) Administrative Procedures 2012 (Government of Western Australia 2012) (**Table 10**).

Table 10: Key information for EPA significance test criteria (Government of Western Australia 2012)

Criteria	Key information presented
a) values, sensitivity and quality of the environment which is likely to be impacted	The environment likely to be impacted is described in 'Environmental Setting' (Section 3)
(b) extent (intensity, duration, magnitude and geographic footprint) of the likely impacts	Impacts for the Proposal will be largely temporary with a total ground disturbance of 881 ha, of which 746 ha (85%) will be rehabilitated. A total of 135 ha will be permanently impacted from the access track (see Section 2.2 and Section 4).
c) consequence of the likely impacts (or change)	Relevant information is provided in Section 4.
(d) resilience of the environment to cope with the impacts or change	Based on the Proponents experience with rehabilitation of linear infrastructure works, the majority of the Proposal area is expected to return to a natural vegetated state. (Further information regarding the potential impacts is provided in Section 4).
(e) cumulative impact with other projects	The majority of the Proposal area does not overlie the footprint of any other major projects in the region. However, the eastern portion of the Proposal area overlaps the proposed Koodaideri Western Transport Corridor (links the Koodaideri mine to the existing rail network for the transport of ore), and lies in close proximity to Fortescue Metal Group's Solomon Mine (for which the Proposal will service). The Proposal area has been aligned with Pannawonica Road, and other degraded areas to minimise cumulative disturbance in the region (Section 2.2.1).
(f) level of confidence in the prediction of impacts and the success of proposed mitigation	The Proponent is highly experienced with environmental management of the installation of pipelines similar to the Proposal. As such, potential impacts and relevant management measures are well understood and will be thoroughly addressed within the CEMP (see Section 4).
(g) objects of the Act, policies, guidelines, procedures and standards against which a proposal can be assessed	Section 1.4 describes the legal framework and assessment process, and Section 5.2 refers to DBP's consideration of EPA Principles of Environmental Protection.
(h) presence of strategic planning policy framework	This criterion is not applicable to the Proposal.
(i) presence of other statutory decision-making processes which regulate the mitigation of the potential effects on the environment to meet the EPA's objectives and principles for EIA	Section 1.4 provides a summary of environmental control instruments including other statutory decision making processes in regards to environmental management of the Proposal. Section 4 indicates how each of these control instruments applies to the relevant environmental factors.

Criteria	Key information presented
(j) public concern about the likely effect of the proposal, if implemented, on the environment	A stakeholder consultation program has been implemented (refer to Section 2.5) during the planning phase of the Proposal. No major issues have been raised to date. Stakeholder consultation will continue to be undertaken during the implementation of the Proposal which is not expected to generate any public concern.

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Appendix A: Vegetation communities (Mattiske 2013)

Vegetation Code	Vegetation community description
<i>Vegetation of Flats to Lower Slopes</i>	
FL1:	<i>Acacia xiphophylla</i> , <i>Acacia synchronicia</i> , <i>Acacia bivenosa</i> tall sparse shrubland and <i>Senna notabilis</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Senna glutinosa</i> subsp. <i>glutinosa</i> mid isolated shrubs over <i>Salsola australis</i> , <i>Enchylaena tomentosa</i> , <i>Maireana planifolia</i> low isolated chenopod shrubs with <i>Triodia pungens</i> , <i>Triodia wiseana</i> low open hummock grassland and <i>Eragrostis xerophila</i> , <i>Sporobolus australasicus</i> low isolated tussock grasses.
FL2:	<i>Corymbia hamersleyana</i> low isolated clumps of trees over <i>Acacia inaequilatera</i> , <i>Acacia bivenosa</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> tall sparse shrubland and <i>Cullen martini</i> , <i>Senna notabilis</i> , <i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i> mid isolated shrubs over <i>Tephrosia uniovulata</i> , <i>Isotropis atropurpurea</i> , <i>Corchorus tectus</i> low sparse shrubs and <i>Triodia wiseana</i> low sparse hummock grassland.
FL3:	<i>Acacia xiphophylla</i> , <i>Acacia synchronicia</i> , <i>Acacia bivenosa</i> tall sparse shrubland over <i>Senna glutinosa</i> subsp. <i>glutinosa</i> , <i>Sarcostemma viminalis</i> , <i>Hibiscus sturtii</i> var. <i>platyklamys</i> mid isolated shrubs over <i>Triodia wiseana</i> low sparse hummock grassland.
FL4:	<i>Streptoglossa bubakii</i> , <i>Phyllanthus maderaspatensis</i> , <i>Sida trichopoda</i> low sparse forbland with <i>Triodia wiseana</i> low open hummock grassland and <i>Aristida latifolia</i> , <i>Brachyachne convergens</i> , <i>Eragrostis xerophila</i> low sparse tussock grassland.
FL5:	<i>Sida spinosa</i> , <i>Phyllanthus maderaspatensis</i> , <i>Cullen cinereum</i> low sparse shrubland with <i>Panicum decompositum</i> , <i>Enneapogon caerulescens</i> low sparse tussock grassland and <i>Stemodia kingii</i> , <i>Heliotropium crispatum</i> , <i>Desmodium muelleri</i> low sparse forbland.
FL6:	<i>Acacia inaequilatera</i> tall open shrubland over <i>Senna glutinosa</i> subsp. <i>glutinosa</i> , <i>Senna glutinosa</i> subsp. <i>pruinosa</i> , * <i>Vachellia farnesiana</i> mid sparse shrubland over <i>Triodia brizoides</i> low open hummock grassland and <i>Eriachne aristidea</i> , <i>Enneapogon caerulescens</i> , <i>Aristida anthoxanthoides</i> low sparse tussock grassland.
FL7:	<i>Acacia ancistrocarpa</i> , <i>Acacia coleii</i> var. <i>coleii</i> , <i>Acacia dictyophleba</i> tall sparse shrubland over <i>Ptilotus astrolasius</i> , <i>Pterocaulon sphacelatum</i> , <i>Indigofera boviparda</i> subsp. <i>boviparda</i> low sparse shrubland over <i>Triodia pungens</i> , <i>Triodia wiseana</i> low open hummock grassland.
FL8:	<i>Acacia ancistrocarpa</i> , <i>Acacia bivenosa</i> , <i>Acacia synchronicia</i> tall sparse shrubland over <i>Gossypium australe</i> , <i>Eremophila longifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> mid sparse shrubland over <i>Triodia pungens</i> low sparse hummock grassland and <i>Eulalia aurea</i> , <i>Chrysopogon fallax</i> , <i>Bothriochloa ewartiana</i> low open tussock grassland.
FL9:	<i>Acacia atkinsiana</i> , <i>Acacia ancistrocarpa</i> , <i>Acacia bivenosa</i> tall sparse shrubland over <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Senna glutinosa</i> subsp. <i>glutinosa</i> , <i>Scaevola spinescens</i> mid sparse shrubland over <i>Triodia wiseana</i> , <i>Triodia longiceps</i> low open

Vegetation Code	Vegetation community description
	hummock grassland.
FL10:	<i>Corymbia hamersleyana</i> low open woodland over <i>Acacia trachycarpa</i> , <i>Acacia ancistrocarpa</i> , <i>Acacia dictyophleba</i> tall open shrubland and <i>Gossypium australe</i> , <i>Grevillea wickhamii</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> mid sparse shrubland over <i>Triodia pungens</i> , <i>Triodia wiseana</i> low open hummock grassland and <i>Eulalia aurea</i> , <i>Aristida latifolia</i> , <i>Themeda triandra</i> low sparse tussock grassland.
FL11:	<i>Corymbia hamersleyana</i> low open woodland over <i>Acacia trachycarpa</i> , <i>Cullen lachnostachys</i> , <i>Grevillea wickhamii</i> mid sparse shrubland over <i>Themeda triandra</i> , <i>Eulalia aurea</i> , <i>Paraneurachne muelleri</i> low sparse tussock grassland.
FL12:	<i>Corymbia hamersleyana</i> low open woodland over <i>Grevillea wickhamii</i> , <i>Acacia ancistrocarpa</i> , <i>Acacia bivenosa</i> tall sparse shrubland and <i>Gossypium australe</i> , <i>Hakea chordophylla</i> , <i>Acacia dictyophleba</i> mid sparse shrubland over <i>Bonamia erecta</i> , <i>Corchorus tectus</i> , <i>Ptilotus obovatus</i> var. <i>obovatus</i> low sparse shrubland and <i>Triodia pungens</i> , <i>Triodia wiseana</i> low open hummock grassland.
FL13:	<i>Acacia bivenosa</i> , <i>Acacia synchronicia</i> tall isolated shrubs over <i>Triodia longiceps</i> , <i>Triodia pungens</i> low sparse hummock grassland.
FL14:	<i>Acacia xiphophylla</i> , <i>Acacia atkinsiana</i> tall sparse shrubland and <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Senna notabilis</i> , <i>Hibiscus sturtii</i> mid sparse shrubland over <i>Triodia pungens</i> low open hummock grassland and <i>Eulalia aurea</i> , <i>Sporobolus australasicus</i> , <i>Chrysopogon fallax</i> low sparse tussock grassland.
FL15:	<i>Astrebla lappacea</i> (P3), <i>Aristida latifolia</i> , <i>Panicum decompositum</i> low tussock grassland.
Vegetation of Mid Slopes to Ridges	
MR1:	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>Corymbia hamersleyana</i> low isolated trees over <i>Acacia bivenosa</i> , <i>Acacia ancistrocarpa</i> , <i>Acacia inaequilatera</i> tall sparse shrubland and <i>Senna glutinosa</i> subsp. <i>glutinosa</i> , <i>Senna glutinosa</i> subsp. <i>pruinosa</i> , <i>Acacia maitlandii</i> mid isolated shrubs over <i>Triodia wiseana</i> low open hummock grassland.
MR2:	<i>Acacia monticola</i> , <i>Acacia pyrifolia</i> , <i>Acacia trachycarpa</i> tall sparse shrubland over <i>Petalostylis cassioides</i> , <i>Senna glutinosa</i> subsp. <i>glutinosa</i> mid isolated shrubs over <i>Triodia wiseana</i> low hummock grassland.
MR3:	<i>Acacia inaequilatera</i> , <i>Acacia ancistrocarpa</i> , <i>Acacia bivenosa</i> tall sparse shrubland and <i>Senna glutinosa</i> subsp. <i>pruinosa</i> , <i>Senna glutinosa</i> subsp. <i>glutinosa</i> , <i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i> mid sparse shrubland over <i>Ptilotus nobilis</i> , <i>Ptilotus calostachyus</i> , <i>Corchorus tectus</i> low isolated shrubs and <i>Triodia wiseana</i> low open hummock grassland.
MR4:	<i>Grevillea pyramidalis</i> subsp. <i>leucadendron</i> , <i>Acacia inaequilatera</i> , <i>Acacia colei</i> var. <i>ileocarpa</i> tall isolated shrubs and <i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i> , <i>Cajanus cinereus</i> , <i>Abutilon lepidum</i> mid sparse shrubland over <i>Corchorus tectus</i> , <i>Triumfetta clementii</i> , <i>Tribulus platypterus</i> low sparse shrubland and <i>Triodia wiseana</i> low open hummock grassland.
MR5:	<i>Acacia inaequilatera</i> , <i>Grevillea pyramidalis</i> subsp. <i>leucadendron</i> , <i>Hakea lorea</i> tall sparse shrubland over <i>Senna glutinosa</i> subsp. <i>pruinosa</i> , <i>Senna glutinosa</i> subsp.

Vegetation Code	Vegetation community description
	<i>glutinosa</i> , <i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i> mid sparse shrubland over <i>Triodia wiseana</i> low open hummock grassland and <i>Aristida holathera</i> var. <i>holathera</i> , <i>Enneapogon caerulescens</i> , <i>Eriachne flaccida</i> low isolated tussock grasses.
MR6:	<i>Acacia bivenosa</i> , <i>Hakea lorea</i> tall isolated shrubs over <i>Triodia wiseana</i> low sparse hummock grassland.
MR7:	<i>Eremophila longifolia</i> , <i>Acacia maitlandii</i> , <i>Acacia atkinsiana</i> mid sparse shrubland over <i>Abutilon lepidum</i> , <i>Gomphrena cunninghamii</i> , <i>Tephrosia rosea</i> var. <i>Fortescue creeks</i> (M.I.H. Brooker 2186) low sparse shrubland and <i>Triodia wiseana</i> low hummock grassland.
Vegetation of Creeklines, Flowlines and Drainage Areas	
CD1:	<i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Acacia ancistrocarpa</i> , <i>Acacia trachycarpa</i> tall open shrubland and <i>Gossypium robinsonii</i> , <i>Acacia pyrifolia</i> , <i>Senna glutinosa</i> subsp. <i>glutinosa</i> mid sparse shrubland over <i>Hybanthus aurantiacus</i> , <i>Ptilotus obovatus</i> var. <i>obovatus</i> , <i>Ptilotus nobilis</i> low isolated shrubs with <i>Triodia pungens</i> low open hummock grassland and <i>Themeda triandra</i> , <i>Cymbopogon obtectus</i> low sparse tussock grassland.
CD2:	<i>Corymbia candida</i> , <i>Corymbia hamersleyana</i> , <i>Eucalyptus camaldulensis</i> low open woodland over <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Gossypium robinsonii</i> , <i>Acacia ancistrocarpa</i> tall sparse shrubland over <i>Eragrostis tenellula</i> , <i>Sporobolus australasicus</i> , <i>Eragrostis cumingii</i> low sparse tussock grassland and <i>Alternanthera nodiflora</i> , <i>Ipomoea muelleri</i> , <i>Waltheria indica</i> low sparse forbland.
CD3:	<i>Eucalyptus victrix</i> mid open woodland over <i>Acacia ampliceps</i> , <i>Acacia trachycarpa</i> , <i>Sesbania cannabina</i> tall sparse shrubland over <i>Cyperus vaginatus</i> mid sparse sedgeland and <i>Eriachne benthamii</i> , <i>Enneapogon caerulescens</i> , <i>Cymbopogon obtectus</i> low sparse tussock grassland.
CD4:	<i>Eucalyptus victrix</i> , <i>Eucalyptus camaldulensis</i> mid open woodland over <i>Acacia pyrifolia</i> , <i>Grevillea wickhamii</i> , <i>Acacia trachycarpa</i> tall open shrubland over <i>Pterocaulon sphacelatum</i> , <i>Phyllanthus maderaspatensis</i> , <i>Hybanthus aurantiacus</i> mid sparse shrubland with <i>Cyperus vaginatus</i> mid sparse sedgeland and <i>Sporobolus australasicus</i> , <i>Chrysopogon fallax</i> , <i>Enteropogon ramosus</i> low sparse tussock grassland.
CD5:	<i>Corymbia hamersleyana</i> low open woodland over <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Acacia atkinsiana</i> , <i>Acacia inaequilatera</i> tall sparse shrubland over <i>Bonamia erecta</i> , <i>Goodenia stobbsiana</i> , <i>Ptilotus obovatus</i> var. <i>obovatus</i> low isolated shrubs and <i>Triodia wiseana</i> low open hummock grassland.
CD6:	<i>Acacia bivenosa</i> , <i>Jasminum didymium</i> subsp. <i>lineare</i> , <i>Acacia ampliceps</i> tall sparse shrubland over <i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Indigofera monophylla</i> mid sparse shrubland over <i>Triodia wiseana</i> isolated hummock grasses and <i>Cymbopogon obtectus</i> , <i>Aristida contorta</i> , <i>Eriachne aristidea</i> low isolated tussock grasses.
CD7:	<i>Corymbia hamersleyana</i> low open woodland over <i>Acacia ancistrocarpa</i> , <i>Acacia trachycarpa</i> , <i>Acacia dictyophleba</i> tall sparse shrubland and <i>Cullen lachnostachys</i> , <i>Gossypium australe</i> , <i>Grevillea wickhamii</i> mid sparse shrubland over <i>Pterocaulon sphacelatum</i> , <i>Pluchea dunlopii</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> low open

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	shrubland with <i>Triodia pungens</i> low open hummock grassland and <i>Eulalia aurea</i> , <i>Chrysopogon fallax</i> , <i>Eriachne pulchella</i> low sparse tussock grassland.
CD8:	<i>Eucalyptus victrix</i> low open woodland over <i>Grevillea wickhamii</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Acacia pyrifolia</i> tall open shrubland and <i>Tephrosia rosea</i> , <i>Corchorus lasiocarpus</i> , <i>Indigofera monophylla</i> mid sparse shrubland over <i>Triodia pungens</i> low open hummock grassland and <i>Eriachne aristidea</i> , <i>Eriachne pulchella</i> , * <i>Cenchrus ciliaris</i> low open tussock grassland.

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